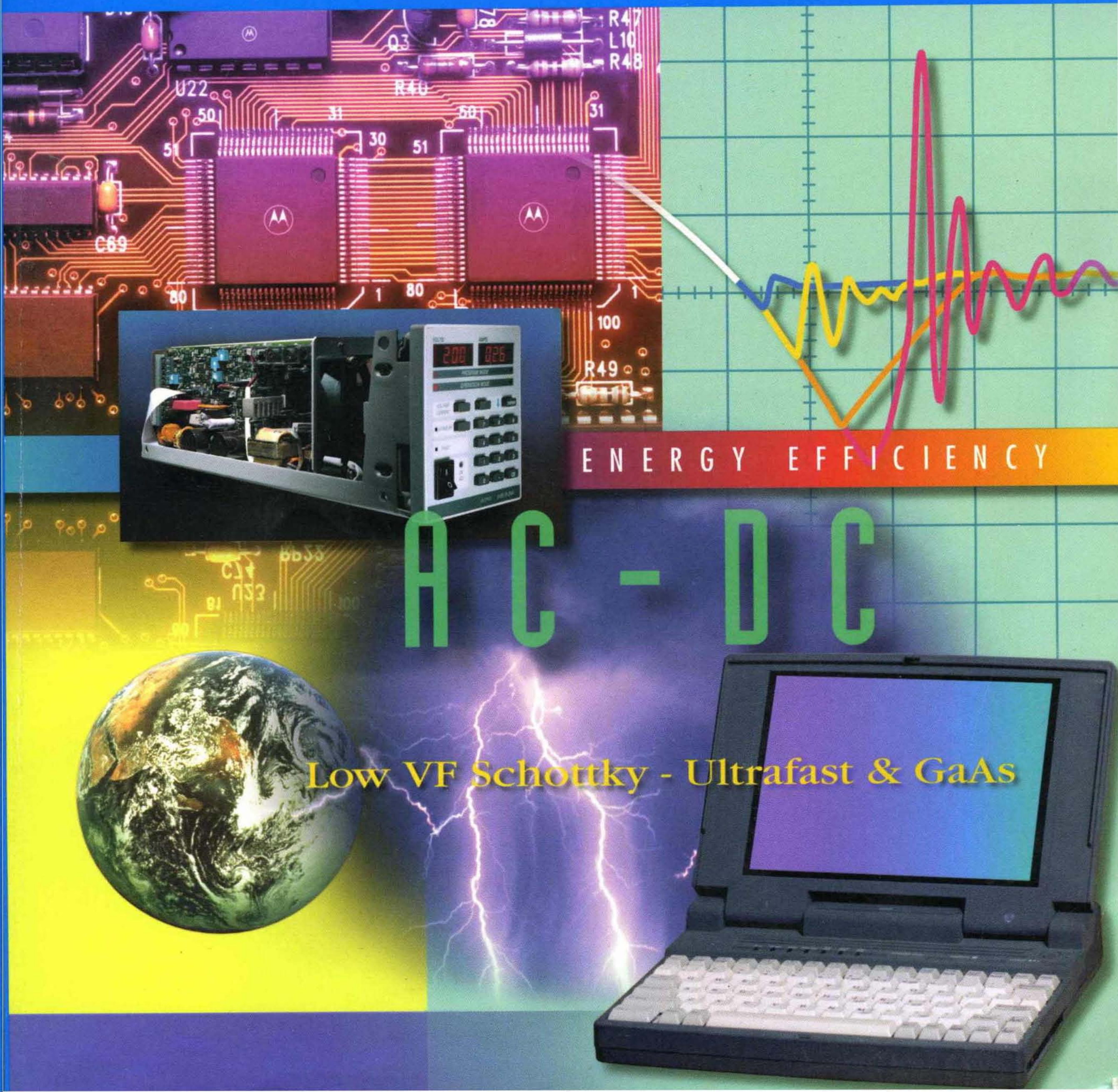
MOTOROLA

DL151/D
REV 2

Rectifier

Device Data



MOTOROLA RECTIFIER DEVICE DATA

Q1/95
DL151
REV 2

MOTOROLA

Rectifier Device Data

This book presents technical data for Motorola's broad line of rectifiers. Complete specifications are provided in the form of data sheets and accompanying selection guides provide a quick comparison of characteristics to simplify the task of choosing the best device for a circuit.

The information in this book has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies.

Printed in U.S.A.

DATA CLASSIFICATION

PRODUCT PREVIEW

Data sheets herein contain information on a product under development. Motorola reserves the right to change or discontinue these products without notice.

ADVANCED INFORMATION

Data sheets herein contain information on new products. Specifications and information are subject to change without notice.

FORMAL

For a fully characterized device there must be devices in the warehouse and price authorization.

DESIGNER'S

The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

MOTOROLA DEVICE CLASSIFICATIONS

In an effort to provide up-to-date information to the customer regarding the status of any given device, Motorola has classified all devices into three categories: "Preferred" products, "Current" products and "Not Recommended for New Design" products.

PREFERRED PRODUCTS

A Preferred Type is a device which is recommended as a first choice for future use. These devices are "preferred" by virtue of their performance, price, functionality, or combination of attributes which offer the overall "best" value to the customer. This category contains both advanced and mature devices which will remain available for the foreseeable future.

"Preferred Devices" are identified in the Selector Guide Section and the Data Sheet Sections.

CURRENT PRODUCTS

Device types identified as "current" may not be a first choice for **new** designs, but will continue to be available because of the popularity and/or standardization or volume usage in current production designs. These products can be acceptable for new designs but the preferred types are considered better alternatives for long term usage.

Any device that has not been identified as a "preferred device" is a "current" device.

NOT RECOMMENDED FOR NEW DESIGN PRODUCTS

Products designated as "Not Recommended for New Design" have become obsolete as dictated by poor market acceptance, or a technology or package that is reaching the end of its life cycle. Devices in this category have an uncertain future and do not represent a good selection for new device designs or long term usage.

The RF Device Data book does not contain any "Not Recommended for New Design" devices.

Section 1

Index and Cross Reference

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Index and Cross Reference

The following table represents an index and cross reference guide for all rectifier devices which are either manufactured directly by Motorola or for which Motorola manufactures a suitable equivalent. Where the Motorola part number differs from the industry part number, the Motorola device is a form, fit and function replacement for the industry type number — however, subtle differences in characteristics and/or specifications may exist. The part numbers listed in this Cross Reference are in computer sort.

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10CTF20		MUR840	4–56
10CTF30		MUR840	4–56
10CTF40		MUR840	4–56
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12CTQ040	MBR1545CT		3–64
12CTQ045	MBR1545CT		3–64
15CTO035		MBR1545CT	3–64
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1N2070,A	1N4004		5–2
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1N3611		1N4003	5–2
1N3611GP		1N4003	5–2
1N3612		1N4004	5–2
1N3612GP		1N4004	5–2
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1N3613GP		1N4005	5–2
1N3614		1N4006	5–2
1N3614GP		1N4006	5–2
1N3957		1N4007	5–2
1N3957GP		1N4007	5–2
1N4001	1N4001		5–2
1N4001GP		1N4001	5–2
1N4002	1N4002		5–2
1N4002GP		1N4002	5–2
1N4003	1N4003		5–2
1N4003GP		1N4003	5–2
1N4004	1N4004		5–2
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1N4005	1N4005		5–2
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1N4006	1N4006		5–2
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1N4245		1N4003	5–2
1N4245GP		1N4003	5–2
1N4246		1N4004	5–2
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1N4248		1N4006	5–2
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1N4936	1N4936		5–3
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1N5186GP		MR852	5–6
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1N5187GP		MR852	5–6
1N5188		MR856	5–6
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1N5189GP		MR856	5–6
1N5190		MR856	5–6
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1N5401	1N5401		5–5
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INDEX AND CROSS REFERENCE (continued)

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BYW80–50	MUR820		4–56
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CPT12045	MBRP20045CT		3–182
CPT12050	MBRP20060CT		3–182
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CPT20045	MBRP20045CT		3–182
CPT20050	MBRP20060CT		3–182
CPT20120	MBRP20030CTL		3–181
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MBR20050CT	MBRP20060CT		3–182
MBR20060CT	MBRP20060CT		3–182
MBR20100CT	MBR20100CT		3–73
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MBR20200CT	MBR20200CT		3–75
MBR2030CTL	MBR2030CTL		3–66
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MBR2045CT	MBR2045CT		3–69
MBR2060CT	MBR2060CT		3–73
MBR2070CT	MBR20100CT		3–73
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MBR30045CT	MBRP30045CT		3–183
MBR30050CT	MBRP30060CT		3–183
MBR30060CT	MBRP30060CT		3–183
MBR3020CT	MBR3045CT		3–178
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UTX3120		MR852	5–6
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UTX4110		MR852	5–6
UTX4115		MR852	5–6
UTX4120		MR852	5–6
V322	1N5402		5–5
V324	1N5404		5–5
V326	1N5406		5–5
V330X	MR852		5–6
V331X	MR852		5–6
V332X	MR852		5–6
V334X	MR856		5–6
V336X	MR856		5–6
V342	1N5402		5–5
V344	1N5404		5–5
V346	1N5406		5–5
V350X	MR852		5–6
V351X	MR852		5–6
V352X	MR852		5–6
V354X	MR856		5–6
V356X	MR856		5–6

Industry Part Number	Motorola Nearest Replacement	Motorola Similar Replacement	Page Number
VHE1401		MUR820	4–56
VHE1402		MUR820	4–56
VHE1403		MUR820	4–56
VHE1404		MUR820	4–56
VHE205	MUR120		4–23
VHE210	MUR120		4–23
VHE215	MUR120		4–23
VHE220	MUR120		4–23
VHE2401		MUR1620CT	4–46
VHE2402		MUR1620CT	4–46
VHE2403		MUR1620CT	4–46
VHE2404		MUR1620CT	4–46
VHE605	MUR420		4–31
VHE610	MUR420		4–31
VHE615	MUR420		4–31
VHE620	MUR420		4–31
VSK1020	MBR1045		3–86
VSK1035	MBR1045		3–86
VSK1045	MBR1045		3–86
VSK12	MBR1545CT		3–64
VSK120		1N5817	3–38
VSK13	MBR1545CT		3–64
VSK130		1N5818	3–38
VSK14	MBR1545CT		3–64
VSK140		1N5819	3–38
VSK1520	1N5829		3–139
VSK1530	1N5830		3–139
VSK1540	1N5831		3–139
VSK2004	MBRP20060CT		3–182
VSK2020	MBR2045CT		3–69
VSK2035	MBR2045CT		3–69
VSK2045	MBR2045CT		3–69
VSK2420	MBR2545CT		3–80
VSK2435	MBR2545CT		3–80
VSK2445	MBR2545CT		3–80
VSK3020S	MBR3545		3–148
VSK3020T	MBR3045CT		3–178
VSK3030S	MBR3545		3–148
VSK3030T	MBR3045CT		3–178
VSK3040S	MBR3545		3–148
VSK3040T	MBR3045CT		3–178
VSK32	MBR3545		3–148
VSK320	MBR340		3–53
VSK330	MBR340		3–53
VSK340	MBR340		3–53
VSK4020	1N5832		3–152
VSK4030	1N5833		3–152
VSK4040	1N5834		3–152
VSK41	SD41		3–144
VSK51	SD51		3–156
VSK62	MBR745		3–84
VSK63	MBR745		3–84
VSK64	MBR745		3–84
VSK920		MBR1545CT	3–64
VSK935		MBR1545CT	3–64
VSK945		MBR1545CT	3–64

Section 2

Selector Guide

2

In Brief . . .

Continuing investment in research and development for discrete products has created a rectifier manufacturing facility that matches the precision and versatility of the most advanced integrated circuits. As a result, Motorola's silicon rectifiers span all high tech applications with quality levels capable of passing the most stringent environmental tests . . . including those for automotive under–hood applications.

Product Highlights:

- Surface Mount Devices — A major thrust has been the development and introduction of a broad range of power rectifiers, Schottky and Ultrafast, 1/2 amp to 25 amp, 15 to 600 volts.
- Application Specific Rectifiers —
  - — MEGAHERTZ ™ series for high frequency power supplies and power factor correction.
  - — Schottky rectifiers having lower forward voltage drop (0.3 to 0.6 volts) for use in low voltage SMPS outputs and as "OR"ing diodes.
  - — Automotive transient suppressors.
- Ultrafast rectifiers having reverse recovery times as low as 25 ns to complement the Schottky devices for higher voltage requirements in high frequency applications.
- A wide variety of package options to match virtually any potential requirement.

The rectifier selector section that follows has generally been arranged by package and technology. The individual tables have been sorted by voltage and current with the package types for the devices listed shown above each table. The Application Specific Rectifiers are also included in their respective tables.

Motorola's commitment to Six–Sigma is showing its worth. Refined processes no longer produce fallout as such and therefore only **Motorola Preferred Devices** are listed in the tables. The non–preferred devices will continue to be offered, but customers are encouraged to begin designing using the preferred types.

Page

RECTIFIER NUMBERING SYSTEM

PART NUMBER KEY XXX X XX XX XX X

- XXX — PREFIX (TYPE DESIGNATOR)
- X — F = FULLY ISOLATED
  - S = SURFACE MT (SMB/SMC)
  - D = DPAK
  - B = D^2PAK
  - H = MEGAHERTZ
- XX — I_O
- XX — V_R (X10 EXCEPT SCHOTTKY)
- XX — SUFFIX (DUAL DESIGNATOR)
- X — R = REVERSE, L = LOW V_F, E = ENERGY

PREFIX KEY

MUR = MOTOROLA ULTRA FAST RECTIFIER
MBR = MOTOROLA (SCHOTTKY) BARRIER RECTIFIER
MR = MOTOROLA STANDARD & FAST RECOVERY

SUFFIX KEY

CT = CENTER TAP (DUAL) TO–220, TO–3, POWERTAP
PT = CENTER TAP (DUAL) TO–218 PACKAGE
WT = CENTER TAP (DUAL) TO–247 / TO–3P

EXAMPLE:	MUR	30	20	WT
	MOTOROLA ULTRAFAST	30 AMP	200 V	CENTER TAP (DUAL) TO–247
EXAMPLE:	MBR	30	45	WT
	MOTOROLA SCHOTTKY	30 AMP	45 V	CENTER TAP (DUAL) TO–247

Application Specific Rectifiers

The focus for Rectifier Products continues to be on Schottky and Ultrafast technologies, with process and packaging improvements to achieve greater efficiency in high frequency switching power supplies, and high current mainframe supplies. Our new product thrust is intended to be more "application specific" than in the past, while continuing to strive for broad market acceptance.

2

Table 1. Low V_F Schottky Rectifiers

State of the art geometry is used in low V_F Schottky devices for improved efficiency in low voltage, high frequency switching power supplies, free–wheeling diodes, polarity protection diodes and "OR"ing diodes.

Device	I_O Amps	V_{RRM} (Volts)	V_F @ Rated I_O and Temperature Volts (Max)	I_R @ Rated V_{RRM} mAmps (Max)	Package	Page
MBR0520LT1	0.5	20	0.33	0.25	SOD-123	3–2
MBRS130LT3	1	30	0.395	1	SMB	3–7
MBRD835L	8	35	0.41	1.4	DPAK	3–21
MBRD1035CTL	10	35	0.41	6	DPAK	—
MBR2030CTL	20	30	0.48	5	TO-220	3–66
MBRB2535CTL	25	35	0.41	10	D^2PAK	3–34
MBR2535CTL	25	35	0.41	5	TO-220	3–78
MBRB2515L	25	15	0.42	15	D^2PAK	3–32
MBR2515L	25	15	0.42	15	TO-220	3–77
MBRB3030CTL	30	30	0.58	5	D^2PAK	—
MBR4015LWT	40	15	0.42	5	TO-247	3–129
MBR5025L	50	25	0.58	0.5	TO-218 TYPE	3–125
MBR6030L	60	30	0.38	50	DO-203AB	3–160
MBRP20030CTL	200	30	0.39	5	POWERTAP	3–181
MBRP60035CTL	600	35	0.50	10	POWERTAP	3–184

Table 2. MEGAHERTZ Rectifiers

MEGAHERTZ Series — This group of ultrafast rectifiers is designed to provide improved efficiency in very high frequency switching power supplies and for use in power factor correction circuits.

Device	I_O Amps	V_{RRM} (Volts)	Maximum		t_{rr} (Nanosecond)	Page
			V_F @ Rated I_O and Temp. (Volts)	I_R @ Rated V_{RRM} (mAmps)		
MURH840CT	8	400	1.7	0.01	28	4–41
MURH860CT	8	600	2.0	0.01	28	4–44

Table 3. SCANSWITCH Rectifiers

These ultrafast rectifiers are designed for improved performance in very high resolution monitors and work stations where forward recovery time (t_{fr}) and high voltage (1200–1500 volts) are primary considerations.

Device	I_O Amps	V_{RRM} (Volts)	Maximum		V_{RFM} (6) (Volts)	Page
			t_{fr} (Nanoseconds)	t_{rr} (Nanoseconds)		
MUR5150E	5	1500	225	175	20	4–54
MUR880E	8	800	—	75	—	—
MUR10120E	10	1200	175	175	14	4–65
MUR10150E	10	1500	175	175	16	4–68

Table 4. Automotive Transient Suppressors

Automotive transient suppressors are designed for protection against over–voltage conditions in the auto electrical system including the "LOAD DUMP" phenomenon that occurs when the battery open circuits while the car is running.

Device	I_O Amps	V_{RRM} (Volts)	$V_{(BR)}$ (Volts)	I_{RSM}(7) (Amps)	T (°C)	Page
MR2535L	35	20	24–32	110	175	5–19

(6)V_{RFM} = Maximum Transient Overshoot Voltage.
(7)Time constant = 10 ms, Duty Cycle ≤ 1%, T_C = 25°C.

Devices listed in bold, italic are Motorola preferred devices.

SWITCHMODE™ Rectifiers

Schottky power rectifiers with the high speed and low forward voltage drop characteristic of Schottky's metal/silicon junctions are produced with ruggedness and temperature performance comparable to silicon–junction rectifiers. Ideal for use in low–voltage, high–frequency power supplies, and as very fast clamping diodes, these devices feature switching times less than 10 ns, and are offered in current ranges from 0.5 to 600 amperes, and reverse voltages to 200 volts.

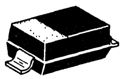
In some current ranges, devices are available with junction temperature specifications of 125°C, 150°C and 175°C. Devices with higher T_J ratings can have significantly lower leakage currents, but higher forward–voltage specifications. These parameter tradeoffs should be considered when selecting devices for applications that can be satisfied by more than one device type number.

All devices are connected cathode–to–case or cathode–to–heatsink, where applicable. Contact your Motorola representative for more information.

There are many other standard features in Motorola Schottky rectifiers that give added performance and reliability.

1. GUARDRINGS were pioneered by Motorola and are included in all Schottky die for reverse voltage stress protection from high rates of dv/dt to virtually eliminate the need for snubber networks. The guardring also operates like a zener and avalanches when subjected to voltage transients.
2. MOLYBDENUM DISCS on both sides of the die minimize fatigue from power cycling in all metal products. Plastic encapsulated devices have a special solder formulation for the same purpose.
3. QUALITY CONTROL monitors all critical fabrication operations and performs selected stress tests to assure constant processes. Motorola's commitment to six sigma has provided significant quality improvement.

Case 425
SOD–123



Cathode = Notch

Case 403A
SMB

Cathode = Notch

Case 403
SMC

Cathode = Notch

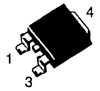
Table 5. Surface Mount Schottky Rectifiers

V_{RRM} (Volts)	I_O(1) (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Package	Page
20	0.5	T_L = 105°C	***MBR0520LT1*** ★	0.310 @ 0.1 A 0.385 @ 0.5 A	5	125	SOD-123	3–2
30	0.5	T_L = 105°C	***MBR0530T1*** ★	0.375 @ 0.1 A 0.430 @ 0.5 A	5	125	SOD-123	3–4
40	0.5	T_L = 110°C	***MBR0540T1*** ★	0.53 @ 0.5 A	20	150	SOD-123	3–6
30	1	T_L = 120°C	***MBRS130LT3***	0.395 @ 1.0 A	40	125	SMB	3–7
40	1	T_L = 115°C	***MBRS140T3***	0.6 @ 1.0 A	40	125	SMB	3–9
100	1	T_L = 120°C	***MBRS1100T3***	0.75 @ 1.0 A	40	150	SMB	3–11
40	3	T_L = 100°C	***MBRS340T3***	0.525 @ 3.0 A	80	125	SMC	3–13
60	3	T_L = 100°C	***MBRS360T3*** ★	0.74 @ 3.0 A	80	125	SMC	3–13

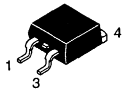
(1) I_O is total device current capability.
★ New Product

Devices listed in bold, italic are Motorola preferred devices.

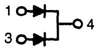
Case 369A
DPAK
Style 3



Case 418B
D^2PAK
Style 3



"CT" Suffix:



Non–"CT" Suffix:

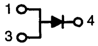


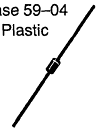
Table 5. Surface Mount Schottky Rectifiers (continued)

V_{RRM} (Volts)	I_O(1) (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Package	Page
40	3	T_C = 125°C	***MBRD340***	0.60 @ 3.0 A	75	150	DPAK	3–15
60	3	T_C = 125°C	***MBRD360***	0.60 @ 3.0 A	75	150	DPAK	3–15
40	6	T_C = 130°C	***MBRD640CT***	0.70 @ 3.0 A	75	150	DPAK	3–18
60	6	T_C = 130°C	***MBRD660CT***	0.70 @ 3.0 A	75	150	DPAK	3–18
35	8	T_C = 100°C	***MBRD835L*** ★	0.40 @ 3.0 A 0.51 @ 8.0 A	100	125	DPAK	3–21
35	10	T_C = 90°C	***MBRD1035CTL***★	0.49 @ 10 A	100	125	DPAK	—
45	15	T_C = 105°C	***MBRB1545CT***	0.84 @ 15 A	150	150	D^2PAK	3–24
60	20	T_C = 110°C	***MBRB2060CT***	0.95 @ 20 A	150	150	D^2PAK	3–26
100	20	T_C = 110°C	***MBRB20100CT***	0.85 @ 10 A 0.95 @ 20 A	150	150	D^2PAK	3–28
200	20	T_C = 125°C	***MBRB20200CT***★	1.0 @ 20 A	150	150	D^2PAK	3–30
15	25	T_C = 90°C	***MBRB2515L***★	0.45 @ 25 A	150	100	D^2PAK	3–32
35	25	T_C = 110°C	***MBRB2535CTL***	0.47 @ 12.5 A 0.55 @ 25 A	150	125	D^2PAK	3–34
45	25	T_C = 130°C	***MBRB2545CT***	0.82 @ 30 A	150	150	D^2PAK	3–36
30	30	T_C = 115°C	***MBRB3030CT***★	0.51 @ 15 A 0.62 @ 30 A	300	150	D^2PAK	3–190
30	30	T_C = 95°C	***MBRB3030CTL***★	0.45 @ 15 A 0.51 @ 30 A	150	125	D^2PAK	—
30	40	T_C = 110°C	***MBRB4030***★	0.46 @ 20 A 0.55 @ 40 A	300	150	D^2PAK	3–193

(1) I_O is total device current capability.
★ New Product

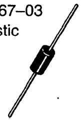
Devices listed in bold, italic are Motorola preferred devices.

Case 59–04
Plastic



Cathode = Polarity Band

Case 267–03
Plastic



Cathode = Polarity Band

Case 60–01
Metal
Style 1

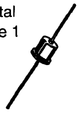
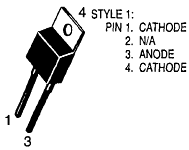


Table 6. Axial Lead Schottky Rectifiers

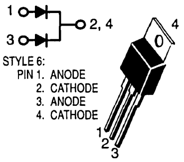
V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
20	1	T_A = 55°C $R_{\theta JA}$ = 80°C/W	***1N5817***	0.45 @ 1.0 A	25	125	59-04	3–38
30	1	T_A = 55°C $R_{\theta JA}$ = 80°C/W	***1N5818***	0.55 @ 1.0 A	25	125	59-04	3–38
40	1	T_A = 55°C $R_{\theta JA}$ = 80°C/W	***1N5819***	0.60 @ 1.0 A	25	125	59-04	3–38
60	1	T_A = 55°C $R_{\theta JA}$ = 80°C/W	***MBR160***	0.75 @ 1.0 A	25	150	59-04	3–43
100	1	T_A = 120°C $R_{\theta JA}$ = 50°C/W	***MBR1100***	0.79 @ 1.0 A	50	150	59-04	3–46
20	3	T_A = 76°C $R_{\theta JA}$ = 28°C/W	***1N5820***	0.457 @ 3.0 A	80	125	267-03	3–49
30	3	T_A = 71°C $R_{\theta JA}$ = 28°C/W	***1N5821***	0.500 @ 3.0 A	80	125	267-03	3–49
40	3	T_A = 61°C $R_{\theta JA}$ = 28°C/W	***1N5822***	0.525 @ 3.0 A	80	125	267-03	3–49
40	3	T_A = 65°C $R_{\theta JA}$ = 28°C/W	***MBR340***	0.600 @ 3.0 A	80	150	267-03	3–53
60	3	T_A = 65°C $R_{\theta JA}$ = 28°C/W	***MBR360***	0.740 @ 3.0 A	80	150	267-03	3–53
100	3	T_A = 100°C $R_{\theta JA}$ = 28°C/W	***MBR3100***	0.79 @ 3.0 A	150	150	267-03	3–57
20	5	T_A = 30°C $R_{\theta JA}$ = 25°C/W	***1N5823***	0.360 @ 5.0 A	500	125	60-01	3–60
30	5	T_A = 40°C $R_{\theta JA}$ = 25°C/W	***1N5824***	0.370 @ 5.0 A	500	125	60-01	3–60
40	5	T_A = 45°C $R_{\theta JA}$ = 25°C/W	***1N5825***	0.380 @ 5.0 A	500	125	60-01	3–60

Devices listed in bold, italic are Motorola preferred devices.

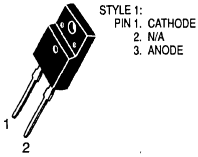
Case 221B
(TO–220AC)



Case 221A–06
(TO–220AB)



Case 221E



Case 221D

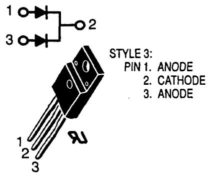


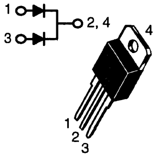
Table 7. TO–220 Type Schottky Rectifiers

V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
45	15	T_C = 105°C	***MBR1545CT***	0.84 @ 15 A	150	150	221A-06	3–64
30	20	T_C = 137°C	***MBR2030CTL***★	0.52 @ 10 A 0.58 @ 20 A	150	150	221A-06	3–66
45	20	T_C = 135°C	***MBR2045CT***	0.84 @ 20 A	150	150	221A-06	3–69
60	20	T_C = 133°C	***MBR2060CT***	0.85 @ 10 A 0.95 @ 20 A	150	150	221A-06	3–73
100	20	T_C = 133°C	***MBR20100CT***	0.85 @ 10 A 0.95 @ 20 A	150	150	221A-06	3–73
200	20	T_C = 125°C	***MBR20200CT***	1.0 @ 20 A	150	150	221A-06	3–75
15	25	T_C = 90°C	***MBR2515L***★	0.45 @ 25 A	150	100	221A-06	3–77
35	25	T_C = 95°C	***MBR2535CTL***★	0.55 @ 25 A	150	125	221A-06	3–78
45	25	T_C = 130°C	***MBR2545CT***	0.82 @ 30 A	150	150	221A-06	3–80
45	30	T_C = 130°C	***MBR3045ST***★	0.76 @ 30 A	150	150	221A-06	3–82
45	7.5	T_C = 105°C	***MBR745***	0.84 @ 15 A	150	150	221B	3–84
45	10	T_C = 135°C	***MBR1045***	0.84 @ 20 A	150	150	221B	3–86
60	10	T_C = 133°C	***MBR1060***	0.80 @ 10 A	150	150	221B	3–90
100	10	T_C = 133°C	***MBR10100***	0.80 @ 10 A	150	150	221B	3–90
45	16	T_C = 125°C	***MBR1645***	0.63 @ 16 A	150	150	221B	3–92
45	15	T_C = 105°C	UL ***MBRF1545CT***★	0.84 @ 15 A	150	150	ISOLATED 221D	3–94
45	20	T_C = 135°C	UL ***MBRF2045CT***★	0.84 @ 20 A	150	150	ISOLATED 221D	3–97
60	20	T_C = 133°C	UL ***MBRF2060CT***★	0.95 @ 20 A	150	150	ISOLATED 221D	3–100
100	20	T_C = 133°C	UL ***MBRF20100CT***★	0.95 @ 20 A	150	150	ISOLATED 221D	3–103
200	20	T_C = 125°C	UL ***MBRF20200CT***★	1.0 @ 20 A	150	150	ISOLATED 221D	3–106
45	25	T_C = 125°C	UL ***MBRF2545CT***★	0.82 @ 25 A	150	150	ISOLATED 221D	3–109
45	7.5	T_C = 105°C	***MBRF745***★	0.84 @ 15 A	150	150	ISOLATED 221E	3–112
45	10	T_C = 135°C	***MBRF1045***★	0.84 @ 20 A	150	150	ISOLATED 221E	3–115

UL Indicates UL Recognized — File #E69369
★ New Product

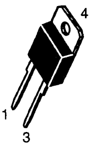
Devices listed in bold, italic are Motorola preferred devices.

Case 340D
(TO–218AC)



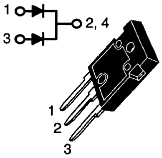
STYLE 2:
PIN 1. ANODE 1
2. CATHODES
3. ANODE 2
4. CATHODES

Case 340E
(TO–218)



STYLE 1:
PIN 1. CATHODE
3. ANODE
4. CATHODE

Case 340F
(TO–247)



STYLE 2:
PIN 1. ANODE 1
2. CATHODES
3. ANODE 2
4. CATHODES
(BACK HEATSINK)

Table 8. TO–218 Types and TO–247 Schottky Rectifiers

V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F $T_C = 25°C$ (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
45	30	$T_C = 105°C$	***MBR3045PT***	0.76 @ 30 A	200	150	340D	3–119
45	40	$T_C = 125°C$	***MBR4045PT***	0.70 @ 20 A 0.80 @ 40 A	400	150	340D	3–121
45	60	$T_C = 125°C$	***MBR6045PT***⋆	0.62 @ 30 A 0.75 @ 60 A	500	150	340D	3–123
25	50	$T_C = 125°C$	***MBR5025L***⋆	0.54 @ 30 A 0.62 @ 50 A	300	150	340E	3–125
45	30	$T_C = 105°C$	***MBR3045WT***	0.76 @ 30 A	200	150	340F	3–127
15	40	$T_C = 125°C$	***MBR4015LWT*** ⋆	0.42 @ 20 A 0.50 @ 40 A	400	150	340F	3–129
45	40	$T_C = 125°C$	***MBR4045WT***	0.70 @ 20 A 0.80 @ 40 A	400	150	340F	3–131
45	60	$T_C = 125°C$	***MBR6045WT***⋆	0.62 @ 30 A 0.75 @ 60 A	500	150	340F	3–133

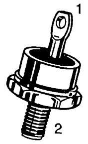
⋆ New Product

Devices listed in bold, italic are Motorola preferred devices.

Case 56
(DO–203AA)

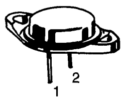
STYLE 2:
PIN 1. ANODE
2. CATHODE (CASE)

Case 257
(DO–203AB)



STYLE 2:
PIN 1. ANODE
2. CATHODE (CASE)

Case 11–03
(TO–204AA)



STYLE 4:
PIN 1. ANODE #1
2. ANODE #2
CASE. COMMON CATHODE

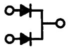
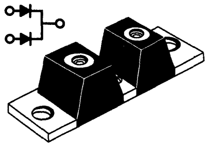


Table 9. TO–204AA (formerly TO–3), DO–203AA and DO–203AB (formerly DO–4 and DO–5) Schottky Rectifier Metal Packages DEVICES NOT RECOMMENDED FOR NEW DESIGN

V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F $T_C = 25°C$ (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
20	15	$T_C = 85°C$ ($V_R = 4$ V)	***1N5826***	0.44 @ 15 A	500	125	56	3–135
30	15	$T_C = 85°C$ ($V_R = 6$ V)	***1N5827***	0.47 @ 15 A	500	125	56	3–135
40	15	$T_C = 85°C$ ($V_R = 8$ V)	***1N5828***	0.50 @ 15 A	500	125	56	3–135
20	25	$T_C = 85°C$ ($V_R = 4$ V)	***1N5829***	0.44 @ 25 A	800	125	56	3–139
30	25	$T_C = 85°C$ ($V_R = 6$ V)	***1N5830***	0.46 @ 25 A	800	125	56	3–139
40	25	$T_C = 85°C$ ($V_R = 8$ V)	***1N5831***	0.48 @ 25 A	800	125	56	3–139
30	25	$T_C = 70°C$	***1N6095***	0.86 @ 78.5 A $T_C = 70°C$	400	125	56	3–144
40	25	$T_C = 70°C$	***1N6096***	0.86 @ 78.5 A $T_C = 70°C$	400	125	56	3–144
45	30	$T_C = 105°C$	***SD41***	0.55 @ 78.5 A $T_C = 125°C$	600	150	56	3–144
45	35	$T_C = 110°C$	***MBR3545***	0.63 @ 35 A	600	150	56	3–148
20	40	$T_C = 75°C$ ($V_R = 4$ V)	***1N5832***	0.052 @ 40 A	800	125	257	3–152
30	40	$T_C = 75°C$ ($V_R = 6$ V)	***1N5833***	0.55 @ 40 A	800	125	257	3–152
40	40	$T_C = 75°C$ ($V_R = 8$ V)	***1N5834***	0.59 @ 40 A	800	125	257	3–152
30	50	$T_C = 70°C$	***1N6097***	0.86 @ 157 A $T_C = 70°C$	800	125	257	3–156
40	50	$T_C = 70°C$	***1N6098***	0.86 @ 157 A $T_C = 70°C$	800	125	257	3–156
30	60	$T_C = 120°C$	***MBR6030L***	0.42 @ 30 A 0.48 @ 60 A	1000	150	257	3–160
45	60	$T_C = 90°C$	***SD51***	0.70 @ 60 A	800	150	257	3–156
45	60	$T_C = 100°C$	***MBR6045***	0.70 @ 60 A	800	150	257	3–164
45	65	$T_C = 120°C$	***MBR6545***	0.78 @ 65 A	800	175	257	3–168
45	75	$T_C = 90°C$	***MBR7545***	0.60 @ 60 A $T_C = 125°C$	1000	150	257	3–172
45	80	$T_C = 120°C$	***MBR8045***	0.72 @ 80 A	1000	175	257	3–174
45	30	$T_C = 105°C$	***MBR3045CT***	0.76 @ 30 A	400	150	11-03	3–178
45	30	$T_C = 105°C$	***SD241***	0.60 @ 20 A $T_C = 125°C$	400	150	11-03	3–178

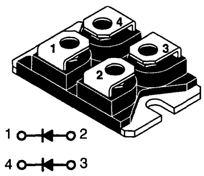
Devices listed in bold, italic are Motorola preferred devices.

Case 357C
POWERTAP™



Cathode = Mounting Plate
Anode = Terminal

SOT–227B



STYLE 2

Table 10. POWERTAP II and SOT–227B Schottky Rectifiers

V_{RRM} (Volts)	I_O(1) (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F $T_C = 25°C$ (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
30	200	$T_C = 125°C$	***MBRP20030CTL***★	0.52 @ 100 A 0.60 @ 200 A	1500	150	357C	3–181
45	200	$T_C = 125°C$	***MBRP20045CT***★	0.78 @ 100 A	1500	175	357C	3–182
60	200	$T_C = 125°C$	***MBRP20060CT***★	0.800 @ 100 A	1500	175	357C	3–182
45	300	$T_C = 120°C$	***MBRP30045CT***★	0.70 @ 150 A 0.82 @ 300 A	2500	175	357C	3–183
60	300	$T_C = 120°C$	***MBRP30060CT***★	0.79 @ 150 A 0.89 @ 300 A	2500	175	357C	3–183
35	600	$T_C = 100°C$	***MBRP60035CTL***★	0.57 @ 300 A	4000	150	357C	3–184
100	80	$T_C = 125°C$	***MBR240100V***★	0.95 @ 40 A	600	150	SOT-227B Style 2	3–185
60	100	$T_C = 125°C$	***MBR25060V***★	0.65 @ 50 A	800	150	SOT-227B Style 2	3–187
45	160	$T_C = 125°C$	***MBR28045V***★	0.80 @ 80 A 1.0 @ 160 A	900	150	SOT-227B Style 2	3–188

(1) I_O is total device current capability.
All POWERTAP devices are being converted to the new, more rugged, POWERTAP II configuration beginning January 1994. Contact your Motorola representative for more details.
All SOT–227B devices have 2500 volts isolation between the heatsink and active elements.
★ New Product

Devices listed in bold, italic are Motorola preferred devices.

Ultrafast Rectifiers

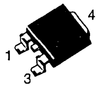
Case 403A
SMB

Cathode = Notch

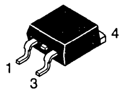
Case 403
SMC

Cathode = Notch

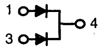
Case 369A
DPAK
Style 3



Case 418B
D^2PAK
Style 3



"CT" Suffix:



Non–"CT" Suffix:

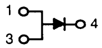
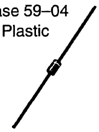


Table 11. Surface Mount Ultrafast Rectifiers

V_{RRM} (Volts)	I_O(1) (Amperes)	I_O Rating Condition	Device	Max t_{rr} (ns)	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Package	Page
200	1	T_L = 155°C	***MURS120T3***	35	0.875 @ 1.0 A	40	175	SMB	4–2
600	1	T_L = 150°C	***MURS160T3***	75	1.25 @ 1.0 A	35	175	SMB	4–2
200	3	T_L = 140°C	***MURS320T3***	35	0.875 @ 3.0 A	75	175	SMC	4–5
600	3	T_L = 130°C	***MURS360T3***	75	1.25 @ 3.0 A	75	175	SMC	4–5
200	3	T_L = 158°C	***MURD320***	35	0.95 @ 3.0 A	75	175	DPAK	4–8
200	6	T_L = 145°C	***MURD620CT***	35	1.0 @ 3.0 A	63	175	DPAK	4–11
400	8	T_L = 120°C	***MURHB840CT***★	28	2.2 @ 4.0 A	100	175	D^2PAK	4–14
200	16	T_L = 150°C	***MURB1620CT***	35	0.975 @ 8.0 A	100	175	D^2PAK	4–17
600	16	T_L = 150°C	***MURB1660CT***	60	1.5 @ 8.0 A	100	175	D^2PAK	4–20

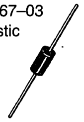
(1) I_O is total device current capability.
★ New Product

Case 59–04
Plastic



Cathode = Polarity Band

Case 267–03
Plastic



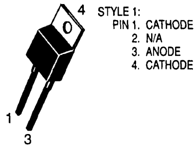
Cathode = Polarity Band

Table 12. Axial Lead Ultrafast Rectifiers

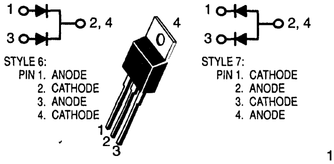
V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max t_{rr} (ns)	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
200	1	T_A = 130°C $R_{\theta JA}$ = 50°C/W	***MUR120***	25	0.875 @ 1.0 A	35	175	59-04	4–23
400	1	T_A = 120°C $R_{\theta JA}$ = 50°C/W	***MUR140***	50	1.25 @ 1.0 A	35	175	59-04	4–23
600	1	T_A = 120°C $R_{\theta JA}$ = 50°C/W	***MUR160***	50	1.25 @ 1.0 A	35	175	59-04	4–23
1000	1	T_A = 95°C $R_{\theta JA}$ = 50°C/W	***MUR1100E***	75	1.75 @ 1.0 A	35	175	59-04	4–27
200	4	T_A = 80°C $R_{\theta JA}$ = 28°C/W	***MUR420***	25	0.875 @ 3.0 A	125	175	267-03	4–31
400	4	T_A = 40°C $R_{\theta JA}$ = 28°C/W	***MUR440***	50	1.25 @ 3.0 A	70	175	267-03	—
600	4	T_A = 40°C $R_{\theta JA}$ = 28°C/W	***MUR460***	50	1.25 @ 3.0 A	70	175	267-03	4–31
1000	4	T_A = 35°C $R_{\theta JA}$ = 28°C/W	***MUR4100E***	75	1.75 @ 3.0 A	70	175	267-03	4–35

Devices listed in bold, italic are Motorola preferred devices.

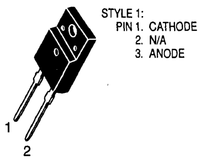
Case 221B
(TO-220AC)



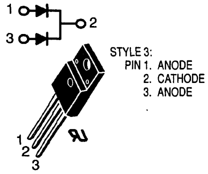
Case 221A-06
(TO-220AB)



Case 221E



Case 221D



2

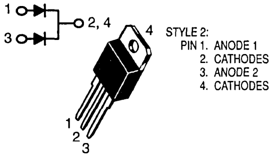
Table 13. TO–220 Type Ultrafast Rectifiers

V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max t_{rr} (ns)	Max V_F @ i_F $T_C = 25°C$ (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
200	6	T_C = 130°C	***MUR620CT***	35	0.975 @ 3.0 A	75	175	221A-06	4–39
400	8	T_C = 120°C	***MURH840CT***	28	2.0 @ 4.0 A	100	175	221A-06	4–41
600	8	T_C = 120°C	***MURH860CT***	35	2.8 @ 4.0 A	100	175	221A-06	4–44
200	16	T_C = 150°C	***MUR1620CT***	35	0.975 @ 8.0 A	100	175	221A-06	4–46
200	16	T_C = 160°C	***MUR1620CTR***	85	1.2 @ 8.0 A	100	175	221A-06	4–51
400	16	T_C = 150°C	***MUR1640CT***	60	1.30 @ 8.0 A	100	175	221A-06	4–46
600	16	T_C = 150°C	***MUR1660CT***	60	1.5 @ 8.0 A	100	175	221A-06	4–46
1500	5	T_C = 125°C	***MUR5150E***	175	2.4 @ 5.0 A	100	125	221B	4–54
200	8	T_C = 150°C	***MUR820***	35	0.975 @ 8.0 A	100	175	221B	4–56
400	8	T_C = 150°C	***MUR840***★	50	1.30 @ 8.0 A	100	175	221B	4–56
600	8	T_C = 150°C	***MUR860***★	50	1.50 @ 8.0 A	100	175	221B	4–56
800	8	T_C = 175°C	***MUR880E***	75	1.80 @ 8.0 A	100	175	221B	—
1000	8	T_C = 150°C	***MUR8100E***	75	1.80 @ 8.0 A	100	175	221B	4–61
1200	10	T_C = 125°C	***MUR10120E***	175	2.2 @ 6.5 A	100	125	221B	4–65
1500	10	T_C = 125°C	***MUR10150E***	175	2.4 @ 6.5 A	100	125	221B	4–68
200	15	T_C = 150°C	***MUR1520***	35	1.05 @ 15 A	200	175	221B	4–71
400	15	T_C = 150°C	***MUR1540***	60	1.25 @ 15 A	150	175	221B	4–71
600	15	T_C = 145°C	***MUR1560***	60	1.50 @ 15 A	150	175	221B	4–71
200	8	T_C = 150°C	***MURF820***★	25	0.975 @ 8.0 A	100	150	ISOLATED 221E	4–76
200	16	T_C = 150°C	ЯU ***MURF1620CT***★	25	0.975 @ 8.0 A	100	150	ISOLATED 221D	4–79
600	16	T_C = 150°C	ЯU ***MURF1660CT***★	50	1.50 @ 8.0 A	100	150	ISOLATED 221D	4–82

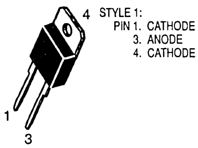
ЯU Indicates UL Recognized — File #E69369
★ New Product

Devices listed in bold, italic are Motorola preferred devices.

Case 340D
(TO–218AC)



Case 340E
(TO–218)



Case 340F
(TO–247)

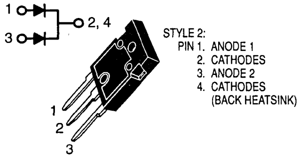
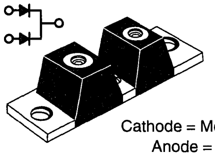


Table 14. TO–218 Types and TO–247 Ultrafast Rectifiers

V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max t_{rr} (ns)	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
200	30	T_C = 145°C	***MUR3020WT***	35	1.05 @ 15 A	150	175	340F	4–85
400	30	T_C = 145°C	***MUR3040WT***	60	1.25 @ 15 A	150	175	340F	4–85
600	30	T_C = 145°C	***MUR3060WT***	60	1.70 @ 15 A	150	175	340F	4–85
200	30	T_C = 150°C	***MUR3020PT***	35	1.12 @ 15 A	200	175	340D	4–90
400	30	T_C = 150°C	***MUR3040PT***	60	1.12 @ 15 A	150	175	340D	4–90
600	30	T_C = 145°C	***MUR3060PT***	60	1.20 @ 15 A	150	175	340D	4–90
400	30	T_C = 70°C	***MUR3040★***	100	1.5 @ 30 A	300	175	340E	4–95
800	30	T_C = 70°C	***MUR3080★***	110	1.90 @ 30 A	300	175	340E	4–97
400	60	T_C = 70°C	***MUR6040***	100	1.50 @ 60 A	600	175	340E	4–98

★ New Product

Case 357C
POWERTAP™



SOT–227B

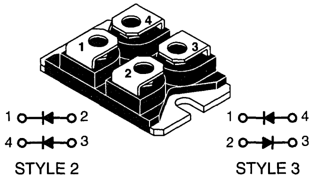


Table 15. POWERTAP II and SOT–227B Ultrafast Rectifiers

V_{RRM} (Volts)	I_O(1) (Amperes)	I_O Rating Condition	Device	Max t_{rr} (ns)	Max V_F @ i_F T_C = 25°C (Volts)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
400	60	T_C = 60°C	***BYT230PIV-400M★*** (UL)	100	1.5 @ 30 A	200	150	SOT-227B Style 3	4–100
1000	60	T_C = 50°C	***BYT230PIV-1000M★*** (UL)	165	1.9 @ 30 A	200	150	SOT-227B Style 3	4–104
400	120	T_C = 80°C	***BYT261PIV-400M★*** (UL)	100	1.5 @ 60 A	600	150	SOT-227B Style 2	4–108
1000	120	T_C = 60°C	***BYT261PIV-1000M★*** (UL)	170	1.9 @ 60 A	400	150	SOT-227B Style 2	4–112
200	200	T_C = 130°C	***MURP20020CT★***	50	1.00 @ 100 A	800	175	357C	4–116
400	200	T_C = 100°C	***MURP20040CT★***	50	1.30 @ 100 A	800	175	357C	4–116

(1) I_O is total device current capability.

All POWERTAP devices are being converted to the new, more rugged, POWERTAP II configuration beginning January 1994. Contact your Motorola representative for more details.

All SOT–227B devices have 2500 volts isolation between the heatsink and active elements.

(UL) Indicates UL Recognized — File #E69369

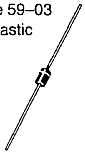
★ New Product

Devices listed in bold, italic are Motorola preferred devices.

Fast Recovery Rectifiers/General–Purpose Rectifiers

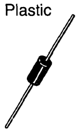
Axial lead Fast Recovery Rectifiers having maximum switching times of 200 ns and low cost general purpose rectifiers are listed in the table below.

Case 59–03
Plastic



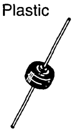
Cathode = Polarity Band

Case 267–03
Plastic



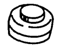
Cathode = Polarity Band

Case 194–04
Plastic



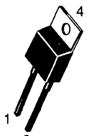
Cathode indicated by diode symbol

Case 193–04
Plastic(10)



Cathode = Polarity Band

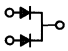
Case 221B
(TO–220AC)

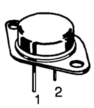


STYLE 1:
PIN 1. CATHODE
2. N/A
3. ANODE
4. CATHODE

Case 1–07
(TO–204AA)
Metal

STYLE 9:
PIN 1 ANODE #1
2. ANODE #2
CASE. COMMON CATHODE





STYLE 8:
PIN 1. CATHODE #1
2. CATHODE #2
CASE. COMMON ANODE

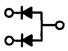


Table 16. Fast Recovery Rectifiers/General Purpose Rectifiers

V_{RRM} (Volts)	I_O (Amperes)	I_O Rating Condition	Device	Max V_F @ i_F T_J = 25°C (Volts)	Max t_{rr} (ns)	I_{FSM} (Amperes)	T_J Max (°C)	Case	Page
400	1	T_A = 75°C	***1N4004***	1.1 @ 1.0 A	—	30	150	59-03(3)	5–2
1000	1	T_A = 75°C	***1N4007***	1.1 @ 1.0 A	—	30	150	59-03(3)	5–2
200	1	T_A = 75°C	***1N4935***	1.2 @ 3.14 A T_J = 125°C	200	30	150	59-03(3)	5–3
600	1	T_A = 75°C	***1N4937***	1.2 @ 3.14 A T_J = 125°C	200	30	150	59-03(3)	5–3
400	3	T_L = 105°C	***1N5404***	1.2 @ 9.4 A	—	200	150	267-03	5–5
600	3	T_L = 105°C	***1N5406***	1.2 @ 9.4 A	—	200	150	267-03	5–5
200	3	T_A = 80°C(8)	***MR852***	1.25 @ 3.0 A	200	100	150	267-03	5–6
600	3	T_A = 80°C(8)	***MR856***	1.25 @ 3.0 A	200	100	150	267-03	5–6
400	6	T_A = 60°C $R_{\theta JA}$ = 25°C/W	***MR754***	1.25 @ 100 A	—	400	175	194-04	5–8
1000	6	T_A = 60°C $R_{\theta JA}$ = 25°C/W	***MR760***	1.25 @ 100 A	—	400	175	194-04	5–8
400	25	T_C = 150°C	***MR2504***	1.18 @ 78.5 A	—	400	175	193-04	5–12
1000	25	T_C = 150°C	***MR2510***	1.18 @ 78.5 A	—	400	175	193-04	5–12
100	30	T_C = 125°C	***MR4422CTR***	1.2 @ 15 A	—	400	150	1-07 Style 8	5–18
100	30	T_C = 125°C	***MR4422CT***	1.2 @ 15 A	—	400	150	1-07 Style 9	5–18
20	35	T_C = 150°C	***MR2535L(11)***	1.1 @ 100 A	—	400	175	194-04	5–19

(3) Package Size: 0.120″ max diameter by 0.260″ length.
(8) Must be derated for reverse power dissipation. See data sheet.
(10) Request data sheet for mounting information.
(11) Overvoltage Transient Suppressor: 24–32 volts avalanche voltage.

Devices listed in bold, italic are Motorola preferred devices.

Section 3

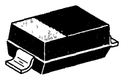
Schottky Data Sheets

3

Surface Mount Schottky Power Rectifier
Plastic SOD–123 Package

MBR0520LT1
MBR0520LT3
Motorola Preferred Devices

SCHOTTKY BARRIER RECTIFIER
0.5 AMPERES
20 VOLTS



CASE 425–04, Style 1
SOD–123

The Schottky Power Rectifier employs the Schottky Barrier principle with a barrier metal that produces optimal forward voltage drop–reverse current tradeoff. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes in surface mount applications where compact size and weight are critical to the system. This package provides an alternative to the leadless 34 MELF style package. These state–of–the–art devices have the following features:

- Guardring for Stress Protection
- Very Low Forward Voltage (0.38 V Max @ 0.5 A, 25°C)
- 125°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Package Designed for Optimal Automated Board Assembly

Mechanical Characteristics

- Reel Options: MBR0520LT1 = 3,000 per 7″ reel/8 mm tape.
  MBR0520LT3 = 10,000 per 13″ reel/8 mm tape.
- Device Marking: B2
- Polarity Designator: Cathode Band
- Weight: 11.7 mg (approximately)
- Case: Epoxy, Molded
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	Volts
Average Rectified Forward Current (Rated V_R) T_L = 90°C	$I_{F(AV)}$	0.5	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	5.5	Amps
Storage Temperature	T_{stg}	–65 to +125	°C
Operating Junction Temperature	T_J	–65 to +125	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/µs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Ambient (1)	$R_{\theta JA}$	340	°C/W
Thermal Resistance — Junction to Lead	$R_{\theta JL}$	150	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2)	V_F	T_J = 25°C	T_J = 100°C	Volts
(i_F = 0.1 Amps)		0.300	0.220	
(i_F = 0.5 Amps)		0.385	0.330	
Maximum Instantaneous Reverse Current (2)	I_R	T_J = 25°C	T_J = 100°C	mA
(V_R = 10 V)		75 µA	5 mA	
(Rated dc Voltage = 20 V)		250 µA	8 mA	

(1) FR–4 or FR–5 = 3.5 x 1.5 inches using the Motorola minimum recommended footprint.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

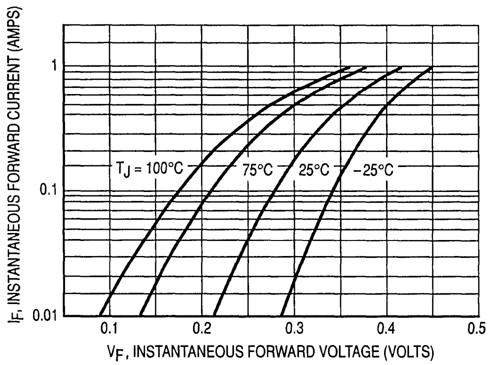


Figure 1. Typical Forward Voltage

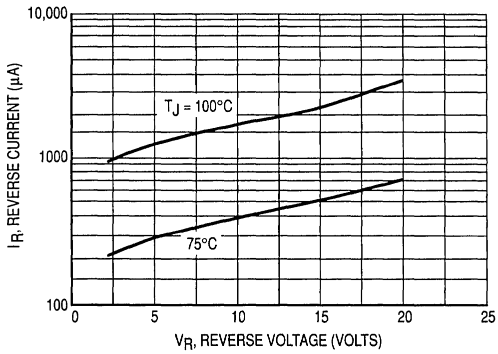


Figure 2. Typical Reverse Current

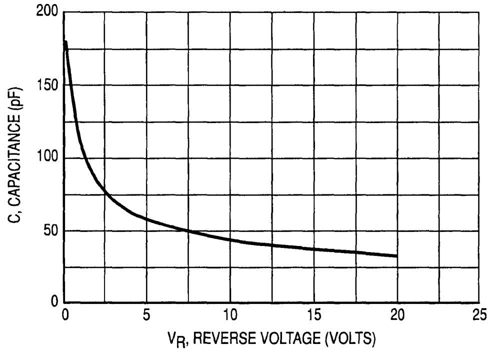


Figure 3. Typical Capacitance

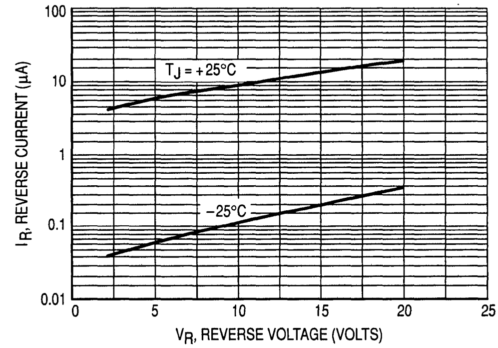


Figure 4. Typical Reverse Current

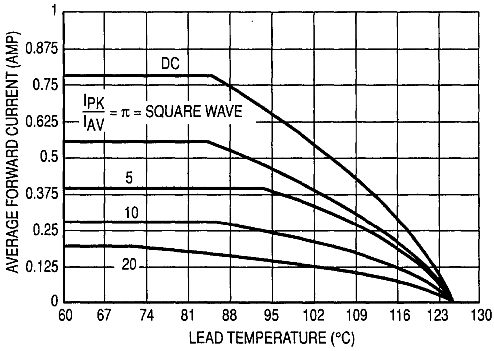


Figure 5. Current Derating (Lead)

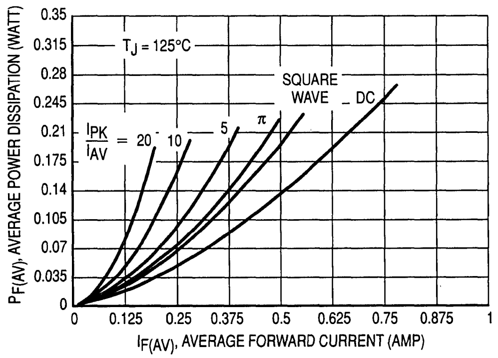


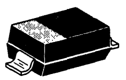
Figure 6. Power Dissipation

3

Surface Mount Schottky Power Rectifier
Plastic SOD–123 Package

MBR0530T1
MBR0530T3
Motorola Preferred Devices

SCHOTTKY BARRIER RECTIFIER
0.5 AMPERES
30 VOLTS



CASE 425–04
SOD–123

3

. . . using the Schottky Barrier principle with a large area metal–to–silicon power diode. Ideally suited for low voltage, high frequency rectification or as free wheeling and polarity protection diodes in surface mount applications where compact size and weight are critical to the system. This package also provides an easy to work with alternative to leadless 34 package style. These state–of–the–art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 125°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Package Designed for Optimal Automated Board Assembly

Mechanical Characteristics

- Reel Options: MBR0530T1 = 3,000 per 7″ reel/8 mm tape
  MBR0530T3 = 10,000 per 13″ reel/8 mm tape
- Device Marking: B3
- Polarity Designator: Cathode Band
- Weight: 11.7 mg (approximately)
- Case: Epoxy, Molded
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	Volts
Average Rectified Forward Current (Rated V_R) T_L = 100°C	$I_{F(AV)}$	0.5	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	5.5	Amps
Storage Temperature	T_{stg}	–65 to +125	°C
Operating Junction Temperature	T_J	–65 to +125	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/µs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Ambient (1)	$R_{\theta JA}$	340	°C/W
Thermal Resistance — Junction to Lead (1)	$R_{\theta JL}$	150	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) (i_F = 0.1 Amps, T_J = 25°C) (i_F = 0.5 Amps, T_J = 25°C)	V_F	 0.375 0.43	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 25°C) (V_R = 15 V, T_C = 25°C)	I_R	 130 20	µA

(1) FR–4 or FR–5 = 3.5 x 1.5 inches using the Motorola minimum recommended footprint.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

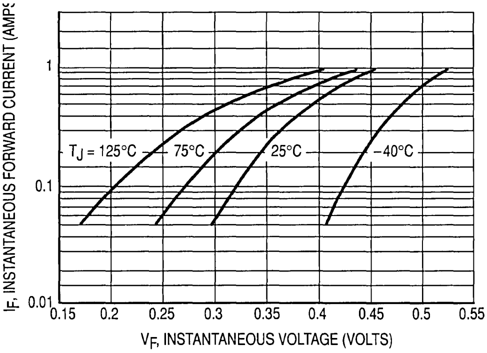


Figure 1. Typical Forward Voltage

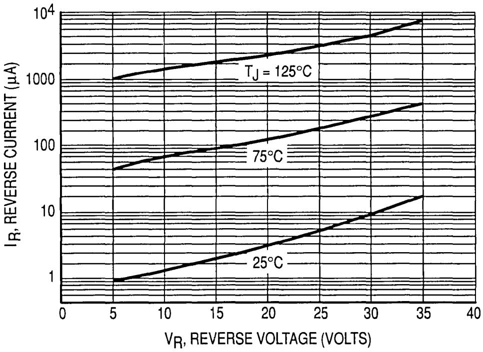


Figure 2. Typical Reverse Current

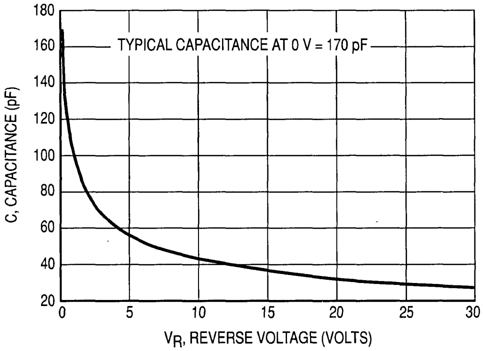


Figure 3. Typical Capacitance

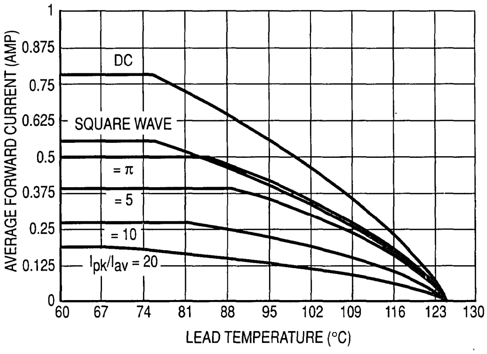


Figure 4. Current Derating (Lead)

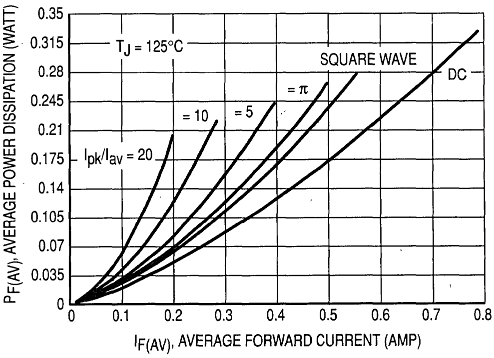


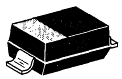
Figure 5. Power Dissipation

3

Surface Mount Schottky Power Rectifier
Plastic SOD–123 Package

MBR0540T1
MBR0540T3
Motorola Preferred Devices

SCHOTTKY BARRIER RECTIFIER
0.5 AMPERES
40 VOLTS



CASE 425–04
SOD–123

. . . using the Schottky Barrier principle with a large area metal–to–silicon power diode. Ideally suited for low voltage, high frequency rectification or as free wheeling and polarity protection diodes in surface mount applications where compact size and weight are critical to the system. This package also provides an easy to work with alternative to leadless 34 package style. These state–of–the–art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Package Designed for Optimal Automated Board Assembly

Mechanical Characteristics

- Reel Options: MBR0540T1 = 3,000 per 7″ reel/8 mm tape
  MBR0540T3 = 10,000 per 13″ reel/8 mm tape
- Device Marking: B4
- Polarity Designator: Cathode Band
- Weight: 11.7 mg (approximately)
- Case: Epoxy, Molded
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	40	Volts
Average Rectified Forward Current (Rated V_R) T_L = 100°C	$I_{F(AV)}$	0.5	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	5.5	Amps
Storage Temperature	T_{stg}	–65 to +150	°C
Operating Junction Temperature	T_J	–65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/µs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Ambient (1)	$R_{\theta JA}$	340	°C/W
Thermal Resistance — Junction to Lead (1)	$R_{\theta JL}$	150	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) (i_F = 0.5 Amps, T_J = 25°C)	V_F	0.51	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 25°C) (V_R = 20 V, T_C = 25°C)	I_R	 20 10	µA

(1) FR–4 or FR–5 = 3.5 x 1.5 inches using the Motorola minimum recommended footprint.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

Designer's™ Data Sheet

Schottky Power Rectifier Surface Mount Power Package

MBRS130LT3

Motorola Preferred Device

. . . Employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes, in surface mount applications where compact size and weight are critical to the system.

- Very Low Forward Voltage Drop (0.395 Volts Max @ 1.0 A, T_J = 25°C)
- Small Compact Surface Mountable Package with J–Bend Leads
- Highly Stable Oxide Passivated Junction
- Guardring for Stress Protection

SCHOTTKY BARRIER RECTIFIER 1.0 AMPERE 30 VOLTS

CASE 403A–03

3

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 95 mg (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped in 12 mm Tape and Reel, 2500 units per reel
- Polarity: Notch in Plastic Body Indicates Cathode Lead
- Marking: B130

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	30	Volts
Average Rectified Forward Current	T_L = 120°C T_L = 110°C	$I_{F(AV)}$	1.0 2.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	40	Amps
Operating Junction Temperature		T_J	– 65 to +125	°C

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{\theta JL}$	12	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C) (i_F = 2.0 A, T_J = 25°C)	V_F	 0.395 0.445	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	I_R	 1.0 10	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

3

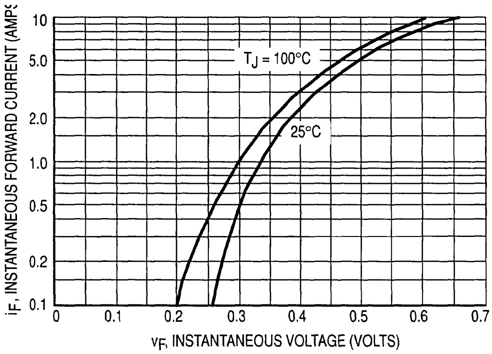


Figure 1. Typical Forward Voltage

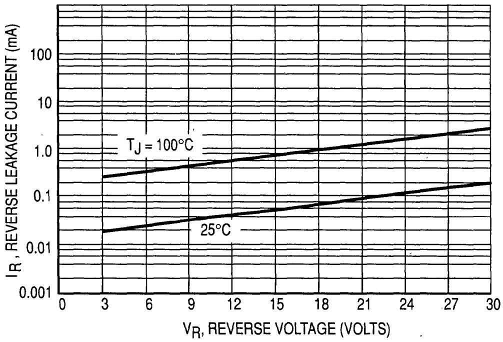


Figure 2. Typical Reverse Leakage Current

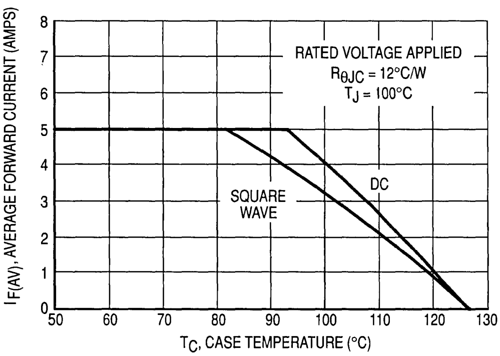


Figure 3. Current Derating (Case)

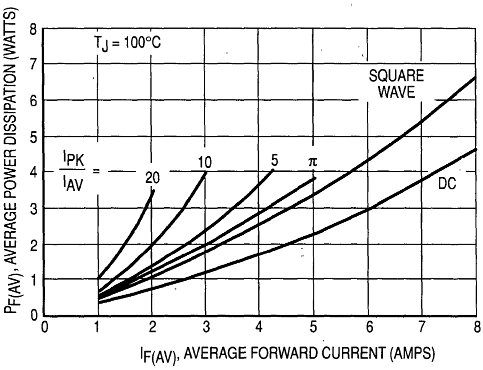


Figure 4. Typical Power Dissipation

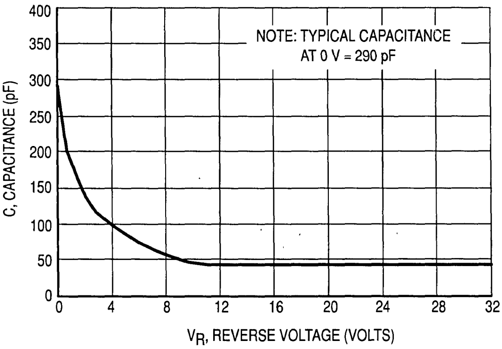


Figure 5. Typical Capacitance

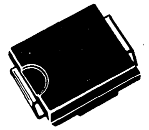
MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Surface Mount Schottky Power Rectifier

MBRS140T3

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS 1.0 AMPERE 40 VOLTS



CASE 403A-03

3

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop (0.55 Volts Max @ 1.0 A, T_J = 25°C)
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection

Mechanical Characteristics:
- Case: Epoxy, Molded
- Weight: 95 mg (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped in 12 mm Tape and Reel, 2500 units per reel
- Polarity: Notch in Plastic Body Indicates Cathode Lead
- Marking: B140

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	40	Volts
Average Rectified Forward Current T_L = 115°C	$I_{F(AV)}$	1	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	40	Amps
Operating Junction Temperature	T_J	–65 to +125	°C

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{θJL}$	12	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C)	v_F	0.6	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	i_R	 1.0 10	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 2

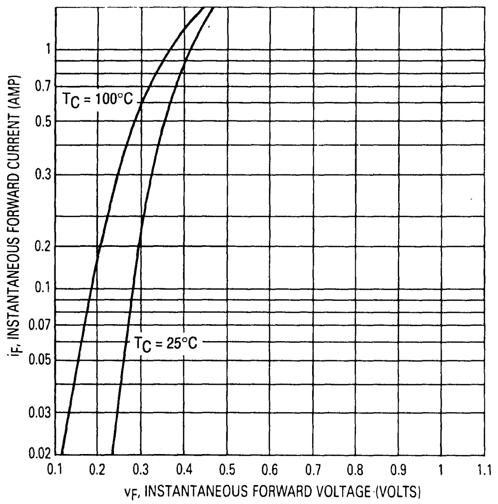


Figure 1. Typical Forward Voltage

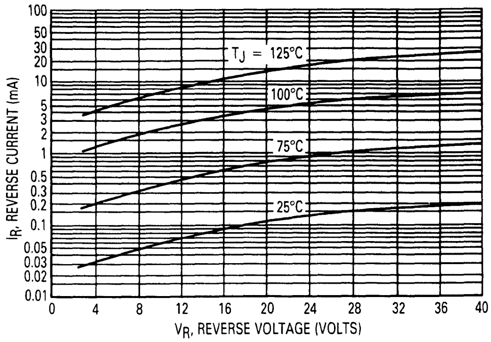


Figure 2. Typical Reverse Current

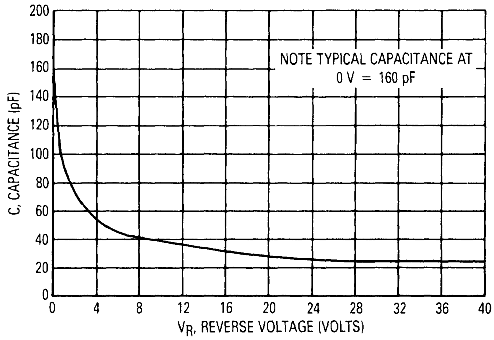


Figure 3. Typical Capacitance

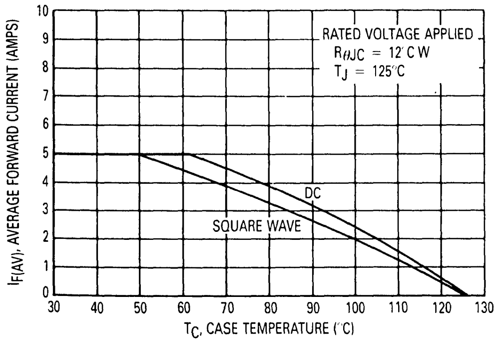


Figure 4. Current Derating (Case)

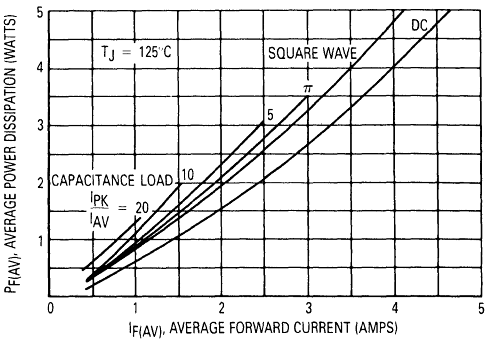


Figure 5. Power Dissipation

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Designer's™ Data Sheet

Schottky Power Rectifier

Surface Mount Power Package

MBRS1100T3

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER 1.0 AMPERE 100 VOLTS

CASE 403A-03

3

Schottky Power Rectifiers employ the use of the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes, in surface mount applications where compact size and weight are critical to the system. These state-of-the-art devices have the following features:

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Highly Stable Oxide Passivated Junction
- High Blocking Voltage — 100 Volts
- 150°C Operating Junction Temperature
- Guardring for Stress Protection

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 95 mg (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped in 12 mm Tape and Reel, 2500 units per reel
- Polarity: Notch in Plastic Body Indicates Cathode Lead
- Marking: B110

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current	T_L = 120°C T_L = 100°C	$I_{F(AV)}$	1.0 2.0	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	50	Amps
Operating Junction Temperature		T_J	−65 to +150	°C
Voltage Rate of Change		dv/dt	10	V/ns

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{\theta JL}$	22	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C)	v_F	0.75	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	i_R	 0.5 5.0	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Rev 2

3

TYPICAL ELECTRICAL CHARACTERISTICS

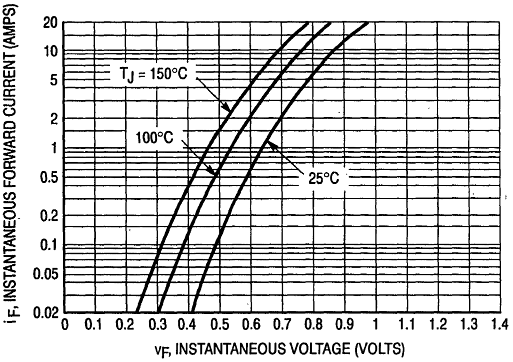


Figure 1. Typical Forward Voltage

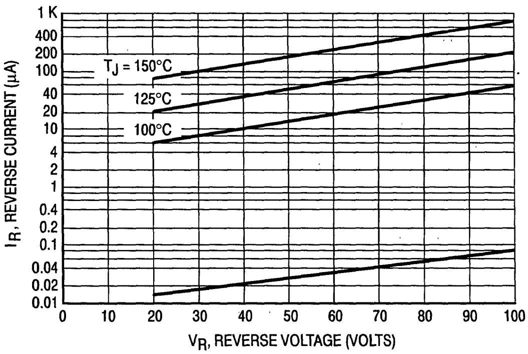


Figure 2. Typical Reverse Current

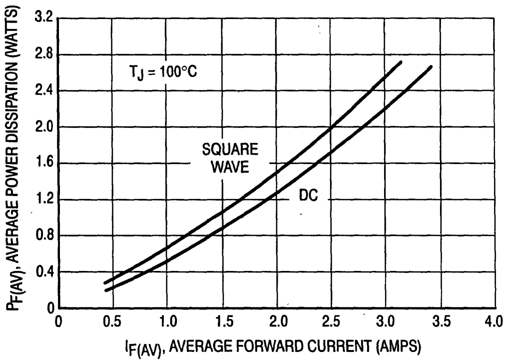


Figure 3. Power Dissipation

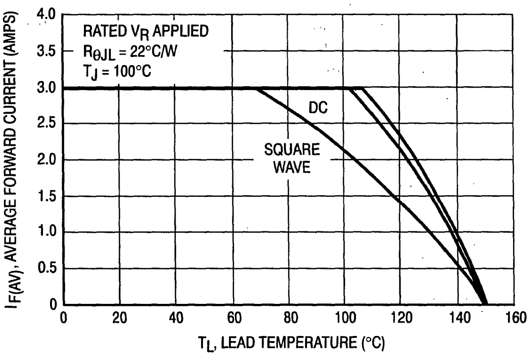


Figure 4. Current Derating, Lead

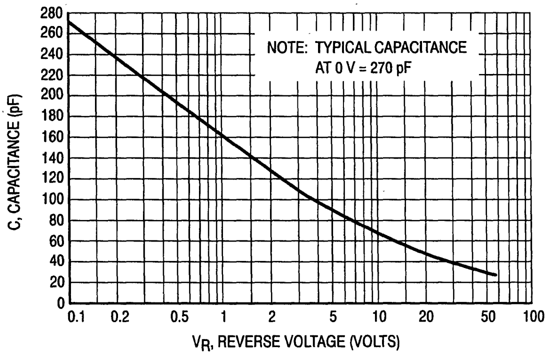


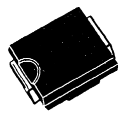
Figure 5. Typical Capacitance

Surface Mount Schottky Power Rectifier

MBRS340T3
MBRS360T3

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
3.0 AMPERES
40, 60 VOLTS



CASE 403-03

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes, in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop (0.5 Volts Max @ 3.0 A, T_J = 25°C)
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 217 mg (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped in 16 mm Tape and Reel, 2500 units per reel
- Polarity: Notch in Plastic Body Indicates Cathode Lead
- Marking: B34, B36

MAXIMUM RATINGS

Rating	Symbol	MBRS340T3	MBRS360T3	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	40	60	Volts
Average Rectified Forward Current	$I_{F(AV)}$	3.0 @ T_L = 100°C 4.0 @ T_L = 90°C		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	80		Amps
Operating Junction Temperature	T_J	−65 to +125		°C

THERMAL CHARACTERISTICS

Rating	Symbol	MBRS340T3	MBRS360T3	Unit
Thermal Resistance — Junction to Lead	$R_{\theta JL}$	11	11	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MBRS340T3	MBRS360T3	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 3.0 A, T_J = 25°C)	v_F	0.525	0.740	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	I_R	2.0 20	0.5 20	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 2

3

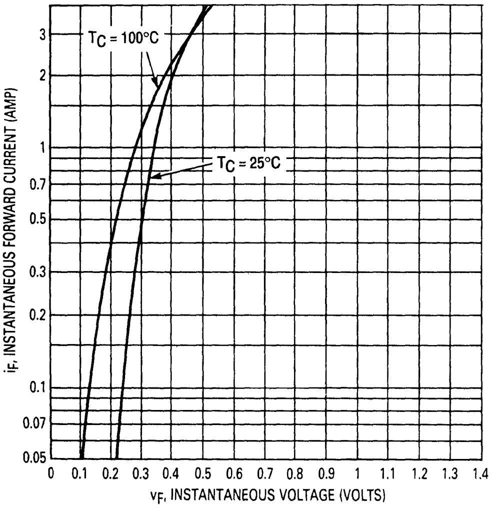


Figure 1. Typical Forward Voltage

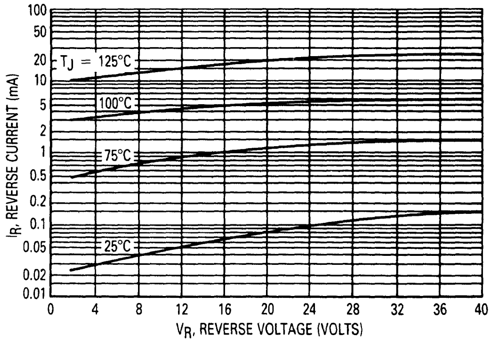


Figure 2. Typical Reverse Current

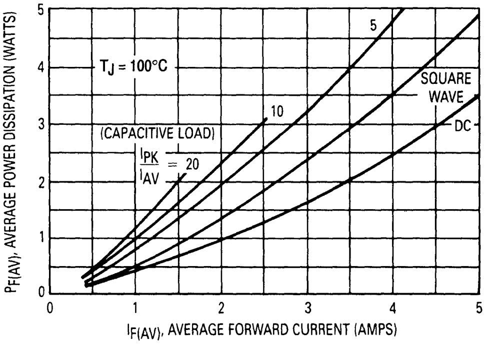


Figure 3. Power Dissipation

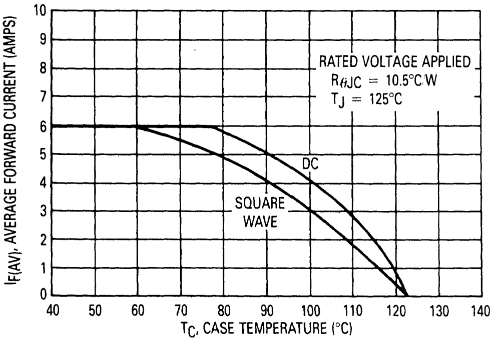


Figure 4. Current Derating (Case)

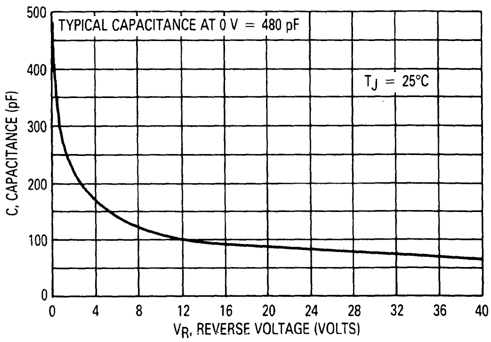


Figure 5. Typical Capacitance

SWITCHMODE Power Rectifiers

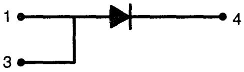
DPAK Surface Mount Package

. . . designed for use as output rectifiers, free wheeling, protection and steering diodes in switching power supplies, inverters and other inductive switching circuits. These state-of-the-art devices have the following features:

- Extremely Fast Switching
- Extremely Low Forward Drop
- Platinum Barrier with Avalanche Guardrings
- Guaranteed Reverse Avalanche

Mechanical Characteristics:

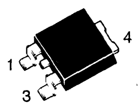
- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 75 units per plastic tube
- Available in 16 mm Tape and Reel, 2500 units per reel, by adding a "T4" suffix to the part number
- Marking: B320, B330, B340, B350, B360



MBRD320
MBRD330
MBRD340
MBRD350
MBRD360

MBRD320, MBRD340 and MBRD360 are Motorola Preferred Devices

SCHOTTKY BARRIER RECTIFIERS
3 AMPERES
20 TO 60 VOLTS



CASE 369A-13
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBRD					Unit
		320	330	340	350	360	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	Volts
Average Rectified Forward Current ($T_C = +125°C$, Rated V_R)	$I_{F(AV)}$	3					Amps
Peak Repetitive Forward Current, $T_C = +125°C$ (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	6					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	75					Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}	1					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000					V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	6	°C/W
Maximum Thermal Resistance, Junction to Ambient (1)	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) i_F = 3 Amps, $T_C = +25°C$ i_F = 3 Amps, $T_C = +125°C$ i_F = 6 Amps, $T_C = +25°C$ i_F = 6 Amps, $T_C = +125°C$	v_F	 0.6 0.45 0.7 0.625	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, $T_C = +25°C$) (Rated dc Voltage, $T_C = +125°C$)	i_R	 0.2 20	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

3

TYPICAL CHARACTERISTICS

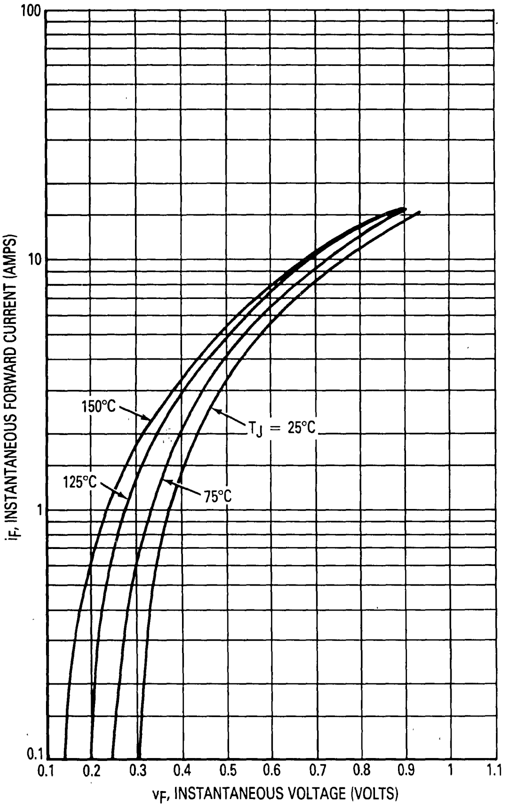
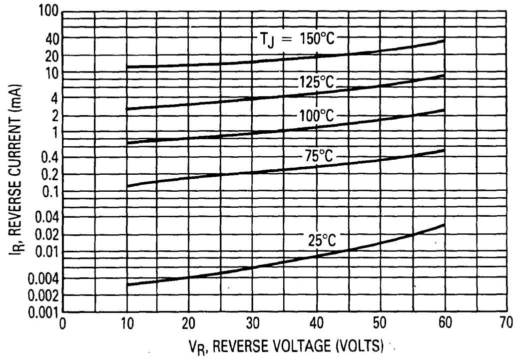


Figure 1. Typical Forward Voltage



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Reverse Current

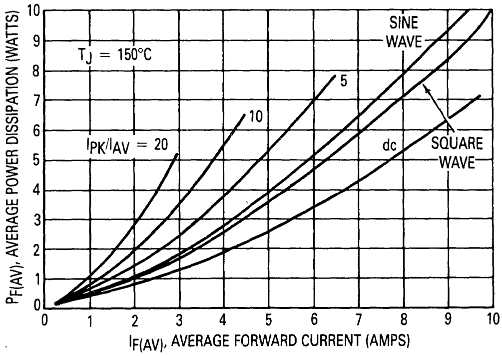


Figure 3. Average Power Dissipation

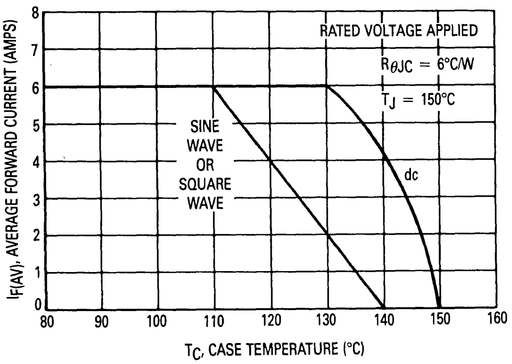


Figure 4. Current Derating, Case

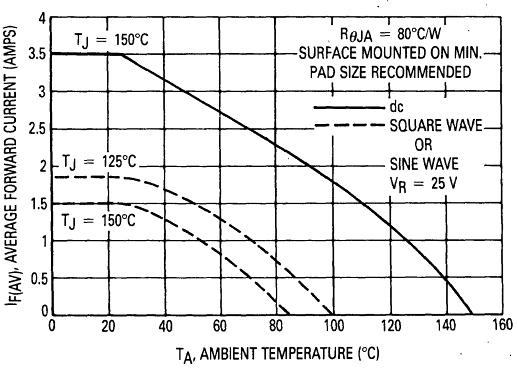


Figure 5. Current Derating, Ambient

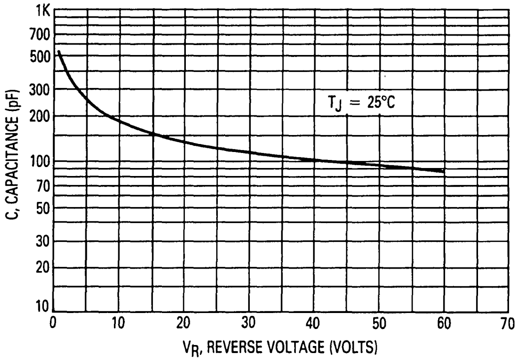


Figure 6. Typical Capacitance

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

3

SWITCHMODE Power Rectifiers

DPAK Surface Mount Package

MBRD620CT
MBRD630CT
MBRD640CT
MBRD650CT
MBRD660CT

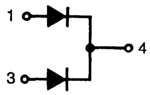
MBRD620CT, MBRD640CT and MBRD660CT are Motorola Preferred Devices

. . . in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

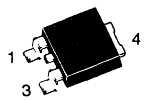
- Extremely Fast Switching
- Extremely Low Forward Drop
- Platinum Barrier with Avalanche Guardrings
- Guaranteed Reverse Avalanche

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 75 units per plastic tube
- Available in 16 mm Tape and Reel, 2500 units per reel, by adding a "T4" suffix to the part number
- Marking: B620T, B630T, B640T, B650T, B660T



SCHOTTKY BARRIER RECTIFIERS
6 AMPERES
20 TO 60 VOLTS



CASE 369A-13
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBRD 620CT	630CT	640CT	650CT	660CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	Volts
Average Rectified Forward Current T_C = 130°C (Rated V_R) Per Diode Per Device	$I_{F(AV)}$			3 6			Amps
Peak Repetitive Forward Current, T_C = 130°C (Rated V_R, Square Wave, 20 kHz) Per Diode	I_{FRM}			6			Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}			75			Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}			1			Amp
Operating Junction Temperature	T_J			−65 to +150			°C
Storage Temperature	T_{stg}			−65 to +175			°C
Voltage Rate of Change (Rated V_R)	dv/dt			10000			V/μs

THERMAL CHARACTERISTICS PER DIODE

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	6	°C/W
Maximum Thermal Resistance, Junction to Ambient (1)	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage (2) i_F = 3 Amps, T_C = 25°C i_F = 3 Amps, T_C = 125°C i_F = 6 Amps, T_C = 25°C i_F = 6 Amps, T_C = 125°C	v_F	 0.7 0.65 0.9 0.85	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	i_R	 0.1 15	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

TYPICAL CHARACTERISTICS

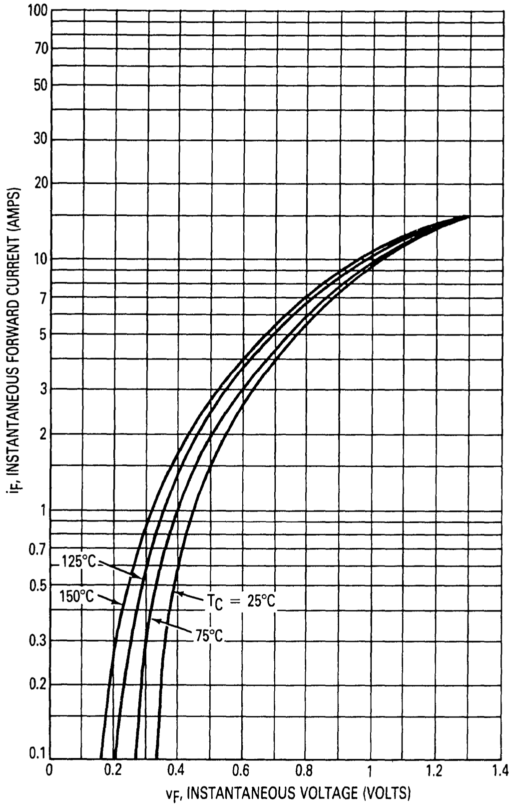
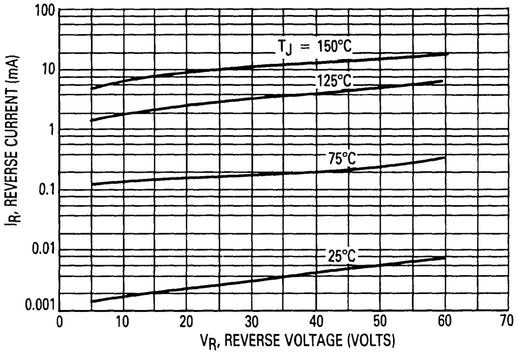


Figure 1. Typical Forward Voltage, Per Leg



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Reverse Current,* Per Leg

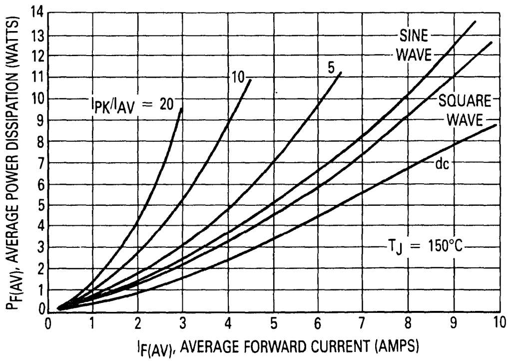


Figure 3. Average Power Dissipation, Per Leg

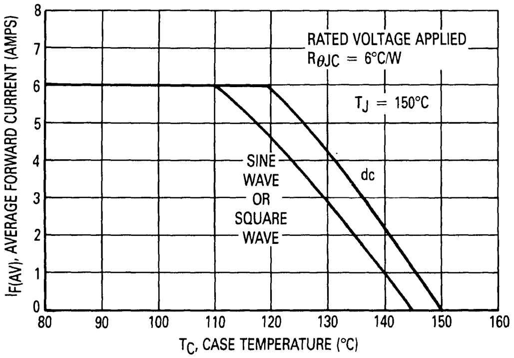


Figure 4. Current Derating, Case, Per Leg

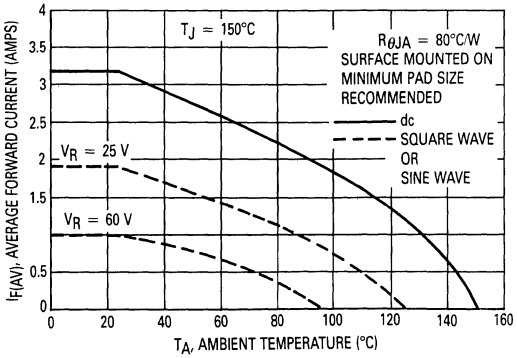


Figure 5. Current Derating, Ambient, Per Leg

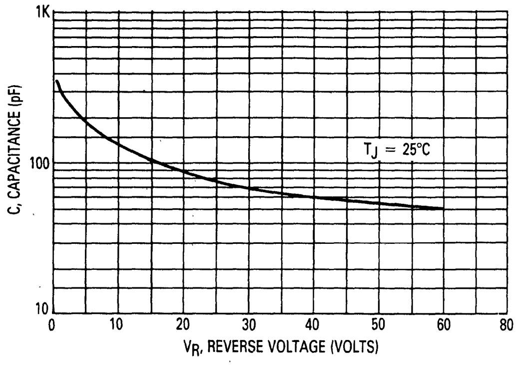


Figure 6. Typical Capacitance, Per Leg

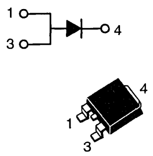
SWITCHMODE™ Power Rectifier

DPAK Surface Mount Package

MBRD835L

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
8 AMPERES
35 VOLTS



CASE 369A–13
DPAK PLASTIC, STYLE 3

This SWITCHMODE power rectifier which uses the Schottky Barrier principle with a proprietary barrier metal, is designed for use as output rectifiers, free wheeling, protection and steering diodes in switching power supplies, inverters and other inductive switching circuits. This state of the art device has the following features:

- Low Forward Voltage
- 125°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Compact Size
- Lead Formed for Surface Mount

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 75 units per plastic tube
- Available in 16 mm Tape and Reel, 2500 units per 13" reel, by adding a "T4" suffix to the part number
- Marking: B835L

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	Volts
Average Rectified Forward Current (At Rated V_R) $T_C = +88°C$	$I_{F(AV)}$	8	Amps
Peak Repetitive Forward Current (At Rated V_R, Square Wave, 20 kHz) $T_C = +80°C$	I_{FRM}	16	Amps
Non–Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	75	Amps
Repetitive Avalanche Current (Current Decaying Linearly to Zero in 1 μs, Frequency Limited by T_{Jmax})	I_{AR}	2	Amps
Storage Temperature	T_{stg}	–65 to +150	°C
Operating Junction Temperature	T_J	–65 to +125	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	6	°C/W
Thermal Resistance — Junction to Ambient(1)	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage(2) (i_F = 8 Amps, $T_C = +25°C$) (i_F = 8 Amps, $T_C = +125°C$)	V_F	0.51 0.41	Volts
Maximum Instantaneous Reverse Current(2) (Rated dc Voltage, $T_C = +25°C$) (Rated dc Voltage, $T_C = +100°C$)	I_R	1.4 35	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

3

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TYPICAL CHARACTERISTICS

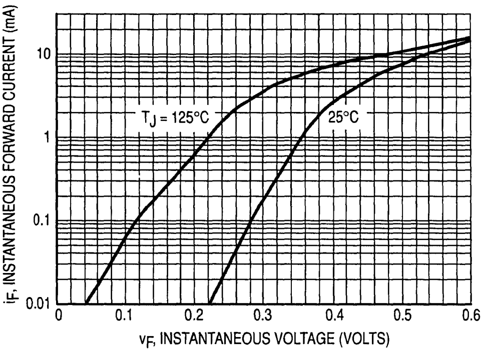

Figure 1. Maximum Forward Voltage

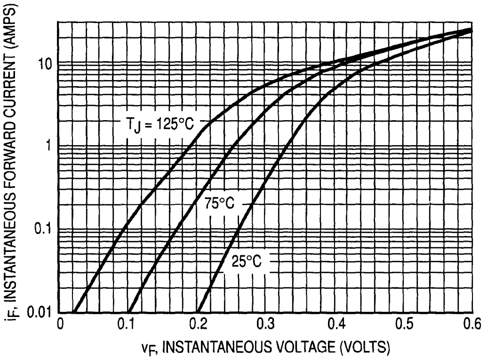

Figure 2. Typical Forward Voltage

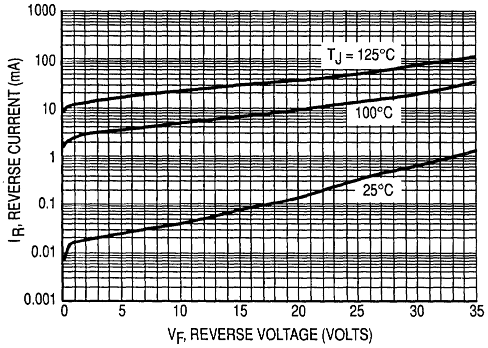

Figure 3. Maximum Reverse Current

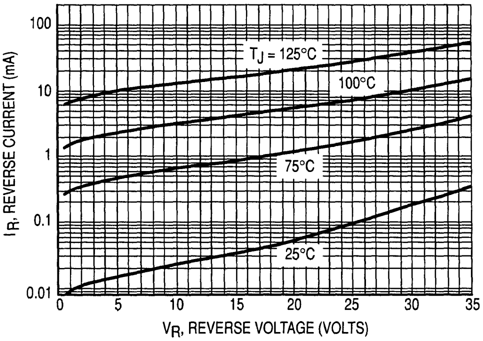

Figure 4. Typical Reverse Current

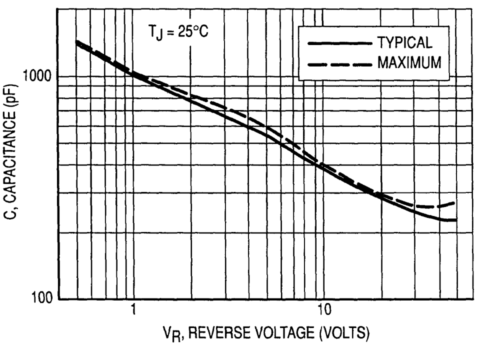

Figure 5. Maximum and Typical Capacitance

TYPICAL CHARACTERISTICS

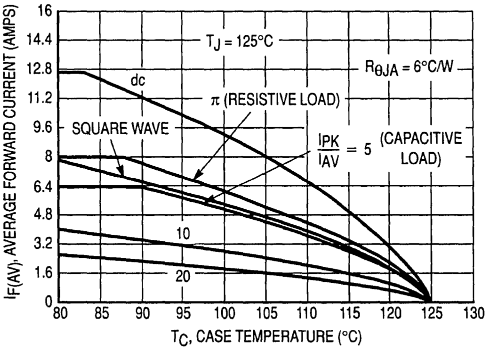

Figure 6. Current Derating, Infinite Heatsink

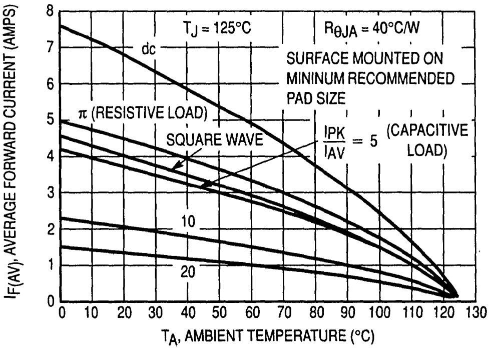

Figure 7. Current Derating

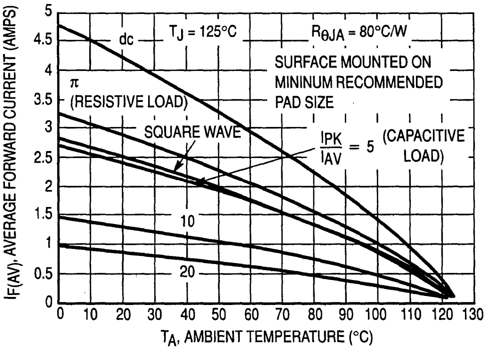

Figure 8. Current Derating, Free Air

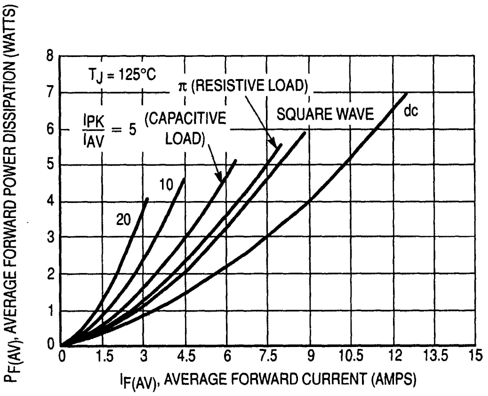

Figure 9. Forward Power Dissipation

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MBRB1545CT

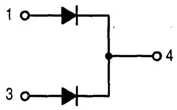
Motorola Preferred Device

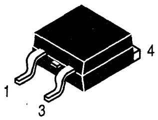
Designer's™ Data Sheet
SWITCHMODE™ Power Rectifier
D2PAK Surface Mount Power Package

SCHOTTKY BARRIER RECTIFIER
15 AMPERES
45 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO-220 Package





CASE 418B-01
D2PAK

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B1545T

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C Total Device	$I_{F(AV)}$	7.5 15	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 105°C	I_{FRM}	15	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Storage Temperature	T_{stg}	−65 to +175	°C
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

(1) When mounted using minimum recommended pad size on FR-4 board.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 7.5 Amps, T_J = 125°C) (i_F = 15 Amps, T_J = 125°C) (i_F = 15 Amps, T_J = 25°C)	v_F	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 15 0.1	mA

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

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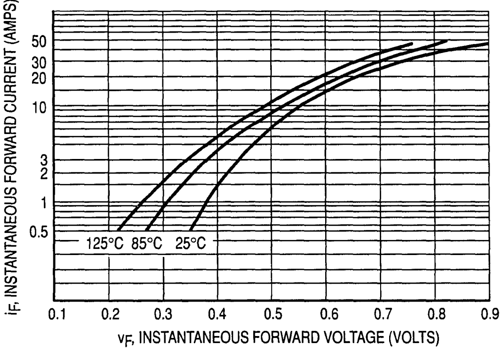


Figure 1. Typical Forward Voltage, Per Leg

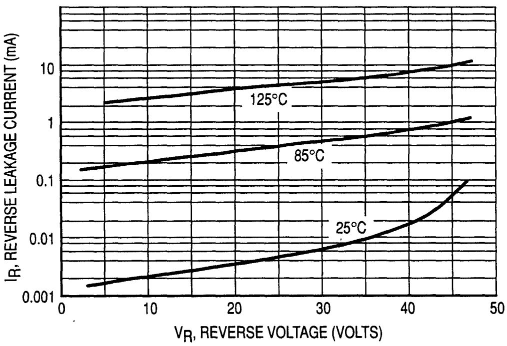


Figure 2. Typical Reverse Current, Per Leg

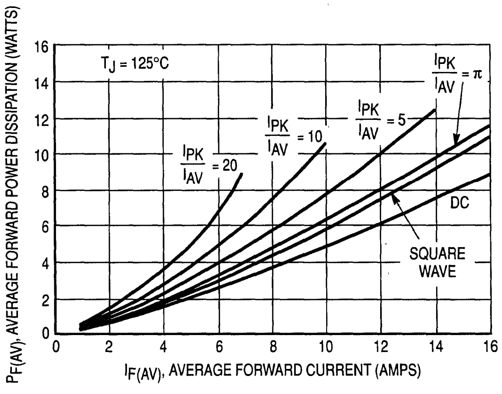


Figure 3. Typical Forward Power Dissipation

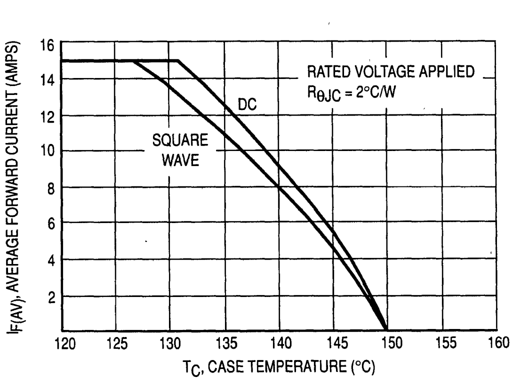


Figure 4. Current Derating, Case

MBRB2060CT

Motorola Preferred Device

Designer's™ Data Sheet

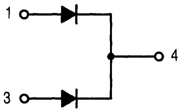
SWITCHMODE™ Power Rectifier

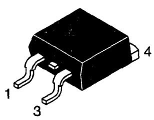
D2PAK Surface Mount Power Package

SCHOTTKY BARRIER RECTIFIER
20 AMPERES
60 VOLTS

Employs the use of the Schottky Barrier principle with a platinum barrier metal. These state–of–the–art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Center–Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to Industry Standard TO–220 Package





CASE 418B–02

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B2060T

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	20	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	0.5	Amp
Storage Temperature	T_{stg}	–65 to +175	°C
Operating Junction Temperature	T_J	–65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (2)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

(2) See Chapter 7 for mounting conditions

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Rev 1

3

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_J = 125°C) (i_F = 20 Amps, T_J = 25°C)	v_F	 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 150 0.15	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2%

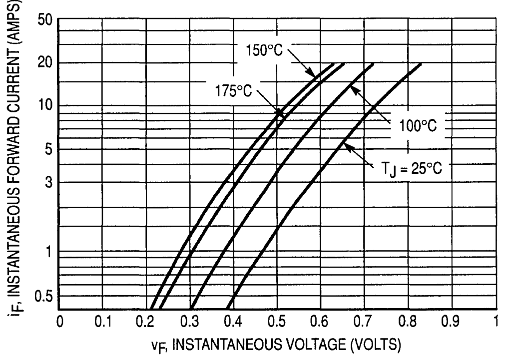


Figure 1. Typical Forward Voltage Per Diode

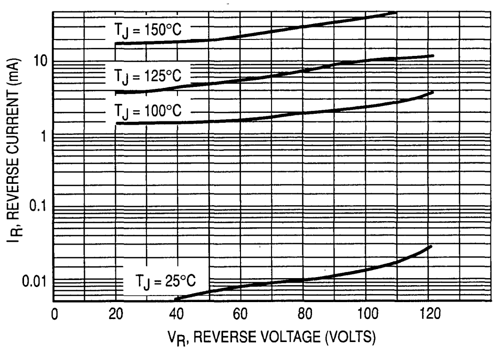


Figure 2. Typical Reverse Current Per Diode

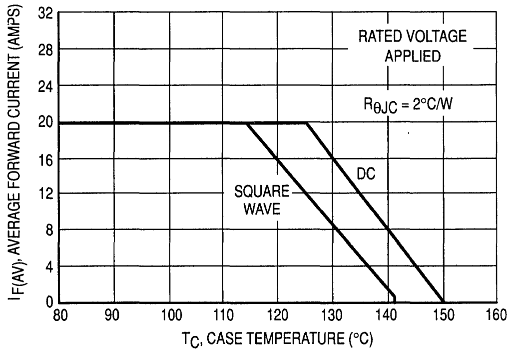


Figure 3. Typical Current Derating, Case, Per Leg

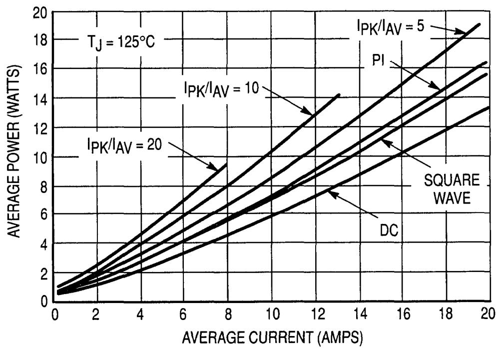


Figure 4. Average Power Dissipation and Average Current

Designer's™ Data Sheet

SWITCHMODE™ Power Rectifier

D2PAK Surface Mount Power Package

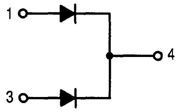
MBRB20100CT

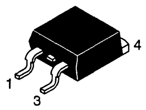
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
20 AMPERES
100 VOLTS

The D2PAK Power Rectifier employs the use of the Schottky Barrier principle with a platinum barrier metal. These state–of–the–art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Center–Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to Industry Standard TO–220 Package





CASE 418B–02
D2PAK

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B20100T

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	20	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	0.5	Amp
Storage Temperature	T_{stg}	–65 to +175	°C
Operating Junction Temperature	T_J	–65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (2)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

(2) See Chapter 7 for mounting conditions

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Rating		Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1)	(i_F = 10 Amp, T_C = 125°C)	v_F	0.75	Volts
	(i_F = 10 Amp, T_C = 25°C)		0.85	
	(i_F = 20 Amp, T_C = 125°C)		0.85	
	(i_F = 20 Amp, T_C = 25°C)		0.95	
Maximum Instantaneous Reverse Current (1)	(Rated dc Voltage, T_J = 125°C)	i_R	6.0	mA
	(Rated dc Voltage, T_J = 25°C)		0.1	

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2%

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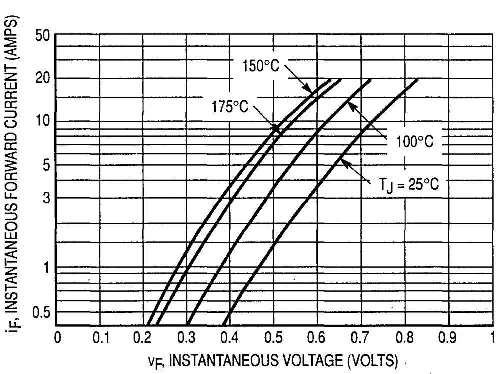


Figure 1. Typical Forward Voltage Per Diode

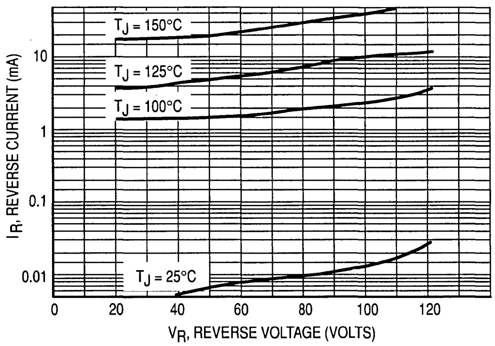


Figure 2. Typical Reverse Current Per Diode

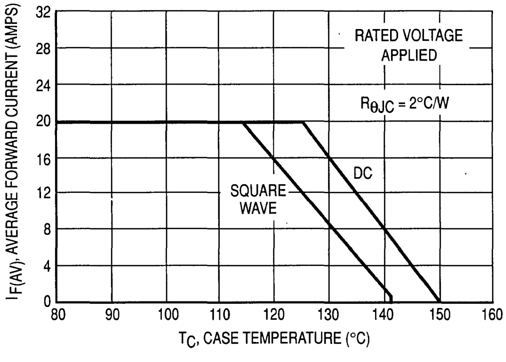


Figure 3. Typical Current Derating, Case, Per Leg

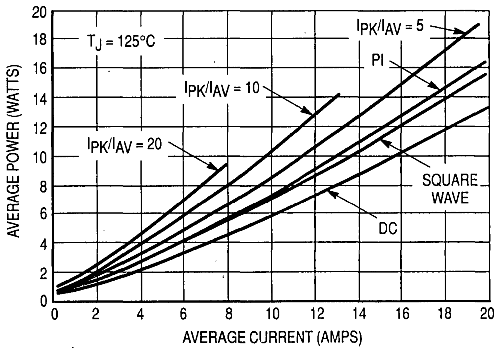


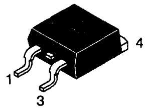
Figure 4. Average Power Dissipation and Average Current

Switchmode™ Power
Dual Schottky Rectifier

MBRB20200CT

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
20 AMPERES
200 VOLTS



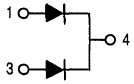
CASE 418B–02

. . . using Schottky Barrier technology with a platinum barrier metal. This state–of–the–art device is designed for use in high frequency switching power supplies and converters with up to 48 volt outputs. They block up to 200 volts and offer improved Schottky performance at frequencies from 250 kHz to 5.0 MHz.

- **200 Volt Blocking Voltage**
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (10,000 V/μs)
- Dual Diode Construction — Terminals 1 and 3 Must be Connected for Parallel Operation at Full Rating

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B20200



MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C — Per Leg Per Package	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 90°C	I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	Amp
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1) (I_F = 10 Amps, T_C = 25°C) (I_F = 10 Amps, T_C = 125°C) (I_F = 20 Amps, T_C = 25°C) (I_F = 20 Amps, T_C = 125°C)	V_F	0.9 0.8 1.0 0.9	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	I_R	1.0 50	mA

DYNAMIC CHARACTERISTICS (PER LEG)

Capacitance (V_R = –5.0 V, T_C = 25°C, Frequency = 1.0 MHz)	C_T	500	pF

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%.

Preferred devices are Motorola recommended choices for future use and best overall value.

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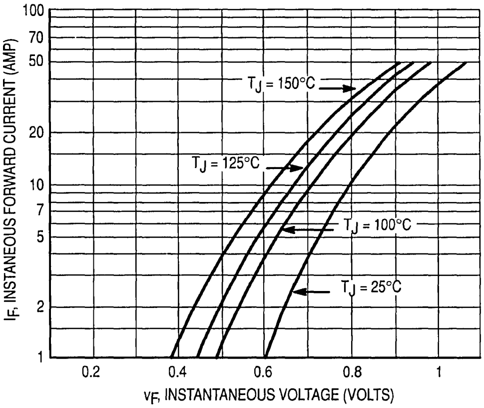


Figure 1. Typical Forward Voltage (Per Leg)

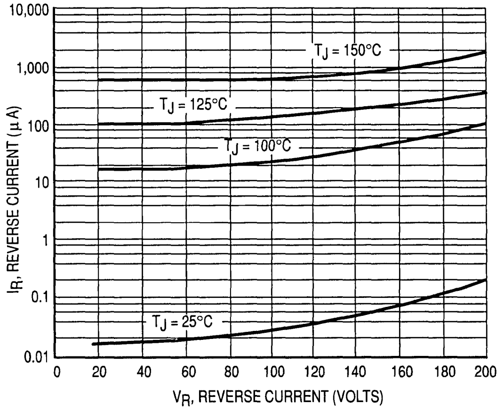


Figure 2. Typical Reverse Current (Per Leg)

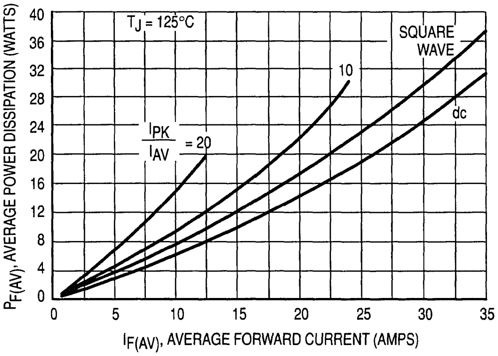


Figure 3. Forward Power Dissipation

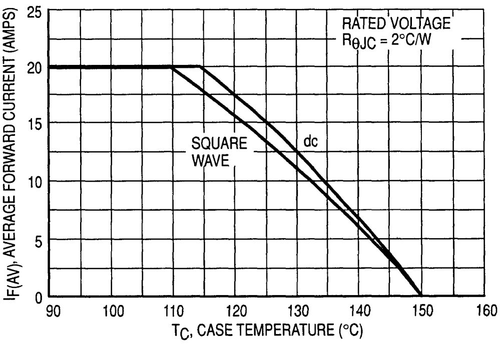


Figure 4. Current Derating, Case

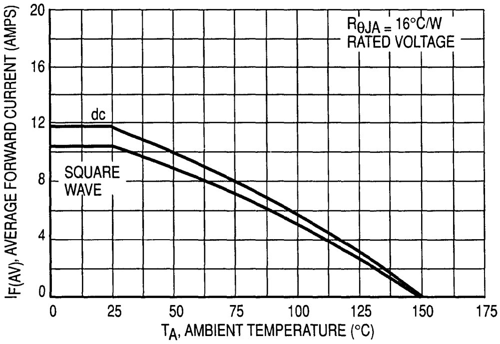


Figure 5. Current Derating, Ambient

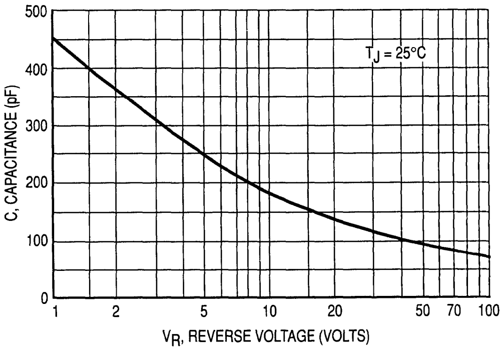


Figure 6. Typical Capacitance (Per Leg)

MBRB2515L

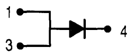
Motorola Preferred Device

Designer's™ Data Sheet

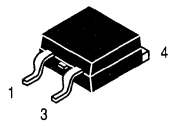
SWITCHMODE™ Power Rectifier OR'ing Function Diode D2PAK Surface Mount Power Package

SCHOTTKY BARRIER RECTIFIER
25 AMPERES
15 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle in a large metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use in low voltage, high frequency switching power supplies, free wheeling diodes, and polarity protection diodes. These state-of-the-art devices have the following features:



- Guardring for Stress Protection
- Low Forward Voltage
- 100°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO-220 Package



CASE 418B-01
D2PAK

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B2515L

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	15	Volts
Average Rectified Forward Current (Rated V_R) T_C = 90°C	$I_{F(AV)}$	25	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Storage Temperature	T_{stg}	−65 to +150	°C
Operating Junction Temperature	T_J	100	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/μs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	1.0 50	°C/W

(1) When mounted using minimum recommended pad size on FR-4 board.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

3

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 19 Amps, T_J = 70°C) (i_F = 25 Amps, T_J = 70°C) (i_F = 25 Amps, T_J = 25°C)	V_F	 0.28 0.42 0.45	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_J = 70°C) (Rated dc Voltage, T_J = 25°C)	I_R	 200 15	mA

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

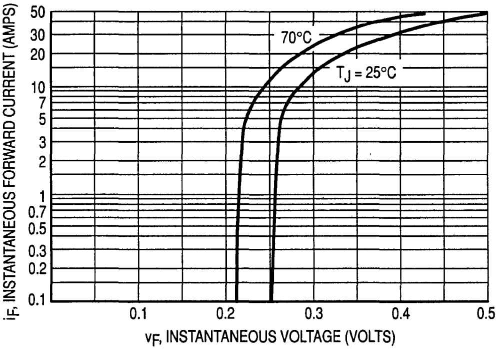


Figure 1. Typical Forward Voltage

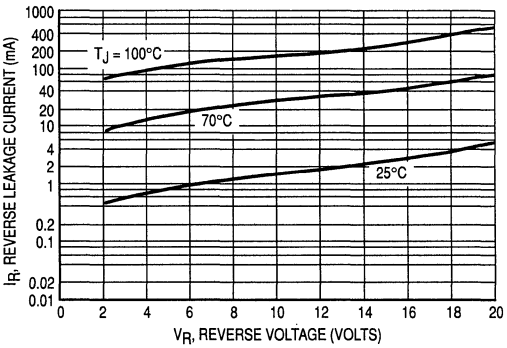


Figure 2. Typical Reverse Leakage Current

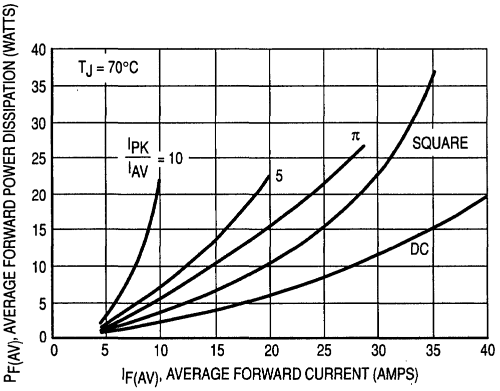


Figure 3. Typical Forward Power Dissipation

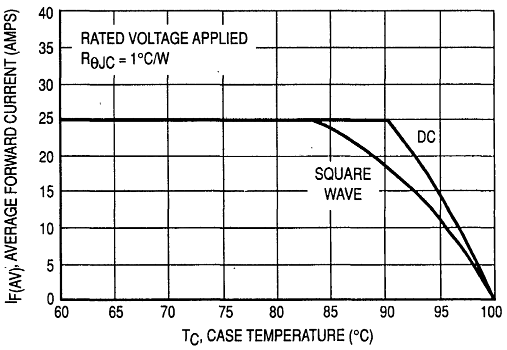


Figure 4. Current Derating, Case

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Designer's™ Data Sheet

SWITCHMODE™ Power Rectifier

D2PAK Surface Mount Power Package

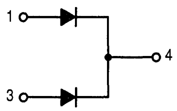
MBRB2535CTL

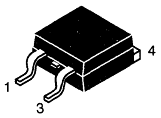
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER 25 AMPERES 35 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle in a large metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use in low voltage, high frequency switching power supplies, free wheeling diodes, and polarity protection diodes. These state–of–the–art devices have the following features:

- Center–Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 125°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO–220 Package





CASE 418B–02
D2PAK

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B2535L

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C	$I_{F(AV)}$	12.5	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 90°C	I_{FRM}	25	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Storage Temperature	T_{stg}	–65 to +150	°C
Operating Junction Temperature	T_J	–65 to +125	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/µs

THERMAL CHARACTERISTICS (PER LEG)

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

(1) When mounted using minimum recommended pad size on FR–4 board.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS (PER LEG)

Rating		Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (2)	(i_F = 25 Amps, T_J = 25°C) (i_F = 12.5 Amps, T_J = 125°C) (i_F = 12.5 Amps, T_J = 25°C)	v_F	0.55 0.41 0.47	Volts
Maximum Instantaneous Reverse Current (2)	(Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	500 10	mA

(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

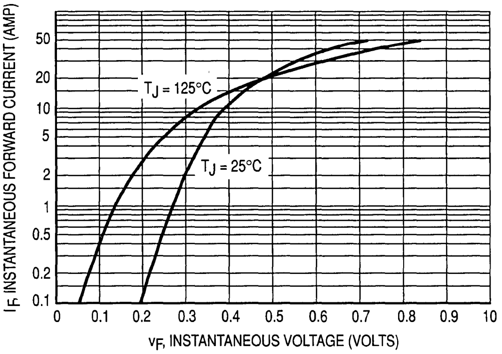


Figure 1. Typical Forward Voltage, Per Leg

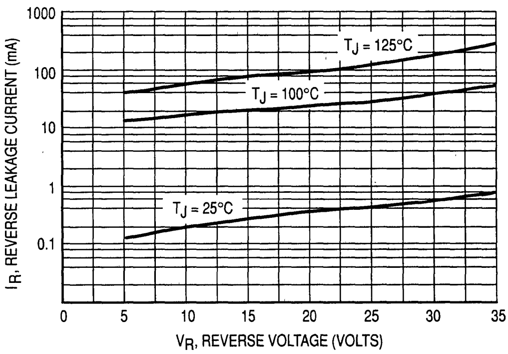


Figure 2. Typical Reverse Current, Per Leg

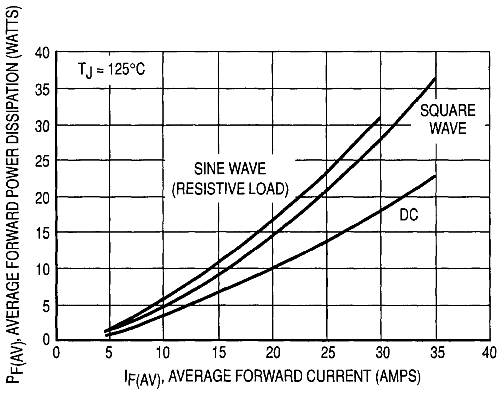


Figure 3. Typical Forward Power Dissipation

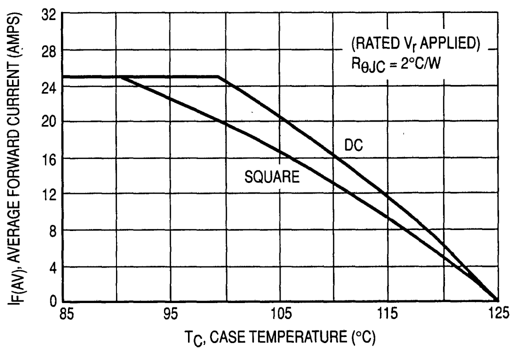


Figure 4. Current Derating, Case

3

Designer's™ Data Sheet
SWITCHMODE™ Power Rectifier
D2PAK Surface Mount Power Package

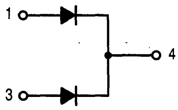
MBRB2545CT

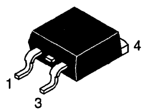
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
30 AMPERES
45 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle with a platinum barrier metal. These state–of–the–art devices have the following features:

- Center–Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO–220 Package





CASE 418B–02
D2PAK

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per 13″ reel by adding a "T4" suffix to the part number
- Marking: B2545T

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 130°C Total Device	$I_{F(AV)}$	15 30	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 130°C	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Storage Temperature	T_{stg}	−65 to +175	°C
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	1.5 50	°C/W

(1) When mounted using minimum recommended pad size on FR–4 board.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

ELECTRICAL CHARACTERISTICS, PER LEG

Rating		Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (2)	(i_F = 30 Amps, T_J = 125°C) (i_F = 30 Amps, T_J = 25°C)	v_F	0.73 0.82	Volts
Maximum Instantaneous Reverse Current (2)	(Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	40 0.2	mA

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

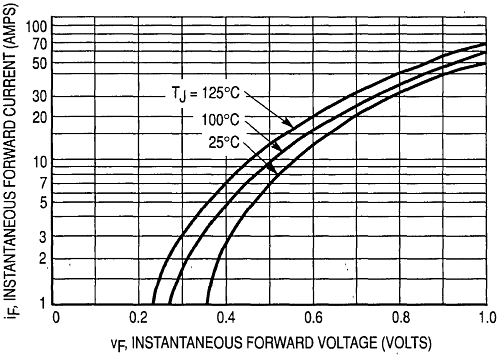


Figure 1. Typical Forward Voltage, Per Leg

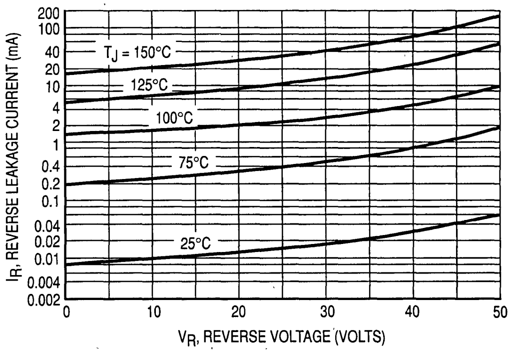


Figure 2. Typical Reverse Current, Per Leg

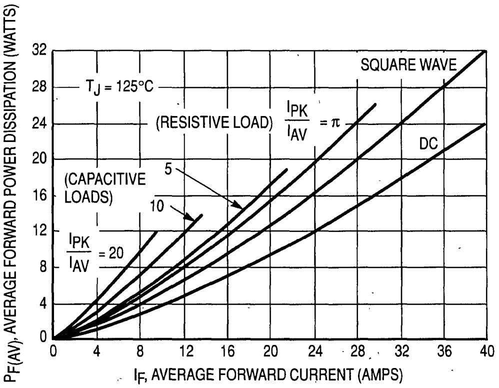


Figure 3. Typical Forward Power Dissipation

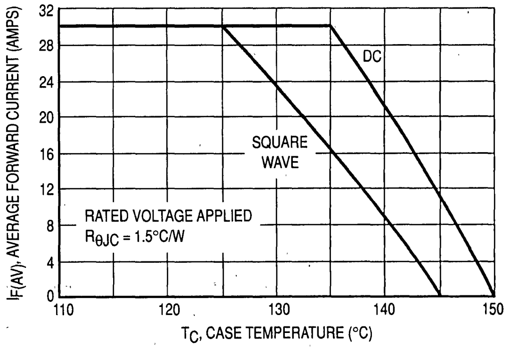


Figure 4. Current Derating, Case

Axial Lead Rectifiers

1N5817
1N5818
1N5819

1N5817 and 1N5819 are Motorola Preferred Devices

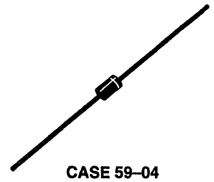
SCHOTTKY BARRIER RECTIFIERS
1 AMPERE
20, 30 and 40 VOLTS

. . . employing the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low–voltage, high–frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N5817, 1N5818, 1N5819



CASE 59–04

MAXIMUM RATINGS

Rating	Symbol	1N5817	1N5818	1N5819	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	V
Non–Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	V
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	V
Average Rectified Forward Current (2) ($V_{R(equiv)} \leq 0.2\ V_R(dc)$, $T_L = 90°C$, $R_{\theta JA} = 80°C/W$, P.C. Board Mounting, see Note 2, $T_A = 55°C$)	I_O	1.0			A
Ambient Temperature (Rated $V_R(dc)$, $P_{F(AV)} = 0$, $R_{\theta JA} = 80°C/W$)	T_A	85	80	75	°C
Non–Repetitive Peak Surge Current (Surge applied at rated load conditions, half–wave, single phase 60 Hz, $T_L = 70°C$)	I_{FSM}	25 (for one cycle)			A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	–65 to +125			°C
Peak Operating Junction Temperature (Forward Current applied)	$T_{J(pk)}$	150			°C

THERMAL CHARACTERISTICS (2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS ($T_L = 25°C$ unless otherwise noted) (2)

Characteristic	Symbol	1N5817	1N5818	1N5819	Unit
Maximum Instantaneous Forward Voltage (1) ($i_F = 0.1$ A) ($i_F = 1.0$ A) ($i_F = 3.0$ A)	v_F	0.32 0.45 0.75	0.33 0.55 0.875	0.34 0.6 0.9	V
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) ($T_L = 25°C$) ($T_L = 100°C$)	I_R	1.0 10	1.0 10	1.0 10	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.

Rev 3

NOTE 1 — DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.1 V_{RWM}. Proper derating may be accomplished by use of equation (1).

$$T_{A(max)} = T_{J(max)} - R_{\theta JA}P_{F(AV)} - R_{\theta JA}P_{R(AV)} \quad (1)$$

where $T_{A(max)}$ = Maximum allowable ambient temperature
$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest)
$P_{F(AV)}$ = Average forward power dissipation
$P_{R(AV)}$ = Average reverse power dissipation
$R_{\theta JA}$ = Junction–to–ambient thermal resistance

Figures 1, 2, and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2).

$$T_R = T_{J(max)} - R_{\theta JA}P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA}P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2, and 3 as a difference in the rate of change of the slope in the vicinity of 115°C. The data of Figures 1, 2, and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

$$V_{R(equiv)} = V_{in(PK)} \times F \quad (4)$$

The factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

EXAMPLE: Find $T_{A(max)}$ for 1N5818 operated in a 12–volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 0.4 A ($I_{F(AV)}$ = 0.5 A), $I_{(FM)}/I_{(AV)}$ = 10, Input Voltage = 10 $V_{(rms)}$, $R_{\theta JA}$ = 80°C/W.

Step 1. Find $V_{R(equiv)}$. Read F = 0.65 from Table 1,
$\therefore V_{R(equiv)} = (1.41)(10)(0.65) = 9.2$ V.
Step 2. Find T_R from Figure 2. Read T_R = 109°C
@ V_R = 9.2 V and $R_{\theta JA}$ = 80°C/W.
Step 3. Find $P_{F(AV)}$ from Figure 4. **Read $P_{F(AV)}$ = 0.5 W

$$@ \frac{I_{(FM)}}{I_{(AV)}} = 10 \text{ and } I_{F(AV)} = 0.5 \text{ A.}$$

Step 4. Find $T_{A(max)}$ from equation (3).
$T_{A(max)}$ = 109 – (80) (0.5) = 69°C.

**Values given are for the 1N5818. Power is slightly lower for the 1N5817 because of its lower forward voltage, and higher for the 1N5819.

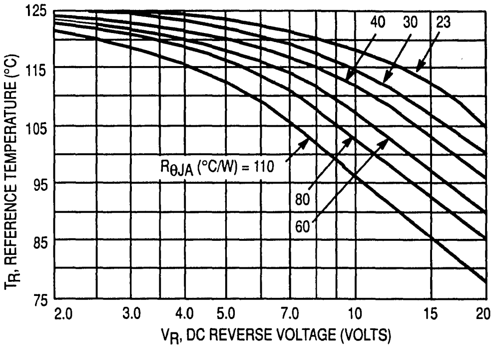


Figure 1. Maximum Reference Temperature 1N5817

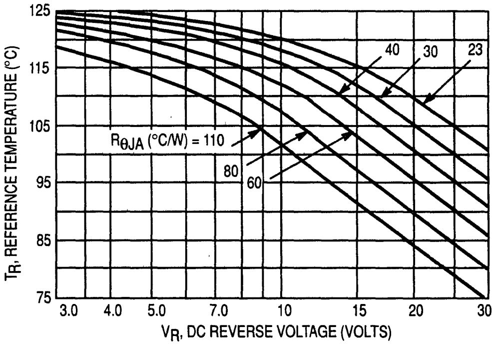


Figure 2. Maximum Reference Temperature 1N5818

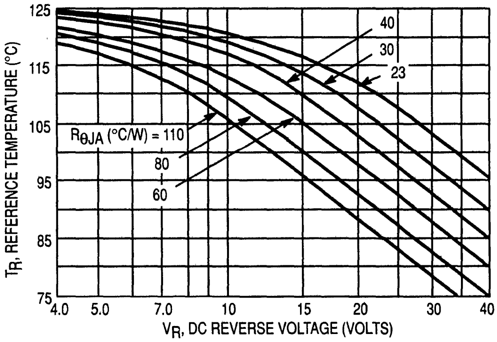


Figure 3. Maximum Reference Temperature 1N5819

Table 1. Values for Factor F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped*†	
Load	Resistive	Capacitive*	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

*Note that $V_{R(PK)} \approx 2.0\ V_{in(PK)}$. † Use line to center tap voltage for V_{in}.

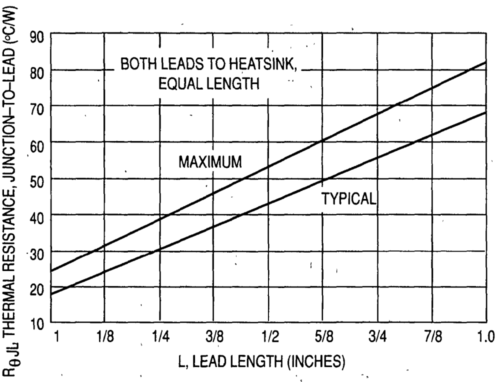


Figure 4. Steady–State Thermal Resistance

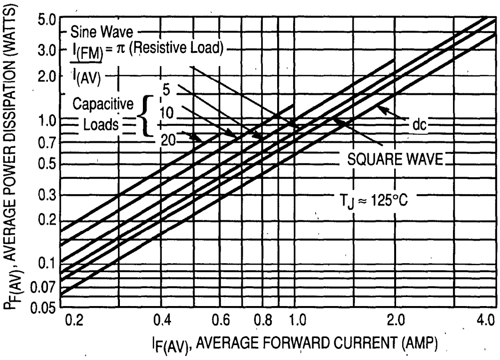


Figure 5. Forward Power Dissipation 1N5817–19

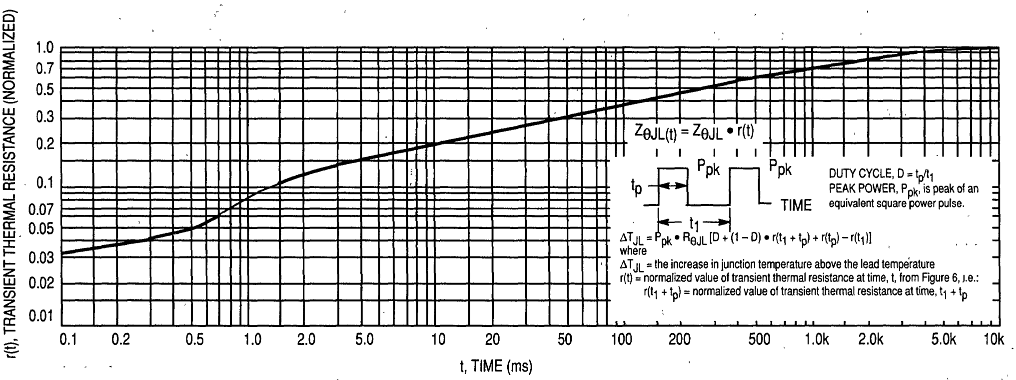


Figure 6. Thermal Response

NOTE 2 — MOUNTING DATA

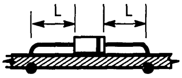
Data shown for thermal resistance junction–to–ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

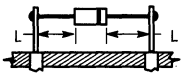
Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	52	65	72	85	°C/W
2	67	80	87	100	°C/W
3	50				°C/W

Mounting Method 1

P.C. Board with 1–1/2″ x 1–1/2″ copper surface.



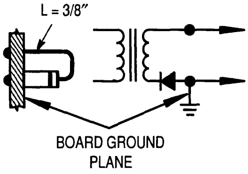
Mounting Method 2



VECTOR PIN MOUNTING

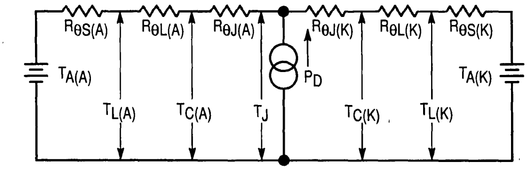
Mounting Method 3

P.C. Board with 1–1/2″ x 1–1/2″ copper surface.



3

NOTE 3 — THERMAL CIRCUIT MODEL
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heatsink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heatsink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heatsink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:

$R_{\theta L}$ = 100°C/W/in typically and 120°C/W/in maximum
$R_{\theta J}$ = 36°C/W typically and 46°C/W maximum.

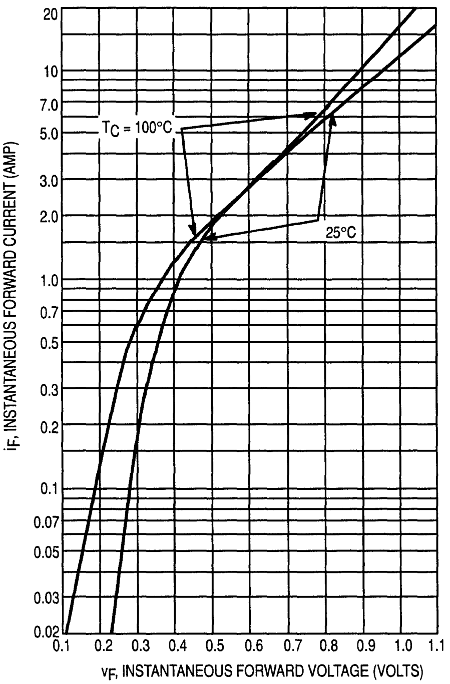


Figure 7. Typical Forward Voltage

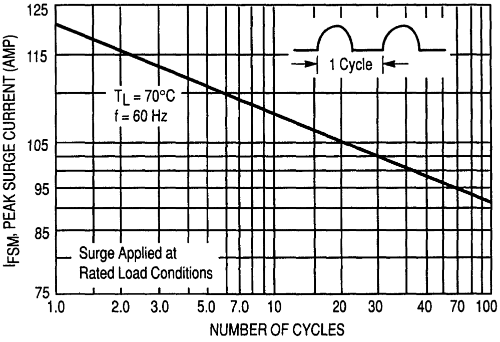


Figure 8. Maximum Non-Repetitive Surge Current

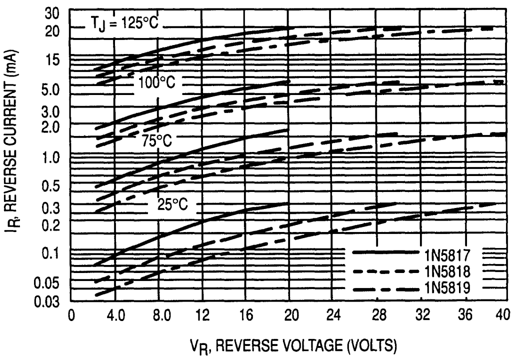


Figure 9. Typical Reverse Current

NOTE 4 — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 10.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss: it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

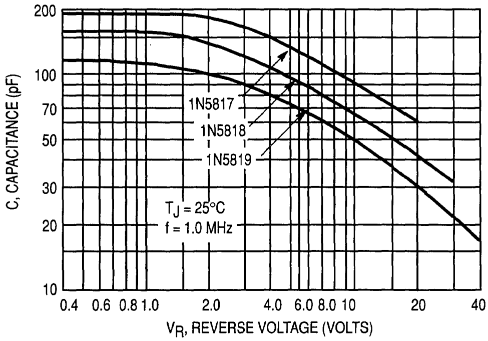


Figure 10. Typical Capacitance

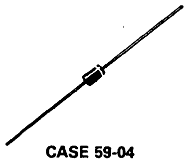
3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR150
MBR160

MBR160 is a
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
1 AMPERE
50, 60 VOLTS



CASE 59-04
PLASTIC

3

Axial Lead Rectifiers

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Low Reverse Current
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: B150, B160

MAXIMUM RATINGS

Rating	Symbol	MBR150	MBR160	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	60	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	42	Volts
Average Rectified Forward Current (2) ($V_{R(equiv)} \leq 0.2\ V_R(dc)$, $T_L = 90°C$, $R_{\theta JA} = 80°C/W$, P.C. Board Mounting, see Note 3, $T_A = 55°C$)	I_O	1		Amp
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase, 60 Hz, $T_L = 70°C$)	I_{FSM}	25 (for one cycle)		Amps
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	−65 to +150		°C
Peak Operating Junction Temperature (Forward Current applied)	$T_{J(pk)}$	150		°C

THERMAL CHARACTERISTICS (Notes 3 and 4)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS ($T_L = 25°C$ unless otherwise noted) (2)

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (1) ($i_F = 0.1$ A) ($i_F = 1$ A) ($i_F = 3$ A)	v_F	 0.550 0.750 1.000	Volt
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) ($T_L = 25°C$) ($T_L = 100°C$)	i_R	 0.5 5	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.

Rev 1

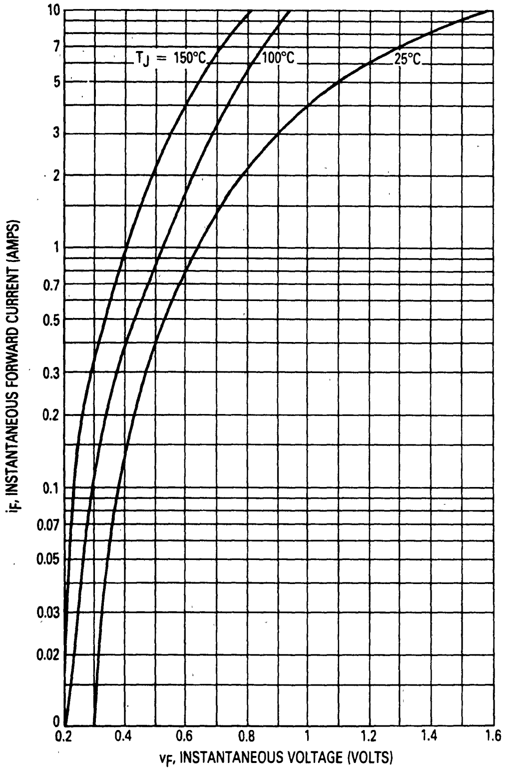


Figure 1. Typical Forward Voltage

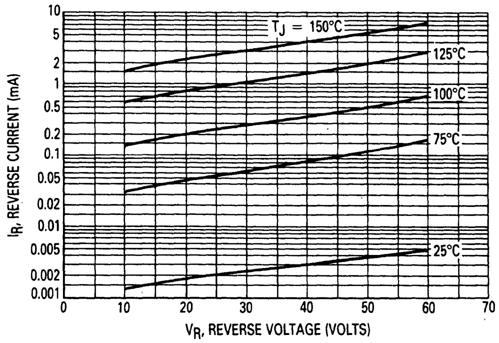


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

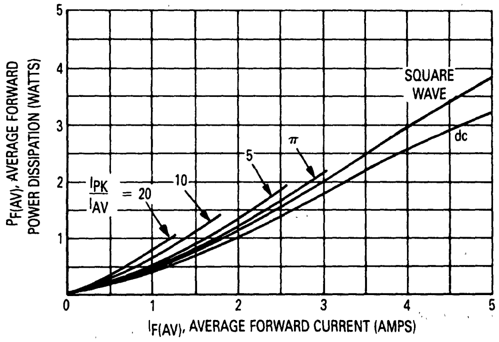


Figure 3. Forward Power Dissipation

THERMAL CHARACTERISTICS

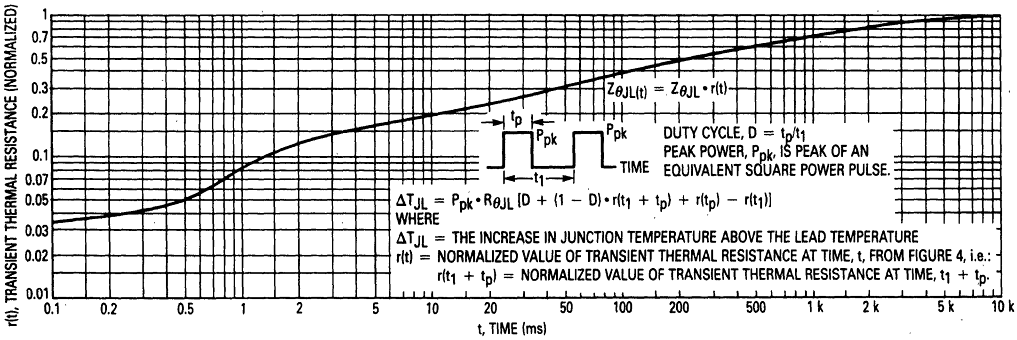


Figure 4. Thermal Response

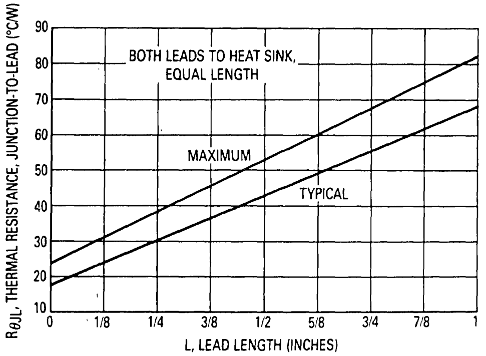


Figure 5. Steady-State Thermal Resistance

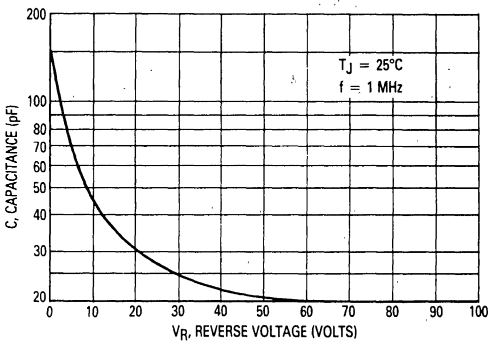


Figure 6. Typical Capacitance

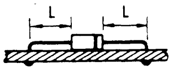
NOTE 3 — MOUNTING DATA:

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mounting shown is to be used as a typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

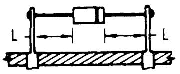
Typical Values for $R_{\theta JA}$ in Still Air

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	52	65	72	85	°C/W
2	67	80	87	100	°C/W
3			50		°C/W

Mounting Method 1
P.C. Board with
1-1/2″ x 1-1/2″
copper surface.

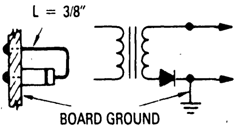


Mounting Method 2

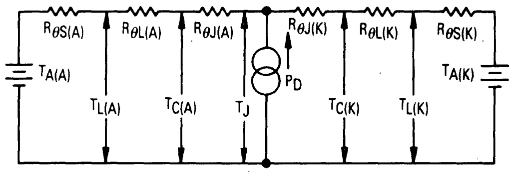


VECTOR PIN MOUNTING

Mounting Method 3
P.C. Board with
1-1/2″ x 1-1/2″
copper surface.



NOTE 4 — THERMAL CIRCUIT MODEL:
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:
$R_{\theta L}$ = 100°C/W/in typically and 120°C/W/in maximum.
$R_{\theta J}$ = 36°C/W typically and 46°C/W maximum.

NOTE 5 — HIGH FREQUENCY OPERATION:

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 6.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximatley 70 percent at 2 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss: it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

3

Axial Lead Rectifiers

MBR170
MBR180
MBR190
MBR1100

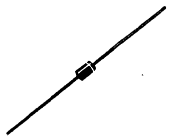
MBR1100 is a Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS 1 AMPERE 70, 80, 90, 100 VOLTS

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Low Reverse Current
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction
- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- High Surge Capacity

3



CASE 59-04
PLASTIC

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: B170, B180, B190, B1100

MAXIMUM RATINGS

Rating	Symbol	MBR170	MBR180	MBR190	MBR1100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	70	80	90	100	Volts
Average Rectified Forward Current ($V_{R(equiv)} \leq 0.2\ V_R(dc)$, $R_{\theta JA}$ = 50°C/W, P.C. Board Mounting, see Note 1, T_A = 120°C)	I_O	1				Amp
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase, 60 Hz)	I_{FSM}	50				Amps
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +150				°C
Voltage Rate of Change (Rated V_R)	dv/dt	10				V/ns

THERMAL CHARACTERISTICS (See Note 2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted)

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage* (i_F = 1 A, T_L = 25°C) (i_F = 1 A, T_L = 100°C)	v_F	 0.79 0.69	Volt
Maximum Instantaneous Reverse Current @ Rated dc Voltage* (T_L = 25°C) (T_L = 100°C)	i_R	 0.5 5	mA

*Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 1

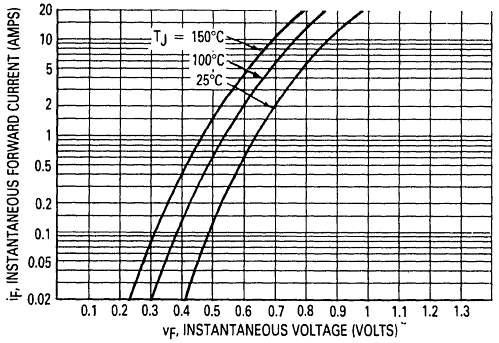


Figure 1. Typical Forward Voltage

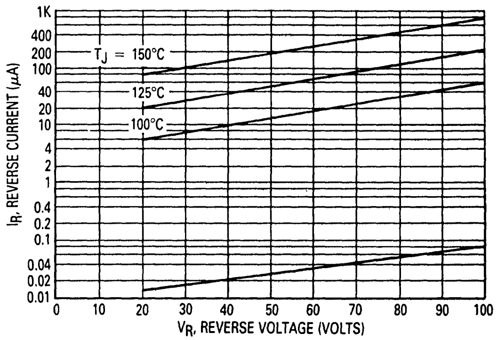


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

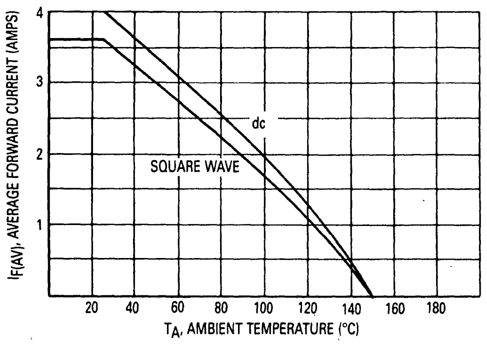


Figure 3. Current Derating
(Mounting method 3 per note 1.)

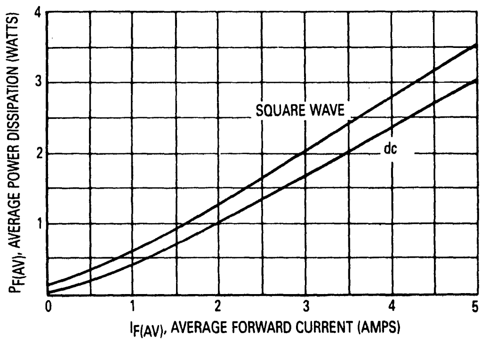


Figure 4. Power Dissipation

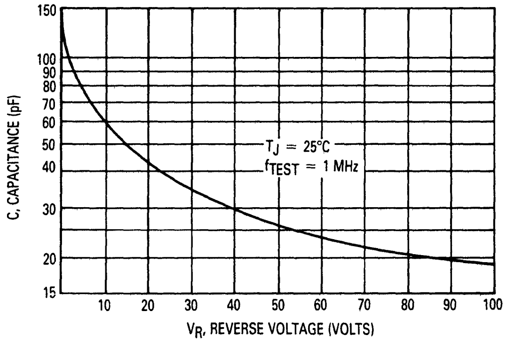


Figure 5. Typical Capacitance

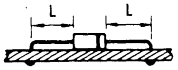
NOTE 1 — MOUNTING DATA:

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

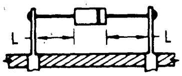
Typical Values for $R_{\theta JA}$ in Still Air

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	52	65	72	85	°C/W
2	67	80	87	100	°C/W
3		50			°C/W

Mounting Method 1
P.C. Board with
1-1/2″ x 1-1/2″
copper surface.

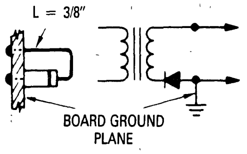


Mounting Method 2

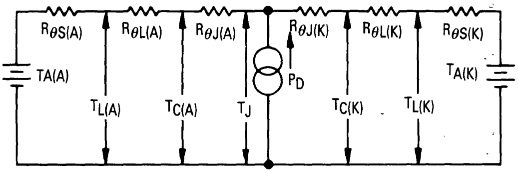


VECTOR PIN MOUNTING

Mounting Method 3
P.C. Board with
1-1/2″ x 1-1/2″
copper surface.



NOTE 2 — THERMAL CIRCUIT MODEL:
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:
$R_{\theta L}$ = 100°C/W/in typically and 120°C/W/in maximum.
$R_{\theta J}$ = 36°C/W typically and 46°C/W maximum.

NOTE 3 — HIGH FREQUENCY OPERATION:

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 5.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss: it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5820
1N5821
1N5822

1N5820 and 1N5822 are Motorola Preferred Devices

Designer's Data Sheet

Axial Lead Rectifiers

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

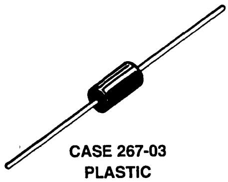
- Extremely Low V_F
- Low Power Loss/High Efficiency
- Low Stored Charge, Majority Carrier Conduction

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N5820, 1N5821, 1N5822

SCHOTTKY BARRIER RECTIFIERS

3.0 AMPERES
20, 30, 40 VOLTS



CASE 267-03
PLASTIC

Rating	Symbol	1N5820	1N5821	1N5822	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	V
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	V
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	V
Average Rectified Forward Current (2) $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_L = 95°C$ ($R_{\theta JA} = 28°C/W$, P.C. Board Mounting, see Note 2)	I_O	← 3.0 →			A
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$ $R_{\theta JA} = 28°C/W$	T_A	90	85	80	°C
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase 60 Hz, $T_L = 75°C$)	I_{FSM}	← 80 (for one cycle) →			A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	← −65 to +125 →			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			°C

***THERMAL CHARACTERISTICS** (Note 2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	28	°C/W

***ELECTRICAL CHARACTERISTICS** ($T_L = 25°C$ unless otherwise noted) (2)

Characteristic	Symbol	1N5820	1N5821	1N5822	Unit
Maximum Instantaneous Forward Voltage (1)	v_F				V
($i_F = 1.0$ Amp)		0.370	0.380	0.390	
($i_F = 3.0$ Amp)		0.475	0.500	0.525	
($i_F = 9.4$ Amp)		0.850	0.900	0.950	
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1)	i_R				mA
$T_L = 25°C$		2.0	2.0	2.0	
$T_L = 100°C$		20	20	20	

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.
*Indicates JEDEC Registered Data for 1N5820-22.

Rev 2

NOTE 1 — DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.1 V_{RWM}. Proper derating may be accomplished by use of equation (1).

$$T_{A(max)} = T_{J(max)} - R_{\theta JA}P_{F(AV)} - R_{\theta JA}P_{R(AV)} \quad (1)$$

where $T_{A(max)}$ = Maximum allowable ambient temperature
$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest)
$P_{F(AV)}$ = Average forward power dissipation
$P_{R(AV)}$ = Average reverse power dissipation
$R_{\theta JA}$ = Junction-to-ambient thermal resistance

Figures 1, 2, and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2).

$$T_R = T_{J(max)} - R_{\theta JA}P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA}P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2, and 3 as a difference in the rate of change of the slope in the vicinity of 115°C. The data of Figures 1, 2, and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

$$V_{R(equiv)} = V_{(FM)} \times F \quad (4)$$

The factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

EXAMPLE: Find $T_{A(max)}$ for 1N5821 operated in a 12-volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 2.0 A ($I_{F(AV)}$ = 1.0 A), $I_{(FM)}/I_{(AV)}$ = 10, Input Voltage = 10 $V_{(rms)}$, $R_{\theta JA}$ = 40°C/W.

Step 1. Find $V_{R(equiv)}$. Read F = 0.65 from Table 1,
$\therefore V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.2 V.

Step 2. Find T_R from Figure 2. Read T_R = 108°C
@ V_R = 9.2 V and $R_{\theta JA}$ = 40°C/W.

Step 3. Find $P_{F(AV)}$ from Figure 6. **Read $P_{F(AV)}$ = 0.85 W
@ $\frac{I_{(FM)}}{I_{(AV)}}$ = 10 and $I_{F(AV)}$ = 1.0 A.

Step 4. Find $T_{A(max)}$ from equation (3).
$T_{A(max)}$ = 108 − (0.85)(40) = 74°C.

**Values given are for the 1N5821. Power is slightly lower for the 1N5820 because of its lower forward voltage, and higher for the 1N5822. Variations will be similar for the MBR-prefix devices, using $P_{F(AV)}$ from Figure 7.

3

TABLE 1 — VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped*†	
Load	Resistive	Capacitive*	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

*Note that $V_{R(PK)} \approx 2.0\ V_{in(PK)}$. †Use line to center tap voltage for V_{in}.

FIGURE 1 — MAXIMUM REFERENCE TEMPERATURE
1N5820

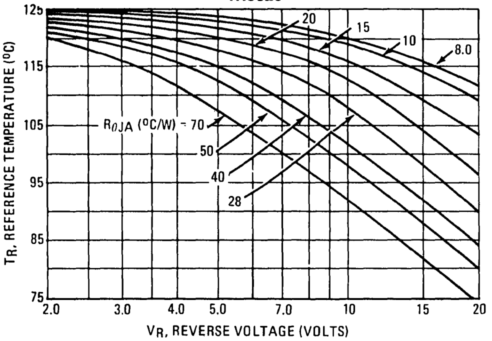


FIGURE 2 — MAXIMUM REFERENCE TEMPERATURE
1N5821

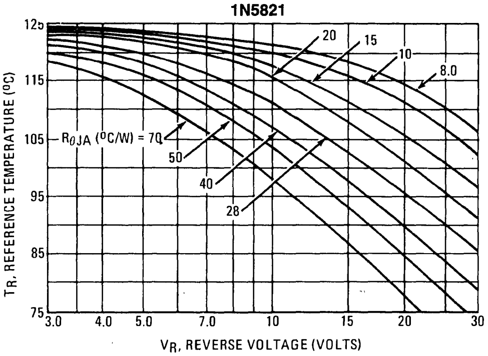


FIGURE 3 — MAXIMUM REFERENCE TEMPERATURE
1N5822

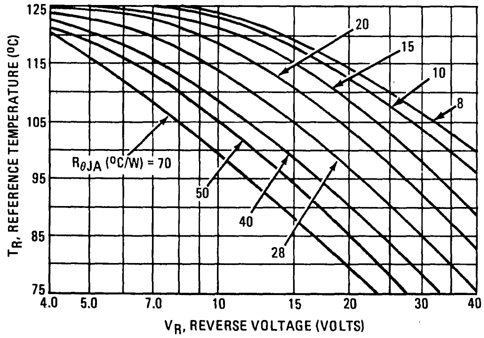


FIGURE 4 — STEADY-STATE THERMAL RESISTANCE

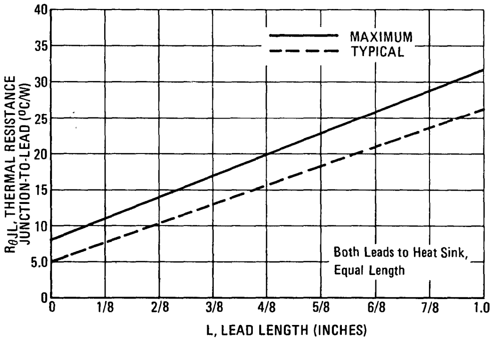


FIGURE 5 – THERMAL RESPONSE

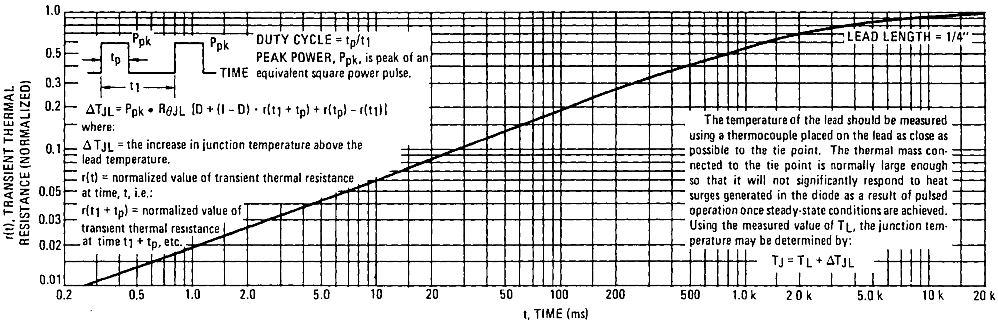
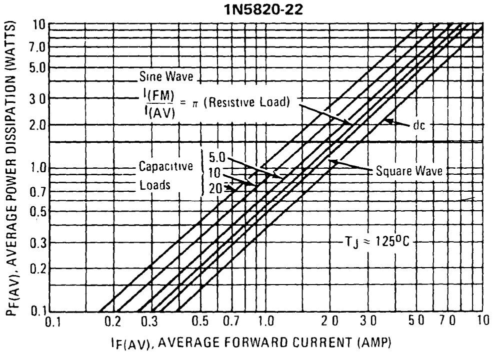
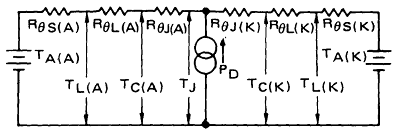


FIGURE 6 – FORWARD POWER DISSIPATION 1N5820-22



NOTE 3 – APPROXIMATE THERMAL CIRCUIT MODEL



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Total Power Dissipation = $P_F + P_R$
P_F = Forward Power Dissipation
P_R = Reverse Power Dissipation

(Subscripts (A) and (K) refer to anode and cathode sides, respectively.) Values for thermal resistance components are:

$R_{\theta L}$ = 42°C/W/in typically and 48°C/W/in maximum
$R_{\theta J}$ = 10°C/W typically and 16°C/W maximum

The maximum lead temperature may be found as follows:

$$T_L = T_{J(max)} - \Delta T_{JL}$$

where $\Delta T_{JL} \approx R_{\theta JL} \cdot P_D$

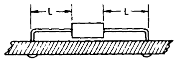
NOTE 2 – MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

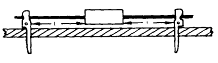
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3			28		°C/W

Mounting Method 1
P.C. Board where available copper surface is small.



Mounting Method 2
Vector Push-In Terminals T-28



Mounting Method 3
P.C. Board with with 2-1/2″ X 2-1/2″ copper surface.

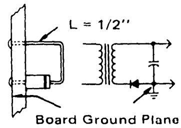


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FIGURE 8 — TYPICAL FORWARD VOLTAGE

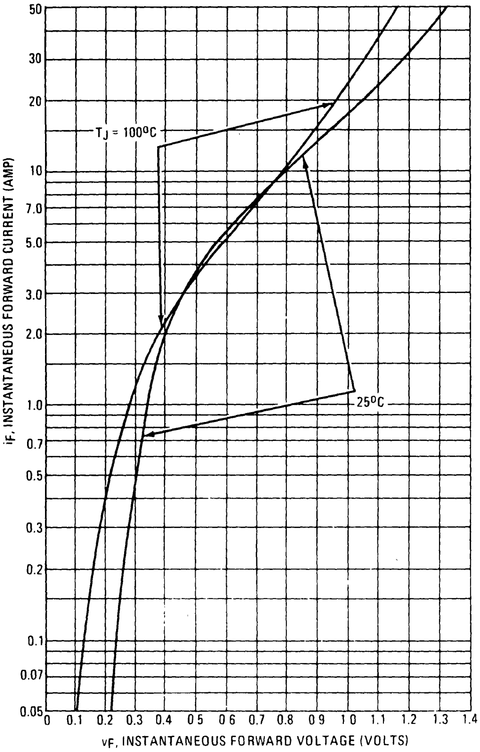


FIGURE 9 — MAXIMUM NON-REPETITIVE SURGE CURRENT

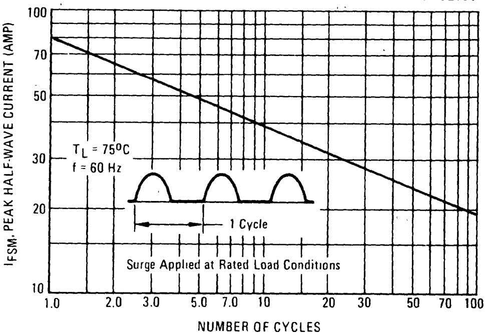


FIGURE 10 — TYPICAL REVERSE CURRENT

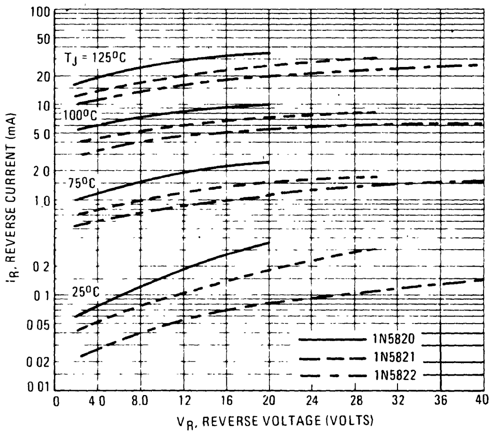
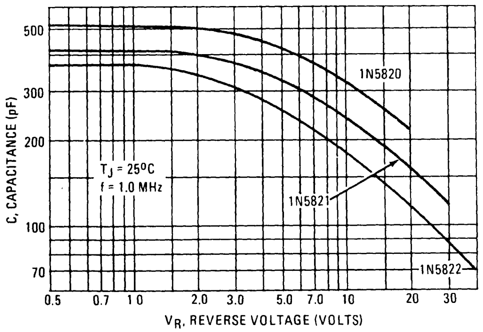


FIGURE 11 — TYPICAL CAPACITANCE



NOTE 4 — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 11.)

MBR320 MBR340
MBR330 MBR350
MBR360

MBR340 and MBR360 are
Motorola Preferred Devices

Axial Lead Rectifiers

... employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

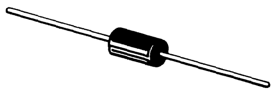
- Extremely Low v_F
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction
- Low Stored Charge, Majority Carrier Conduction

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: B320, B330, B340, B350, B360

SCHOTTKY BARRIER RECTIFIERS

3.0 AMPERES
20, 30, 40, 50, 60 VOLTS



CASE 267-03
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR320	MBR330	MBR340	MBR350	MBR360	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	V
Average Rectified Forward Current T_A = 65°C ($R_{\theta JA}$ = 28°C/W, P.C. Board Mounting, see Note 3)	I_O			3.0			A
Nonrepetitive Peak Surge Current (2) (Surge applied at rated load conditions, half wave, single phase 60 Hz, T_L = 75°C)	I_{FSM}			80			A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}			−65 to 150°C			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$			150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient, (see Note 3, Mounting Method 3)	$R_{\theta JA}$	28	°C/W

ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted)(2)

Characteristic	Symbol	MBR320	MBR330	MBR340	MBR350	MBR360	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 Amp) (i_F = 3.0 Amp) (i_F = 9.4 Amp)	v_F		0.500 0.600 0.850			0.600 0.740 1.080	V
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) T_L = 25°C T_L = 100°C	i_R			0.60 20			mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.

Rev 1

3

MBR320, 330 AND 340

FIGURE 1 — TYPICAL FORWARD VOLTAGE

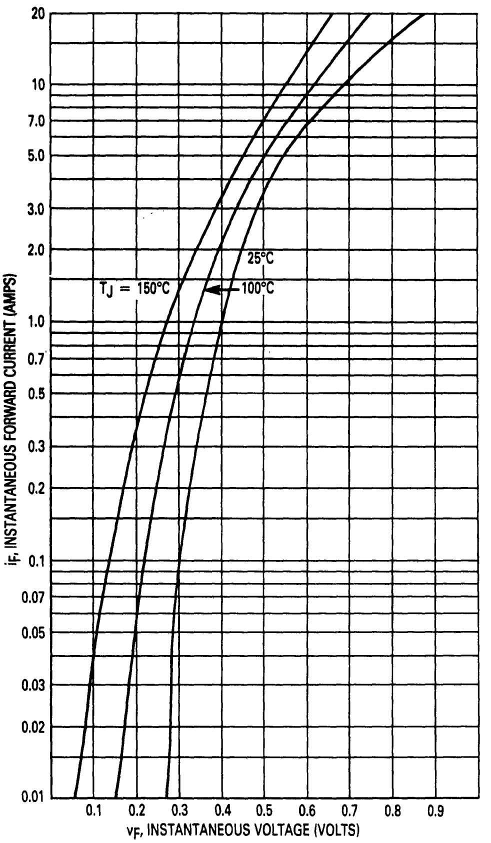
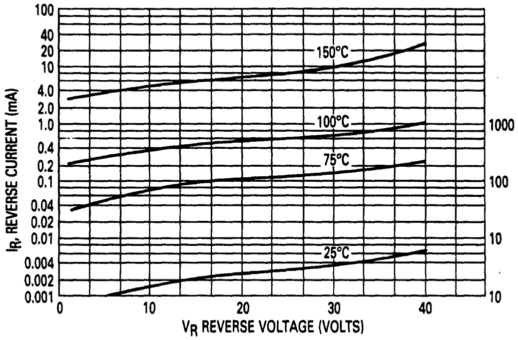


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

FIGURE 3 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 3)

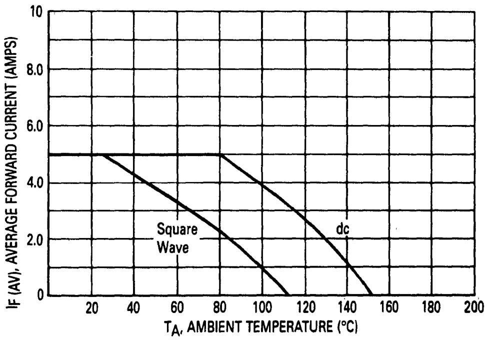


FIGURE 4 — POWER DISSIPATION

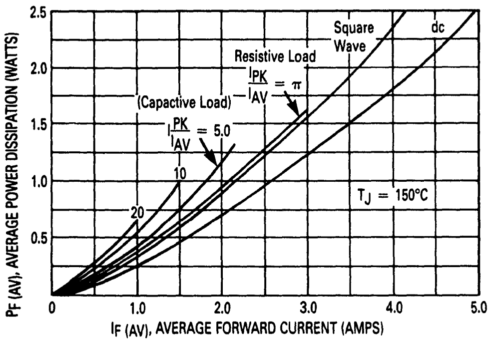
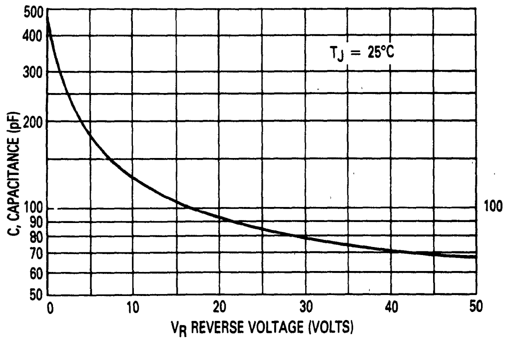


FIGURE 5 — TYPICAL CAPACITANCE



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MBR350 AND 360

FIGURE 6 — TYPICAL FORWARD VOLTAGE

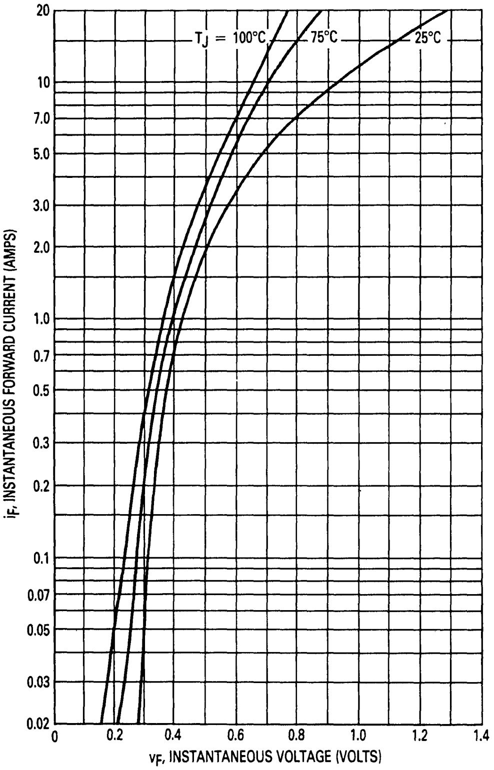


FIGURE 7 — TYPICAL REVERSE CURRENT*

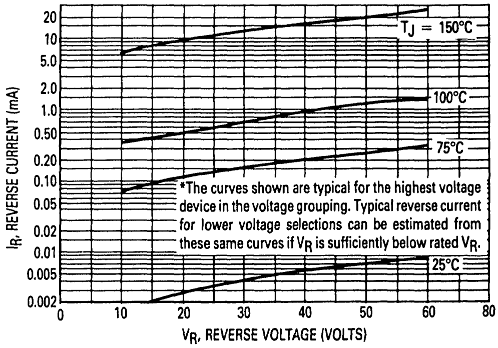


FIGURE 8 — CURRENT DERATING AMBIENT (MOUNTING METHOD #3 PER NOTE 3)

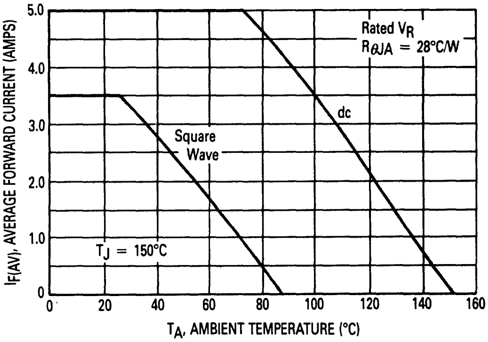


FIGURE 9 — POWER DISSIPATION

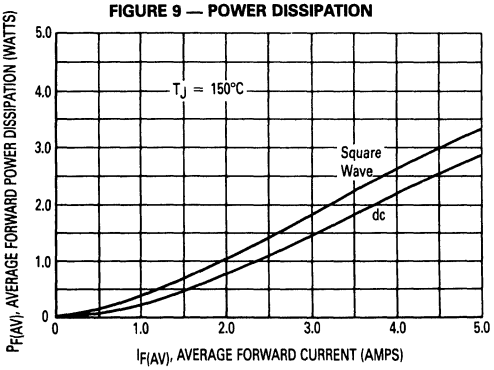
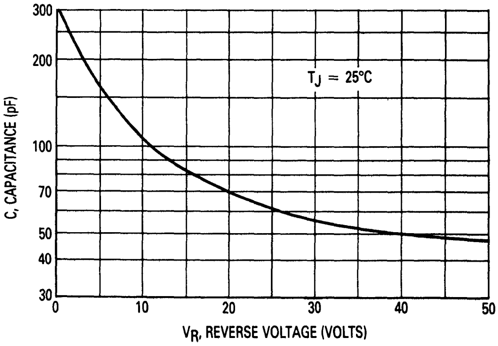


FIGURE 10 — TYPICAL CAPACITANCE



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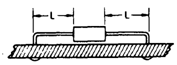
NOTE 3 — MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

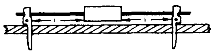
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	28				°C/W

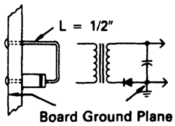
Mounting Method 1
P.C. Board where available copper surface is small.



Mounting Method 2
Vector Push-In Terminals T-28



Mounting Method 3
P.C. Board with 2-1/2″ × 2-1/2″ copper surface.



MBR370
MBR380
MBR390
MBR3100

MBR3100 is a Motorola Preferred Device

Axial Lead Rectifiers

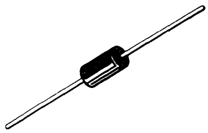
. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Low Reverse Current
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction
- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- High Surge Capacity

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: B370, B380, B390, B3100

SCHOTTKY BARRIER RECTIFIERS
3 AMPERES
70, 80, 90, 100 VOLTS



CASE 267-03
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR370	MBR380	MBR390	MBR3100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	70	80	90	100	V
Average Rectified Forward Current T_A = 100°C ($R_{\theta JA}$ = 28°C/W, P.C. Board Mounting, see Note 1)	I_O	3				A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase, 60 Hz)	I_{FSM}	150				A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	−65 to +150				°C
Voltage Rate of Change (Rated V_R)	dv/dt	10				V/ns

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (see Note 1, Mounting Method 3)	$R_{\theta JA}$	28	°C/W

ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted)

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage* (i_F = 3 Amps, T_L = 25°C) (i_F = 3 Amps, T_L = 100°C)	v_F	 0.79 0.69	V
Maximum Instantaneous Reverse Current @ Rated dc Voltage* (T_L = 25°C) (T_L = 100°C)	i_R	 0.6 20	mA

*Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 1

3

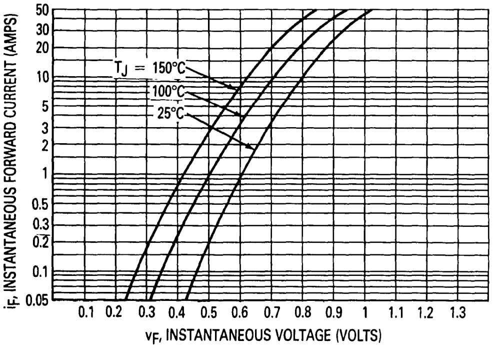


Figure 1. Typical Forward Voltage

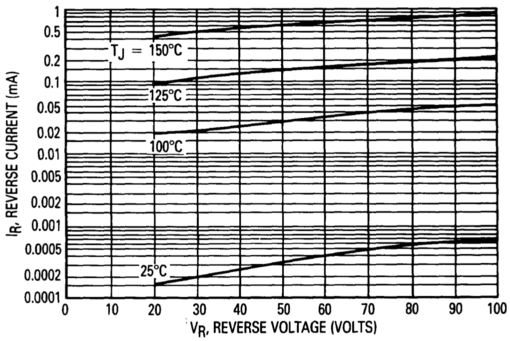


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

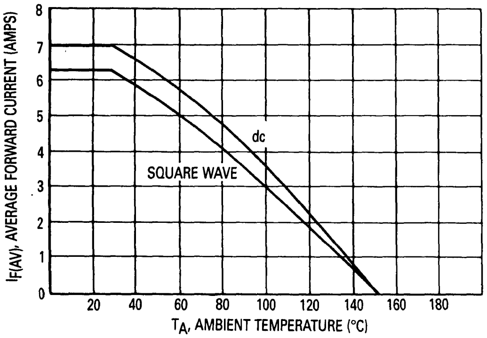


Figure 3. Current Derating (Mounting method 3 per note 1.)

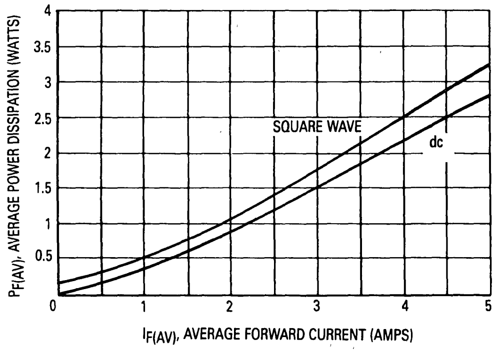


Figure 4. Power Dissipation

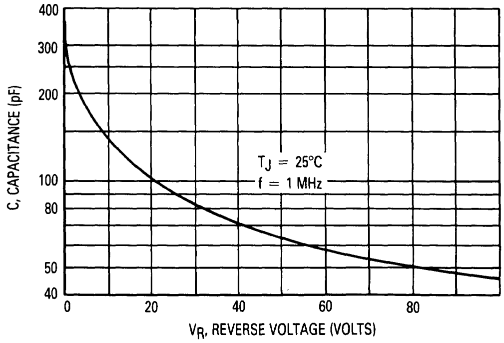


Figure 5. Typical Capacitance

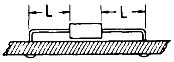
NOTE 1 — MOUNTING DATA:

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

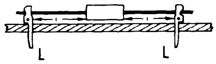
Typical Values for $R_{\theta JA}$ in Still Air

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3		28			°C/W

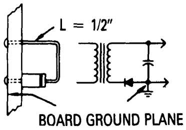
Mounting Method 1
P.C. Board where available copper surface is small.



Mounting Method 2
Vector Push-In Terminals T-28



Mounting Method 3
P.C. Board with 2-1/2" x 2-1/2" copper surface.



3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5823, 1N5824 1N5825

1N5823 and 1N5825 are Motorola Preferred Devices

Designer's Data Sheet

Power Rectifiers

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free-wheeling diodes, and polarity-protection diodes.

- Extremely Low v_F
- Low Power Loss/High Efficiency
- Low Stored Charge, Majority Carrier Conduction

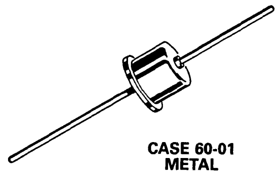
SCHOTTKY BARRIER RECTIFIERS

5 AMPERE
20, 30, 40 VOLTS

3

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 2.4 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Polarity: Cathode to Case
- Shipped 50 units per tray
- Marking: 1N5823, 1N5824, 1N5825



CASE 60-01
METAL

***MAXIMUM RATINGS**

Rating	Symbol	1N5823	1N5824	1N5825	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	Volts
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	Volts
Average Rectified Forward Current $V_{R(equiv)} \leq 0.2\ V_{R\ (dc)}$, $T_C = 75°C$ $V_{R(equiv)} \leq 0.2\ V_{R\ (dc)}$, $T_L = 80°C$ $R_{\theta JA} = 25°C/W$, P.C. Board Mounting, See Note 3)	I_O	← 15 → ← 5.0 →			Amp
Ambient Temperature Rated $V_{R\ (dc)}$, $P_{F(AV)} = 0$ $R_{\theta JA} = 25°C/W$	T_A	65	60	55	°C
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase 60 Hz)	I_{FSM}	← 500 (for 1 cycle) →			Amp
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	← −65 to +125 →			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			°C

***THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

***ELECTRICAL CHARACTERISTICS** ($T_C = 25°C$ unless otherwise noted)

Characteristic	Symbol	1N5823	1N5824	1N5825	Unit
Maximum Instantaneous Forward Voltage (1) ($i_F = 3.0$ Amp) ($i_F = 5.0$ Amp) ($i_F = 15.7$ Amp)	v_F	 0.330 0.360 0.470	 0.340 0.370 0.490	 0.350 0.380 0.520	Volts
Maximum Instantaneous Reverse Current @ rated dc Voltage $T_C = 25°C$ $T_C = 100°C$	i_R	 10 100	 10 125	 10 150	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0% *Indicates JEDEC Registered Data for 1N5823–1N5825

Rev 1

NOTE 1: DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.1 V_{RWM}. Proper derating may be accomplished by use of equation (1):

$$T_{A(max)} = T_{J(max)} - R_{\theta JA} P_{F(AV)} - R_{\theta JA} P_{R(AV)} \quad (1)$$

where

$T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest).

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R_{\theta JA}$ = Junction-to-ambient thermal resistance

Figures 1, 2 and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2):

$$T_R = T_{J(max)} - R_{\theta JA} P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA} P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2 and 3 as a difference in the rate of change of the slope in the vicinity of 115°C. The data of Figures 1, 2 and 3 is based upon dc conditions. For use in common rectifier circuits, Table I indicates suggested factors for an equivalent dc voltage to use for conservative design; i.e.:

$$V_{R(equiv)} = V_{IN(PK)} \times F \quad (4)$$

The Factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

Example: Find $T_{A(max)}$ for 1N5825 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 10 A ($I_{F(AV)}$ = 5 A), $I_{(PK)}/I_{(AV)}$ = 10, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 10°C/W.

Step 1: Find $V_{R(equiv)}$. Read F = 0.65 from Table I ∴
$V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.2 V

Step 2: Find T_R from Figure 3. Read T_R = 113°C @ V_R = 9.2 V & $R_{\theta JA}$ = 10°C/W.

Step 3: Find $P_{F(AV)}$ from Figure 4.**Read $P_{F(AV)}$ = 5.5 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 10 & $I_{F(AV)}$ = 5 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 113-(10)(5.5) = 58°C.

**Value given are for the 1N5825. Power is slightly lower for the other units because of their lower forward voltage.

TABLE I – VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped *†	
Load	Resistive	Capacitive*	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

*Note that $V_{R(PK)} \approx 2\ V_{in(PK)}$ †Use line to center tap voltage for V_{in}.

FIGURE 1 – MAXIMUM REFERENCE TEMPERATURE – 1N5823

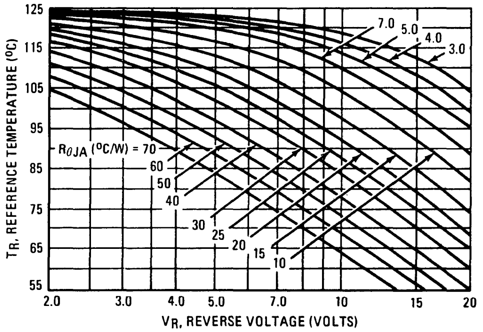


FIGURE 2 – MAXIMUM REFERENCE TEMPERATURE – 1N5824

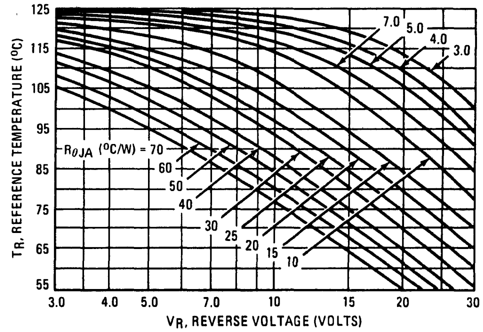


FIGURE 3 – MAXIMUM REFERENCE TEMPERATURE 1N5825 AND MBR5825H, H1

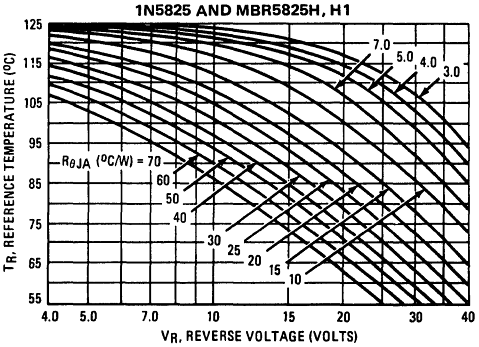
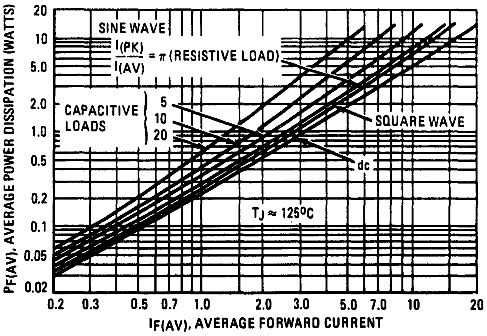


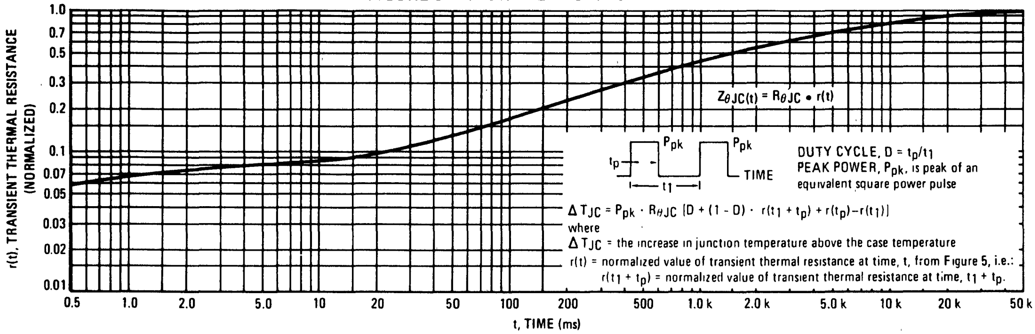
FIGURE 4 – FORWARD POWER DISSIPATION



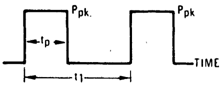
3

THERMAL CHARACTERISTICS

FIGURE 5 – THERMAL RESPONSE



NOTE 2 – FINDING JUNCTION TEMPERATURE



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3). The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

r(t) = normalized value of transient thermal resistance at time, t, from Figure 5, i.e.

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

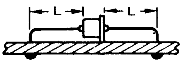
NOTE 3 – MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering.

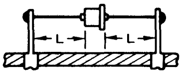
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD	LEAD LENGTH, L (IN) 1/4	1	$R_{\theta JA}$
1	55	60	°C/W
2	65	70	°C/W
3	25		°C/W

MOUNTING METHOD 1



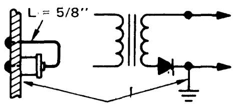
MOUNTING METHOD 2



Vector pin mounting

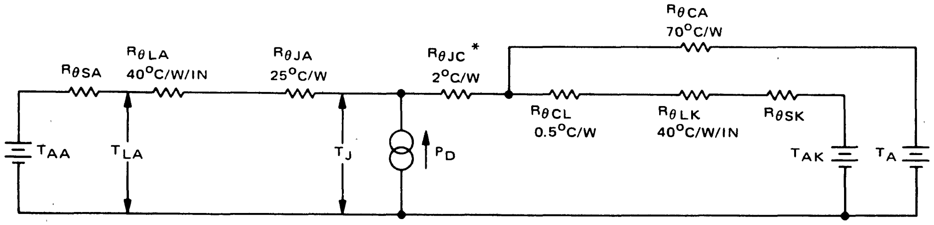
MOUNTING METHOD 3

P. C. Board with 2 1/2″ x 2 1/2″ copper surface



Board Ground Plane

FIGURE 6 – APPROXIMATE THERMAL CIRCUIT MODEL



Use of the above model permits calculation of average junction temperature for any mounting situation. Lowest values of thermal resistance will occur when the cathode lead is brought as close as possible to a heat dissipator; as heat conduction through the anode lead is small. Terms in the model are defined as follows:

***Case temperature reference is at cathode end.**

TEMPERATURES

T_A = Ambient
T_{AA} = Anode Heat Sink Ambient
T_{AK} = Cathode Heat Sink Ambient
T_{LA} = Anode Lead
T_{LK} = Cathode Lead
T_J = Junction

THERMAL RESISTANCES

$R_{\theta CA}$ = Case to Ambient
$R_{\theta SA}$ = Anode Lead Heat Sink to Ambient
$R_{\theta SK}$ = Cathode Lead Heat Sink to Ambient
$R_{\theta LA}$ = Anode Lead
$R_{\theta LK}$ = Cathode Lead
$R_{\theta CL}$ = Case to Cathode Lead
$R_{\theta JC}$ = Junction to Case
$R_{\theta JA}$ = Junction to Anode Lead (S bend)

FIGURE 7 — TYPICAL FORWARD VOLTAGE

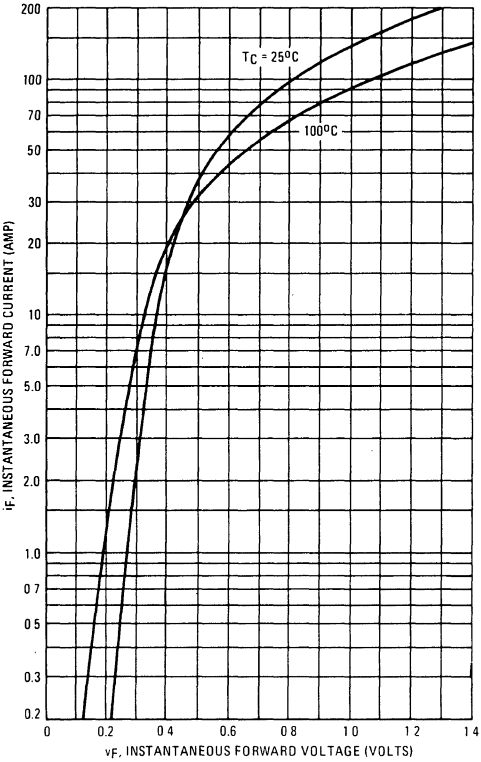


FIGURE 8 — MAXIMUM SURGE CAPABILITY

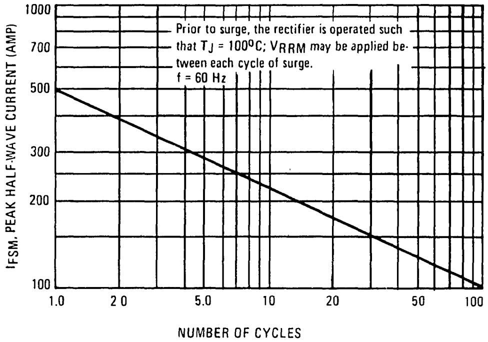


FIGURE 9 — TYPICAL REVERSE CURRENT

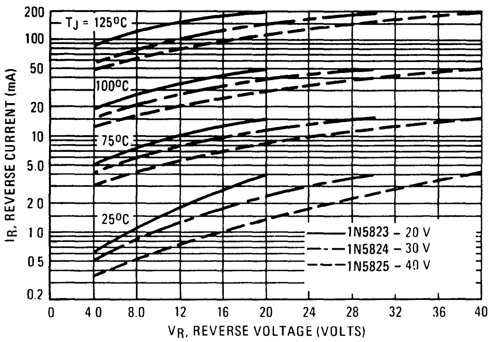
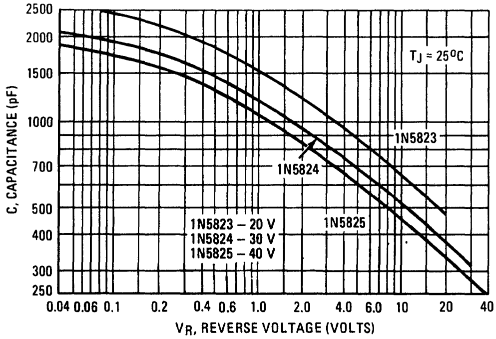


FIGURE 10 — CAPACITANCE



NOTE 4 — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 10).

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

MBR1535CT
MBR1545CT

MBR1545CT is a Motorola Preferred Device

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

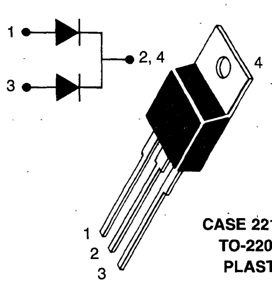
- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B1535, B1545

SCHOTTKY BARRIER RECTIFIERS

15 AMPERES
35 and 45 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS

Rating		Symbol	MBR1535CT	MBR1545CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current $T_C = 105°C$ (Rated V_R)	Per Diode Per Device	$I_{F(AV)}$	7.5 15	7.5 15	Amps
Peak Repetitive Forward Current, $T_C = 105°C$ (Rated V_R, Square Wave, 20 kHz) Per Diode		I_{FRM}	15	15	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)		I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature		T_J	−65 to +150	−65 to +150	°C
Storage Temperature		T_{stg}	−65 to +175	−65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	3.0	°C/W
Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	60	60	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage (1) (i_F = 7.5 Amp, $T_C = 125°C$) (i_F = 15 Amp, $T_C = 125°C$) (i_F = 15 Amp, $T_C = 25°C$)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, $T_C = 125°C$) (Rated dc Voltage, $T_C = 25°C$)	i_R	 15 0.1	 15 0.1	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

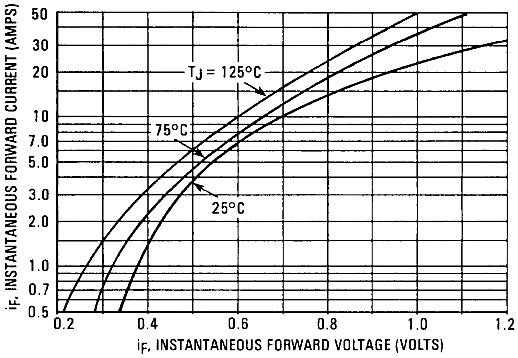


FIGURE 2 — TYPICAL REVERSE CURRENT

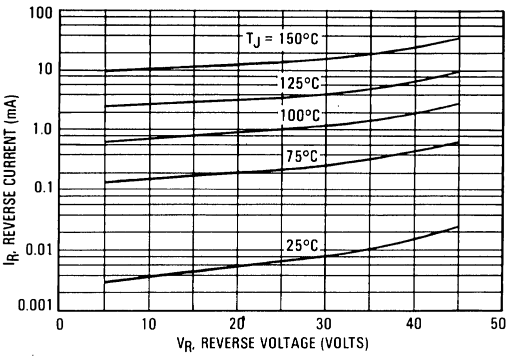


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FIGURE 3 — CURRENT DERATING, CASE

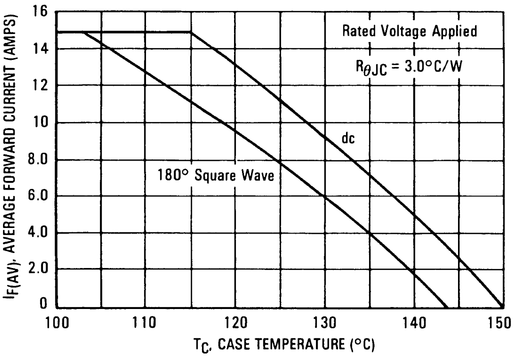


FIGURE 4 — CURRENT DERATING, AMBIENT

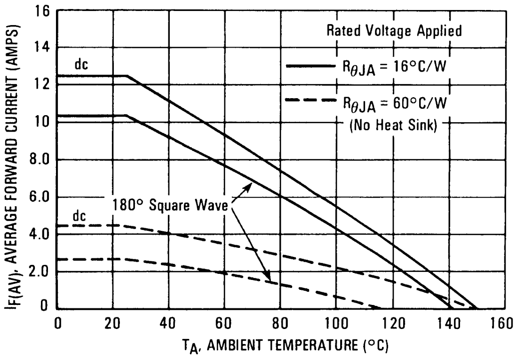
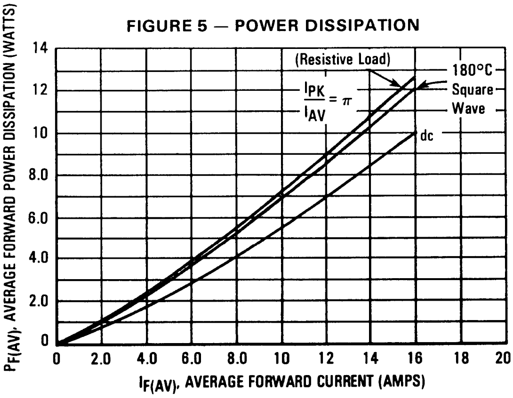


FIGURE 5 — POWER DISSIPATION

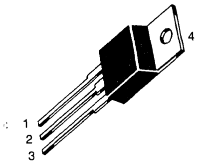


SWITCHMODE Dual Schottky Power Rectifiers

MBR2015CTL
MBR2030CTL

MBR2030CTL is a Motorola Preferred Device

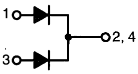
SCHOTTKY BARRIER RECTIFIERS
20 AMPERES
15 and 30 VOLTS



CASE 221A-06
TO-220AB

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low-voltage, high-frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop (0.4 Max @ 10 A, T_C = 150°C)
- Matched Dual Die Construction (10 A per Leg or 20 A per Package)
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, VO at 1/8″



Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2015, B2030

MAXIMUM RATINGS (Per Leg)

Rating	Symbol	MBR2015CTL	MBR2030CTL	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	15	30	Volts
Average Rectified Forward Current	$I_{F(AV)}$	10		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150		Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0		Amp
Operating Junction Temperature	T_J	−65 to +150		°C
Storage Temperature	T_{stg}	−65 to +175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000		V/μs

THERMAL CHARACTERISTICS (Per Leg)

Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (Per Leg)

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 25°C) (i_F = 10 Amp, T_C = 150°C) (i_F = 20 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 150°C)	v_F	 0.52 0.40 0.58 0.48	Volts
Maximum Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C) (Rated DC Voltage, T_C = 125°C)	i_R	 5.0 40 75	mA

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.

Rev 2

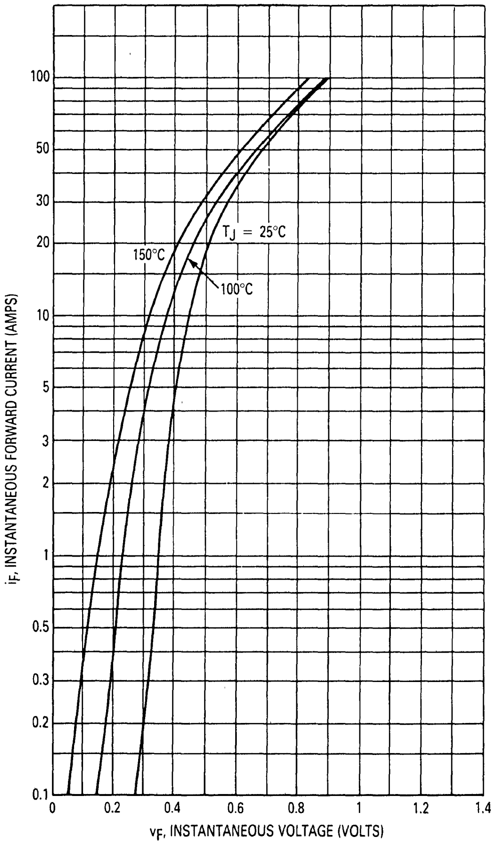


Figure 1. Typical Forward Voltage (Per Leg)

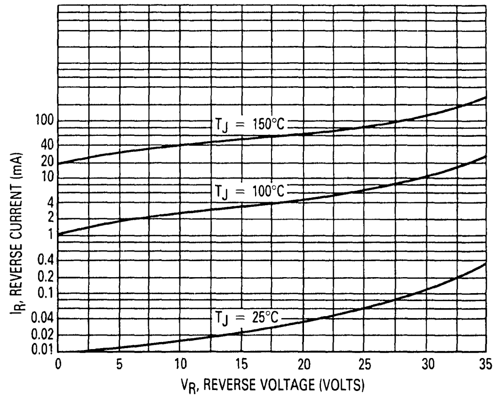


Figure 2. Typical Reverse Current (Per Leg)

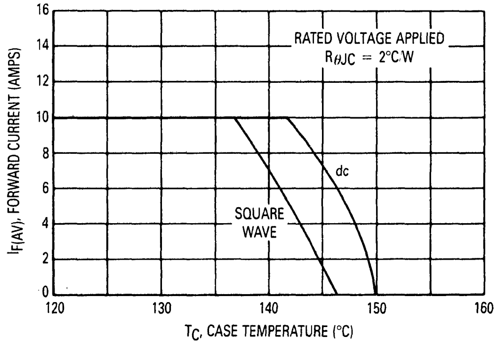


Figure 3. Current Derating, Case

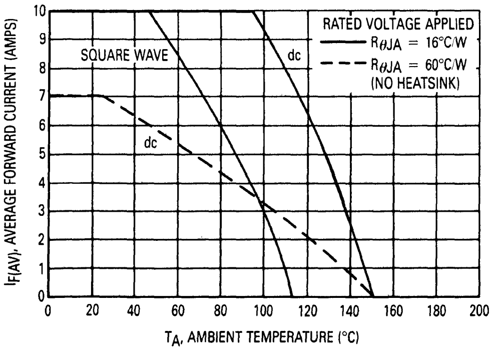


Figure 4. Current Derating, Ambient

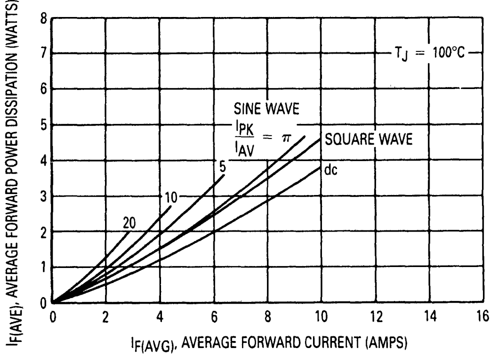


Figure 5. Forward Power Dissipation

3

HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 6.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

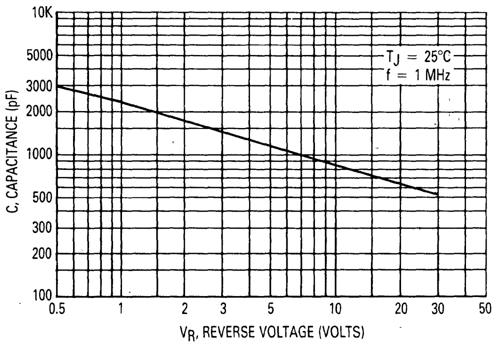


Figure 6. Typical Capacitance

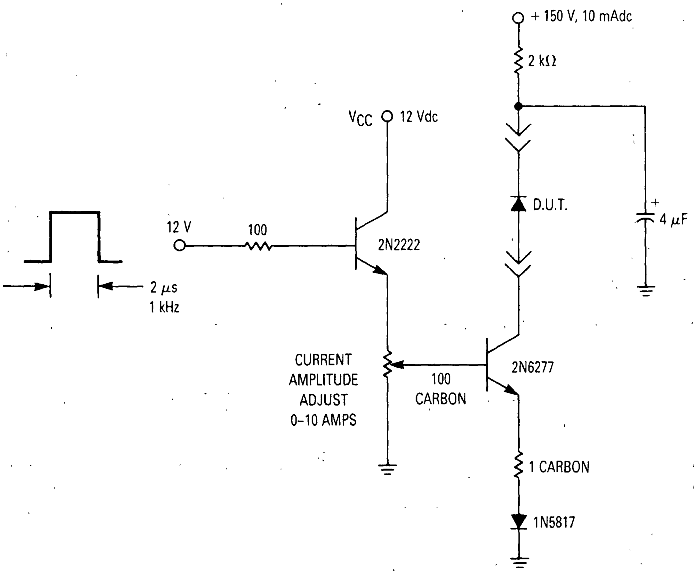


Figure 7. Test Circuit for dv/dt and Reverse Surge Current

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR2035CT
MBR2045CT

MBR2045CT is a Motorola Preferred Device

Switchmode Power Rectifiers

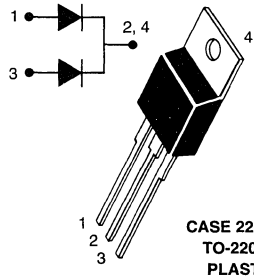
. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″

Mechanical Characteristics:
- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2035, B2045

SCHOTTKY BARRIER RECTIFIERS

20 AMPERES
35 and 45 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR2035CT	MBR2045CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 135°C$	$I_{F(AV)}$	20	20	Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz) $T_C = 135°C$	I_{FRM}	20	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 11	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	−65 to +150	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	−65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 2

3

FIGURE 1 — MAXIMUM FORWARD VOLTAGE

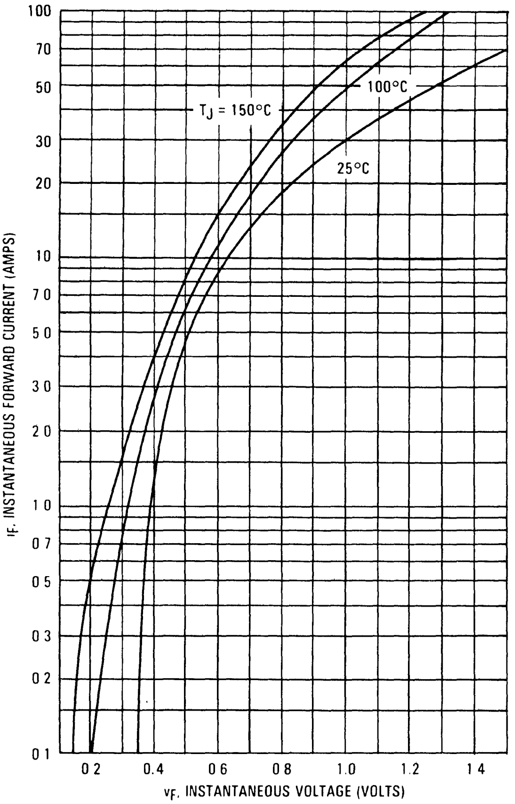


FIGURE 2 — TYPICAL FORWARD VOLTAGE

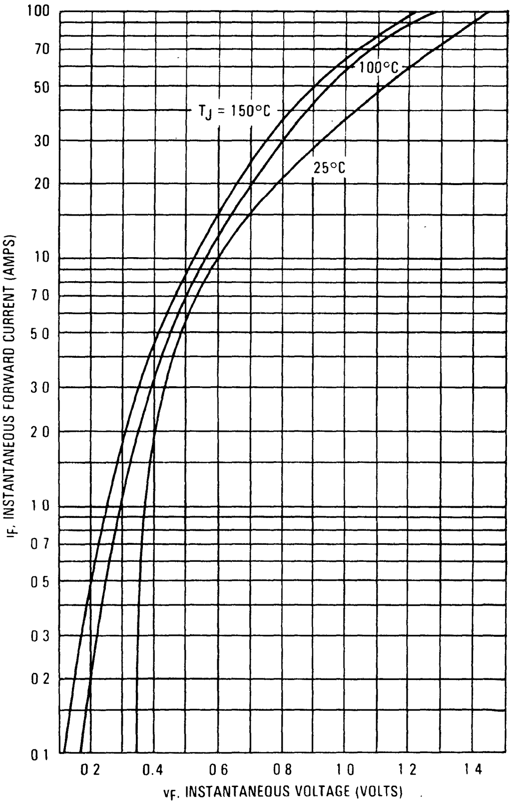


FIGURE 3 — MAXIMUM REVERSE CURRENT

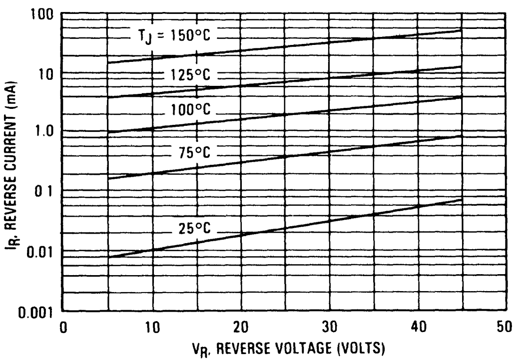


FIGURE 4 — MAXIMUM SURGE CAPABILITY

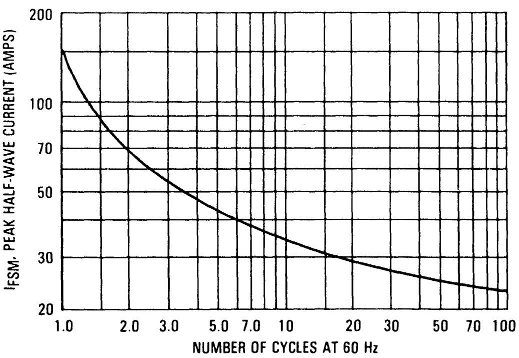


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FIGURE 5 — CURRENT DERATING, INFINITE HEATSINK

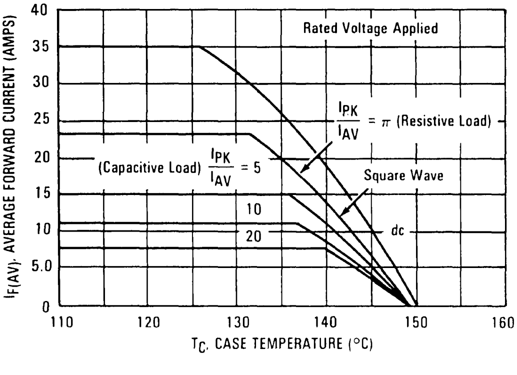


FIGURE 6 — CURRENT DERATING, $R_{\theta JA}$ = 16° C/W

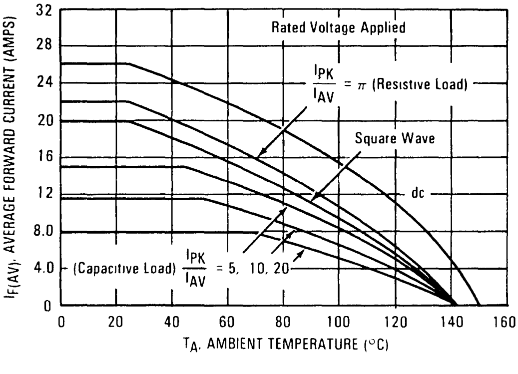


FIGURE 7 — FORWARD POWER DISSIPATION

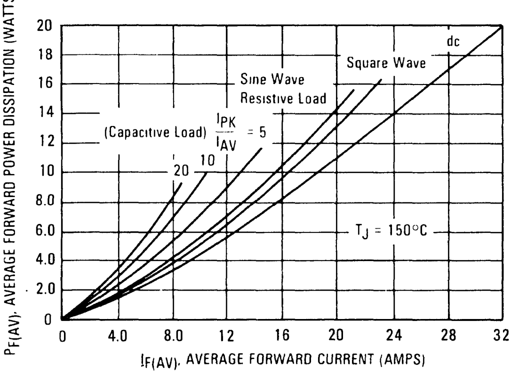


FIGURE 8 — CURRENT DERATING, FREE AIR

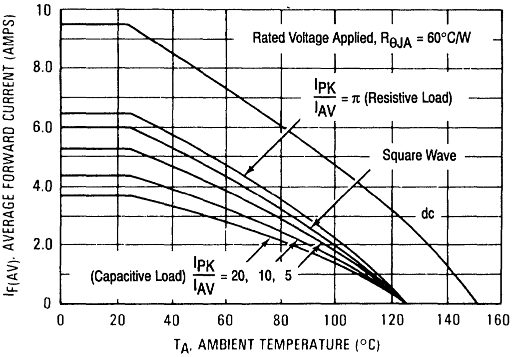
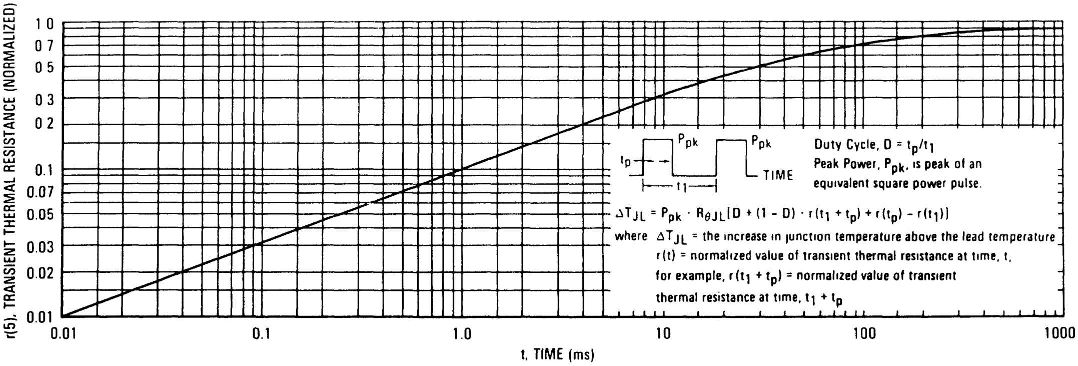


FIGURE 9 — THERMAL RESPONSE



HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 10.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficieny is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

3

FIGURE 10 — CAPACITANCE

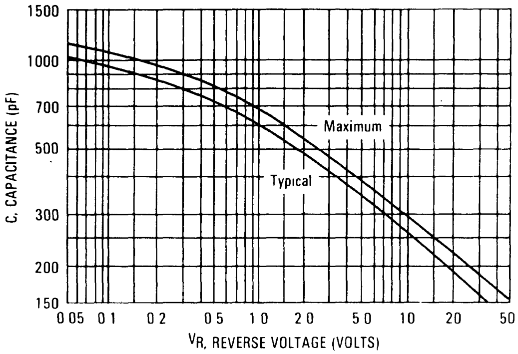
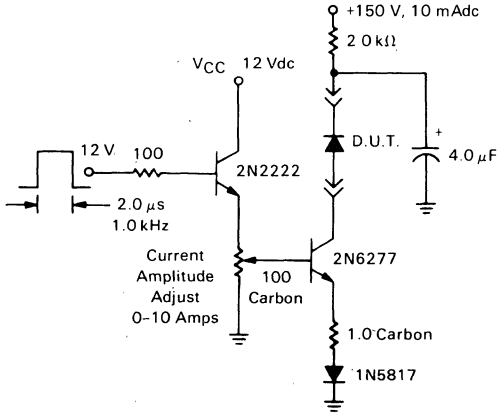


FIGURE 11 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Switchmode Power Rectifiers

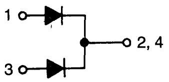
MBR2060CT
MBR2070CT
MBR2080CT
MBR2090CT
MBR20100CT

MBR2060CT and MBR20100CT are Motorola Preferred Devices

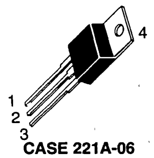
SCHOTTKY BARRIER RECTIFIERS
20 AMPERES
60–100 VOLTS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- 20 Amps Total (10 Amps Per Diode Leg)
- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″
- Low Power Loss/High Efficiency
- High Surge Capacity
- Low Stored Charge Majority Carrier Conduction



Mechanical Characteristics:
- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2060, B2070, B2080, B2090, B20100



CASE 221A-06
TO-220AB
PLASTIC

MAXIMUM RATINGS PER DIODE LEG

Rating	Symbol	MBR 2060CT	2070CT	2080CT	2090CT	20100CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	70	80	90	100	Volts
Average Rectified Forward Current (Rated V_R) T_C = 133°C	$I_{F(AV)}$	10					Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 133°C	I_{FRM}	20					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150					Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}	0.5					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000					V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	2 60	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	 0.75 0.85 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 6 0.1	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Rev 2

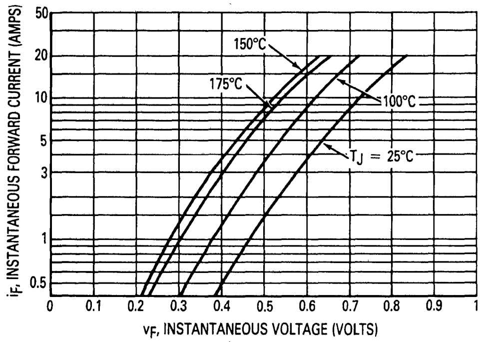


Figure 1. Typical Forward Voltage Per Diode

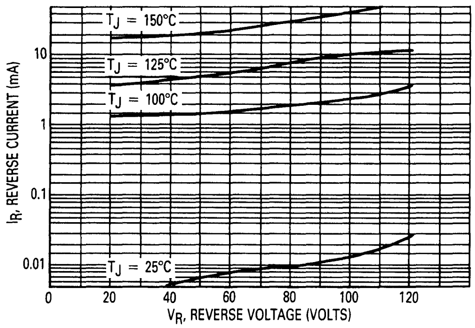


Figure 2. Typical Reverse Current Per Diode

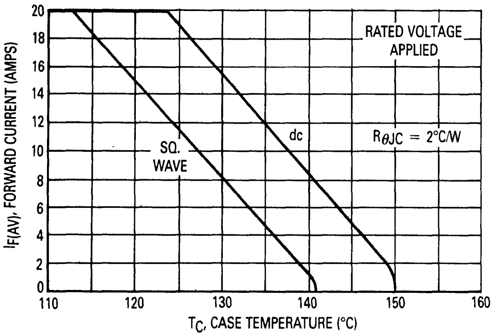


Figure 3. Current Derating, Case

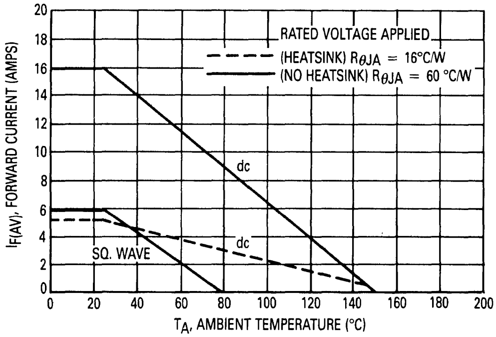


Figure 4. Current Derating, Ambient

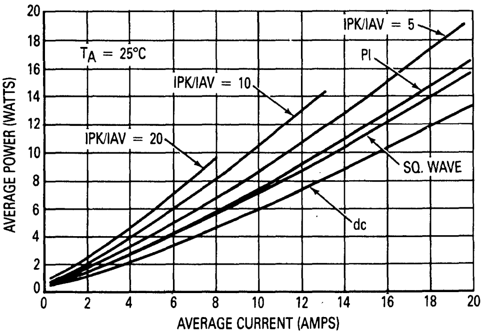
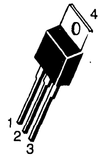


Figure 5. Average Power Dissipation and Average Current

MBR20200CT

Switchmode™ Power
Dual Schottky Rectifier

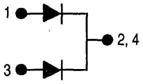
SCHOTTKY BARRIER RECTIFIER
20 AMPERES
200 VOLTS



CASE 221A–06
(TO–220)

. . . using Schottky Barrier technology with a platinum barrier metal. This state–of–the–art device is designed for use in high frequency switching power supplies and converters with up to 48 volt outputs. They block up to 200 volts and offer improved Schottky performance at frequencies from 250 kHz to 5.0 MHz.

- **200 Volt Blocking Voltage**
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (10,000 V/µs)
- Dual Diode Construction — Terminals 1 and 3 Must be Connected for Parallel Operation at Full Rating



Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B20200

MAXIMUM RATINGS (PER LEG)

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	Per Leg Per Package	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 90°C		I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)		I_{RRM}	1.0	Amp
Operating Junction Temperature		T_J	–65 to +150	°C
Storage Temperature		T_{stg}	–65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10,000	V/µs

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1)	(I_F = 10 Amps, T_C = 25°C) (I_F = 10 Amps, T_C = 125°C) (I_F = 20 Amps, T_C = 25°C) (I_F = 20 Amps, T_C = 125°C)	V_F	0.9 0.8 1.0 0.9	Volts
Maximum Instantaneous Reverse Current (1)	(Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	I_R	1.0 50	mA

DYNAMIC CHARACTERISTICS (PER LEG)

Capacitance (V_R = –5.0 V, T_C = 25°C, Frequency = 1.0 MHz)	C_T	500	pF

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤2.0%.

Rev 1

3

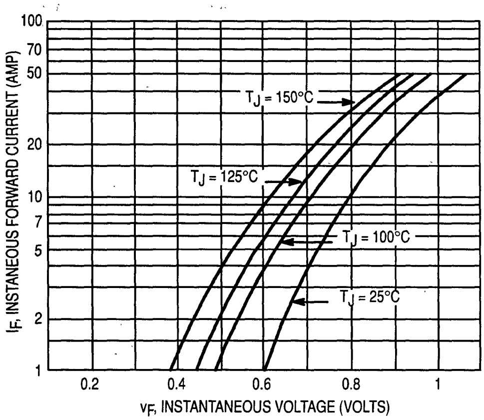


Figure 1. Typical Forward Voltage (Per Leg)

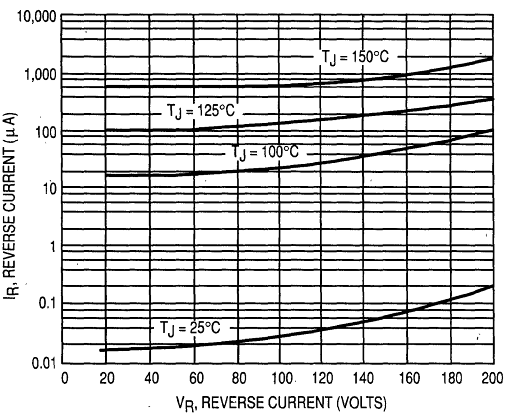


Figure 2. Typical Reverse Current (Per Leg)

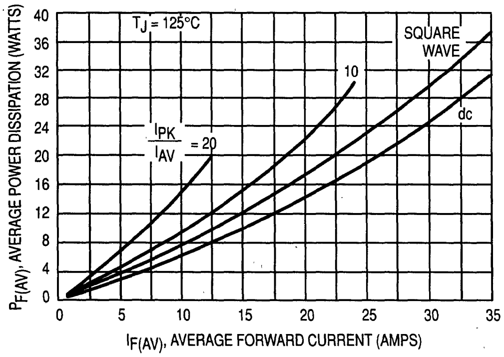


Figure 3. Forward Power Dissipation

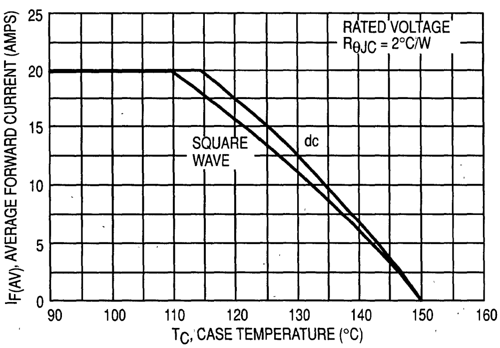


Figure 4. Current Derating, Case

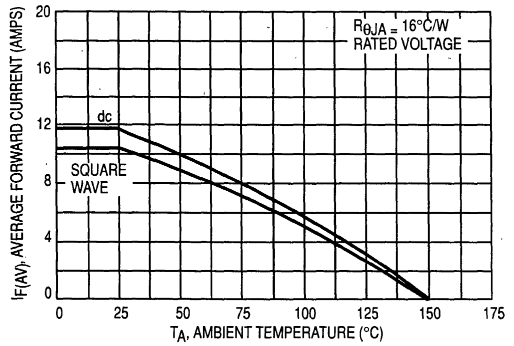


Figure 5. Current Derating, Ambient

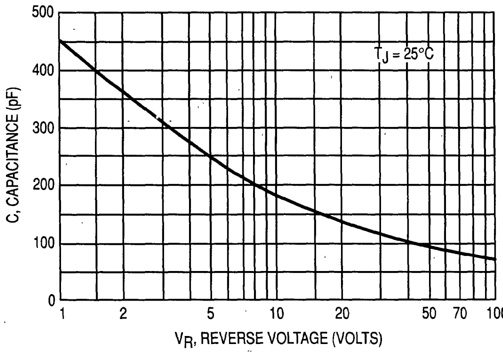


Figure 6. Typical Capacitance (Per Leg)

Advance Information

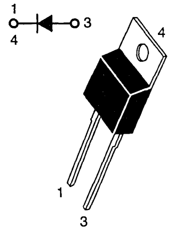
SWITCHMODE™ Power Rectifiers

MBR2515L

SCHOTTKY BARRIER RECTIFIER
25 AMPERES
15 VOLTS

. . . employing the Schottky Barrier principle in a large metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use in low voltage, high frequency switching power supplies, low voltage converters, OR'ing diodes, and polarity protection devices.

- Very Low Forward Voltage (0.28 V Maximum @ 19 Amps, 70°C)
- Guardring for Stress Protection
- Highly Stable Oxide Passivated Junction (100°C Operating Junction Temperature)
- Epoxy Meets UL94, VO at 1/8″



CASE 221B–03, STYLE 1
(TO–220AC)

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 Units Per Plastic Tube
- Marking: B2515L

MAXIMUM RATINGS (Per Leg)

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	15	Volts
Average Rectified Forward Current (Rated V_R) T_C = 90°C	$I_{F(AV)}$	25	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 90°C	I_{FRM}	30	Amps
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amps
Operating Junction Temperature	T_J	–65 to +100	°C
Storage Temperature	T_{stg}	–65 to +125	°C

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (I_F = 25 Amps, T_J = 25°C) (I_F = 25 Amps, T_J = 70°C) (I_F = 19 Amps, T_J = 70°C)	V_F	 0.45 0.42 0.28	Volts
Maximum Instantaneous Reverse Current (1) (Rated DC Voltage, T_J = 25°C) (Rated DC Voltage, T_J = 70°C)	I_R	 15 200	mA

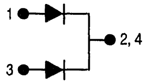
(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%

Switchmode™ Power Rectifier

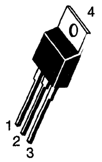
MBR2535CTL

. . . employing the Schottky Barrier principle in a large metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use in low voltage, high frequency switching power supplies, free wheeling diodes, and polarity protection diodes.

- Very Low Forward Voltage (0.55 V Maximum @ 25 Amps)
- Matched Dual Die Construction (12.5 A per Leg or 25 A per Package)
- Guardring for Stress Protection
- Highly Stable Oxide Passivated Junction (125°C Operating Junction Temperature)
- Epoxy Meets UL94, VO at 1/8″



SCHOTTKY BARRIER RECTIFIER
25 AMPERES
35 VOLTS



CASE 221A–06
(TO–220AC)

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2535L

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35 35 35	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C	$I_{F(AV)}$	12.5	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 95°C	I_{FRM}	25	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	Amp
Operating Junction Temperature	T_J	–65 to +125	°C
Storage Temperature	T_{stg}	–65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/μs
Controlled Avalanche Energy	W_{aval}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (I_F = 25 Amps, T_J = 25°C) (I_F = 12.5 Amps, T_J = 25°C) (I_F = 12.5 Amps, T_J = 125°C)	V_F	 0.55 0.47 0.41	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 125°C)	I_R	 5.0 500	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%.

Rev 1

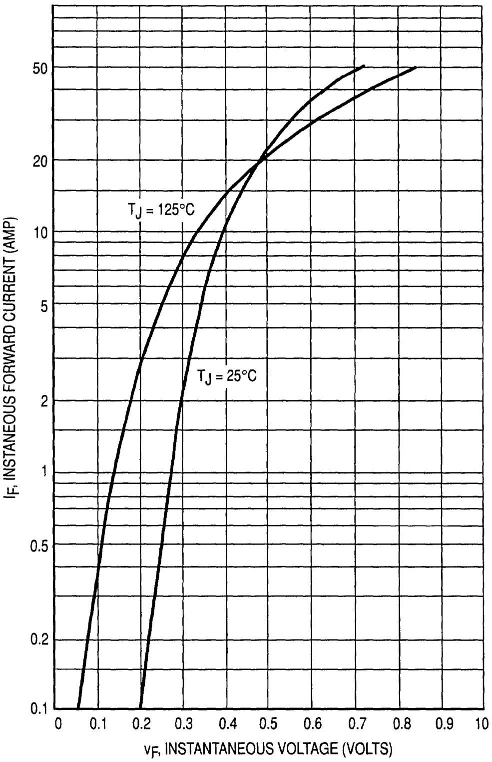


Figure 1. Typical Forward Voltage, Per Leg

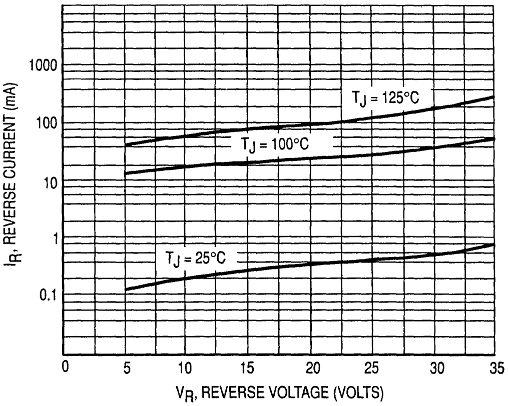


Figure 2. Typical Reverse Current, Per Leg

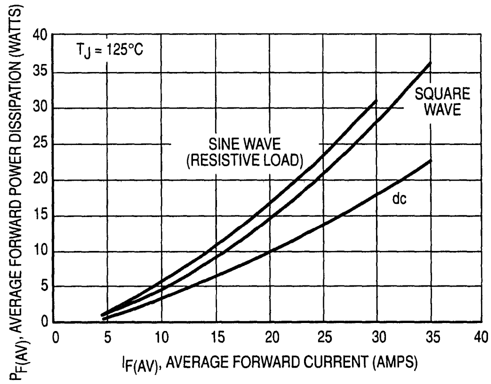


Figure 3. Forward Power Dissipation, Per Leg

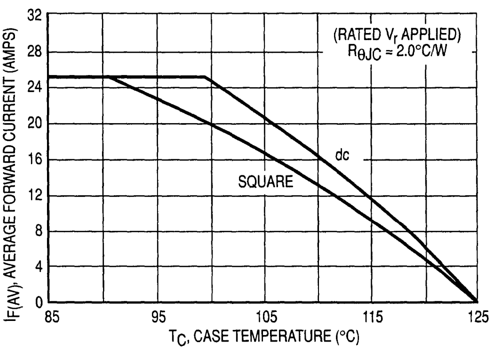


Figure 4. Current Derating

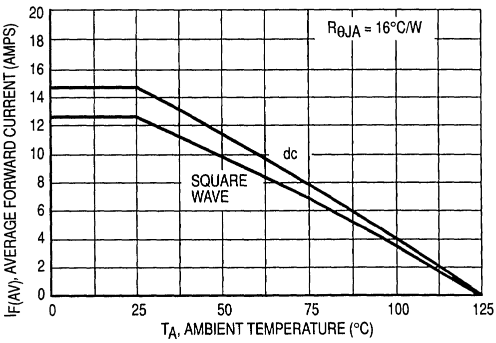


Figure 5. Current Derating Ambient, Per Leg

MBR2535CT
MBR2545CT

MBR2545CT is a Motorola Preferred Device

3

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

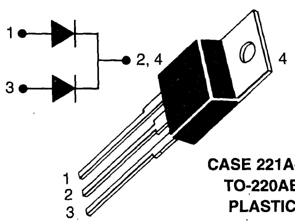
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2535, B2545

SCHOTTKY BARRIER RECTIFIERS

30 AMPERES
35 and 45 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBR2535CT	MBR2545CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 130°C$	$I_{F(AV)}$	30	30	Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz) $T_C = 130°C$	I_{FRM}	30	30	Amps
Nonrepetitive Peak Surge Current per Diode Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	−65 to + 150	−65 to + 150	°C
Storage Temperature	T_{stg}	−65 to +175	−65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs
THERMAL CHARACTERISTICS PER DIODE LEG				
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	1.5	°C/W
ELECTRICAL CHARACTERISTICS PER DIODE LEG				
Maximum Instantaneous Forward Voltage (1) (i_F = 30 Amp, $T_C = 125°C$) (i_F = 30 Amp, $T_C = 25°C$)	v_F	 0.73 0.82	 0.73 0.82	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, $T_C = 125°C$) (Rated dc Voltage, $T_C = 25°C$)	i_R	 40 0.2	 40 0.2	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

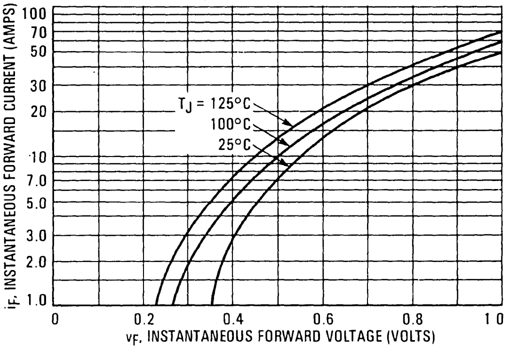


FIGURE 2 — TYPICAL REVERSE CURRENT

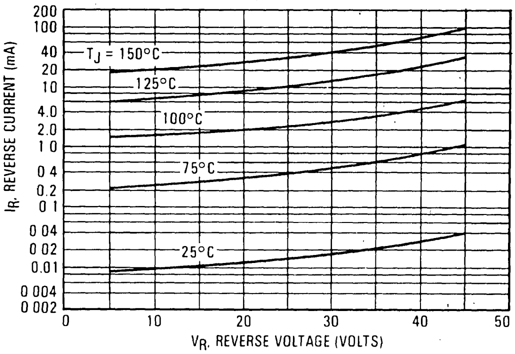


FIGURE 3 — CURRENT DERATING, CASE

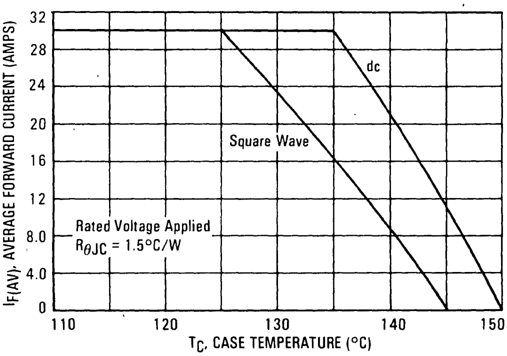


FIGURE 4 — CURRENT DERATING, AMBIENT

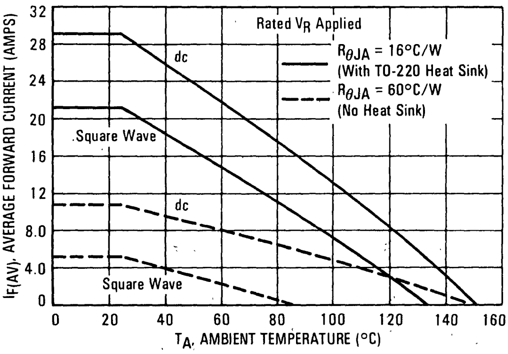
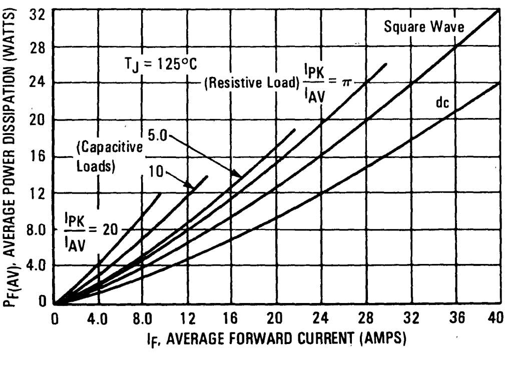


FIGURE 5 — FORWARD POWER DISSIPATION



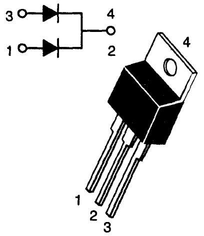
Advance Information
SWITCHMODE™ Power Rectifier

MBR3045ST
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
30 AMPERES
45 VOLTS

... using the Schottky Barrier principle with a platinum barrier metal. This state–of–the–art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 May Be Connected for Parallel Operation at Full Rating
- 45 V Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche



CASE 221A–06, STYLE 6
(TO–220AB)

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 Units Per Plastic Tube
- Marking: B3045

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	V
Average Rectified Current Per Device T_C = 130°C Per Diode	$I_{F(AV)}$	30 15	A
Peak Repetitive Forward Current, Per Diode (Square Wave, V_R = 45 V, 20 kHz)	I_{FRM}	30	A
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	A
Peak Repetitive Reverse Current, Per Diode (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	A
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change (Rated V_R)	dV/dt	10000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	°C/W

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS PER DIODE

Rating	Symbol	Max	Unit
Instantaneous Forward Voltage (1) (I_F = 30 Amp, T_C = 25°C) (I_F = 30 Amp, T_C = 125°C) (I_F = 20 Amp, T_C = 125°C)	V_F	 0.76 0.72 0.60	V
Instantaneous Reverse Current (1) (V_R = 45 Volts, T_C = 25°C) (V_R = 45 Volts, T_C = 125°C)	I_R	 0.2 40	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

MBR735
MBR745

MBR745 is a Motorola Preferred Device

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

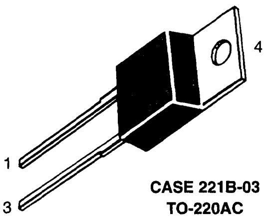
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B735, B745

SCHOTTKY BARRIER RECTIFIERS

7.5 AMPERES
35 and 45 VOLTS



CASE 221B-03
TO-220AC

MAXIMUM RATINGS

Rating	Symbol	MBR735	MBR745	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C	$I_{F(AV)}$	7.5	7.5	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 105°C	I_{FRM}	15	15	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	-65 to +150	-65 to +150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	3.0	°C/W
Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	60	60	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 7.5 Amp, T_C = 125°C) (i_F = 15 Amp, T_C = 125°C) (i_F = 15 Amp, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

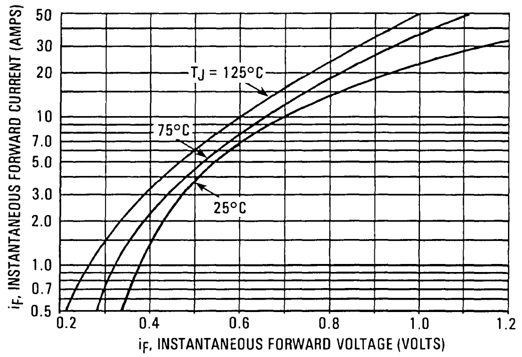


FIGURE 2 — TYPICAL REVERSE CURRENT

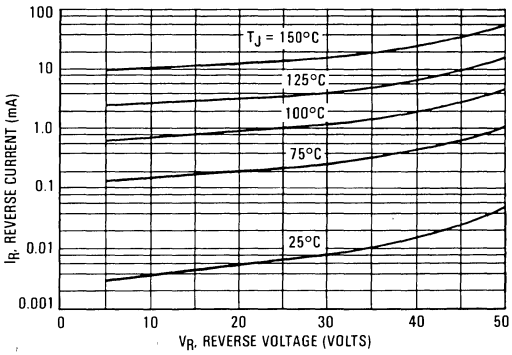


FIGURE 3 — CURRENT DERATING, CASE

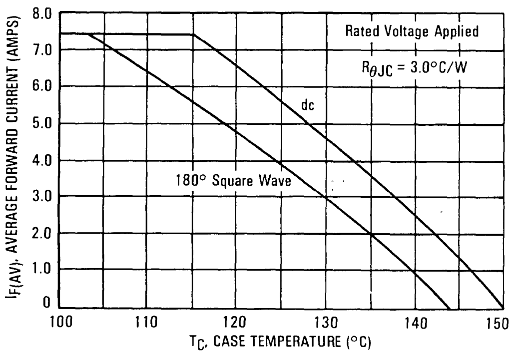


FIGURE 4 — CURRENT DERATING, AMBIENT

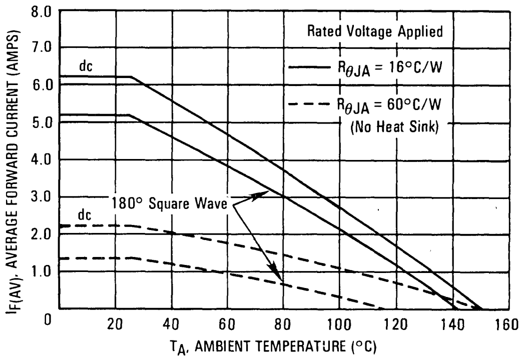
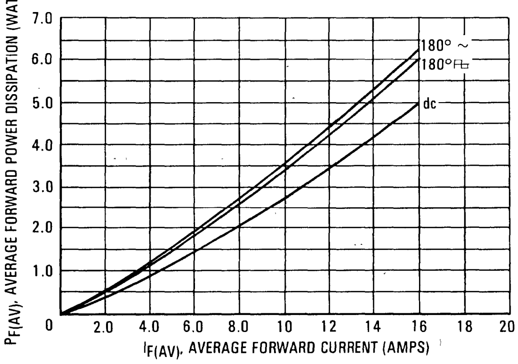


FIGURE 5 — POWER DISSIPATION



MBR1035
MBR1045

MBR1045 is a Motorola Preferred Device

3

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

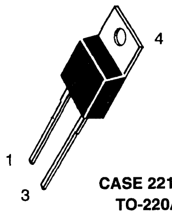
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B1035, B1045

SCHOTTKY BARRIER RECTIFIERS

10 AMPERES
20 to 45 VOLTS



CASE 221B-03
TO-220AC
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBR1035	MBR1045	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 135°C	$I_{F(AV)}$	10	10	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 135°C	I_{FRM}	20	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 12	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	–65 to + 150	–65 to + 150	°C
Storage Temperature	T_{stg}	–65 to +175	–65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	MBR1035	MBR1045	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MBR1035	MBR1045	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 10 A, T_C = 125°C) (i_F = 20 A, T_C = 125°C) (i_F = 20 A, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 2

FIGURE 1 —MAXIMUM FORWARD VOLTAGE

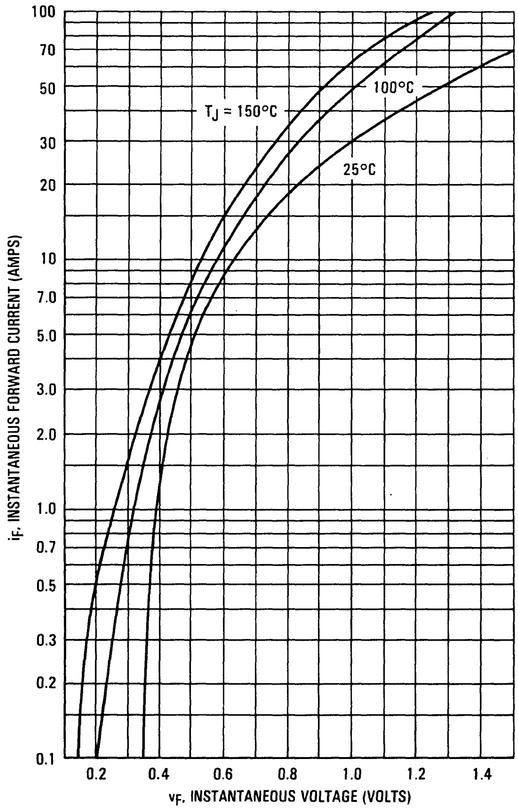


FIGURE 2 —TYPICAL FORWARD VOLTAGE

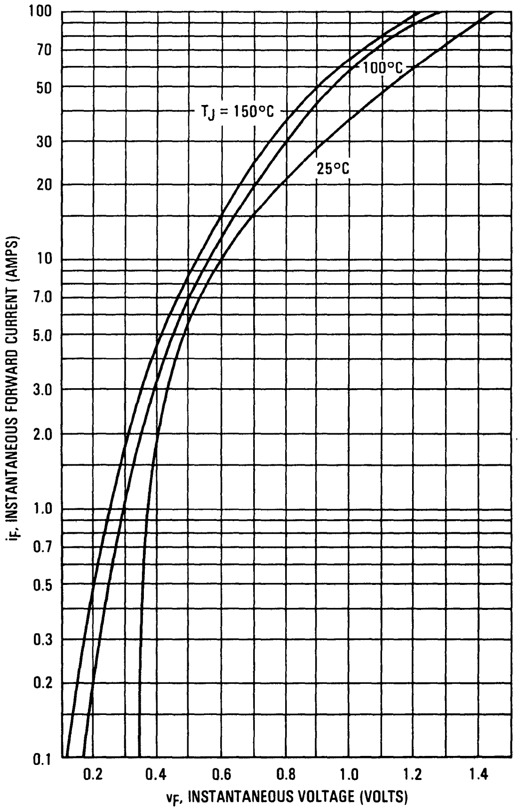


FIGURE 3 — MAXIMUM REVERSE CURRENT

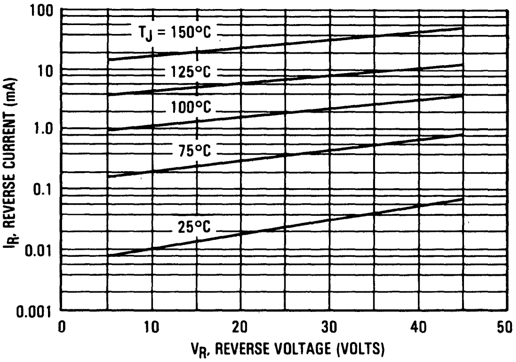


FIGURE 4 — MAXIMUM SURGE CAPABILITY

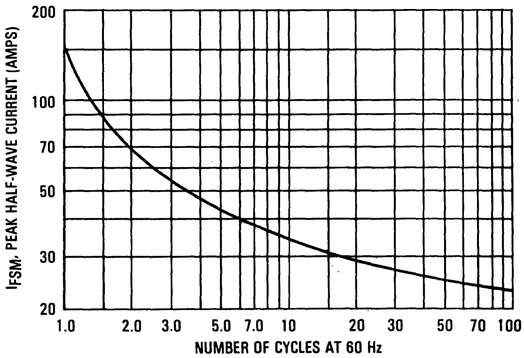


FIGURE 5 — CURRENT DERATING, INFINITE HEATSINK

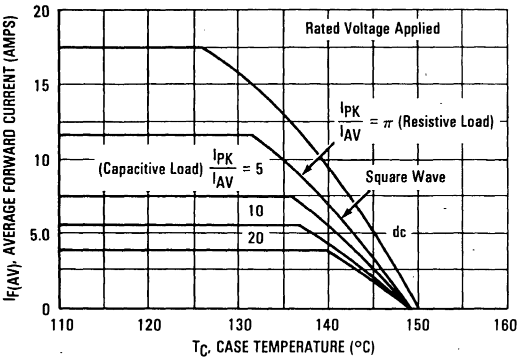


FIGURE 6 — CURRENT DERATING, $R_{\theta JA}$ = 16° C/W

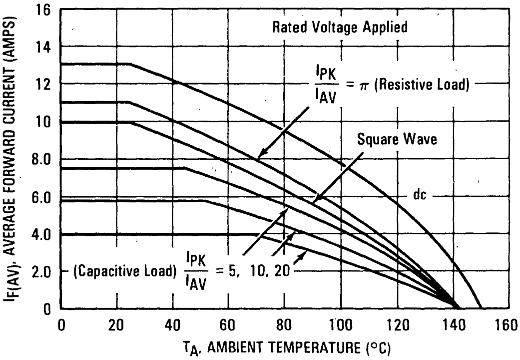


FIGURE 7 — FORWARD POWER DISSIPATION

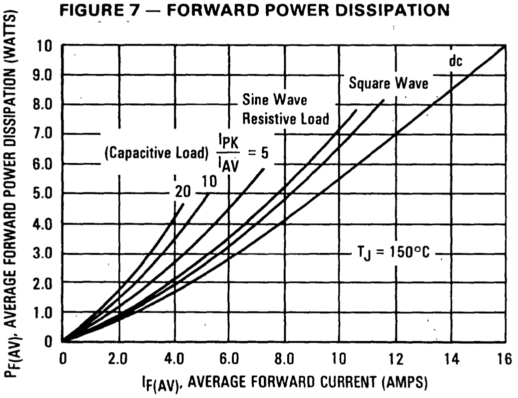


FIGURE 8 — CURRENT DERATING, FREE AIR

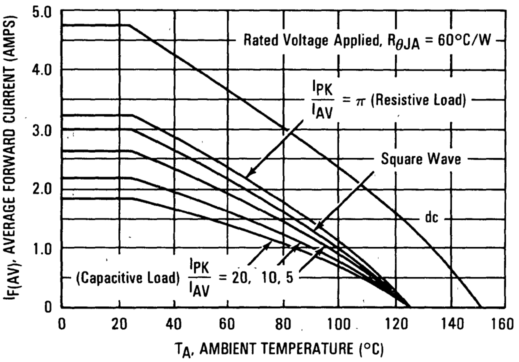
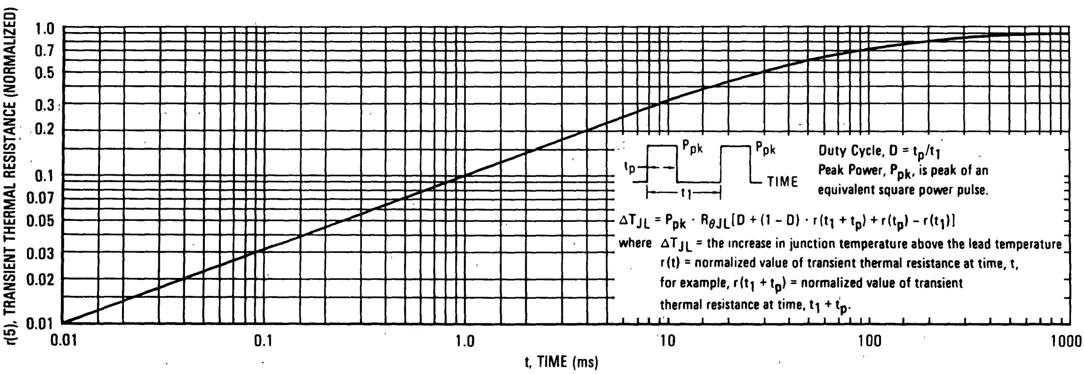


FIGURE 9 — THERMAL RESPONSE



HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 10.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficieny is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 10 — CAPACITANCE

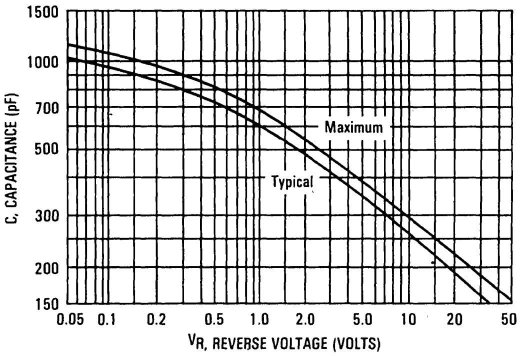
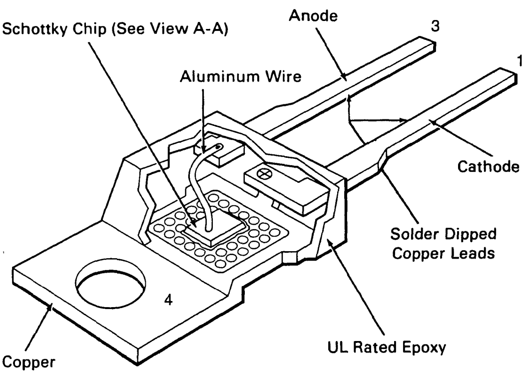
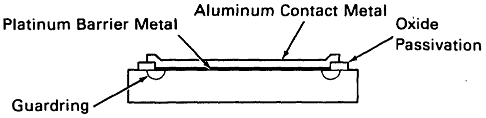


FIGURE 11 — SCHOTTKY RECTIFIER



Schottky Chip — View A-A



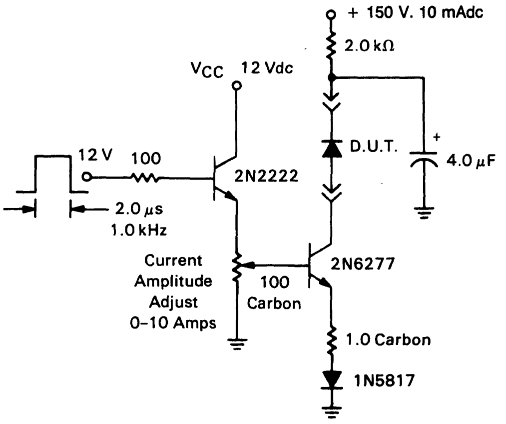
Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the barrier metal and aluminum-contact metal to eliminate any possible interaction between the two. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb over-voltage transients.

Second is the package. The Schottky chip is bonded to the copper heat sink using a specially formulated solder. This gives the unit the capability of passing 10,000 operating thermal-fatigue cycles having a ΔT_J of 100°C. The epoxy molding compound is rated per UL 94, VO @ 1/8″. Wire bonds are 100% tested in assembly as they are made.

Third is the electrical testing, which includes 100% dv/dt at 1600 V/μs and reverse avalanche as part of device characterization.

FIGURE 12 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MBR1060
MBR1070
MBR1080
MBR1090
MBR10100

MBR1060 and MBR10100 are Motorola Preferred Devices

3

Switchmode Power Rectifiers

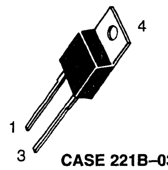
. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″
- Low Power Loss/High Efficiency
- High Surge Capacity
- Low Stored Charge Majority Carrier Conduction

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B1060, B1070, B1080, B1090, B10100

SCHOTTKY BARRIER RECTIFIERS
10 AMPERES
60–100 VOLTS



CASE 221B–03
TO–220AC

MAXIMUM RATINGS

Rating	Symbol	MBR					Unit
		1060	1070	1080	1090	10100	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	70	80	90	100	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 133°C$	$I_{F(AV)}$	10					Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) $T_C = 133°C$	I_{FRM}	20					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150					Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}	0.5					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000					V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	2 60	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	 0.7 0.8 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 6.0 0.10	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Rev 2

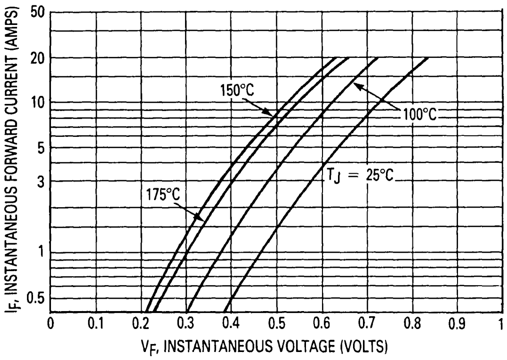


Figure 1. Typical Forward Voltage

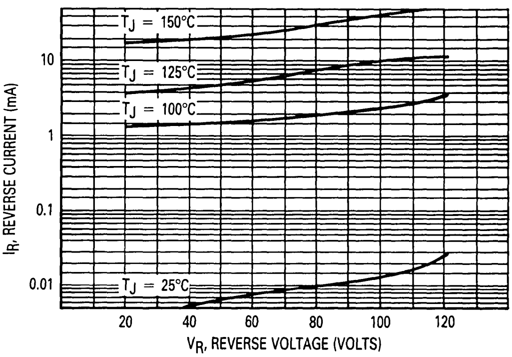


Figure 2. Typical Reverse Current

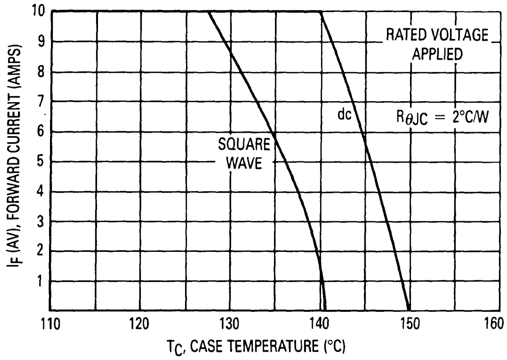


Figure 3. Current Derating, Case

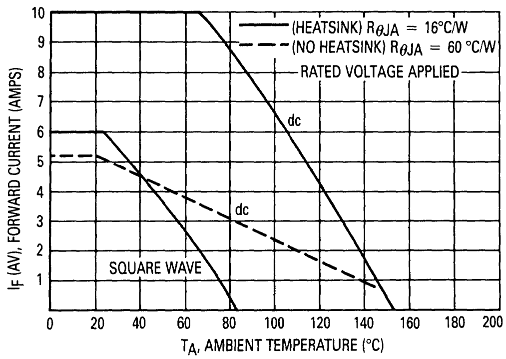


Figure 4. Current Derating, Ambient

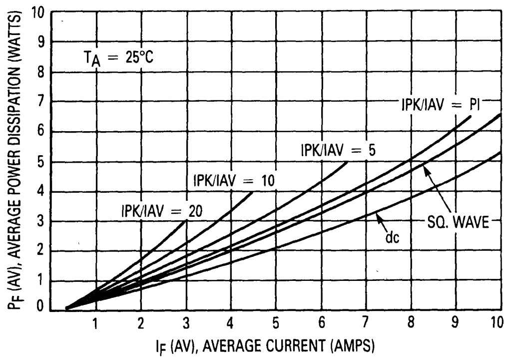


Figure 5. Forward Power Dissipation

MBR1635
MBR1645

MBR1645 is a
Motorola Preferred Device

3

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

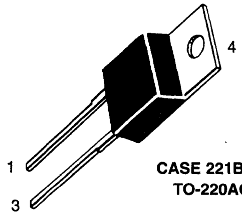
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B1635, B1645

SCHOTTKY BARRIER RECTIFIERS

16 AMPERES
35 and 45 VOLTS



CASE 221B-03
TO-220AC

MAXIMUM RATINGS

Rating	Symbol	MBR1635	MBR1645	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	16	16	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	32	32	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	-65 to +150	-65 to +150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	1.5	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 16 Amp, T_C = 125°C) (i_F = 16 Amp, T_C = 25°C)	v_F	 0.57 0.63	 0.57 0.63	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 40 0.2	 40 0.2	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

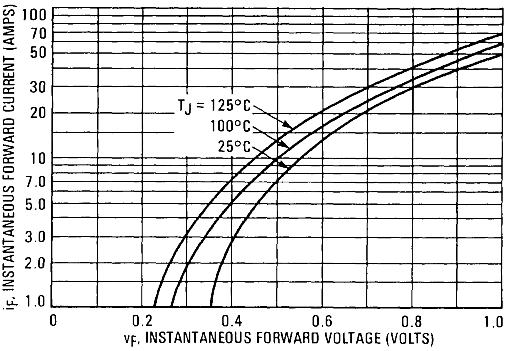


FIGURE 2 — TYPICAL REVERSE CURRENT

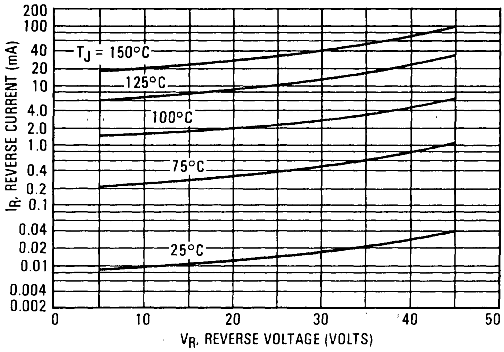


FIGURE 3 — CURRENT DERATING, CASE

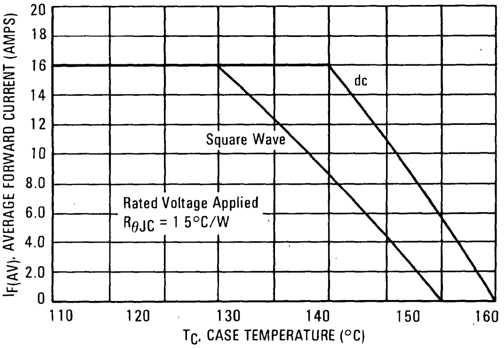


FIGURE 4 — CURRENT DERATING, AMBIENT

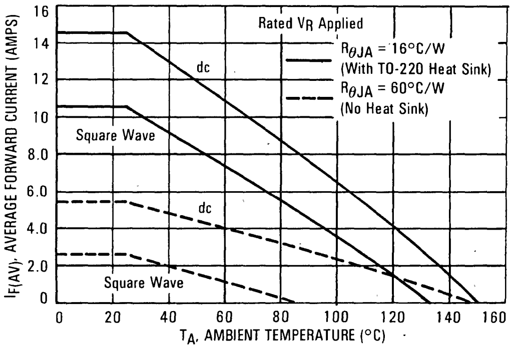
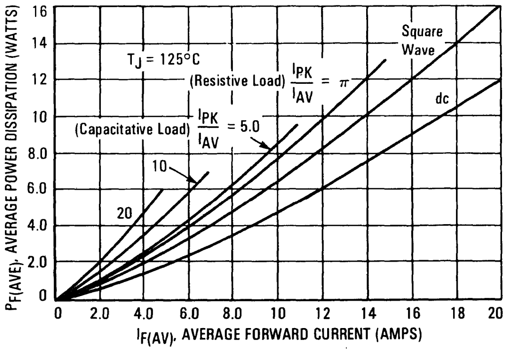


FIGURE 5 — FORWARD POWER DISSIPATION



SWITCHMODE™ Schottky Power Rectifiers

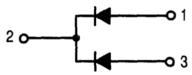
MBRF1545CT

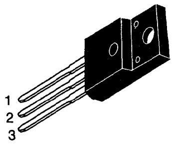
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
15 AMPERES
45 VOLTS

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- Matched Dual Die Construction
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, VO at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369[1]





CASE 221D–02
ISOLATED TO–220

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B1545

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R), T_C = 105°C Total Device	$I_{F(AV)}$	7.5 15	Amps
Peak Repetitive Forward Current, T_C = 105°C (Rated V_R, Square Wave, 20 kHz) Per Diode	I_{FRM}	15	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Operating Junction and Storage Temperature	T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/µs
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)[2] Per Figure 3 Per Figure 4[1] Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.1	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value.

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ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3)	v_F		Volts
(i_F = 15 Amp, T_C = 25°C)		0.84	
(i_F = 15 Amp, T_C = 125°C)		0.72	
(i_F = 7.5 Amp, T_C = 125°C)		0.57	
Maximum Instantaneous Reverse Current (3)	i_R		mA
(Rated DC Voltage, T_C = 25°C)		0.1	
(Rated DC Voltage, T_C = 125°C)		15	

(3) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤2.0%.

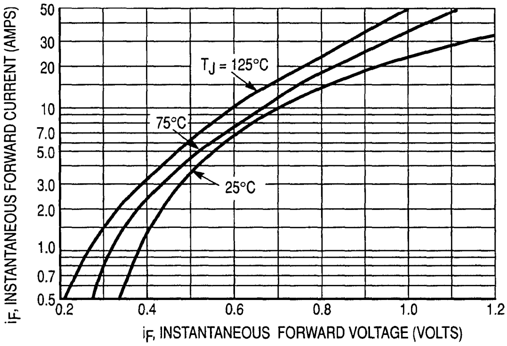


Figure 1. Typical Forward Voltage

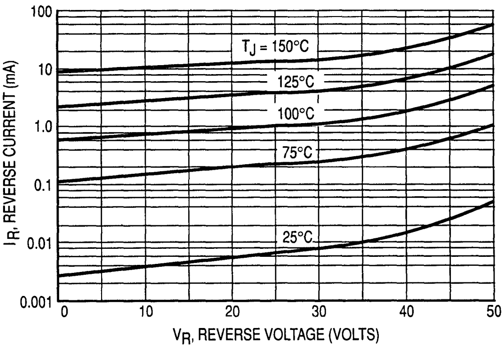


Figure 2. Typical Reverse Current

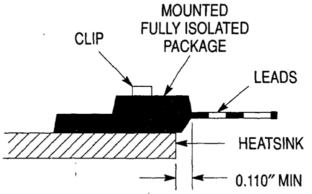


Figure 3. Clip Mounting Position for Isolation Test Number 1

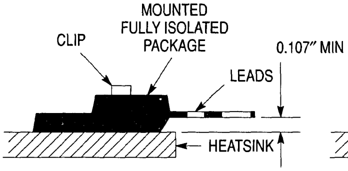


Figure 4. Clip Mounting Position for Isolation Test Number 2

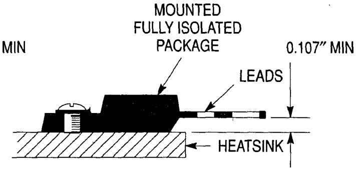
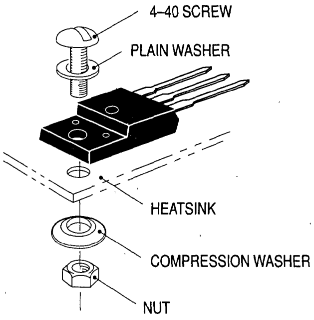


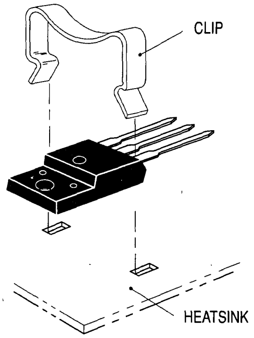
Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



6a. Screw–Mounted



6b. Clip–Mounted

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions

**For more information about mounting power semiconductors see Application Note AN1040.

SWITCHMODE™ Schottky Power Rectifiers

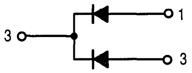
MBRF2045CT

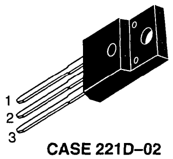
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS 20 AMPERES 45 VOLTS

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- Matched Dual Die Construction
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, VO at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)





CASE 221D–02 ISOLATED TO–220

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2045

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R), T_C = 135°C	 Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz), T_C = 135°C		I_{FRM}	20	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)		I_{RRM}	1.0	Amp
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/µs
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 5 Per Figure 6(1) Per Figure 7	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.0	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 seconds	T_L	260	°C

(1) UL recognized mounting method is per Figure 6.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3) (i_F = 20 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 125°C)	v_F	 0.84 0.72 0.57	Volts
Maximum Instantaneous Reverse Current (3) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 125°C)	i_R	 0.1 15	mA

(3) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%.

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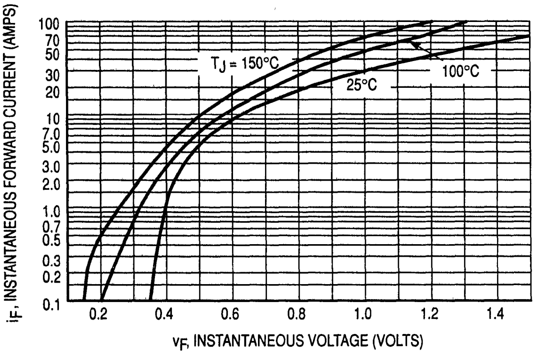


Figure 1. Maximum Forward Voltage

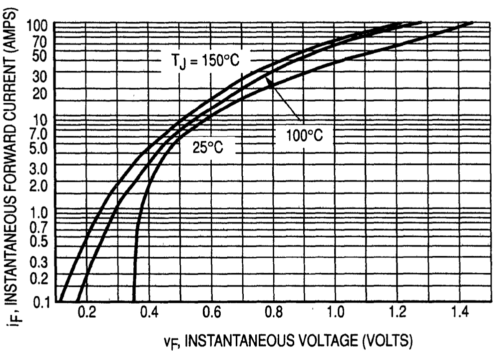


Figure 2. Typical Forward Voltage

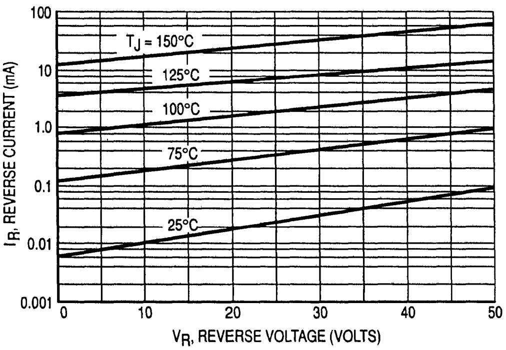


Figure 3. Maximum Reverse Current

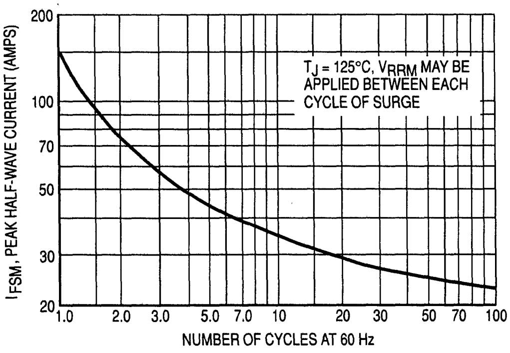


Figure 4. Maximum Surge Capability

TEST CONDITIONS FOR ISOLATION TESTS*

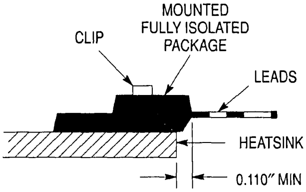


Figure 5. Clip Mounting Position for Isolation Test Number 1

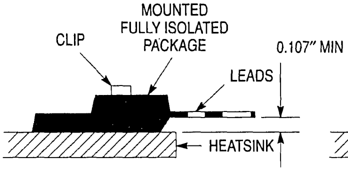


Figure 6. Clip Mounting Position for Isolation Test Number 2

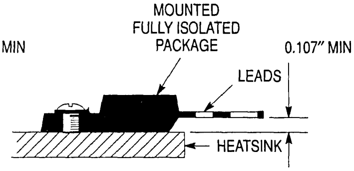
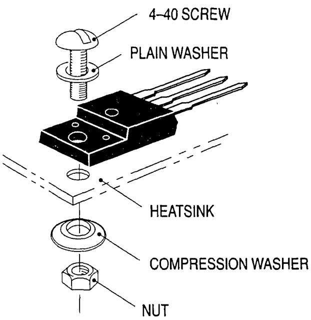


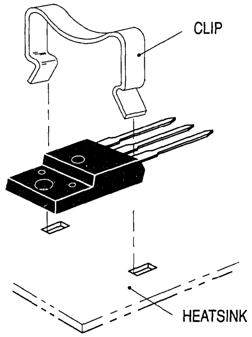
Figure 7. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



8a. Screw–Mounted



8b. Clip–Mounted

Figure 8. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

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SWITCHMODE™ Schottky Power Rectifiers

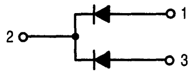
MBRF2060CT

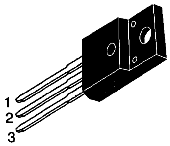
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS 20 AMPERES 60 VOLTS

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- Matched Dual Die Construction
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, V_O at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)





CASE 221D–02 ISOLATED TO–220

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2060

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	Volts
Average Rectified Forward Current (Rated V_R), T_C = 133°C Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 133°C	I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	0.5	Amp
Operating Junction and Storage Temperature	T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/µs
RMS Isolation Voltage (t = 1.0 second, R.H. ≤ 30%, T_A = 25°C)(2) Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.0	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3)	v_F		Volts
(i_F = 10 Amp, T_C = 25°C)		0.85	
(i_F = 10 Amp, T_C = 125°C)		0.75	
(i_F = 20 Amp, T_C = 25°C)		0.95	
(i_F = 20 Amp, T_C = 125°C)		0.85	
Maximum Instantaneous Reverse Current (3)	i_R		mA
(Rated DC Voltage, T_C = 25°C)		0.15	
(Rated DC Voltage, T_C = 125°C)		150	

(3)Pulse Test: Pulse Width = 300 µs, Duty Cycle ≥ 2.0%

3

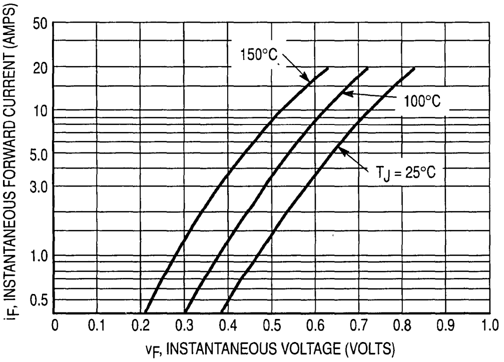


Figure 1. Typical Forward Voltage Per Diode

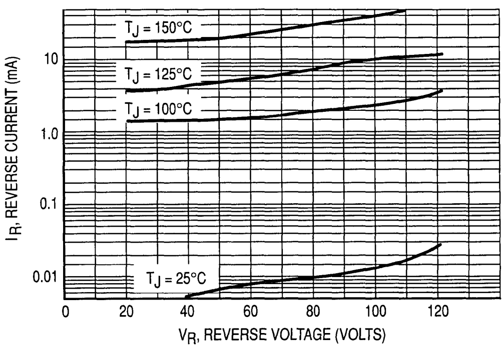


Figure 2. Typical Reverse Current Per Diode

3

TEST CONDITIONS FOR ISOLATION TESTS*

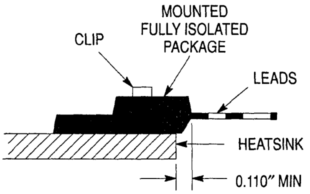


Figure 3. Clip Mounting Position for Isolation Test Number 1

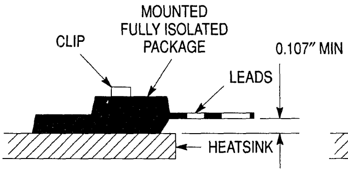


Figure 4. Clip Mounting Position for Isolation Test Number 2

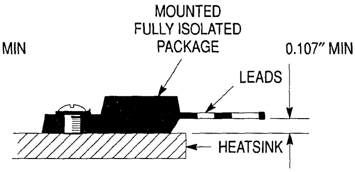
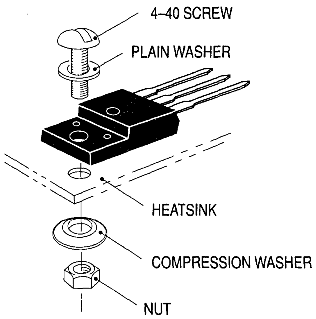


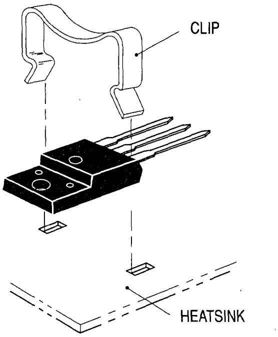
Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



6a. Screw–Mounted



6b. Clip–Mounted

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

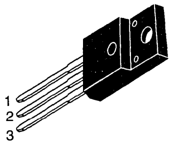
**For more information about mounting power semiconductors see Application Note AN1040

SWITCHMODE™ Schottky Power Rectifiers

MBRF20100CT

Motorola Preferred Device

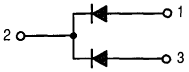
**SCHOTTKY BARRIER RECTIFIERS
20 AMPERES
100 VOLTS**



**CASE 221D–02
ISOLATED TO–220**

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- Matched Dual Die Construction
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, V_O at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)



Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B20100

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current (Rated V_R), T_C = 133°C	Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 133°C		I_{FRM}	20	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)		I_{RRM}	0.5	Amp
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/µs
RMS Isolation Voltage (t = 1.0 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Thermal Resistance — Junction to Case	$R_{\theta JC}$	3.5	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3) (i_F = 10 Amp, T_C = 25°C) (i_F = 10 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C)	v_F	 0.85 0.75 0.95 0.85	Volts
Maximum Instantaneous Reverse Current (3) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 125°C)	i_R	 0.15 150	mA

(3) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≥ 2%.

3

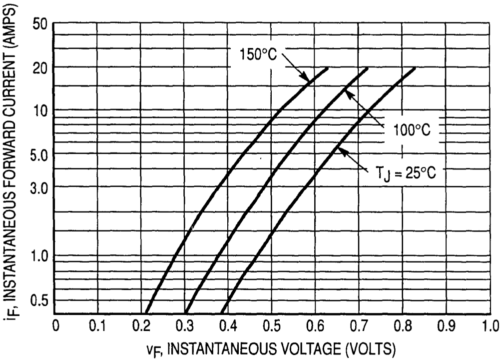


Figure 1. Typical Forward Voltage Per Diode

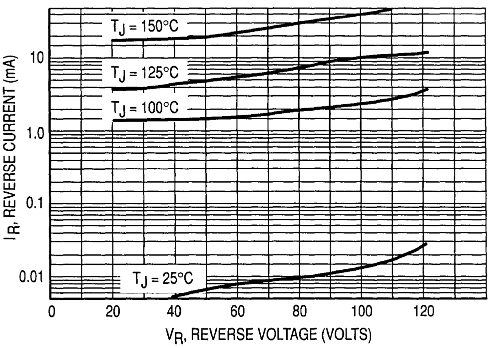


Figure 2. Typical Reverse Current Per Diode

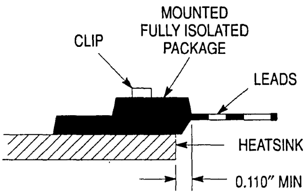


Figure 3. Clip Mounting Position for Isolation Test Number 1

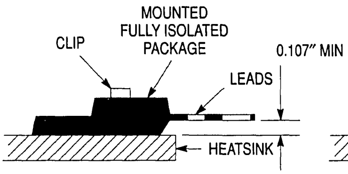


Figure 4. Clip Mounting Position for Isolation Test Number 2

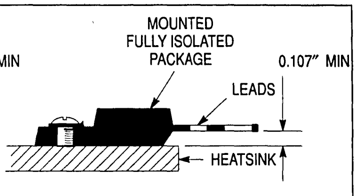
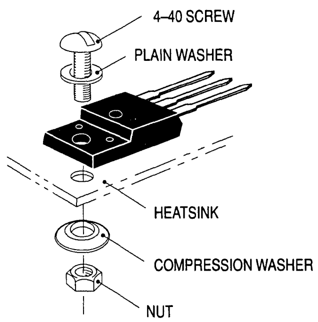


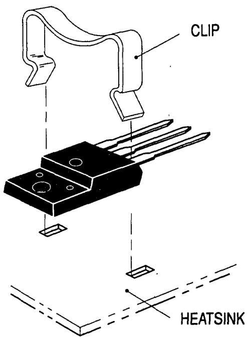
Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



6a. Screw–Mounted



6b. Clip–Mounted

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

SWITCHMODE™ Schottky Power Rectifiers

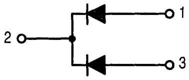
MBRF20200CT

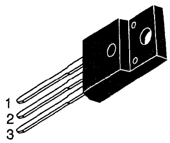
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER 20 AMPERES 150 and 200 VOLTS

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- Matched Dual Die Construction
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, V_O at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369





CASE 221D–02
ISOLATED TO–220

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B20200

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	Per Leg Per Package	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 90°C		I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)		I_{RRM}	1.0	Amp
Operating Junction Temperature and Storage Temperature		T_J, T_{stg}	–65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10,000	V/µs

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Case	$R_{\theta JC}$	3.5	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 25°C) (i_F = 10 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C)	v_F	 0.9 0.8 1.0 0.9	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	i_R	 1.0 50	mA

DYNAMIC CHARACTERISTICS, PER LEG

Capacitance (V_R = −5.0 V, T_C = 25°C, Freq. = 1.0 MHz)	C_T	500	pF

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%

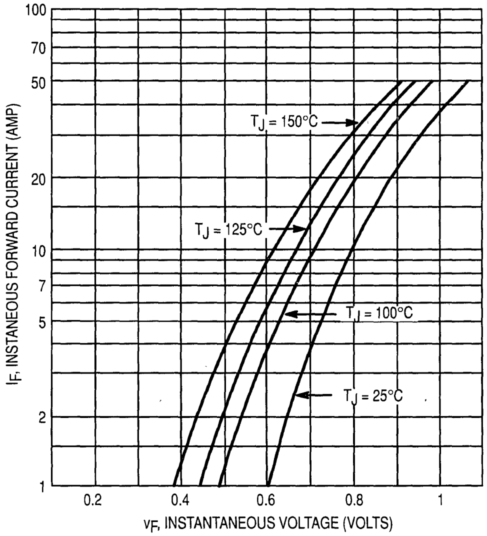


Figure 1. Typical Forward Voltage (Per Leg)

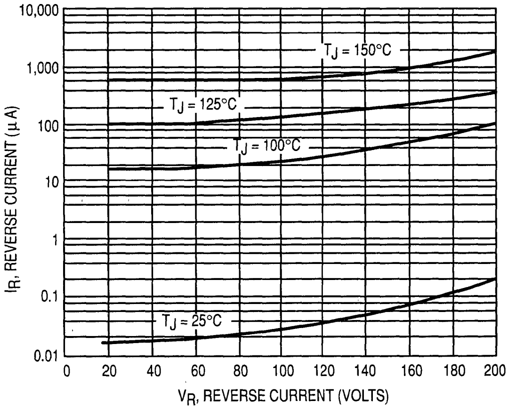


Figure 2. Typical Reverse Current (Per Leg)

3

TEST CONDITIONS FOR ISOLATION TESTS*

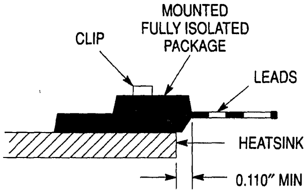


Figure 3. Screw or Clip Mounting Position for Isolation Test Number 1

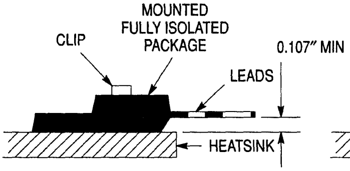


Figure 4. Clip Mounting Position for Isolation Test Number 2

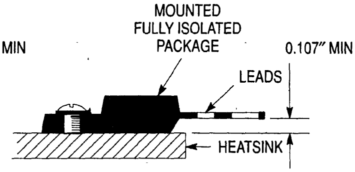


Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**

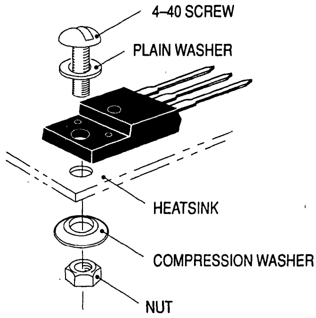


Figure 6a. Screw–Mounted

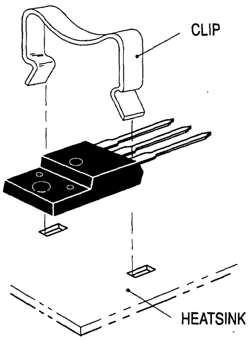


Figure 6b. Clip–Mounted

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

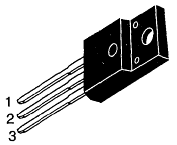
MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

SWITCHMODE™ Schottky Power Rectifiers

MBRF2545CT

Motorola Preferred Device

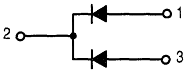
SCHOTTKY BARRIER RECTIFIERS 25 AMPERES 45 VOLTS



CASE 221D–02
ISOLATED TO–220

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- Matched Dual Die Construction
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, V_O at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)



Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B2545

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R), T_C = 125°C	 Total Device	$I_{F(AV)}$	12.5 25	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 125°C		I_{FRM}	25	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)		I_{RRM}	1.0	Amp
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/µs
RMS Isolation Voltage (t = 1.0 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{θJC}$	3.5	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) UL recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

3

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic		Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3)	(i_F = 12.5 Amps, T_C = 25°C) (i_F = 12.5 Amps, T_C = 125°C)	v_F	0.7 0.62	Volts
Maximum Instantaneous Reverse Current (3)	(Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 125°C)	i_R	0.2 40	mA

(3) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤2.0%.

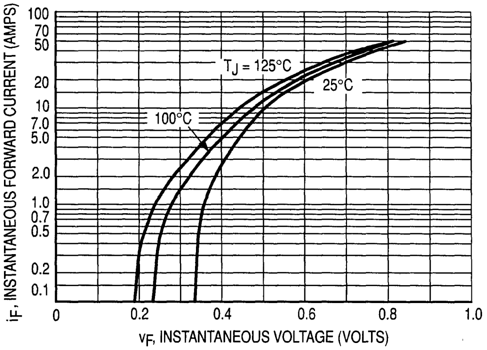


Figure 1. Typical Forward Voltage, Per Leg

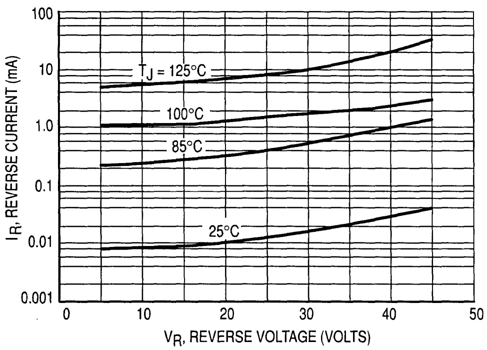


Figure 2. Typical Reverse Current, Per Leg

TEST CONDITIONS FOR ISOLATION TESTS*

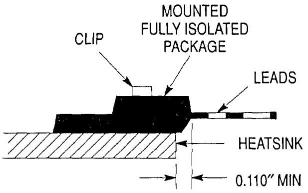


Figure 3. Clip Mounting Position for Isolation Test Number 1

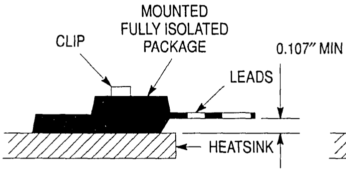


Figure 4. Clip Mounting Position for Isolation Test Number 2

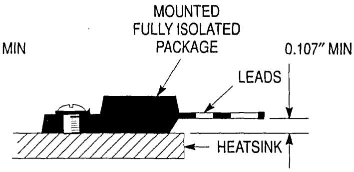
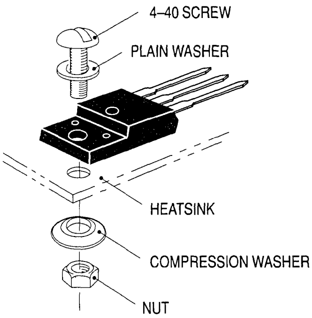


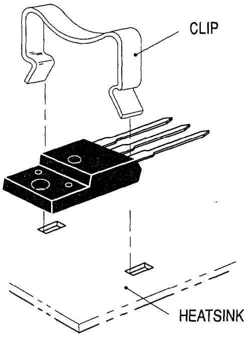
Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



6a. Screw–Mounted



6b. Clip–Mounted

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

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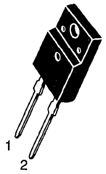
SWITCHMODE™ Schottky Power Rectifiers

MBRF745

Motorola Preferred Device

**SCHOTTKY BARRIER RECTIFIERS
7.5 AMPERES
45 VOLTS**



**CASE 221E–01
ISOLATED TO–220**

3

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, VO at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B745

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R), T_C = 105°C		$I_{F(AV)}$	7.5	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 105°C		I_{FRM}	15	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)		I_{RRM}	1.0	Amp
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/µs
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.2	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3)	v_F		Volts
(i_F = 15 Amp, T_C = 25°C)		0.84	
(i_F = 15 Amp, T_C = 125°C)		0.72	
(i_F = 7.5 Amp, T_C = 125°C)		0.57	
Maximum Instantaneous Reverse Current (3)	i_R		mA
(Rated DC Voltage, T_C = 25°C)		0.1	
(Rated DC Voltage, T_C = 125°C)		15	

(3) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%.

3

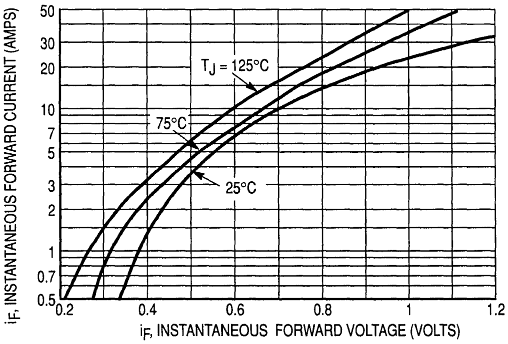


Figure 1. Typical Forward Voltage

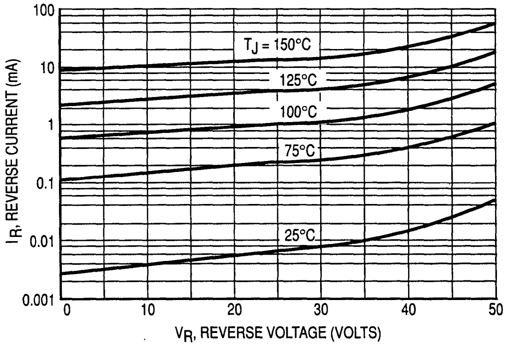


Figure 2. Typical Reverse Current

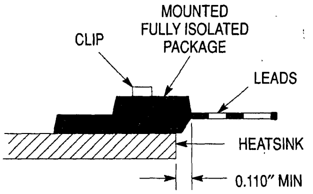


Figure 3. Clip Mounting Position for Isolation Test Number 1

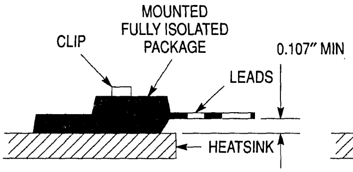


Figure 4. Clip Mounting Position for Isolation Test Number 2

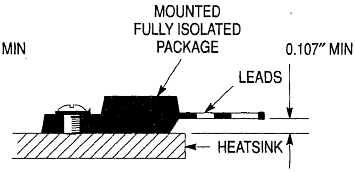
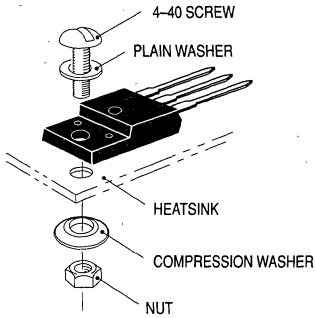


Figure 5. Screw Mounting Position for Isolation Test Number 3

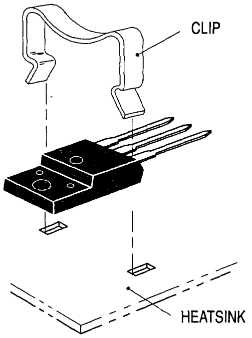
* Measurement made between leads and heatsink with all leads shorted together.

3

MOUNTING INFORMATION**



6a. Screw–Mounted



6b. Clip–Mounted

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

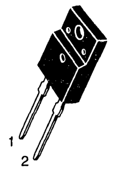
**For more information about mounting power semiconductors see Application Note AN1040.

SWITCHMODE™ Schottky Power Rectifiers

MBRF1045

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
10 AMPERES
45 VOLTS



CASE 221E–01
ISOLATED TO–220

The SWITCHMODE Power Rectifier employs the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use as rectifiers in very low–voltage, high–frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, VO at 1/8″
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: B1045

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R), T_C = 135°C		$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 135°C		I_{FRM}	20	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) Figure 6		I_{RRM}	1.0	Amp
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/μs
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 8 Per Figure 9(1) Per Figure 10	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.0	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 9.
(2) Proper strike and creepage distance must be provided.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3) (i_F = 20 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 125°C)	v_F	 0.84 0.72 0.57	Volts
Maximum Instantaneous Reverse Current (3) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 125°C)	i_R	 0.1 15	mA

(3) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

3

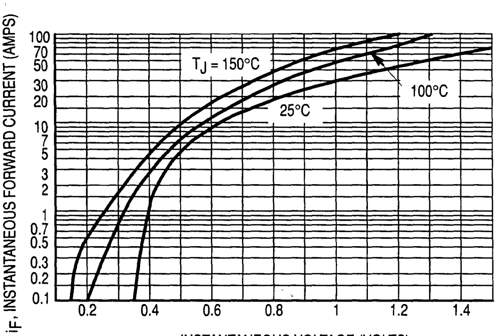


Figure 1. Maximum Forward Voltage

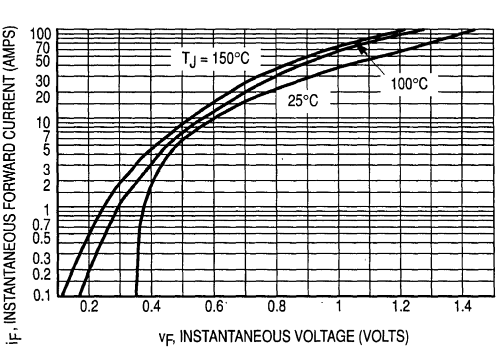


Figure 2. Typical Forward Voltage

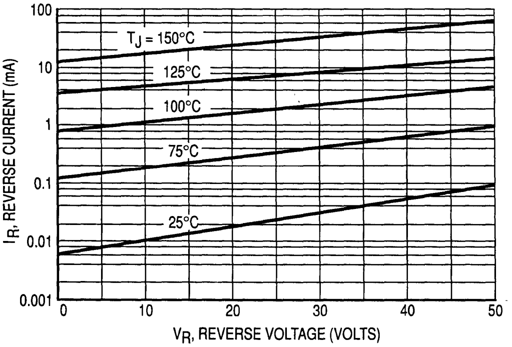


Figure 3. Maximum Reverse Current

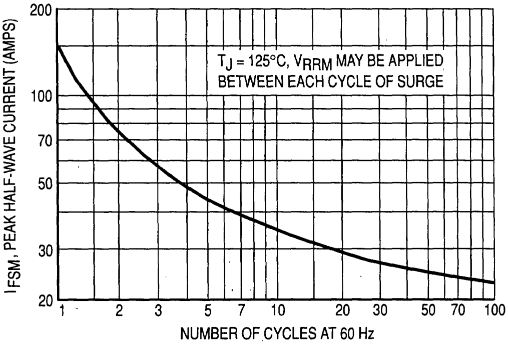


Figure 4. Maximum Surge Capability

HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 5.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

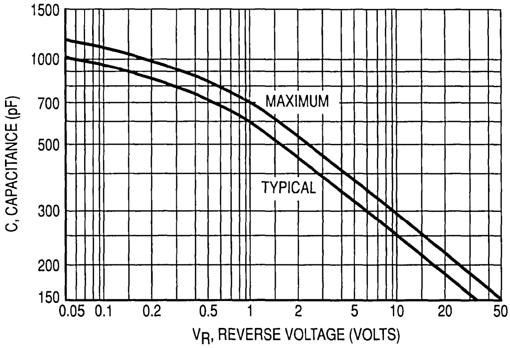


Figure 5. Capacitance

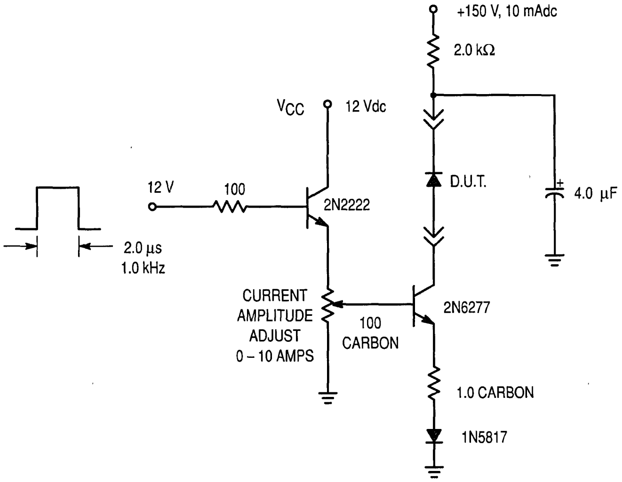


Figure 6. Test Circuit for dv/dt and Reverse Surge Current

3

3

TEST CONDITIONS FOR ISOLATION TESTS*

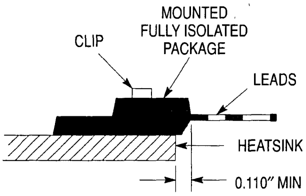


Figure 7. Clip Mounting Position for Isolation Test Number 1

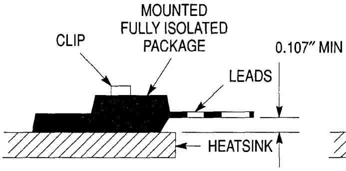


Figure 8. Clip Mounting Position for Isolation Test Number 2

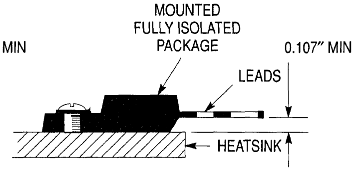
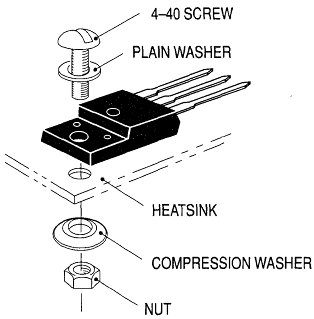


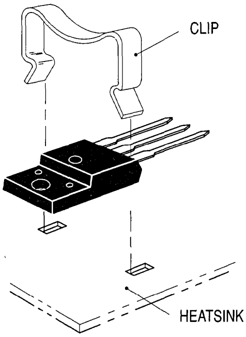
Figure 9. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



10a. Screw–Mounted



10b. Clip–Mounted

Figure 10. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3035PT
MBR3045PT

MBR3045PT is a Motorola Preferred Device

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — Terminals 1 and 3 May Be Connected For Parallel Operation At Full Rating
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

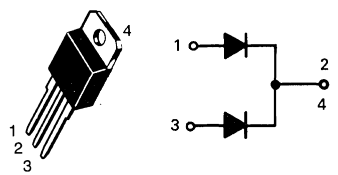
Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B3035, B3045

SCHOTTKY BARRIER RECTIFIERS

30 AMPERES
35 to 45 VOLTS

3



CASE 340D-01

RATINGS

Rating		Symbol	Maximum	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR3035PT MBR3045PT	V_{RRM} V_{RWM} V_R	35 45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C	Per Device Per Diode	$I_{F(AV)}$	30 15	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)		I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge Applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	200	Amps
Peak Repetitive Reverse Current, Per Diode (2.0 μs, 1.0 kHz) See Figure 6		I_{RRM}	2.0	Amps
Operating Junction Temperature		T_J	-65 to +150	°C
Storage Temperature		T_{stg}	-65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)		$T_{J(pk)}$	175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	40	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) (i_F = 20 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 0.60 0.72 0.76	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 100 1.0	mA

(1) Pulse Test Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 2

3

FIGURE 1 — TYPICAL FORWARD VOLTAGE

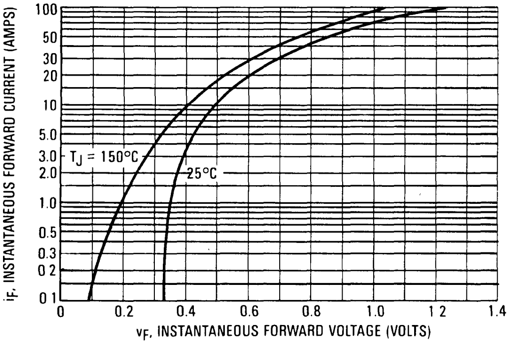


FIGURE 2 — TYPICAL REVERSE CURRENT

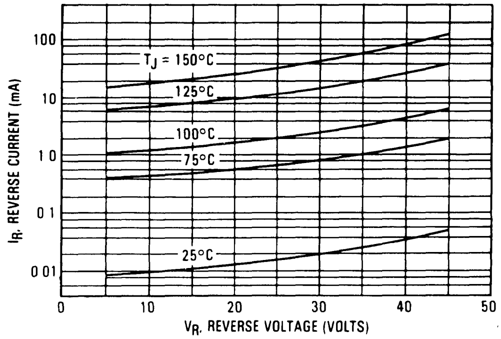


FIGURE 3 — CURRENT DERATING PER LEG

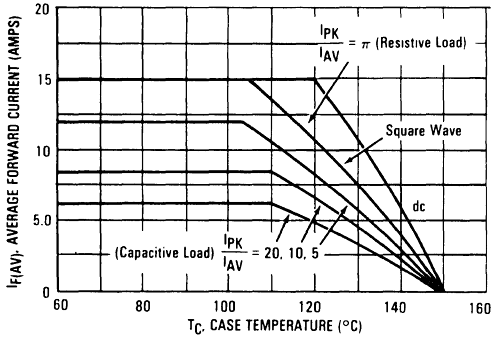


FIGURE 4 — FORWARD POWER DISSIPATION PER LEG

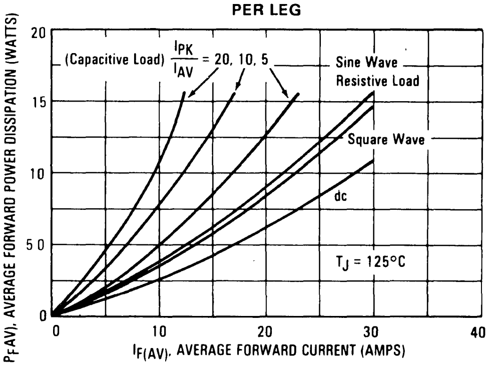


FIGURE 5 — CAPACITANCE

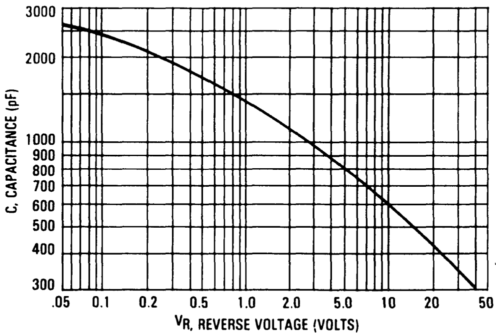
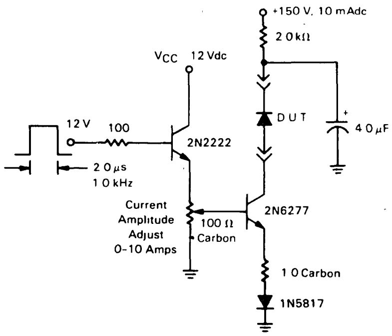


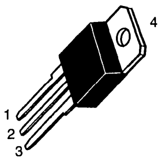
FIGURE 6 — TEST CIRCUIT FOR REPETITIVE REVERSE CURRENT



SWITCHMODE Power Rectifier

MBR4045PT

**SCHOTTKY BARRIER RECTIFIER
40 AMPERES
45 VOLTS**



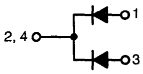
CASE 340D-01

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B4045



MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C — Total Device	$I_{F(AV)}$	20 40	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	40	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_C = 25°C) (i_F = 20 Amps, T_C = 125°C) (i_F = 40 Amps, T_C = 25°C) (i_F = 40 Amps, T_C = 125°C)	v_F	 0.70 0.60 0.80 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 2

3

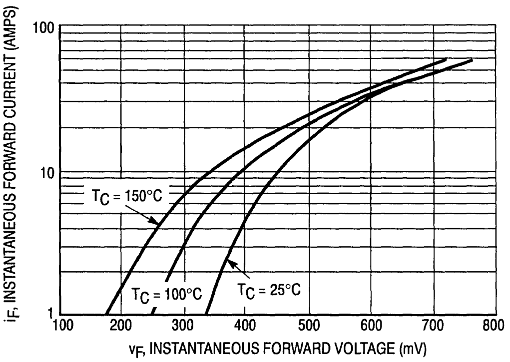


Figure 1. Typical Forward Voltage

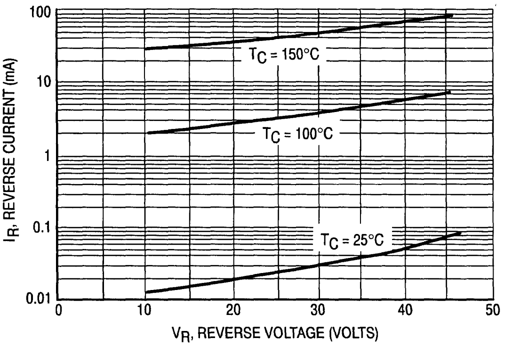


Figure 2. Typical Reverse Current

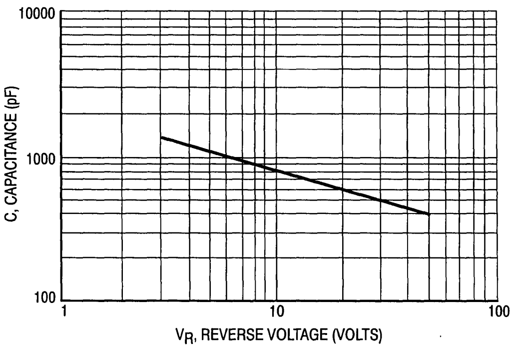


Figure 3. Typical Capacitance Per Leg

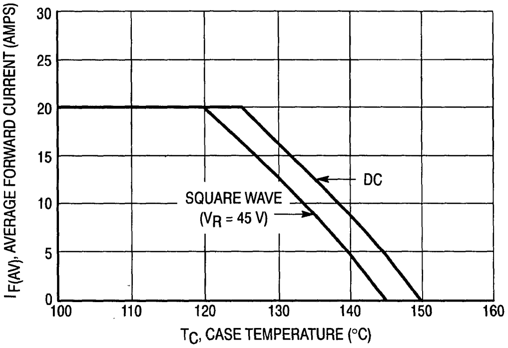


Figure 4. Current Derating Per Leg

SWITCHMODE Power Rectifier

MBR6045PT

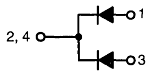
**SCHOTTKY BARRIER RECTIFIER
60 AMPERES
45 VOLTS**

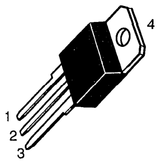
The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B6045





CASE 340D-01

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C Total Device	$I_{F(AV)}$	30 60	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	60	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	500	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Instantaneous Forward Voltage (1) (i_F = 30 Amps, T_C = 25°C) (i_F = 30 Amps, T_C = 125°C) (i_F = 60 Amps, T_C = 25°C)	v_F	 0.62 0.55 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 2

3

3

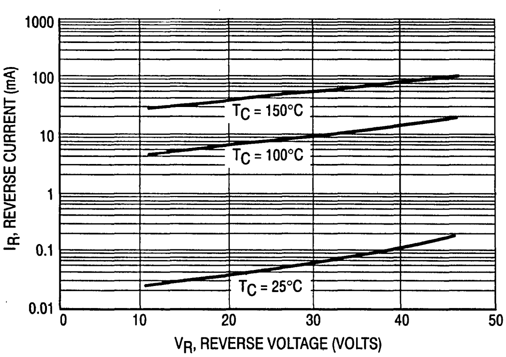


Figure 1. Typical Reverse Current

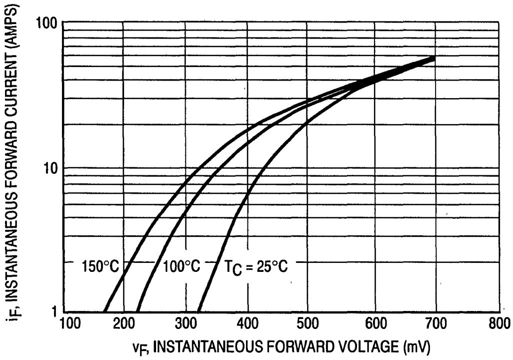


Figure 2. Typical Forward Voltage

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

SWITCHMODE Power Rectifier

MBR5025L

Motorola Preferred Device

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

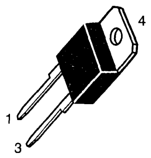
- Very Low Forward Voltage Drop (Max 0.58 V @ 100°C)
- Guardring for Stress Protection and High dv/dt Capability (10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature
- Specially Designed for SWITCHMODE Power Supplies with Operating Frequency up to 300 kHz

SCHOTTKY BARRIER RECTIFIER
LOW v_F
50 AMPERES
25 VOLTS

3

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B5025L



CASE 340E-01

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	25	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	50	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 90°C	I_{FRM}	150	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	300	Amps
Peak Repetitive Reverse Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/µs

THERMAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.75	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 50 Amps, T_C = 25°C) (i_F = 50 Amps, T_C = 100°C) (i_F = 30 Amps, T_C = 25°C)	v_F	 0.62 0.58 0.54	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 0.5 60	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Preferred devices are Motorola recommended choices for future use and best overall value

Rev 1

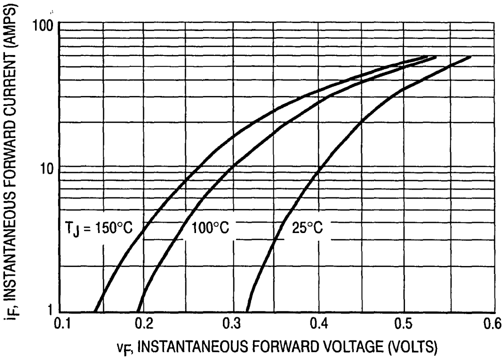


Figure 1. Typical Forward Voltage

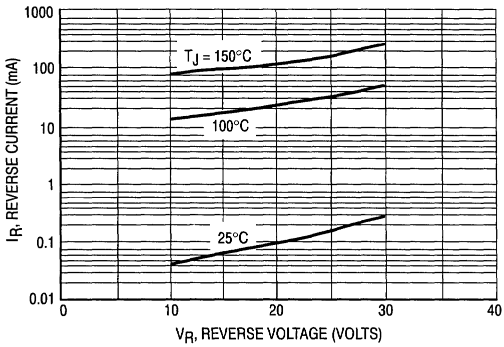


Figure 2. Typical Reverse Current

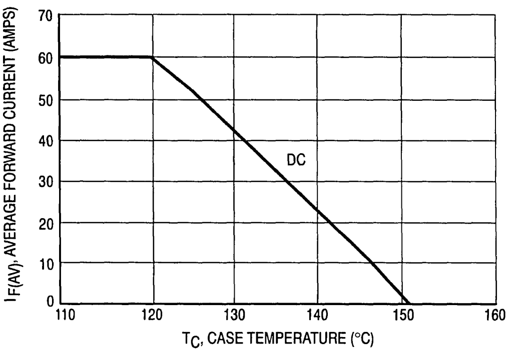


Figure 3. Current Derating, Case

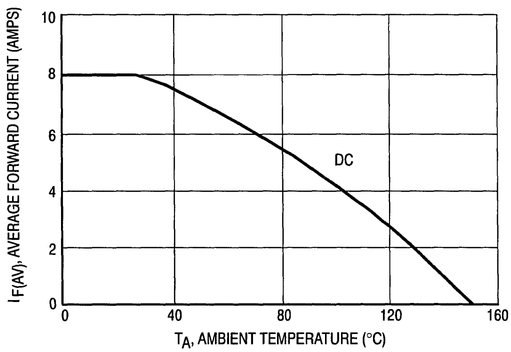


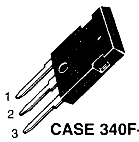
Figure 4. Current Derating, Ambient

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3035WT
MBR3045WT

MBR3045WT is a Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
30 AMPERES
35–45 VOLTS



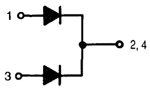
CASE 340F-03
TO-247AC

3

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — Terminals 1 and 3 May Be Connected For Parallel Operation At Full Rating
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Popular TO-247 Package



Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B3035, B3045

MAXIMUM RATINGS

Rating	Symbol	MBR 3035WT	MBR 3045WT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C — Per Device Per Diode	$I_{F(AV)}$	30 15		Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30		Amps
Nonrepetitive Peak Surge Current (Surge Applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	200		Amps
Peak Repetitive Reverse Current, Per Diode (2.0 µs, 1.0 kHz) See Figure 6	I_{RRM}	2.0		Amps
Operating Junction Temperature	T_J	−65 to +150		°C
Storage Temperature	T_{stg}	−65 to +175		°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000		V/µs

THERMAL CHARACTERISTICS (Per Diode)

Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.4 40	°C/W

ELECTRICAL CHARACTERISTICS (Per Diode)

Instantaneous Forward Voltage (1) (i_F = 20 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 0.6 0.72 0.76	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 100 1.0	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Rev 1

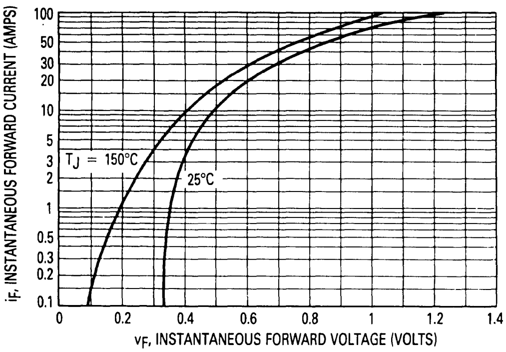


Figure 1. Typical Forward Voltage

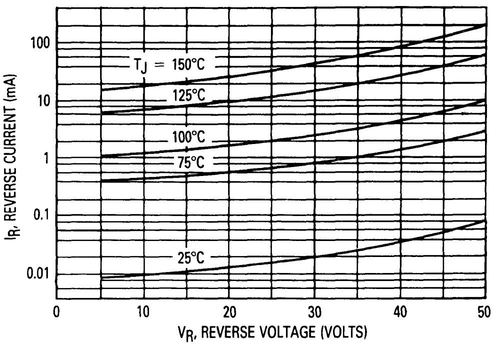


Figure 2. Typical Reverse Current

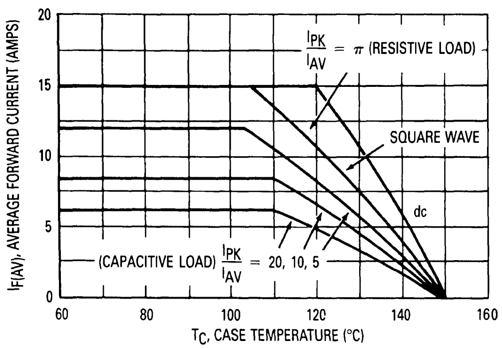


Figure 3. Current Derating (Per Leg)

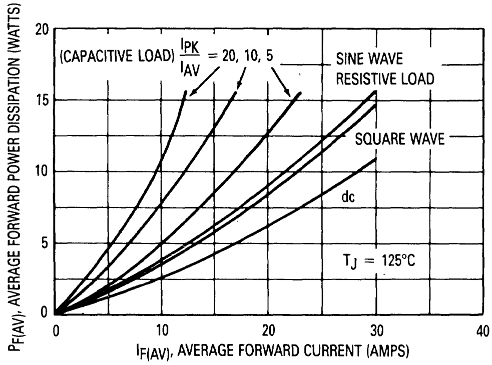


Figure 4. Forward Power Dissipation (Per Leg)

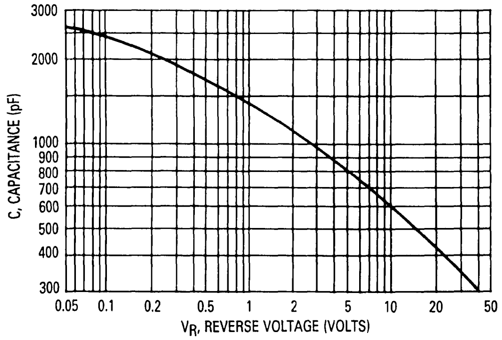


Figure 5. Capacitance

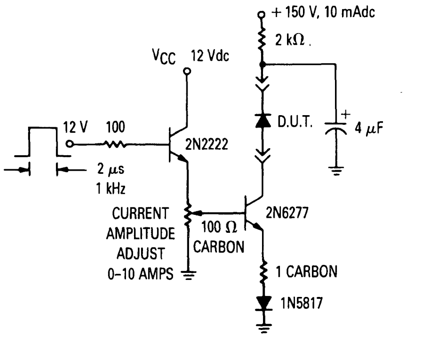


Figure 6. Test Circuit For Repetitive Reverse Current

MBR4015LWT
Motorola Preferred Device

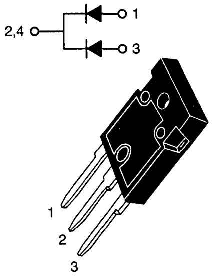
Advance Information

SWITCHMODE™ Power Rectifier

. . . using the Schottky Barrier principle this state–of–the–art device is dedicated to the ORing function in paralleling power supply and has the following features:

- Dual Diode Construction — Terminals 1 and 3 May Be Connected for Parallel Operation at Full Rating
- 15 Volt Blocking Voltage
- Very Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

SCHOTTKY BARRIER RECTIFIER 40 AMPERES 15 VOLTS



CASE 340F–03 TO–247AC

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 Units Per Plastic Tube
- Marking: B4015L

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	15	Volt
Average Rectified Forward Current — Per Diode (Rated V_R) @ T_C = 125°C — Per Device	$I_{F(AV)}$	20 40	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	40	Amp
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	Amp
Peak Repetitive Reverse Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +150	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	150	°C
Voltage Rate of Change	dv/dt	10000	V/µs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.4 40	°C/W

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Instantaneous Forward Voltage (1)	V_F		Volts
@ I_F = 20 Amps, T_C = 25°C		0.42	
@ I_F = 20 Amps, T_C = 125°C		0.33	
@ I_F = 40 Amps, T_C = 25°C		0.50	
@ I_F = 40 Amps, T_C = 125°C		0.42	
Instantaneous Reverse Current (1)	I_R		mA
@ Rated DC Voltage, T_C = 25°C		5.0	
@ Rated DC Voltage, T_C = 75°C		150	

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle < 2.0%

SWITCHMODE
Schottky Power Rectifier

MBR4045WT

Motorola Preferred Device

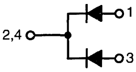
**SCHOTTKY BARRIER RECTIFIER
40 AMPERES
45 VOLTS**

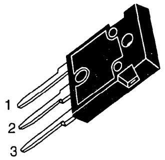
The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B4045





**CASE 340F-03
TO-247AC**

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C	 Total Device	$I_{F(AV)}$	20 40	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C		I_{FRM}	40	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	400	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)		I_{RRM}	2.0	Amp
Operating Junction Temperature		T_J	−65 to +150	°C
Storage Temperature		T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)		$T_{J(pk)}$	175	°C
Voltage Rate of Change		dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_C = 25°C) (i_F = 20 Amps, T_C = 125°C) (i_F = 40 Amps, T_C = 25°C) (i_F = 40 Amps, T_C = 125°C)	v_F	 0.70 0.60 0.80 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

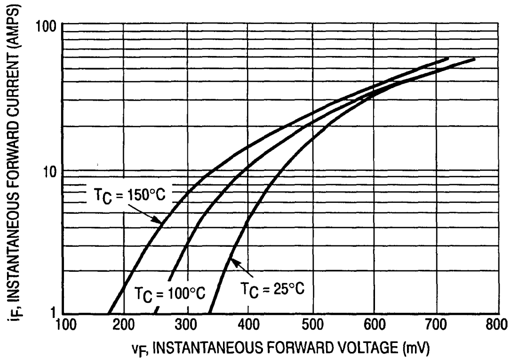


Figure 1. Typical Forward Voltage

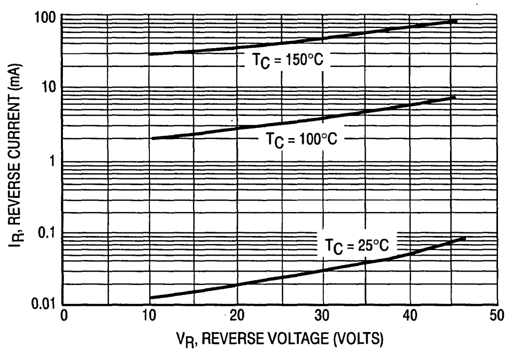


Figure 2. Typical Reverse Current

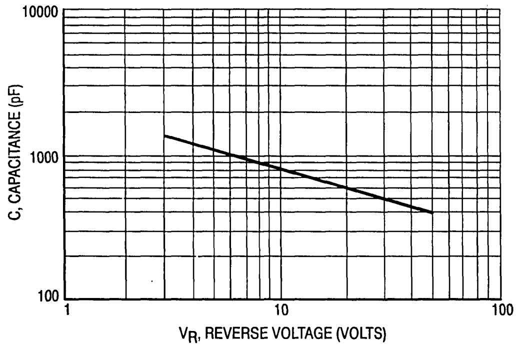


Figure 3. Typical Capacitance Per Leg

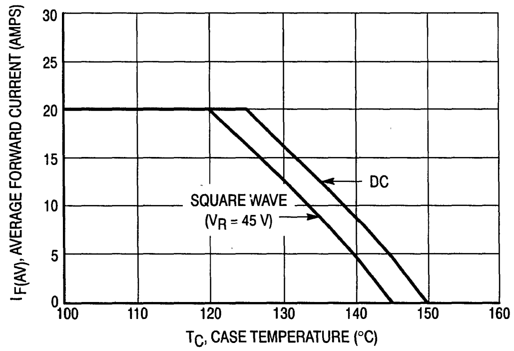


Figure 4. Current Derating Per Leg

SWITCHMODE Power Rectifier

MBR6045WT

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

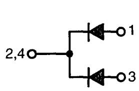
- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

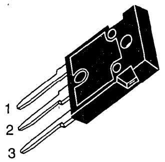
SCHOTTKY BARRIER RECTIFIER
60 AMPERES
45 VOLTS

3

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: B6045





CASE 340F-03
TO-247AC

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C Total Device	$I_{F(AV)}$	30 60	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	60	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	500	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Instantaneous Forward Voltage (1) (i_F = 30 Amps, T_C = 25°C) (i_F = 30 Amps, T_C = 125°C) (i_F = 60 Amps, T_C = 25°C)	v_F	 0.62 0.55 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

(1) Pulse Test. Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 2

3

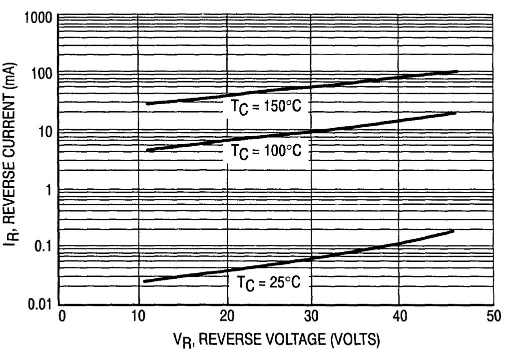


Figure 1. Typical Reverse Current

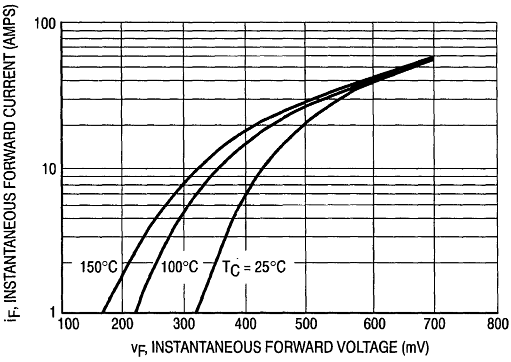


Figure 2. Typical Forward Voltage

1N5826
1N5827
1N5828

1N5826 and 1N5828 are Motorola Preferred Devices

Designer's Data Sheet

Power Rectifiers

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

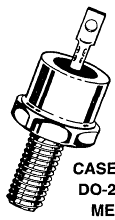
- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- High Surge Capacity

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 45.6 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 15 lb-in max
- Shipped 25 units per rail
- Marking: 1N5826, 1N5827, 1N5828

SCHOTTKY
BARRIER
RECTIFIERS

15 AMPERE
20,30,40 VOLTS



CASE 56-03
DO-203AA
METAL

Rating	Symbol	1N5826	1N5827	1N5828	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	Volts
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	Volts
Average Rectified Forward Current $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_C = 85°C$	I_O	← 15 →			Amp
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$, $R_{\theta JA} = 5.0°C/W$	T_A	95	90	85	°C
Non-Repetitive Peak Surge Current (surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	← 500 (for 1 cycle) →			Amp
Operating and Storage Junction Temperature Range (Reverse voltage applied)	T_J, T_{stg}	← −65 to +125 →			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.5	°C/W

*ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	1N5826	1N5827	1N5828	Unit
Maximum Instantaneous Forward Voltage (1)	v_F				Volts
(i_F = 8.0 Amp)		0.380	0.400	0.420	
(i_F = 15 Amp)		0.440	0.470	0.500	
(i_F = 47.1 Amp)		0.670	0.770	0.870	
Maximum Instantaneous Reverse Current @ rated dc Voltage (1)	i_R	10	10	10	mA
T_C = 100°C		75	75	75	

*Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

Rev 1

NOTE 1: DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.2 V_{RWM}. Proper derating may be accomplished by use of equation (1):

$$T_{A(max)} = T_{J(max)} - R_{\theta JA}\,P_{F(AV)} - R_{\theta JA}\,P_{R(AV)} \quad (1)$$

where

$T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest).

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R_{\theta JA}$ = Junction-to-ambient thermal resistance

Figures 1, 2 and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2):

$$T_R = T_{J(max)} - R_{\theta JA}\,P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA}\,P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2 and 3 as a difference in the rate of change of the slope in the vicinity of 115°C. The data of Figures 1, 2 and 3 is based upon dc conditions. For use in common rectifier circuits, Table I indicates suggested factors for an equivalent dc voltage to use for conservative design; i.e.:

$$V_{R(equiv)} = V_{in(PK)} \times F \quad (4)$$

The Factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

Example: Find $T_{A(max)}$ for 1N5828 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 10 A ($I_{F(AV)}$ = 5 A), $I_{(PK)}/I_{(AV)}$ = 20, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 5°C/W.

Step 1: Find $V_{R(equiv)}$. Read F = 0.65 from Table I ∴ $V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.18 V

Step 2: Find T_R from Figure 3. Read T_R = 121°C @ V_R = 9.18 & $R_{\theta JA}$ = 5°C/W

Step 3: Find $P_{F(AV)}$ from Figure 4.** Read $P_{F(AV)}$ = 10 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 20 & $I_{F(AV)}$ = 5 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 121-(5)(10) = 71°C

** Value given are for the 1N5828. Power is slightly lower for the other units because of their lower forward voltage.

TABLE I – VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped *†	
Load	Resistive	Capacitive*	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

*Note that $V_{R(PK)} \approx 2\,V_{in(PK)}$

*†Use line to center tap voltage for V_{in}.

FIGURE 1 – MAXIMUM REFERENCE TEMPERATURE – 1N5826

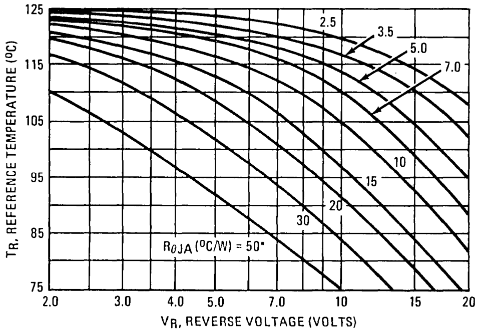


FIGURE 2 – MAXIMUM REFERENCE TEMPERATURE – 1N5827

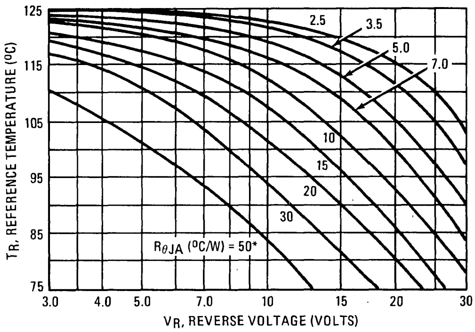


FIGURE 3 – MAXIMUM REFERENCE TEMPERATURE – 1N5828

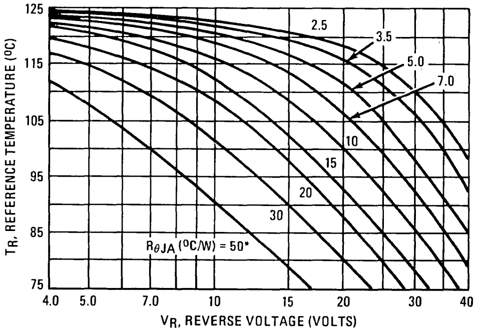
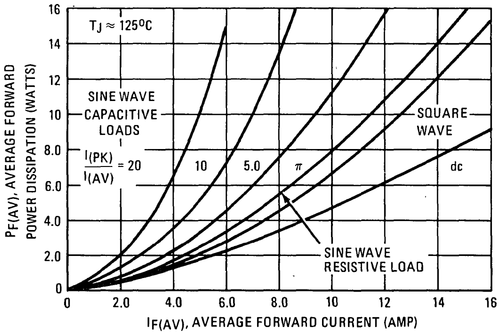


FIGURE 4 – FORWARD POWER DISSIPATION



*No external heat sink.

FIGURE 5 — TYPICAL FORWARD VOLTAGE

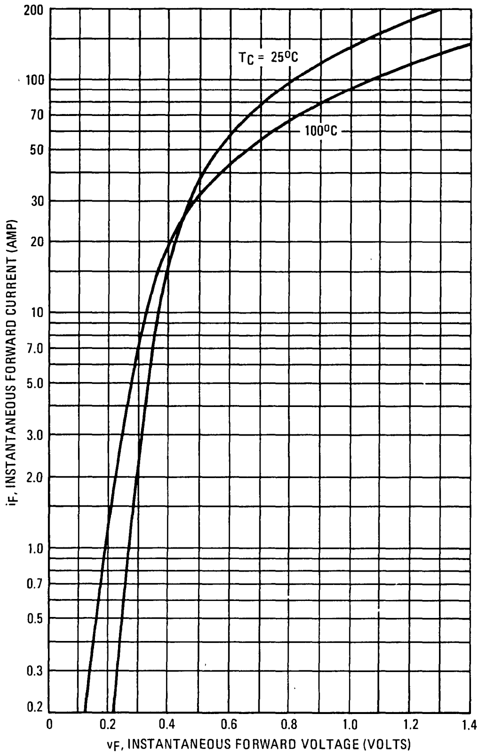


FIGURE 6 — MAXIMUM SURGE CAPABILITY

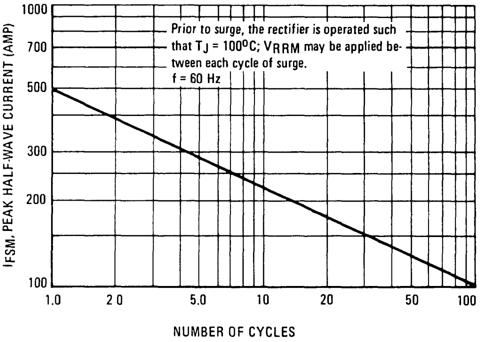


FIGURE 7 — CURRENT DERATING

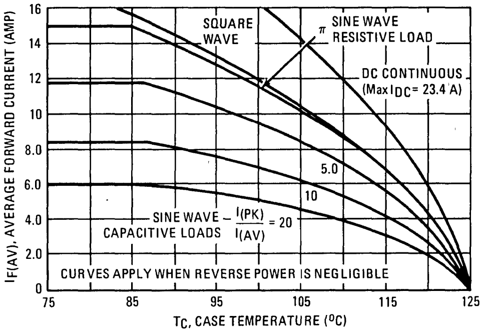


FIGURE 8 — THERMAL RESPONSE

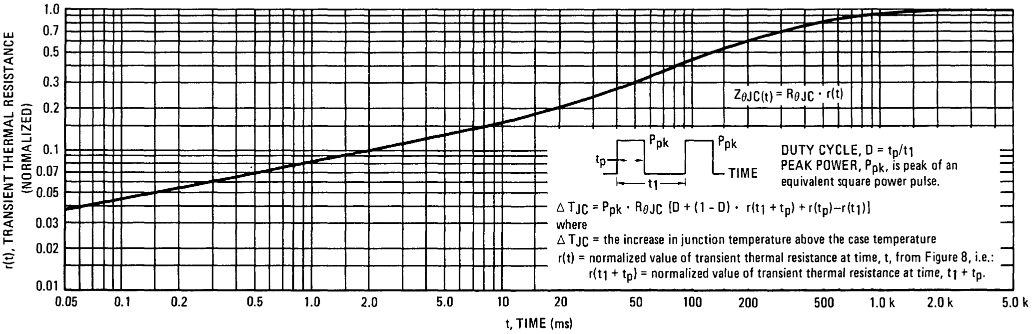


FIGURE 9 – NORMALIZED REVERSE CURRENT

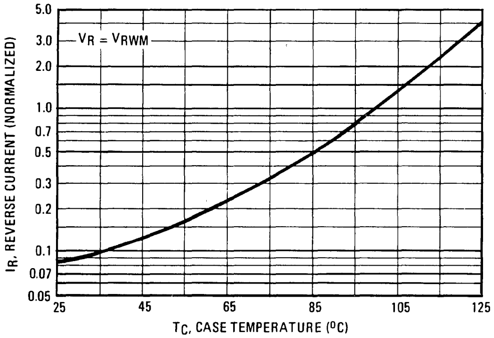


FIGURE 10 – TYPICAL REVERSE CURRENT

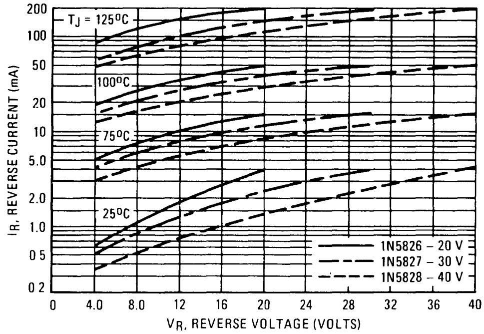
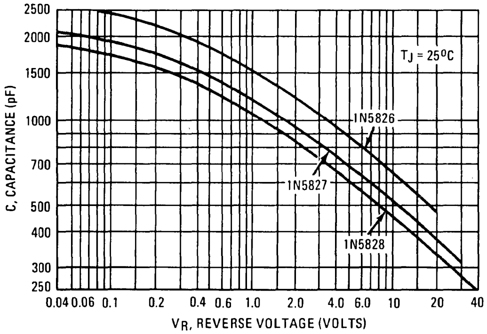


FIGURE 11 – CAPACITANCE



NOTE 2 – HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 11).

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

Designer's Data Sheet

Switchmode Power Rectifiers

... employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- High Surge Capacity

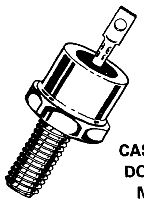
Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 45.6 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 15 lb-in max
- Shipped 25 units per rail
- Marking: 1N5829, 1N5830, 1N5831

1N5829
1N5830
1N5831

1N5831 is a
Motorola Preferred Device

25 AMPERE
20, 30, 40 VOLTS



CASE 56-03
DO-203AA
METAL

3

MAXIMUM RATINGS

Rating	Symbol	*1N5829	*1N5830	*1N5831	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	Volts
Nonrepetitive Peak Reverse Voltage	V_{RSM}	24	36	48	Volts
Average Rectified Forward Current $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_C = 85°C$	I_O		25		Amps
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$, $R_{\theta JA} = 3.5°C/W$	T_A	90	85	80	°C
Nonrepetitive Peak Surge Current (surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}		800 (for 1 cycle)		Amps
Operating and Storage Junction Temperature Range (Reverse voltage applied)	T_J, T_{stg}		−65 to +125		°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$		150		°C

THERMAL CHARACTERISTICS

Chaeracteristics	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.75	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	*1N5829	*1N5830	*1N5831	Unit
Maximum Instantaneous Forward Voltage(1) (i_F = 10 Amps) (i_F = 25 Amps) (i_F = 78.5 Amps)	v_F	0.360 0.440 0.720	0.370 0.460 0.770	0.380 0.480 0.820	Volts
Maximum Instantaneous Reverse Current @ Rated dc Voltage(1) (T_C = 100°C)		20 150	20 150	20 150	mA

*Indicates JEDEC Registered Data.
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.
Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely fromthe information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Rev 2

NOTE 1: DETERMINING MAXIMUM RATINGS

3

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.2 V_{RWM}. Proper derating may be accomplished by use of equation (1):

$$T_{A(max)} = T_{J(max)} - R_{\theta JA} P_{F(AV)} - R_{\theta JA} P_{R(AV)} \quad (1)$$

where

$T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest).

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R_{\theta JC}$ = Junction-to-ambient thermal resistance

Figures 1, 2 and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2):

$$T_R = T_{J(max)} - R_{\theta JA} P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation 91) yields:

$$T_{A(max)} = T_R - R_{\theta JA} P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2 and 3 as a difference in the rate of change of the slope in the vicinity of 115°C.

The data of Figures 1, 2 and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design; i.e.:

$$V_{R(equiv)} = V_{in(PK)} \times F \quad (4)$$

The Factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

Example: Find $T_{A(max)}$ for 1N5831 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 16 A ($I_{F(AV)}$ = 8 A), $I_{(PK)}/I_{(AV)}$ = 20, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 5°C/W.

Step 1: Find $V_{R(equiv)}$. Read F = 0.65 from Table 1
$V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.18 V

Step 2: Find T_R from Figure 3. Read T_R = 113°C @ V_R = 9.18 & $R_{\theta JA}$ = 5°C/W

Step 3: Find $P_{F(AV)}$ from Figure 4.** Read $P_{F(AV)}$ = 12.8 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 20 & $I_{F(AV)}$ = 8 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 113-(5) (12.8) = 49°C

**Value given are for the 1N5828. Power is slightly lower for the other units because of their lower forward voltage.

Table 1. Values for Factor F

Circuit Load	Half Wave		Full Wave, Bridge		Full Wave Center Tapped††	
	Resistive	Capacitive†	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

†Note that $V_{R(PK)} \approx 2 V_{in(PK)}$

††Use line to center tape voltage for V_{in}.

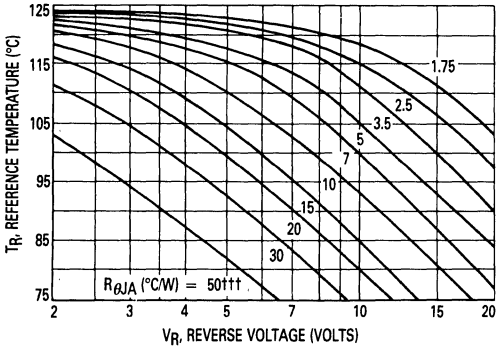


Figure 1. Maximum Reference Temperature — 1N5829

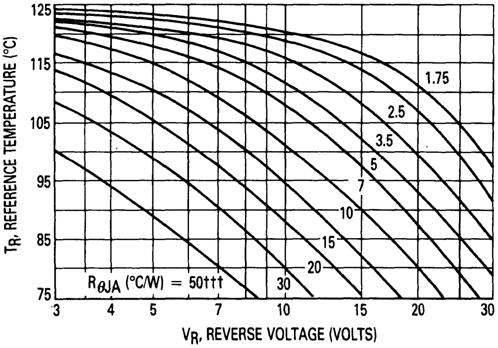
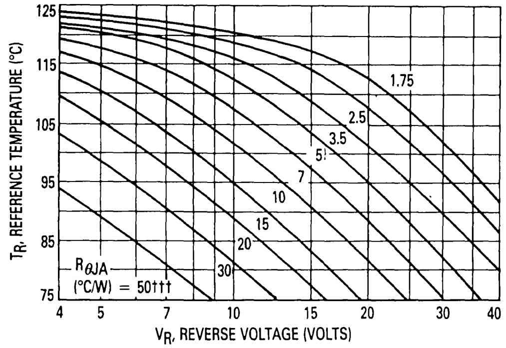


Figure 2. Maximum Reference Temperature — 1N5830

†††NO EXTERNAL HEAT SINK



†††NO EXTERNAL HEAT SINK.

Figure 3. Maximum Reference Temperature — 1N5831

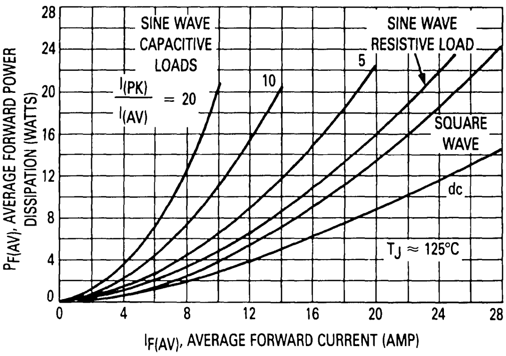


Figure 4. Forward Power Dissipation

3

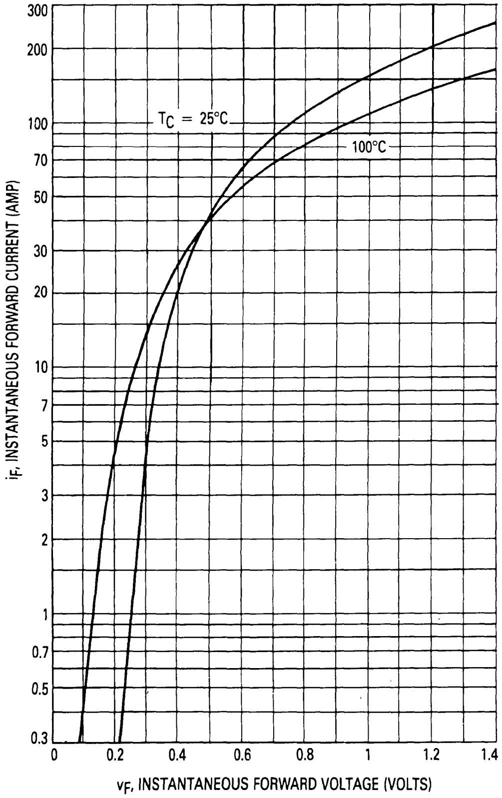


Figure 5. Typical Forward Voltage

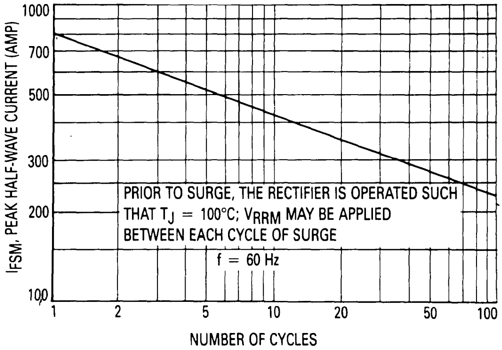


Figure 6. Maximum Surge Capability

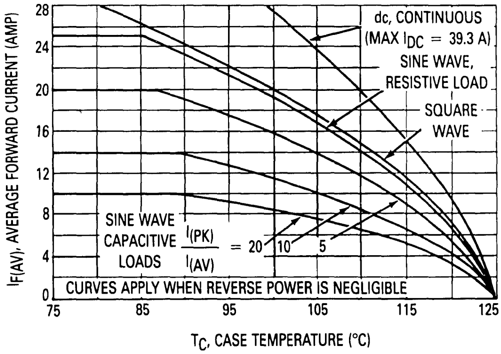


Figure 7. Current Derating

3

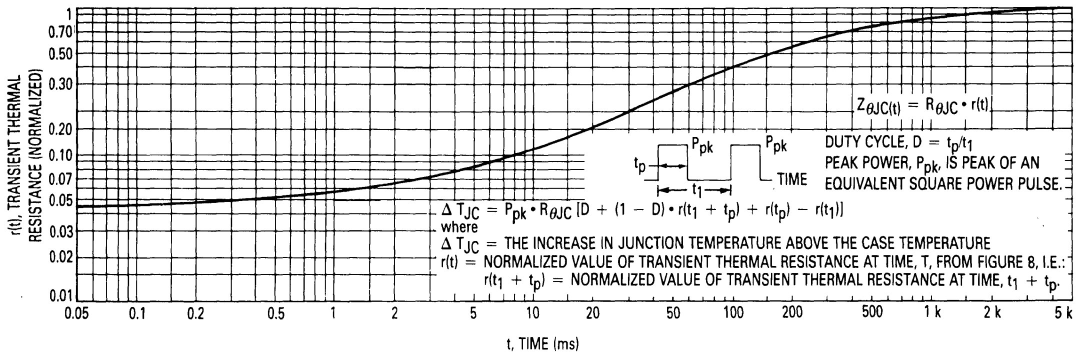


Figure 8. Thermal Response

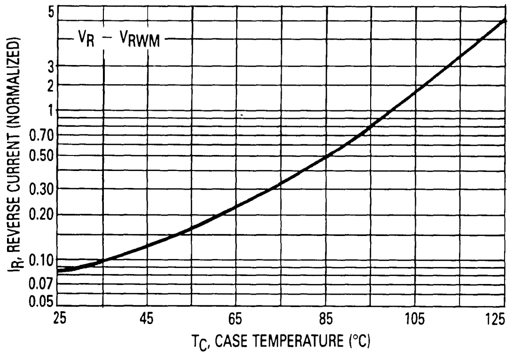


Figure 9. Normalized Reverse Current

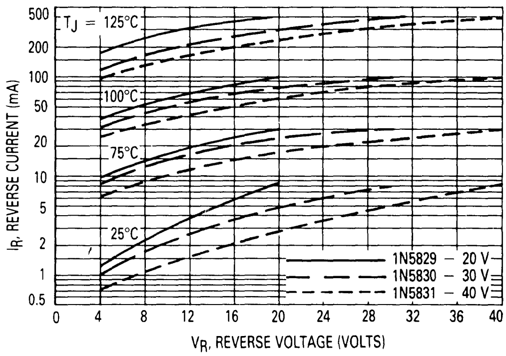


Figure 10. Typical Reverse Current

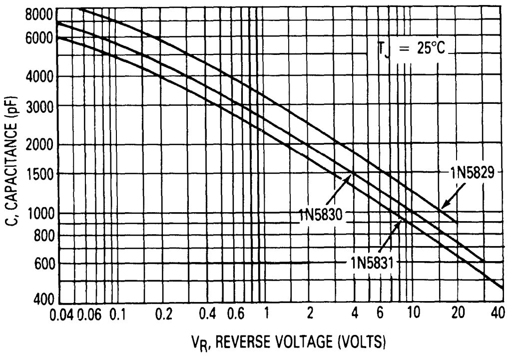


Figure 11. Capacitance

NOTE 2 — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 11.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicate of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

1N6095
1N6096
SD41

1N6096 and SD41 are
Motorola Preferred Devices

3

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

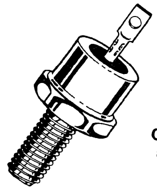
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature Capability
- Guaranteed Reverse Avalanche
- Mounting Torque: 15 in-lb max

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 45.6 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 15 lb-in max
- Shipped 25 units per rail
- Marking: 1N6095, 1N6096, SD41

SCHOTTKY BARRIER RECTIFIERS

25 and 30 AMPERES
30 to 45 VOLTS



CASE 56-03
DO-203AA
METAL

MAXIMUM RATINGS

Rating	Symbol	1N6095*	1N6096*	SD41	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	40	45 35 45	Volts
Average Rectified Forward Current (Rated V_R)	I_O	25 T_C = 70°C	25 T_C = 70°C	30 T_C = 105°C	Amps
Case Temperature (Rated V_R)	T_C	105	105	—	°C
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	400	600	Amp
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 10. (1)	I_{RRM}	2.0	2.0	2.0	Amps
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to + 125	-65 to + 125	-55 to + 150°C	°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	150	150	150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	10000	10000	V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	1N6095*	1N6096*	SD41	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	←	2.0	→	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	1N6095*	1N6096*	SD41	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 30 Amp, T_C = 125°C) (i_F = 78.5 Amp, T_C = 70°C)	v_F	 — 0.86	 — 0.86	 0.55 —	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 125°C)	i_R	250	250	125 @ V_R = 35 V	mA
Capacitance (100 kHz ≥ f ≥ 1.0 MHz)	C_t	6000 V_R = 1.0 V	6000 V_R = 1.0 V	2000 V_R = 5.0 V	pF

*Indicates JEDEC Registered Data.
(1) Not JEDEC requirement, but a Motorola product capability.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

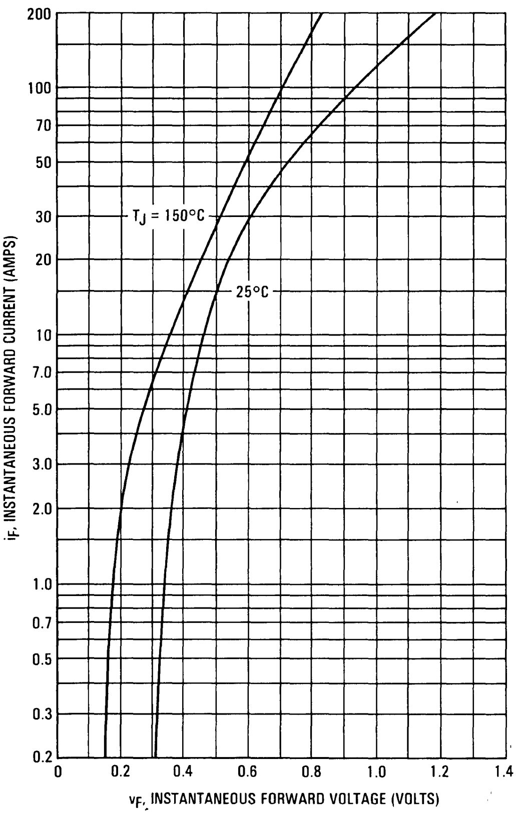


FIGURE 2 — TYPICAL REVERSE CURRENT

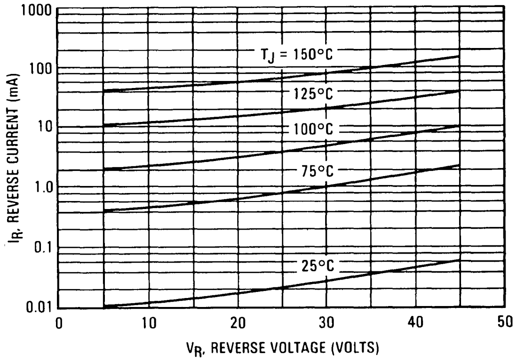


FIGURE 3 — MAXIMUM SURGE CAPABILITY

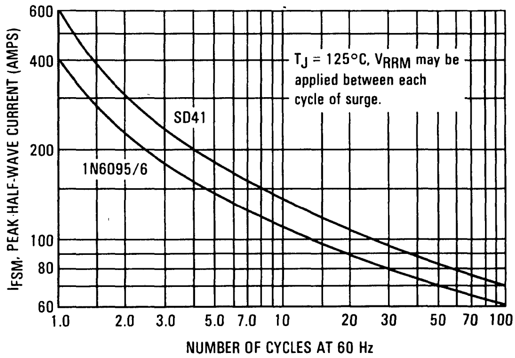
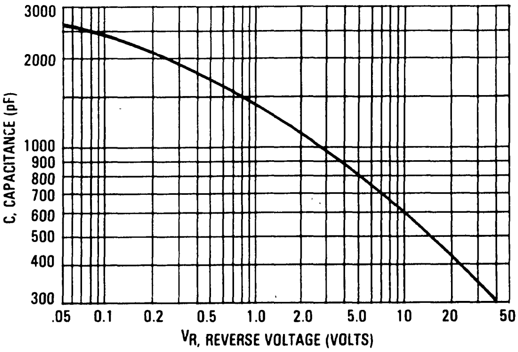


FIGURE 4 — CAPACITANCE



HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 4.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficieny is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 5 — SD41 CURRENT DERATING

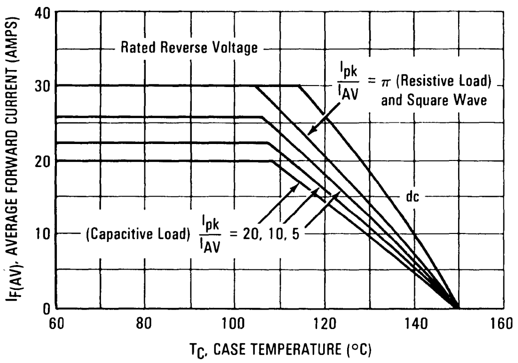


FIGURE 6 — 1N6095/6 CURRENT DERATING

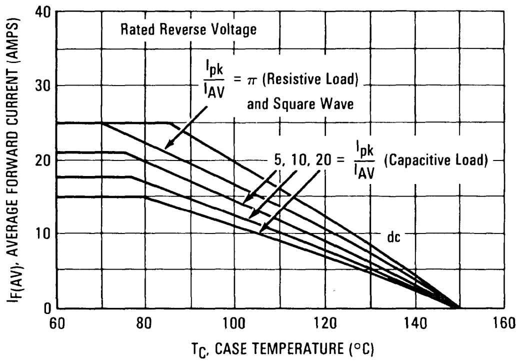


FIGURE 7 — FORWARD POWER DISSIPATION

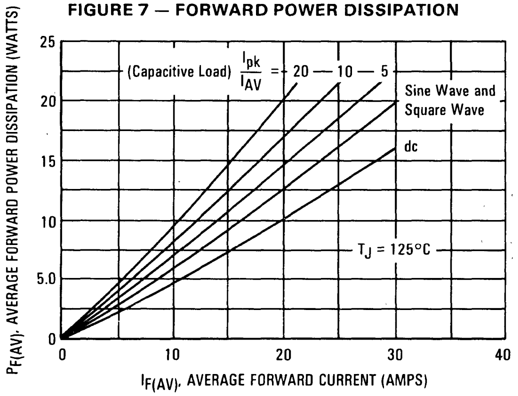


FIGURE 8 — THERMAL RESPONSE

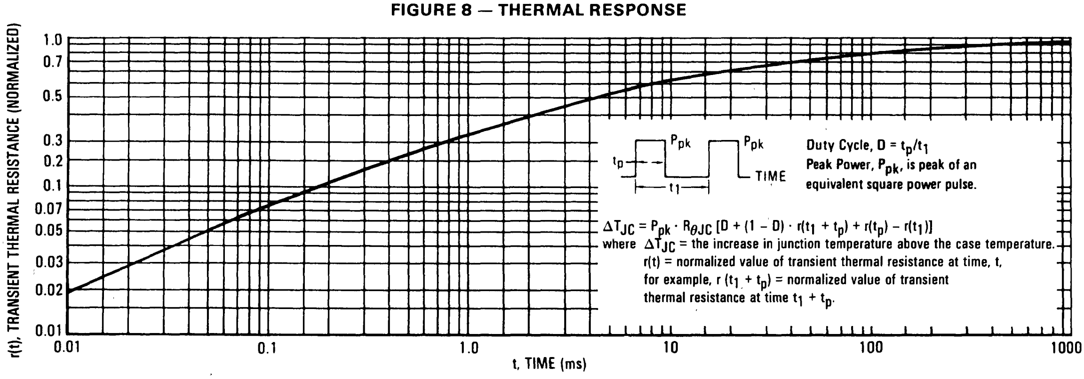
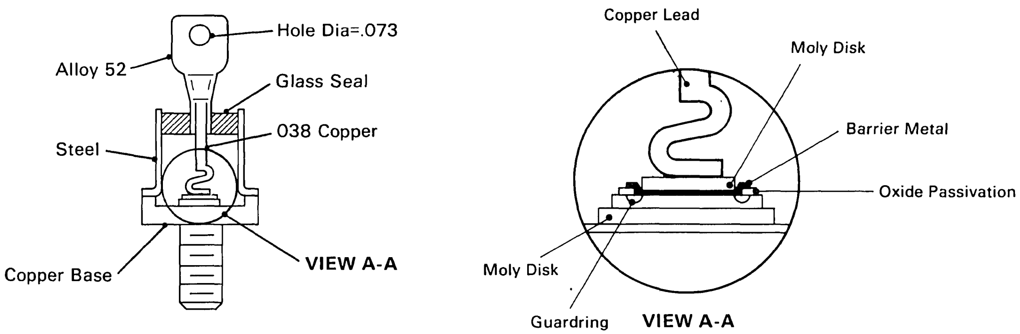


FIGURE 9 — SCHOTTKY RECTIFIER



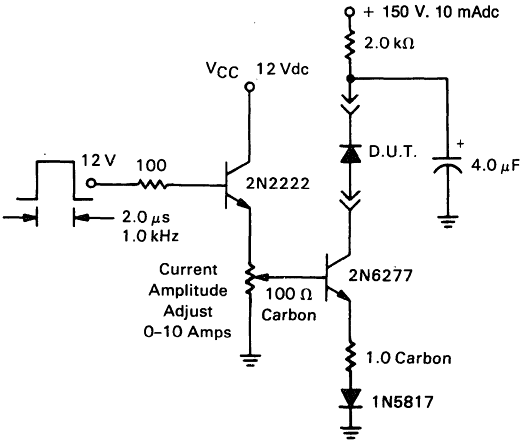
Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not required. The guardring also operates like a zener to absorb over-voltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead is also stress relieved.These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

FIGURE 10 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3520
MBR3535
MBR3545

MBR3545 is a Motorola Preferred Device

Switchmode Power Rectifiers

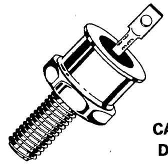
. . . using a platinum barrier metal in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free-wheeling diodes, and polarity-protection diodes.

- Guardring for dv/dt Stress Protection
- Guaranteed Reverse Surge Current/Avalanche
- 150°C Operating Junction Temperature
- Mounting Torque: 15 in-lb max

Mechanical Characteristics:
- Case: Welded steel, hermetically sealed
- Weight: 45.6 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 15 lb-in max
- Shipped 25 units per rail
- Marking: B3520, B3535, B3545

SCHOTTKY BARRIER RECTIFIERS

35 AMPERES
20 to 45 VOLTS



CASE 56-03
DO-203AA
METAL

MAXIMUM RATINGS

Rating	Symbol	MBR3520	MBR3535	MBR3545	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz, T_C = 110°C)	I_{FRM}	70			Amps
Average Rectified Forward Current (Rated V_R, T_C = 110°C)	$I_{F(AV)}$	35			Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 8	I_{RRM}	2.0			Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	600			Amps
Operating Junction Temperature	T_J	–65 to + 150			°C
Storage Temperature	T_{stg}	–65 to +175			°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000			V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.3	1.5	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Characteristic	Symbol	Typ	Max	Unit
Instantaneous Forward Voltage (1)	v_F			Volts
(i_F = 35 Amp, T_C = 125°C)		0.49	0.55	
(i_F = 35 Amp, T_C = 25°C)		0.55	0.63	
(i_F = 70 Amp, T_C = 125°C)		0.60	0.69	
Instantaneous Reverse Current (1)	i_R			mA
(Rated Voltage, T_C = 125°C)		60	100	
(Rated Voltage, T_C = 25°C)		0.1	0.3	
Capacitance (V_R = 1.0 Vdc, 100 kHz > f > 1.0 MHz, T_C = 25°C)	C_t	3000	3700	pF

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%

Rev 2

FIGURE 1 — MAXIMUM FORWARD VOLTAGE

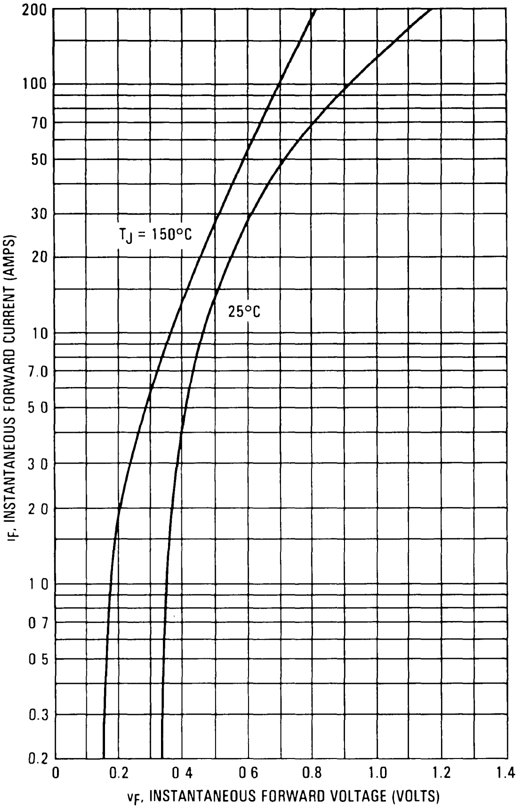


FIGURE 2 — MAXIMUM REVERSE CURRENT

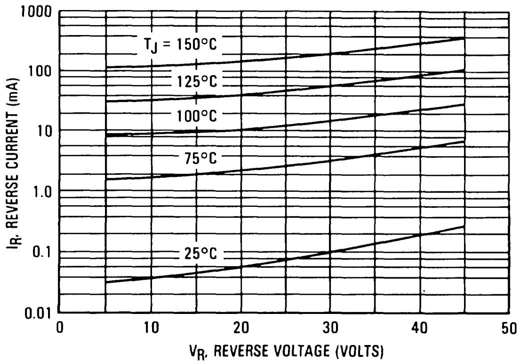


FIGURE 3 — MAXIMUM SURGE CAPABILITY

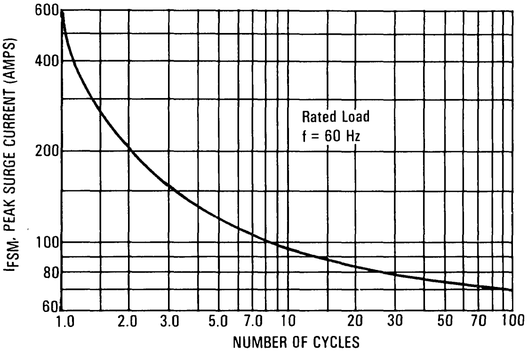


FIGURE 4 — CURRENT DERATING

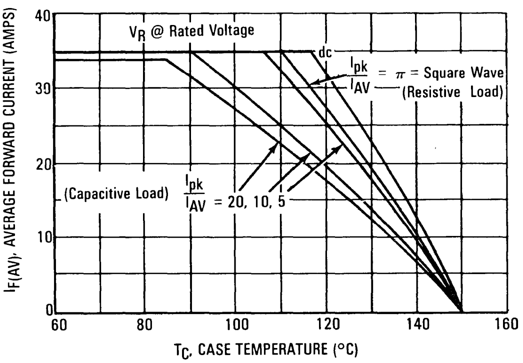


FIGURE 5 — POWER DISSIPATION

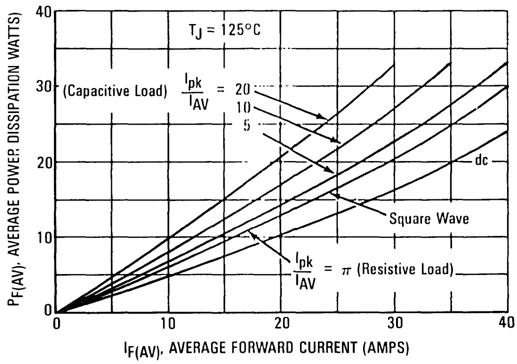


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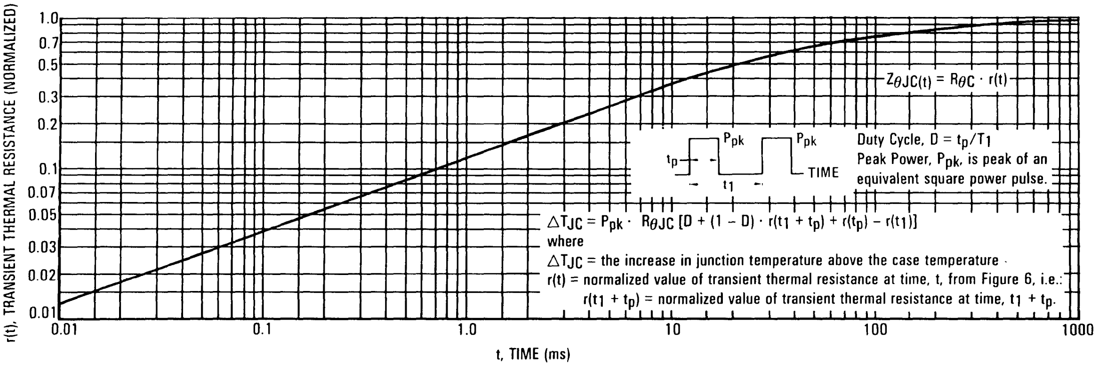
FIGURE 6 — THERMAL RESPONSE



HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 7.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 7 — CAPACITANCE

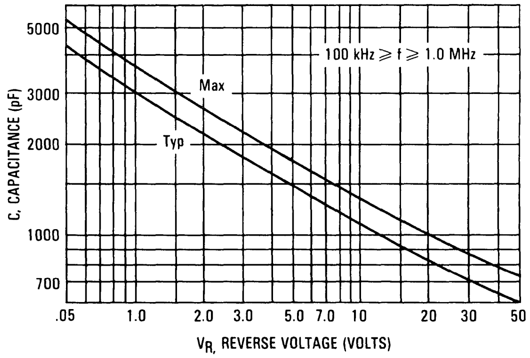


FIGURE 8 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT

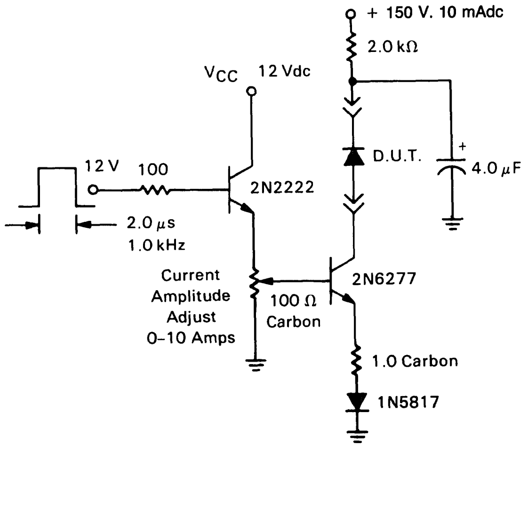
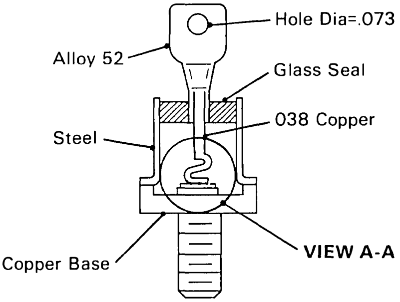
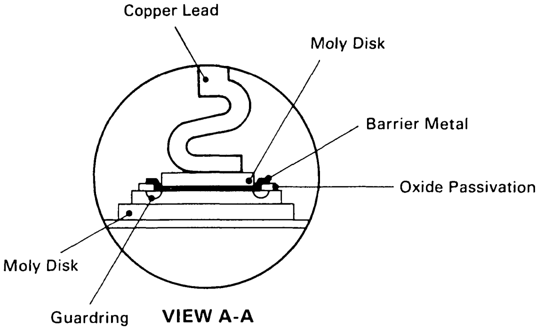


FIGURE 9 — SCHOTTKY RECTIFIER





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Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche. Devices are also 100% reverse scope tested for trace anomalies.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5832
1N5833
1N5834

1N5832 and 1N5834 are Motorola Preferred Devices

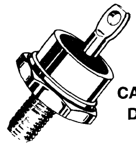
3

Designer's Data Sheet

Switchmode Power Rectifier

SCHOTTKY BARRIER RECTIFIERS

40 AMPERE
20,30,40 VOLTS



CASE 257-01
DO-203AB
METAL

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- High Surge Capacity

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: 1N5832, 1N5833, 1N5834

*MAXIMUM RATINGS

Rating	Symbol	1N5832	1N5833	1N5834	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	Volts
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	Volts
Average Rectified Forward Current $V_{R(equiv)} \leq 0.2\ V_{R(dc)}, T_C = 75°C$	I_O	← 40 →			Amp
Ambient Temperature Rated $V_{R(dc)}, P_{F(AV)} = 0$, $R_{\theta JA} = 2.0°C/W$	T_A	100	95	90	°C
Non-Repetitive Peak Surge Current (surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	← 800 (for 1 cycle) →			Amp
Operating and Storage Junction Temperature Range (Reverse voltage applied)	T_J, T_{stg}	← -65 to +125 →			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

*ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	1N5832	1N5833	1N5834	Unit
Maximum Instantaneous Forward Voltage(1) (i_F = 10 Amp) (i_F = 40 Amp) (i_F = 125 Amp)	v_F	 0.360 0.520 0.980	 0.370 0.550 1.080	 0.380 0.590 1.180	Volts
Maximum Instantaneous Reverse Current @ rated dc Voltage (1) T_C = 100°C	i_R	20 150	20 150	20 150	mA

*Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

Rev 2

NOTE 1: DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.2 V_{RWM}. Proper derating may be accomplished by use of equation (1):

$$T_{A(max)} = T_{J(max)} - R_{\theta JA}\,P_{F(AV)} - R_{\theta JA}\,P_{R(AV)} \quad (1)$$

where

$T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest).

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R_{\theta JC}$ = Junction-to-ambient thermal resistance

Figures 1, 2 and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2):

$$T_R = T_{J(max)} - R_{\theta JA}\,P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA}\,P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2 and 3 as a difference in the rate of change of the slope in the vicinity of 115°C. The data of Figures 1, 2 and 3 is based upon dc conditions. For use in common rectifier circuits, Table I indicates suggested factors for an equivalent dc voltage to use for conservative design; i.e.:

$$V_{R(equiv)} = V_{in(PK)} \times F \quad (4)$$

The Factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

Example: Find $T_{A(max)}$ for 1N5834 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 30 A ($I_{F(AV)}$ = 15 A), $I_{(PK)}/I_{(AV)}$ = 10, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 3°C/W.

Step 1: Find $V_{R(equiv)}$. Read F = 0.65 from Table I ∴ $V_{R(equiv)}$ = (10)(1.41)(0.65) = 9.18 V

Step 2: Find T_R from Figure 3. Read T_R = 118°C @ V_R = 9.18 V & $R_{\theta JA}$ = 3°C/W

Step 3: Find $P_{F(AV)}$ from Figure 4.†Read $P_{F(AV)}$ = 20 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 10 & $I_{F(AV)}$ = 15 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 118-(3)(20) = 58°C

†Values given are for the 1N5834. Power is slightly lower for the other units because of their lower forward voltage.

TABLE I — VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped (1),(2)	
Load	Resistive	Capacitive (1)	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

(1) Note that $V_{R(PK)} \approx 2\,V_{in(PK)}$

(2) Use line to center tap voltage for V_{in}.

FIGURE 1 — MAXIMUM REFERENCE TEMPERATURE — 1N5832

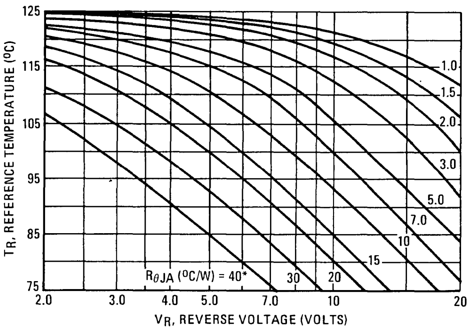


FIGURE 2 — MAXIMUM REFERENCE TEMPERATURE — 1N5833

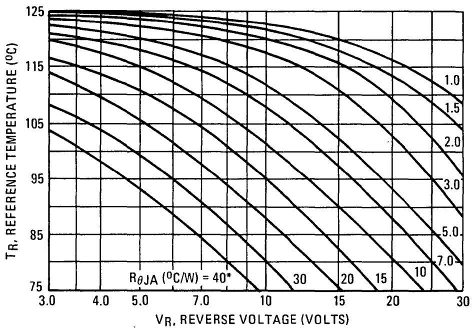


FIGURE 3 — MAXIMUM REFERENCE TEMPERATURE — 1N5834

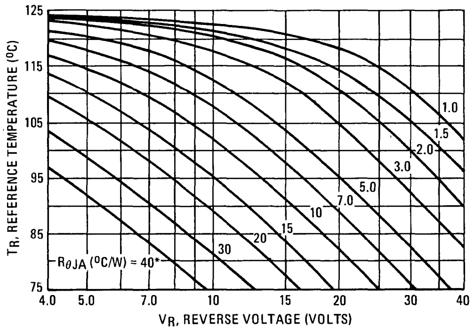
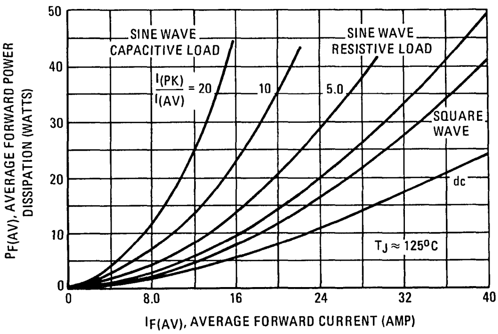


FIGURE 4 — FORWARD POWER DISSIPATION



*No external heat sink.

3

FIGURE 5 — TYPICAL FORWARD VOLTAGE

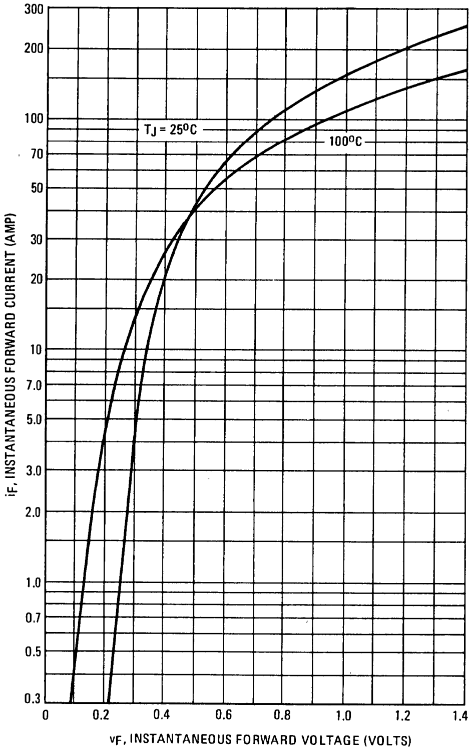


FIGURE 6 — MAXIMUM SURGE CAPABILITY

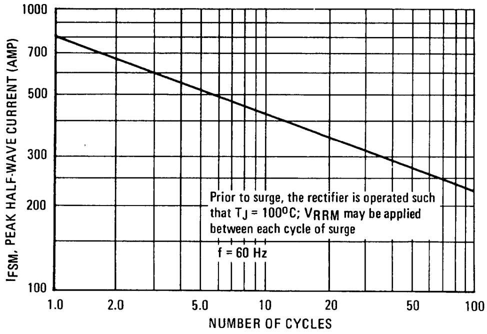


FIGURE 7 — CURRENT DERATING

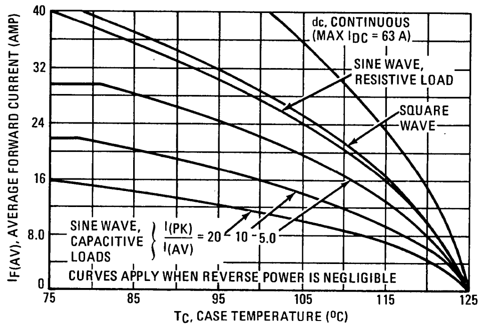


FIGURE 8 — THERMAL RESPONSE

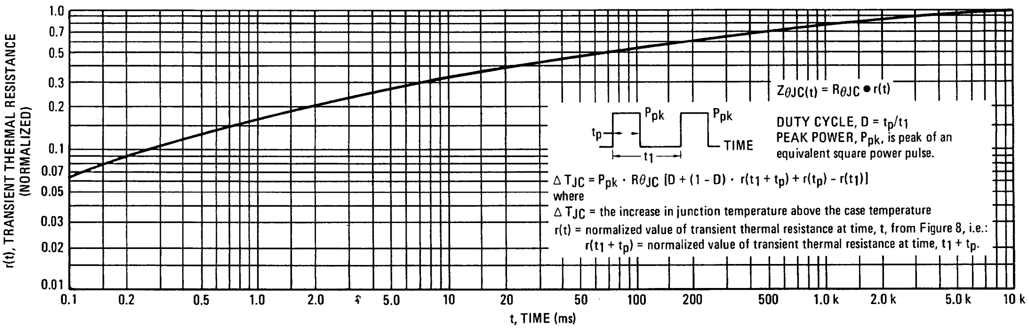


FIGURE 9 – NORMALIZED REVERSE CURRENT

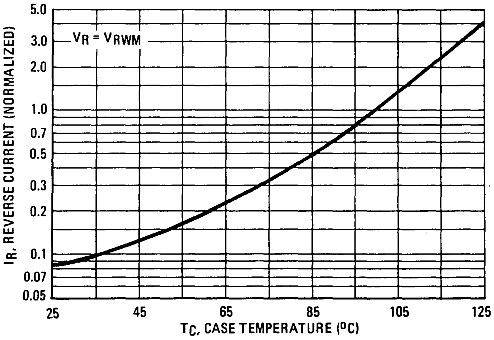


FIGURE 10 – TYPICAL REVERSE CURRENT

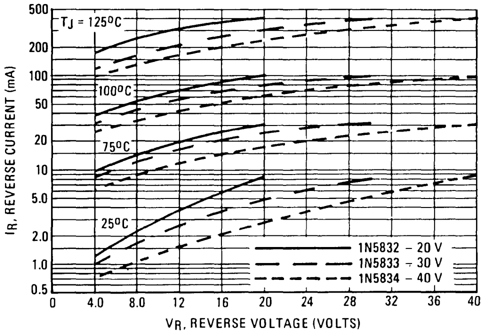
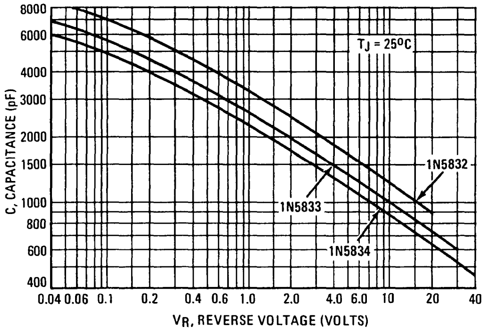


FIGURE 11 – CAPACITANCE



NOTE 2: HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 11).

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

NOTE 3: SOLDER HEAT

The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Switchmode Power Rectifiers

1N6097
1N6098
SD51

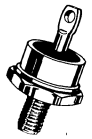
1N6098 and SD51 are Motorola Preferred Devices

... using the platinum barrier metal in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free-wheeling diodes, and polarity-protection diodes.

- Guaranteed Reverse Avalanche
- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Guardring for Stress Protection
- Low Power Loss/High Efficiency
- 150°C Operating Junction Temperature Capability
- High Surge Capacity

SCHOTTKY BARRIER RECTIFIERS

60 AMPERES
20 to 45 VOLTS



CASE 257-01
DO-203AB
METAL

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: 1N6097, 1N6098, SD51

MAXIMUM RATINGS

Rating	Symbol	1N6097*	1N6098*	SD51	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	40	45 35 45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	—	—	120 T_C = 90°C	Amps
Average Rectified Forward Current (Rated V_R)	I_O	50 T_C = 70°C	50 T_C = 70°C	—	Amps
Case Temperature (Rated V_R)	T_C	115	115	—	°C
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	←	800	→	Amps
Peak Repetitive Reverse Surge Current (2) (2.0 μs, 1.0 kHz) See Figure 10.	I_{RRM}	←	2.0	→	Amps
Operating Junction Temperature Range (Reverse Voltage Applied)	T_J	-65 to +125	-65 to +125	-65 to +150	°C
Storage Temperature Range	T_{stg}	-65 to +125	-65 to +125	-65 to +165	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	10000	10000	V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	1N6097*	1N6098*	SD51	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	←	1.0	→	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	1N6097*	1N6098*	SD51	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 157 Amp, T_C = 70°C) (i_F = 60 Amp) (i_F = 60 Amp, T_C = 125°C) (i_F = 120 Amp, T_C = 125°C)	v_F	 0.86 — — —	 0.86 — — —	 — 0.70 0.60 0.84	Volts
Maximum Instantaneous Reverse Current (2) (Rated Voltage, T_C = 125°C) (Rated Voltage, T_C = 25°C)	i_R	 250 —	 250 —	200 50 @ V_R = 35 V	mA
DC Reverse Current (Rated Voltage, T_C = 115°C)	I_R	250	250	—	mA
Maximum Capacitance (100 kHz ≤ f ≤ 1.0 MHz)	C_t	7000 V_R = 1.0 Vdc	7000 V_R = 1.0 Vdc	4000 V_R = 5.0 Vdc	pF

*Indicates JEDEC Registered Data.
(1) Not a JEDEC requirement, but of Motorola product capability.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

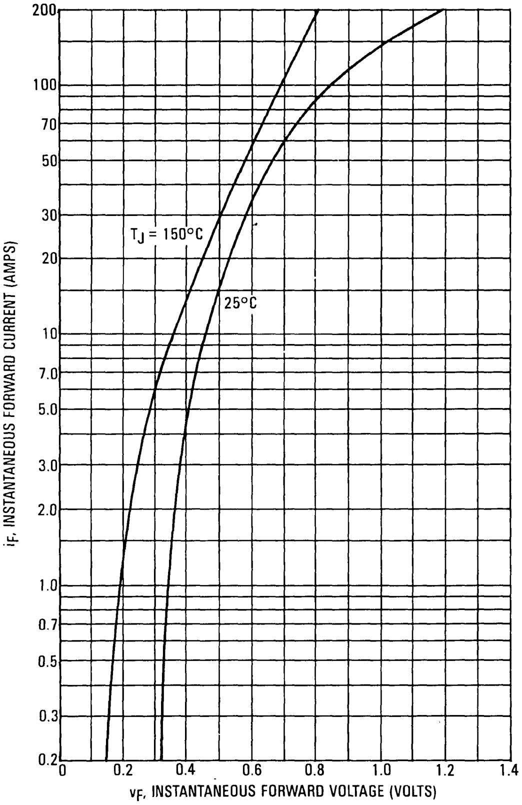


FIGURE 2 — TYPICAL REVERSE CURRENT

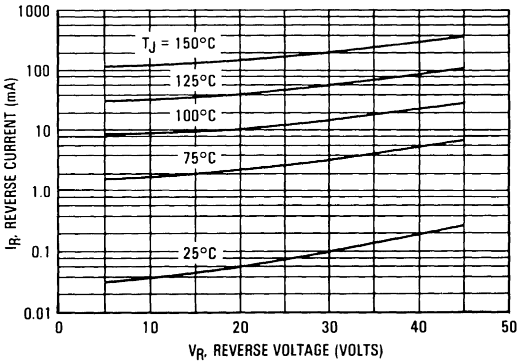


FIGURE 3 — TYPICAL SURGE CAPABILITY

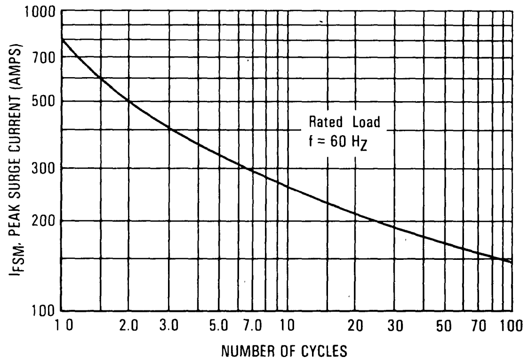
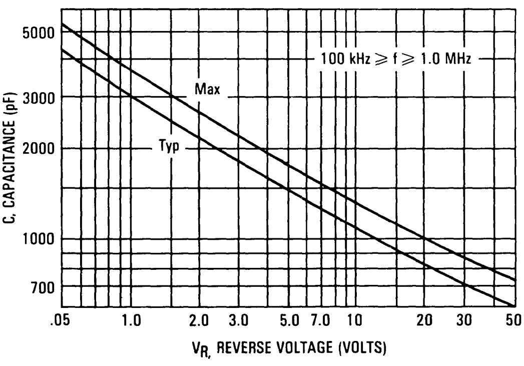


FIGURE 4 — CAPACITANCE



NOTE 1
HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 4.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 5 — CURRENT DERATING (SD51)

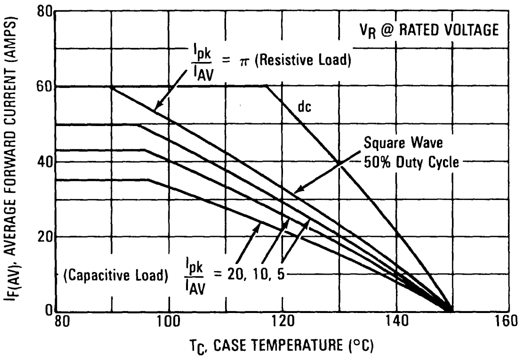


FIGURE 6 — CURRENT DERATING (1N6097/1N6098)

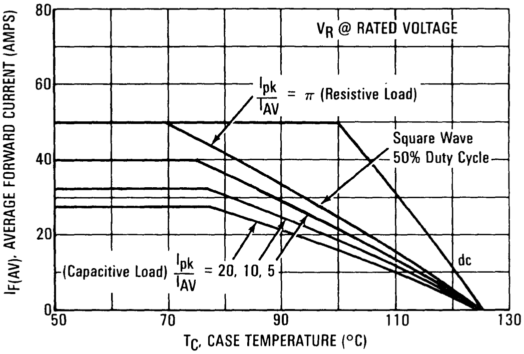
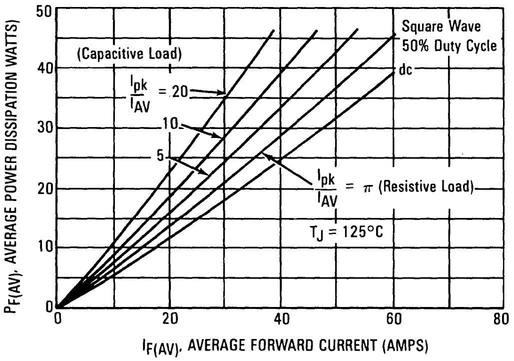
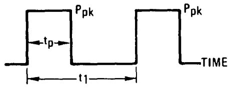


FIGURE 7 — POWER DISSIPATION



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by:

$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$ where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i.e.:

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

FIGURE 8 — THERMAL RESPONSE

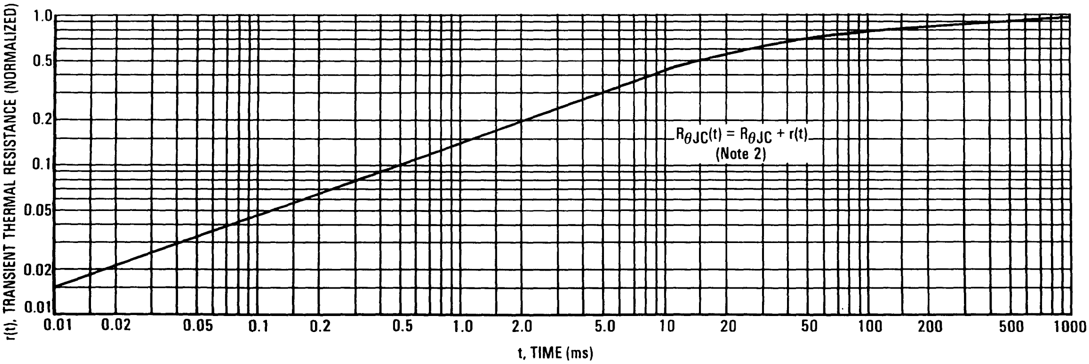
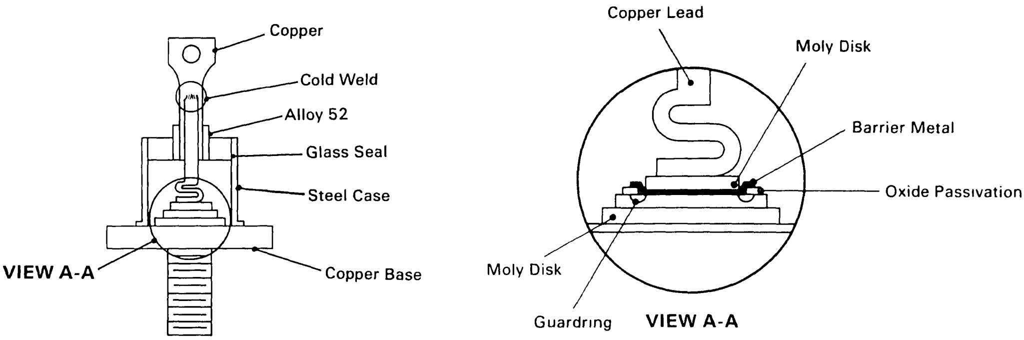


FIGURE 9 — SCHOTTKY RECTIFIER



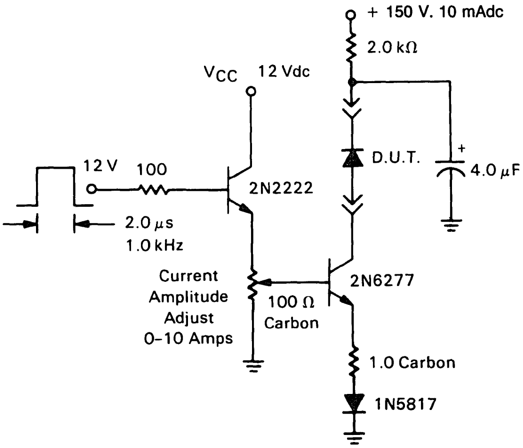
Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

FIGURE 10 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MBR6015L
MBR6020L
MBR6025L
MBR6030L

MBR6030L is a
Motorola Preferred Device

Switchmode Power Rectifiers

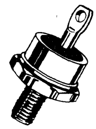
. . . using a platinum barrier metal in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high frequency inverters, free-wheeling diodes, and polarity-protection diodes.

- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 175°C Operating Junction Temperature
- Extremely Low Forward Voltage

SCHOTTKY RECTIFIERS
60 AMPERES
15 TO 30 VOLTS

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: B6015L, B6020L, B6025L, B6030L



CASE 257-01
DO-203AB
METAL

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR6015L MBR6020L MBR6025L MBR6030L	V_{RRM} V_{RWM} V_R	15 20 25 30	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 90°C		I_{FRM}	150	Amps
Average Rectified Forward Current (Rated V_R) T_C = 120°C		I_O	60	Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz) See Figure 7		I_{RRM}	2	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	10000	Amps
Operating Junction Temperature		T_J	−65 to +150	°C
Storage Temperature Range		T_{stg}	−65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 30 Amps, T_C = 25°C) (i_F = 60 Amps, T_C = 25°C) (i_F = 30 Amps, T_C = 150°C) (i_F = 60 Amps, T_C = 150°C)	v_F	 0.42 0.48 0.30 0.38	Volts
Maximum Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 125°C)	i_R	 50 280	mA
Capacitance (V_R = 1 Vdc, 100 kHz ≤ f ≤ 1 MHz)	C_t	6000	pF

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

Rev 1

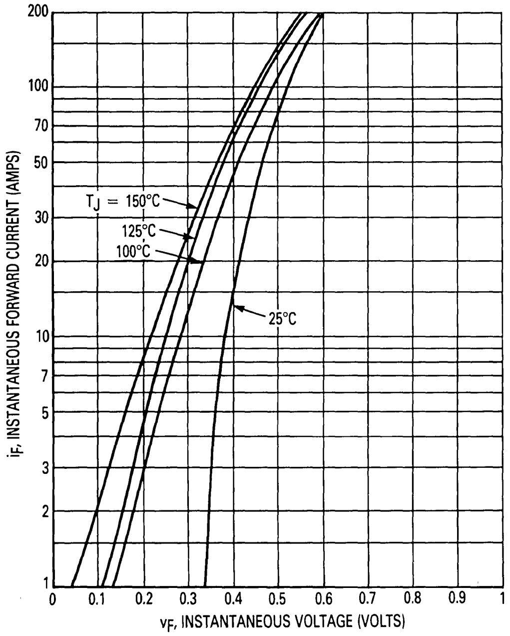


Figure 1. Typical Forward Voltage

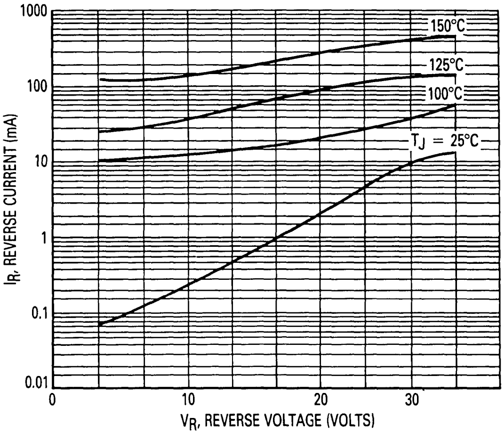


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

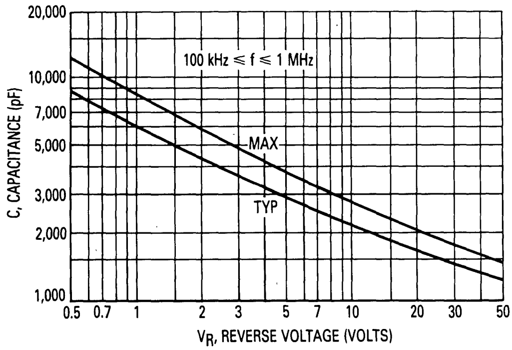


Figure 3. Capacitance

NOTE 1

HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 4.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

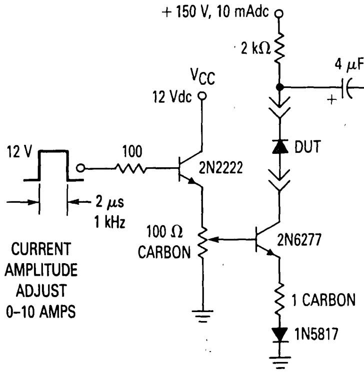


Figure 4. Test Circuit for dv/dt and Reverse Surge Current

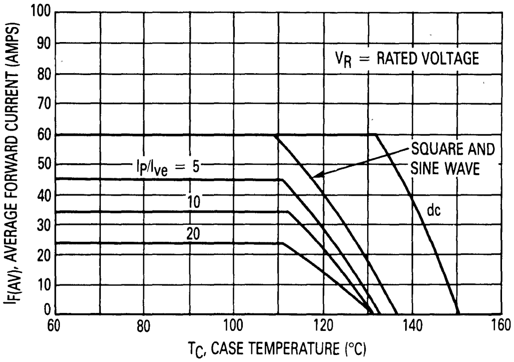


Figure 5. Forward Current Derating

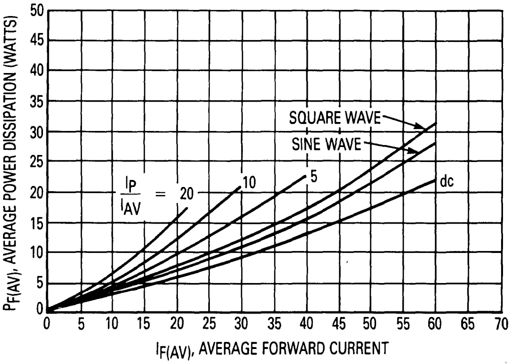
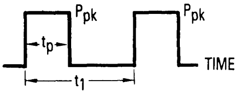


Figure 6. Power Dissipation

3

NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, IS PEAK OF AN EQUIVALENT SQUARE POWER PULSE.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by:

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 7, i.e.:

$r(t_1 - t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

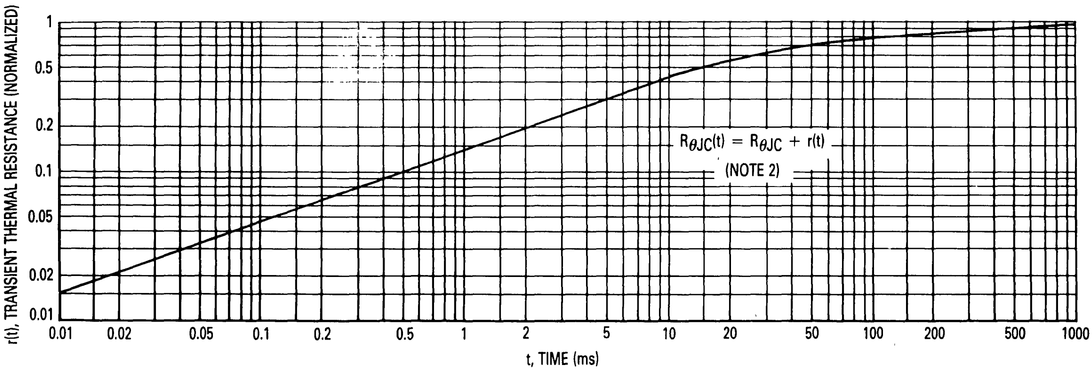
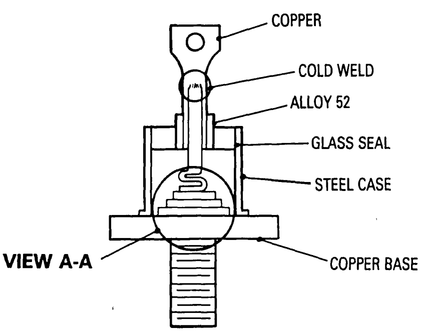
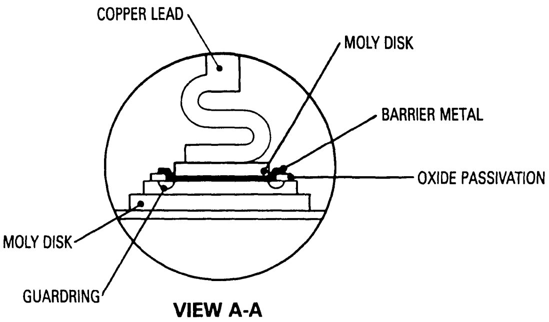


Figure 7. Thermal Response





Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatique tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

Figure 8. Schottky Rectifier

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR6035
MBR6045

MBR6045 is a
Motorola Preferred Device

Switchmode Power Rectifiers

. . . using a platinum barrier metal in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free-wheeling diodes, and polarity-protection diodes.

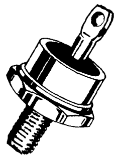
- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 150°C Operating Junction Temperature
- Low Forward Voltage

Mechanical Characteristics:
- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: B6035, B6045

3

SCHOTTKY RECTIFIERS

60 AMPERES
35 AND 45 VOLTS



CASE 257-01
DO-203AB
METAL

MAXIMUM RATINGS

Rating	Symbol	MBR6035	MBR6045	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 100°C	I_{FRM}	← 120 →		Amps
Average Rectified Forward Current (Rated V_R) T_C = 100°C	I_O	← 60 →		Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz) See Figure 7	I_{RRM}	← 2.0 →		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	← 800 →		Amps
Operating Junction Temperature	T_J	← –65 to + 150 →		°C
Storage Temperature	T_{stg}	← –65 to +175 →		°C
Voltage Rate of Change (Rated V_R)	dv/dt	← 10000 →		V/µs

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.85	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 60 Amp, T_C = 25°C) (i_F = 60 Amp, T_C = 125°C) (i_F = 120 Amp, T_C = 125°C)	v_F	 0.65 0.57 0.70	 0.70 0.60 0.76	Volts
Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 125°C)	i_R	 0.1 55	 0.3 100	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz ≤ 1.0 MHz)	C_t	3000	3700	pF

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2.0%

Rev 2

FIGURE 1 — TYPICAL FORWARD VOLTAGE

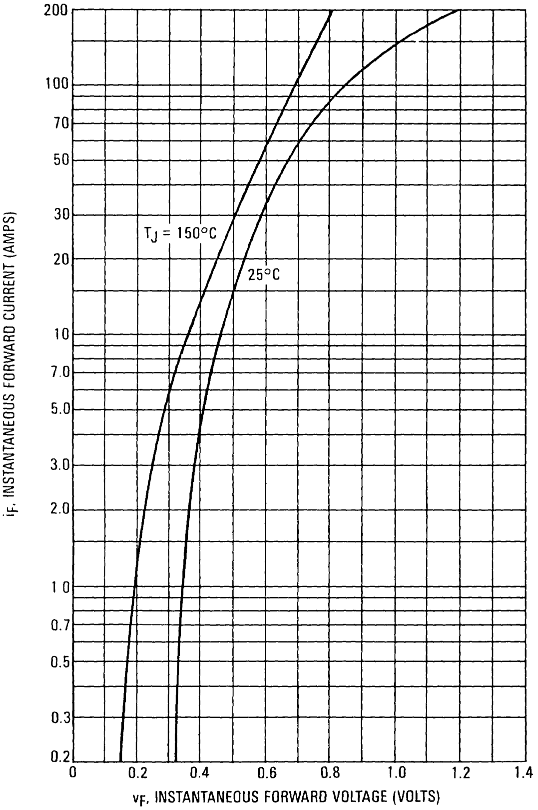


FIGURE 2 — TYPICAL REVERSE CURRENT

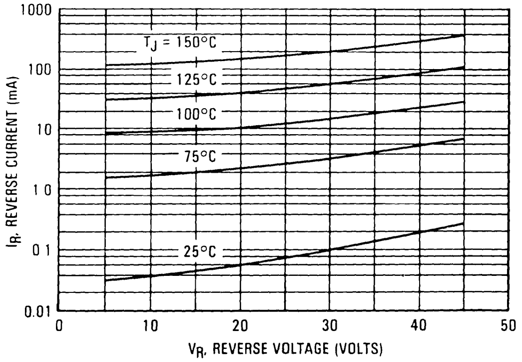


FIGURE 3 — MAXIMUM SURGE CAPABILITY

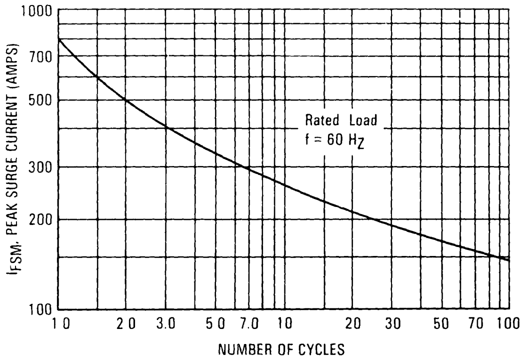
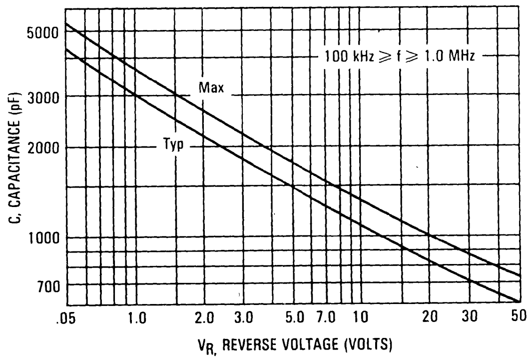


FIGURE 4 — CAPACITANCE



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Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

3

FIGURE 5 — FORWARD CURRENT DERATING

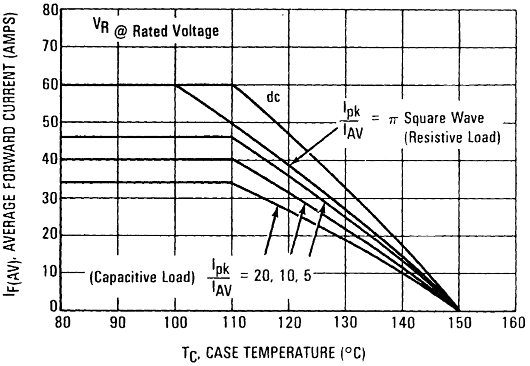


FIGURE 6 — POWER DISSIPATION

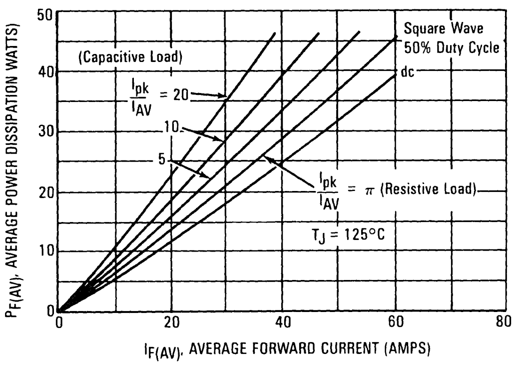
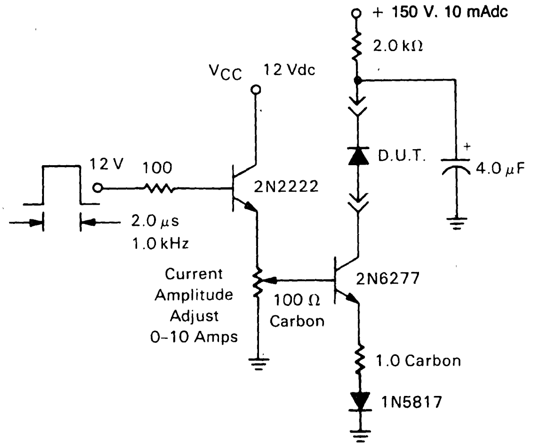
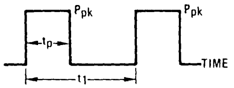


FIGURE 7 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by:

$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$ where
$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i.e.:
$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 8 — THERMAL RESPONSE

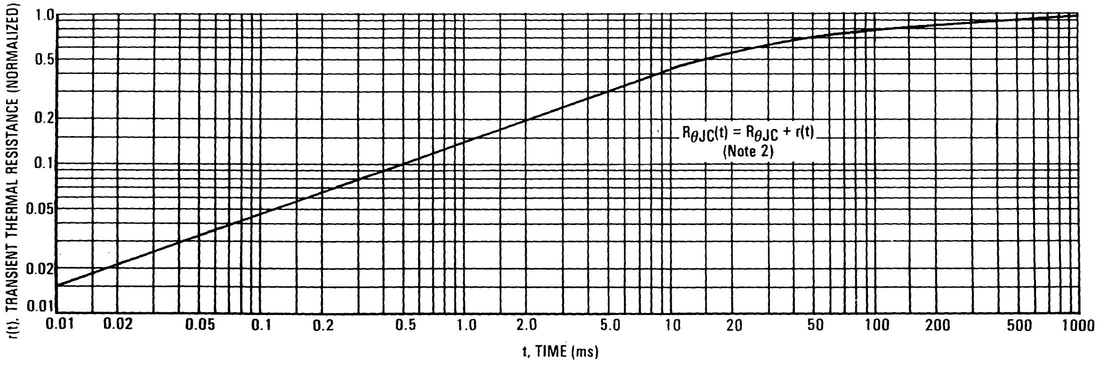
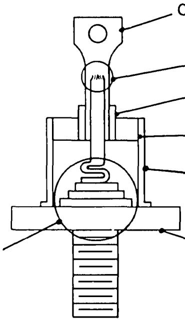
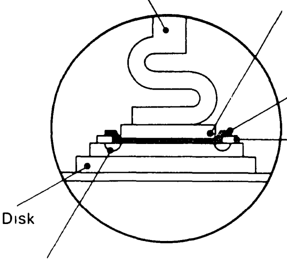


FIGURE 9 — SCHOTTKY RECTIFIER





Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

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MBR6535
MBR6545

MBR6545 is a
Motorola Preferred Device

Switchmode Power Rectifiers

. . . using a platinum barrier metal in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free-wheeling diodes, and polarity-protection diodes.

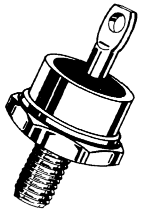
- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 175°C Operating Junction Temperature
- Low Forward Voltage

Mechanical Characteristics:
- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: B6535, B6545

3

HIGH TEMPERATURE SCHOTTKY RECTIFIERS

65 AMPERES
35 and 45 VOLTS



CASE 257-01
DO-203AB
METAL

MAXIMUM RATINGS

Rating	Symbol	MBR6535	MBR6545	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 120°C	I_{FRM}	130	130	Amps
Average Rectified Forward Current (Rated V_R) T_C = 120°C	I_O	65	65	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 7	I_{RRM}	2.0	2.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	800	800	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	−65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 65 Amp, T_C = 25°C) (i_F = 65 Amp, T_C = 150°C) (i_f = 130 Amp, T_C = 150°C)	v_F	 0.78 0.62 0.73	 0.78 0.62 0.73	Volts
Maximum Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 150°C)	i_R	 0.07 125	 0.07 125	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz ≤ f ≤ 1.0 MHz)	C_t	3700	3700	pF

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

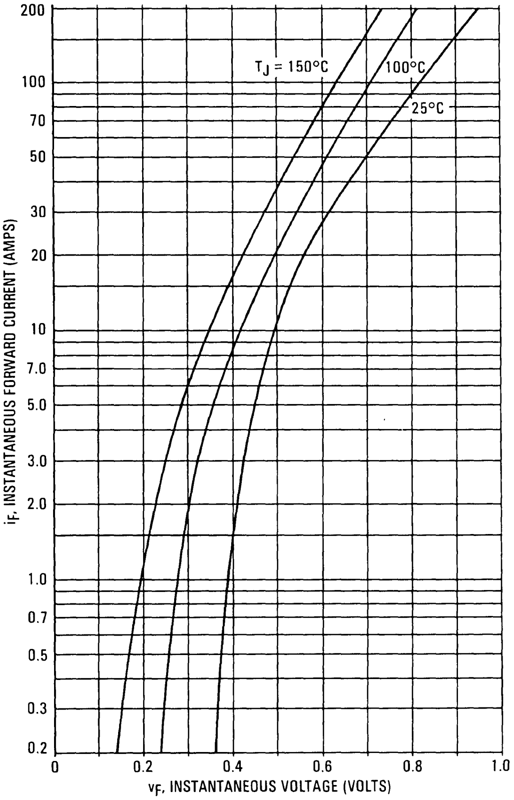


FIGURE 2 — TYPICAL REVERSE CURRENT

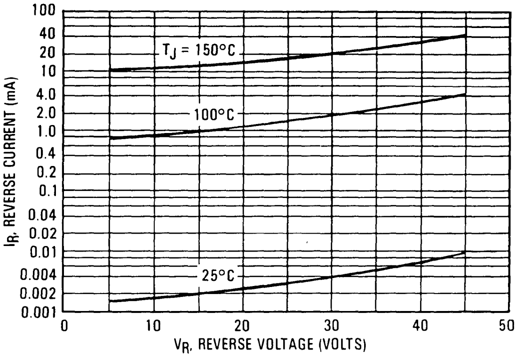


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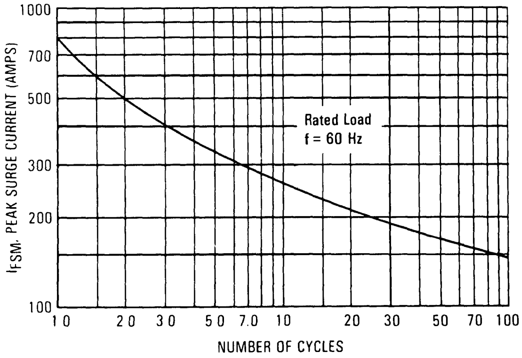
FIGURE 3 — MAXIMUM SURGE CAPABILITY



NOTE 1
HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 4.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 4 — CAPACITANCE

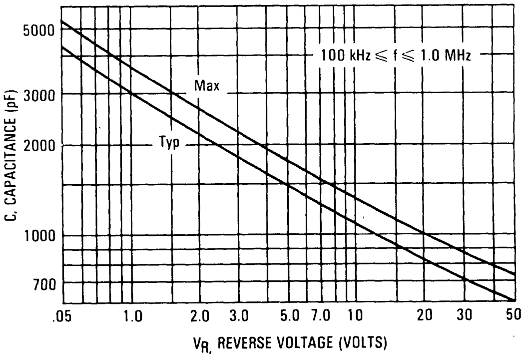


FIGURE 5 — FORWARD CURRENT DERATING

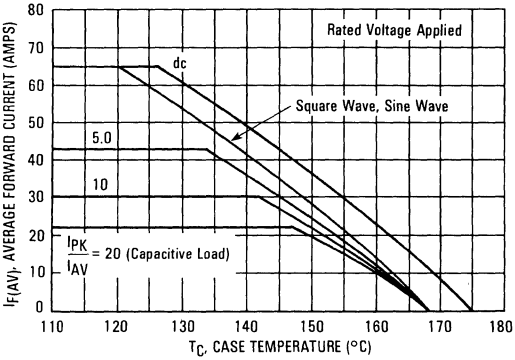
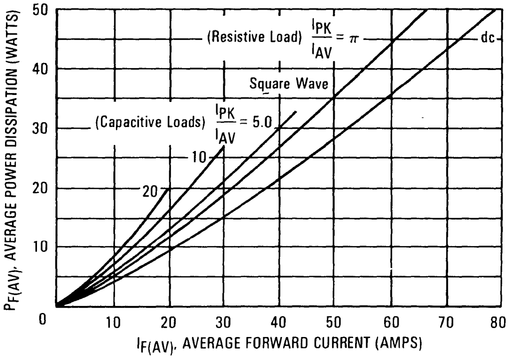
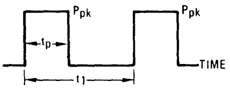


FIGURE 6 — POWER DISSIPATION



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

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where ΔT_C is the increase in junction temperature above the case temperature It may be determined by

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FIGURE 7 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT

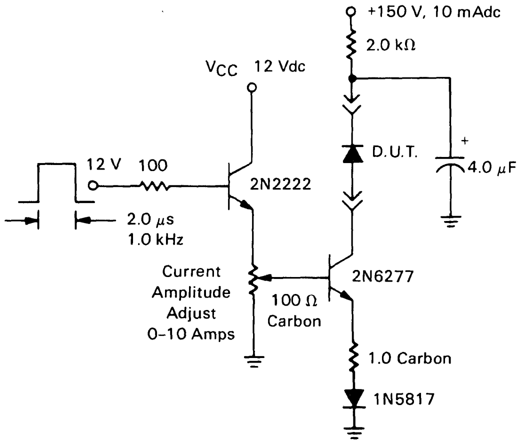


FIGURE 8 — THERMAL RESPONSE

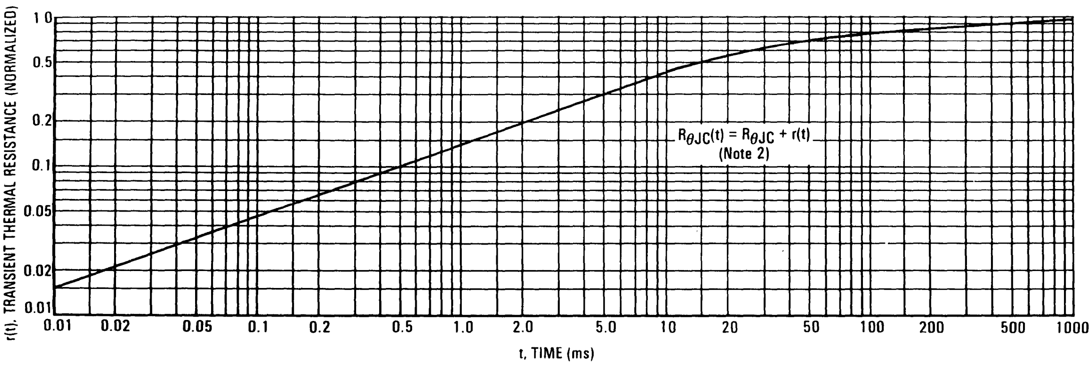
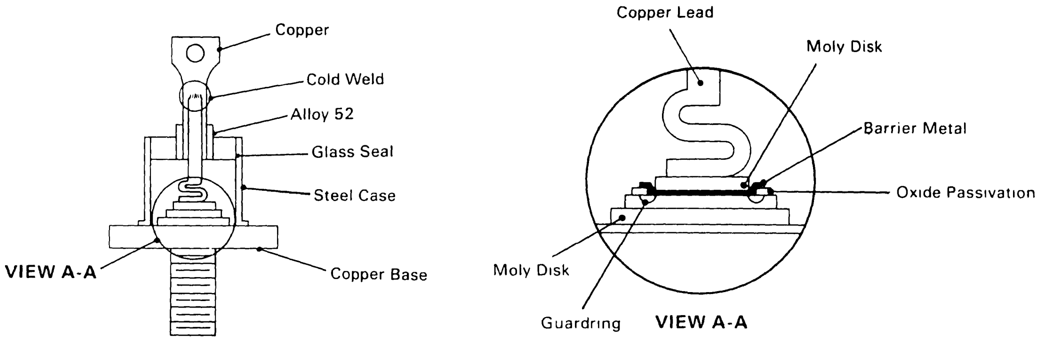


FIGURE 9 — SCHOTTKY RECTIFIER



3

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MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR7535
MBR7545

MBR7545 is a
Motorola Preferred Device

Switchmode Power Rectifiers

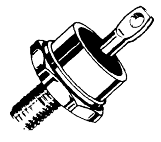
. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free-wheeling diodes, and polarity-protection diodes.

- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/ High Efficiency
- High Surge Capacity

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: B7535, B7545

SCHOTTKY BARRIER RECTIFIERS
75 AMPERES
35 AND 45 VOLTS



CASE 257-01
DO-203AB
METAL

3

MAXIMUM RATINGS

Rating	Symbol	MBR7535	MBR7545	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	150 $T_C = 90°C$		Amp
Average Rectified Forward Current (Rated V_R)	I_O	75 $T_C = 90°C$		Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	1000		Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +150		°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000		V/µs

THERMAL CHARACTERISTICS

Rating	Symbol	MBR7535	MBR7545	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8		°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Rating	Symbol	MBR7535	MBR7545	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 60 Amp, T_C = 125°C) (i_F = 220 Amp, T_C = 125°C)	v_F	 0.60 0.90		Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C)	i_R	150	250	mA
Capacitance (V_R = 5.0 Vdc, 100 kHz ≤ f ≤ 1.0 MHz)	C_t	4000		pF

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2.0%.

Rev 2

3

FIGURE 1 – TYPICAL FORWARD VOLTAGE

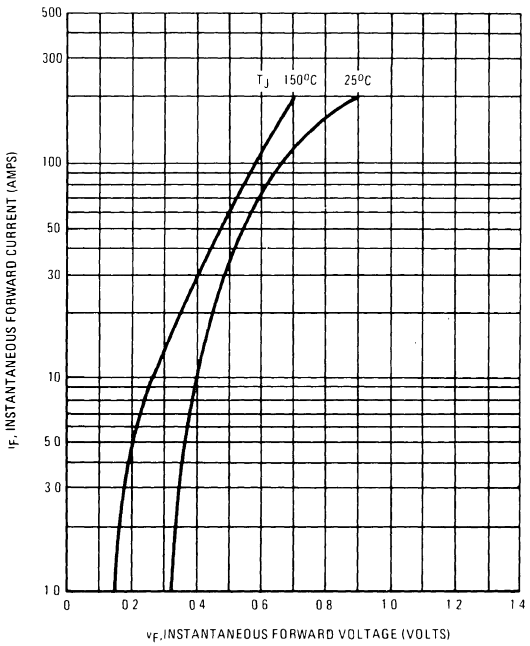


FIGURE 2 – CURRENT DERATING

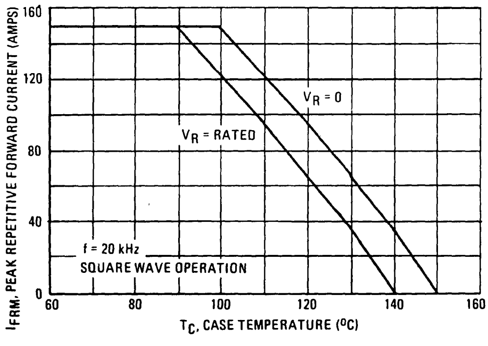
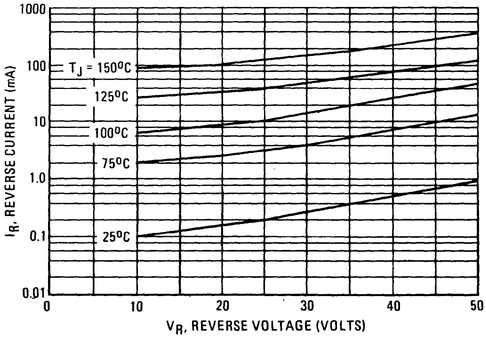


FIGURE 3 – TYPICAL REVERSE OPERATION



MBR8035
MBR8045

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Switchmode Power Rectifiers

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- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 175°C Operating Junction Temperature
- Low Forward Voltage

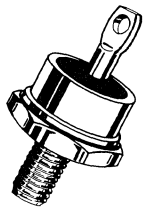
3

Mechanical Characteristics:

- Case: Welded steel, hermetically sealed
- Weight: 17 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Lead is Readily Solderable
- Solder Heat: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.
- Stud Torque: 25 lb-in max
- Shipped 25 units per rail
- Marking: B8035, B8045

SCHOTTKY RECTIFIERS

80 AMPERES
35 and 45 VOLTS



CASE 257-01
DO-203AB
METAL

MAXIMUM RATINGS

Rating	Symbol	MBR8035	MBR8045	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 120°C	I_{FRM}	160	160	Amps
Average Rectified Forward Current (Rated V_R) T_C = 120°C	I_O	80	80	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 7	I_{RRM}	2.0	2.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	1000	1000	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	−65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	10000	V/μs

THERMAL CHARACTERISTICS

Rating	Symbol	MBR8035	MBR8045	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.80	0.80	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	MBR8035	MBR8045	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 80 Amp, T_C = 25°C) (i_F = 80 Amp, T_C = 150°C) (i_F = 160 Amp, T_C = 150°C)	v_F	 0.72 0.59 0.67	 0.72 0.59 0.67	Volts
Maximum Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 150°C)	i_R	 1.0 150	 1.0 150	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz ≤ f ≤ 1.0 MHz)	C_t	5000	5000	pF

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

FIGURE 1 — TYPICAL FORWARD VOLTAGE

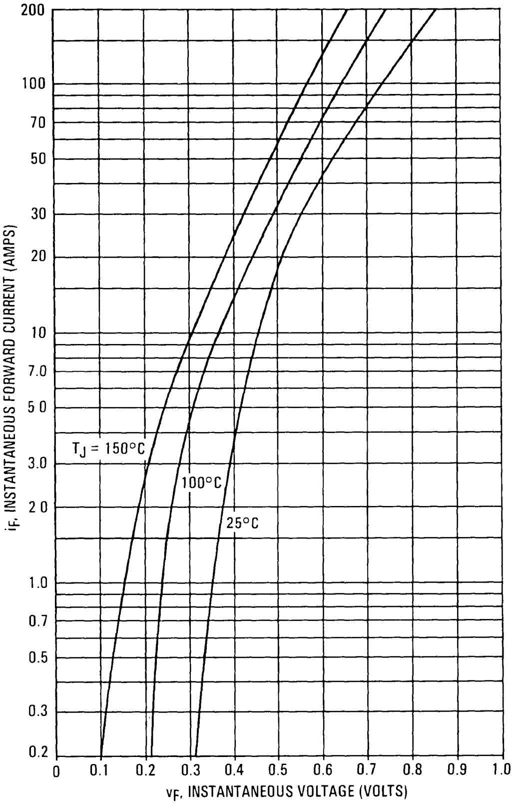


FIGURE 2 — TYPICAL REVERSE CURRENT

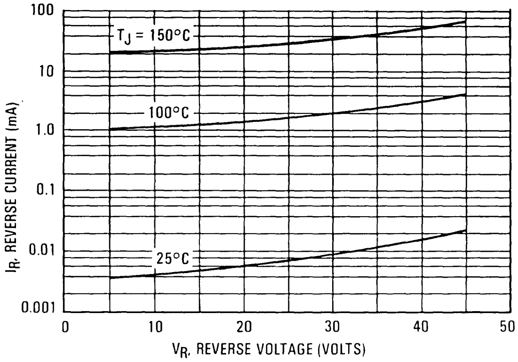
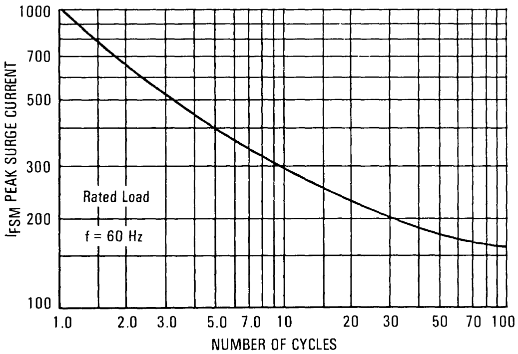


FIGURE 3 — MAXIMUM SURGE CAPABILITY



NOTE 1
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Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 4 — CAPACITANCE

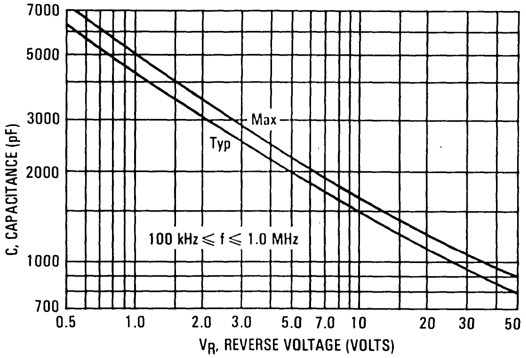


FIGURE 5 — FORWARD CURRENT DERATING

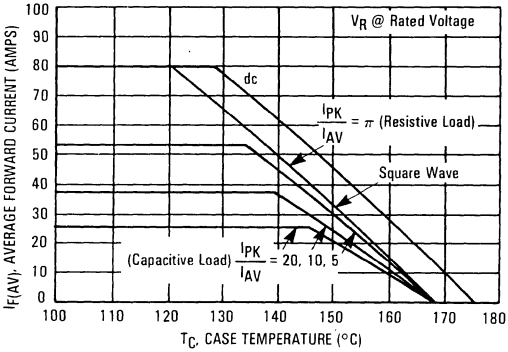
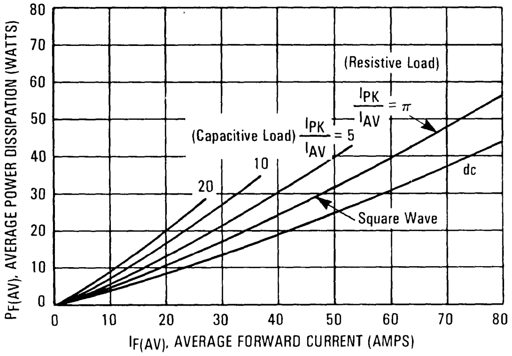
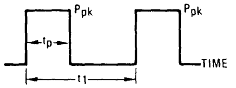


FIGURE 6 — POWER DISSIPATION



NOTE 2



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$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by:

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$ where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i.e.:

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FIGURE 7 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT

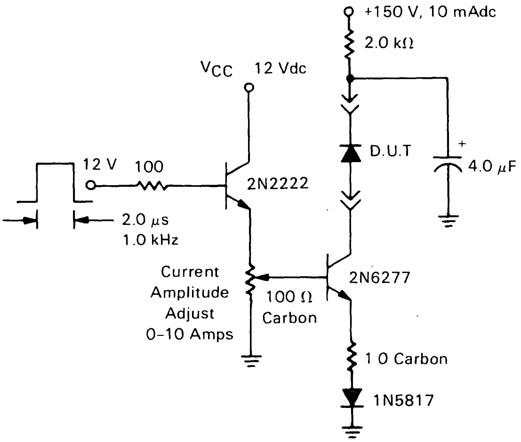


FIGURE 8 — THERMAL RESPONSE

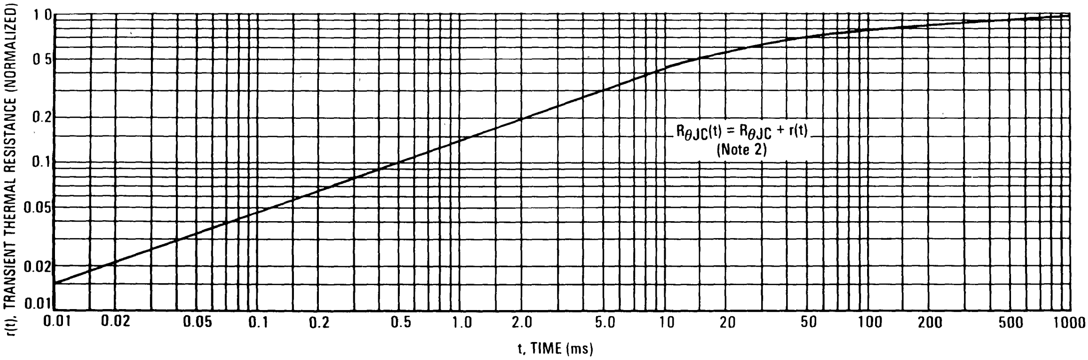
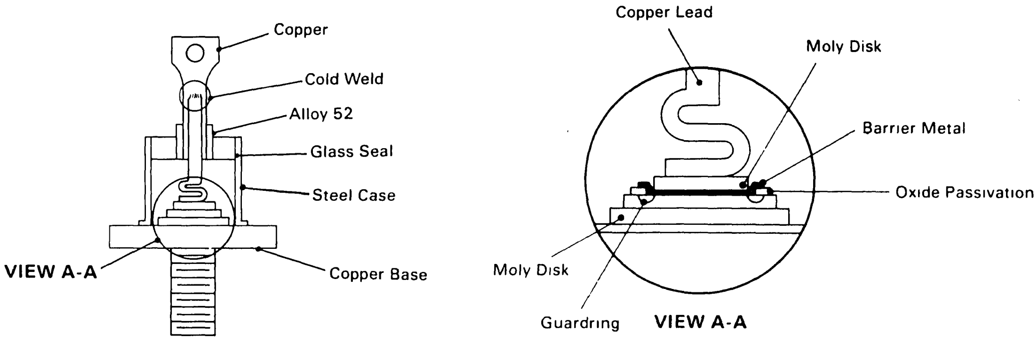


FIGURE 9 — SCHOTTKY RECTIFIER



3

Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3045CT
SD241

MBR3045CT and SD241 are Motorola Preferred Devices

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

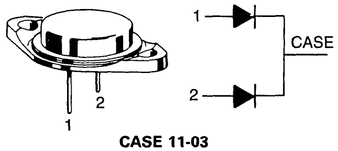
Mechanical Characteristics:

- Case: Copper slug header, welded steel can, hermetically sealed
- Weight: 18.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 100 units per foam tray
- Marking: MBR3045CT, SD241

3

SCHOTTKY BARRIER RECTIFIERS

30 AMPERES
20 to 45 VOLTS



CASE 11-03
TO-204AA
METAL

MAXIMUM RATINGS

Rating	Symbol	MBR3045CT	SD241	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	45	Volts
Average Rectified Forward Current Per Device (Rated V_R) T_C = 105°C Per Diode	I_O	30 15	30 15	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	400	Amps
Peak Repetitive Reverse Current, Per Diode (2.0 µs, 1.0 kHz) See Figure 8	I_{RRM}	2.0	2.0	Amps
Operating Junction Temperature	T_J	−65 to +150	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	T_J(pk)	175	175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	10000	V/µs

THERMAL CHARACTERISTICS PER DIODE

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	1.4	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 — 0.60 0.72 0.76	 0.47 0.60 — —	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 60 1.0	 100 V_R = 35 V	mA
Capacitance	C_t	2000	2000	pF

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%

Rev 2

FIGURE 1 — TYPICAL FORWARD VOLTAGE

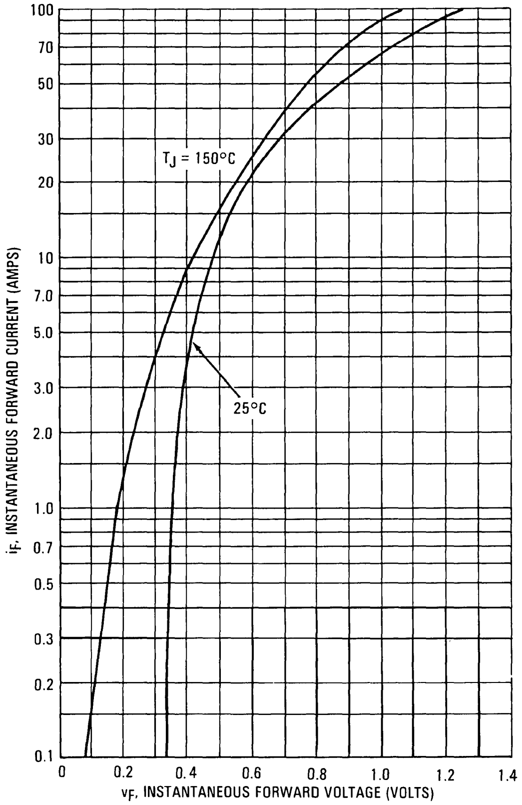


FIGURE 2 — TYPICAL REVERSE CURRENT

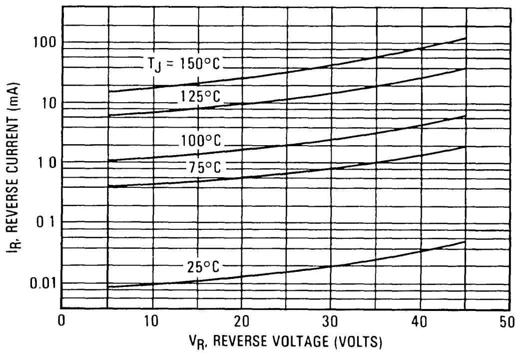


FIGURE 3 — MAXIMUM SURGE CAPABILITY

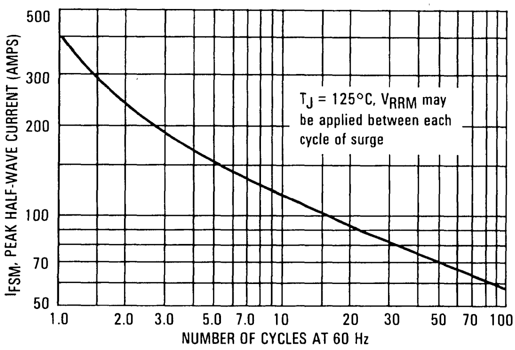


FIGURE 4 — CURRENT DERATING

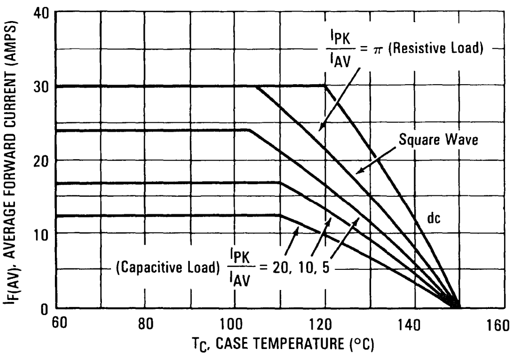


FIGURE 5 — FORWARD POWER DISSIPATION

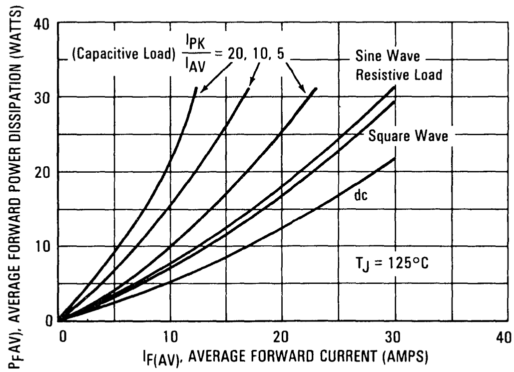


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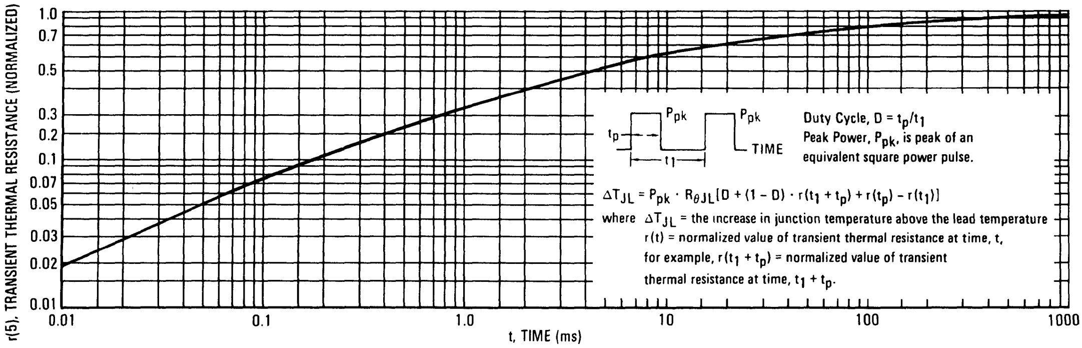
FIGURE 6 — THERMAL RESPONSE PER DIODE LEG



HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 7.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficieny is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

FIGURE 7 — CAPACITANCE

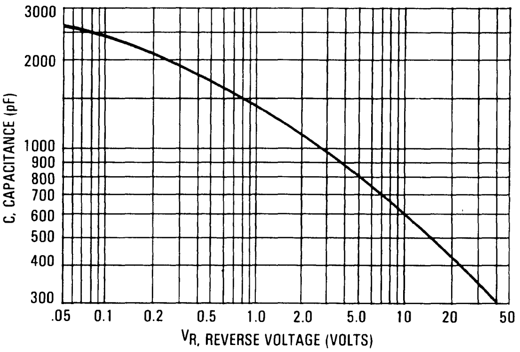
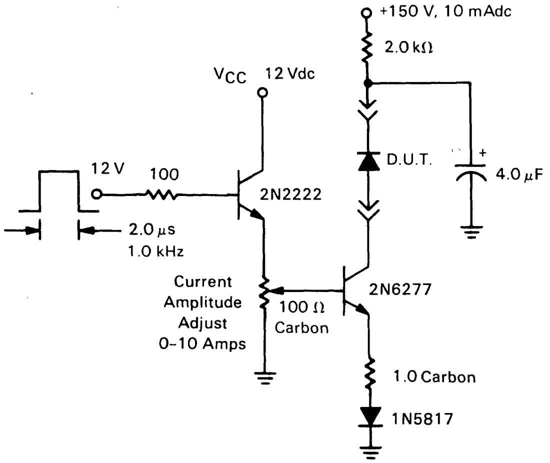


FIGURE 8 — TEST CIRCUIT FOR REPETITIVE REVERSE CURRENT



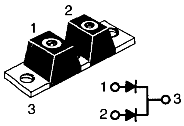
Product Preview

POWERTAP™ II SWITCHMODE™ Power Rectifier

MBRP20030CTL

Motorola Preferred Device

LOW V_F SCHOTTKY BARRIER RECTIFIER 200 AMPERES 30 VOLTS



CASE 357C–03 POWERTAP

The SWITCHMODE Power Rectifier uses the Schottky Barrier principle with a platinum barrier metal. This state–of–the–art device has the following features:

- Dual Diode Construction — May Be Paralleled for Higher Current Output
- Guardring for Stress Protection
- Low Forward Voltage Drop
- 150°C Operating Junction Temperature
- Recyclable Epoxy
- Guaranteed Reverse Avalanche Energy Capability
- Improved Mechanical Ratings

Mechanical Characteristics

- Case: Epoxy, Molded with metal heatsink base
- Weight: 80 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Top Terminal Torque: 25–40 lb–in max
- Base Plate Torques: See procedure given in the Package Outline Section
- Shipped 25 units per foam
- Marking: B20030L

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	30	Volts
Average Rectified Forward Current (At Rated V_R) T_C = +125°C	Per Leg Per Device	$I_{F(AV)}$	100 200	Amps
Peak Repetitive Forward Current (At Rated V_R, Square Wave, 20 kHz) T_C = +100°C		I_{FRM}	200	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	1500	Amps
Peak Repetitive Reverse Surge Current (2 µs, 1 kHz)		I_{RRM}	2	Amp
Storage Temperature		T_{stg}	−55 to +150	°C
Operating Junction Temperature		T_J	−55 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/µs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	0.45	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) (i_F = 200 Amps, T_C = +25°C) (i_F = 200 Amps, T_C = +25°C)	V_F	 0.52 0.60	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = +25°C)	I_R	5	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBRP20045CT
MBRP20060CT

Motorola Preferred Devices

Preliminary Data Sheet

POWERTAP II
SWITCHMODE Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Guardring For Stress Protection
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

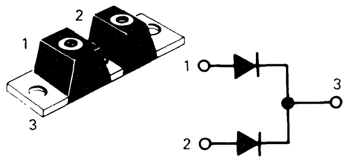
Mechanical Characteristics:

- Case: Epoxy, Molded with metal heatsink base
- Weight: 80 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Top Terminal Torque: 25 – 40 lb – in max
- Base Plate Torques: See procedure given in the Package Outline Section
- Shipped 25 units per foam
- Marking: B20045T, B20060T

3

SCHOTTKY BARRIER RECTIFIERS

200 AMPERES
45 to 60 VOLTS



CASE 357C–03
POWERTAP II

MAXIMUM RATINGS

Rating	Symbol	MBRP20045CT	MBRP20060CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	60	Volts
Average Rectified Forward Current (Rated V_R) T_C = 140°C — Per Device Per Leg	$I_{F(AV)}$	200 100	200 100	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 140°C	I_{FRM}	200	200	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	1500	1500	Amps
Peak Repetitive Reverse Current, Per Leg (2.0 µs, 1.0 kHz) See Figure 6	I_{RRM}	2.0	2.0	Amps
Operating Junction Temperature	T_J	–55 to +175	–55 to +175	°C
Storage Temperature	T_{stg}	–55 to +150	–55 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	10000	V/µs

THERMAL CHARACTERISTICS PER LEG

Thermal Resistance — Junction to Case	$R_{\theta JC}$	0.6	0.6	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 200 Amp, T_J = 25°C) (i_F = 200 Amp, T_J = 25°C)	v_F	 0.89 0.78	 0.91 0.80	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	I_R	 50 0.5	 50 0.5	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2 0%

Rev 2

MBRP30045CT
MBRP30060CT

Motorola Preferred Devices

Preliminary Data Sheet

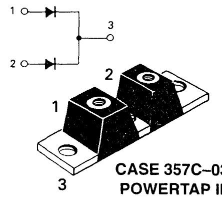
POWERTAP II
SWITCHMODE Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Guardring For Stress Protection
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

Mechanical Characteristics:
- Case: Epoxy, Molded with metal heatsink base
- Weight: 80 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Top Terminal Torque: 25–40 lb–in max
- Base Plate Torques: See procedure given in the Package Outline Section
- Shipped 25 units per foam
- Marking: B30045T, B30060T

SCHOTTKY BARRIER RECTIFIERS 300 AMPERES 45 to 60 VOLTS



CASE 357C–03
POWERTAP II

3

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	 MBRP30045CT MBRP30060CT	V_{RRM} V_{RWM} V_R	 45 60	Volts
Average Rectified Forward Current (Rated V_R) T_C = 140°C	Per Device Per Leg	$I_{F(AV)}$	300 150	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 140°C		I_{FRM}	300	Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	2500	Amps
Peak Repetitive Reverse Current, Per Leg (2.0 μs, 1.0 kHz) See Figure 6		I_{RRM}	2.0	Amps
Operating Junction Temperature		T_J	–55 to +175	°C
Storage Temperature		T_{stg}	–55 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/μs

THERMAL CHARACTERISTICS PER LEG

Thermal Resistance — Junction to Case	$R_{\theta JC}$	0.45	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 150 Amp, T_J = 25°C) (i_F = 300 Amp, T_J = 25°C) (i_F = 150 Amp, T_J = 25°C) (i_F = 300 Amp, T_J = 25°C)	 MBRP30045CT MBRP30045CT MBRP30060CT MBRP30060CT	v_F	 0.70 0.82 0.79 0.89	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)		I_R	 75 0.8	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 2

3

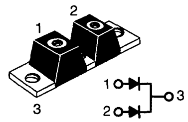
Product Preview

POWERTAP™ II SWITCHMODE™ Power Rectifier

MBRP60035CTL

Motorola Preferred Device

**LOW V_F
SCHOTTKY BARRIER
RECTIFIER
600 AMPERES
35 VOLTS**



**CASE 357C-03
POWERTAP**

The SWITCHMODE Power Rectifier uses the Schottky Barrier principle with a platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — May Be Paralleled for Higher Current Output
- Guardring for Stress Protection
- Low Forward Voltage Drop
- 150°C Operating Junction Temperature
- Recyclable Epoxy
- Guaranteed Reverse Avalanche Energy Capability
- Improved Mechanical Ratings

Mechanical Characteristics

- Case: Epoxy, Molded with metal heatsink base
- Weight: 80 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Top Terminal Torque: 25–40 lb–in max
- Base Plate Torques: See procedure given in the Package Outline Section
- Shipped 25 units per foam
- Marking: B60035L

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	35	Volts
Average Rectified Forward Current (At Rated V_R) T_C = +100°C	Per Leg Per Device	$I_{F(AV)}$	300 600	Amps
Peak Repetitive Forward Current (At Rated V_R, Square Wave, 20 kHz) T_C = +100°C		I_{FRM}	300	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	4000	Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)		I_{RRM}	2	Amp
Storage Temperature		T_{stg}	−55 to +150	°C
Operating Junction Temperature		T_J	−55 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	10000	V/μs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	0.4	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) (i_F = 300 Amps, T_C = +25°C) (i_F = 300 Amps, T_C = +100°C)	V_F	 0.57 0.50	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = +25°C) (Rated dc Voltage, T_C = +100°C)	I_R	 10 250	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

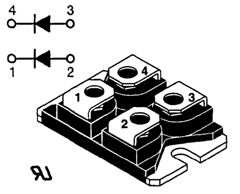
Rev 2

Advance Information

SWITCHMODE™ Schottky Power Rectifier

MBR240100V

SCHOTTKY BARRIER RECTIFIER
80 AMPERES
100 VOLTS



SOT–227B, STYLE 2

3

. . . using the Schottky Barrier principle with a platinum barrier metal. This state–of–the–art device has the following features:

- 100 V Blocking Voltage, Low Forward Voltage Drop
- Double Rectifier Diodes Construction: May Be Paralleled for Higher Current Output up to 80 Amp
- Guardring Construction Guarantees Stress Protection, High dV/dt Capability (10 kV/µs) and Reverse Avalanche
- Very Low Internal Parasitic Inductance (≤ 5.0 nH)
- Isolated Power Package (2500 Vac Insulation Rating)
- 175°C Operating Junction Temperature
- UL — UL Recognized, File #E69369

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 g (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: MBR240100V

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current — Per Diode (Rated V_C) @ T_C = 125°C — Per Device	$I_{F(AV)}$	40 80	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	120	Amps
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	600	Amps
Peak Repetitive Reverse Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	–65 to 150	°C
Storage Temperature	T_{stg}	–65 to 150	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dV/dt	10000	V/µs
Package Insulation Rating (AC)	V_{isol}	2500	Volts

Rev 1

3

THERMAL CHARACTERISTICS

Rating		Symbol	Max	Unit
Thermal Resistance, Junction to Case	Per Diode Per Device	$R_{\theta JC}$	1.2 0.7	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) @ i_F = 40 Amps, T_C = 25°C @ i_F = 40 Amps, T_C = 100°C @ i_F = 80 Amps, T_C = 100°C	v_F	 0.95 0.80 0.90	Volts
Instantaneous Reverse Current (1) @ Rated DC Voltage, T_C = 25°C @ Rated DC Voltage, T_C = 100°C	i_R	 0.1 20	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle < 2.0%

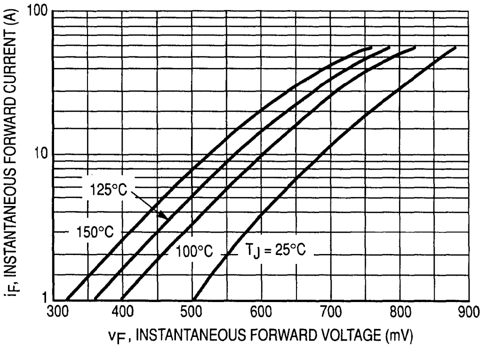


Figure 1. Typical Forward Voltage

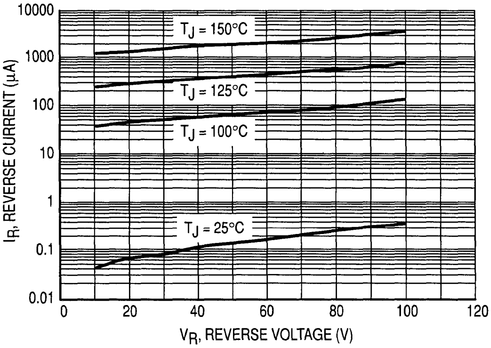


Figure 2. Typical Reverse Current

Advance Information

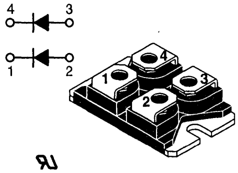
SWITCHMODE™ Schottky Power Rectifier

MBR25060V

... using the Schottky Barrier principle with a Platinum barrier metal. This state–of–the–art device has the following features:

- 60 V Blocking Voltage, Low Forward Voltage Drop
- Double Rectifier Diodes Construction: May Be Paralleled for Higher Current Output up to 100 Amp
- Guardring Construction Guarantees Stress Protection, High dV/dt Capability (10 kV/μs) and Reverse Avalanche
- Very Low Internal Parasitic Inductance (≤ 5.0 nH)
- Isolated Power Package (2500 Vac Insulation Rating)
- 150°C Operating Junction Temperature
- UL — UL Recognized, File #E69369

SCHOTTKY BARRIER RECTIFIER
100 AMPERES
60 VOLTS



SOT–227B
STYLE 2

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: MBR25060V

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	Volts
Average Rectified Forward Current — Per Diode (Rated V_R) @ T_C = 125°C — Per Device	$I_{F(AV)}$	50 100	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	150	Amps
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	800	Amps
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	–65 to 150	°C
Storage Temperature	T_{stg}	–65 to 150	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dV/dt	10000	V/μs
Package Insulation Rating (AC)	V_{isol}	2500	Volts

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	Per Diode Per Device	$R_{\theta JC}$	1.2 0.7	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) @ i_F = 50 Amps, T_C = 25°C @ i_F = 50 Amps, T_C = 100°C	v_F	0.65 0.60	Volts
Instantaneous Reverse Current (1) @ Rated DC Voltage, T_C = 25°C @ Rated DC Voltage, T_C = 100°C	i_R	0.5 20	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle < 2.0%

This document contains information on a new product. Specifications and information herein are subject to change without notice.

Rev 1

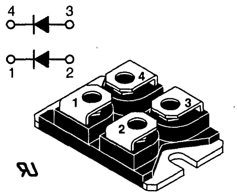
3

Advance Information

SWITCHMODE™ Schottky Power Rectifier

MBR28045V

SCHOTTKY BARRIER RECTIFIER
160 AMPERES
45 VOLTS



SOT–227B, STYLE 2

. . . using the Schottky Barrier principle with a platinum barrier metal. This state–of–the–art device has the following features:

- 45 V Blocking Voltage, Low Forward Voltage Drop
- Double Rectifier Diodes Construction: May Be Paralleled for Higher Current Output up to 160 Amp
- Guardring Construction Guarantees Stress Protection, High dV/dt Capability (10 kV/μs) and Reverse Avalanche
- Very Low Internal Parasitic Inductance (≤ 5.0 nH)
- Isolated Power Package (2500 Vac Insulation Rating)
- 175°C Operating Junction Temperature
- UL — UL Recognized, File #E69369

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 g (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: MBR28045V

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current — Per Diode (Rated V_R) @ T_C = 125°C — Per Device	$I_{F(AV)}$	80 160	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	145	Amps
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	900	Amps
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	–65 to 150	°C
Storage Temperature	T_{stg}	–65 to 150	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dV/dt	10000	V/μs
Package Insulation Rating (AC)	V_{isol}	2500	Volts

Rev 1

THERMAL CHARACTERISTICS

Rating		Symbol	Max	Unit
Thermal Resistance, Junction to Case	Per Diode Per Device	$R_{\theta JC}$	1.1 0.6	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Rating	Symbol	Max	Unit
Instantaneous Forward Voltage (1) @ i_F = 80 Amps, T_C = 25°C @ i_F = 80 Amps, T_C = 150°C @ i_F = 160 Amps, T_C = 25°C	v_F	 0.8 0.69 1.0	Volts
Instantaneous Reverse Current (1) @ Rated DC Voltage, T_C = 25°C @ Rated DC Voltage, T_C = 100°C	i_R	 1.0 80	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle < 2.0%

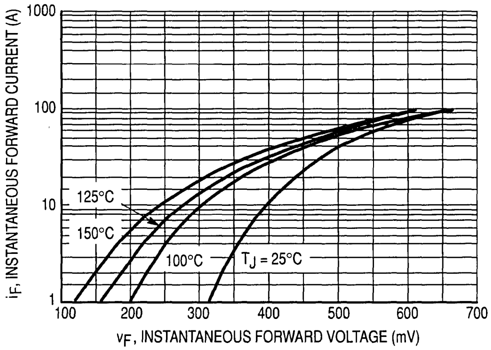


Figure 1. Typical Forward Voltage

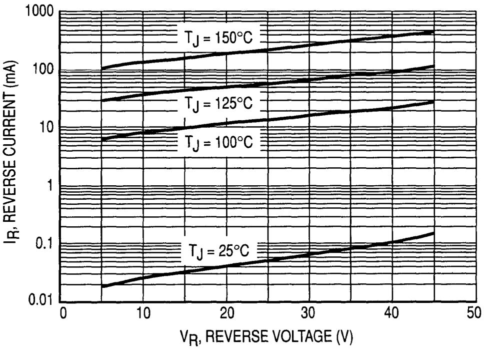


Figure 2. Typical Reverse Current

Switchmode™ Power Rectifier

MBRB3030CT

Motorola Preferred Device

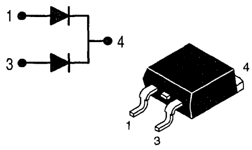
Using the Schottky Barrier principle with a proprietary barrier metal. These state–of–the–art devices have the following features:

- Guardring for Stress Protection
- Maximum Die Size
- 150°C Operating Junction Temperature
- Short Heat Sink Tab Manufactured – Not Sheared

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 Units per Plastic Tube
- Available in 24 mm Tape and Reel, 800 Units per 13" Reel by Adding a "T4" Suffix to the Part Number
- Marking: B3030

SCHOTTKY BARRIER RECTIFIER
30 AMPERES
30 VOLTS



CASE 418B–02
D^2PAK

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	V
Average Rectified Forward Current Per Device (At Rated V_R) T_C = +134°C) Per Leg	$I_{F(AV)}$	30 15	A
Peak Repetitive Forward Current, Per Leg (At Rated V_R, Square Wave, 20 kHz) T_C = +137°C	I_{FRM}	30	A
Nonrepetitive Peak Surge Current (Surge Applied at Rated Load Conditions Halfwave, Single Phase, 60 Hz)	I_{FSM}	200	A
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	A
Storage Temperature	T_{stg}	– 55 to +150	°C
Operating Junction Temperature	T_J	– 55 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/μs
Reverse Energy (Unclamped Inductive Surge) (Inductance = 3 mH), T_C = 25°C	W	100	mJ

THERMAL CHARACTERISTICS

Thermal Resistance – Junction to Case	$R_{\theta JC}$	1.0	°C/W
Thermal Resistance – Junction to Ambient (1)	$R_{\theta JA}$	50	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2), per Leg (I_F = 15 A, T_C = + 25°C) (I_F = 15 A, T_C = +150°C) (I_F = 30 A, T_C = + 25°C) (I_F = 30 A, T_C = +150°C)	V_F	 0.54 0.47 0.67 0.66	V
Maximum Instantaneous Reverse Current (2), per Leg (Rated DC Voltage, T_C = + 25°C) (Reverse Voltage = 10 V, T_C = +150°C) (Rate DC Voltage, T_C = +150°C)	I_R	 0.6 46 145	mA

1. When mounted using minimum recommended pad size on FR–4 board.
2. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Preferred devices are Motorola recommended choices for future use and best overall value.

Electrical Characteristics

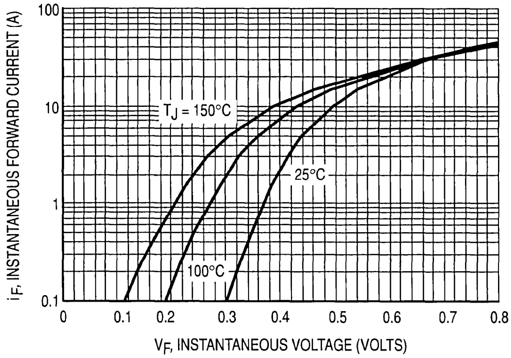


Figure 1. Maximum Forward Voltage, Per Leg

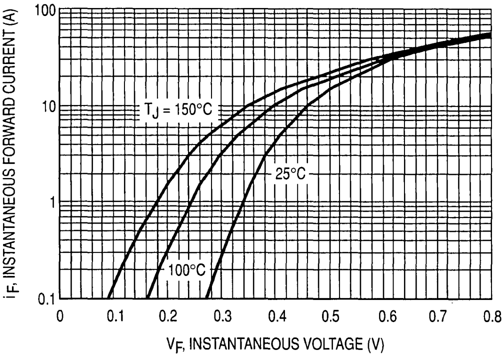


Figure 2. Typical Forward Voltage, Per Leg

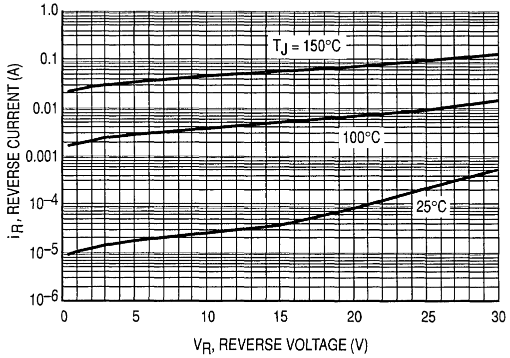


Figure 3. Maximum Reverse Current, Per Leg

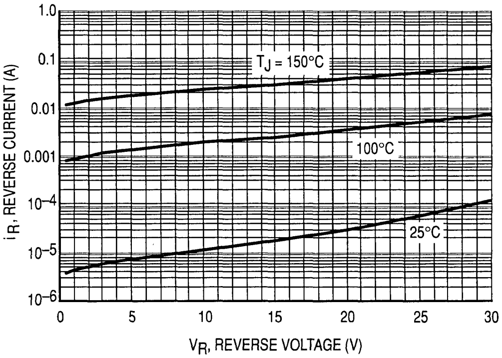


Figure 4. Typical Reverse Current, Per Leg

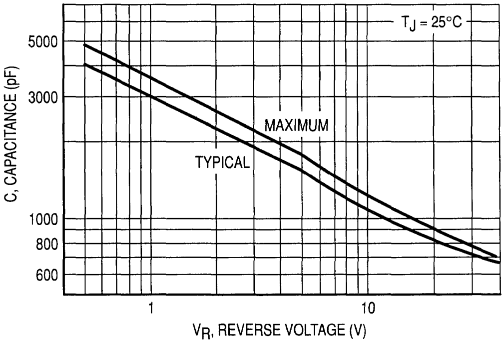


Figure 5. Capacitance

3

Typical Characteristics

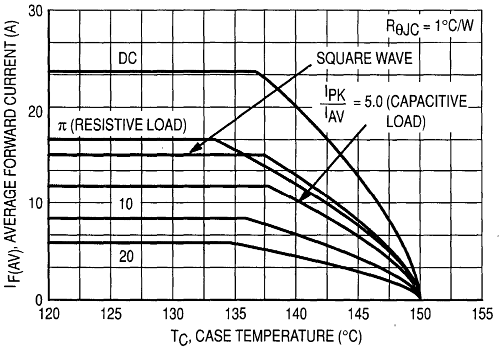


Figure 6. Current Derating, Infinite Heatsink

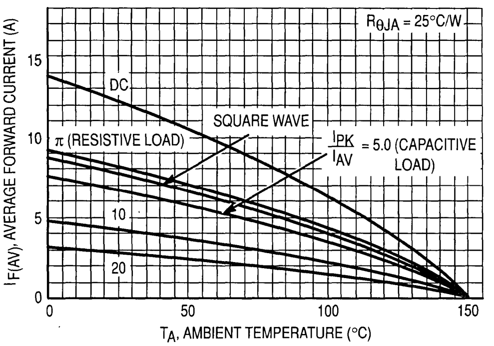


Figure 7. Current Derating

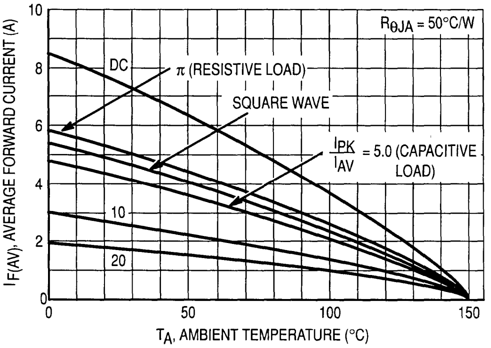


Figure 8. Current Derating, Free Air

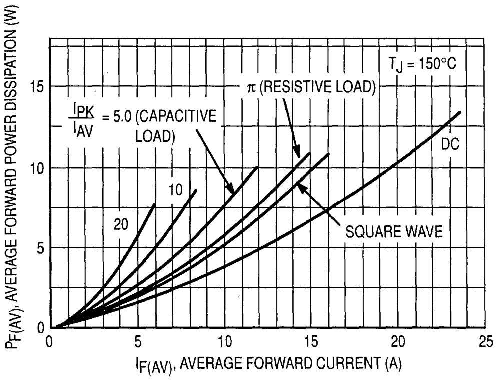


Figure 9. Forward Power Dissipation

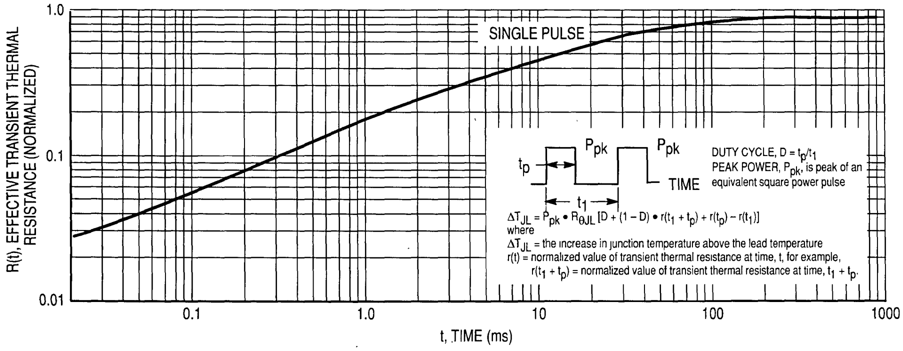


Figure 10. Thermal Response

MBRB4030

Motorola Preferred Device

Switchmode Power Rectifier

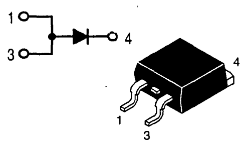
Using the Schottky Barrier principle with a proprietary barrier metal. These state–of–the–art devices have the following features:

- Guardring for Stress Protection
- Maximum Die Size
- 150°C Operating Junction Temperature
- Short Heat Sink Tab Manufactured – Not Sheared

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 Grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads Readily Solderable
- Shipped 50 Units per Plastic Tube
- Available in 24 mm Tape and Reel, 800 Units per 13″ Reel by Adding a "T4" Suffix to the Part Number
- Marking: B4030

SCHOTTKY BARRIER RECTIFIER
40 AMPERES
30 VOLTS



CASE 418B–02
D^2PAK

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	V
Average Rectified Forward Current (At Rated V_R) T_C = +115°C (1)	$I_{F(AV)}$	40	A
Peak Repetitive Forward Current (At Rated V_R, Square Wave, 20 kHz) T_C = + 112°C	I_{FRM}	80	A
Nonrepetitive Peak Surge Current (Surge Applied at Rated Load Conditions Halfwave, Single Phase, 60 Hz)	I_{FSM}	300	A
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	A
Storage Temperature	T_{stg}	– 65 to +150	°C
Operating Junction Temperature	T_J	– 65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/µs
Reverse Energy (Unclamped Inductive Surge) (Inductance = 3 mH), T_c = 25°C	W	600	mJ

THERMAL CHARACTERISTICS

Thermal Resistance – Junction to Case	$R_{\theta JC}$	1.0	°C/W
Thermal Resistance – Junction to Ambient (2)	$R_{\theta JA}$	50	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1 and 3), per Device (I_F = 20 A, T_C = + 25°C) (I_F = 20 A, T_C = +150°C) (I_F = 40 A, T_C = + 25°C) (I_F = 40 A, T_C = +150°C)	V_F	 0.46 0.34 0.55 0.45	V
Maximum Instantaneous Reverse Current (3), per Device (Rated DC Voltage, T_C = + 25°C) (Rated DC Voltage, T_C = +125°C)	I_R	 0.35 150	mA

NOTES:
1. Rating applies when pins 1 and 3 are connected.
2. Rating applies when surface mounted on the miniumum pad size recommended.
3. Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%

Preferred devices are Motorola recommended choices for future use and best overall value.

Electrical Characteristics

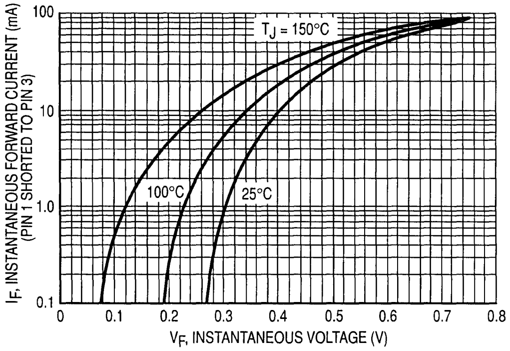


Figure 1. Maximum Forward Voltage

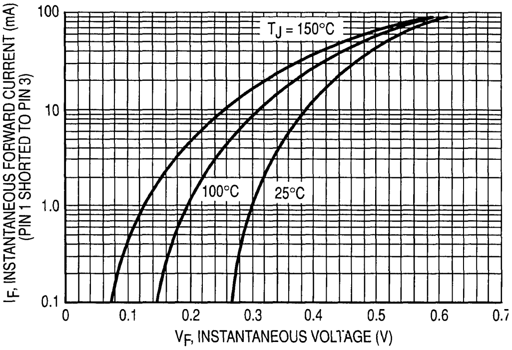


Figure 2. Typical Forward Voltage

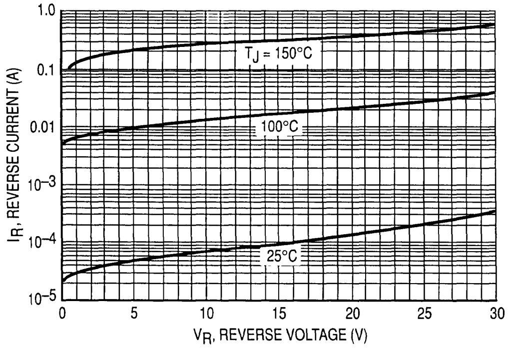


Figure 3. Maximum Reverse Current

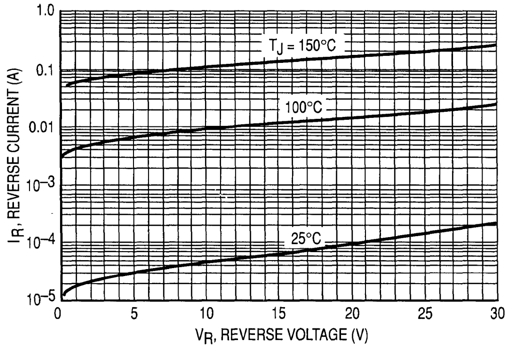


Figure 4. Typical Reverse Current

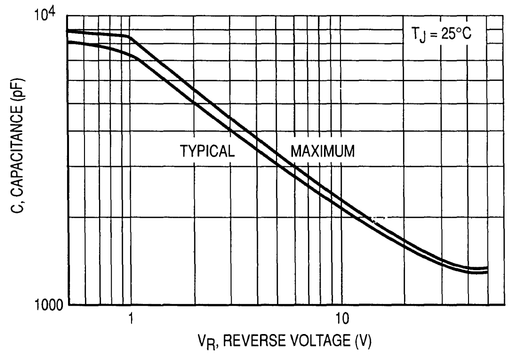


Figure 5. Maximum and Typical Capacitance

Electrical Characteristics

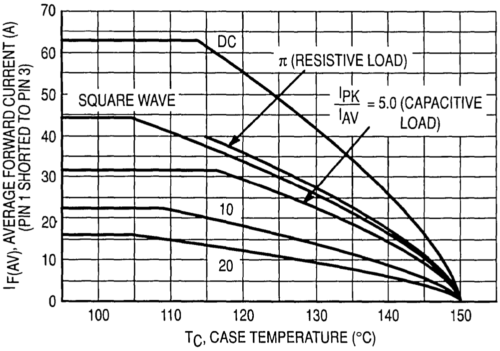


Figure 6. Current Derating, Infinite Heatsink

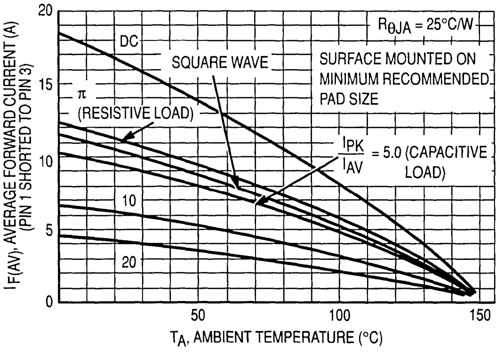


Figure 7. Current Derating

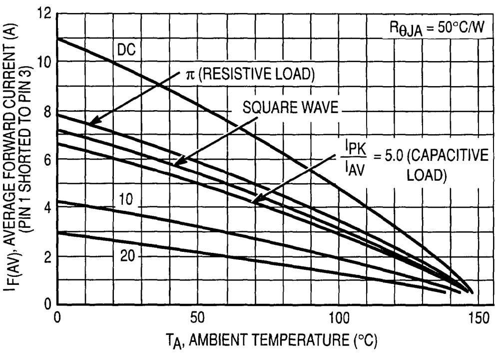


Figure 8. Current Derating, Free Air

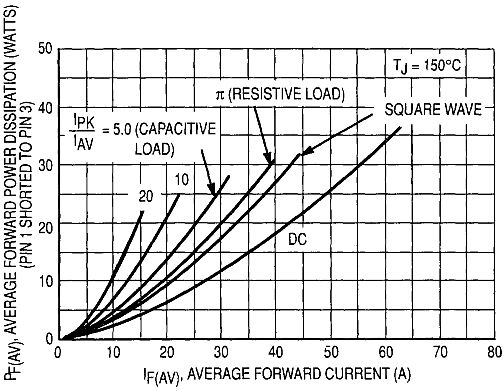


Figure 9. Forward Power Dissipation

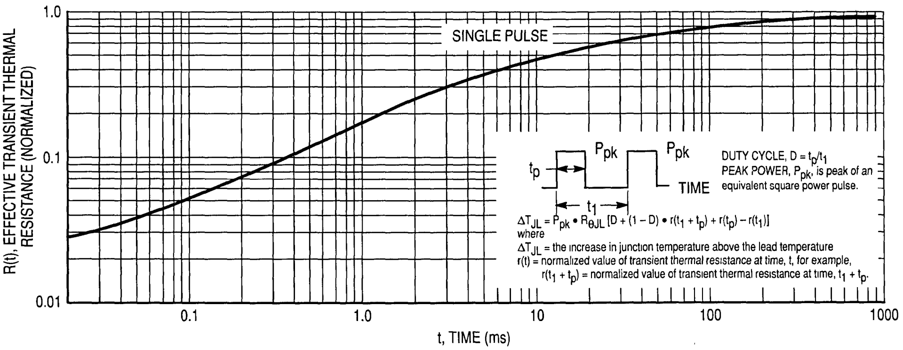


Figure 10. Thermal Response

Section 4

Ultrafast Data Sheets

4

Surface Mount Ultrafast Power Rectifiers

MURS120T3
MURS160T3

Motorola Preferred Devices

Ideally suited for high voltage, high frequency rectification, or as free wheeling and protection diodes in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- High Temperature Glass Passivated Junction
- Low Forward Voltage Drop (0.71 to 1.05 Volts Max @ 1.0 A, T_J = 150°C)

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 95 mg (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped in 12 mm Tape and Reel, 2500 units per reel
- Polarity: Notch in Plastic Body Indicates Cathode Lead
- Marking: U1D, U1J

ULTRAFAST RECTIFIERS
1.0 AMPERE
200–600 VOLTS

CASE 403A-03

4

MAXIMUM RATINGS

Rating	Symbol	MURS 120T3	MURS 160T3	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	600	Volts
Average Rectified Forward Current	$I_{F(AV)}$	1.0 @ T_L = 155°C 2.0 @ T_L = 145°C	1.0 @ T_L = 150°C 2.0 @ T_L = 125°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	40	35	Amps
Operating Junction Temperature	T_J	−65 to +175		°C

THERMAL CHARACTERISTICS

Rating	Symbol	MURS 120T3	MURS 160T3	Unit
Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{\theta JL}$	13		°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	MURS 120T3	MURS 160T3	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C) (i_F = 1.0 A, T_J = 150°C)	v_F	 0.875 0.71	 1.25 1.05	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 150°C)	i_R	 2.0 50	 5.0 150	μA
Maximum Reverse Recovery Time (i_F = 1.0 A, di/dt = 50 A/μs) (i_F = 0.5 A, i_R = 1.0 A, I_R to 0.25 A)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (i_F = 1.0 A, di/dt = 100 A/μs, Rec. to 1.0 V)	t_{fr}	25	50	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 2

MURS120T3

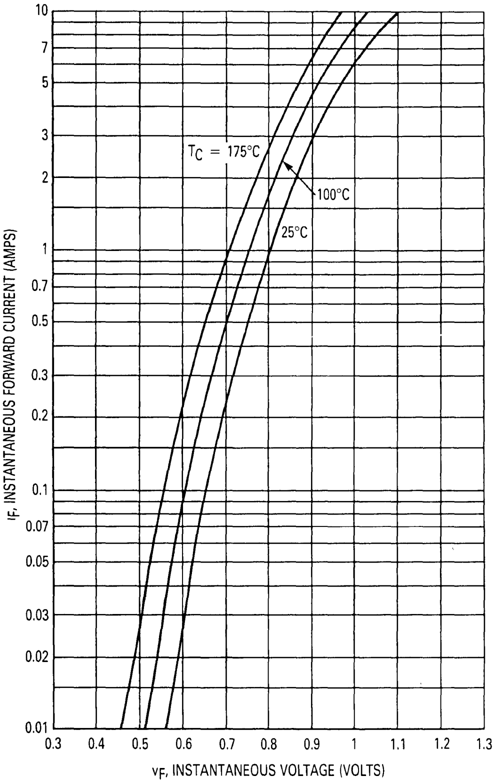


Figure 1. Typical Forward Voltage

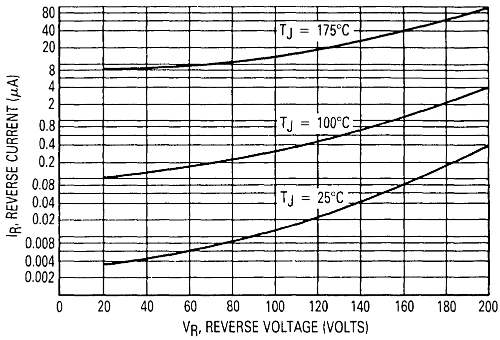


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if applied V_R is sufficiently below rated V_R.

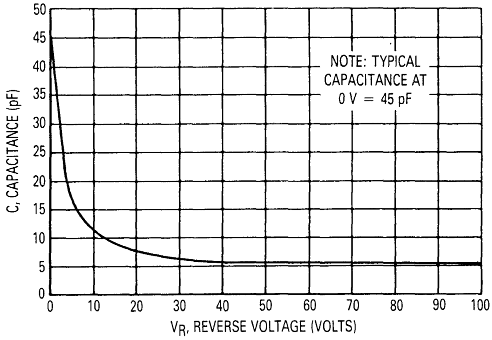


Figure 3. Typical Capacitance

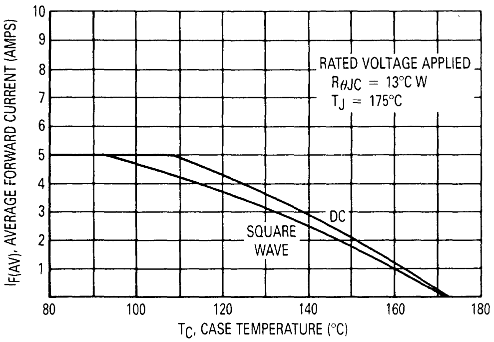


Figure 4. Current Derating, Case

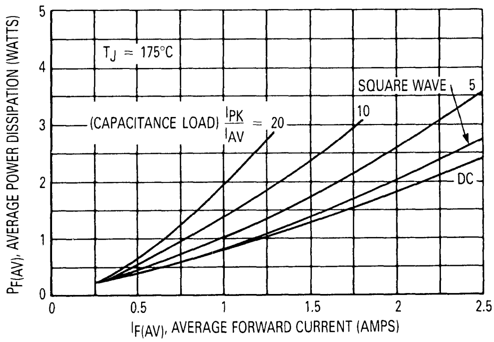


Figure 5. Power Dissipation

MURS160T3

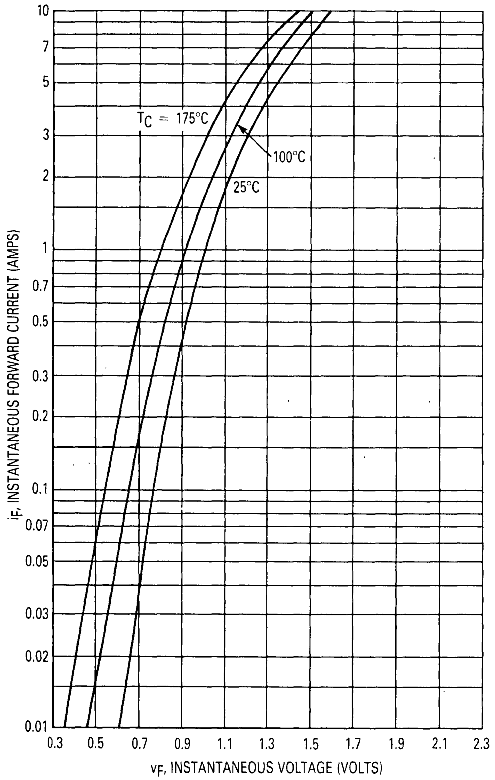


Figure 6. Typical Forward Voltage

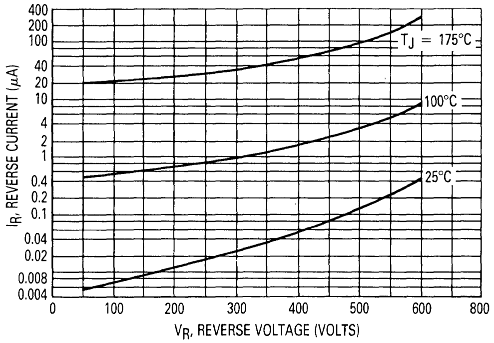


Figure 7. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if applied V_R is sufficiently below rated V_R.

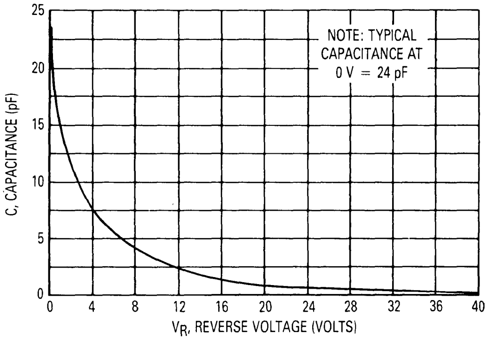


Figure 8. Typical Capacitance

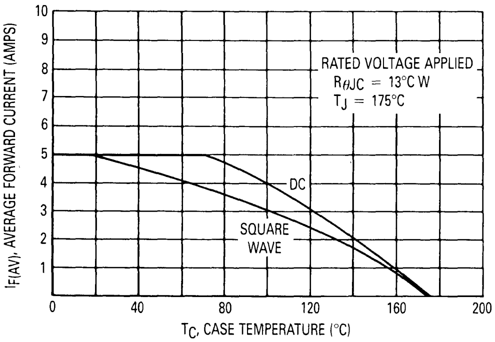


Figure 9. Current Derating, Case

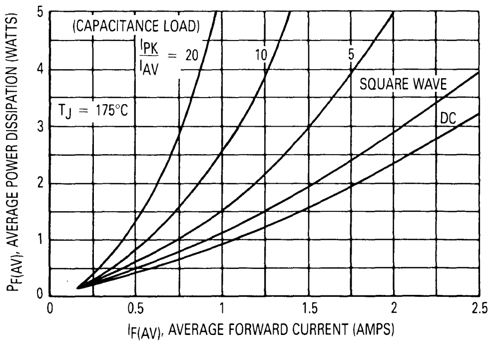


Figure 10. Power Dissipation

Surface Mount
Ultrafast Power Rectifiers

MURS320T3
MURS360T3

Motorola Preferred Devices

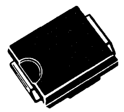
. . . employing state-of-the-art epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for high voltage, high frequency rectification, or as free wheeling and protection diodes, in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Highly Stable Oxide Passivated Junction
- Low Forward Voltage Drop (0.71 to 1.05 Volts Max @ 3.0 A, T_J = 150°C)

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 217 mg (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped in 16 mm Tape and Reel, 2500 units per reel
- Polarity: Notch in Plastic Body Indicates Cathode Lead
- Marking: U3D, U3J

ULTRAFAST RECTIFIERS
3.0 AMPERES
200–600 VOLTS



CASE 403-03

4

MAXIMUM RATINGS

Rating	Symbol	MURS 320T3	MURS 360T3	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	600	Volts
Average Rectified Forward Current	$I_{F(AV)}$	3.0 @ T_L = 140°C 4.0 @ T_L = 130°C	3.0 @ T_L = 130°C 4.0 @ T_L = 115°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	75		Amps
Operating Junction Temperature	T_J	−65 to +175		°C

THERMAL CHARACTERISTICS

Rating	Symbol	MURS 320T3	MURS 360T3	Unit
Thermal Resistance — Junction to Lead	$R_{\theta JL}$	11		°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	MURS 320T3	MURS 360T3	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 3.0 A, T_J = 25°C) (i_F = 4.0 A, T_J = 25°C) (i_F = 3.0 A, T_J = 150°C)	v_F	 0.875 0.89 0.71	 1.25 1.28 1.05	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 150°C)	i_R	 5.0 15	 10 250	μA
Maximum Reverse Recovery Time (I_F = 1.0 A, di/dt = 50 A/μs) (I_F = 0.5 A, i_R = 1.0 A, I_{REC} to 0.25 A)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (I_F = 1.0 A, di/dt = 100 A/μs, Recovery to 1.0 V)	t_{fr}	25	50	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 2

MURS320T3

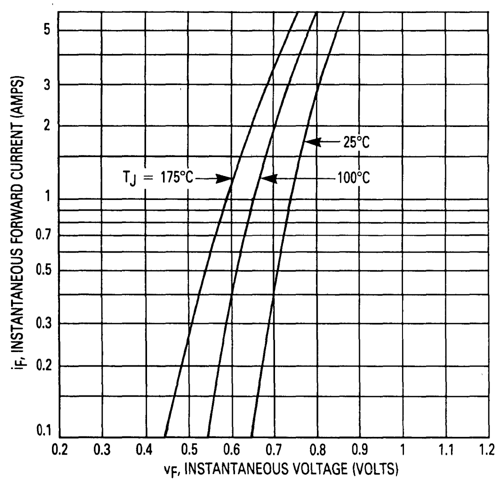


Figure 1. Typical Forward Voltage

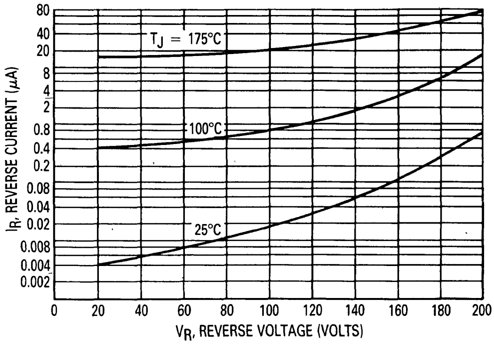


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

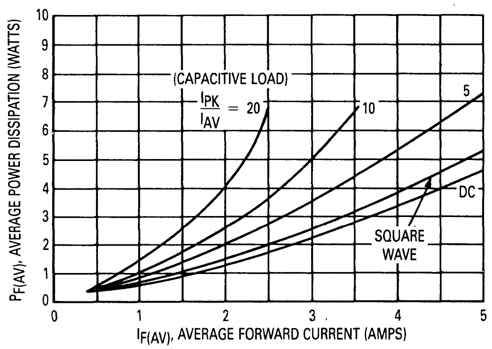


Figure 3. Power Dissipation

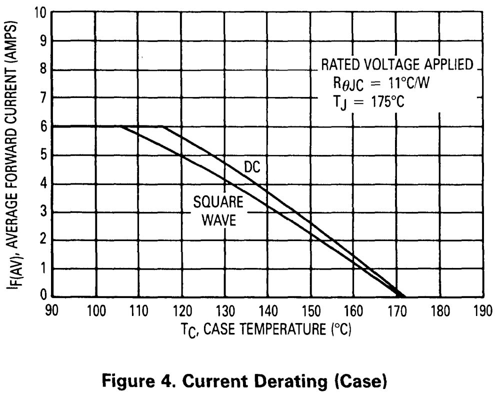


Figure 4. Current Derating (Case)

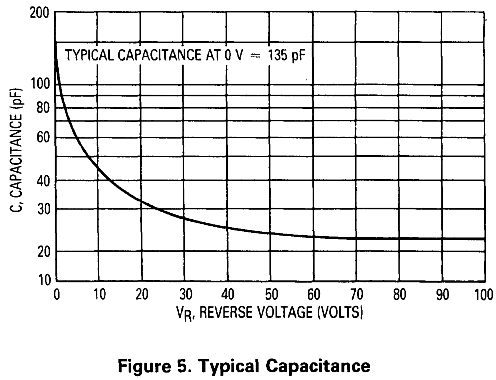


Figure 5. Typical Capacitance

MURS360T3

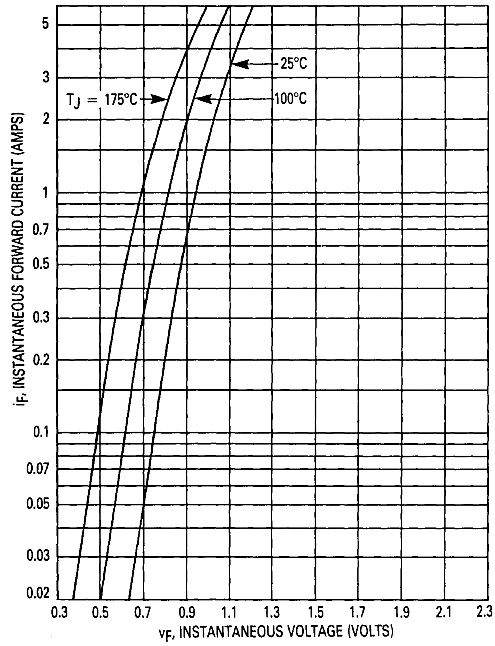


Figure 6. Typical Forward Voltage

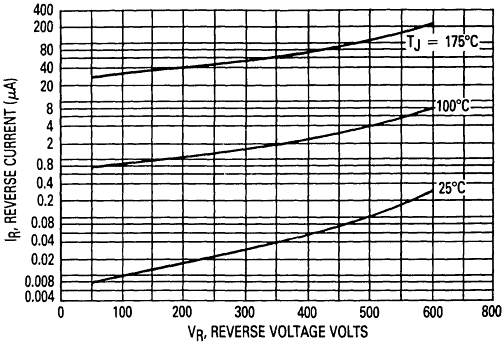


Figure 7. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

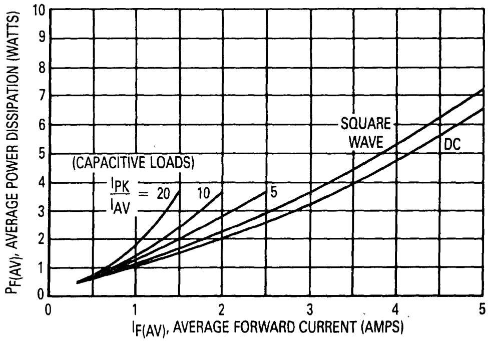


Figure 8. Power Dissipation

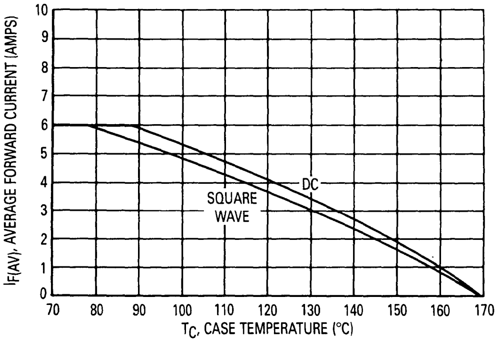


Figure 9. Current Derating (Case)

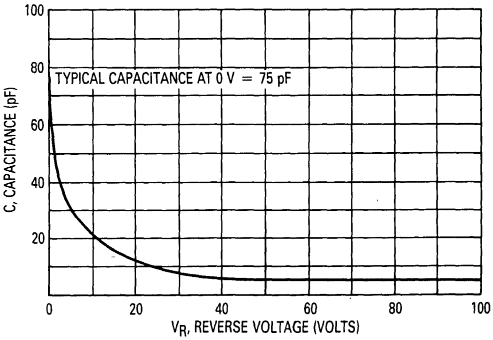


Figure 10. Typical Capacitance

4

SWITCHMODE Power Rectifiers
DPAK Surface Mount Package

MURD320

MURD320 is a Motorola Preferred Device

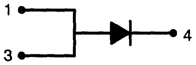
**ULTRAFAST RECTIFIERS
3 AMPERES
200 VOLTS**

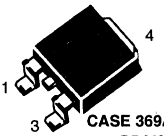
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Low Leakage

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 75 units per plastic tube
- Available in 16 mm Tape and Reel, 2500 units per reel, by adding a “T4” suffix to the part number
- Marking: U320





CASE 369A-13
DPAK

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current (T_C = 158°C, Rated V_R)	$I_{F(AV)}$	3	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz, T_C = 158°C)	I_{FRM}	6	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, 60 Hz)	I_{FSM}	75	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	6 80	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage Drop (2) (i_F = 3 Amps, T_J = 25°C) (i_F = 3 Amps, T_J = 125°C)	v_F	 0.95 0.75	Volts
Maximum Instantaneous Reverse Current (2) (T_J = 25°C, Rated dc Voltage) (T_J = 125°C, Rated dc Voltage)	i_R	 5 500	µA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/µs, V_R = 30 V, T_J = 25°C) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 A, V_R = 30 V, T_J = 25°C)	t_{rr}	 35 25	ns

(1) Rating applies when surface mounted on the minimum pad sizes recommended.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Rev 1

TYPICAL CHARACTERISTICS

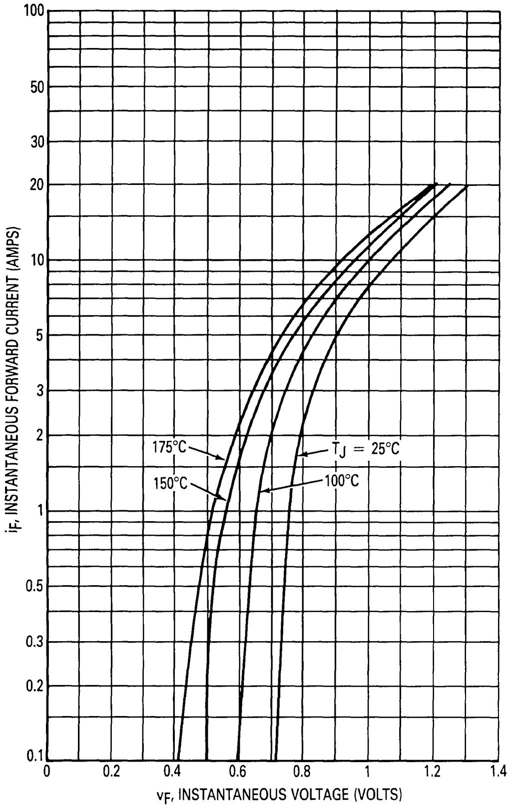
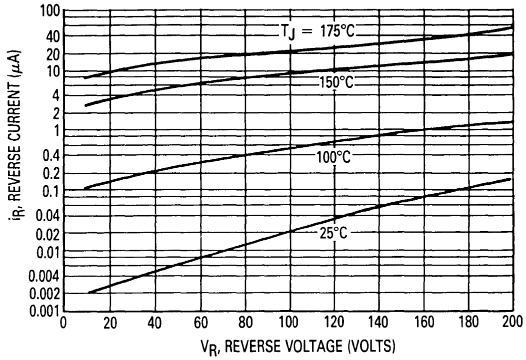


Figure 1. Typical Forward Voltage



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Reverse Current*

4

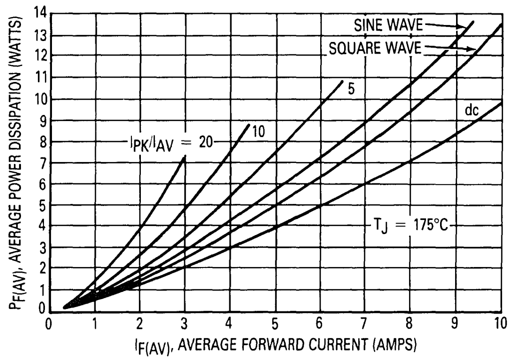


Figure 3. Average Power Dissipation

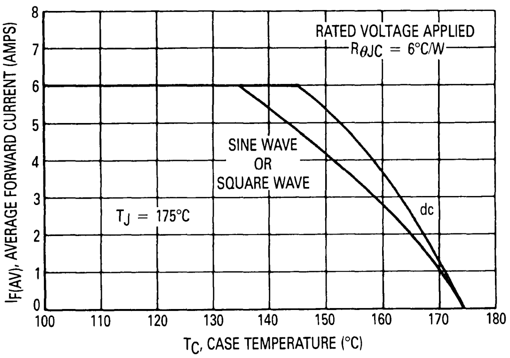


Figure 4. Current Derating, Case

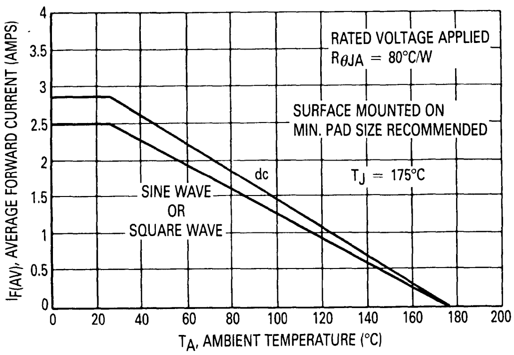


Figure 5. Current Derating, Ambient

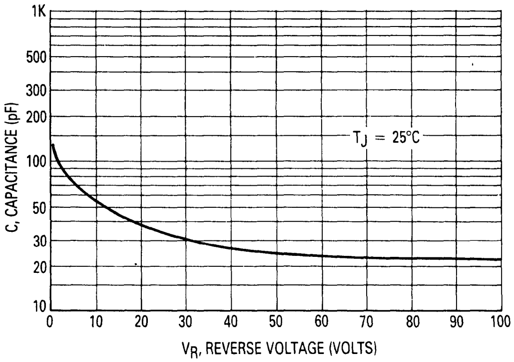


Figure 6. Typical Capacitance

4

SWITCHMODE Power Rectifiers
DPAK Surface Mount Package

MURD620CT

MURD620CT is a Motorola Preferred Device

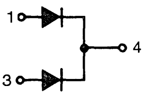
**ULTRAFAST RECTIFIERS
6 AMPERES
200 VOLTS**

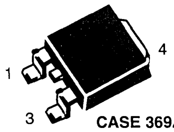
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Low Leakage

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 75 units per plastic tube
- Available in 16 mm Tape and Reel, 2500 units per reel, by adding a "T4" suffix to the part number
- Marking: U620T





CASE 369A-13
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Voltage (T_C = 140°C, Rated V_R) Per Diode Per Device	$I_{F(AV)}$	3 6	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz, T_C = 145°C) Per Diode	I_F	6	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, 60 Hz)	I_{FSM}	50	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS PER DIODE

Thermal Resistance, Junction to Case Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	9 80	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage Drop (2) i_F = 3 Amps, T_C = 25°C i_F = 3 Amps, T_C = 125°C i_F = 6 Amps, T_C = 25°C i_F = 6 Amps, T_C = 125°C	v_F	 1 0.96 1.2 1.13	Volts
Maximum Instantaneous Reverse Current (2) (T_J = 25°C, Rated dc Voltage) (T_J = 125°C, Rated dc Voltage)	i_R	 5 250	μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/μs, V_R = 30 V, T_J = 25°C) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 A, V_R = 30 V, T_J = 25°C)	t_{rr}	 35 25	ns

(1) Rating applies when surface mounted on the minimum pad sizes recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Rev 1

4

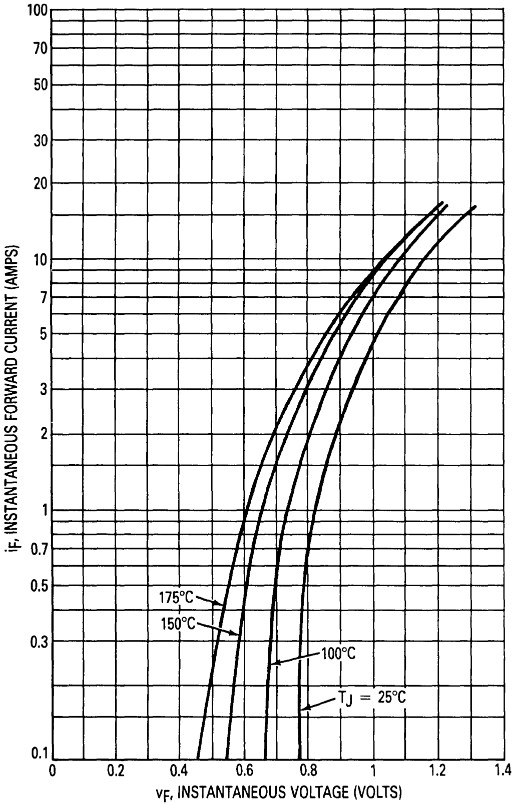
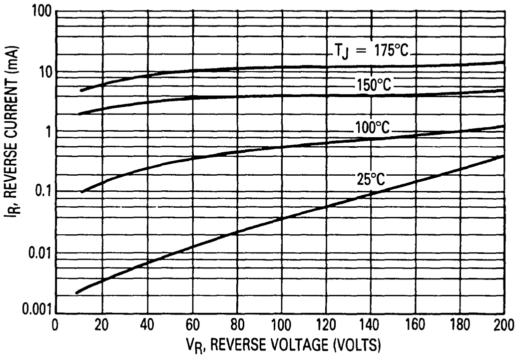


Figure 1. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Leakage Current* (Per Leg)

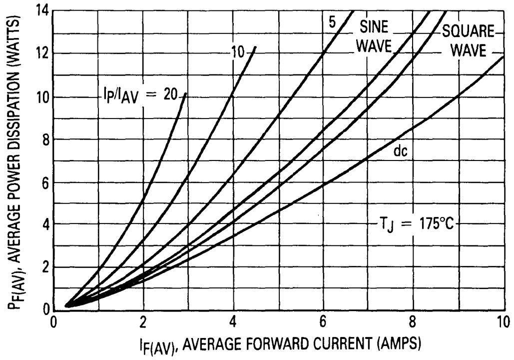


Figure 3. Average Power Dissipation (Per Leg)

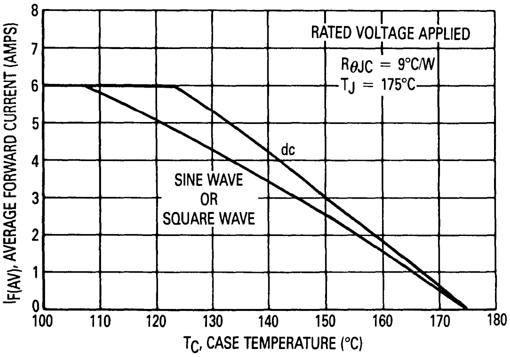


Figure 4. Current Derating, Case (Per Leg)

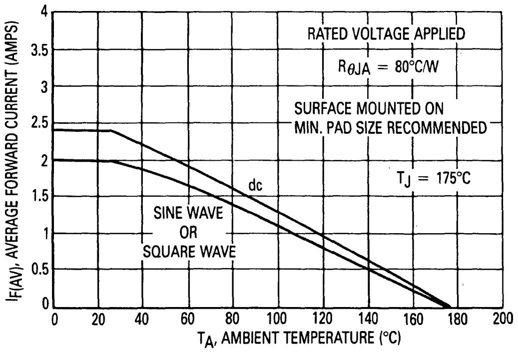


Figure 5. Current Derating, Ambient (Per Leg)

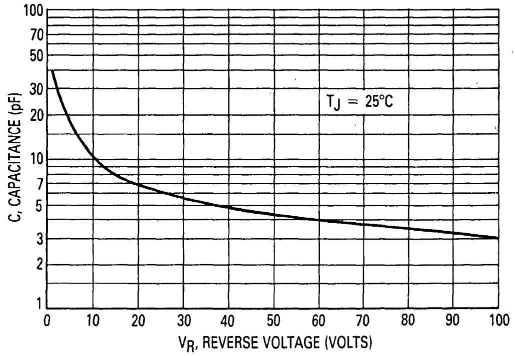


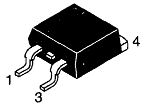
Figure 6. Typical Capacitance (Per Leg)

Designer's™ Data Sheet
SWITCHMODE™ Power Rectifiers
D2PAK Power Surface Mount Package

MURHB840CT

Motorola Preferred Device

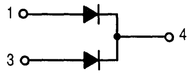
ULTRAFAST RECTIFIER
8.0 AMPERES
400 VOLTS



CASE 418B–02
D2PAK

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Ultrafast 28 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability
- Low Leakage Specified @ 150°C Case Temperature
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to Industry Standard TO–220 Package



Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per reel by adding a "T4" suffix to the part number
- Marking: UH840

4

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	400	Volts
Average Rectified Forward Current (Rated V_R), T_C = 120°C Total Device	$I_{F(AV)}$	4.0 8.0	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 120°C	I_{FM}	8	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Controlled Avalanche Energy	W_{AVAL}	20	mJ
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	–65 to +175	°C

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	3.0 50	°C/W

(1) See Chapter 7 for mounting conditions

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Rev 1

4

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic		Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (2)	(i_F = 4.0 Amps, T_C = 150°C) (i_F = 4.0 Amps, T_C = 25°C)	v_F	1.9 2.2	Volts
Maximum Instantaneous Reverse Current (2)	(Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	500 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)		t_{rr}	28	ns

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%

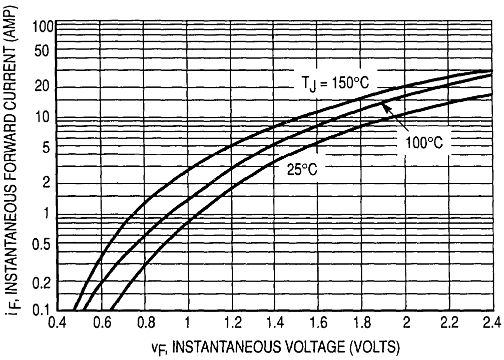


Figure 1. Typical Forward Voltage

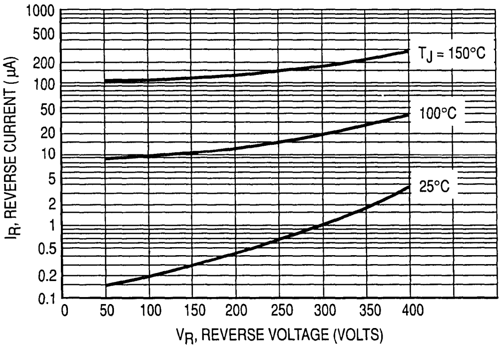


Figure 2. Typical Reverse Current, Per Leg

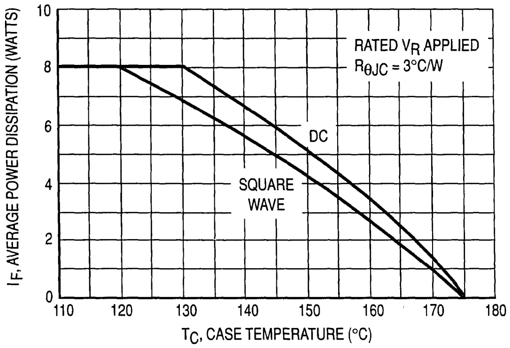


Figure 3. Current Derating, Case

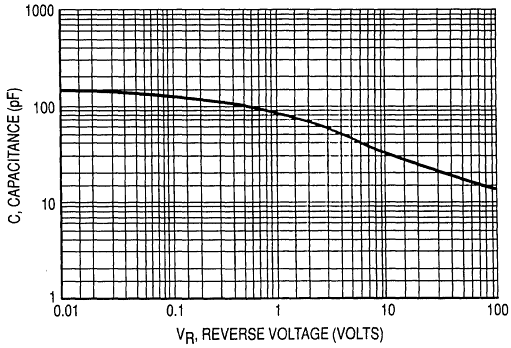


Figure 4. Typical Capacitance, Per Leg

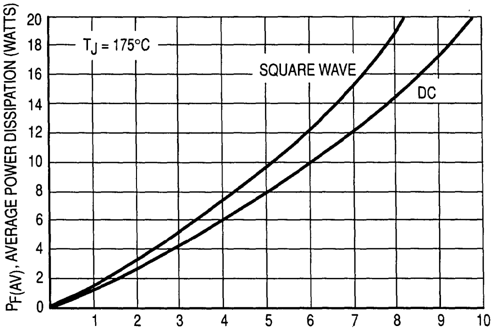
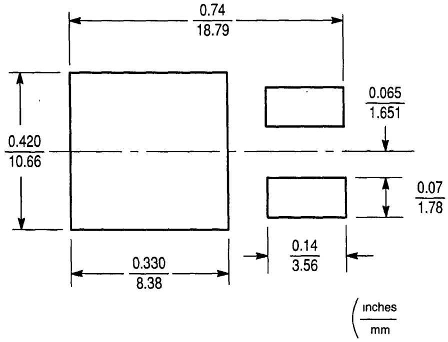


Figure 5. Forward Power Dissipation, Per Leg

INFORMATION FOR USING THE D2PAK SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



D2PAK POWER DISSIPATION

The power dissipation of the D2PAK is a function of the drain pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient; and the operating temperature, T_A. Using the values provided on the data sheet for the D2PAK package, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device which in this case is 3.0 watts.

$$P_D = \frac{175°C - 25°C}{50°C/W} = 3.0 \text{ watts}$$

The 50°C/W for the D2PAK package assumes the recommended drain pad area of 158K mil^2 on FR–4 glass epoxy printed circuit board to achieve a power dissipation of 3.0 watts using the footprint shown. Another alternative is to use a ceramic substrate or an aluminum core board such as Thermal Clad™. By using an aluminum core board material such as Thermal Clad, the power dissipation can be doubled using the same footprint.

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Designer's™ Data Sheet
SWITCHMODE™ Power Rectifiers
D2PAK Power Surface Mount Package

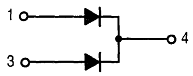
MURB1620CT

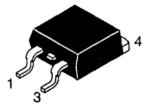
Motorola Preferred Device

ULTRAFAST RECTIFIERS
16 AMPERES
200 VOLTS

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Ultrafast 35 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Short Heat Sink Tab Manufactured – Not Sheared!
- Similar in Size to Industrial Standard TO–220 Package





CASE 418B–02
D2PAK

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per reel by adding a "T4" suffix to the part number
- Marking: U1620T

4

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C — Total Device	$I_{F(AV)}$	8 16	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	– 65 to +175	°C

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3	°C/W
Maximum Thermal Resistance, Junction to Ambient(1)	$R_{\theta JA}$	50	°C/W
Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) See Chapter 7 for Mounting Conditions.

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves —representing boundaries on device characteristics — are given to facilitate "worst case" design.

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ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 8 Amp, T_C = 150°C) (i_F = 8 Amp, T_C = 25°C)	v_F	 0.895 0.975	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 250 5	μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25	ns

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

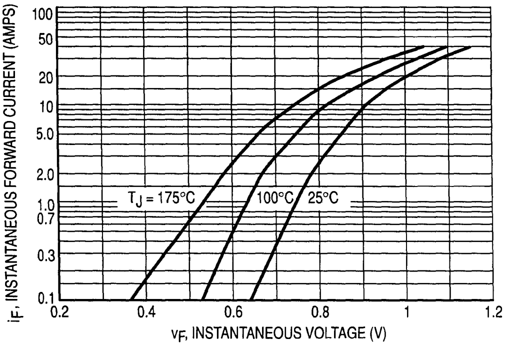


Figure 1. Typical Forward Voltage, Per Leg

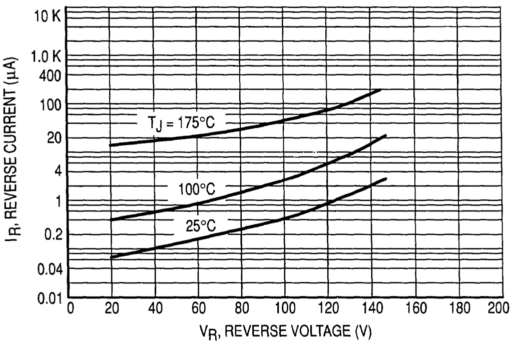


Figure 2. Typical Reverse Current, Per Leg*

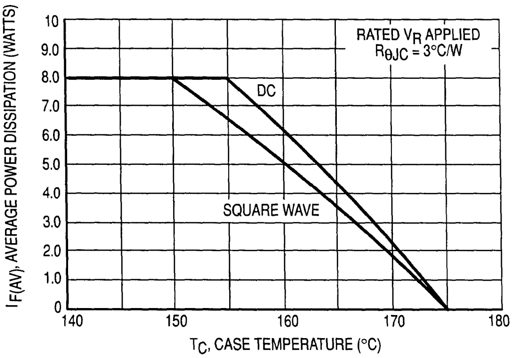


Figure 3. Current Derating Case, Per Leg

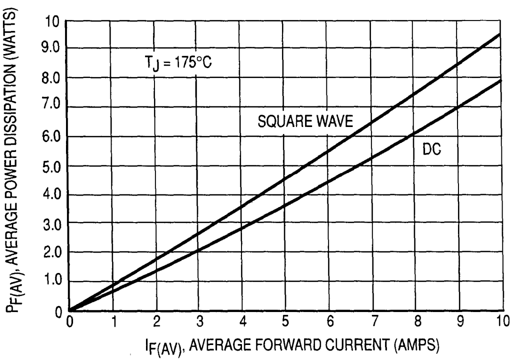


Figure 4. Power Dissipation, Per Leg

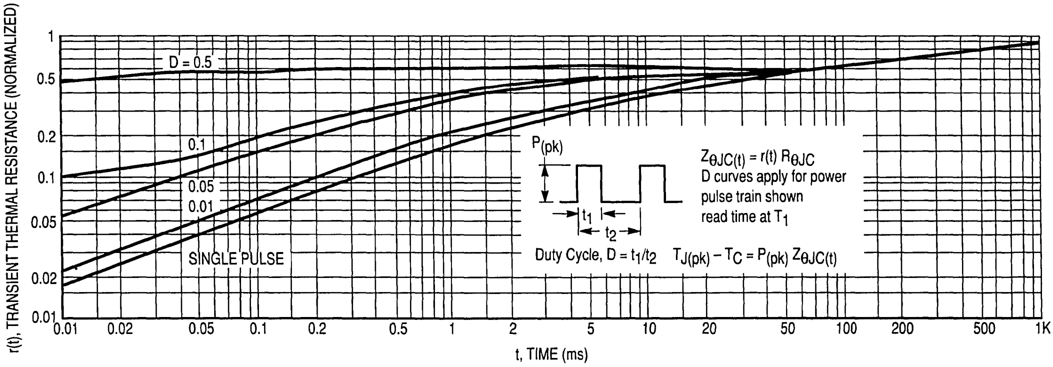


Figure 5. Thermal Response

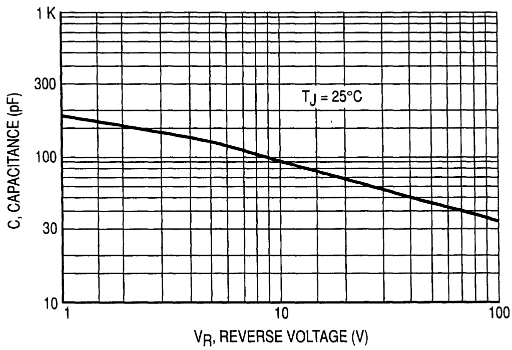


Figure 6. Typical Capacitance, Per Leg

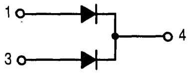
Designer's™ Data Sheet
SWITCHMODE™ Power Rectifiers
D2PAK Power Surface Mount Package

MURB1660CT

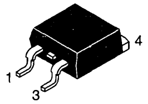
Motorola Preferred Device

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Ultrafast 60 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 600 V
- Low Leakage Specified @ 150°C Case Temperature
- Short Heat Sink Tab Manufactured – Not Sheared!
- Similar in Size to Industrial Standard TO–220 Package



ULTRAFAST RECTIFIERS
16 AMPERES
600 VOLTS



CASE 418B–02
D2PAK

Mechanical Characteristics
- Case: Epoxy, Molded
- Weight: 1.7 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Available in 24 mm Tape and Reel, 800 units per reel by adding a "T4" suffix to the part number
- Marking: U1660T

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	600	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C — Total Device	$I_{F(AV)}$	8 16	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	– 65 to +175	°C

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2	°C/W
Maximum Thermal Resistance, Junction to Ambient(1)	$R_{\theta JA}$	50	°C/W
Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) See Chapter 7 for Mounting Conditions

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 8 Amp, T_C = 150°C) (i_F = 8 Amp, T_C = 25°C)	v_F	 1.20 1.50	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 60 50	ns

(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%

4

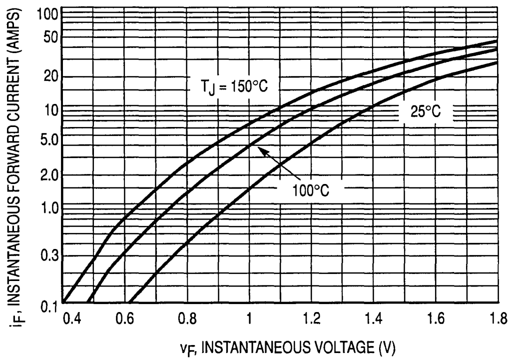


Figure 1. Typical Forward Voltage, Per Leg

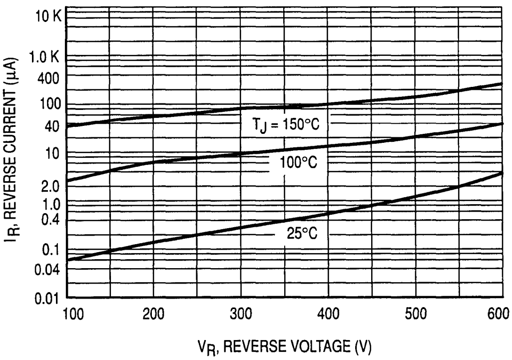


Figure 2. Typical Reverse Current, Per Leg

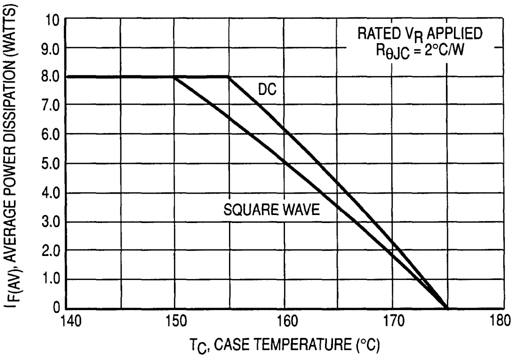


Figure 3. Current Derating, Case, Per Leg

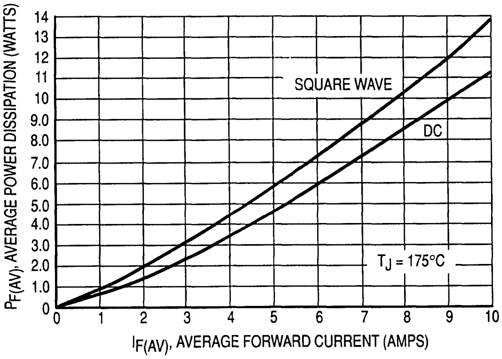


Figure 4. Power Dissipation, Per Leg

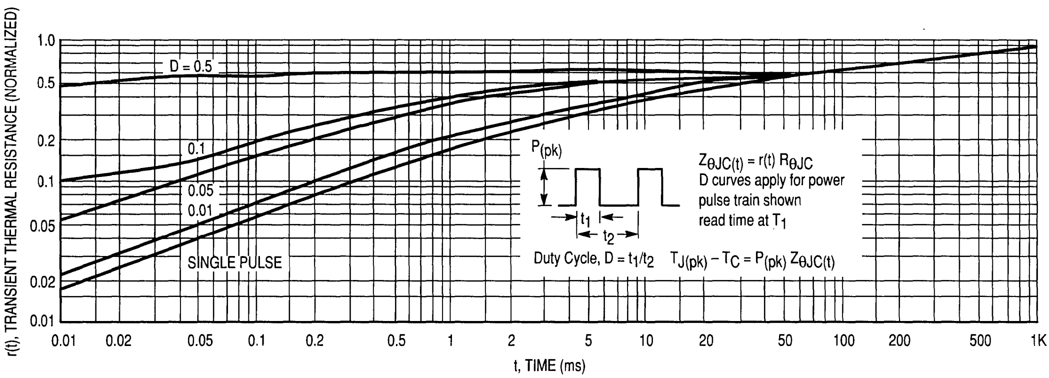


Figure 5. Thermal Response

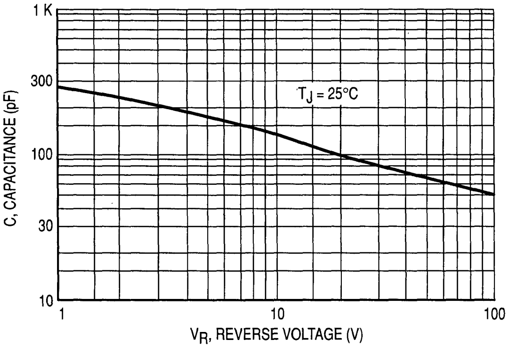


Figure 6. Typical Capacitance, Per Leg

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR120
MUR140
MUR160

MUR120, MUR140 and MUR160 are Motorola Preferred Devices

Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

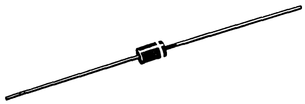
- Ultrafast 25, 50 and 75 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a “RL” suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: U120, U140, U160

ULTRAFAST RECTIFIERS

1.0 AMPERE
200–400–600 VOLTS



CASE 59-04
PLASTIC

4

MAXIMUM RATINGS

Rating	Symbol	MUR 120	MUR 140	MUR 160	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current (Square Wave Mounting Method #3 Per Note 1)	$I_{F(AV)}$	1.0 @ T_A = 130°C	1.0 @ T_A = 120°C		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}		35		Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}		– 65 to +175		°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MUR120	MUR140, MUR160	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 Amp, T_J = 150°C) (i_F = 1.0 Amp, T_J = 25°C)	v_F	 0.710 0.875	 1.05 1.25	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 150°C) (Rated dc Voltage, T_J = 25°C)	i_R	 50 2.0	 150 5.0	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 A)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (I_F = 1.0 A, di/dt = 100 A/μs, I_{REC} to 1.0 V)	t_{fr}	25	50	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 3

MUR120

FIGURE 1 — TYPICAL FORWARD VOLTAGE

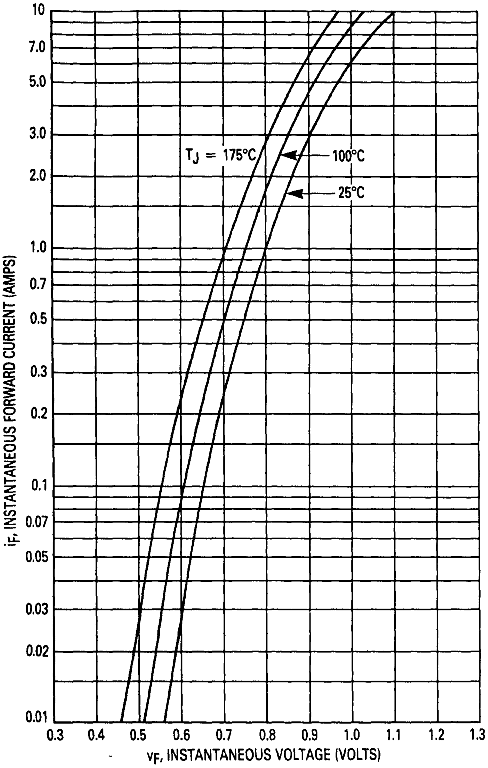


FIGURE 2 — TYPICAL REVERSE CURRENT*

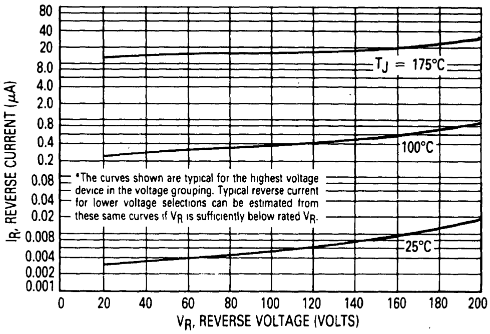


FIGURE 3 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

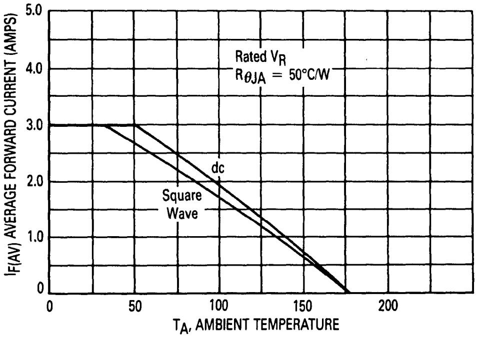


FIGURE 4 — POWER DISSIPATION

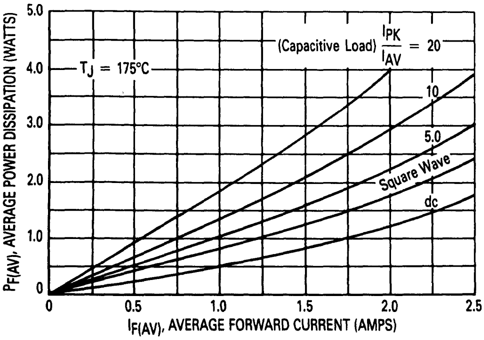
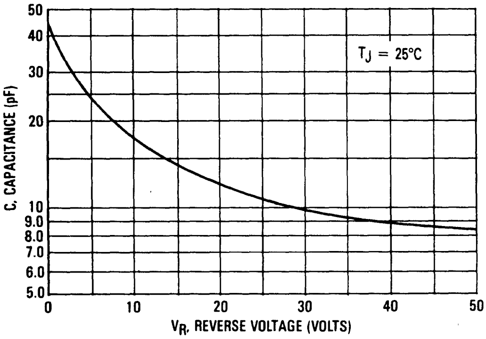


FIGURE 5 — TYPICAL CAPACITANCE



4

MUR140, MUR160

FIGURE 6 — TYPICAL FORWARD VOLTAGE

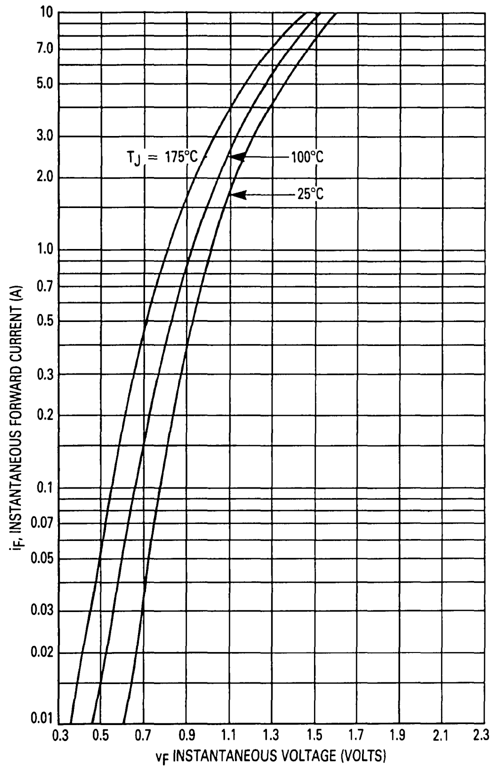


FIGURE 7 — TYPICAL REVERSE CURRENT*

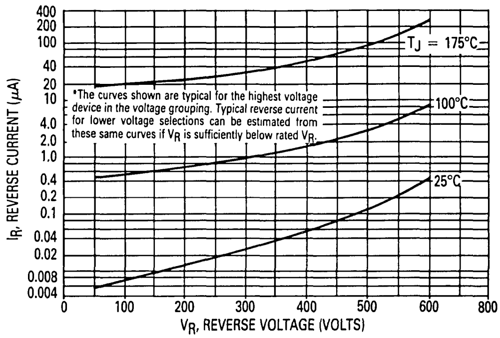


FIGURE 8 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

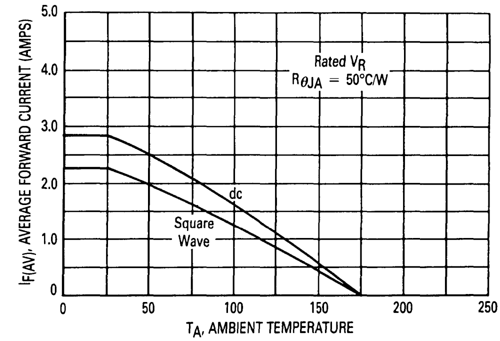


FIGURE 9 — POWER DISSIPATION

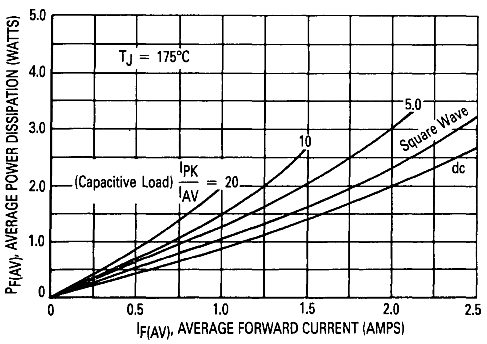
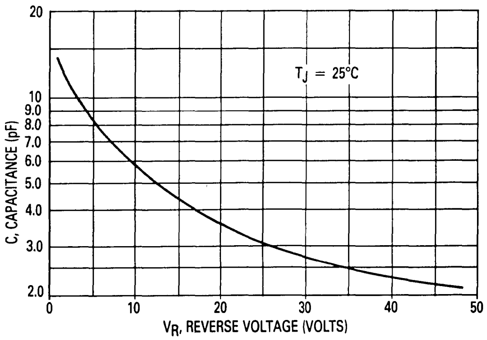


FIGURE 10 — TYPICAL CAPACITANCE



4

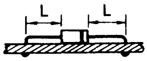
NOTE 1 — AMBIENT MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

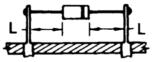
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD		LEAD LENGTH, L			UNITS
		1/8	1/4	1/2	
1	$R_{\theta JA}$	52	65	72	°C/W
2	$R_{\theta JA}$	67	80	87	°C/W
3	$R_{\theta JA}$	50			°C/W

MOUNTING METHOD 1

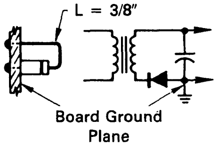


MOUNTING METHOD 2



Vector Pin Mounting

MOUNTING METHOD 3



P.C. Board with
1-1/2″ x 1-1/2″ Copper Surface

SWITCHMODE Power Rectifiers Ultrafast "E" Series w/High Reverse Energy Capability

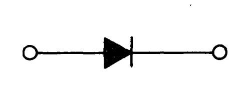
MUR190E
MUR1100E

MUR1100E is a
Motorola Preferred Device

ULTRAFAST RECTIFIERS
1.0 AMPERE
900–1000 VOLTS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- 20 mjoules Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 Volts



Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: U190E, U1100E

CASE 59-04

4

MAXIMUM RATINGS

Rating	Symbol	MUR 190E	MUR 1100E	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	900	1000	Volts
Average Rectified Forward Current (Square Wave) (Mounting Method #3 Per Note 1)	$I_{F(AV)}$	1.0 @ $T_A = 95°C$		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	35		Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (I_F = 1.0 Amps, T_J = 150°C) (I_F = 1.0 Amps, T_J = 25°C)	v_F	 1.50 1.75	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 100°C) (Rated dc Voltage, T_J = 25°C)	i_R	 600 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 100 75	ns
Maximum Forward Recovery Time (I_F = 1.0 Amp, di/dt = 100 Amp/μs, Recovery to 1.0 V)	t_{fr}	75	ns
Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	10	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%

Rev 1

4

ELECTRICAL CHARACTERISTICS

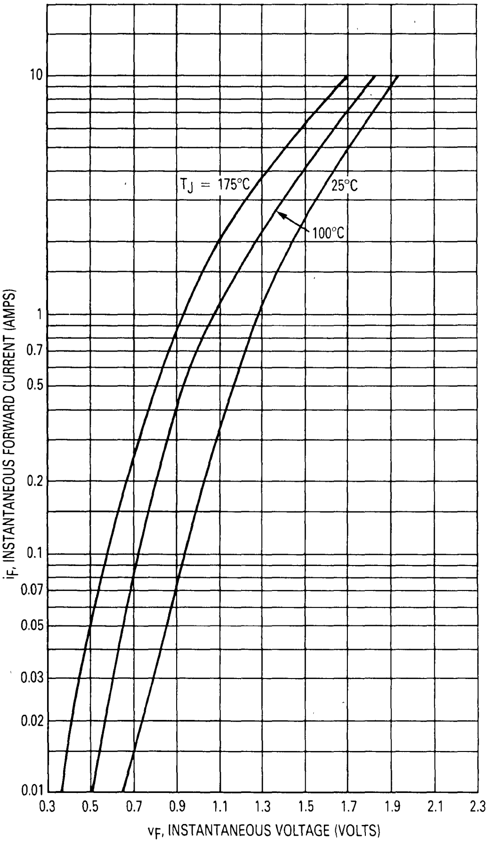


Figure 1. Typical Forward Voltage

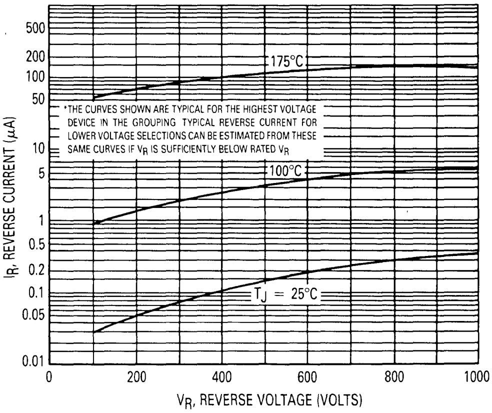


Figure 2. Typical Reverse Current*

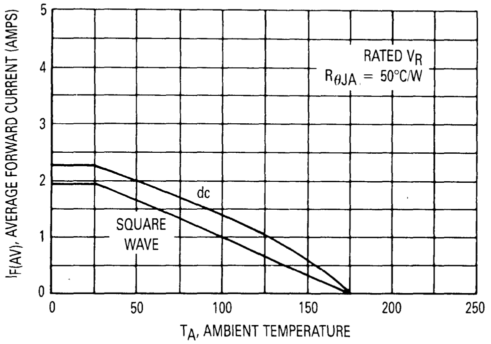


Figure 3. Current Derating (Mounting Method #3 Per Note 1)

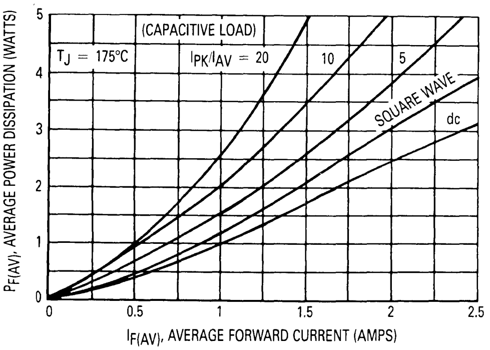


Figure 4. Power Dissipation

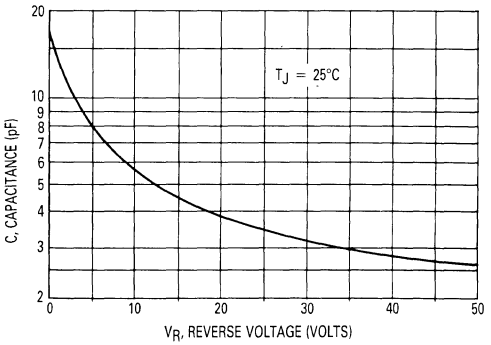


Figure 5. Typical Capacitance

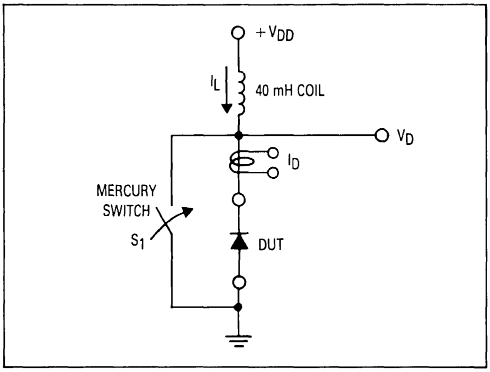


Figure 6. Test Circuit

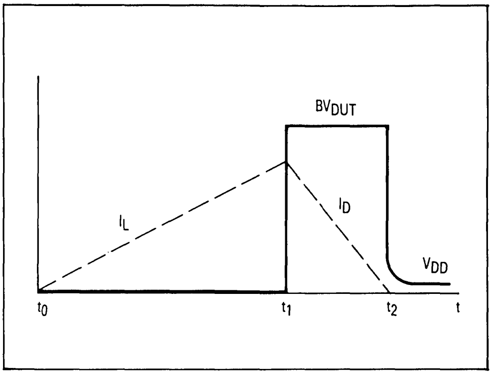


Figure 7. Current-Voltage Waveforms

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the information obtained for the MUR8100E (similar die construction as the MUR1100E Series) in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 volts, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.

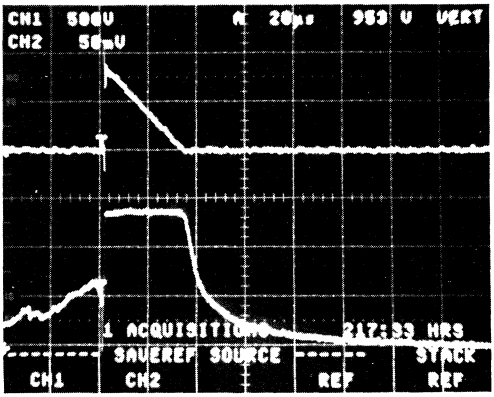
Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2 \left(\frac{BV_{DUT}}{BV_{DUT} - V_{DD}} \right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2$$



CHANNEL 2:
I_L
0.5 AMPS/DIV.

CHANNEL 1:
V_{DUT}
500 VOLTS/DIV.

TIME BASE:
20 μs/DIV.

Figure 8. Current-Voltage Waveforms

Note 1. Ambient Mounting Data

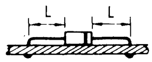
Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

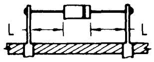
MOUNTING METHOD		LEAD LENGTH, L			UNITS
		1/8	1/4	1/2	
1	$R_{\theta JA}$	52	65	72	°C/W
2	$R_{\theta JA}$	67	80	87	°C/W
3	$R_{\theta JA}$	50			°C/W

4

MOUNTING METHOD 1

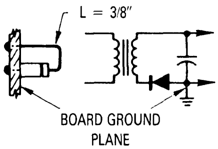


MOUNTING METHOD 2



VECTOR PIN MOUNTING

MOUNTING METHOD 3



P.C. BOARD WITH
1-1/2″ x 1-1/2″ COPPER SURFACE

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR420
MUR460

MUR420 and MUR460 are Motorola Preferred Devices

Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

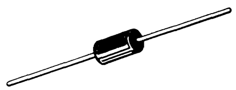
- Ultrafast 25, 50 and 75 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: U420, U460

ULTRAFAST RECTIFIERS

4.0 AMPERES 200–600 VOLTS



CASE 267-03 PLASTIC

4

MAXIMUM RATINGS

Rating	Symbol	MUR 420	MUR 460	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	600	Volts
Average Rectified Forward Current (Square Wave) (Mounting Method #3 Per Note 1)	$I_{F(AV)}$	4.0 @ T_A = 80°C	4.0 @ T_A = 40°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	125	70	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	–65 to +175		°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 3.0 Amp, T_J = 150°C) (i_F = 3.0 Amp, T_J = 25°C) (i_F = 4.0 Amp, T_J = 25°C)	v_F	 0.710 0.875 0.890	 1.05 1.25 1.28	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 150°C) (Rated dc Voltage, T_J = 25°C)	i_R	 150 5.0	 250 10	µA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/µs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (I_F = 1.0 A, di/dt = 100 A/µs, Recovery to 1.0 V)	t_{fr}	25	50	ns

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤2.0%

Rev 3

MUR420

FIGURE 1 — TYPICAL FORWARD VOLTAGE

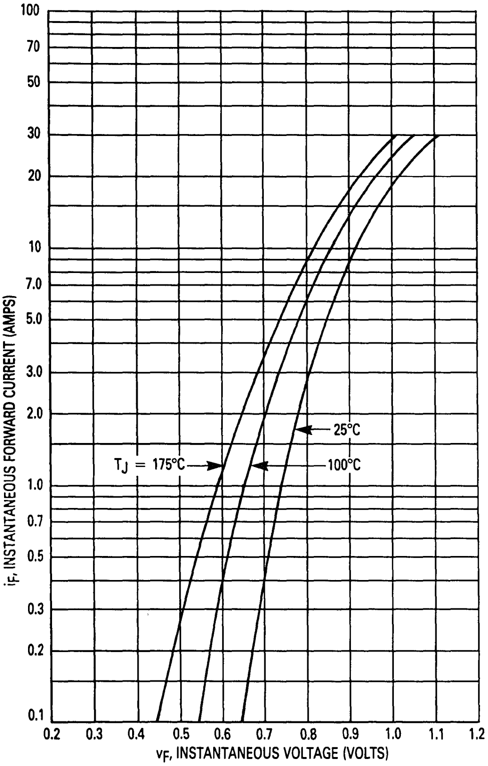


FIGURE 2 — TYPICAL REVERSE CURRENT*

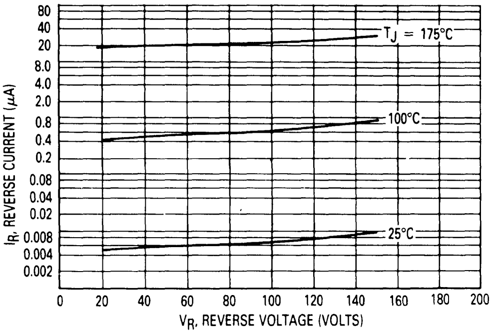


FIGURE 3 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

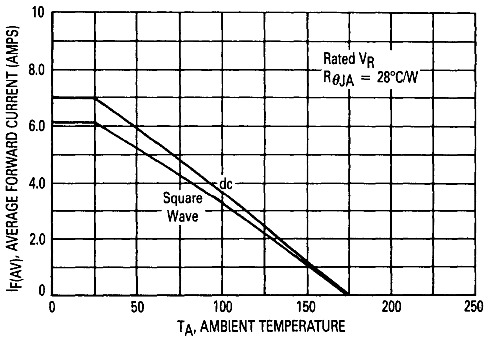


FIGURE 4 — POWER DISSIPATION

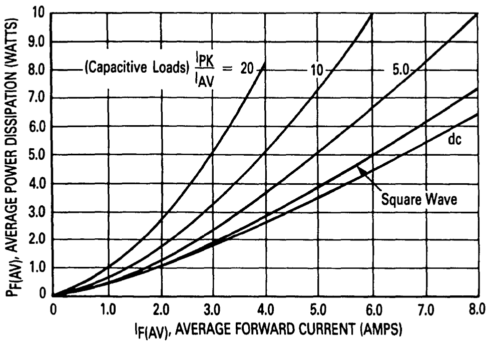
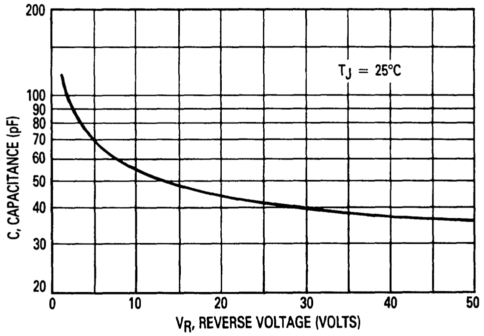


FIGURE 5 — TYPICAL CAPACITANCE



MUR460

FIGURE 6 — TYPICAL FORWARD VOLTAGE

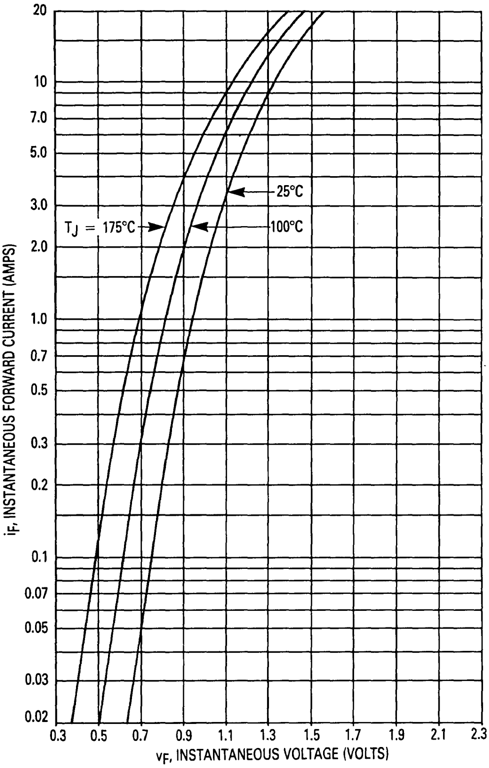


FIGURE 7 — TYPICAL REVERSE CURRENT*

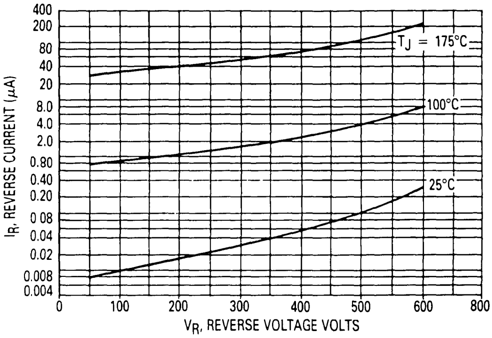


FIGURE 8 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

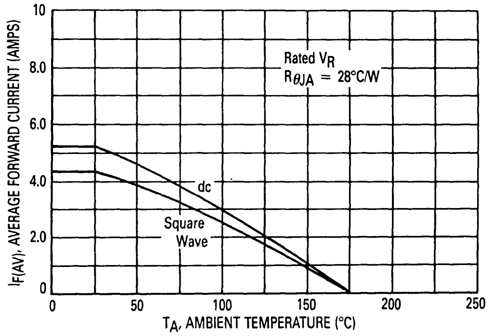


FIGURE 9 — POWER DISSIPATION

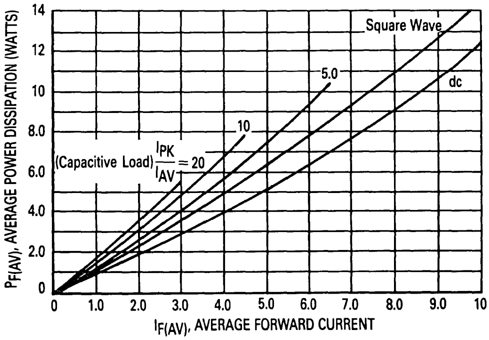
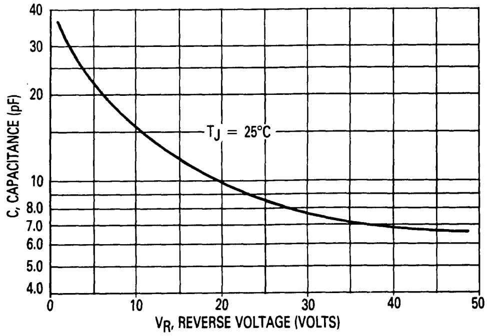


FIGURE 10 — TYPICAL CAPACITANCE



4

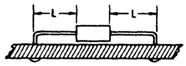
NOTE 1 — AMBIENT MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

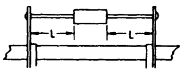
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD		LEAD LENGTH, L (IN)				UNITS
		1/8	1/4	1/2	3/4	
1	$R_{\theta JA}$	50	51	53	55	°C/W
2	$R_{\theta JA}$	58	59	61	63	°C/W
3	$R_{\theta JA}$	28				°C/W

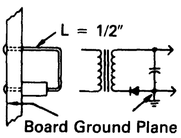
MOUNTING METHOD 1
P.C. Board Where Available Copper Surface area is small.



MOUNTING METHOD 2
Vector Push-In Terminals T-28



MOUNTING METHOD 3
P.C. Board with
1-1/2" x 1-1/2" Copper Surface



Switchmode Power Rectifiers
Ultrafast "E" Series
w/High Reverse Energy Capability

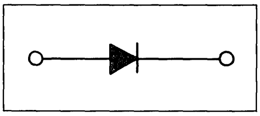
MUR490E
MUR4100E

MUR4100E is a Motorola Preferred Device

ULTRAFAST RECTIFIERS
4.0 AMPERES
900–1000 VOLTS

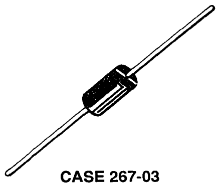
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- 20 mJ Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 Volts



Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: U490E, U4100E



CASE 267-03

MAXIMUM RATINGS

Rating	Symbol	MUR490E	MUR4100E	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	900	1000	Volts
Average Rectified Forward Current (Square Wave) (Mounting Method #3 Per Note 1)	$I_{F(AV)}$	4.0 @ T_A = 35°C		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	70		Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175		°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (I_F = 3.0 Amps, T_J = 150°C) (I_F = 3.0 Amps, T_J = 25°C) (I_F = 4.0 Amps, T_J = 25°C)	v_F	 1.53 1.75 1.85	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 100°C) (Rated dc Voltage, T_J = 25°C)	i_R	 900 25	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 100 75	ns
Maximum Forward Recovery Time (I_F = 1.0 Amp, di/dt = 100 Amp/μs, Recovery to 1.0 V)	t_{fr}	75	ns
Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	20	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%

Rev 2

ELECTRICAL CHARACTERISTICS

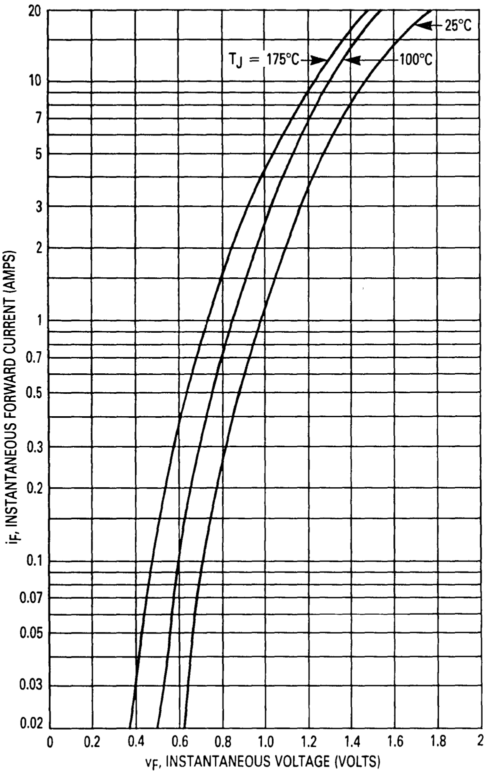


Figure 1. Typical Forward Voltage

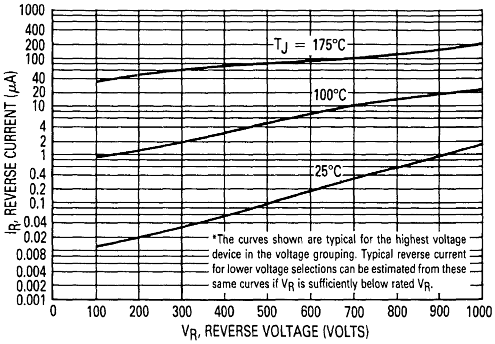


Figure 2. Typical Reverse Current*

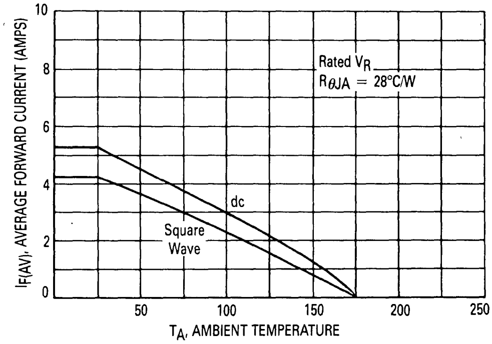


Figure 3. Current Derating (Mounting Method #3 Per Note 1)

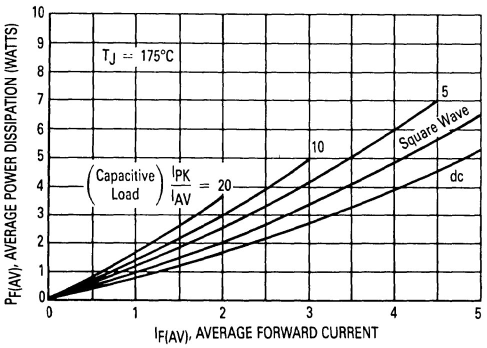


Figure 4. Power Dissipation

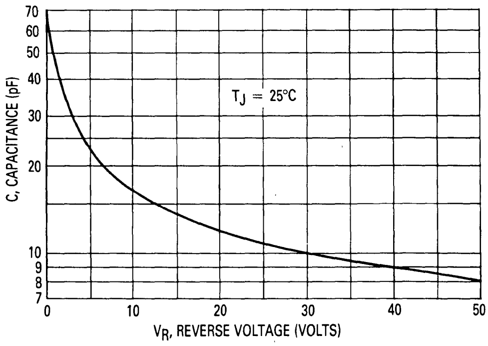


Figure 5. Typical Capacitance

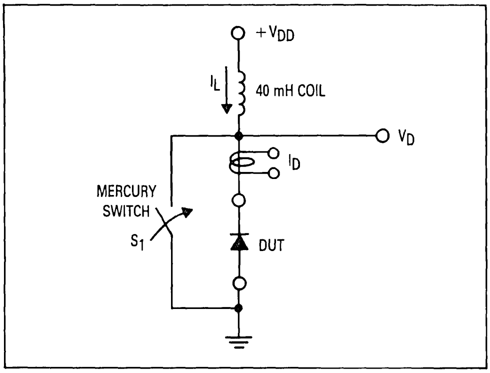


Figure 6. Test Circuit

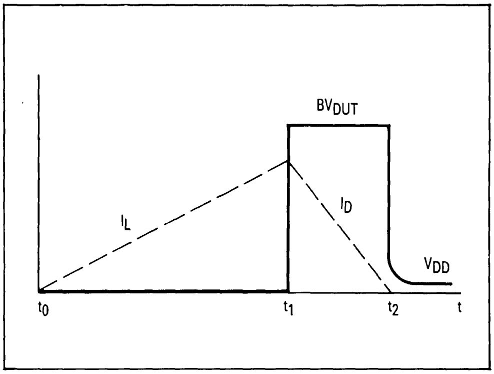


Figure 7. Current-Voltage Waveforms

4

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the information obtained for the MUR8100E (similar die construction as the MUR4100E Series) in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 volts, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.

Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2} L I_{LPK}^2 \left(\frac{BV_{DUT}}{BV_{DUT} - V_{DD}} \right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2} L I_{LPK}^2$$

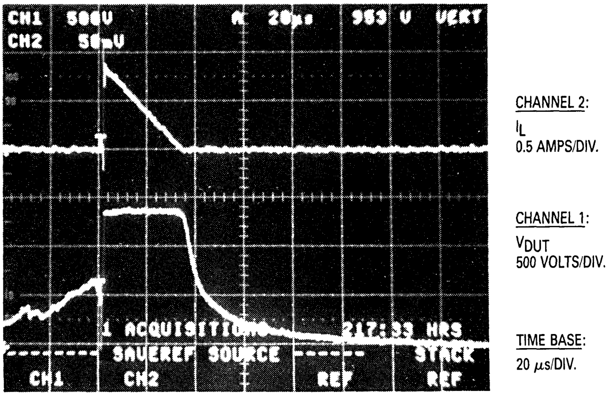


Figure 8. Current-Voltage Waveforms

Note 1 — Ambient Mounting Data

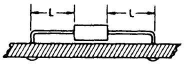
Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

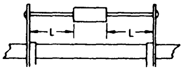
MOUNTING METHOD		LEAD LENGTH, L (IN)				UNITS
		1/8	1/4	1/2	3/4	
1	$R_{\theta JA}$	50	51	53	55	°C/W
2		58	59	61	63	°C/W
3		28				°C/W

4

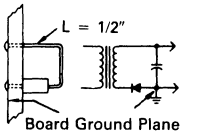
MOUNTING METHOD 1
P.C. Board Where Available Copper Surface area is small.



MOUNTING METHOD 2
Vector Push-In Terminals T-28



MOUNTING METHOD 3
P.C. Board with
1-1/2″ x 1-1/2″ Copper Surface



MUR620CT

Motorola Preferred Device

Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

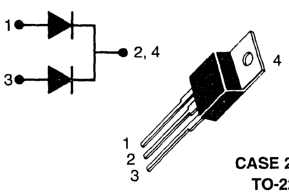
- Ultrafast 35 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U620

ULTRAFAST RECTIFIERS

6 AMPERES
200 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

4

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Voltage (Rated V_R) T_C = 130°C	Per Diode Total Device	$I_{F(AV)}$	3.0 6.0	Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz) T_C = 130°C		I_{FRM}	6.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	75	Amps
Operating Junction Temperature and Storage Temperature		T_J, T_{stg}	– 65 to +175	°C

THERMAL CHARACTERISTICS PER DIODE LEG

Rating	Symbol	Typical	Maximum	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	5.0–6.0	7.0	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

Instantaneous Forward Voltage (1) (i_F = 3.0 Amp, T_C = 150°C) (i_F = 3.0 Amp, T_C = 25°C)	v_F	 0.80 0.94	 0.895 0.975	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 2.0–10 0.01–3.0	 250 5.0	µA
Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/µs)	t_{rr}	20–30	35	ns

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Rev 1

4

FIGURE 1 — TYPICAL FORWARD VOLTAGE

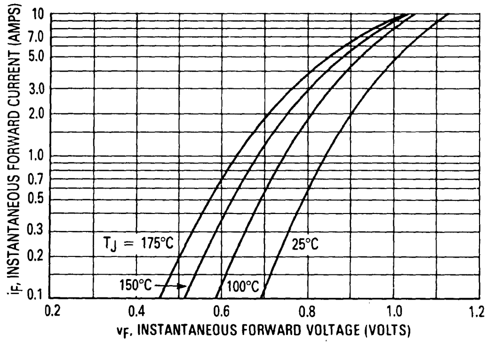


FIGURE 2 — TYPICAL REVERSE CURRENT

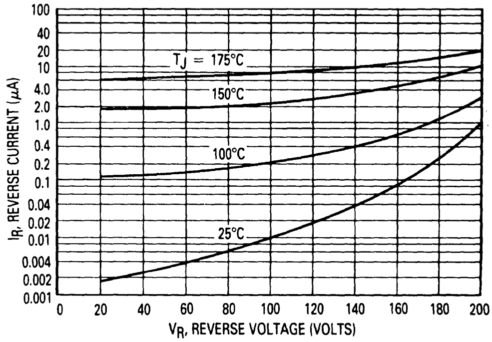


FIGURE 3 — TOTAL DEVICE CURRENT DERATING, CASE

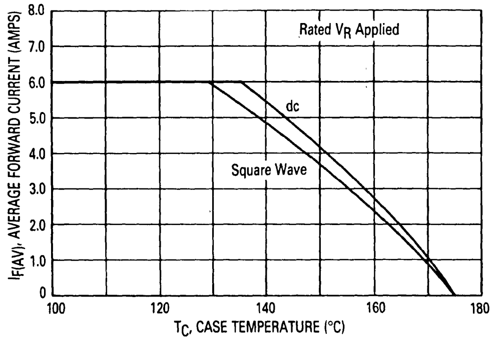


FIGURE 4 — TOTAL DEVICE CURRENT DERATING, AMBIENT

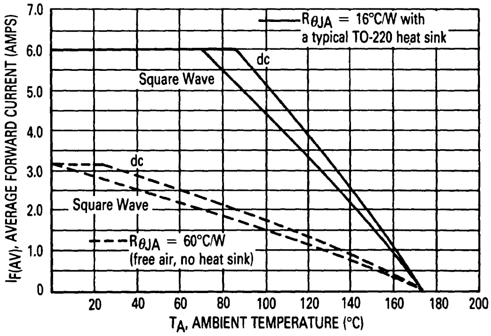
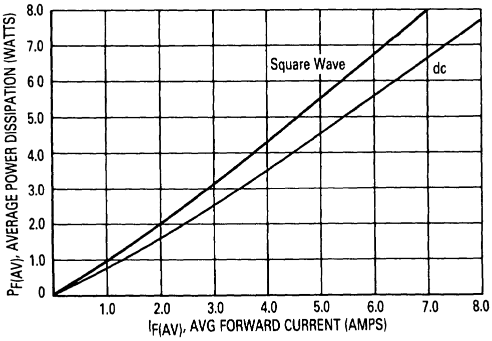


FIGURE 5 — POWER DISSIPATION



Switchmode Power Rectifiers

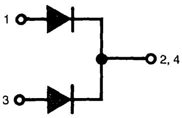
MURH840CT

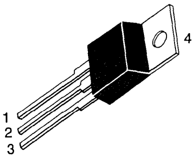
Motorola Preferred Device

**ULTRAFAST RECTIFIER
8.0 AMPERES
400 VOLTS**

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 28 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 400 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures





**CASE 221A-06
TO-220AB**

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: UH840

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	400	Volts
Average Rectified Forward Current — Per Leg Total Device, (Rated V_R), T_C = 120°C — Total Device	$I_{F(AV)}$	4.0 8.0	Amps
Peak Repetitive Forward Current — Per Diode Leg (Rated V_R, Square Wave, 20 kHz), T_C = 120°C	I_{FM}	16	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Controlled Avalanche Energy	W_{AVAL}	20	mJ
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS, PER DIODE LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

ELECTRICAL CHARACTERISTICS, PER DIODE LEG

Maximum Instantaneous Forward Voltage (1) (I_F = 4.0 Amps, T_C = 150°C) (I_F = 4.0 Amps, T_C = 25°C)	v_F	 1.9 2.2	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)	t_{rr}	28	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 1

4

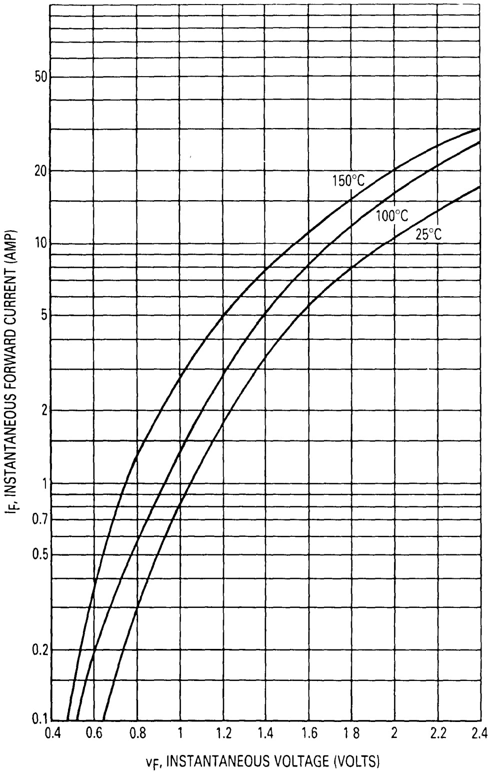


Figure 1. Typical Forward Voltage

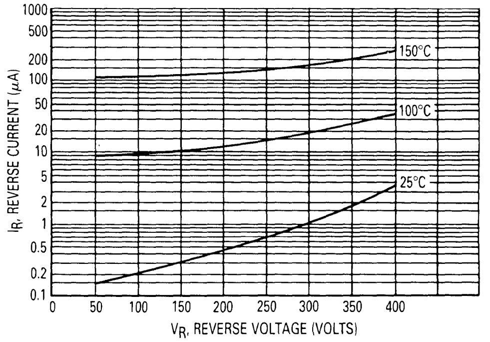


Figure 2. Typical Reverse Current, Per Leg

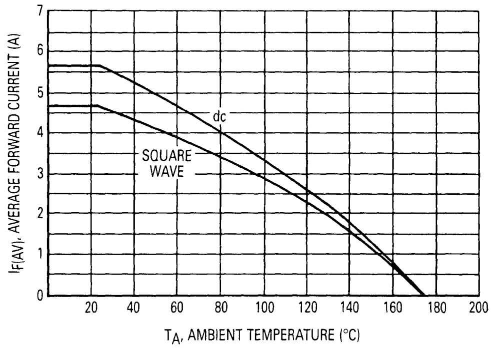


Figure 3. Forward Current Derating, Ambient, Per Leg

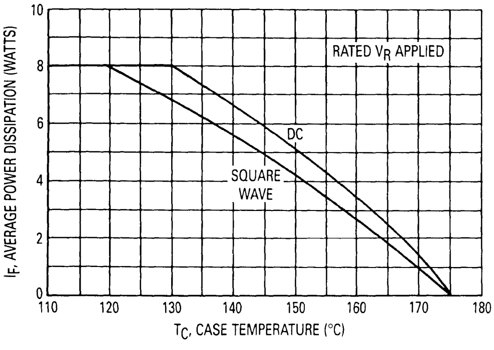


Figure 4. Current Derating, Case, Per Leg

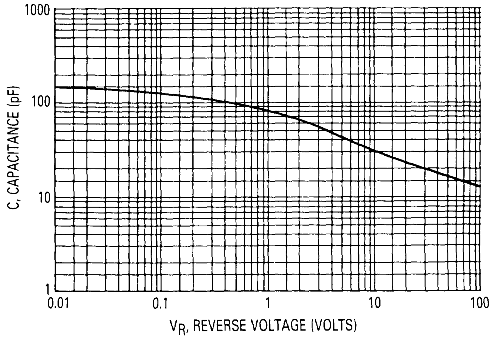


Figure 5. Typical Capacitance, Per Leg

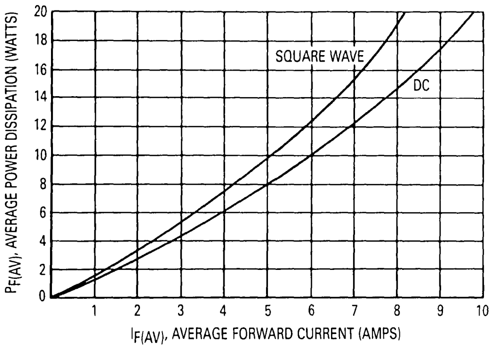


Figure 6. Forward Power Dissipation, Per Leg

4

Designer's™ Data Sheet
Switchmode™ Power Rectifiers

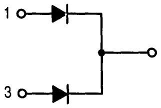
MURH860CT

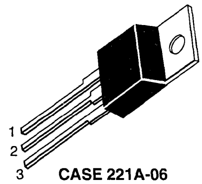
Motorola Preferred Device

ULTRAFAST RECTIFIER
8.0 AMPERES
600 VOLTS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 600 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures





CASE 221A-06
TO-220AB

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: UH860

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	600	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 120°C Total Device	$I_{F(AV)}$	4.0 8.0	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 120°C	I_{FM}	16	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 4.0 Amps, T_C = 150°C) (i_F = 4.0 Amps, T_C = 25°C)	v_F	 2.5 2.8	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	µA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/µs)	t_{rr}	35	ns

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

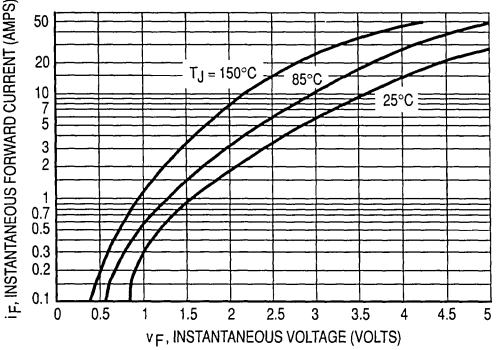


Figure 1. Typical Forward Voltage, Per Leg

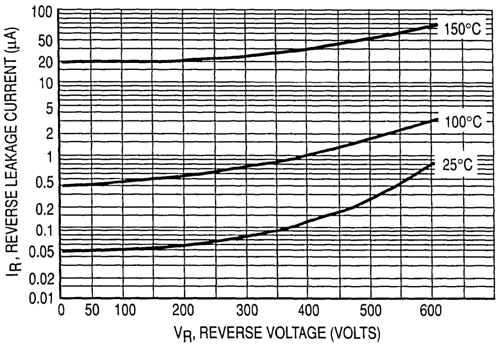


Figure 2. Typical Reverse Leakage Current, Per Leg

4

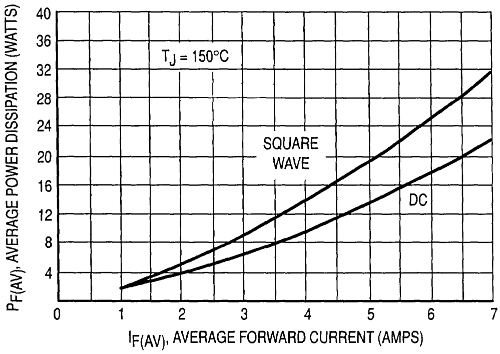


Figure 3. Typical Forward Dissipation, Per Leg

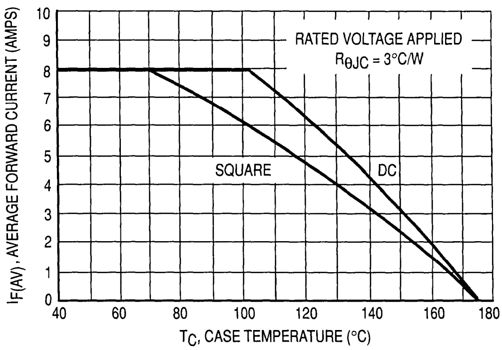


Figure 4. Typical Current Derating, Case, Per Leg

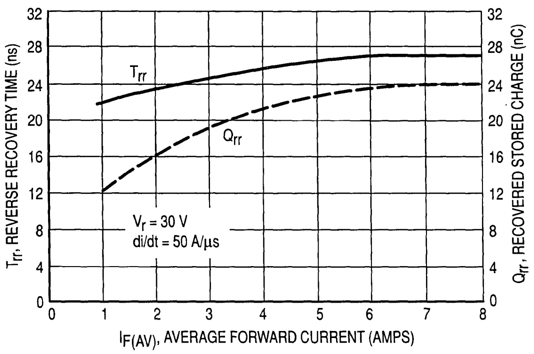


Figure 5. Typical Recovery Characteristics

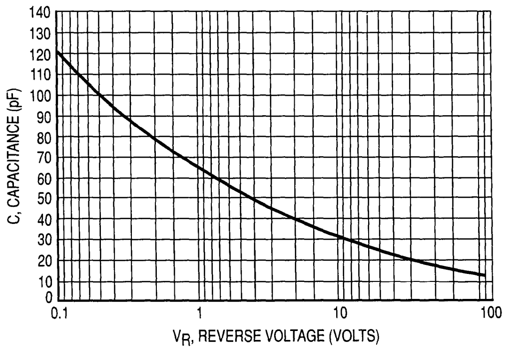


Figure 6. Typical Capacitance, Per Leg

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR1620CT
MUR1640CT
MUR1660CT

Motorola Preferred Devices

Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 600 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures

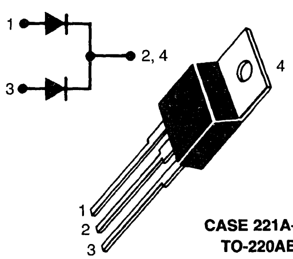
Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U1620, U1640, U1660

4

ULTRAFAST RECTIFIERS

8 AMPERES
200–400–600 VOLTS



CASE 221A-06
TO-220AB

MAXIMUM RATINGS

Rating	Symbol	MUR 1620CT	MUR 1640CT	MUR 1660CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current — Per Leg Total Device, (Rated V_R), T_C = 150°C — Total Device	$I_{F(AV)}$	8.0 16			Amps
Peak Rectified Forward Current — Per Diode Leg (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16			Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100			Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	– 65 to +175			°C

THERMAL CHARACTERISTICS, PER DIODE LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	2.0		°C/W

ELECTRICAL CHARACTERISTICS, PER DIODE LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	0.895 0.975	1.00 1.30	1.20 1.50	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	250 5.0	500 10		μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	35 25	60 50		ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 2

MUR1620CT

FIGURE 1 — TYPICAL FORWARD VOLTAGE, PER LEG

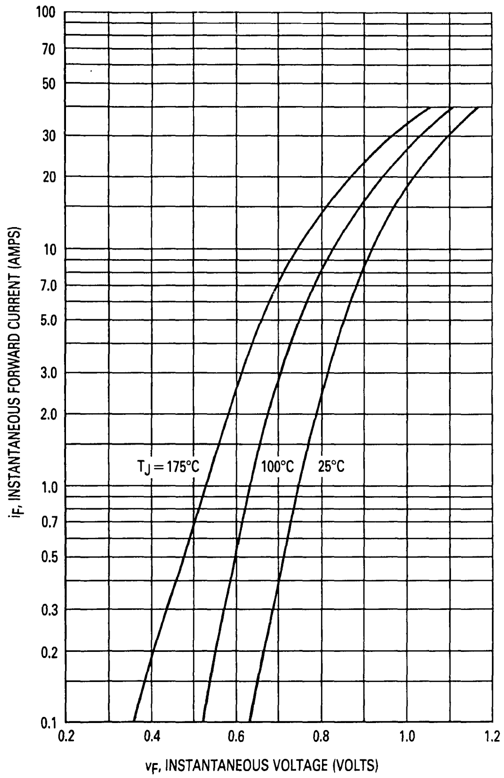


FIGURE 2 — TYPICAL REVERSE CURRENT, PER LEG*

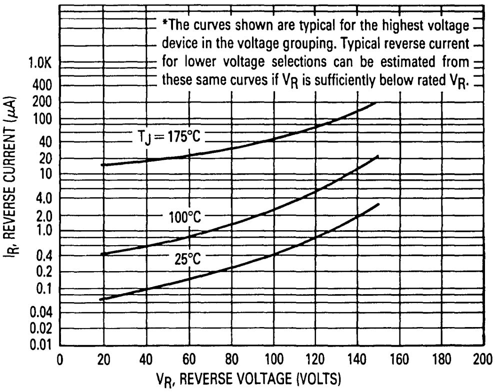


FIGURE 3 — CURRENT DERATING CASE, PER LEG

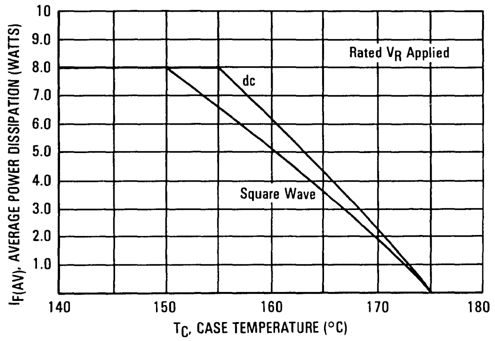


FIGURE 4 — CURRENT DERATING, AMBIENT, PER LEG

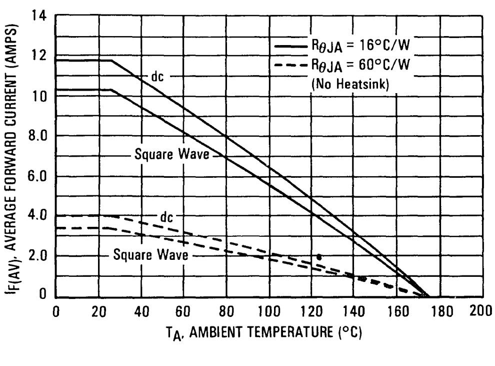
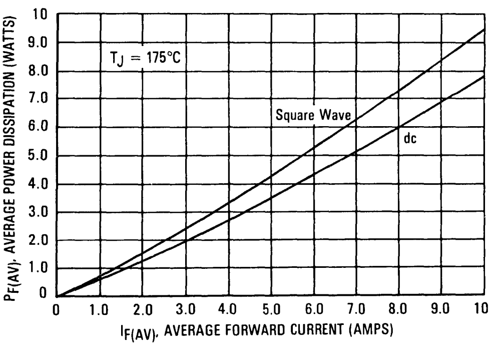


FIGURE 5 — POWER DISSIPATION, PER LEG



MUR1640CT

FIGURE 6 — TYPICAL FORWARD VOLTAGE, PER LEG

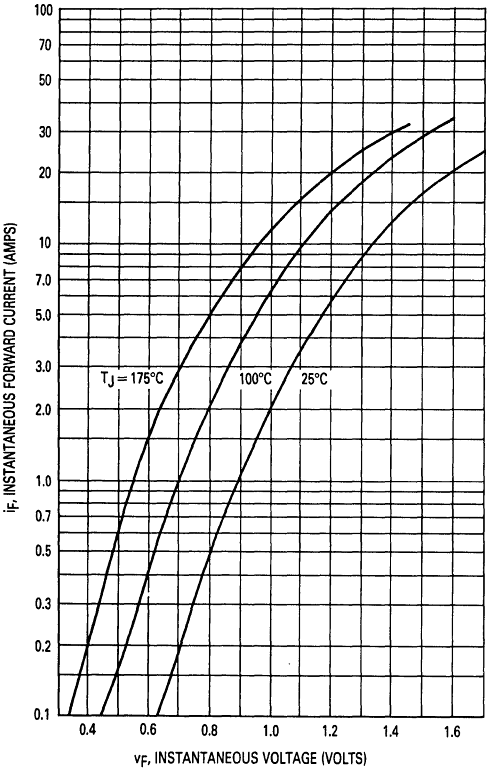


FIGURE 7 — TYPICAL REVERSE CURRENT, PER LEG*

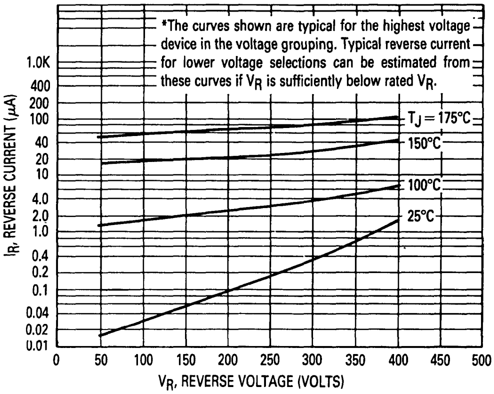


FIGURE 8 — CURRENT DERATING, CASE, PER LEG

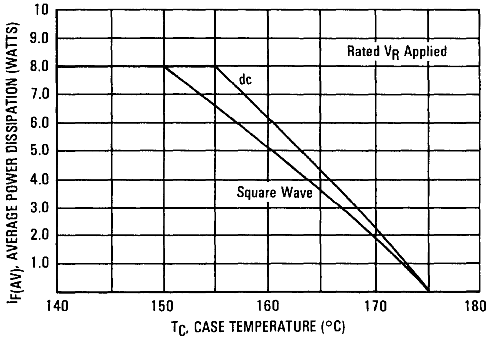


FIGURE 9 — CURRENT DERATING, AMBIENT, PER LEG

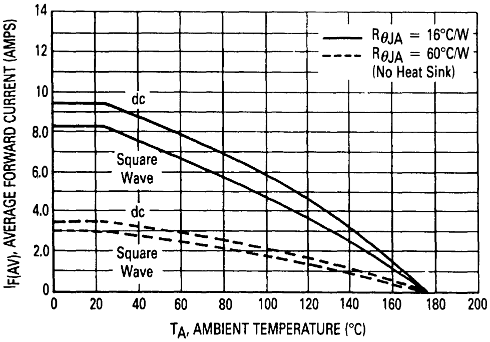
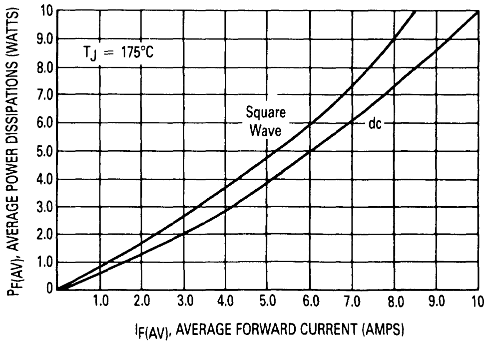


FIGURE 10 — POWER DISSIPATION, PER LEG



MUR1660CT

FIGURE 11 — TYPICAL FORWARD VOLTAGE, PER LEG

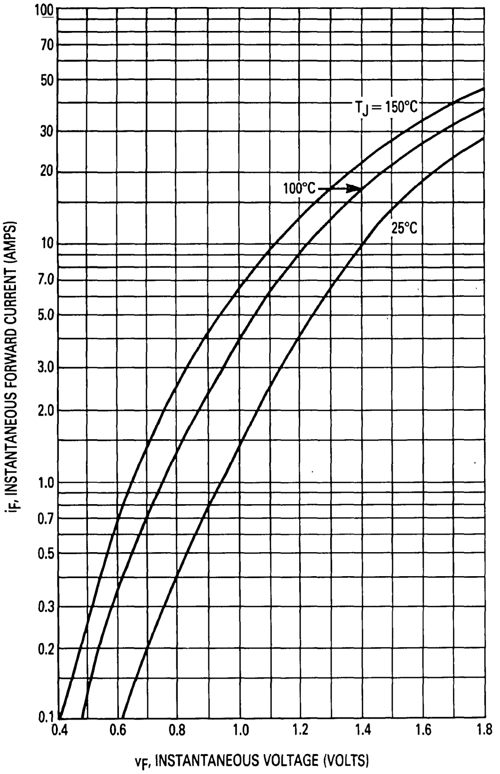


FIGURE 12 — TYPICAL REVERSE CURRENT, PER LEG*

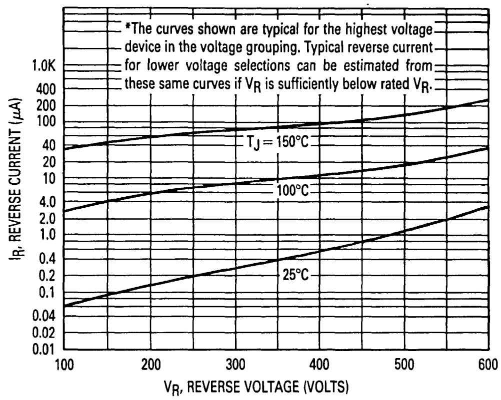


FIGURE 13 — CURRENT DERATING, CASE, PER LEG

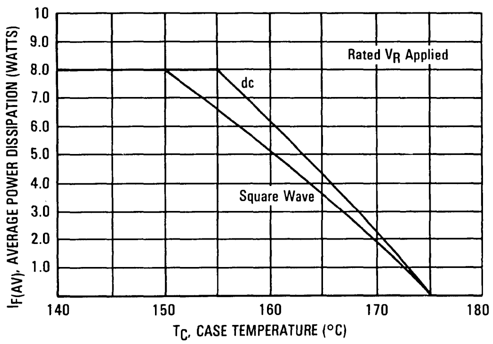


FIGURE 14 — CURRENT DERATING, AMBIENT, PER LEG

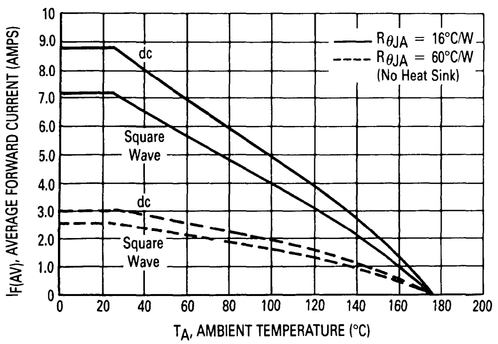


FIGURE 15 — POWER DISSIPATION, PER LEG

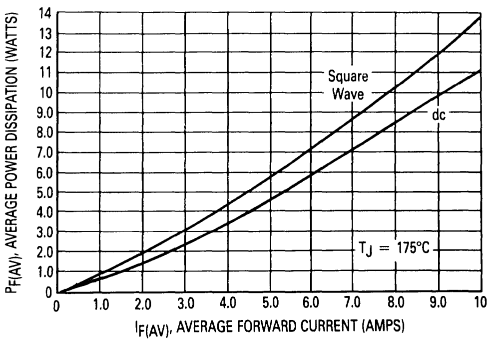


FIGURE 16 — THERMAL RESPONSE

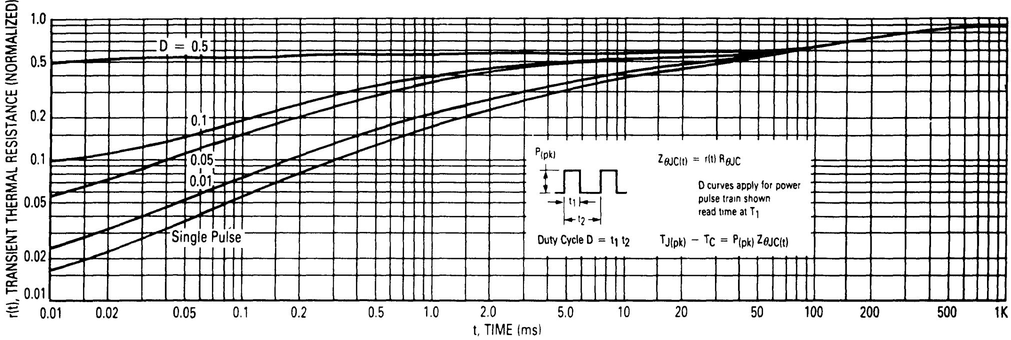
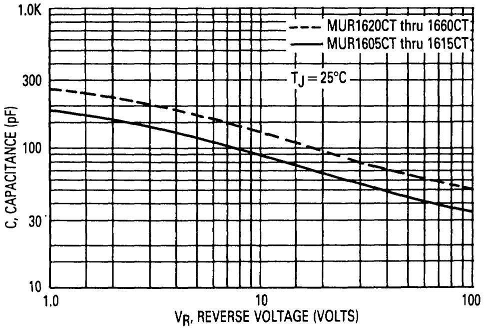


FIGURE 17 — TYPICAL CAPACITANCE, PER LEG



4

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Switchmode
Dual Ultrafast Power Rectifiers

MUR1620CTR

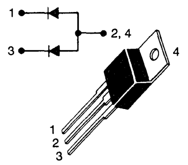
Motorola Preferred Device

. . . designed for use in negative switching power supplies, inverters and as free wheeling diodes. Also, used in conjunction with common cathode dual Ultrafast Rectifiers, makes a single phase full-wave bridge. These state-of-the-art devices have the following features:

- Common Anode Dual Rectifier (8.0 A per Leg or 16 A per Package)
- Ultrafast 35 Nanosecond Reverse Recovery Times
- Exhibits Soft Recovery Characteristics
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Epoxy Meets UL94, V_O @ 1/8″
- Complement to MUR1605CT Series of Common Cathode Devices

Mechanical Characteristics:
- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U1620R

ULTRAFAST RECTIFIERS
16 AMPERES
200 VOLTS



CASE 221A-06
TO-220AB
STYLE 7

MAXIMUM RATINGS (Per Leg)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Voltage, (Rated V_R), T_C = 160°C Per Leg Per Total Device	$I_{F(AV)}$	8.0 16	Amps
Peak Repetitive Surge Current, Per Diode (Rated V_R, Square Wave, 20 kHz) T_C = 140°C	I_{FM}	16	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	–65 to +175	°C

THERMAL CHARACTERISTICS (Per Leg)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (Per Leg)

Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 25°C (i_F = 8.0 Amp, T_C = 150°C)	v_F	 1.2 1.1	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 150°C)	i_R	 5.0 500	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, di/dt = 100 Amp/μs)	t_{rr}	 85 35	ns

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.

Rev 1

4

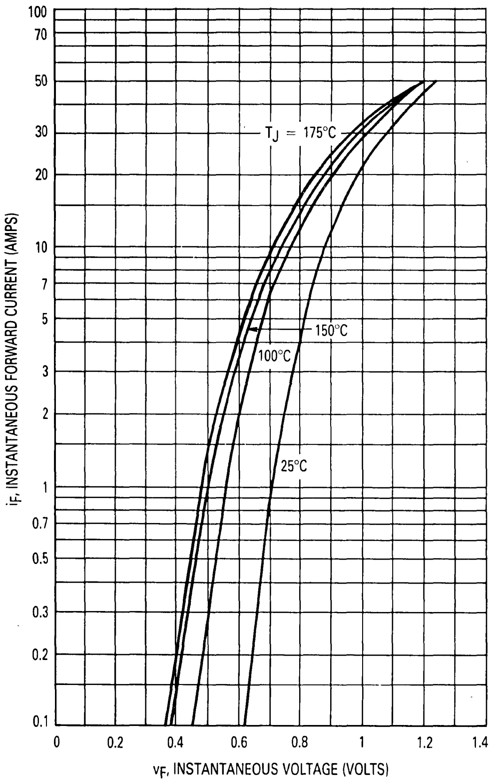


Figure 1. Typical Forward Voltage (Per Leg)

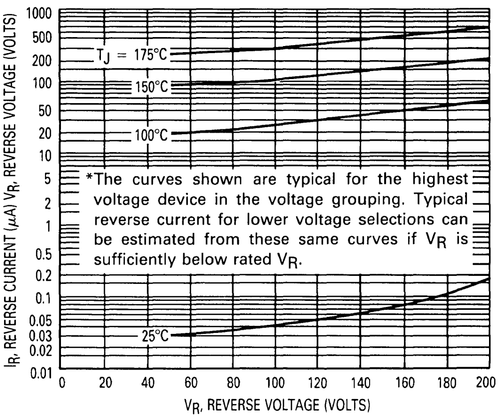


Figure 2. Typical Reverse Current* (Per Leg)

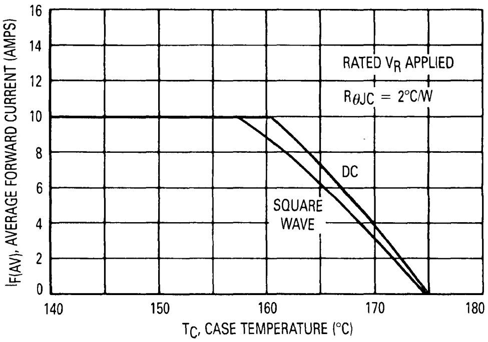


Figure 3. Current Derating, Case (Per Leg)

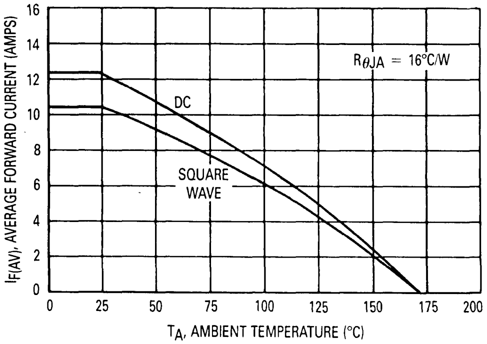


Figure 4. Current Derating, Ambient (Per Leg)

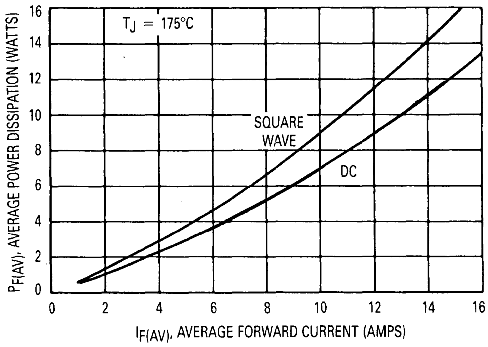


Figure 5. Power Dissipation (Per Leg)

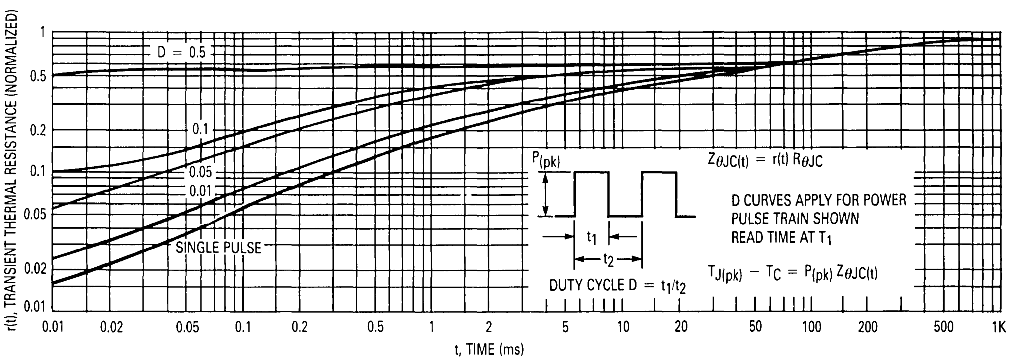


Figure 6. Thermal Response

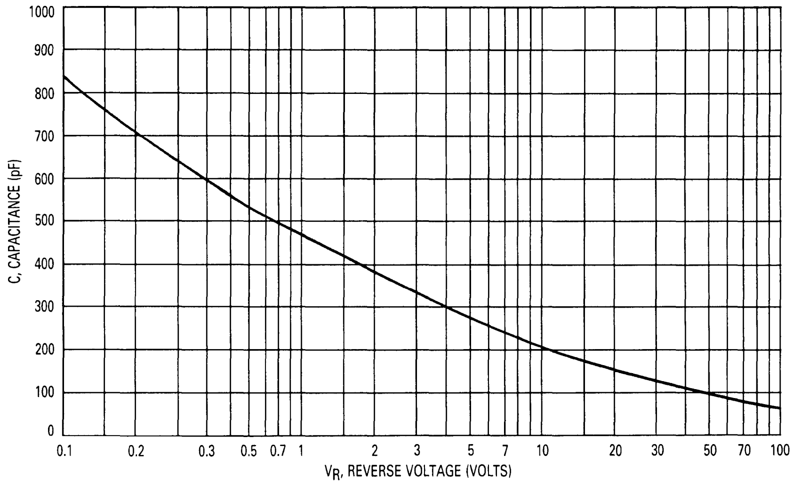


Figure 7. Typical Capacitance (Per Leg)

MUR5150E

Motorola Preferred Device

Designer's™ Data Sheet

SCANSWITCH™ Power Rectifier

For Use As A Damper Diode In High and Very High Resolution Monitors

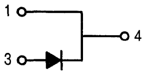
SCANSWITCH RECTIFIER
5.0 AMPERES
1500 VOLTS

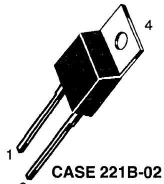
The MUR5150E is a state-of-the-art Ultrafast Power Rectifier specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MUR5150E is fully realized when paired with the appropriate 1500V SCANSWITCH Bipolar Power Transistor.

- 1500 V Blocking Voltage
- 20 mjoules Avalanche Energy Guaranteed
- Peak Transient Overshoot Voltage Specified, 17 Volts (typical)
- Forward Recovery Time Specified, 175 ns (typical)
- Epoxy Meets UL94, V_O at 1/8"

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U5150E





CASE 221B-02
TO-220AC

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1500	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 100°C	$I_{F(AV)}$	5.0	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	10	Amps
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	–65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Typ	Max	Units
Maximum Instantaneous Forward Voltage (1) (i_F = 2.0 Amps, T_J = 25°C) (i_F = 5.0 Amps, T_J = 25°C)	v_F	 1.7 2.0	 2.0 2.4	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 100 10	 500 50	µA
Maximum Reverse Recovery Time (I_F = 1.0 Amps, di/dt = 50 Amps/µs)	t_{rr}	130	175	ns
Maximum Forward Recovery Time (I_F = 6.5 Amps, di/dt = 12 Amps/µs)	t_{fr}	175	225	ns
Peak Transient Overshoot Voltage	V_{RFM}	17	20	Volts

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

TYPICAL ELECTRICAL CHARACTERISTICS

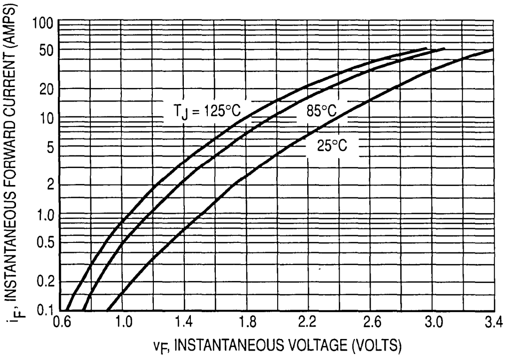


Figure 1. Typical Forward Voltage

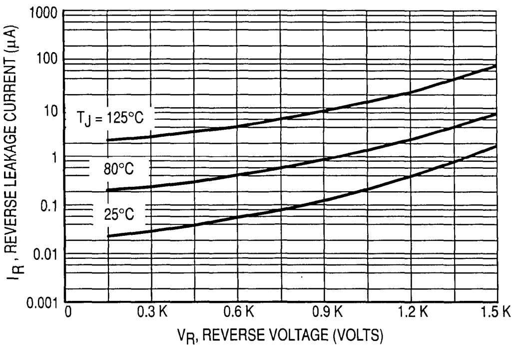


Figure 2. Typical Reverse Leakage Current

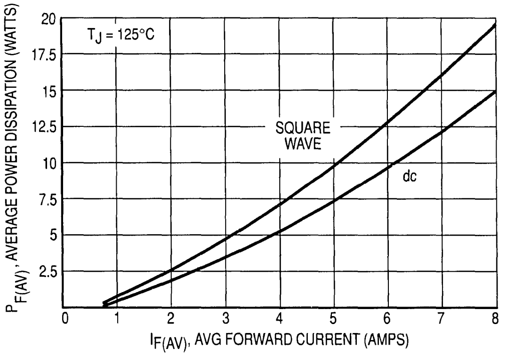


Figure 3. Forward Power Dissipation

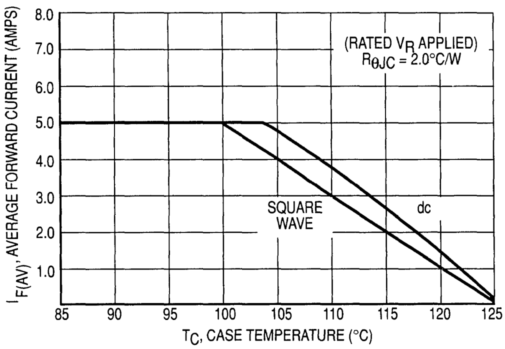


Figure 4. Current Derating Case

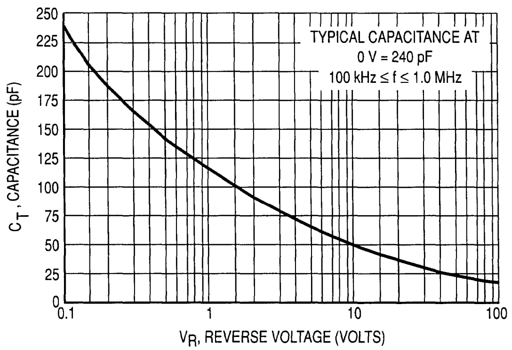


Figure 5. Typical Capacitance

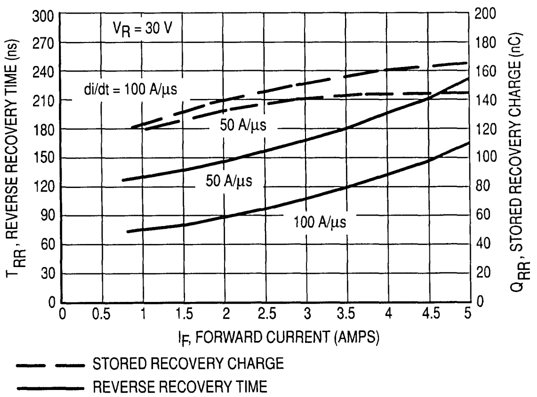


Figure 6. Typical Reverse Switching Characteristics

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR820
MUR840
MUR860

Motorola Preferred Devices

Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

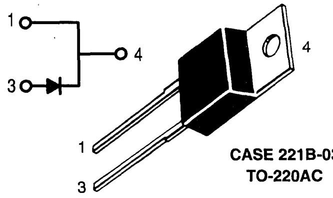
- Ultrafast 25, 50 and 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy meets UL94, V_O @ 1/8″
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U820, U840, U860

ULTRAFAST RECTIFIERS

8 AMPERES
200–400–600 VOLTS



CASE 221B-03
TO-220AC

4

MAXIMUM RATINGS

Rating	Symbol	MUR 820	MUR 840	MUR 860	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C	$I_{F(AV)}$	8.0			Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16			Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100			Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175			°C

THERMAL CHARACTERISTICS

Rating	Symbol	MUR 820	MUR 840	MUR 860	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	2.0		°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	MUR 820	MUR 840	MUR 860	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	 0.895 0.975	 1.00 1.30	 1.20 1.50	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 150°C) (Rated dc Voltage, T_J = 25°C)	i_R	 250 5.0	 500 10		μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25	 60 50		ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 3

MUR820

FIGURE 1 — TYPICAL FORWARD VOLTAGE

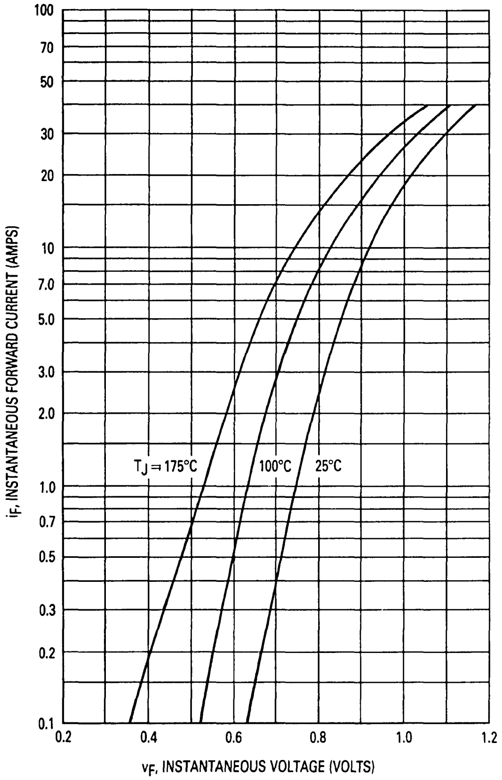


FIGURE 2 — TYPICAL REVERSE CURRENT*

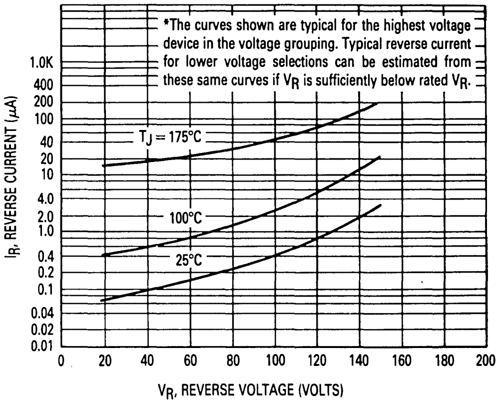


FIGURE 3 — CURRENT DERATING, CASE

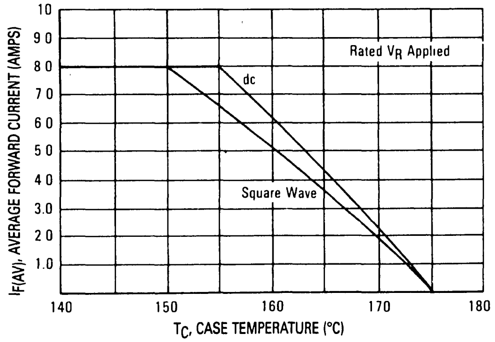


FIGURE 4 — CURRENT DERATING, AMBIENT

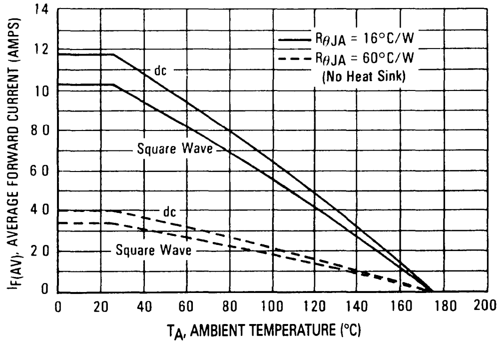
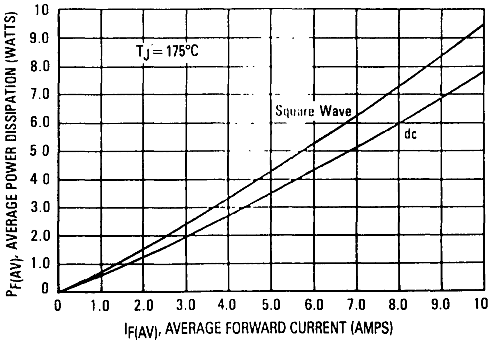


FIGURE 5 — POWER DISSIPATION



MUR840

FIGURE 6 — TYPICAL FORWARD VOLTAGE

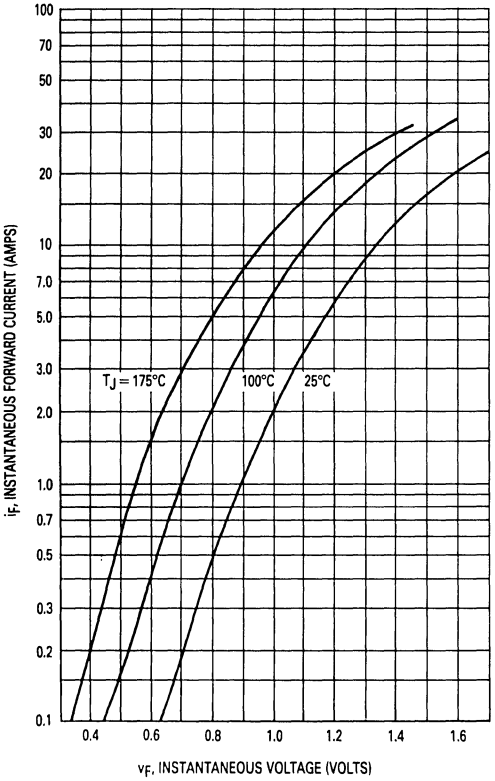


FIGURE 7 — TYPICAL REVERSE CURRENT*

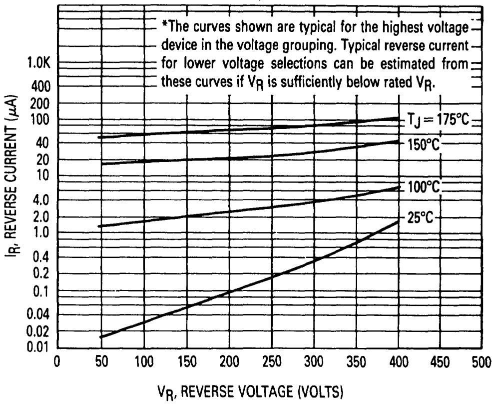


FIGURE 8 — CURRENT DERATING, CASE

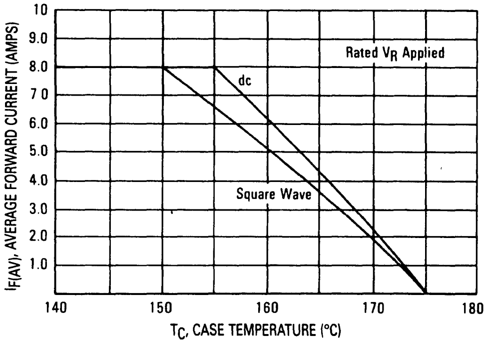


FIGURE 9 — CURRENT DERATING, AMBIENT

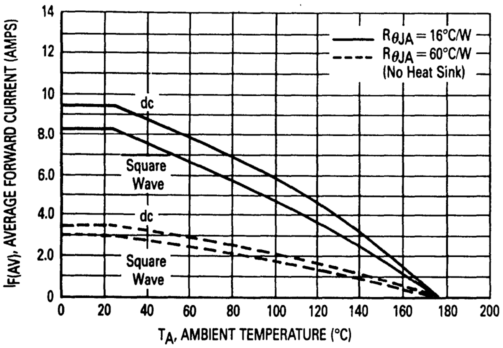
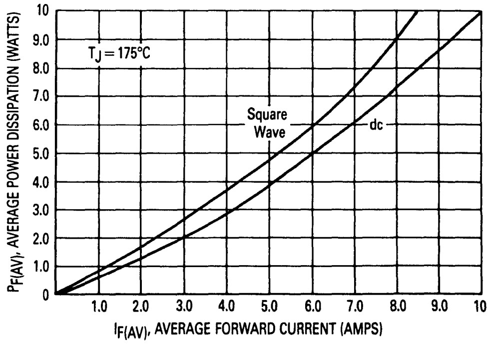


FIGURE 10 — POWER DISSIPATION



MUR860

FIGURE 11 — TYPICAL FORWARD VOLTAGE

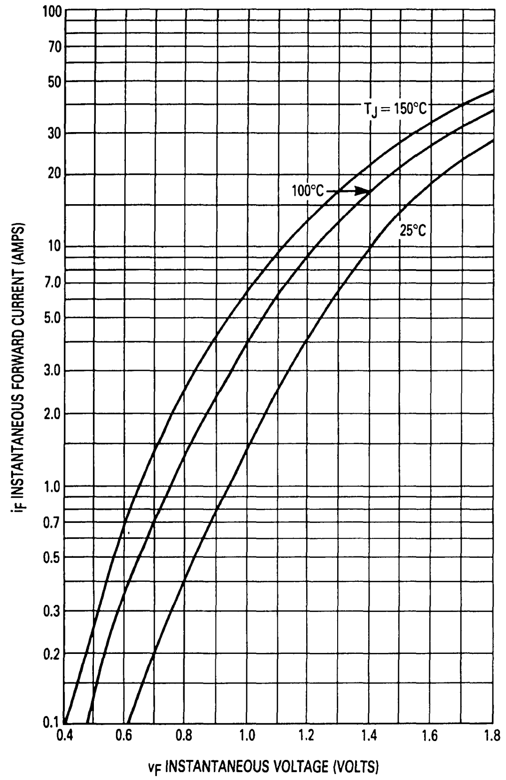


FIGURE 12 — TYPICAL REVERSE CURRENT*

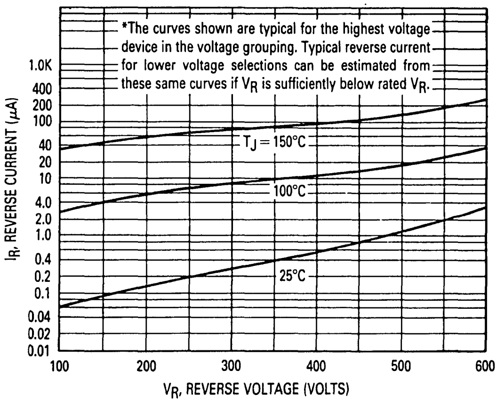


FIGURE 13 — CURRENT DERATING, CASE

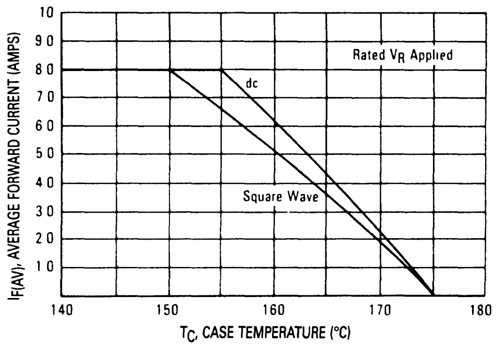


FIGURE 14 — CURRENT DERATING, AMBIENT

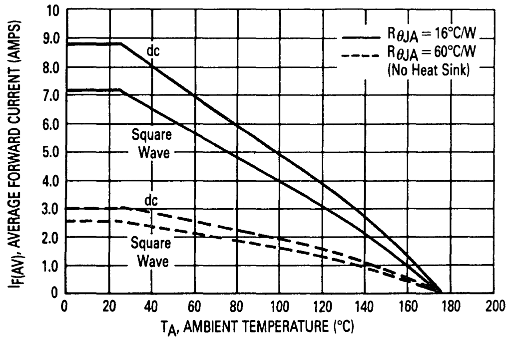
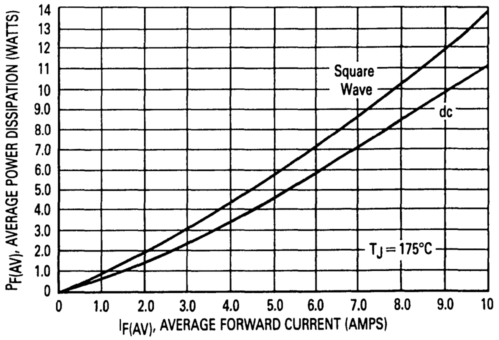


FIGURE 15 — POWER DISSIPATION



4

FIGURE 16 — THERMAL RESPONSE

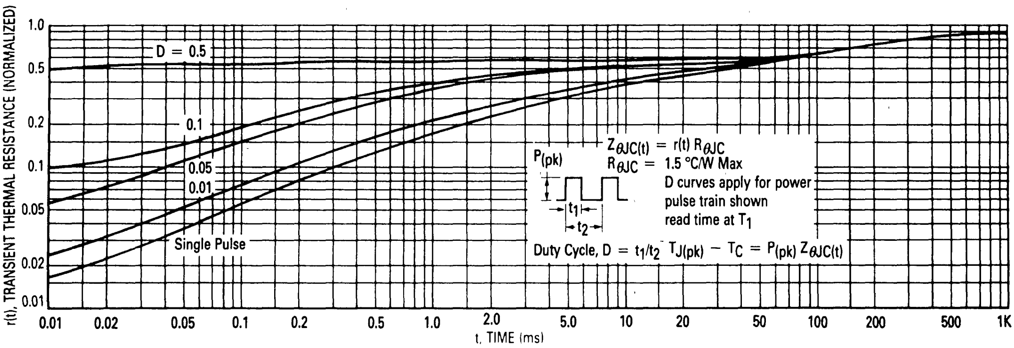
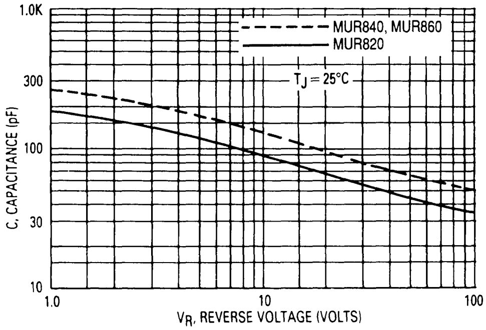


FIGURE 17 — TYPICAL CAPACITANCE



Switchmode Power Rectifiers Ultrafast "E" Series w/High Reverse Energy Capability

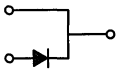
MUR890E
MUR8100E

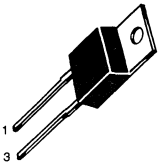
MUR8100E is a Motorola Preferred Device

ULTRAFAST RECTIFIERS
8.0 AMPERES
900–1000 VOLTS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- 20 mjoules Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 Volts





CASE 221B-03
TO-220AC

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U890E, U8100E

MAXIMUM RATINGS

Rating	Symbol	MUR 890E	MUR 8100E	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	900	1000	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C	$I_{F(AV)}$	8.0		Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100		Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	–65 to +175		°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 150°C (i_F = 8.0 Amp, T_C = 25°C)	v_F	 1.5 1.8	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 100°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 25	µA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/µs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 100 75	ns
Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	20	mJ

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Rev 1

4

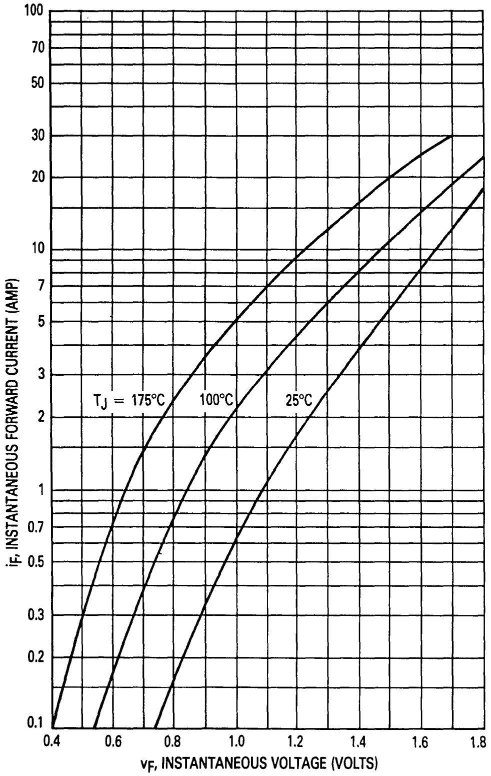


Figure 1. Typical Forward Voltage

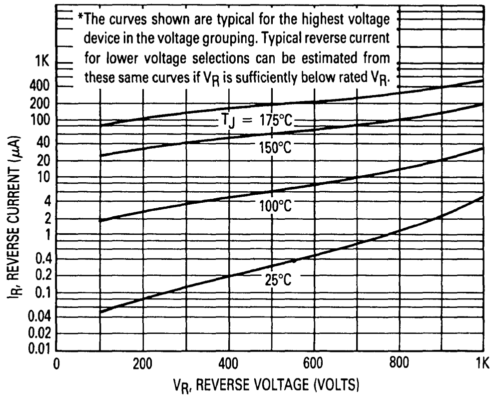


Figure 2. Typical Reverse Current*

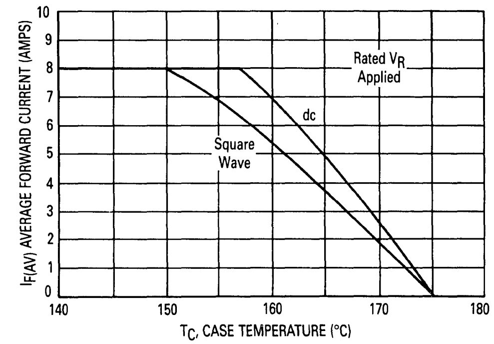


Figure 3. Current Derating, Case

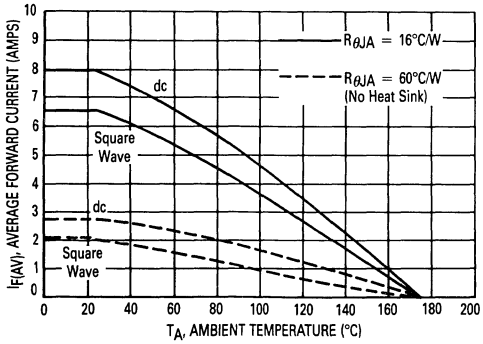


Figure 4. Current Derating, Ambient

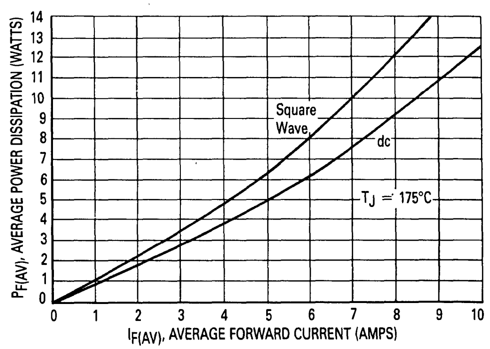


Figure 5. Power Dissipation

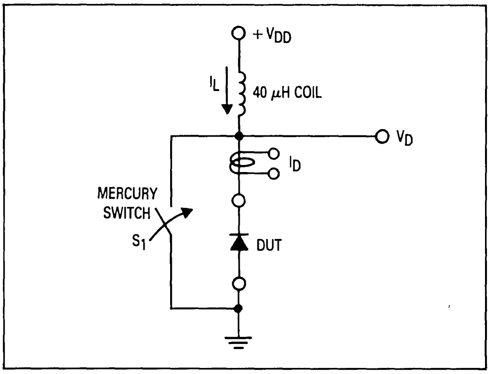


Figure 6. Test Circuit

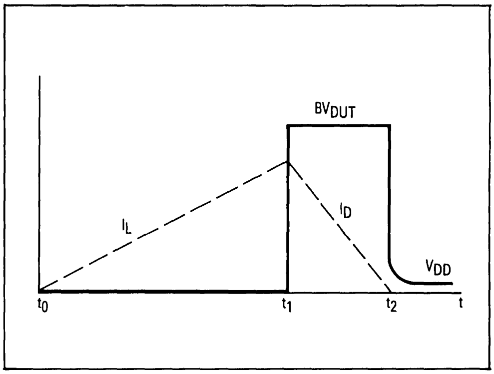


Figure 7. Current-Voltage Waveforms

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the MUR8100E in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 volts, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.

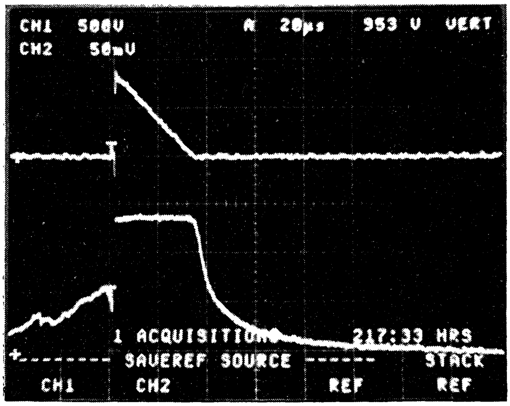
Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2 \left(\frac{BV_{DUT}}{BV_{DUT} - V_{DD}}\right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2$$



CHANNEL 2:
I_L
0.5 AMPS/DIV.

CHANNEL 1:
V_{DUT}
500 VOLTS/DIV.

TIME BASE:
20 μs/DIV.

Figure 8. Current-Voltage Waveforms

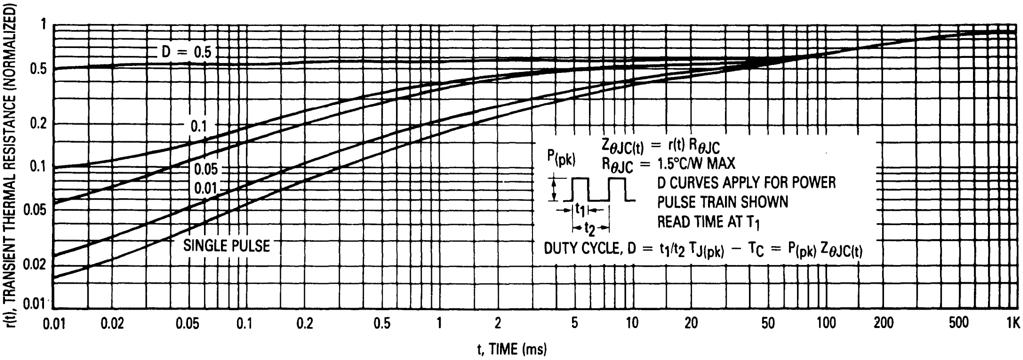


Figure 9. Thermal Response

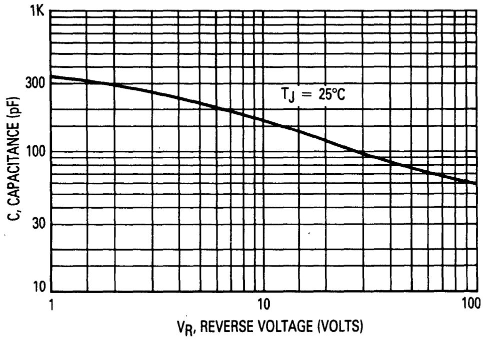


Figure 10. Typical Capacitance

SCANSWITCH™

Power Rectifier For High and Very High Resolution Monitors

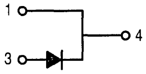
MUR10120E

Motorola Preferred Device

SCANSWITCH RECTIFIER 10 AMPERES 1200 VOLTS

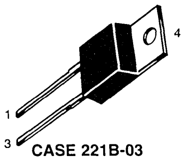
This state-of-the-art power rectifier is specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MUR10120E is fully realized when paired with either the MJH16206 or MJF16206 monitor specific, 1200 volt bipolar power transistor.

- 1200 Volt Blocking Voltage
- 20 mJ Avalanche Energy (Guaranteed)
- 12 Volt (Typical) Peak Transient Overshoot Voltage
- 135 ns (Typical) Forward Recovery Time



Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U10120E



CASE 221B-03
(TO-220AC)
STYLE 1

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction Temperature	T_J	−65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1) (I_F = 6.5 Amps, T_J = 125°C) (I_F = 6.5 Amps, T_J = 25°C)	v_F	 1.7 1.9	 2.0 2.2	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 125°C)	i_R	 25 750	 100 1000	μA
Maximum Reverse Recovery Time (I_F = 1.0 A, di/dt = 50 Amps/μs)	t_{rr}	150	175	ns
Maximum Forward Recovery Time I_F = 6.5 Amps, di/dt = 12 Amps/μs (As Measured on a Deflection Circuit)	t_{fr}	135	175	ns
Peak Transient Overshoot Voltage	V_{RFM}	12	14	Volts

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Rev 1

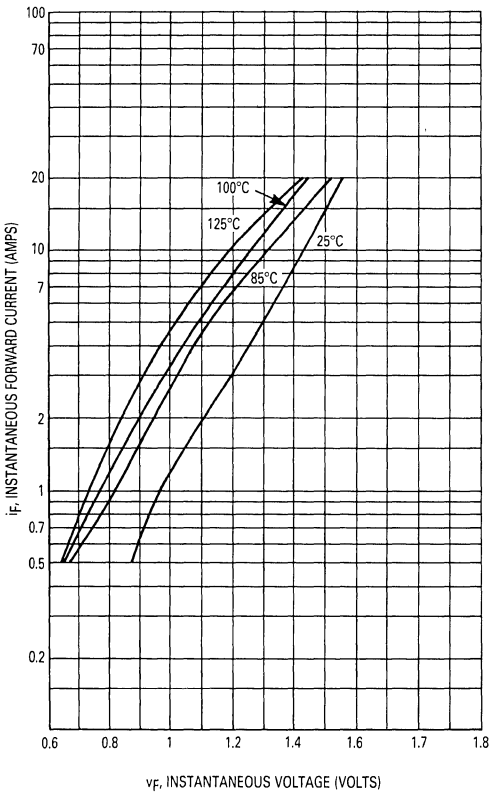


Figure 1. Typical Forward Voltage

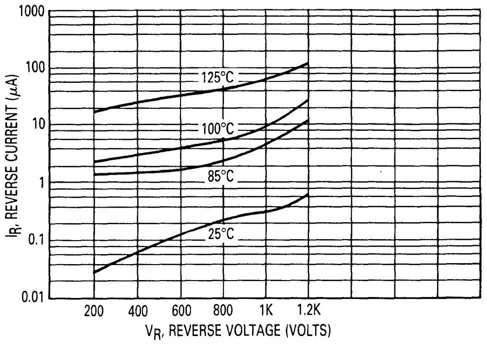


Figure 2. Typical Reverse Current

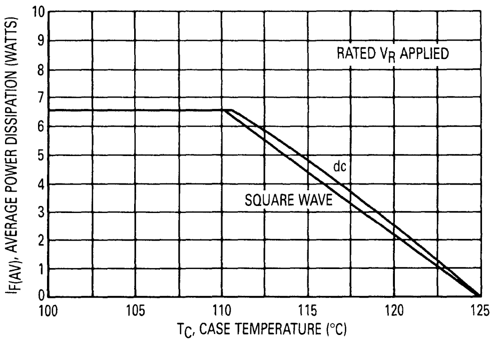


Figure 3. Current Derating, Case

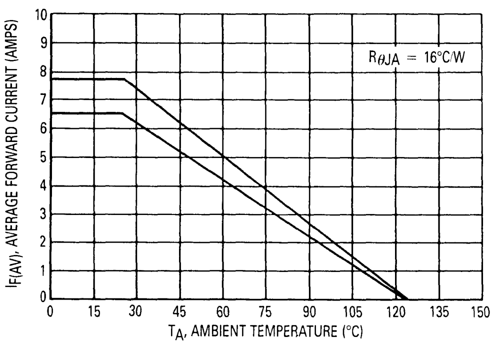


Figure 4. Current Derating, Ambient

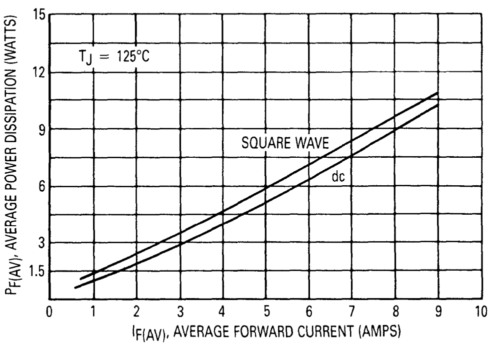


Figure 5. Power Dissipation

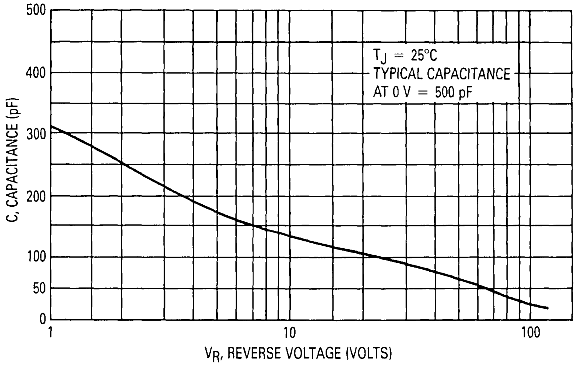


Figure 6. Typical Capacitance

Designer's™ Data Sheet
SCANSWITCH™
Power Rectifier
For Use As A Damper Diode In High And Very High Resolution Monitors

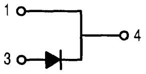
MUR10150E

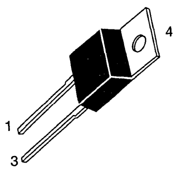
Motorola Preferred Device

SCANSWITCH RECTIFIERS
10 AMPERES
1500 VOLTS

The MUR10150E is a state-of-the-art Power Rectifier specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MUR10150E is fully realized when paired with either the MJW16212 or MJF16212 monitor specific, 1500 V bipolar power transistor.

- 1500 V Blocking Voltage
- 20 mJ Avalanche Energy Guaranteed
- Peak Transient Overshoot Voltage Specified, 14 Volt (typical)
- Forward Recovery Time Specified, 135 ns (typical)
- Epoxy Meets UL94, V_O at 1/8″





CASE 221B-02
TO-220AC

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U10150E

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1500	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 125°C	$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 125°C	I_{FRM}	20	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 6.5 Amps, T_J = 125°C) (i_F = 6.5 Amps, T_J = 25°C)	v_F	1.7 1.9	2.2 2.4	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	750 25	1000 100	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)	t_{rr}	150	175	ns
Maximum Forward Recovery Time (I_F = 6.5 Amp, di/dt = 12 Amps/μs)	t_{fr}	135	175	ns
Peak Transient Overshoot Voltage	V_{RFM}	14	16	Volts

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

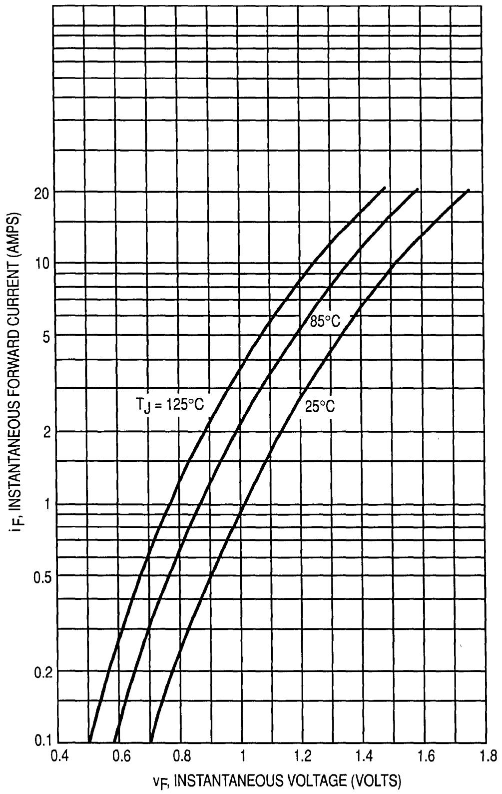


Figure 1. Typical Forward Voltage

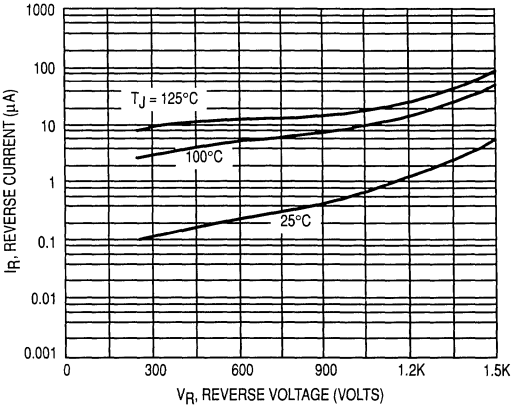


Figure 2. Typical Reverse Current

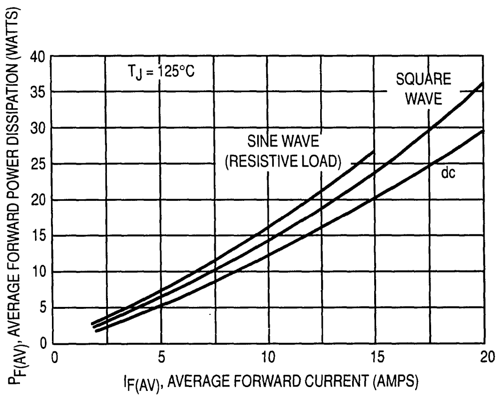


Figure 3. Forward Power Dissipation

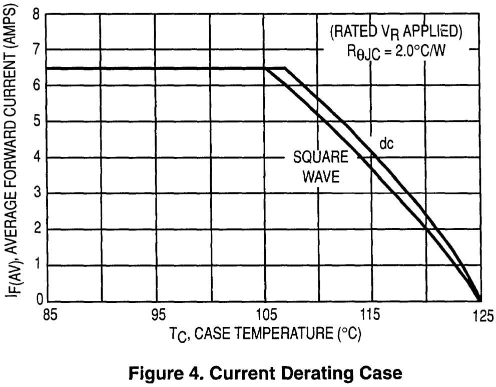


Figure 4. Current Derating Case

4

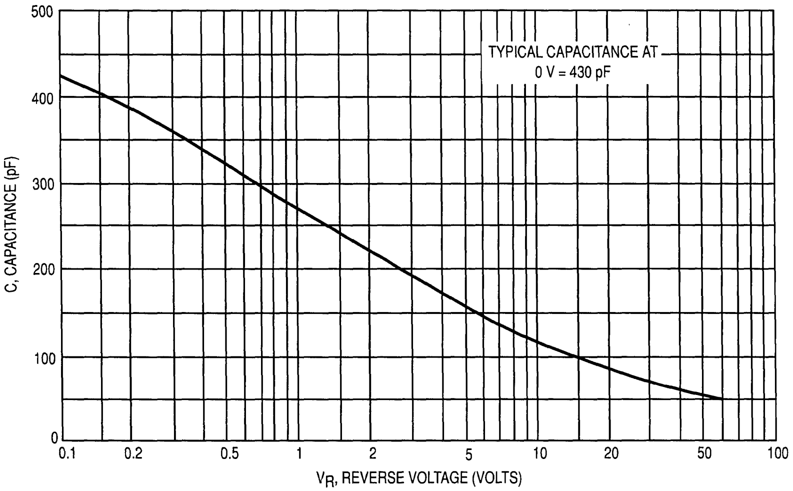


Figure 5. Typical Capacitance

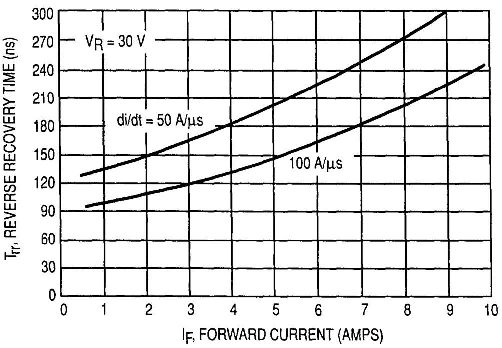


Figure 6. Typical Reverse Recovery Time

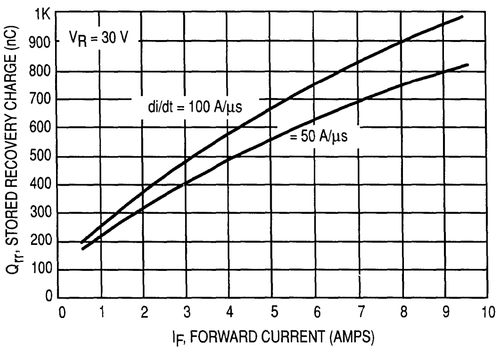
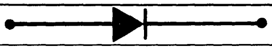


Figure 7. Typical Stored Recovery Charge

MUR1520
MUR1540
MUR1560

Motorola Preferred Devices



Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

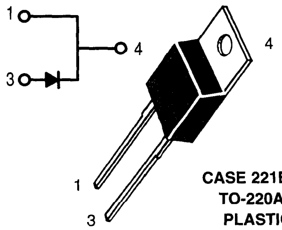
- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- High Voltage Capability to 600 Volts
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U1520, U1540, U1560

ULTRAFAST RECTIFIERS

15 AMPERES
200–400–600 VOLTS



CASE 221B-03
TO-220AC
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MUR 1520	MUR 1540	MUR 1560	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current (Rated V_R)	$I_{F(AV)}$	15 @ T_C = 150°C		15 @ T_C = 145°C	Amps
Peak Rectified Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30 @ T_C = 150°C		30 @ T_C = 145°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	200	150		Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175			°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 15 Amp, T_C = 150°C) (i_F = 15 Amp, T_C = 25°C)	v_F	 0.85 1.05	 1.12 1.25	 1.20 1.50	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	 500 10	 1000 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs)	t_{rr}	35	60		ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

Rev 1

MUR1520

FIGURE 1 — TYPICAL FORWARD VOLTAGE

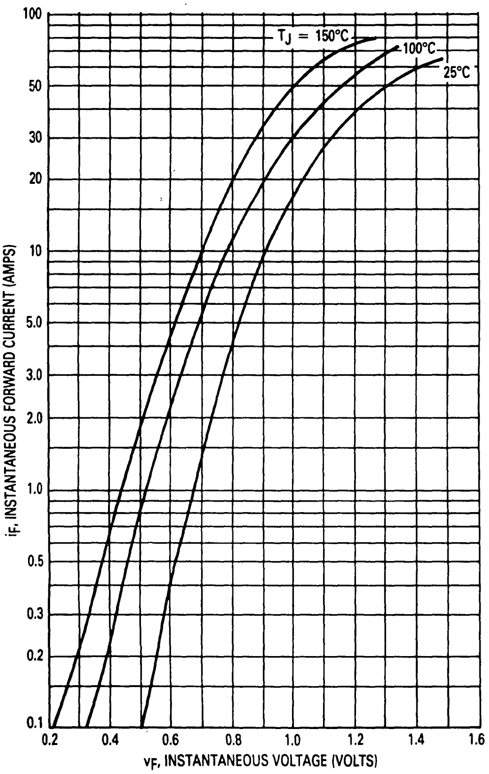


FIGURE 2 — TYPICAL REVERSE CURRENT

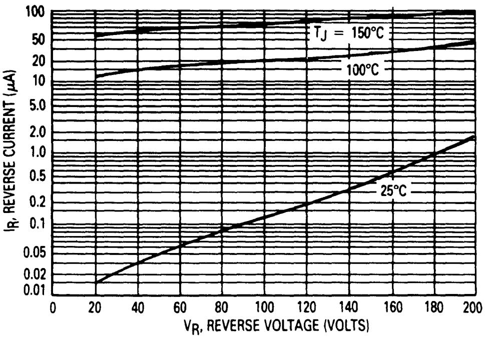


FIGURE 3 — CURRENT DERATING, CASE

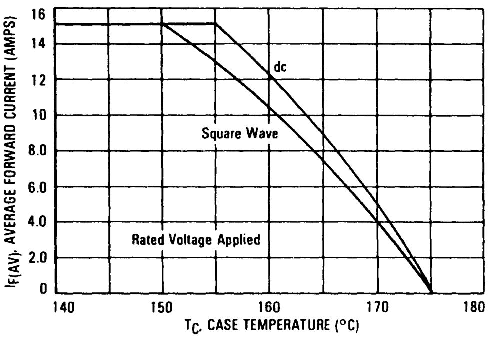


FIGURE 4 — CURRENT DERATING, AMBIENT

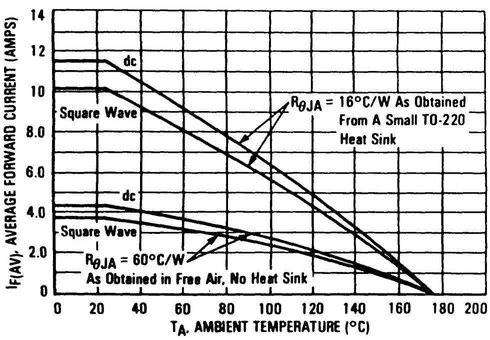
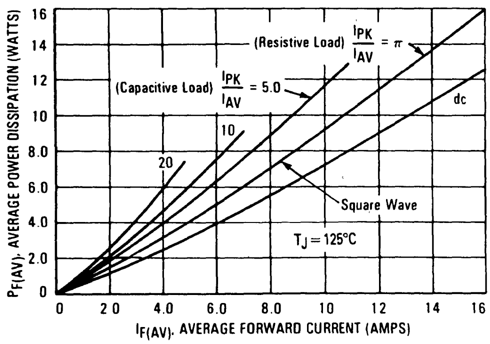


FIGURE 5 — POWER DISSIPATION



MUR1540

FIGURE 6 — TYPICAL FORWARD VOLTAGE

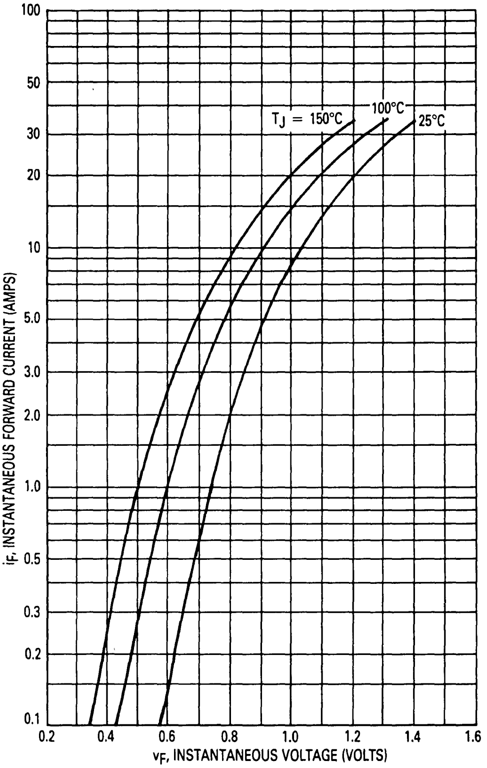
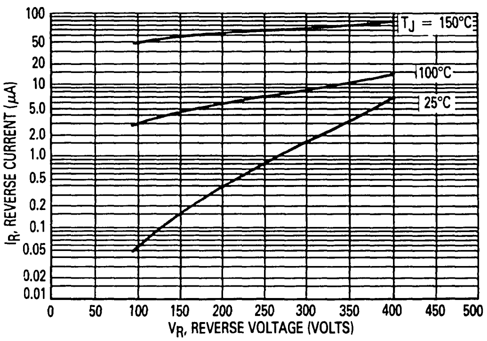


FIGURE 7 — TYPICAL REVERSE CURRENT



4

FIGURE 8 — CURRENT DERATING, CASE

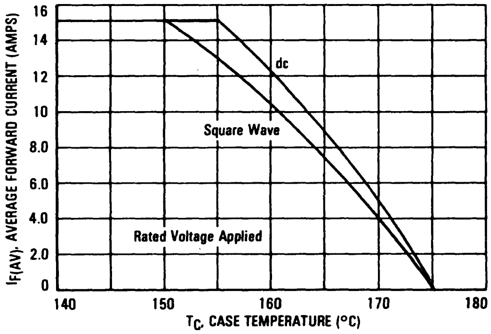


FIGURE 9 — CURRENT DERATING, AMBIENT

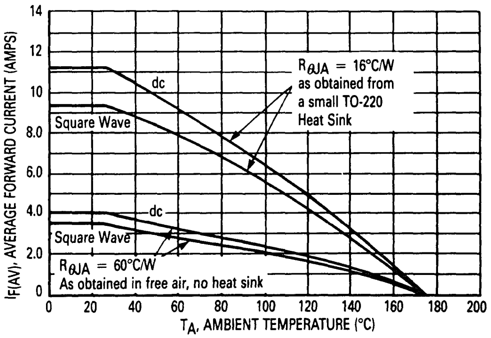
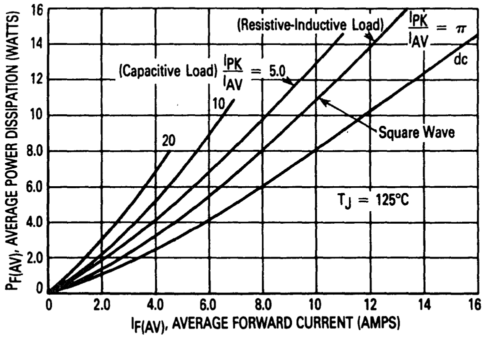


FIGURE 10 — POWER DISSIPATION



MUR1560

FIGURE 11 — TYPICAL FORWARD VOLTAGE

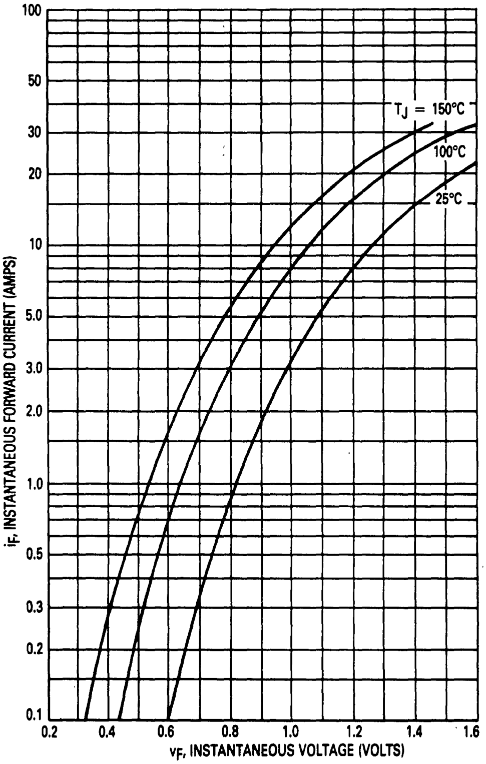


FIGURE 12 — TYPICAL REVERSE CURRENT

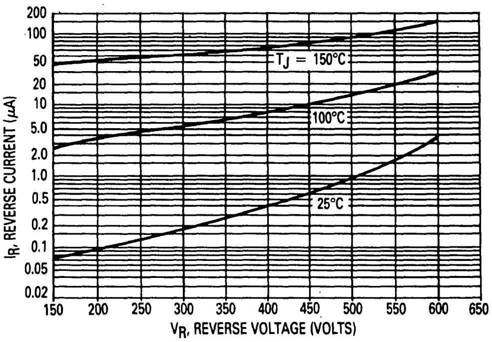


FIGURE 13 — CURRENT DERATING, CASE

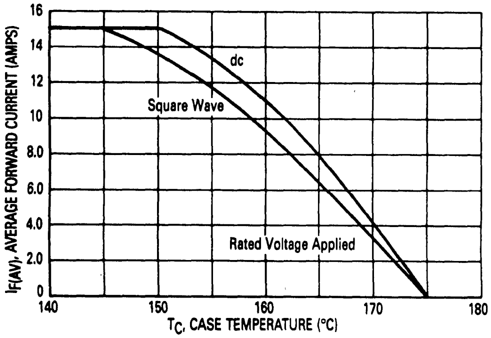


FIGURE 14 — CURRENT DERATING, AMBIENT

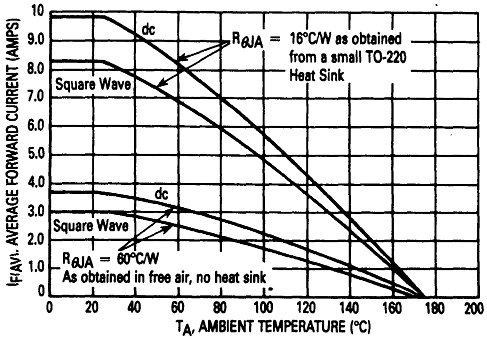


FIGURE 15 — POWER DISSIPATION

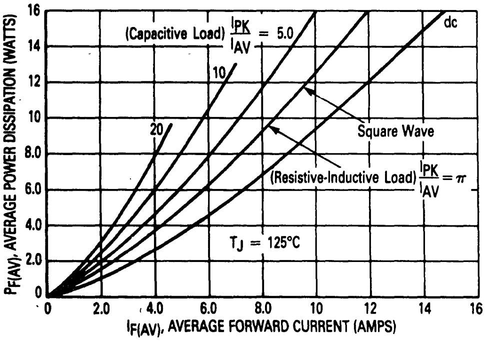


FIGURE 16 — THERMAL RESPONSE

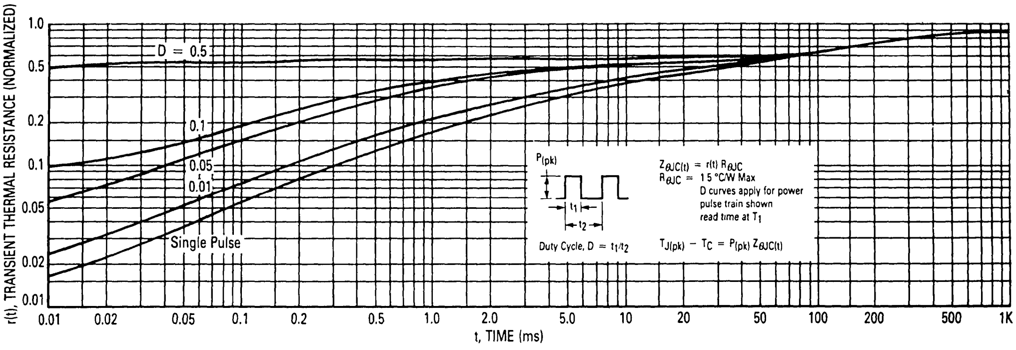
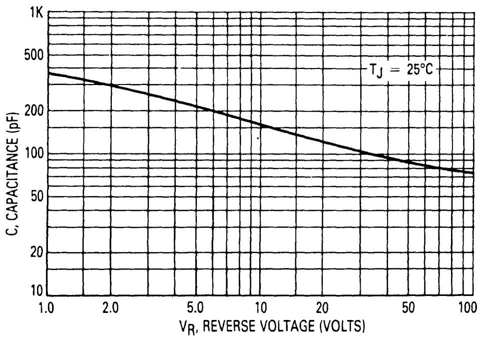


FIGURE 17 — TYPICAL CAPACITANCE



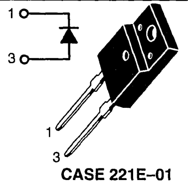
4

Advance Information
SWITCHMODE™ Power Rectifiers

MURF820

Motorola Preferred Device

ULTRAFAST RECTIFIERS
8 AMPERES
200 VOLTS



CASE 221E–01
ISOLATED TO–220

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Ultrafast 35 ns Recovery Times
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)

Mechanical Characteristics
- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U820

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current (Rated V_R), T_C = 150°C	$I_{F(AV)}$	8	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	– 65 to +150	°C
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)(2) Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.2	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

This document contains information on a new product. Specifications and information are subject to change without notice.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (3) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	 0.895 0.975	Volts
Maximum Instantaneous Reverse Current (3) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 250 5.0	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25	ns

(3) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤2.0%.

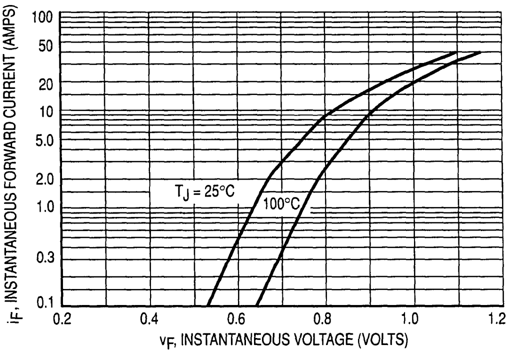


Figure 1. Typical Forward Voltage

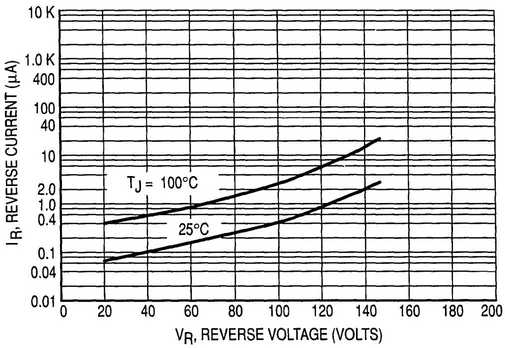


Figure 2. Typical Reverse Leakage Current*

TEST CONDITIONS FOR ISOLATION TESTS*

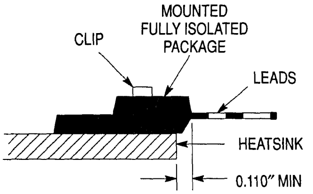


Figure 3. Clip Mounting Position for Isolation Test Number 1

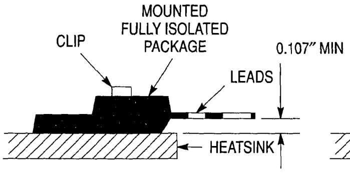


Figure 4. Clip Mounting Position for Isolation Test Number 2

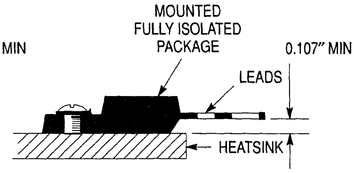
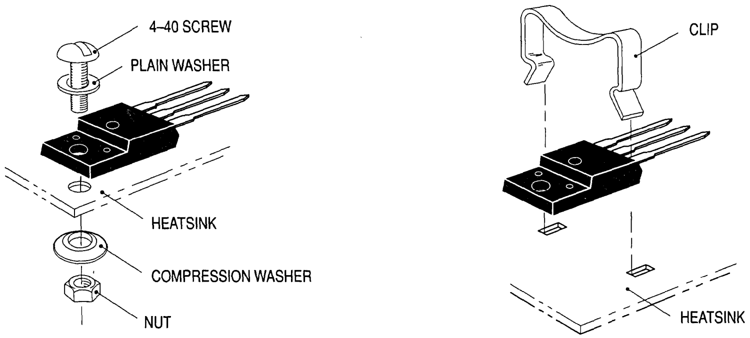


Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



6a. Screw–Mounted **6b. Clip–Mounted**

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

4

Advance Information

SWITCHMODE™ Power Rectifiers

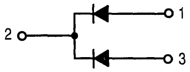
MURF1620CT

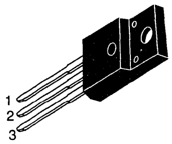
Motorola Preferred Device

ULTRAFAST RECTIFIERS
16 AMPERES
and 200 VOLTS

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Times
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)





CASE 221D–02
ISOLATED TO–220

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U1620

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C	 Total Device	$I_{F(AV)}$	8 16	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C		I_{FM}	16	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	100	Amps
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.2	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from the Case for 5 seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper strike and creepage distance must be provided.

This document contains information on a new product. Specifications and information are subject to change without notice

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (3) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	 0.895 0.975	Volts
Maximum Instantaneous Reverse Current (3) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 250 5.0	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25	ns

(3) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

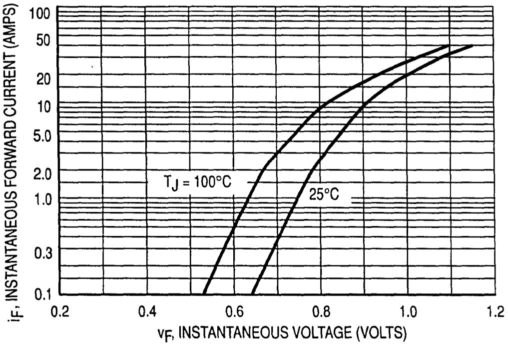


Figure 1. Typical Forward Voltage, Per Leg

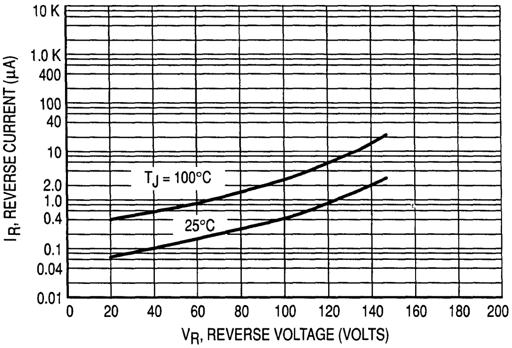


Figure 2. Typical Reverse Current, Per Leg*

TEST CONDITIONS FOR ISOLATION TESTS*

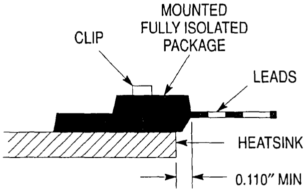


Figure 3. Clip Mounting Position for Isolation Test Number 1

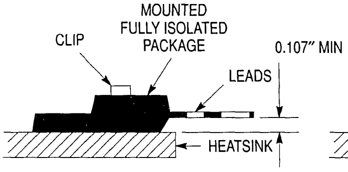


Figure 4. Clip Mounting Position for Isolation Test Number 2

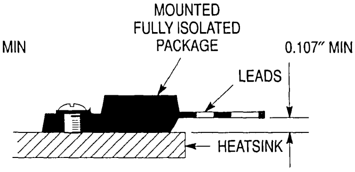
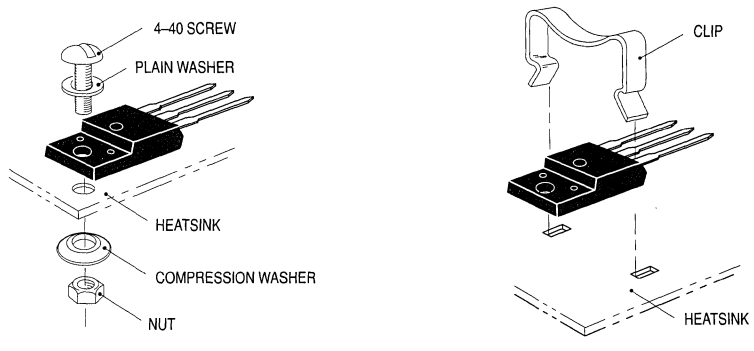


Figure 5. Screw Mounting Position for Isolation Test Number 3

* *Measurement made between leads and heatsink with all leads shorted together.*

MOUNTING INFORMATION**



6a. Screw–Mounted **6b. Clip–Mounted**

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

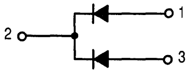
MURF1660CT
Motorola Preferred Device

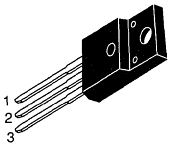
Advance Information
SWITCHMODE™ Power Rectifiers

ULTRAFAST RECTIFIERS 16 AMPERES 600 VOLTS

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Ultrafast 60 Nanosecond Recovery Times
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Electrically Isolated. No Isolation Hardware Required.
- UL Recognized File #E69369(1)





CASE 221D–02
ISOLATED TO–220

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U1660

4

MAXIMUM RATINGS, PER LEG

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	600	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C	Per Diode Per Device	$I_{F(AV)}$	8 16	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C		I_{FM}	16	Amps
Non–repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	100	Amps
Operating Junction and Storage Temperature		T_J, T_{stg}	– 65 to +150	°C
RMS Isolation Voltage (t = 1 second, R.H. ≤ 30%, T_A = 25°C)(2)	Per Figure 3 Per Figure 4(1) Per Figure 5	V_{iso1} V_{iso2} V_{iso3}	4500 3500 1500	Volts

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W
Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

(1) UL Recognized mounting method is per Figure 4.
(2) Proper Strike and creepage distance must be provided.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (3) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	 1.20 1.50	Volts
Maximum Instantaneous Reverse Current (3) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	µA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/µs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 60 50	ns

(3) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

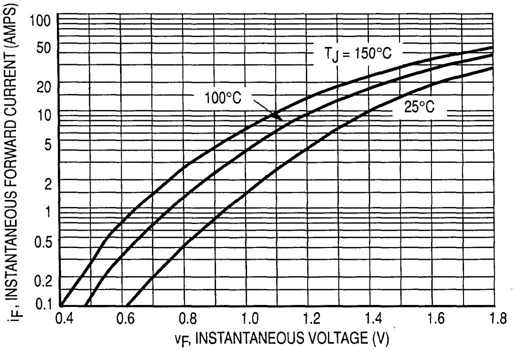


Figure 1. Typical Forward Voltage, Per Leg

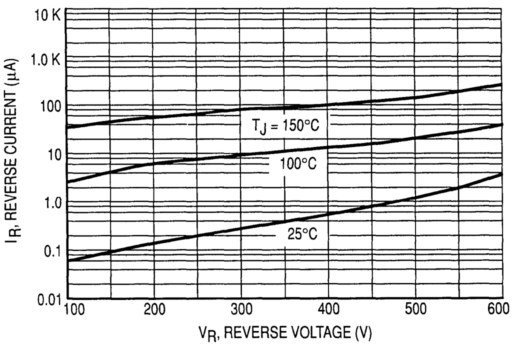


Figure 2. Typical Reverse Current, Per Leg*

TEST CONDITIONS FOR ISOLATION TESTS*

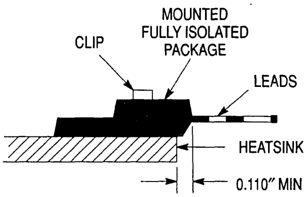


Figure 3. Clip Mounting Position for Isolation Test Number 1

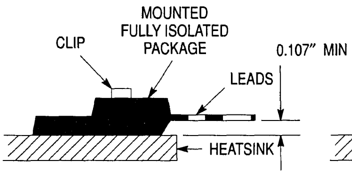


Figure 4. Clip Mounting Position for Isolation Test Number 2

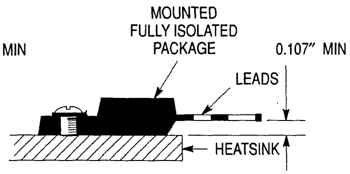
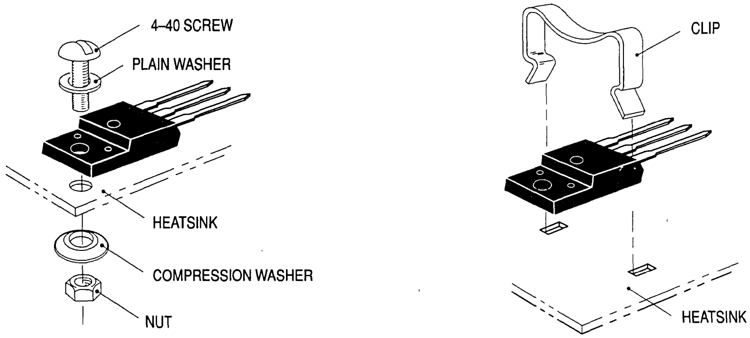


Figure 5. Screw Mounting Position for Isolation Test Number 3

* Measurement made between leads and heatsink with all leads shorted together.

MOUNTING INFORMATION**



6a. Screw–Mounted **6b. Clip–Mounted**

Figure 6. Typical Mounting Techniques

Laboratory tests on a limited number of samples indicate, when using the screw and compression washer mounting technique, a screw torque of 6 to 8 in · lbs is sufficient to provide maximum power dissipation capability. The compression washer helps to maintain a constant pressure on the package over time and during large temperature excursions.

Destructive laboratory tests show that using a hex head 4–40 screw, without washers, and applying a torque in excess of 20 in · lbs will cause the plastic to crack around the mounting hole, resulting in a loss of isolation capability.

Additional tests on slotted 4–40 screws indicate that the screw slot fails between 15 to 20 in · lbs without adversely affecting the package. However, in order to positively ensure the package integrity of the fully isolated device, Motorola does not recommend exceeding 10 in · lbs of mounting torque under any mounting conditions.

**For more information about mounting power semiconductors see Application Note AN1040.

MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

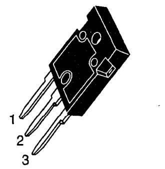
MUR3020WT
MUR3040WT
MUR3060WT
Motorola preferred devices

Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO–247 Package
- High Voltage Capability to 600 Volts
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures
- Epoxy Meets UL94V–O @ 1/8″
- High Temperature Glass Passivated Junction

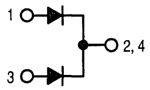
ULTRAFAST RECTIFIERS
30 AMPERES
200–400–600 VOLTS



CASE 340F–03
TO–247AE
STYLE 2

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: U3020, U3040, U3060



4

MAXIMUM RATINGS, PER LEG

Rating	Symbol	MUR3020WT	MUR3040WT	MUR3060WT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current @ 145°C Total Device	$I_{F(AV)}$		15 30		Amps
Peak Repetitive Surge Current (Rated V_R, Square Wave, 20 kHz, T_C = 145°C)	I_{FM}		30		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	200	150		
Operating Junction and Storage Temperature	T_J, T_{stg}		– 65 to +175		°C

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	MUR3020WT	MUR3040WT	MUR3060WT	Unit
Maximum Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$		1.5 40		°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	MUR3020WT	MUR3040WT	MUR3060WT	Unit
Maximum Instantaneous Forward Voltage (1) (I_F = 15 Amp, T_C = 150°C) (I_F = 15 Amp, T_C = 25°C)	V_F	0.85 1.05	1.12 1.25	1.4 1.7	Volts
Maximum Instantaneous Reverse Current (1) (Rated DC Voltage, T_J = 150°C) (Rated DC Voltage, T_J = 25°C)	i_R	500 10		1000 10	µA
Maximum Reverse Recovery Time (i_F = 1.0 A, di/dt = 50 Amps/µs)	t_{rr}	35	60		ns

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

MUR3020WT

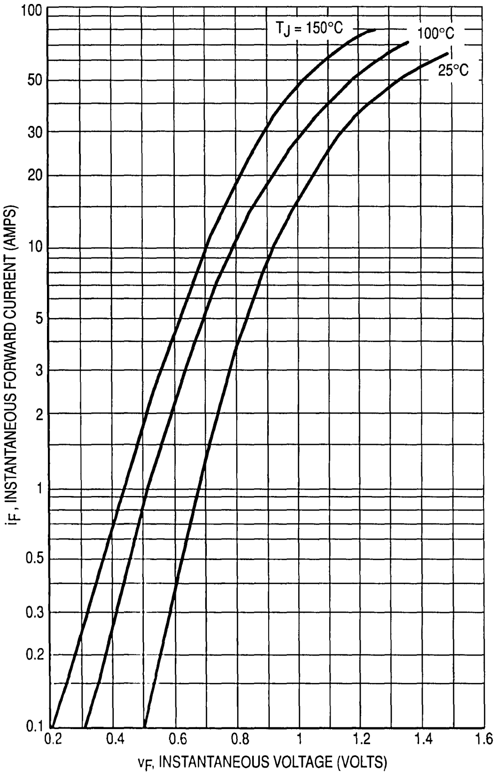


Figure 1. Typical Forward Voltage (Per Leg)

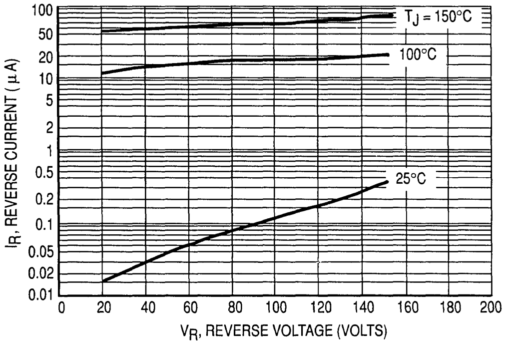


Figure 2. Typical Reverse Current (Per Leg)

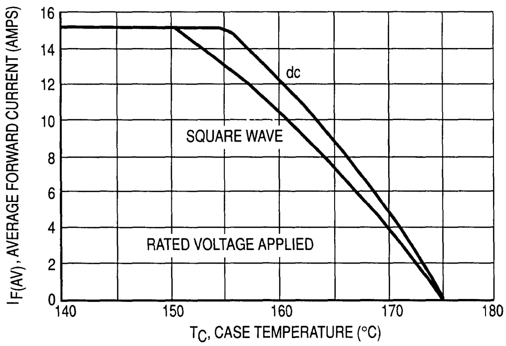


Figure 3. Current Derating, Case (Per Leg)

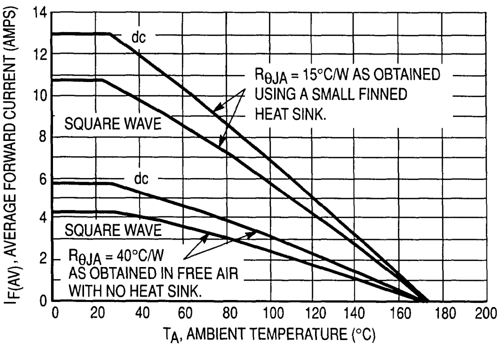


Figure 4. Current Derating, Ambient (Per Leg)

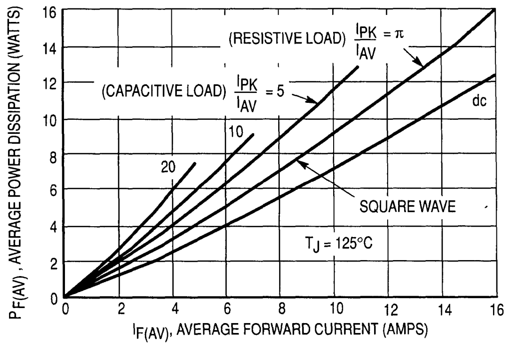


Figure 5. Power Dissipation (Per Leg)

MUR3040WT

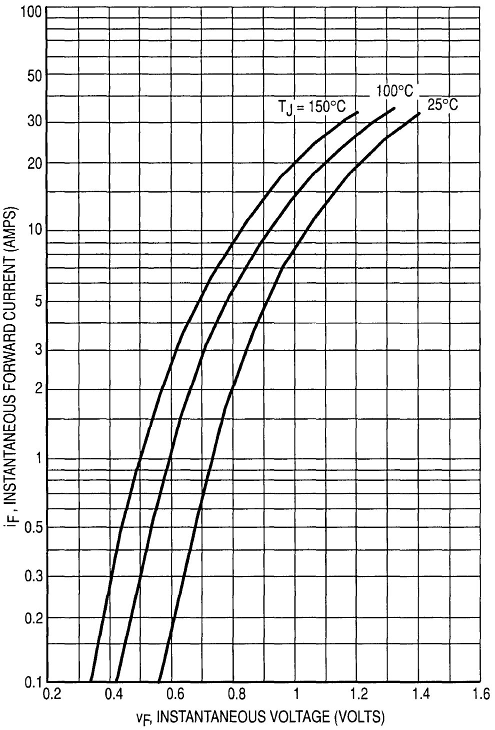


Figure 6. Typical Forward Voltage (Per Leg)

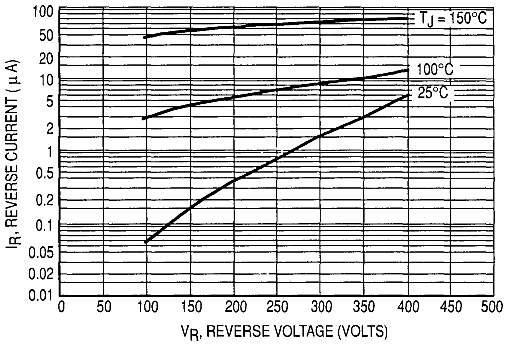


Figure 7. Typical Reverse Current (Per Leg)

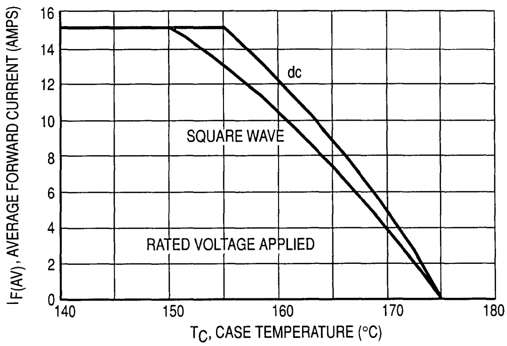


Figure 8. Current Derating, Case (Per Leg)

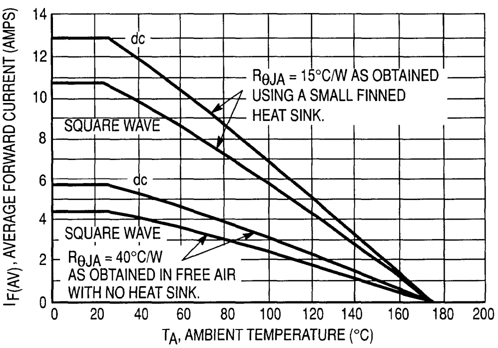


Figure 9. Current Derating, Ambient (Per Leg)

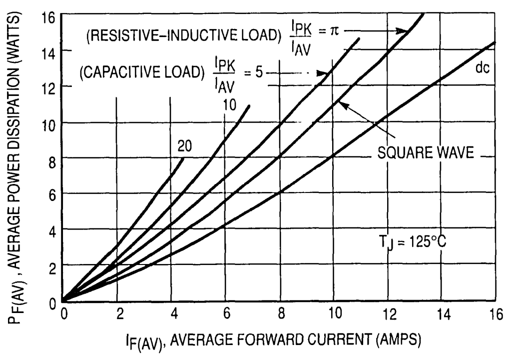


Figure 10. Power Dissipation (Per Leg)

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MUR3060WT

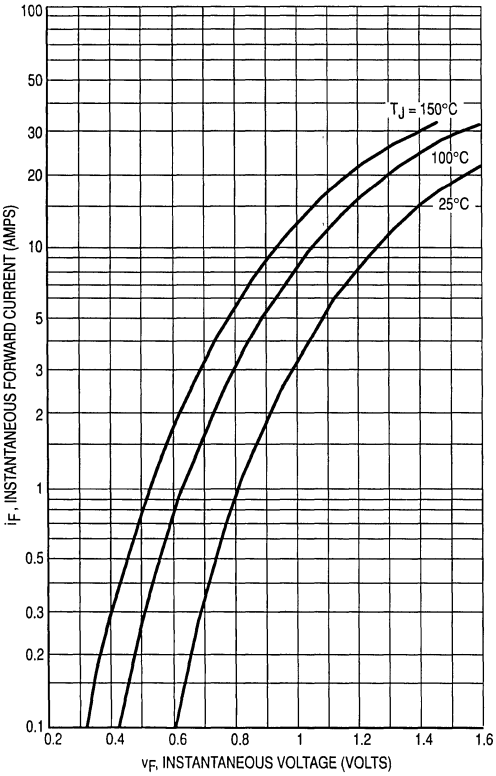


Figure 11. Typical Forward Voltage (Per Leg)

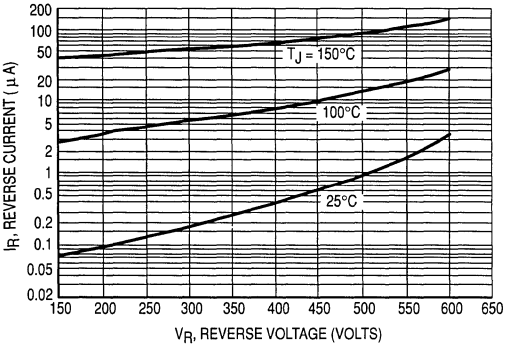


Figure 12. Typical Reverse Current (Per Leg)

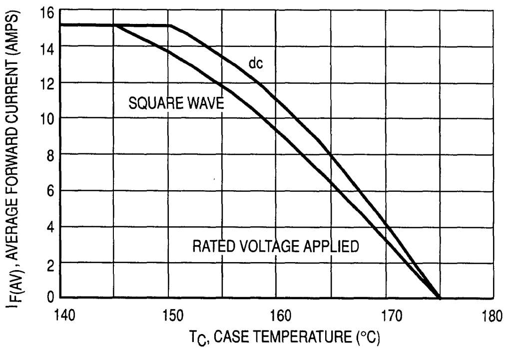


Figure 13. Current Derating, Case (Per Leg)

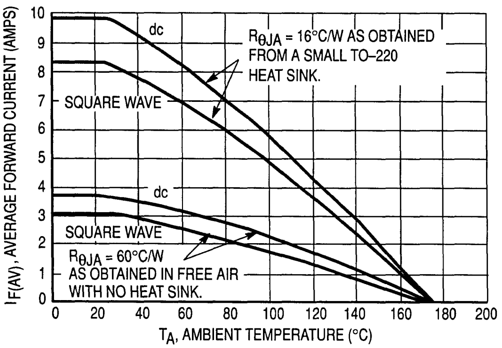


Figure 14. Current Derating, Ambient (Per Leg)

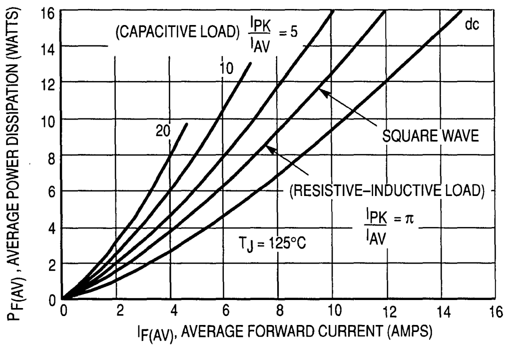


Figure 15. Power Dissipation (Per Leg)

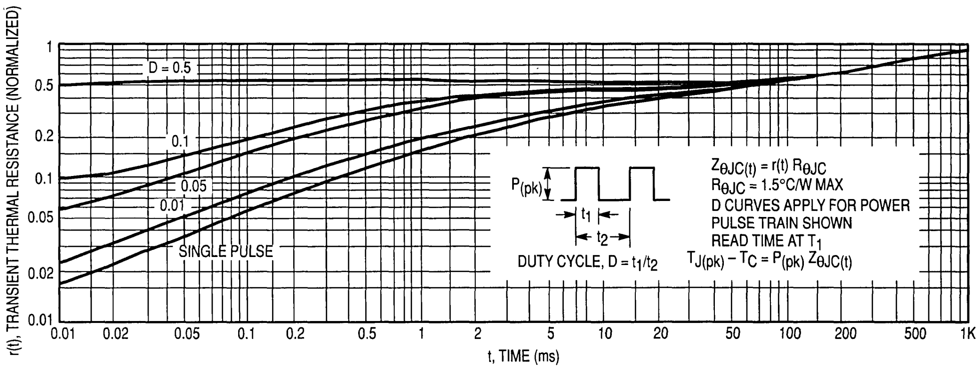


Figure 16. Thermal Response

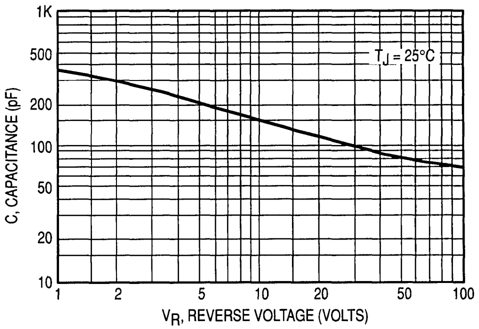


Figure 17. Typical Capacitance (Per Leg)

4

MUR3020PT
MUR3040PT
MUR3060PT

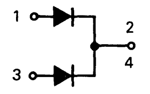
MUR3020PT and MUR3060PT are Motorola Preferred Devices

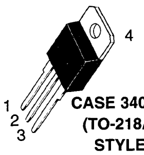
Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- High Voltage Capability to 600 Volts
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction

ULTRAFAST RECTIFIERS
30 AMPERES
200–400–600 VOLTS





CASE 340D-01
(TO-218AC)
STYLE 2

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: U3020, U3040, U3060

MAXIMUM RATINGS

Rating	Symbol	MUR 3020PT	MUR 3040PT	MUR 3060PT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current (Rated V_R) Per Leg Per Device	$I_{F(AV)}$	15 30	T_C = 150°C	15 T_C = 30 145°C	Amps
Peak Rectified Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FRM}	30 @ T_C = 150°C		30 @ T_C = 145°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz) Per Leg	I_{FSM}	200	150		Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	– 65 to +175			°C

THERMAL CHARACTERISTICS PER DIODE LEG

Rating	Symbol	Value	Unit
Maximum Thermal Resistance, Junction to Case Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.5 40	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

Characteristic	Symbol	3020PT	3040PT	3060PT	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 15 Amps, T_C = 150°C) (i_F = 15 Amps, T_C = 25°C)	v_F	0.85 1.05	1.12 1.25	1.2 1.5	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	500 10		1000 10	μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/μs)	t_{rr}	35	60		ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%

Rev 3

MUR3020PT

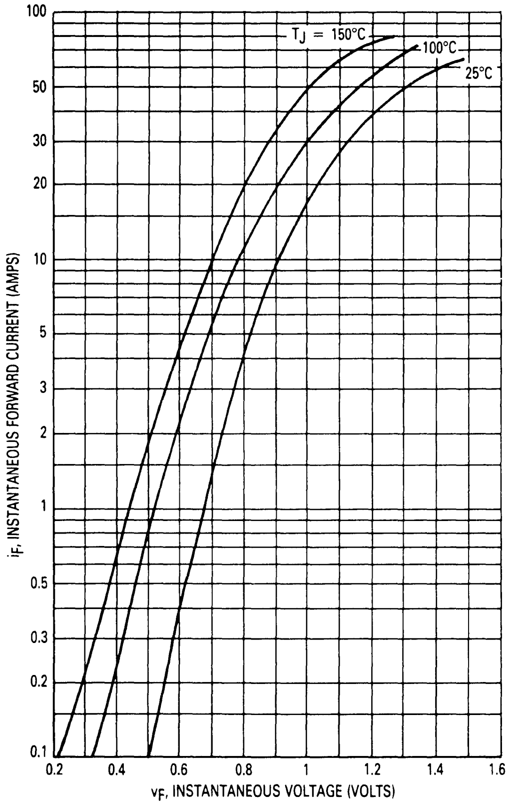


Figure 1. Typical Forward Voltage (Per Leg)

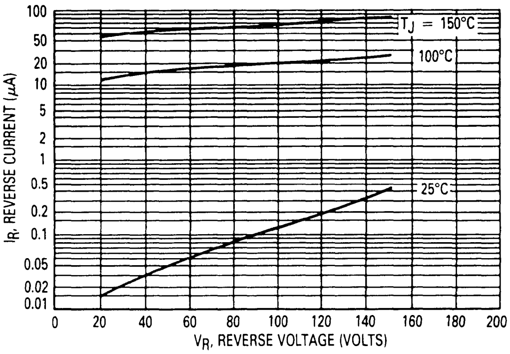


Figure 2. Typical Reverse Current (Per Leg)

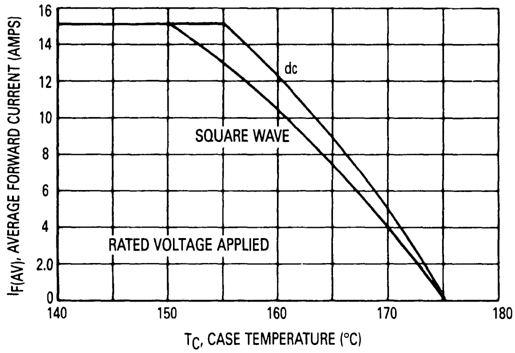


Figure 3. Current Derating, Case (Per Leg)

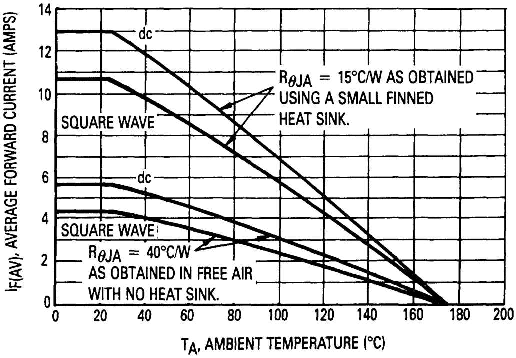


Figure 4. Current Derating, Ambient (Per Leg)

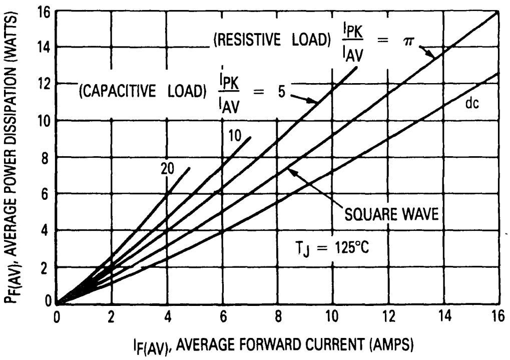


Figure 5. Power Dissipation (Per Leg)

MUR3040PT

4

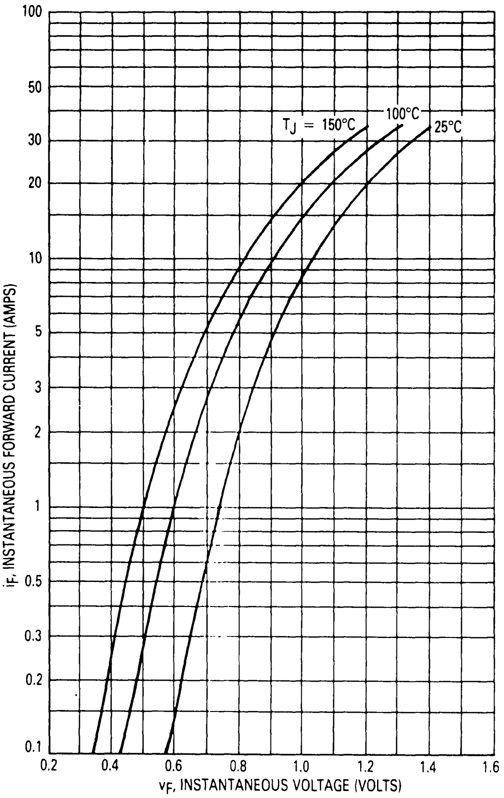


Figure 6. Typical Forward Voltage (Per Leg)

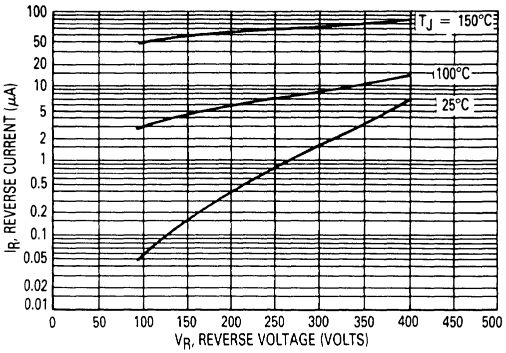


Figure 7. Typical Reverse Current (Per Leg)

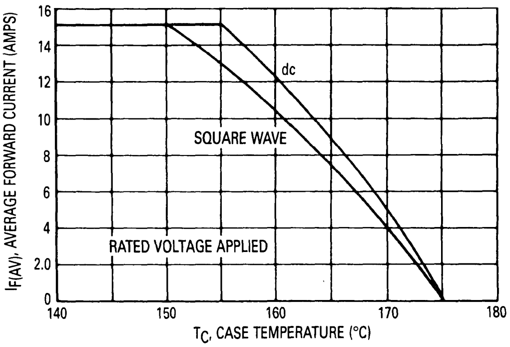


Figure 8. Current Derating, Case (Per Leg)

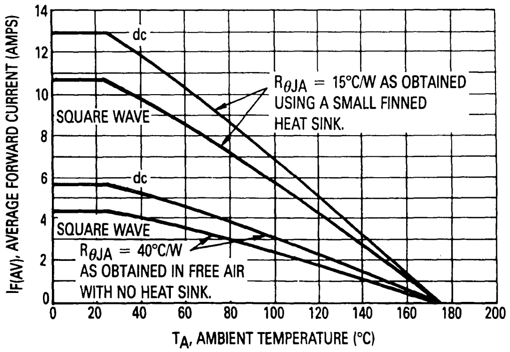


Figure 9. Current Derating, Ambient (Per Leg)

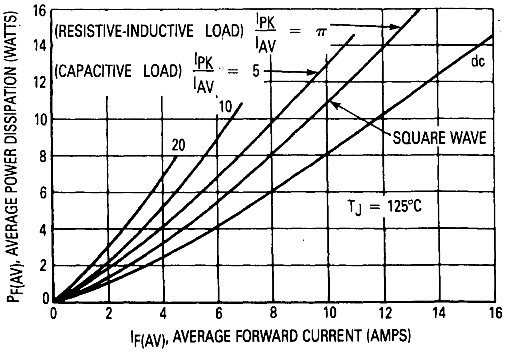


Figure 10. Power Dissipation (Per Leg)

MUR3060PT

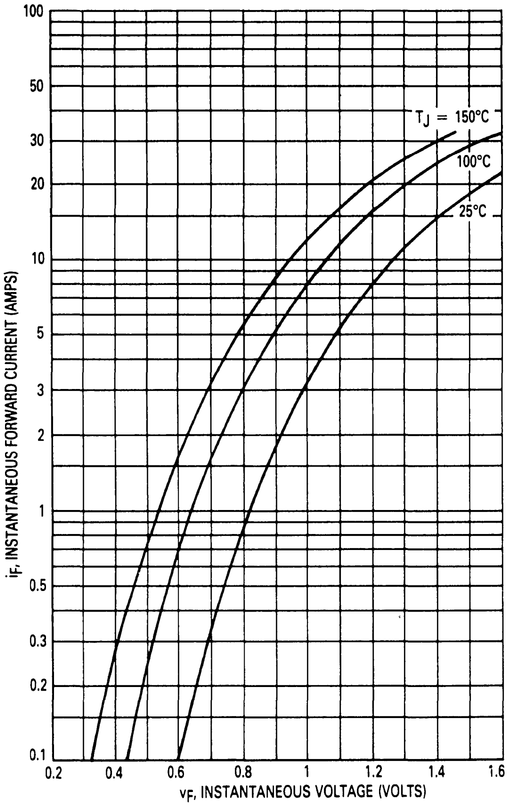


Figure 11. Typical Forward Voltage

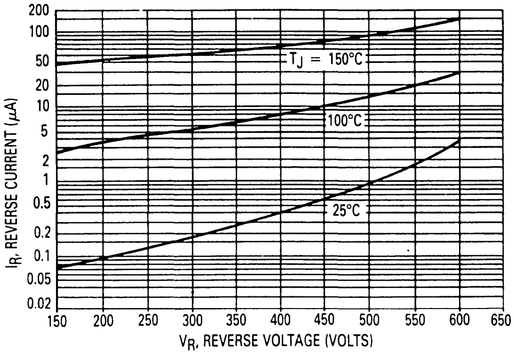


Figure 12. Typical Reverse Current

4

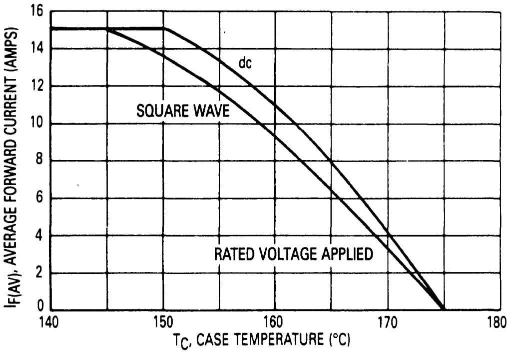


Figure 13. Current Derating, Case

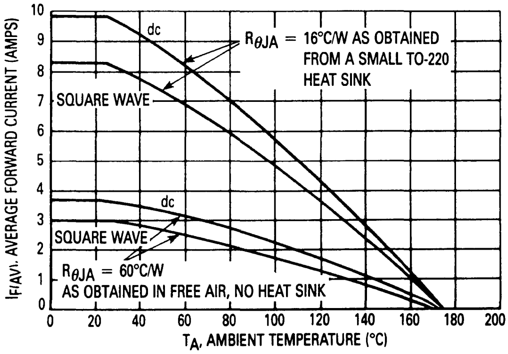


Figure 14. Current Derating, Ambient

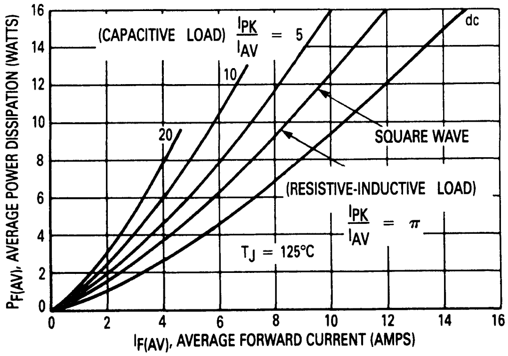


Figure 15. Power Dissipation

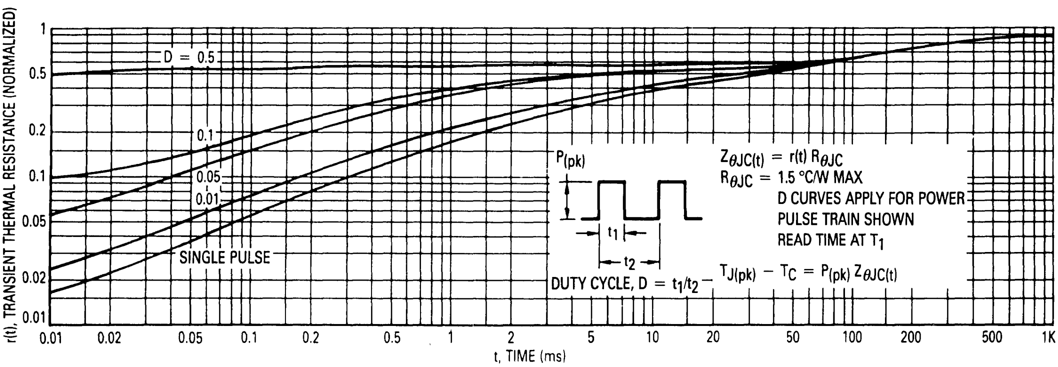


Figure 16. Thermal Response

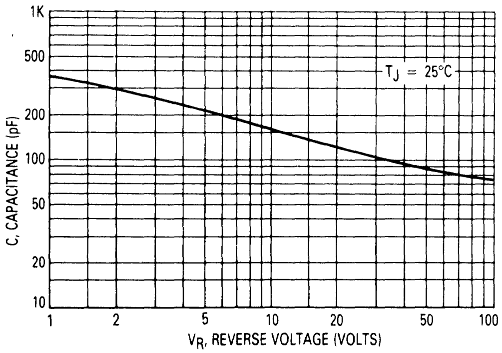


Figure 17. Typical Capacitance (Per Leg)

4

MUR3040

Motorola Preferred Device

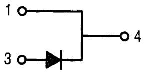
SWITCHMODE Power Rectifiers

... designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

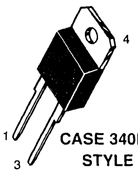
- Ultrafast 100 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- High Voltage Capability to 400 Volts
- Low Forward Voltage Drop
- High Temperature Glass Passivated Junction

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: U3040



**ULTRAFAST RECTIFIERS
30 AMPERES
400 VOLTS**



CASE 340E-01
STYLE 1

4

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	400	Volts
Average Rectified Forward Current $T_C = 70°C$	$I_{F(AV)}$	30	Amps
Peak Repetitive Forward Current (Rated V_R Square Wave 20 kHz) $T_C = 150°C$	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	300	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Instantaneous Forward Voltage ($I_F = 30$ Amp, $T_C = 100°C$) ($I_F = 30$ Amp, $T_C = 25°C$)	v_F	 1.4 1.5	Volts
Instantaneous Reverse Current (Rated dc Voltage, $T_C = 100°C$) (Rated dc Voltage, $T_C = 25°C$)	i_R	 6.0 35	 mA μA
Reverse Recovery Time ($I_F = 1.0$ Amp dI/dt = 15 Amp/μs	t_{rr}	100	ns

Rev 2

TYPICAL ELECTRICAL CHARACTERISTICS

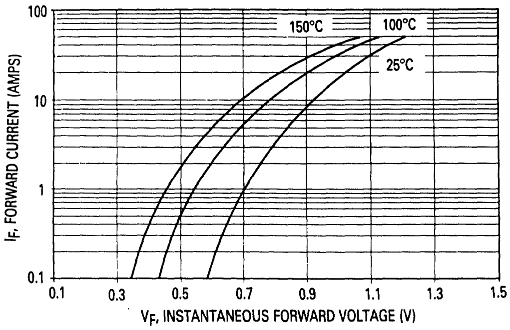


Figure 1. Typical Forward Voltage

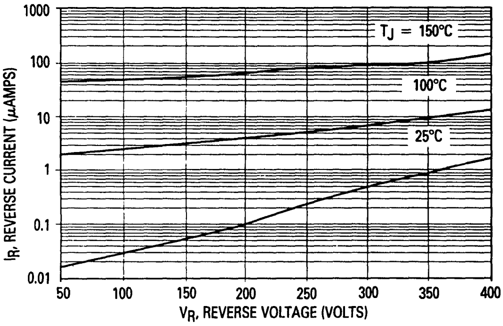


Figure 2. Typical Reverse Current

4

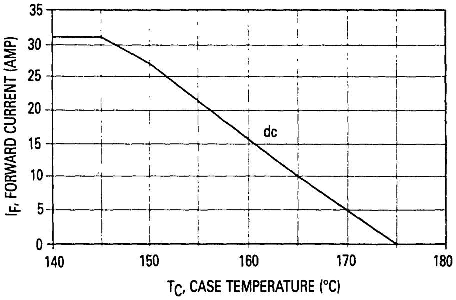


Figure 3. Current Derating, Case

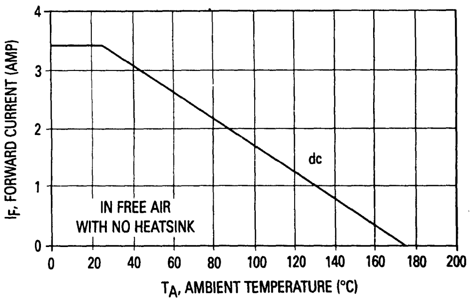


Figure 4. Current Derating, Ambient

Advance Information
SWITCHMODE™ Power Rectifier

MUR3080
Motorola Preferred Device

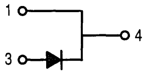
ULTRAFAST RECTIFIERS
30 AMPERES
600–800 VOLTS

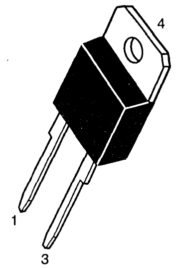
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state–of–the–art devices have the following features:

- Ultrafast 75 ns (Typ) Soft Recovery Time
- 175°C Operating Junction Temperature
- High Voltage Capability to 800 Volts
- Low Forward Voltage Drop
- High Temperature Glass Passivated Junction

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 Units Per Plastic Tube
- Marking: U3080





CASE 340E–01, STYLE 1

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	800	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 70°C$	$I_{F(AV)}$	30	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) $T_C = 150°C$	I_{FRM}	30	Amps
Non Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	300	Amps
Operating Junction Temperature	T_J	–65 to +175	°C
Storage Temperature	T_{stg}	–65 to +175	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS (TYPICAL DATA)

Instantaneous Forward Voltage (1) @ $I_F = 30$ Amps, $T_C = 25°C$ @ $I_F = 30$ Amps, $T_C = 100°C$	V_F	 1.9 1.8	Volts
Instantaneous Reverse Current (1) @ Rated DC Voltage, $T_C = 25°C$ @ Rated DC Voltage, $T_C = 100°C$	I_R	 100 5.0	 μA mA
Reverse Recovery Time $I_F = 1.0$ Amp, $V_R = 30$ V, dI/dt = 50 A/μs	t_{RR}	110	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

This document contains information on a new product. Specifications and information herein are subject to change without notice.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 1

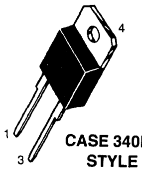
4

SWITCHMODE Power Rectifiers

MUR6040

Motorola Preferred Device

ULTRAFAST RECTIFIERS
60 AMPERES
400 VOLTS



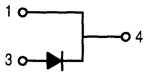
CASE 340E-01
STYLE 1

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 100 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- High Voltage Capability to 400 Volts
- Low Forward Voltage Drop
- High Temperature Glass Passivated Junction

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 4.3 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 30 units per plastic tube
- Marking: U6040



4

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	400	Volts
Average Rectified Forward Current T_C = 70°C	$I_{F(AV)}$	60	Amps
Peak Repetitive Forward Current (Rated V_R Square Wave 20 kHz) T_C = 150°C	I_{FRM}	60	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	600	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	°C/W

ELECTRICAL CHARACTERISTICS

Instantaneous Forward Voltage (I_F = 60 Amp, T_C = 100°C) (I_F = 60 Amp, T_C = 25°C)	V_F	 1.4 1.5	Volts
Instantaneous Reverse Current (Rated dc Voltage, T_C = 100°C) (Rated dc Voltage, T_C = 25°C)	I_R	 10 60	 mA μA
Reverse Recovery Time (I_F = 1.0 Amp dI/dt = 15 Amp/μs	t_{rr}	100	ns

Rev 2

TYPICAL ELECTRICAL CHARACTERISTICS

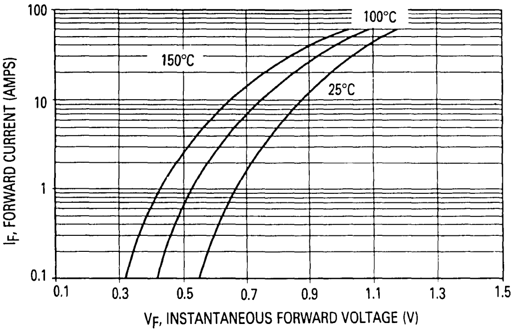


Figure 1. Typical Forward Voltage

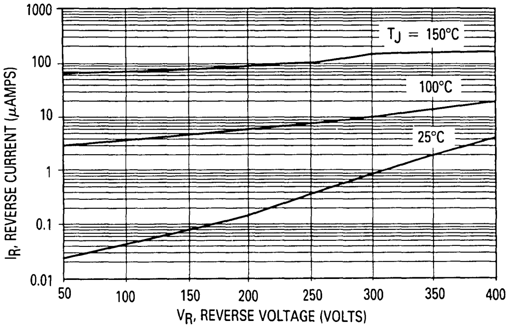


Figure 2. Typical Reverse Current

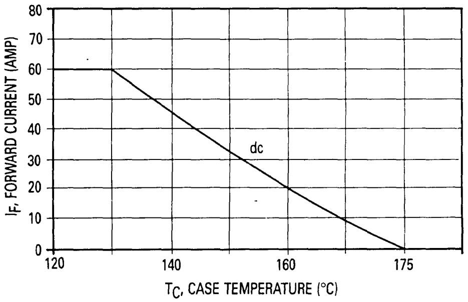


Figure 3. Current Derating, Case

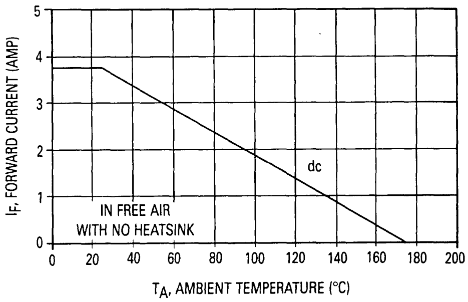


Figure 4. Current Derating, Ambient

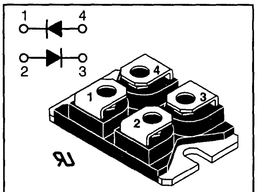
Ultrafast Power Rectifiers

BYT230PIV-400M

Dual high voltage rectifiers ranging from 200 V to 400 V suited for Switch Mode Power Supplies and other power converters.

- Very Low Reverse Recovery Time
- Very Low Switching Losses
- Low Noise Turn–Off Switching
- Insulated Package:
  Insulating voltage = 2500 V_{RMS}
  Capacitance = 45 pF
- UL — UL Recognized, File #E69369

ULTRAFAST RECTIFIERS
60 AMPS
400 VOLTS



SOT–227B, STYLE 3

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 g (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: BYT230PIV–400M

4

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage		V_{RRM}	400	V
Average Rectified Current T_C = 75°C	Per Device Per Diode	$I_{F(AV)}$	60 30	A
Peak Repetitive Forward Current, Per Diode t_p < 10 μs		I_{FRM}	500	A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	350	A
Operating Junction Temperature		T_J	−40 to +150	°C
Storage Temperature		T_{stg}	−40 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	Per Diode Per Device	$R_{\theta JC}$ $R_{\theta JC}$	1.5 0.8	°C/W
Coupling		$R_{\theta C}$	0.1	

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) I_F = 30 A, T_C = 25°C I_F = 30 A, T_C = 100°C	V_F	 1.5 1.4	V
Instantaneous Reverse Current (2) V_R = 400 V, T_C = 25°C V_R = 400 V, T_C = 100°C	I_R	 35 6	 μA mA

(1) Pulse Test: Pulse Width = 380 μs, Duty Cycle ≤ 2%
(2) Pulse Test: Pulse Width = 5 ms, Duty Cycle < 2%

Rev 1

RECOVERY CHARACTERISTICS

Test Conditions	Symbol	Typ	Max	Unit
I_F = 1 A, V_R = 30 V, dIF/dt = –15 A/µs I_F = 0.5 A, I_R = 1 A, I_{rr} = 0.25 A	t_{rr}	— —	100 50	ns

TURN–OFF SWITCHING CHARACTERISTICS (without series inductance)

Test Conditions	Symbol	Typ	Max	Unit
V_{CC} = 200 V, I_F = 30 A, T_J = 100°C, L_p < 0.05 µH (See Figure 11) dIF/dt = –120 A/µs dIF/dt = –240 A/µs	t_{IRM}	 — 50	 75 —	ns
dIF/dt = –120 A/µs dIF/dt = –240 A/µs	I_{RM}	— 12	9 —	A

TURN–OFF OVERVOLTAGE COEFFICIENT (with series inductance)

Test Conditions	Symbol	Typ	Max	Unit
T_J = 100°C, V_{CC} = 60 V, I_F = $I_{F(AV)}$ dIF/dt = –30 A/µs, L_p = 1 µH (See Figure 12)	$C = \frac{V_{RP}}{V_{CC}}$	3.3	—	

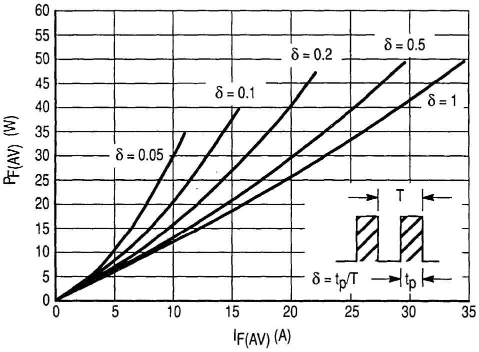


Figure 1. Low Frequency Power Losses versus Average Current

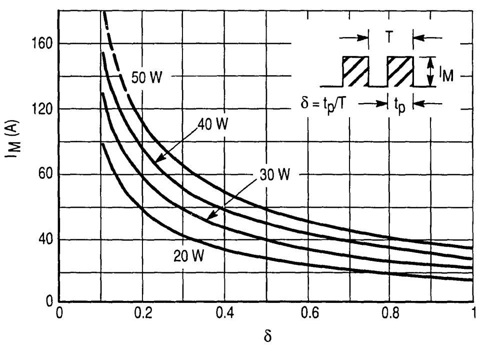


Figure 2. Peak Current versus Form Factor

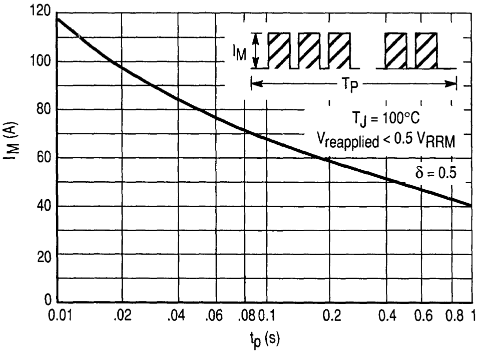


Figure 3. Non–Repetitive Peak Surge Current versus Overload Duration

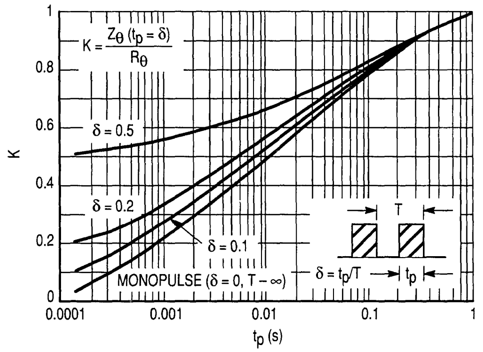


Figure 4. Relative Variation of Thermal Impedance Junction to Case versus Pulse Duration

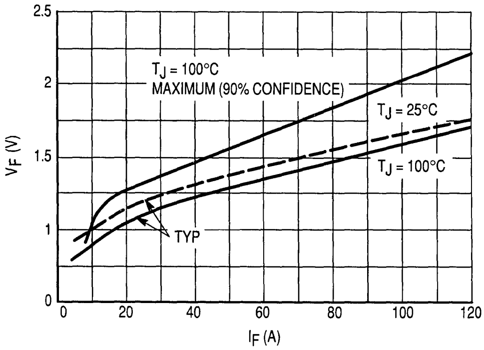


Figure 5. Voltage Drop versus Forward Current

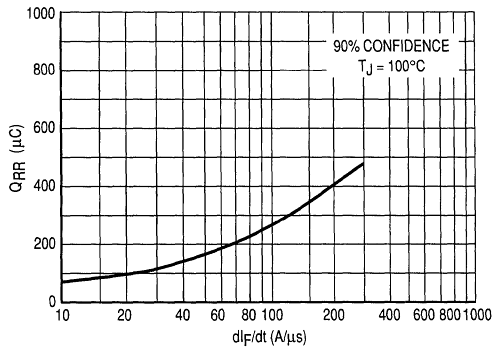


Figure 6. Recovery Charge versus dI_F/dt

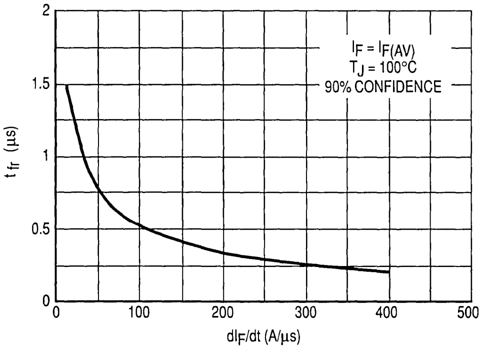


Figure 7. Recovery Time versus dIF/dt

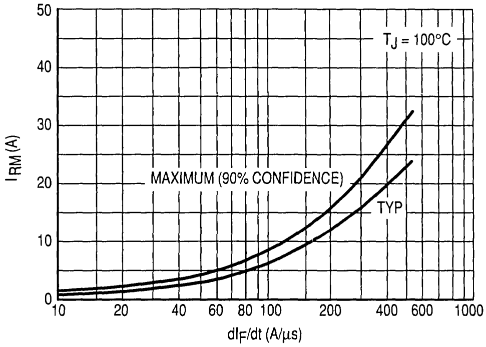


Figure 8. Peak Reverse Current versus dIF/dt

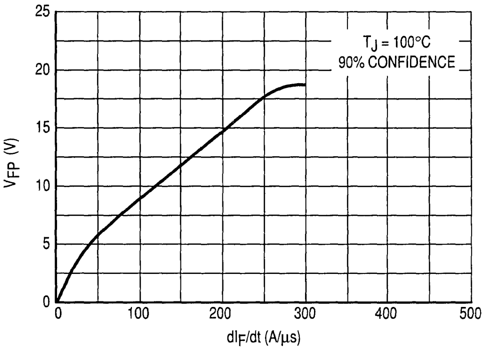


Figure 9. Peak Forward Voltage versus dIF/dt

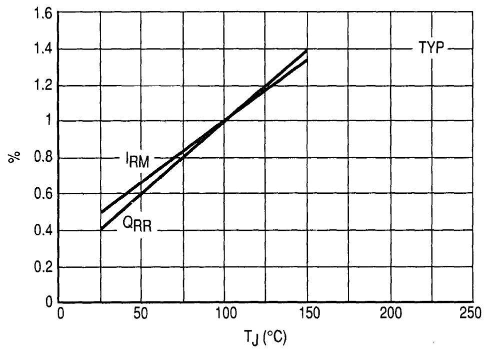


Figure 10. Dynamic Parameters versus Junction Temperature

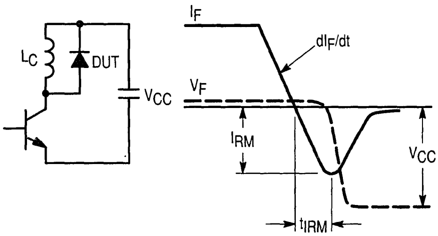


Figure 11. Turn–Off Switching Characteristics (Without series inductance)

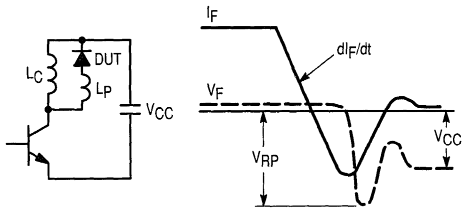


Figure 12. Turn–Off Switching Characteristics (With series inductance)

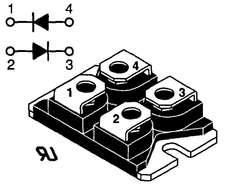
Ultrafast Power Rectifiers

BYT230PIV-1000M

Dual high voltage rectifiers suited for Switchmode Power Supplies and other power converters.

- Very Low Reverse Recovery Time
- Very Low Switching Losses
- Low Noise Turn–Off Switching
- Insulated Package:
  Insulating voltage = 2500 V_{RMS}
  Capacitance = 45 pF
- UL — UL Recognized, File #E69369

ULTRAFAST RECTIFIERS
60 AMPS
1000 VOLTS



SOT–227B, STYLE 3

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 g (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: BYT230PIV–1000M

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage		V_{RRM}	1000	V
Average Rectified Current T_C = 55°C	Per Device Per Diode	$I_{F(AV)}$	60 30	A
Peak Repetitive Forward Current, Per Diode t_p < 10 µs		I_{FRM}	375	A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	200	A
Operating Junction Temperature		T_J	−40 to +150	°C
Storage Temperature		T_{stg}	−40 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case Coupling	Per Diode Per Device	$R_{\theta JC}$ $R_{\theta JC}$ $R_{\theta C}$	1.5 0.8 0.1	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) I_F = 30 A, T_C = 25°C I_F = 30 A, T_C = 100°C	V_F	 1.9 1.8	V
Instantaneous Reverse Current (2) V_R = 1000 V, T_C = 25°C V_R = 1000 V, T_C = 100°C	I_R	 100 5	 µA mA

(1) Pulse Test: Pulse Width = 380 µs, Duty Cycle ≤ 2%
(2) Pulse Test: Pulse Width = 5 ms, Duty Cycle < 2%

Rev 1

RECOVERY CHARACTERISTICS

Test Conditions	Symbol	Typ	Max	Unit
I_F = 1 A, V_R = 30 V, dIF/dt = –15 A/µs I_F = 0.5 A, I_R = 1 A, I_{rr} = 0.25 A	t_{rr}	— —	165 70	ns

TURN–OFF SWITCHING CHARACTERISTICS (without series inductance)

Test Conditions	Symbol	Typ	Max	Unit
V_{CC} = 200 V, I_F = 30 A, T_J = 100°C, L_p < 0.05 µH (See Figure 11) dIF/dt = –120 A/µs dIF/dt = –240 A/µs	t_{IRM}	 — 120	 200 —	ns
dIF/dt = –120 A/µs dIF/dt = –240 A/µs	I_{RM}	— 22	19.5 —	A

TURN–OFF OVERVOLTAGE COEFFICIENT (with series inductance)

Test Conditions	Symbol	Typ	Max	Unit
T_J = 100°C, V_{CC} = 200 V, I_F = $I_{F(AV)}$ dIF/dt = –30 A/µs, L_p = 5 µH (See Figure 12)	$C = \frac{V_{RP}}{V_{CC}}$	—	4.5	

4

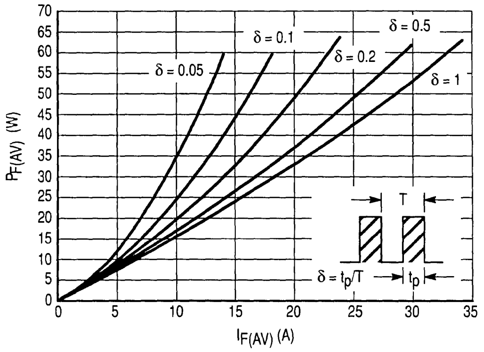


Figure 1. Low Frequency Power Losses versus Average Current

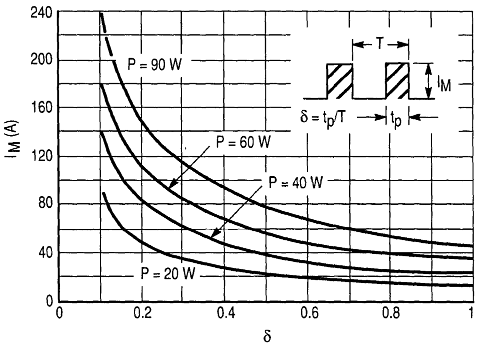


Figure 2. Peak Current versus Form Factor

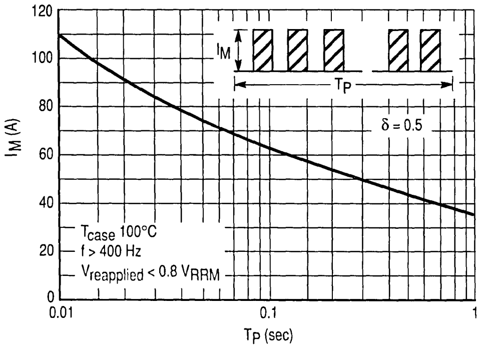


Figure 3. Non–Repetitive Peak Surge Current versus Overload Duration

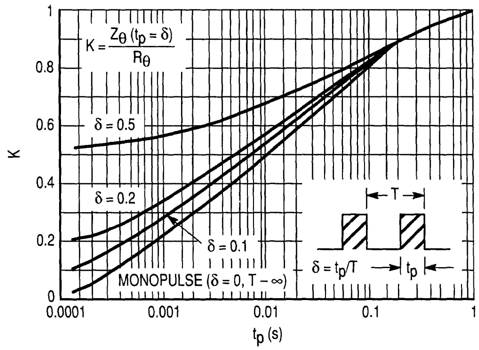


Figure 4. Relative Variation of Thermal Impedance Junction to Case versus Pulse Duration

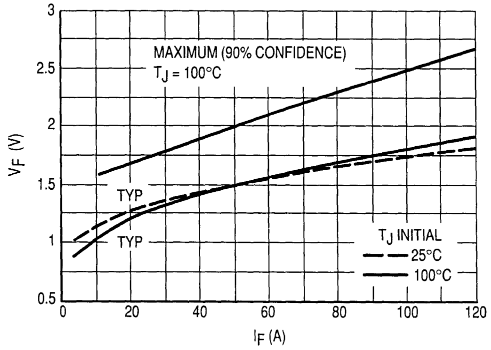


Figure 5. Voltage Drop versus Forward Current

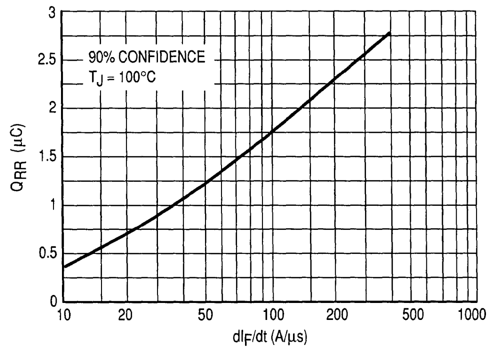


Figure 6. Recovery Charge versus dI_F/dt

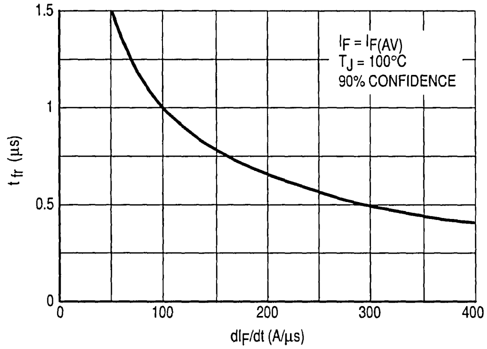


Figure 7. Recovery Time versus dI_F/dt

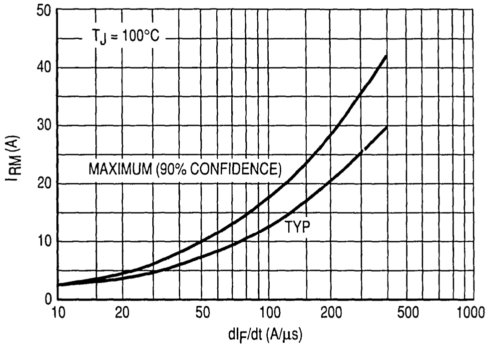


Figure 8. Peak Reverse Current versus dI_F/dt

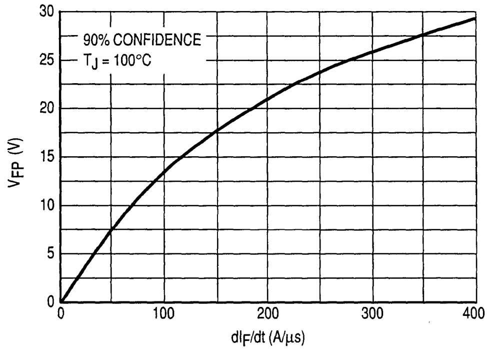


Figure 9. Peak Forward Voltage versus dI_F/dt

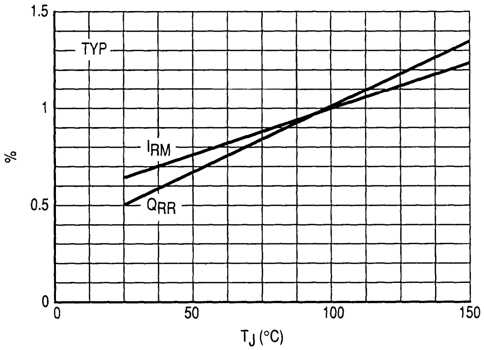


Figure 10. Dynamic Parameters versus Junction Temperature

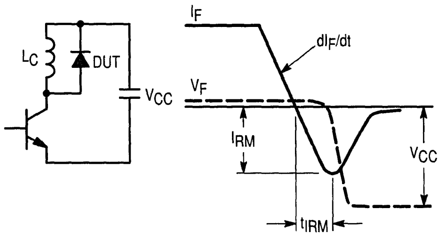


Figure 11. Turn–Off Switching Characteristics (Without series inductance)

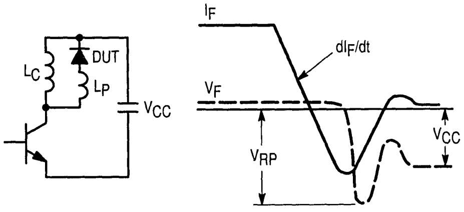


Figure 12. Turn–Off Switching Characteristics (With series inductance)

4

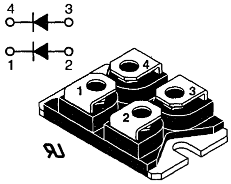
Ultrafast Power Rectifiers

BYT261PIV-400M

Dual high voltage rectifiers suited for Switchmode Power Supplies and other power converters.

- Very Low Reverse Recovery Time
- Very Low Switching Losses
- Low Noise Turn–Off Switching
- Insulated Package:
  Insulating voltage = 2500 V_{RMS}
  Capacitance = 45 pF
- UL — UL Recognized, File #E69369

ULTRAFAST RECTIFIERS
120 AMPS
400 VOLTS



SOT-227B, STYLE 2

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 g (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: BYT261PIV–400M

4

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage		V_{RRM}	400	V
Average Rectified Current T_C = 80°C	Per Device Per Diode	$I_{F(AV)}$	120 60	A
Peak Repetitive Forward Current, Per Diode t_p < 10 μs		I_{FRM}	800	A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	600	A
Operating Junction Temperature		T_J	–40 to +150	°C
Storage Temperature		T_{stg}	–40 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	Per Diode Per Device	$R_{\theta JC}$ $R_{\theta JC}$	0.85 0.5	°C/W
Coupling		$R_{\theta C}$	0.1	

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) I_F = 60 A, T_C = 25°C I_F = 60 A, T_C = 100°C	V_F	 1.5 1.4	V
Instantaneous Reverse Current (2) V_R = 400 V, T_C = 25°C V_R = 400 V, T_C = 100°C	I_R	 60 6	 μA mA

(1) Pulse Test: Pulse Width = 380 μs, Duty Cycle ≤ 2%
(2) Pulse Test: Pulse Width = 5 ms, Duty Cycle < 2%

Rev 1

RECOVERY CHARACTERISTICS

Test Conditions	Symbol	Typ	Max	Unit
I_F = 1 A, V_R = 30 V, dIF/dt = –15 A/µs I_F = 0.5 A, I_R = 1 A, I_{rr} = 0.25 A	t_{rr}	— —	100 50	ns

TURN–OFF SWITCHING CHARACTERISTICS (without series inductance)

Test Conditions	Symbol	Typ	Max	Unit
V_{CC} = 200 V, I_F = 60 A, T_J = 100°C, L_p < 0.05 µH (See Figure 11) dIF/dt = –240 A/µs dIF/dt = –480 A/µs	t_{IRM}	 — 50	 75 —	ns
dIF/dt = –240 A/µs dIF/dt = –480 A/µs	I_{RM}	— 24	18 —	A

TURN–OFF OVERVOLTAGE COEFFICIENT (with series inductance)

Test Conditions	Symbol	Typ	Max	Unit
T_J = 100°C, V_{CC} = 120 V, I_F = $I_{F(AV)}$ dIF/dt = –60 A/µs, L_p = 0.8 µH (See Figure 12)	$C = \frac{V_{RP}}{V_{CC}}$	3.3	4	

4

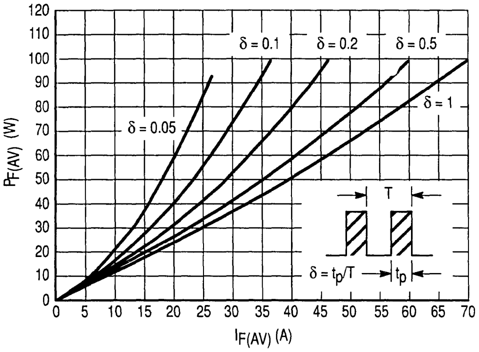


Figure 1. Low Frequency Power Losses versus Average Current

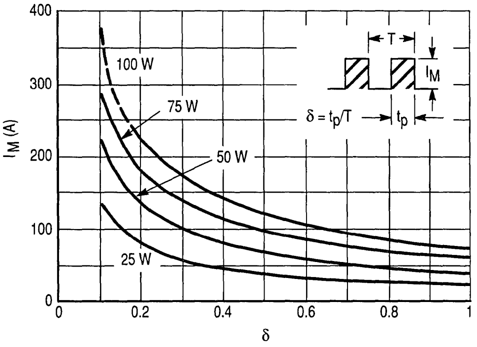


Figure 2. Peak Current versus Form Factor

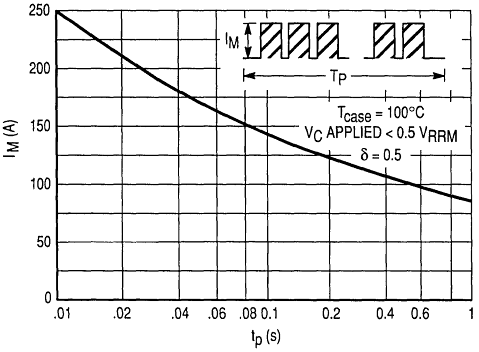


Figure 3. Non–Repetitive Peak Surge Current versus Overload Duration

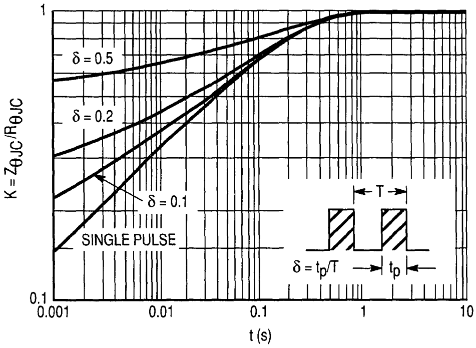


Figure 4. Relative Variation of Thermal Impedance Junction to Case versus Pulse Duration

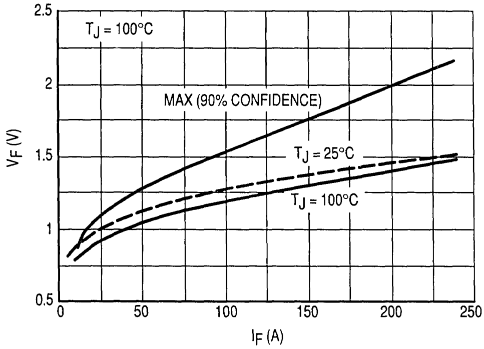


Figure 5. Voltage Drop versus Forward Current

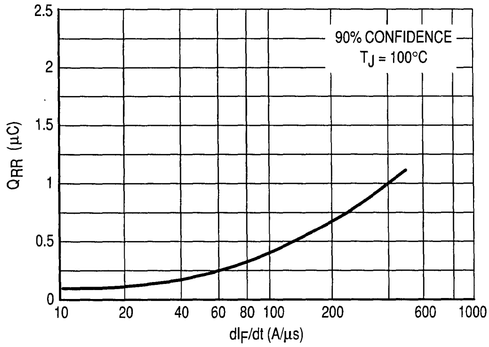


Figure 6. Recovery Charge versus dI_F/dt

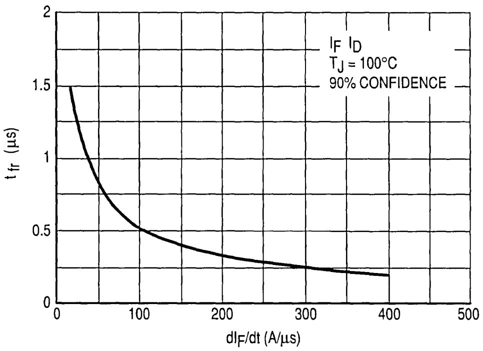


Figure 7. Recovery Time versus dI_F/dt

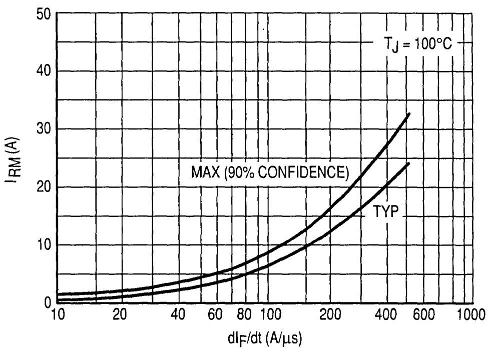


Figure 8. Peak Reverse Current versus dI_F/dt

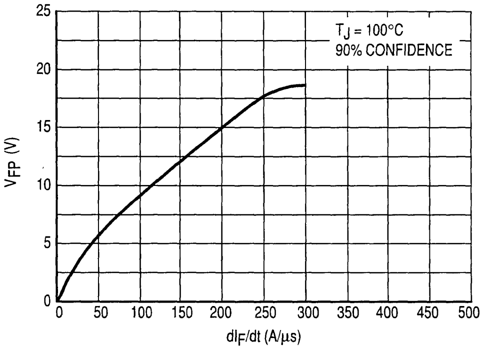


Figure 9. Peak Forward Voltage versus dI_F/dt

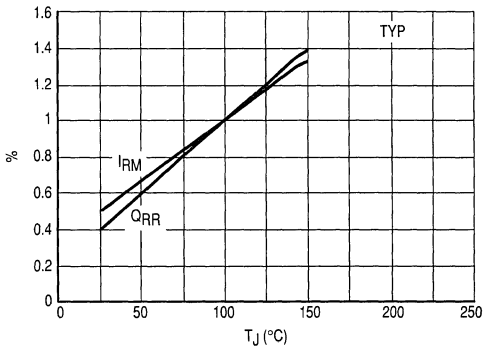


Figure 10. Dynamic Parameters versus Junction Temperature

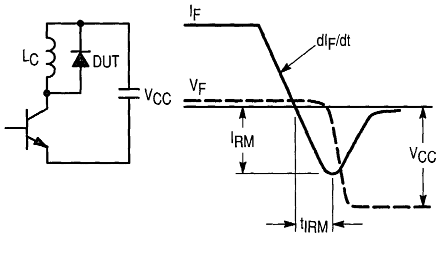


Figure 11. Turn–Off Switching Characteristics (Without series inductance)

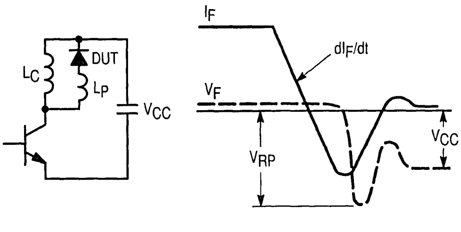


Figure 12. Turn–Off Switching Characteristics (With series inductance)

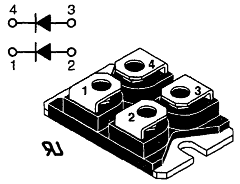
Ultrafast Power Rectifiers

BYT261PIV-1000M

ULTRAFAST RECTIFIERS
120 AMPS
1000 VOLTS

Dual high voltage rectifiers suited for Switchmode Power Supplies and other power converters.

- Very Low Reverse Recovery Time
- Very Low Switching Losses
- Low Noise Turn–Off Switching
- Insulated Package:
  Insulating voltage = 2500 V_{RMS}
  Capacitance = 45 pF
- UL — UL Recognized, File #E69369



SOT–227B, STYLE 2

Mechanical Characteristics

- Case: Molded epoxy with isolated metal base
- Weight: 28 g (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Shipped 10 units per plastic tube
- Marking: BYT261PIV–1000M

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage		V_{RRM}	1000	V
Average Rectified Current T_C = 60°C	Per Device Per Diode	$I_{F(AV)}$	120 60	A
Peak Repetitive Forward Current, Per Diode t_p < 10 μs		I_{FRM}	750	A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	400	A
Operating Junction Temperature		T_J	–40 to +150	°C
Storage Temperature		T_{stg}	–40 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case Coupling	Per Diode Per Device	$R_{\theta JC}$ $R_{\theta JC}$ $R_{\theta C}$	1.1 0.6 0.1	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) I_F = 60 A, T_C = 25°C I_F = 60 A, T_C = 100°C	V_F	 1.9 1.8	V
Instantaneous Reverse Current (2) V_R = 1000 V, T_C = 25°C V_R = 1000 V, T_C = 100°C	I_R	 100 6	 μA mA

(1) Pulse Test: Pulse Width = 380 μs, Duty Cycle ≤ 2%
(2) Pulse Test: Pulse Width = 5 ms, Duty Cycle < 2%

Rev 1

RECOVERY CHARACTERISTICS

Test Conditions	Symbol	Typ	Max	Unit
$I_F = 1$ A, $V_R = 30$ V, dIF/dt = −15 A/µs $I_F = 0.5$ A, $I_R = 1$ A, $I_{rr} = 0.25$ A	t_{rr}	— —	170 70	ns

TURN–OFF SWITCHING CHARACTERISTICS (without series inductance)

Test Conditions	Symbol	Typ	Max	Unit
$V_{CC} = 200$ V, $I_F = 60$ A, $T_J = 100°C$, $L_p < 0.05$ µH (See Figure 11) dIF/dt = −240 A/µs dIF/dt = −480 A/µs	t_{IRM}	 — 120	 200 —	ns
dIF/dt = −240 A/µs dIF/dt = −480 A/µs	I_{RM}	— 44	40 —	A

TURN–OFF OVERVOLTAGE COEFFICIENT (with series inductance)

Test Conditions	Symbol	Typ	Max	Unit
$T_J = 100°C$, $V_{CC} = 200$ V, $I_F = I_{F(AV)}$ dIF/dt = −60 A/µs, $L_p = 2.5$ µH (See Figure 12)	$C = \frac{V_{RP}}{V_{CC}}$	3.3	4.5	

4

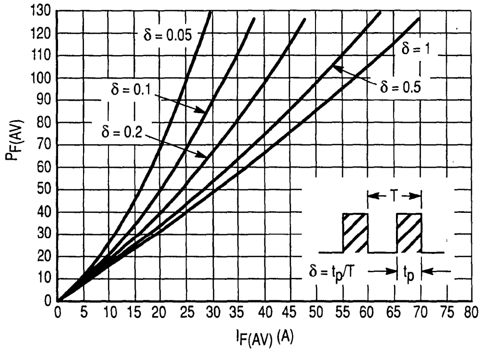


Figure 1. Low Frequency Power Losses versus Average Current

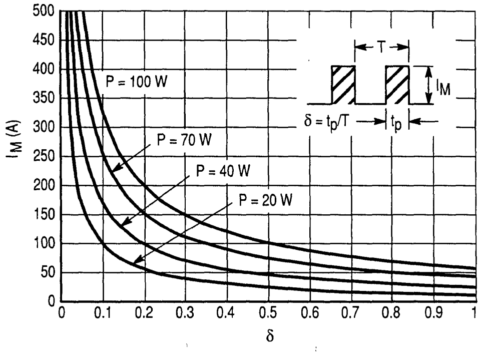


Figure 2. Peak Current versus Form Factor

4

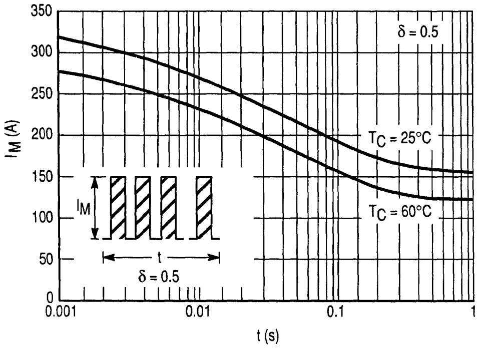


Figure 3. Non–Repetitive Peak Surge Current versus Overload Duration

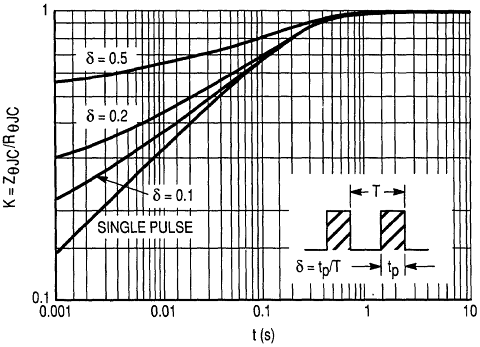


Figure 4. Relative Variation of Thermal Impedance Junction to Case versus Pulse Duration

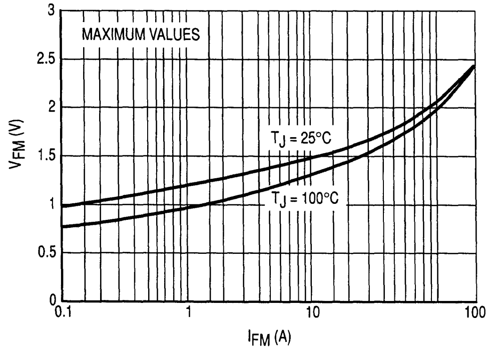


Figure 5. Voltage Drop versus Forward Current

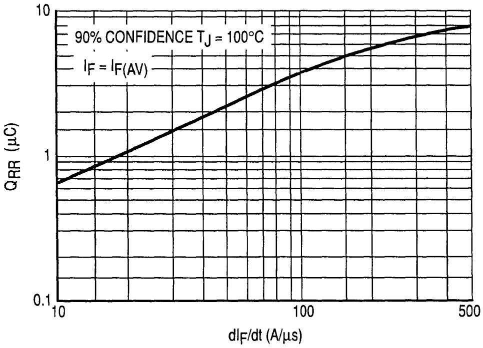


Figure 6. Recovery Charge versus dI_F/dt

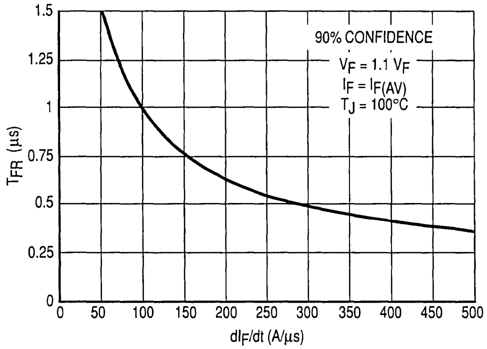


Figure 7. Recovery Time versus dI_F/dt

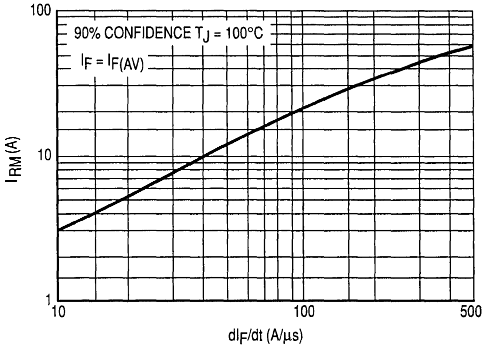


Figure 8. Peak Reverse Current versus dI_F/dt

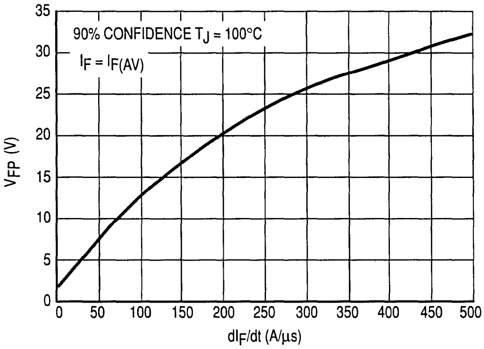


Figure 9. Peak Forward Voltage versus dI_F/dt

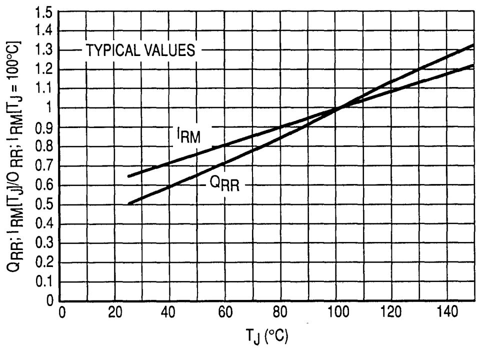


Figure 10. Dynamic Parameters versus Junction Temperature

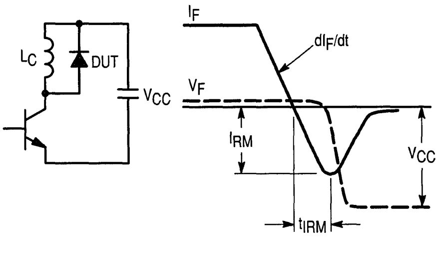


Figure 11. Turn–Off Switching Characteristics (Without series inductance)

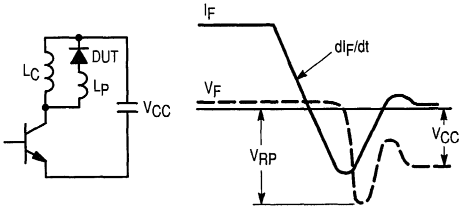


Figure 12. Turn–Off Switching Characteristics (With series inductance)

MURP20020CT
MURP20040CT

Motorola Preferred Devices

Preliminary Data Sheet

POWERTAP II
Ultrafast
SWITCHMODE Power Rectifier

ULTRAFAST RECTIFIER

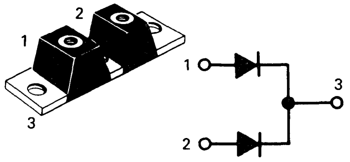
200 AMPERES
200–400 VOLTS

. . . designed for use in switching power supplies, inverters, and as free wheeling diodes. This state-of-the-art device has the following features:

- Dual Diode Construction
- Low Leakage Current
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Labor Saving POWERTAP Package

Mechanical Characteristics:

- Case: Epoxy, Molded with metal heatsink base
- Weight: 80 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant
- Top Terminal Torque: 25–40 lb–in max
- Base Plate Torques: See procedure given in the Package Outline Section
- Shipped 25 units per foam
- Marking: UP20020



CASE 357C-03
POWERTAP II

4

MAXIMUM RATINGS

Rating	Symbol	MURP20020CT	MURP20040CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	Volts
Average Rectified Forward Current (Rated V_R) Per Device Per Leg	$I_{F(AV)}$	200 (T_C = 130°C) 100 (T_C = 130°C)	200 (T_C = 100°C) 100 (T_C = 100°C)	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 95°C	I_{FRM}	200	200	Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	800	800	Amps
Operating Junction Temperature	T_J	–55 to +175	–55 to +175	°C
Storage Temperature	T_{stg}	–55 to +150	–55 to +150	°C

THERMAL CHARACTERISTICS PER LEG

Rating	Symbol	Max		Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.45	0.45	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 100 Amp, T_C = +25°C) (i_F = 200 Amp, T_C = 25°C) (i_F = 100 Amp, T_C = 125°C)	v_F	 1.00 1.10 0.95	 1.30 1.75 1.15	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 1000 150	 500 50	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amps, di/dt = 50 Amps/μs)	t_{rr}	50	75	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

Section 5

Standard and Fast Recovery Data Sheets

5

Axial-Lead Standard Recovery Rectifiers

1N4001 thru 1N4007

1N4004 and 1N4007 are Motorola Preferred Devices

LEAD MOUNTED RECTIFIERS 50–1000 VOLTS DIFFUSED JUNCTION

This data sheet provides information on subminiature size, axial lead mounted rectifiers for general–purpose low–power applications.

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a “RL” suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007

CASE 59–03
DO–41

MAXIMUM RATINGS

Rating	Symbol	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
*Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
*Non–Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz)	V_{RSM}	60	120	240	480	720	1000	1200	Volts
*RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	Volts
*Average Rectified Forward Current (single phase, resistive load, 60 Hz, see Figure 8, T_A = 75°C)	I_O	1.0							Amp
*Non–Repetitive Peak Surge Current (surge applied at rated load conditions, see Figure 2)	I_{FSM}	30 (for 1 cycle)							Amp
Operating and Storage Junction Temperature Range	T_J T_{stg}	– 65 to +175							°C

ELECTRICAL CHARACTERISTICS*

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage Drop (i_F = 1.0 Amp, T_J = 25°C) Figure 1	v_F	0.93	1.1	Volts
Maximum Full–Cycle Average Forward Voltage Drop (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$V_{F(AV)}$	—	0.8	Volts
Maximum Reverse Current (rated dc voltage) (T_J = 25°C) (T_J = 100°C)	I_R	 0.05 1.0	 10 50	µA
Maximum Full–Cycle Average Reverse Current (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$I_{R(AV)}$	—	30	µA

*Indicates JEDEC Registered Data
Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 5

Axial-Lead Fast-Recovery Rectifiers

1N4933 thru 1N4937

1N4935 and 1N4937 are Motorola Preferred Devices

Axial–lead, fast–recovery rectifiers are designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a “RL” suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N4933, 1N4934, 1N4935, 1N4936, 1N4937

FAST RECOVERY RECTIFIERS
50–600 VOLTS
1.0 AMPERE

CASE 59–03
DO–41

MAXIMUM RATINGS (1)

Rating	Symbol	1N4933	1N4934	1N4935	1N4936	1N4937	Unit
*Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
*Non–Repetitive Peak Reverse Voltage RMS Reverse Voltage	V_{RSM} $V_{R(RMS)}$	75 35	150 70	250 140	450 280	650 420	Volts
*Average Rectified Forward Current (Single phase, resistive load, T_A = 75°C) (2)	I_O			1.0			Amp
*Non–Repetitive Peak Surge Current (Surge applied at rated load conditions)	I_{FSM}			30			Amps
Operating Junction Temperature Range Storage Temperature Range	T_J T_{stg}			– 65 to +150 – 65 to +150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Typical Printed Circuit Board Mounting)	$R_{\theta JC}$	65	°C/W

*Indicates JEDEC Registered Data for 1N4933 Series.
(1) Ratings at 25°C ambient temperature unless otherwise specified.
(2) Derate by 20% for capacitive loads.

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 3

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (I_F = 3.14 Amp, T_J = 125°C)	v_F	—	1.0	1.2	Volts
Forward Voltage (I_F = 1.0 Amp, T_A = 25°C)	V_F	—	1.0	1.1	Volts
*Reverse Current (Rated dc Voltage) T_A = 25°C	I_R	—	1.0	5.0	μA
T_A = 100°C		—	50	100	

***REVERSE RECOVERY CHARACTERISTICS**

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	t_{rr}				ns
(I_F = 1.0 Amp to V_R = 30 Vdc)		—	150	200	
(I_{FM} = 15 Amp, di/dt = 10 A/μs)		—	175	300	
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc)	$I_{RM(REC)}$	—	1.0	2.0	Amp

*Indicates JEDEC Registered Data for 1N4933 Series.

5

Axial-Lead Standard Recovery Rectifiers

1N5400 thru 1N5408

1N5404 and 1N5406 are Motorola Preferred Devices

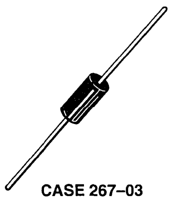
STANDARD RECOVERY RECTIFIERS 50–1000 VOLTS 3.0 AMPERE

Lead mounted standard recovery rectifiers are designed for use in power supplies and other applications having need of a device with the following features:

- High Current to Small Size
- High Surge Current Capability
- Low Forward Voltage Drop
- Void–Free Economical Plastic Package
- Available in Volume Quantities

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a “RL” suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N5400, 1N5401, 1N5402, 1N5404, 1N5406, 1N5407, 1N5408



CASE 267–03

5

MAXIMUM RATINGS

Rating	Symbol	1N5400	1N5401	1N5402	1N5404	1N5406	1N5407	1N5408	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Non–repetitive Peak Reverse Voltage	V_{RSM}	100	200	300	525	800	1000	1200	Volts
Average Rectified Forward Current (Single Phase Resistive Load, 1/2″ Leads, T_L = 105°C)	I_O	3.0							Amp
Non–repetitive Peak Surge Current (Surge Applied at Rated Load Conditions)	I_{FSM}	200 (one cycle)							Amp
Operating and Storage Junction Temperature Range	T_J T_{stg}	– 65 to +170 – 65 to +175							°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Unit
Thermal Resistance, Junction to Ambient (PC Board Mount, 1/2″ Leads)	$R_{\theta JA}$	53	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
*Instantaneous Forward Voltage (1) (i_F = 9.4 Amp)	v_F	—	—	1.2	Volts
Average Reverse Current (1) DC Reverse Current (Rated dc Voltage, T_L = 80°C)	$I_{R(AV)}$ I_R	— —	— —	500 500	µA

*JEDEC Registered Data.
(1) Measured in a single phase halfwave circuit such as shown in Figure 6.25 of EIA RS–282, November 1963. Operated at rated load conditions T_L = 80°C, I_O = 3.0 A, V_r = V_{RWM}.
Preferred devices are Motorola recommended choices for future use and best overall value.
Ratings at 25°C ambient temperature unless otherwise specified.
60 Hz resistive or inductive loads.
For capacitive load, derate current by 20%.

Rev 2

Axial Lead Fast Recovery Rectifiers

MR850
MR851
MR852
MR854
MR856

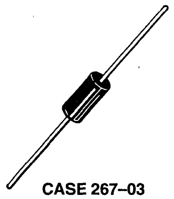
MR852 and MR856 are Motorola Preferred Devices

Axial lead mounted fast recovery power rectifiers are designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 100 nanoseconds providing high efficiency at frequencies to 250 kHz.

FAST RECOVERY POWER RECTIFIERS
50–600 VOLTS
3.0 AMPERES

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag.
- Available Tape and Reeled, 1500 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: R850, R851, R852, R854, R856



CASE 267–03

MAXIMUM RATINGS

Rating	Symbol	MR850	MR851	MR852	MR854	MR856	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Non–Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	Volts
Average Rectified Forward Current (Single phase resistive load, T_A = 80°C)	I_O	3.0					Amp
Non–Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	100 (one cycle)					Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	– 65 to +125 – 65 to +150					°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Recommended Printed Circuit Board Mounting, See Note 4, Page 5)	$R_{\theta JA}$	28	°C/W

Preferred devices are Motorola recommended choices for future use and best overall value.

Rev 2

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Forward Voltage (I_F = 3.0 Amp, T_J = 25°C)	V_F	—	1.04	1.25	Volts
Reverse Current (rated dc voltage) T_J = 25°C	I_R	—	2.0	10	μA
T_J = 80°C MR850		—	—	150	
T_J = 80°C MR851		—	60	150	
T_J = 80°C MR852		—	—	200	
T_J = 80°C MR854		—	—	250	
T_J = 80°C MR856		—	100	300	

REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	t_{rr}				ns
(I_F = 1.0 Amp to V_R = 30 Vdc, Figure 9)		—	100	200	
(I_F = 15 Amp, di/dt = 10 A/μs, Figure 10)		—	150	300	
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc, Figure 9)	$I_{RM(REC)}$	—	—	2.0	Amp

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MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

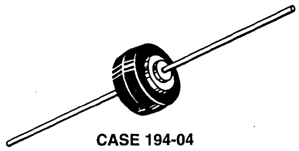
MR750
MR751 MR752
MR754 MR756
MR758 MR760

MR754 and MR760 are
Motorola Preferred Devices

Designers Data Sheet

High Current Lead Mounted Rectifiers

**HIGH CURRENT
LEAD MOUNTED
SILICON RECTIFIERS
50–1000 VOLTS
DIFFUSED JUNCTION**



CASE 194-04

- Current Capacity Comparable To Chassis Mounted Rectifiers
- Very High Surge Capacity
- Insulated Case

Mechanical Characteristics:
- Case: Epoxy, Molded
- Weight: 2.5 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Polarity: cathode polarity band
- Shipped 1000 units per plastic bag. Available Tape and Reeled, 800 units per reel by adding a "RL" suffix to the part number
- Marking: R750, R751, R752, R754, R758, R760

***MAXIMUM RATINGS**

Characteristic	Symbol	MR750	MR751	MR752	MR754	MR756	MR758	MR760	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Non-Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz peak)	V_{RSM}	60	120	240	480	720	960	1200	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	Volts
Average Rectified Forward Current (single phase, resistive load, 60 Hz) See Figures 5 and 6	I_O	22 (T_L = 60°C, 1/8″ Lead Lengths) 6.0 (T_A = 60°C, P.C. Board mounting)							Amp
Non-Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	400 (for 1 cycle)							Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +175							°C

ELECTRICAL CHARACTERISTICS

Characteristic and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage Drop (i_F = 100 Amp, T_J = 25°C)	v_F	1.25	Volts
Maximum Forward Voltage Drop (I_F = 6.0 Amp, T_A = 25°C, 3/8″ leads)	V_F	0.90	Volts
Maximum Reverse Current (rated dc voltage) T_J = 25°C T_J = 100°C	I_R	25 1.0	μA mA

Rev 2

FIGURE 1 – FORWARD VOLTAGE

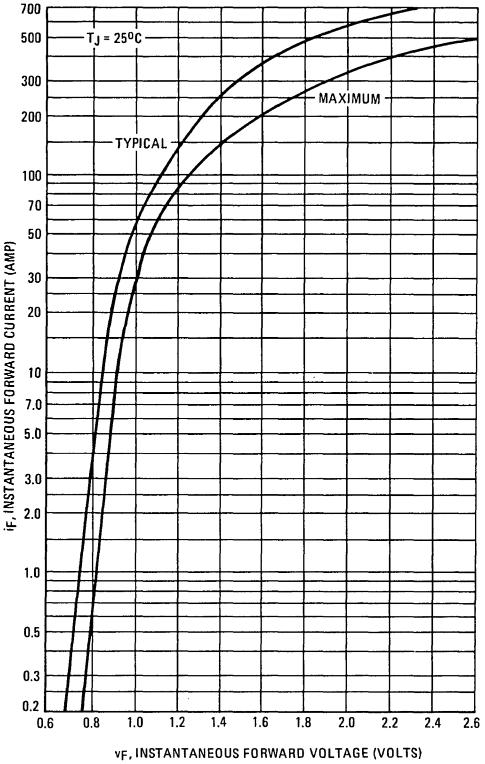


FIGURE 2 – MAXIMUM SURGE CAPABILITY

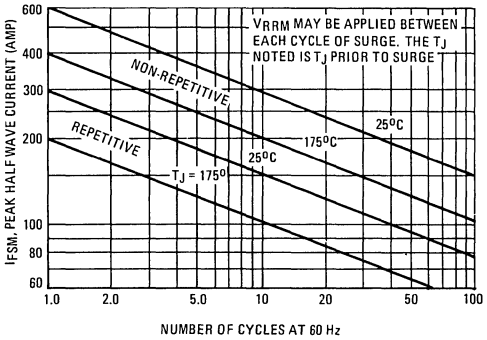


FIGURE 3 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT

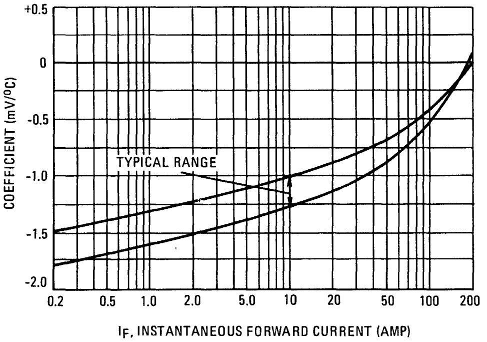


FIGURE 4 – TYPICAL TRANSIENT THERMAL RESISTANCE

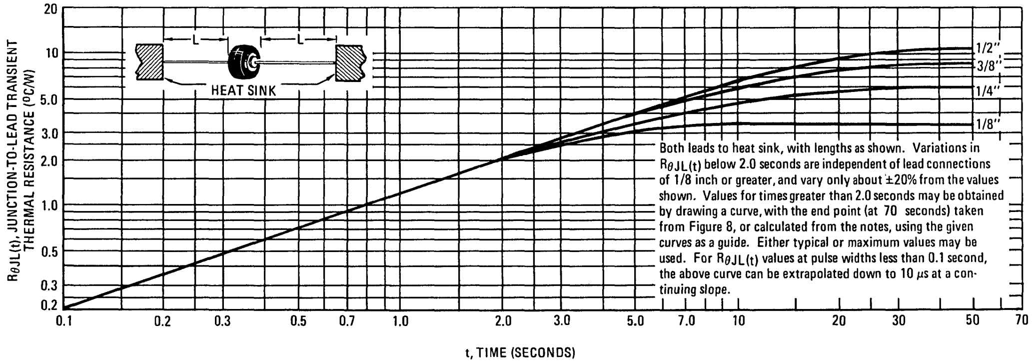


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FIGURE 5 – MAXIMUM CURRENT RATINGS

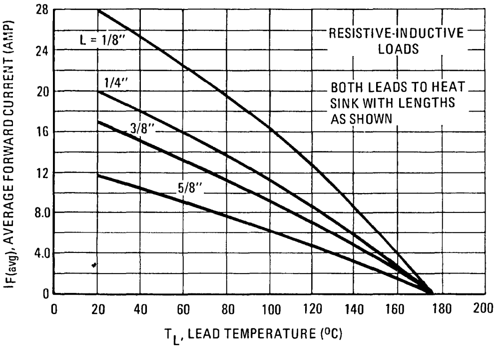


FIGURE 6 – MAXIMUM CURRENT RATINGS

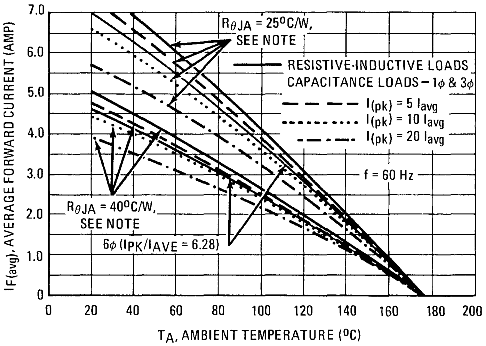


FIGURE 7 – POWER DISSIPATION

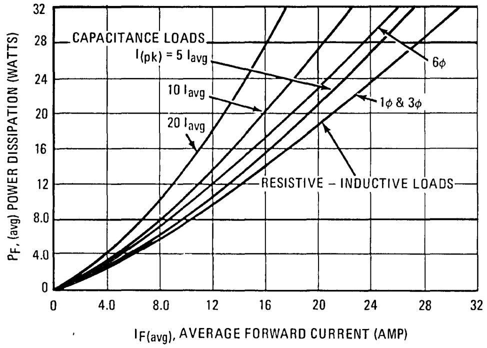
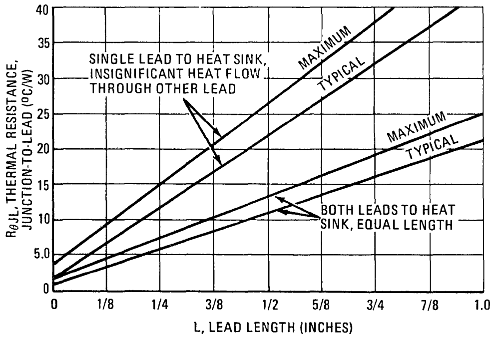


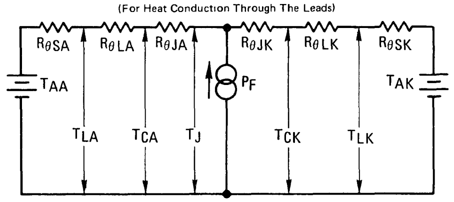
FIGURE 8 – STEADY STATE THERMAL RESISTANCE



NOTES

THERMAL CIRCUIT MODEL

(For Heat Conduction Through The Leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. Lowest values occur when one side of the rectifier is brought as close as possible to the heat sink as shown below. Terms in the model signify:

T_A = Ambient Temperature $R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
T_L = Lead Temperature $R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
T_C = Case Temperature $R_{\theta J}$ = Thermal Resistance, Junction to Case
T_J = Junction Temperature P_F = Power Dissipation

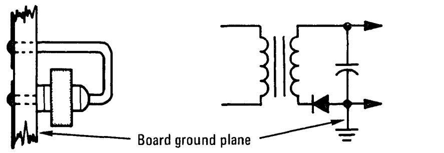
(Subscripts A and K refer to anode and cathode sides respectively.)

Values for thermal resistance components are:

$R_{\theta L}$ = 40°C/W/IN. Typically and 44°C/W/IN Maximum
$R_{\theta J}$ = 2°C/W Typically and 4°C/W Maximum

Since $R_{\theta J}$ is so low, measurements of the case temperature, T_C, will be approximately equal to junction temperature in practical lead mounted applications. When used as a 60 Hz rectifier, the slow thermal response holds $T_{J(PK)}$ close to $T_{J(AVG)}$. Therefore maximum lead temperature may be found from. $T_L = 175° - R_{\theta JL}\ P_F$. P_F may be found from Figure 7.

The recommended method of mounting to a P.C. board is shown on the sketch, where $R_{\theta JA}$ is approximately 25°C/W for a 1-1/2" x 1-1/2" copper surface area. Values of 40°C/W are typical for mounting to terminal strips or P.C. boards where available surface area is small.



Recommended mounting for half wave circuit

5

TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 9 – RECTIFICATION EFFICIENCY

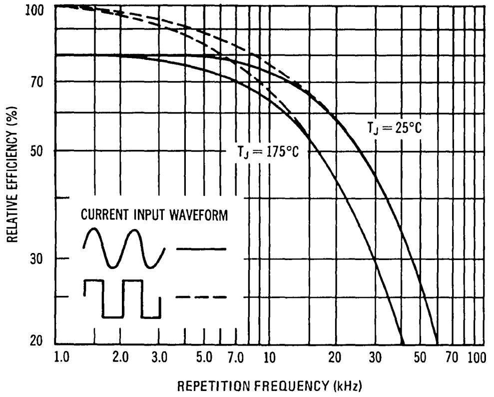


FIGURE 10 – REVERSE RECOVERY TIME

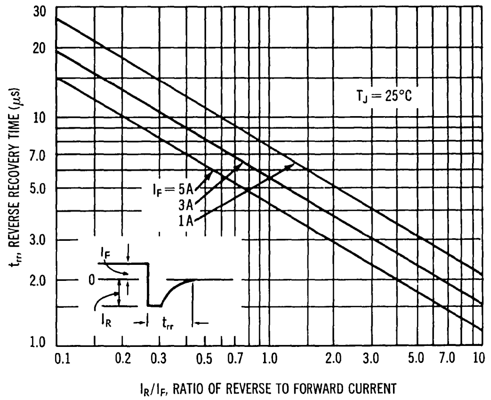


FIGURE 11 – JUNCTION CAPACITANCE

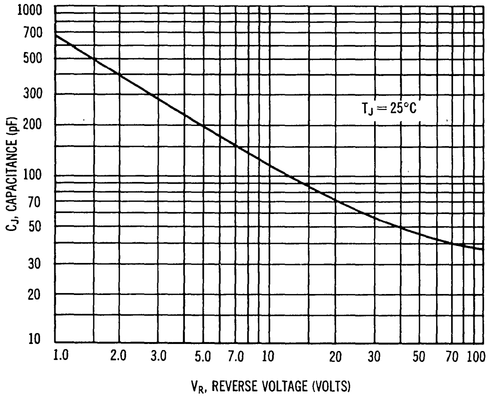


FIGURE 12 – FORWARD RECOVERY TIME

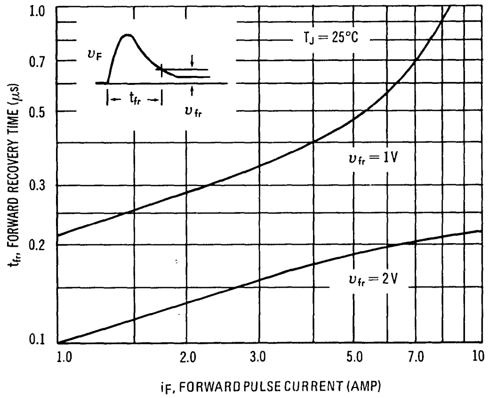
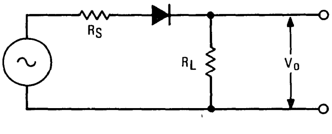


FIGURE 13 – SINGLE-PHASE HALF-WAVE RECTIFIER CIRCUIT



The rectification efficiency factor σ shown in Figure 9 was calculated using the formula:

$$\sigma = \frac{P_{(dc)}}{P_{(rms)}} = \frac{\frac{V^2{}_o(dc)}{R_L}}{\frac{V^2{}_o(rms)}{R_L}} \cdot 100\% = \frac{V^2{}_o(dc)}{V^2{}_o(ac) + V^2{}_o(dc)} \cdot 100\% \quad (1)$$

For a sine wave input $V_m \sin(\omega t)$ to the diode, assumed lossless, the maximum theoretical efficiency factor becomes:

$$\sigma(\text{sine}) = \frac{\frac{V^2{}_m}{\pi^2 R_L}}{\frac{V^2{}_m}{4R_L}} \cdot 100\% = \frac{4}{\pi^2} \cdot 100\% = 40.6\% \quad (2)$$

For a square wave input of amplitude V_m, the efficiency factor becomes:

$$\sigma(\text{square}) = \frac{\frac{V^2{}_m}{2R_L}}{\frac{V^2{}_m}{R_L}} \cdot 100\% = 50\% \quad (3)$$

(A full wave circuit has twice these efficiencies)

As the frequency of the input signal is increased, the reverse recovery time of the diode (Figure 10) becomes significant, resulting in an increasing ac voltage component across R_L which is opposite in polarity to the forward current, thereby reducing the value of the efficiency factor σ, as shown on Figure 9.

It should be emphasized that Figure 9 shows waveform efficiency only; it does not provide a measure of diode losses. Data was obtained by measuring the ac component of V_o with a true rms ac voltmeter and the dc component with a dc voltmeter. The data was used in Equation 1 to obtain points for Figure 9.

5

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR2500 Series

MR2504 and MR2510 are Motorola Preferred Devices

Medium-Current Silicon Rectifiers

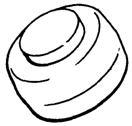
. . . compact, highly efficient silicon rectifiers for medium-current applications requiring:

- High Current Surge — 400 Amperes @ T_J = 175°C
- Peak Performance @ Elevated Temperature — 25 Amperes @ T_C = 150°C
- Low Cost
- Compact, Molded Package — For Optimum Efficiency in a Small Case Configuration
- Available With a Single Lead Attached, Consult Factory

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.8 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminals are Readily Solderable
- Lead Temperature for Soldering Purposes: requires a custom temperature soldering profile
- Polarity: cathode polarity band
- Shipped 5000 units per box
- Marking: R2500, R2501, R2502, R2504, R2506, R2510

MEDIUM-CURRENT SILICON RECTIFIERS
50 – 1000 VOLTS
25 AMPERES
DIFFUSED JUNCTION



CASE 193-04

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MAXIMUM RATINGS

Characteristic	Symbol	MR 2500	MR 2501	MR 2502	MR 2504	MR 2506	MR 2510	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	1000	Volts
Non-Repetitive Peak Reverse Voltage (half wave, single phase, 60 Hz peak)	V_{RSM}	60	120	240	480	720	1200	Volts
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	25						Amp
Non-Repetitive Peak Surge Current (surge applied @ rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	400 (for 1 cycle)						Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +175						°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (Single Side Cooled)	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristics and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 78.5 Amp, T_C = 25°C)	v_F	1.18	Volts
Maximum Reverse Current (rated dc voltage) T_C = 25°C T_C = 100°C	I_R	 100 500	µA

Rev 2

FIGURE 1 – FORWARD VOLTAGE

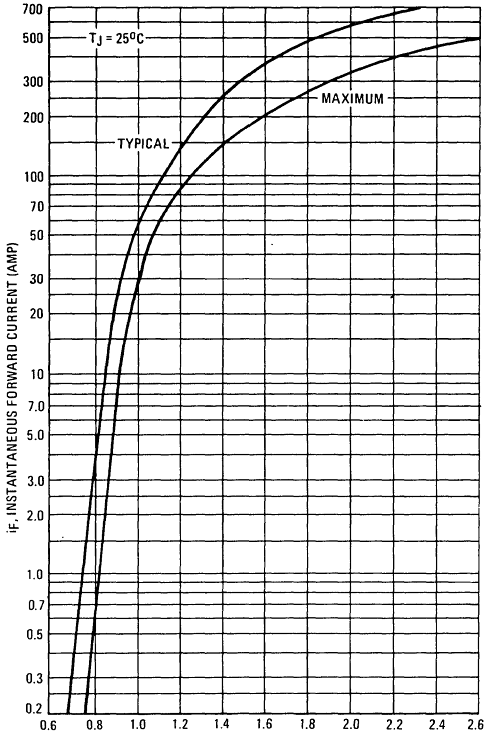

FIGURE 2 – NON-REPETITIVE SURGE CURRENT

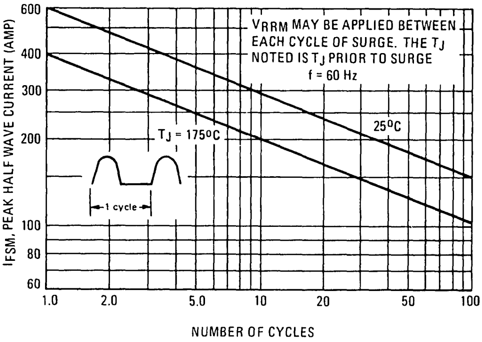

FIGURE 3 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT

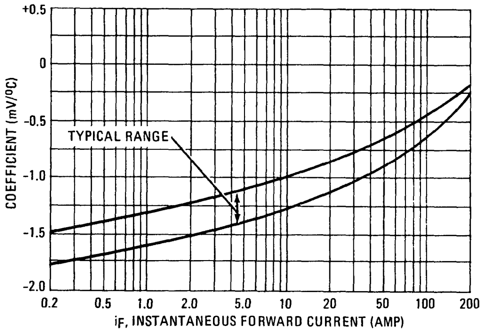

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FIGURE 4 – CURRENT DERATING

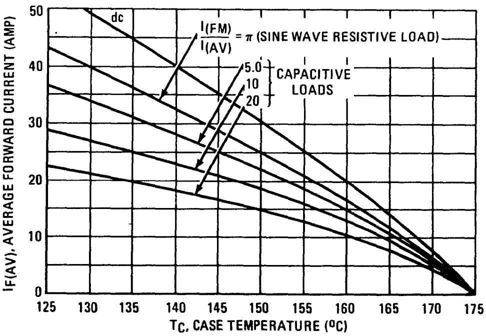


FIGURE 5 – FORWARD POWER DISSIPATION

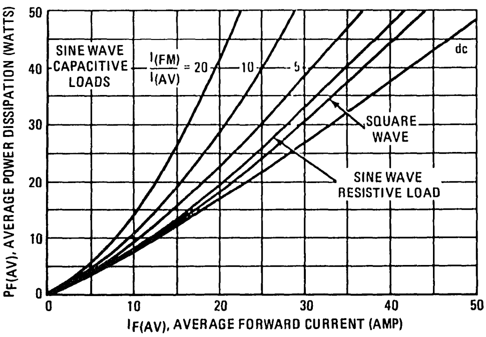
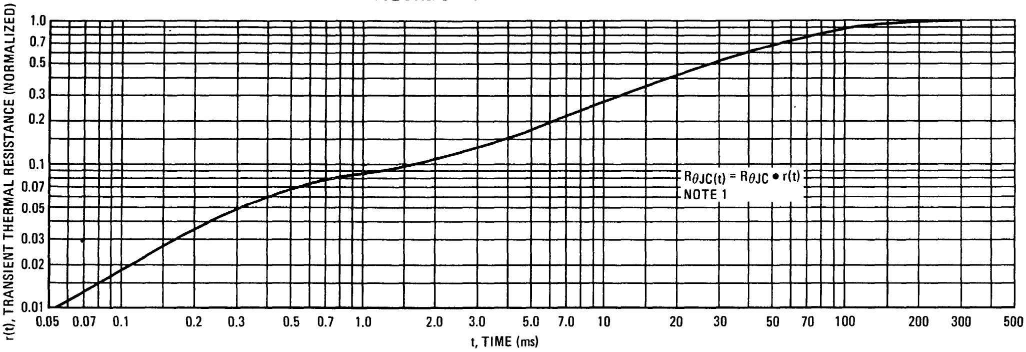
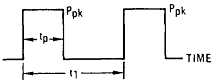


FIGURE 6 – THERMAL RESPONSE





DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see the outline drawing on page 1) The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature It may be determined by

$$\Delta T_{JC} = P_{pk} \bullet R_{\theta JC} [D + (1 - D) \bullet r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 6, i.e.,

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

FIGURE 7 – CAPACITANCE

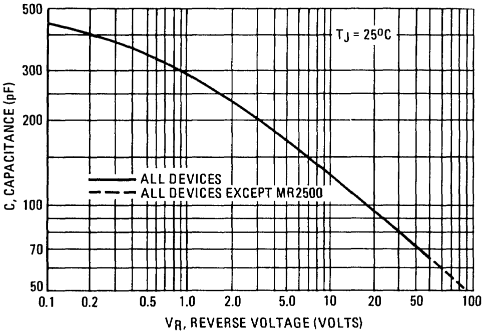


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FIGURE 8 – FORWARD RECOVERY TIME

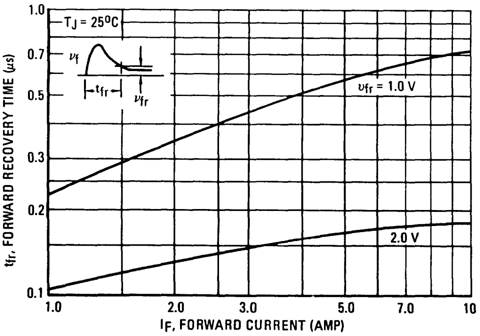


FIGURE 9 – REVERSE RECOVERY TIME

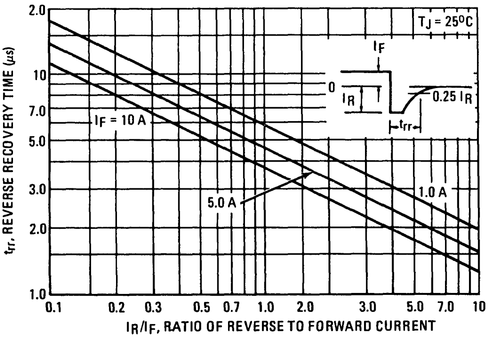
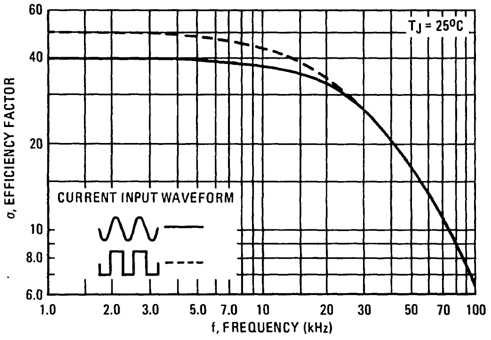


FIGURE 10 – RECTIFICATION WAVEFORM EFFICIENCY



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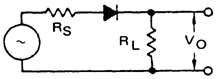
RECTIFICATION EFFICIENCY NOTE

FIGURE 11 – SINGLE-PHASE HALF-WAVE RECTIFIER CIRCUIT



The rectification efficiency factor σ shown in Figure 10 was calculated using the formula:

$$\sigma = \frac{P_{dc}}{P_{rms}} = \frac{\frac{V^2_{O(dc)}}{R_L}}{\frac{V^2_{O(rms)}}{R_L}} \bullet 100\% = \frac{V^2_{O(dc)}}{V^2_{O(ac)} + V^2_{O(dc)}} \bullet 100\% \quad (1)$$

For a sine wave input $V_m \sin(\omega t)$ to the diode, assume lossless, the maximum theoretical efficiency factor becomes:

$$\sigma_{(sine)} = \frac{\frac{V^2_m}{\pi^2 R_L}}{\frac{V^2_m}{4R_L}} \bullet 100\% = \frac{4}{\pi^2} \bullet 100\% = 40.6\% \quad (2)$$

For a square wave input of amplitude V_m, the efficiency factor becomes:

$$\sigma_{(square)} = \frac{\frac{V^2_m}{2R_L}}{\frac{V^2_m}{R_L}} \bullet 100\% = 50\% \quad (3)$$

(A full wave circuit has twice these efficiencies)

As the frequency of the input signal is increased, the reverse recovery time of the diode (Figure 9) becomes significant, resulting in an increasing ac voltage component across R_L which is opposite in polarity to the forward current, thereby reducing the value of the efficiency factor σ, as shown on Figure 10.

It should be emphasized that Figure 10 shows waveform efficiency only; it does not provide a measure of diode losses. Data was obtained by measuring the ac component of V_O with a true rms ac voltmeter and the dc component with a dc voltmeter. The data was used in Equation 1 to obtain points for Figure 10.

ASSEMBLY AND SOLDERING INFORMATION

There are *two basic areas* of consideration for successful implementation of button rectifiers:

1. Mounting and Handling
2. Soldering

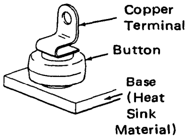
each should be carefully examined before attempting a finished assembly or mounting operation.

MOUNTING AND HANDLING

The button rectifier lends itself to a multitude of assembly arrangements but one key consideration must *always* be included:

One Side of the Connections to the Button Must Be Flexible!

Strain Relief Terminal for Button Rectifier



This stress relief to the button should also be chosen for maximum contact area to afford the best heat transfer – but not at the expense of flexibility. For an annealed copper terminal a thickness of 0.015″ is suggested.

The base heat sink may be of various materials whose shape and size are a function of the individual application and the heat transfer requirements.

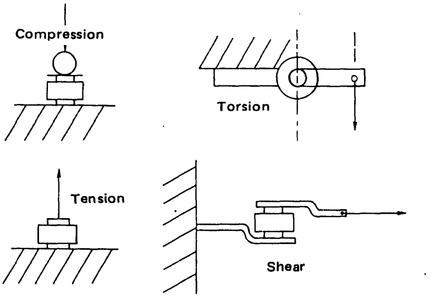
Common Materials	Advantages and Disadvantages
Steel	Low Cost; relatively low heat conductivity
Copper	High Cost; high heat conductivity
Aluminum	Medium Cost; medium heat conductivity Relatively expensive to plate and not all platers can process aluminum.

Handling of the button during assembly must be relatively gentle to minimize sharp impact shocks and avoid nicking of the plastic. Improperly designed automatic handling equipment is the worst source of unnecessary shocks. Techniques for vacuum handling and spring loading should be investigated.

The mechanical stress limits for the button diode are as follows:

Compression	32 lbs.	142.3 Newton
Tension	32 lbs.	142.3 Newton
Torsion	6-inch lbs.	0.68 Newton-meters
Shear	55 lbs.	244.7 Newton

MECHANICAL STRESS



Exceeding these recommended maximums can result in electrical degradation of the device.

SOLDERING

The button rectifier is basically a semiconductor chip bonded between two nickel-plated copper heat sinks with an encapsulating material of thermal-setting silicone. The exposed metal areas are also tin plated to enhance solderability.

In the soldering process it is important that the temperature not exceed 250°C if device damage is to be avoided. Various solder alloys can be used for this operation but two types are recommended for best results:

1. 96.5% tin, 3.5% silver; Melting point is 221°C (this particular eutetic is used by Motorola for its button rectifier assemblies).
2. 63% tin, 37% lead; Melting point 183°C (eutetic).

Solder is available as preforms or paste. The paste contains both the metal and flux and can be dispensed rapidly. The solder preform requires the application of a flux to assure good wetting of the solder. The type of flux used depends upon the degree of cleaning to be accomplished and is a function of the metals involved. These fluxes range from a mild rosin to a strong acid; e.g., Nickel plating oxides are best removed by an acid base flux while an activated rosin flux may be sufficient for tin plated parts.

Since the button is relatively light-weight, there is a tendency for it to float when the solder becomes liquid. To prevent bad joints and misalignment it is suggested that a weighting or spring loaded fixture be employed. It is also important that severe thermal shock (either heating or cooling) be avoided as it may lead to damage of the die or encapsulant of the part.

Button holding fixtures for use during soldering may be of various materials. Stainless steel has a longer use life while black anodized aluminum is less expensive and will limit heat reflection and enhance absorption. The assembly volume will influence the choice of materials. Fixture dimension tolerances for locating the button must allow for expansion during soldering as well as allowing for button clearance.

HEATING TECHNIQUES

The following four heating methods have their advantages and disadvantages depending on volume of buttons to be soldered.

1. **Belt Furnaces** readily handle large or small volumes and are adaptable to establishment of "on-line" assembly since a variable belt speed sets the run rate. Individual furnace zone controls make excellent temperature control possible.

2. **Flame Soldering** involves the directing of natural gas flame jets at the base of a heatsink as the heatsink is indexed to various loading-heating-cooling-unloading positions. This is the most economical labor method of soldering large volumes. Flame soldering offers good temperature control but requires sophisticated temperature monitoring systems such as infrared.

ASSEMBLY AND SOLDERING INFORMATION (continued)

3. **Ovens** are good for batch soldering and are production limited. There are handling problems because of slow cooling. Response time is load dependent, being a function of the watt rating of the oven and the mass of parts. Large ovens may not give an acceptable temperature gradient. Capital cost is low compared to belt furnaces and flame soldering.
4. **Hot Plates** are good for soldering small quantities of prototype devices. Temperature control is fair with overshoot common because of the exposed heating surface. Solder flow and positioning can be corrected during soldering since the assembly is exposed. Investment cost is very low.

Regardless of the heating method used, a soldering profile giving the time-temperature relationship of the particular method must be determined to assure proper soldering. Profiling must be performed on a scheduled basis to minimize poor soldering. The time-temperature relationship will change depending on the heating method used.

SOLDER PROCESS EVALUATION

Characteristics to look for when setting up the soldering process:

I **Overtemperature** is indicated by any one or all three of the following observations.
1. Remelting of the solder inside the button rectifier shows the temperature has exceeded 285°C and is noted by "islands" of shiny solder and solder dewetting when a unit is broken apart.
2. Cracked die inside the button may be observed by a moving reverse oscilloscope trace when pressure is applied to the unit.
3. Cracked plastic may be caused by thermal shock as well as overtemperature so cooling rate should also be checked.

II **Cold soldering** gives a grainy appearance and solder build-up without a smooth continuous solder fillet. The temperature must be adjusted until the proper solder fillet is obtained within the maximum temperature limits.

III **Incomplete solder fillets** result from insufficient solder or parts not making proper contact.

IV **Tilted buttons** can cause a void in the solder between the heatsink and button rectifier which will result in poor heat transfer during operation. An eight degree tilt is a suggested maximum value.

V **Plating problems** require a knowledge of plating operations for complete understanding of observed deficiencies.
1. Peeling or plating separation is generally seen when a button is broken away for solder inspection. If heatsink or terminal base metal is present the plating is poor and must be corrected.
2. Thin plating allows the solder to penetrate through to the base metal and can give a poor connection. A suggested minimum plating thickness is 300 microinches.
3. Contaminated soldering surfaces may out-gas and cause non-wetting resulting in voids in the solder connection. The exact cause is not always readily apparent and can be because of:
   (a) improper plating
   (b) mishandling of parts
   (c) improper and/or excessive storage time

SOLDER PROCESS MONITORING

Continuous monitoring of the soldering process must be established to minimize potential problems. All parts used in the soldering operation should be sampled on a lot by lot basis by assembly of a controlled sample. Evaluate the control sample by break-apart tests to view the solder connections, by physical strength tests and by dimensional characteristics for part mating.

A shear test is a suggested way of testing the solder bond strength.

POST SOLDERING OPERATION CONSIDERATIONS

After soldering, the completed assembly must be unloaded, washed and inspected.

Unloading must be done carefully to avoid unnecessary stress. Assembly fixtures should be cooled to room temperature so solder profiles are not affected.

Washing is mandatory if an acid flux is used because of its ionic and corrosive nature. Wash the assemblies in agitated hot water and detergent for three to five minutes. After washing; rinse, blow off excessive water and bake 30 minutes at 150°C to remove trapped moisture.

Inspection should be both electrical and physical. Any rejects can be reworked as required.

SUMMARY

The Button Rectifier is an excellent building block for specialized applications. The prime example of its use is the output bridge of the automative alternator where millions are used each year. Although the material presented here is not all inclusive, primary considerations for use are presented. For further information, contact the nearest Motorola Sales Office or franchised distributor.

Complementary Medium Current Silicon Rectifiers

For Linear Power Supply Applications

MR4422CT
MR4422CTR

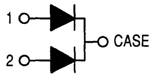
POWER RECTIFIERS
30 AMPERES
100 VOLTS

. . . using monolithic silicon technology for perfect matching of diodes in center tap configuration. These devices have the following features:

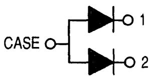
- Low Forward Voltage Drop
- Soft Reverse Recovery for Low Noise
- High Surge Current Capability
- 150°C Operating Junction Temperature
- Direct Replacement for Varo R711 and R711A

Mechanical Characteristics

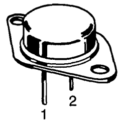
- Case: Welded Steel can, hermetically sealed
- Weight: 11 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 100 units per foam tray
- Marking: R4422T, R4422R



MR4422CT



MR4422CTR



CASE 1–07
(TO–204AA)

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current Per Leg (Rated V_R) T_C = 125°C Per Device	$I_{F(AV)}$	15 30	Amps
Peak Repetitive Forward Current, Per Diode Leg (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +175	°C

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	1.4	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1) (I_F = 15 Amps, T_C = 25°C) (I_F = 10 Amps, T_C = 125°C)	i_F	 1.2 1.1	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	i_R	 1.0 250	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.

Rev 1

Advance Information
Overvoltage Transient Suppressors

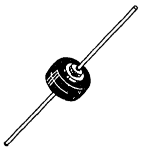
MR2535L
MR2535S

MEDIUM CURRENT OVERVOLTAGE TRANSIENT SUPPRESSORS

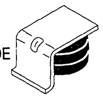
. . . designed for applications requiring a low voltage rectifier with reverse avalanche characteristics for use as reverse power transient suppressors. Developed to suppress transients in the automotive system, these devices operate in the forward mode as standard rectifiers or reverse mode as power avalanche rectifier and will protect electronic equipment from overvoltage conditions.

- Avalanche Voltage 24 to 32 Volts
- High Power Capability
- Economical
- Increased Capacity by Parallel Operation

Mechanical Characteristics
- Case: Epoxy, Molded
- Weight: 2.5 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Polarity: cathode polarity band
- MR2535L shipped 1000 units per plastic bag. Available Tape and Reeled, 800 units per reel by adding a "RL" suffix to the part number.
- MR2535S shipped pocket tape and reeled, 500 per 13″ reel.
- Marking: MR2535L, MR2535S



CASE 194–04



CASE 421A–01

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MAXIMUM RATINGS

Rating	Symbol	Value	Unit
DC Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	Volts
Repetitive Peak Reverse Surge Current (Time Constant = 10 ms, Duty Cycle ≤ 1%, T_C = 25°C) (See Figure 1)	I_{RSM}	110	Amps
Average Rectified Forward Current (Single Phase, Resistive Load, 60 Hz, T_C = 150°C)	I_O	35	Amps
Non–Repetitive Peak Surge Current Surge Supplied at Rated Load Conditions Halfwave, Single Phase	I_{FSM}	600	Amps
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +175	°C

THERMAL CHARACTERISTICS

Characteristic	Lead Length	Symbol	Max	Unit
Thermal Resistance, Junction to Lead @ Both Leads to Heat Sink, Equal Length	1/4″ 3/8″ 1/2″	$R_{\theta JL}$	7.5 10 13	°C/W
Thermal Resistance Junction to Case		$R_{\theta JC}$	0.8*	°C/W

*Typical

This document contains information on a new product. Specifications and information herein are subject to change without notice.

Rev 2

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 100 Amps, T_C = 25°C)	v_F	—	1.1	Volts
Reverse Current (V_R = 20 Vdc, T_C = 25°C)	I_R	—	200	nAdc
Breakdown Voltage (1) (I_R = 100 mAdc, T_C = 25°C)	$V_{(BR)}$	24	32	Volts
Breakdown Voltage (1) (I_R = 90 Amp, T_C = 150°C, PW = 80 µs)	$V_{(BR)}$	—	40	Volts
Breakdown Voltage Temperature Coefficient	$V_{(BR)TC}$	—	0.096*	%/°C
Forward Voltage Temperature Coefficient @ I_F = 10 mA	V_{FTC}	—	2*	mV/°C

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2%.
*Typical

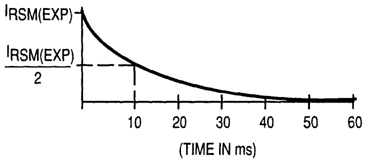

Figure 1. Surge Current Characteristics

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Section 6

Tape and Reel/ Packaging Specifications

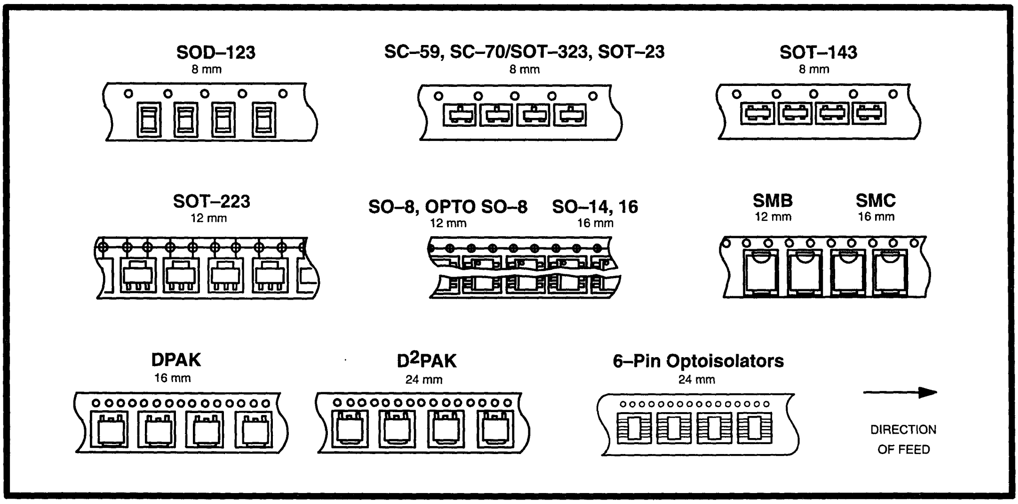
6

Tape and Reel Specifications and Packaging Specifications

Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the "peel–back" cover tape.

- Two Reel Sizes Available (7″ and 13″)
- Used for Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481, –1, –2
- SOD–123, SC–59, SC–70/SOT–323, SOT–23, SOT–143 in 8 mm Tape
- SO–8, OPTO SO–8, SOT–223, SMB in 12 mm Tape
- DPAK, SO–14, SO–16, SMC in 16 mm Tape
- D2PAK, 6–Pin Optoisolators in 24 mm Tape

Use the standard device title and add the required suffix as listed in the option table on the following page. Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity.



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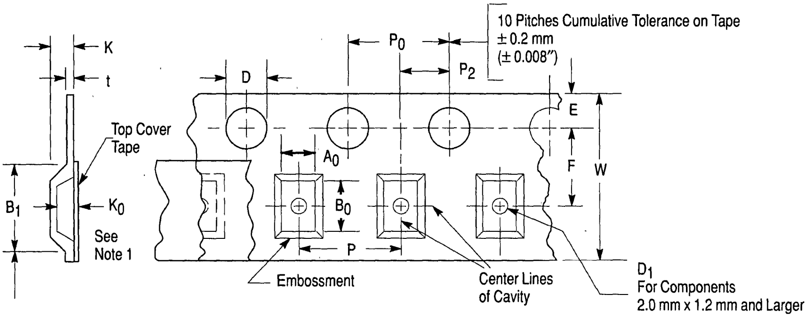
EMBOSSED TAPE AND REEL ORDERING INFORMATION

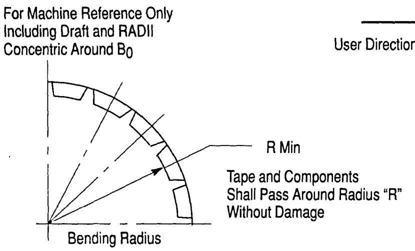
Package	Tape Width (mm)	Pitch mm (inch)	Reel Size mm (inch)	Devices Per Reel and Minimum Order Quantity	Device Suffix
DPAK	16	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	T4
D^2PAK	24	16.0 ± 0.1 (.630 ± .004)	330 (13)	800	T4
SC–59	8	4.0 ± 0.1 (.157 ± .004)	178 (7)	3,000	T1
SC–70/SOT–323	8 8	4.0 ± 0.1 (.157 ± .004)	178 (7) 330 (13)	3,000 10,000	T1 T3
SMB	12	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	T3
SMC	16	8.0 ± 0.1 (.315 ± .004)	330 (13)	2,500	T3
SO–8, OPTO SO–8	12 12	8.0 ± 0.1 (.315 ± .004)	178 (7) 330 (13)	500 2,500	R1 R2
SO–14	16 16	8.0 ± 0.1 (.315 ± .004)	178 (7) 330 (13)	500 2,500	R1 R2
SO–16	16 16	8.0 ± 0.1 (.315 ± .004)	178 (7) 330 (13)	500 2,500	R1 R2
SOD–123	8 8	4.0 ± 0.1 (.157 ± .004)	178 (7) 330 (13)	3,000 10,000	T1 T3
SOT–23	8 8	4.0 ± 0.1 (.157 ± .004)	178 (7) 330 (13)	3,000 10,000	T1 T3
SOT–143	8 8	4.0 ± 0.1 (.157 ± .004)	178 (7) 330 (13)	3,000 10,000	T1 T3
SOT–223	12 12	8.0 ± 0.1 (.315 ± .004)	178 (7) 330 (13)	1,000 4,000	T1 T3
6–Pin Optoisolators	24	12.0 ± 0.1 (.472 ± .004)	330 (13)	1000	R2

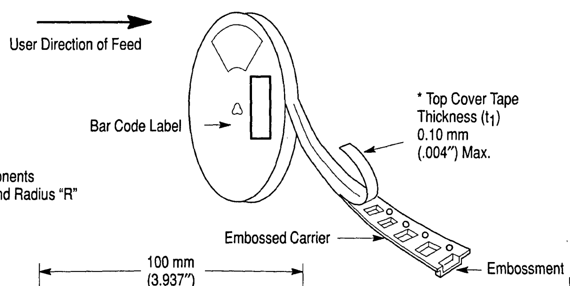
6

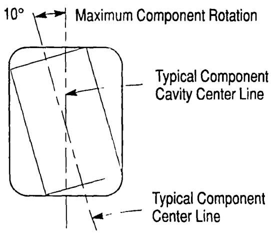
EMBOSSED TAPE AND REEL DATA FOR DISCRETES

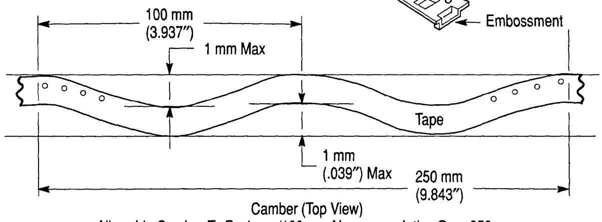
CARRIER TAPE SPECIFICATIONS











Camber (Top View)
Allowable Camber To Be 1 mm/100 mm Nonaccumulative Over 250 mm

6

DIMENSIONS

Tape Size	B_1 Max	D	D_1	E	F	K	P_0	P_2	R Min	T Max	W Max
8 mm	4.55 mm (.179″)	1.5+0.1 mm −0.0 (.059+.004″ −0.0)	1.0 Min (.039″)	1.75±0.1 mm (.069±.004″)	3.5±0.05 mm (.138±.002″)	2.4 mm Max (.094″)	4.0±0.1 mm (.157±.004″)	2.0±0.1 mm (.079±.002″)	25 mm (.98″)	0.6 mm (.024″)	8 3 mm (.327″)
12 mm	8.2 mm (.323″)		1.5 mm Min (.060″)		5.5±0.05 mm (.217±.002″)	6.4 mm Max (.252″)			30 mm (1.18″)		12±.30 mm (.470±.012″)
16 mm	12.1 mm (.476″)				7.5±0.10 mm (.295±.004″)	7.9 mm Max (.311″)					16.3 mm (.642″)
24 mm	20.1 mm (.791″)				11.5±0.1 mm (.453±.004″)	11.9 mm Max (.468″)					24.3 mm (.957″)

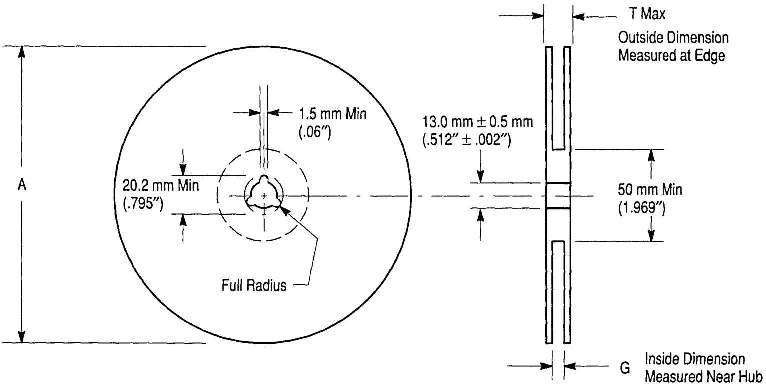
Metric dimensions govern — English are in parentheses for reference only.

NOTE 1: A_0, B_0, and K_0 are determined by component size. The clearance between the components and the cavity must be within .05 mm min. to .50 mm max., the component cannot rotate more than 10° within the determined cavity.

NOTE 2: If B_1 exceeds 4.2 mm (.165) for 8 mm embossed tape, the tape may not feed through all tape feeders.

NOTE 3: Pitch information is contained in the Embossed Tape and Reel Ordering Information on pg. 6–3.

EMBOSSED TAPE AND REEL DATA FOR DISCRETES



Size	A Max	G	T Max
8 mm	330 mm (12.992″)	8.4 mm + 1.5 mm, −0.0 (.33″ + .059″, −0.00)	14.4 mm (.56″)
12 mm	330 mm (12.992″)	12.4 mm + 2.0 mm, −0.0 (.49″ + .079″, −0.00)	18.4 mm (.72″)
16 mm	360 mm (14.173″)	16.4 mm + 2.0 mm, −0.0 (.646″ + .078″, −0.00)	22.4 mm (.882″)
24 mm	360 mm (14.173″)	24.4 mm + 2.0 mm, −0.0 (.961″ + .070″, −0.00)	30.4 mm (1.197″)

Reel Dimensions

Metric Dimensions Govern — English are in parentheses for reference only

6

LEAD TAPE PACKAGING STANDARDS FOR AXIAL–LEAD COMPONENTS

Case Type	Product Category	Device Title Suffix	MPQ Quantity Per Reel (Item 3.3.7)	Component Spacing A Dimension	Tape Spacing B Dimension	Reel Dimension C	Reel Dimension D (Max)	Max Off Alignment E
Case 17–02	Surmetic 40 & 600 Watt TVS	RL	4000	0.2 +/– 0.015	2.062 +/– 0.059	3	14	0.047
Case 41A–02	1500 Watt TVS	RL4	1500	0.4 +/– 0.02	2.062 +/– 0.059	3	14	0.047
Case 51–02	DO–7 Glass (For Reference only)	RL	3000	0.2 +/– 0.02	2.062 +/– 0.059	3	14	0.047
Case 59–03	DO–41 Glass & DO–41 Surmetic 30	RL	6000	0.2 +/– 0.015	2.062 +/– 0.059	3	14	0.047
	Rectifier							
Case 59–04	500 Watt TVS	RL	5000	0.2 +/– 0.02	2.062 +/– 0.059	3	14	0.047
	Rectifier							
Case 194–04	110 Amp TVS (Automotive)	RL	800	0.4 +/– 0.02	1.875 +/– 0.059	3	14	0.047
	Rectifier							
Case 267–02	Rectifier	RL	1500	0.4 +/– 0.02	2.062 +/– 0.059	3	14	0.047
Case 299–02	DO–35 Glass	RL	5000	0.2 +/– 0.02	2.062 +/– 0.059	3	14	0.047

Table 1. Packaging Details (all dimensions in inches)

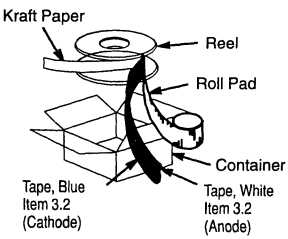


Figure 1. Reel Packing

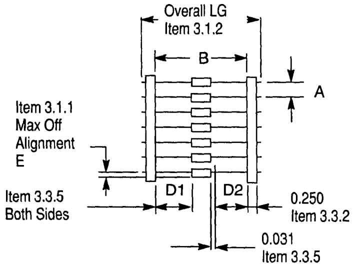


Figure 2. Component Spacing

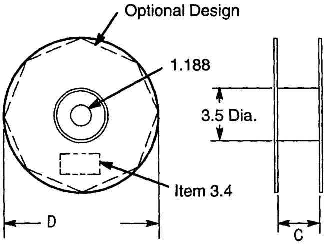


Figure 3. Reel Dimensions

6

Section 7

Surface Mount Information

7

INFORMATION FOR USING SURFACE MOUNT PACKAGES

RECOMMENDED FOOTPRINTS FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.

POWER DISSIPATION FOR A SURFACE MOUNT DEVICE

The power dissipation for a surface mount device is a function of the drain/collector pad size. These can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient, and the operating temperature, T_A. Using the values provided on the data sheet, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device. For example, for a SOT–223 device, P_D is calculated as follows.

$$P_D = \frac{150°C - 25°C}{156°C/W} = 800 \text{ milliwatts}$$

The 156°C/W for the SOT–223 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 800 milliwatts. There are other alternatives to achieving higher power dissipation from the surface mount packages. One is to increase the area of the drain/collector pad. By increasing the area of the drain/collector pad, the power dissipation can be increased. Although the power dissipation can almost be doubled with this method, area is taken up on the printed circuit board which can defeat the purpose of using surface mount technology. For example, a graph of $R_{\theta JA}$ versus drain pad area is shown in Figures 1, 2 and 3.

Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

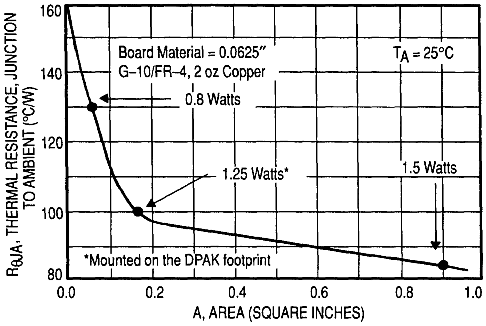


Figure 1. Thermal Resistance versus Drain Pad Area for the SOT–223 Package (Typical)

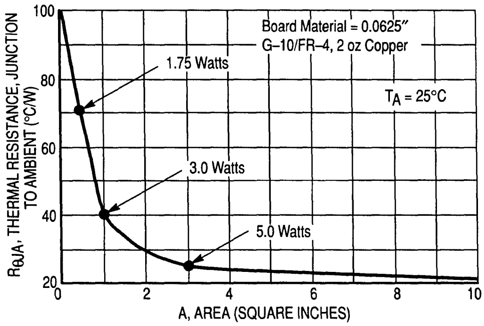


Figure 2. Thermal Resistance versus Drain Pad Area for the DPAK Package (Typical)

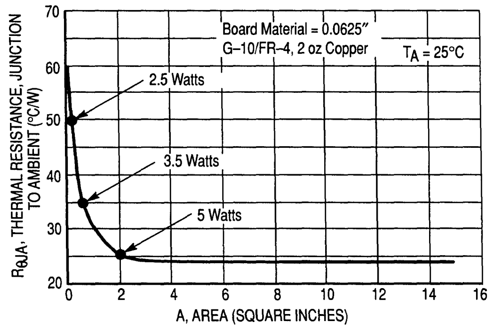


Figure 3. Thermal Resistance versus Drain Pad Area for the D^2PAK Package (Typical)

SOLDER STENCIL GUIDELINES

Prior to placing surface mount components onto a printed circuit board, solder paste must be applied to the pads. Solder stencils are used to screen the optimum amount. These stencils are typically 0.008 inches thick and may be made of brass or stainless steel. For packages such as the SC–59, SC–70/SOT–323, SOD–123, SOT–23, SOT–143, SOT–223, SO–8, SO–14, SO–16, and SMB/SMC diode packages, the stencil opening should be the same as the pad size or a 1:1 registration. This is not the case with the DPAK and D^2PAK packages. If a 1:1 opening is used to screen solder onto the drain pad, misalignment and/or "tombstoning" may occur due to an excess of solder. For these two packages, the opening in the stencil for the paste should be approximately 50% of the tab area. The opening for the leads is still a 1:1 registration. Figure 4 shows a typical stencil for the DPAK and D^2PAK packages. The pattern of the opening in the stencil for the drain pad is not critical as long as it allows approximately 50% of the pad to be covered with paste.

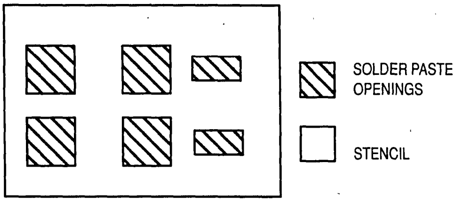


Figure 4. Typical Stencil for DPAK and D^2PAK Packages

SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference should be a maximum of 10°C.
- The soldering temperature and time should not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used since the use of forced cooling will increase the temperature gradient and will result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

* Due to shadowing and the inability to set the wave height to incorporate other surface mount components, the D^2PAK is not recommended for wave soldering.

TYPICAL SOLDER HEATING PROFILE

For any given circuit board, there will be a group of control settings that will give the desired heat pattern. The operator must set temperatures for several heating zones and a figure for belt speed. Taken together, these control settings make up a heating "profile" for that particular circuit board. On machines controlled by a computer, the computer remembers these profiles from one operating session to the next. Figure 5 shows a typical heating profile for use when soldering a surface mount device to a printed circuit board. This profile will vary among soldering systems, but it is a good starting point. Factors that can affect the profile include the type of soldering system in use, density and types of components on the board, type of solder used, and the type of board or substrate material being used. This profile shows temperature versus time. The line on the graph shows the actual temperature that might be experienced on the surface of a test board at or near a central solder joint. The two profiles are based on a high density and a low density board. The Vitronics SMD310 convection/infrared reflow soldering system was used to generate this profile. The type of solder used was 62/36/2 Tin Lead Silver with a melting point between 177–189°C. When this type of furnace is used for solder reflow work, the circuit boards and solder joints tend to heat first. The components on the board are then heated by conduction. The circuit board, because it has a large surface area, absorbs the thermal energy more efficiently, then distributes this energy to the components. Because of this effect, the main body of a component may be up to 30 degrees cooler than the adjacent solder joints.

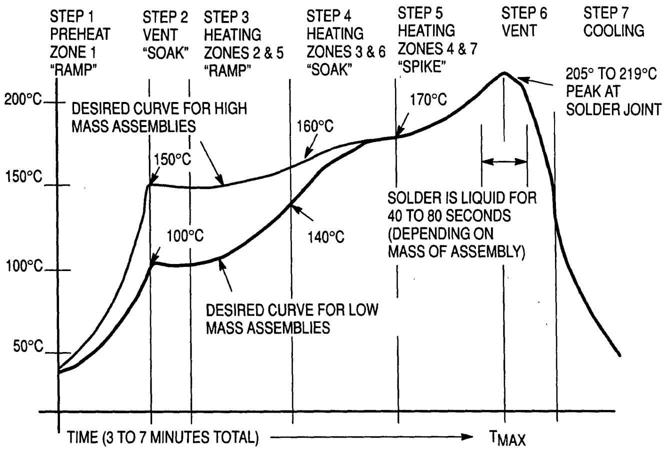
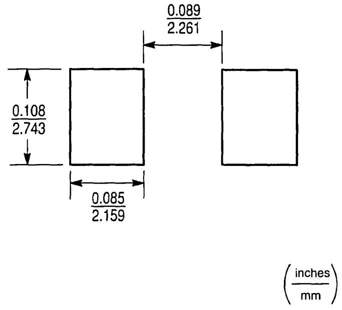


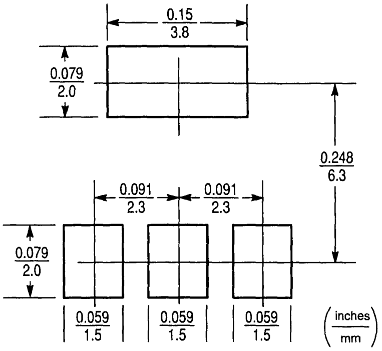
Figure 5. Typical Solder Heating Profile

7

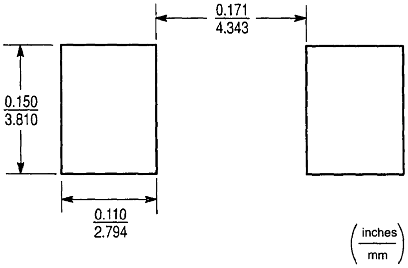
Footprints for Soldering



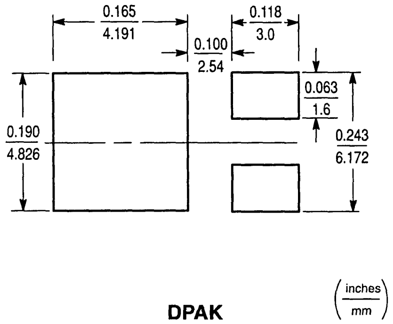
SMB



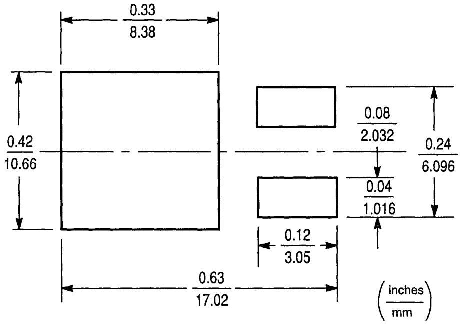
SOT–223



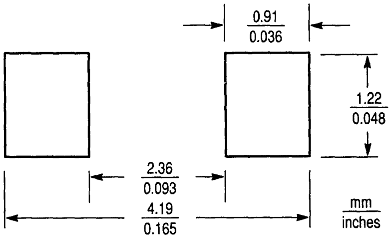
SMC



DPAK



D2PAK



SOD–123

7

Section 8

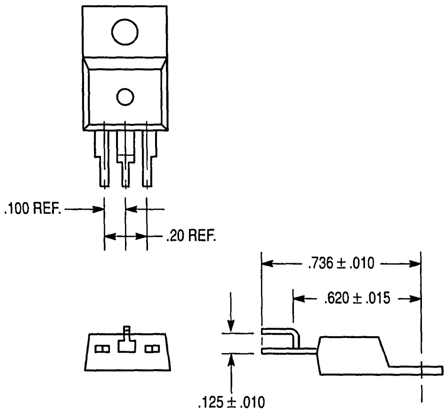
TO–220 Leadform Information

8

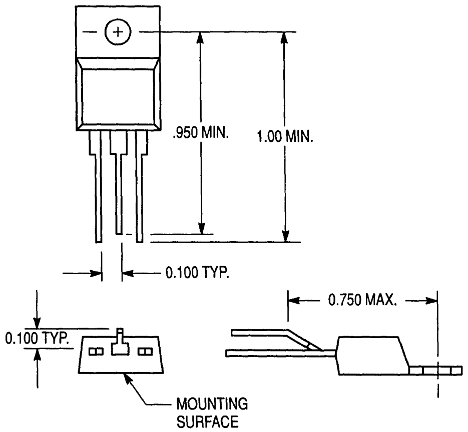
Leadform Options — TO–220 (Case 221A)

- Leadform options require assignment of a special part number before ordering.
- Contact your local Motorola representative for special part number and pricing.
- 10,000 piece minimum quantity orders are required.
- Leadform orders are non–cancellable after processing.
- Leadforms apply to both Motorola Case 221A–04 and 221A–06 except as noted.

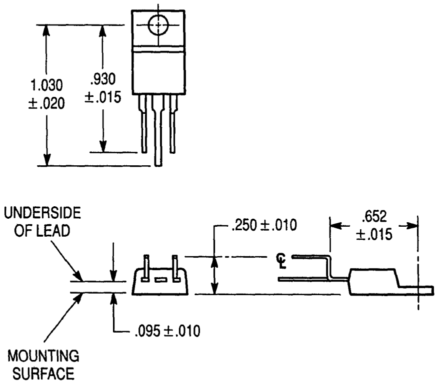
LEADFORM AS



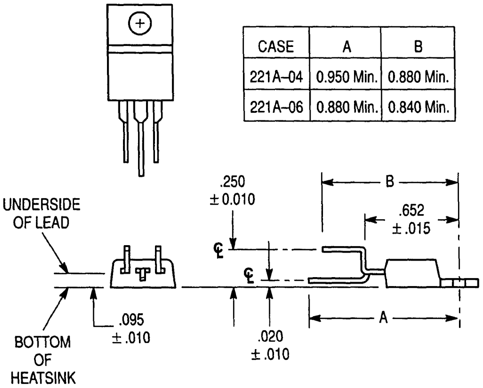
LEADFORM BC



LEADFORM AC



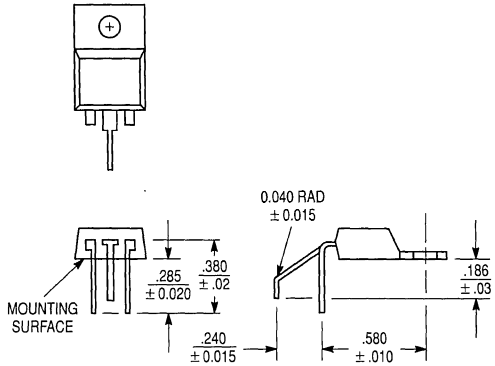
LEADFORM AD



CASE	A	B
221A–04	0.950 Min.	0.880 Min.
221A–06	0.880 Min.	0.840 Min.

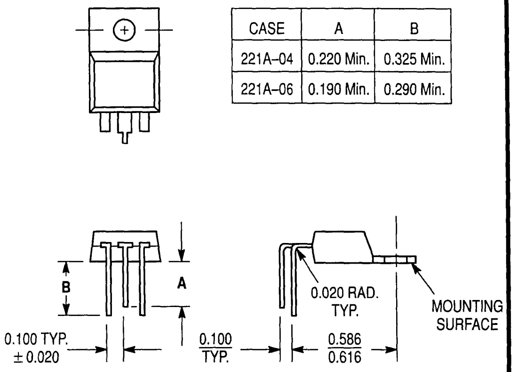
TO–220 Leadform Options (continued)

LEADFORM AN



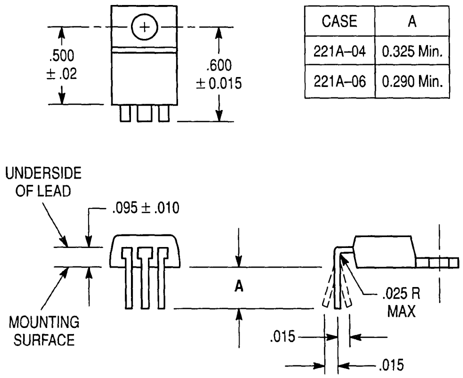
LEADFORM BA

CASE	A	B
221A–04	0.220 Min.	0.325 Min.
221A–06	0.190 Min.	0.290 Min.

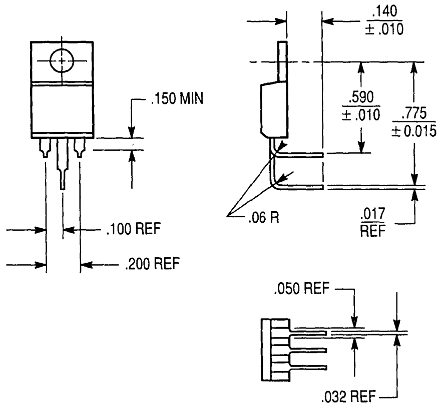


LEADFORM BL

CASE	A
221A–04	0.325 Min.
221A–06	0.290 Min.



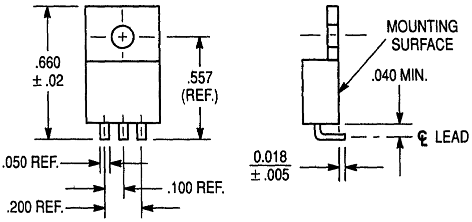
LEADFORM AK



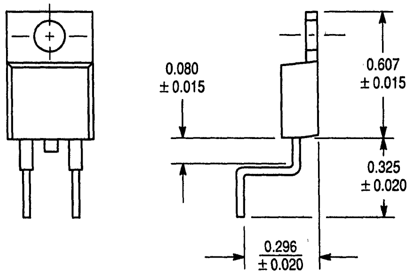
8

TO–220 Leadform Options (continued)

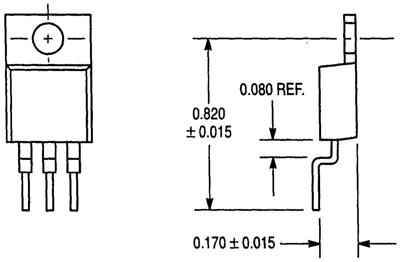
LEADFORM AF



LEADFORM BS

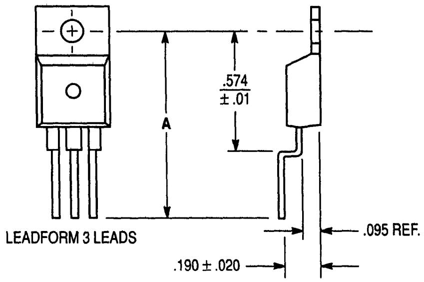


LEADFORM BR



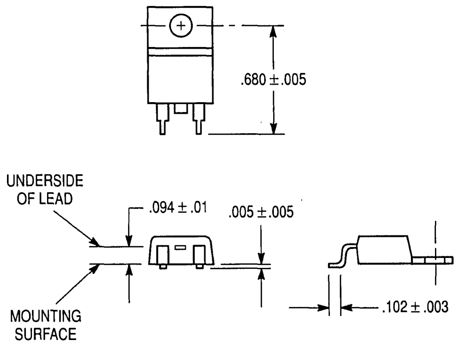
LEADFORM AU

CASE	A
221A–04	0.920 Min.
221A–06	0.885 Min.

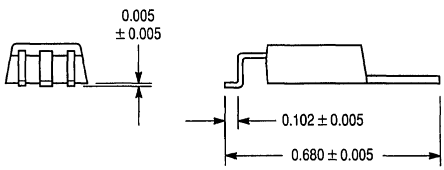


TO–220 Leadform Options (continued)

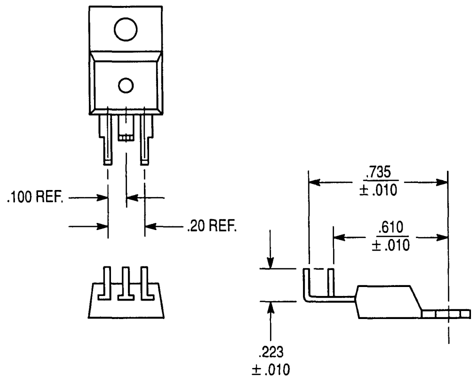
LEADFORM BU



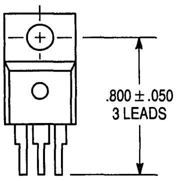
LEADFORM BV



LEADFORM BD

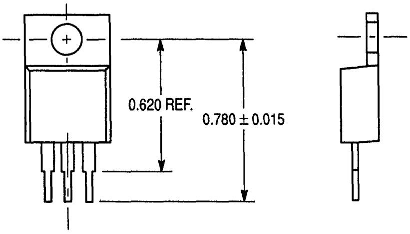


LEADFORM DW

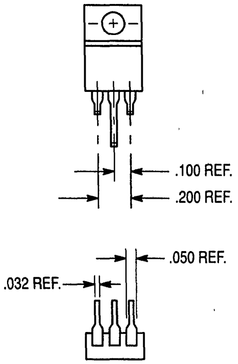


TO–220 Leadform Options (continued)

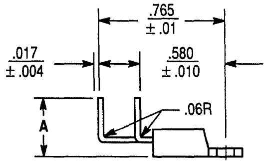
LEADFORM BG



LEADFORM AJ



CASE	A
221A–04	0.360 ± 0.010
221A–06	Lead Not Trimmed 0.300 Min.



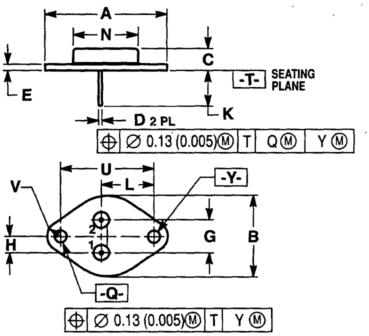
8

Section 9

Package Outline Dimensions and Footprints

9

Package Outline Dimensions and Footprints



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.550 REF		39.37 REF	
B	—	1.050	—	26.67
C	0.250	0.335	6.35	8.51
D	0.038	0.043	0.97	1.09
E	0.055	0.070	1.40	1.77
G	0.430 BSC		10 92 BSC	
H	0.215 BSC		5.46 BSC	
K	0.440	0.480	11.18	12.19
L	0.665 BSC		16.89 BSC	
N	—	0.830	—	21.08
Q	0 151	0.165	3.84	4.19
U	1.187 BSC		30.15 BSC	
V	0.131	0.188	3.33	4.77

STYLE 1:
PIN 1. BASE
2. EMITTER
CASE: COLLECTOR

STYLE 2:
PIN 1. BASE
2. COLLECTOR
CASE: EMITTER

STYLE 3:
PIN 1. GATE
2. SOURCE
CASE: DRAIN

STYLE 4:
PIN 1. GROUND
2. INPUT
CASE: OUTPUT

STYLE 5:
PIN 1. CATHODE
2. EXTERNAL TRIP/DELAY
CASE. ANODE

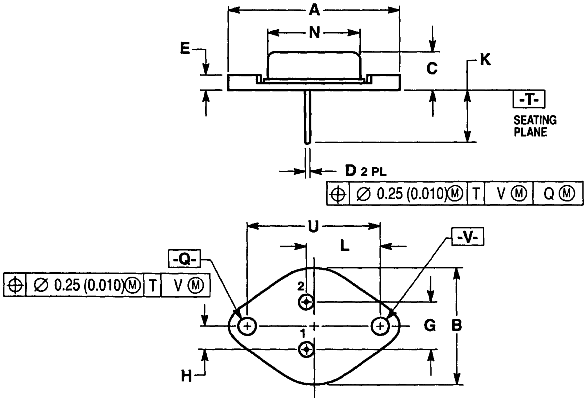
STYLE 6:
PIN 1. GATE
2. EMITTER
CASE: COLLECTOR

STYLE 7:
PIN 1. ANODE
2. OPEN
CASE: CATHODE

STYLE 8:
PIN 1. CATHODE #1
2. CATHODE #2
CASE: ANODE

STYLE 9:
PIN 1. ANODE #1
2. ANODE #2
CASE: CATHODE

CASE 1-07
ISSUE Z



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	—	1.550	—	39.37
B	—	1.050	—	26.67
C	0.250	0.450	6.35	11.43
D	0.039	0.043	0.99	1.09
E	—	0.135	—	3.43
G	0.430 BSC		10.92 BSC	
H	0.215 BSC		5.46 BSC	
K	0.440	0.480	11.18	12.19
L	0.665 BSC		16.89 BSC	
N	—	0.830	—	21.08
Q	0.151	0.161	3 84	4.09
U	1.187 BSC		30.15 BSC	
V	0.151	0.161	3.84	4.09

STYLE 1:
PIN 1. BASE
2. EMITTER
CASE: COLLECTOR

STYLE 2:
PIN 1. EMITTER
2. BASE
CASE: COLLECTOR

STYLE 3:
PIN 1. ANODE
2. CATHODE

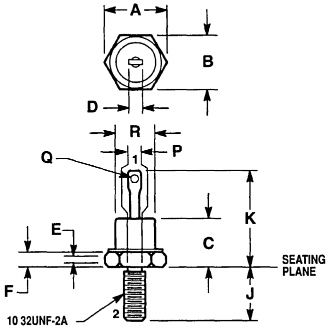
STYLE 4:
PIN 1. ANODE #1
2 ANODE #2
CASE: CATHODE

STYLE 5:
1. CATHODE #1
2. CATHODE #2
CASE: ANODE

CASE 11-03
ISSUE G

9

PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

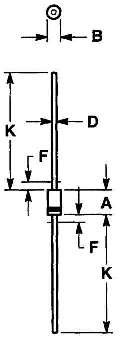
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	—	0.505	—	12.82
B	0.424	0.437	10.77	11.09
C	—	0.405	—	10.28
D	—	0.250	—	6.35
E	0.060	—	1.53	—
F	0.075	0.175	1.91	4.44
J	0.422	0.453	10.72	11.50
K	0.600	0.800	15.24	20.32
P	0.163	0.189	4.14	4.80
Q	0.060	0.095	1.53	2.41
R	0.265	0.424	6.74	10.76

STYLE 1:
TERM. 1. CATHODE
2. ANODE

STYLE 2:
TERM. 1. ANODE
2. CATHODE

STYLE 3:
TERM. 1. ANODE
2. ANODE

CASE 56-03
(DO-4)
ISSUE G

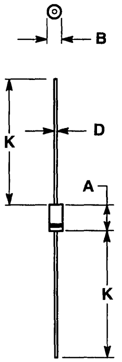


NOTES:
1. POLARITY DENOTED BY CATHODE BAND.
2. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.07	5.20	0.160	0 205
B	2.04	2.71	0.080	0.107
D	0.71	0.86	0.028	0 034
F	—	1.27	—	0 050
K	27.94	—	1.100	—

CASE 59-03
(DO-41)
ISSUE M

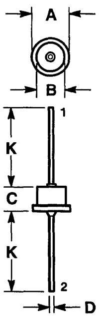
9



NOTES
1. POLARITY DENOTED BY CATHODE BAND.
2. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	5.97	6.60	0.235	0.260
B	2.79	3.05	0.110	0.120
D	0.76	0.86	0.030	0.034
K	27.94	—	1.100	—

CASE 59-04
(DO-41)
ISSUE M



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	—	0.450	—	11.43
B	—	0 350	—	8.89
C	—	0.300	—	7.62
D	0.046	0.056	1.17	1.42
K	0.980	—	24.90	—

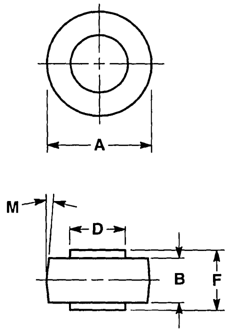
STYLE 1:
PIN 1. CATHODE
2. ANODE

STYLE 2:
PIN 1. ANODE
2. CATHODE

CASE 60-01
ISSUE E

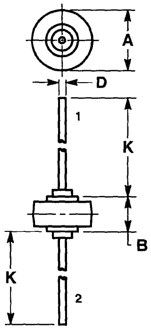
9

PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.43	8.69	0.332	0.342
B	4.19	4.45	0.165	0.175
D	5.54	5.64	0.218	0.222
F	5.94	6.25	0.234	0.246
M	5° NOM		5° NOM	

CASE 193-04
ISSUE J



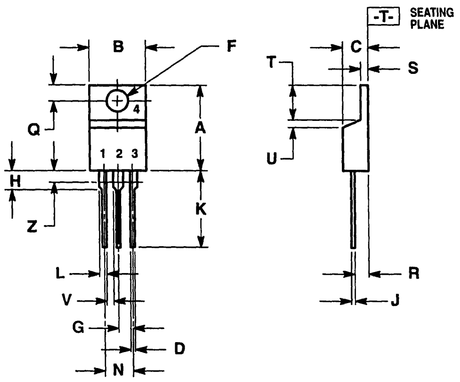
NOTES:
1. CATHODE SYMBOL ON PACKAGE.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.43	8.69	0.332	0.342
B	5.94	6.25	0.234	0.246
D	1.27	1.35	0.050	0.053
K	25.15	25.65	0.990	1.010

STYLE 1:
PIN 1. CATHODE
2. ANODE

CASE 194-04
ISSUE F

9



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. BASE
2. EMITTER
3. COLLECTOR
4. EMITTER

STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE

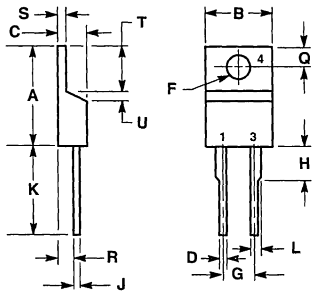
STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE

CASE 221A-06
(TO-220AB)
ISSUE Y

9



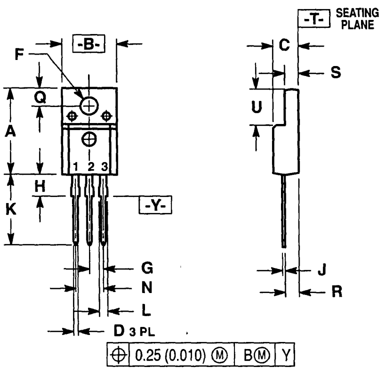
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.595	0.620	15.11	15 75
B	0.380	0.405	9.65	10 29
C	0.160	0.190	4.06	4.82
D	0.025	0 035	0.64	0.89
F	0.142	0.147	3.61	3 73
G	0.190	0.210	4.83	5.33
H	0.110	0.130	2.79	3.30
J	0.018	0 025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.14	1.52
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.14	1.39
T	0.235	0.255	5.97	6.48
U	0.000	0.050	0.00	1.27

STYLE 1:
PIN 1. CATHODE
2. N/A
3. ANODE
4. CATHODE

STYLE 2:
PIN 1. ANODE
2. N/A
3. CATHODE
4. ANODE

CASE 221B-03
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.621	0.629	15.78	15 97
B	0.394	0.402	10 01	10 21
C	0 181	0.189	4.60	4.80
D	0.026	0.034	0 67	0 86
F	0.121	0.129	3 08	3 27
G	0.100 BSC		2 54 BSC	
H	0.123	0.129	3 13	3.27
J	0.018	0.025	0 46	0 64
K	0.500	0.562	12 70	14.27
L	0.045	0.060	1.14	1.52
N	0.200 BSC		5 08 BSC	
Q	0 126	0 134	3 21	3.40
R	0.107	0.111	2 72	2.81
S	0.096	0.104	2 44	2.64
U	0.259	0 267	6 58	6.78

STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE

STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

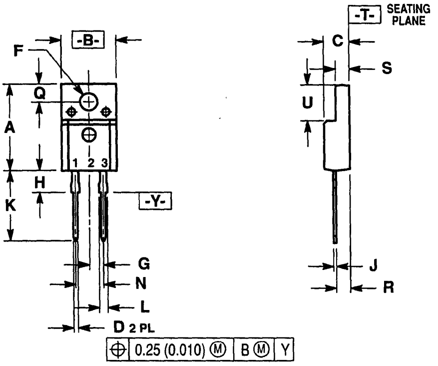
STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE

STYLE 4:
PIN 1. CATHODE
2. ANODE
3. CATHODE

STYLE 5:
PIN 1. CATHODE
2. ANODE
3 GATE

STYLE 6:
PIN 1. MT 1
2. MT 2
3. GATE

CASE 221D–02
ISSUE D

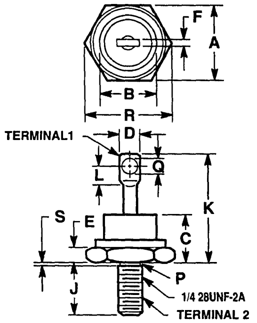


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.621	0.629	15.78	15.97
B	0.394	0.402	10.01	10.21
C	0.181	0.189	4.60	4 80
D	0.026	0.034	0.67	0.86
F	0.121	0.129	3.08	3.27
G	0.100 BSC		2.54 BSC	
H	0.123	0.129	3.13	3.27
J	0.018	0.025	0.46	0.64
K	0.500	0 562	12.70	14.27
L	0.045	0.060	1.14	1.52
N	0.200 BSC		5.08 BSC	
Q	0.126	0.134	3.21	3.40
R	0.107	0.111	2.72	2.81
S	0.096	0.104	2.44	2.64
U	0.259	0.267	6.58	6.78

STYLE 1:
PIN 1. CATHODE
2. N/A
3. ANODE

CASE 221E-01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. DIMENSION P IS A DIAMETER.
3. CHAMFER OR UNDERCUT ON ONE OR BOTH ENDS OF HEXAGONAL BASE IS OPTIONAL.
4. ANGULAR ORIENTATION AND CONTOUR OF TERMINAL ONE IS OPTIONAL.
5. THREADS ARE PLATED.

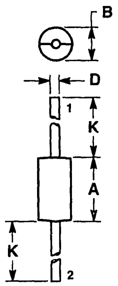
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	16.94	17.45	0.669	0.687
B	—	16.94	—	0.667
C	—	11.43	—	0.450
D	—	9.53	—	0.375
E	2.92	5.08	0.115	0.200
F	—	2.03	—	0.080
J	10.72	11.51	0.422	0.453
K	—	25.40	—	1.000
L	3.86	—	0.156	—
P	5.59	6 32	0.220	0.249
Q	3.56	4.45	0.140	0.175
R	—	20.16	—	0.794
S	—	2.26	—	0.089

STYLE 1:
TERMINAL 1. CATHODE
2. ANODE (CASE)

STYLE 2:
TERMINAL 1. ANODE
2 CATHODE (CASE)

CASE 257-01
ISSUE B

9

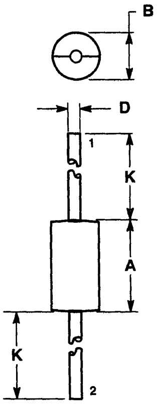


NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	—	0.370	—	9.39
B	—	0.250	—	6.35
D	0.048	0.052	1.22	1.32
K	1.000	—	25.40	—

STYLE 1:
PIN 1. CATHODE
2. ANODE

CASE 267-02
ISSUE B



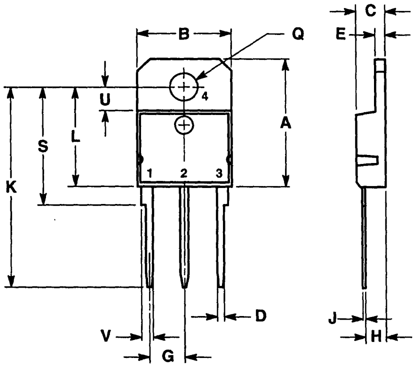
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.370	0.380	9.40	9.65
B	0.190	0.210	4.83	5.33
D	0.048	0.052	1.22	1.32
K	1.000	—	25.40	—

STYLE 1:
PIN 1. CATHODE
2. ANODE

CASE 267-03
ISSUE C

9



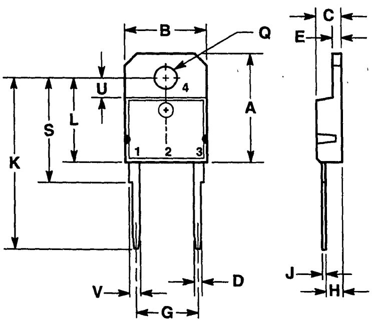
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.00	19.60	0.749	0.771
B	14.00	14.50	0.551	0.570
C	4.20	4.70	0.165	0.185
D	1.00	1.30	0.040	0.051
E	1.45	1.65	0.058	0.064
G	5.21	5.72	0.206	0.225
H	2.60	3.00	0.103	0.118
J	0.40	0.60	0 016	0.023
K	28.50	32.00	1.123	1.259
L	14.70	15.30	0.579	0.602
Q	4.00	4.25	0.158	0.167
S	17.50	18.10	0.689	0.712
U	3.40	3.80	0.134	0.149
V	1.50	2.00	0.060	0.078

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

CASE 340D-01
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982
2. CONTROLLING DIMENSION: MILLIMETER.

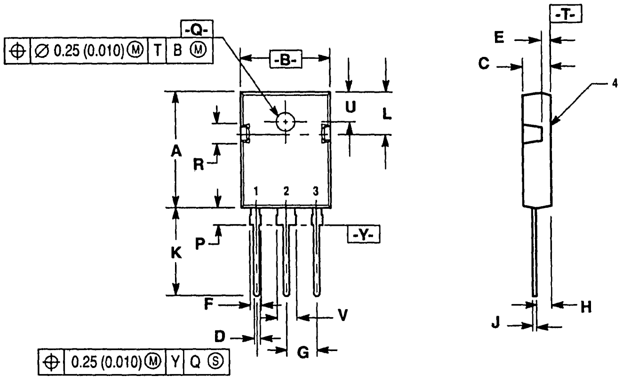
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.00	19.60	0.749	0.771
B	14.00	14.50	0.551	0.570
C	4.20	5.00	0.165	0.196
D	1.00	1.30	0.040	0.051
E	1.45	1.65	0.058	0.064
G	10.42	11.44	0.411	0.450
H	2.60	3.00	0.103	0.118
J	0.40	0.60	0.016	0.023
K	28.50	32.00	1.123	1.259
L	14.70	15.30	0.579	0.602
Q	4.00	4.25	0.158	0.167
S	17.50	19.50	0.689	0.767
U	3.40	3.80	0.134	0.149
V	1.50	2.00	0.060	0.078

STYLE 1:
PIN 1. CATHODE
3. ANODE
4. CATHODE

CASE 340E-01
ISSUE O

9

PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



NOTES:
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
5. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	20.40	20 90	0 803	0.823
B	15.44	15.95	0.608	0 628
C	4.70	5.21	0.185	0 205
D	1 09	1.30	0.043	0.051
E	1.50	1.63	0.059	0 064
F	1.80	2.18	0.071	0 086
G	5.45 BSC		0.215 BSC	
H	2.56	2.87	0.101	0 113
J	0.48	0.68	0.019	0.027
K	15.57	16.08	0.613	0 633
L	7.26	7.50	0.286	0 295
P	3.10	3.38	0 122	0.133
Q	3.50	3 70	0.138	0.145
R	3.30	3.80	0.130	0.150
U	5.30 BSC		0.209 BSC	
V	3.05	3.40	0.120	0.134

STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 2:
PIN 1. ANODE 1
2. CATHODE(S)
3. ANODE 2
4. CATHODE(S)

STYLE 3:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 4:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 340F–03
ISSUE E

9

MAXIMUM MECHANICAL RATINGS

Terminal Penetration:	0.235 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:	30–40 in-lb max
Mounting Torque — Center Hole:	8–10 in-lb max
Seating Plane Flatness	1 mil per in. (between mounting holes)

POWERTAP MECHANICAL DATA APPLIES OVER OPERATING TEMPERATURE

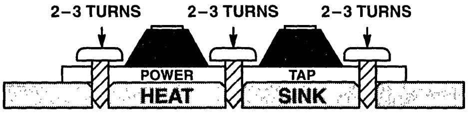
Vertical Pull 250 lbs max **2 in. Lever Pull 50 lbs max**

Note: While the POWERTAP is capable of sustaining these vertical and levered tensions, the intimate contact between POWERTAP and heat sink may be lost. This could lead to thermal runaway. The use of very flexible leads is recommended for the anode connections. Use of thermal grease is highly recommended.

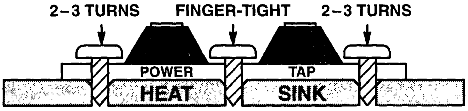
MOUNTING PROCEDURE

The POWERTAP package requires special mounting considerations because of the long longitudinal axis of the copper heat sink. It is important to follow the proper tightening sequence to avoid warping the heat sink, which can reduce thermal contact between the POWERTAP and heat sink.

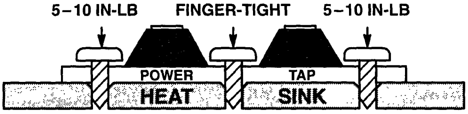
STEP 1:
Locate the POWERTAP on the heat sink and start mounting bolts into the threads by hand (2 or 3 turns).



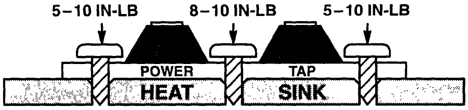
STEP 2:
Finger tighten the center bolt. The bolt may catch on the threads of the heat sink so it is important to make sure the face of the bolt or washer is in contact with the surface of the POWERTAP.



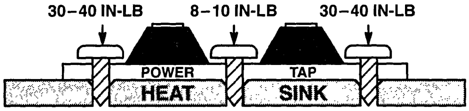
STEP 3:
Tighten each of the end bolts between 5 to 10 in-lb.

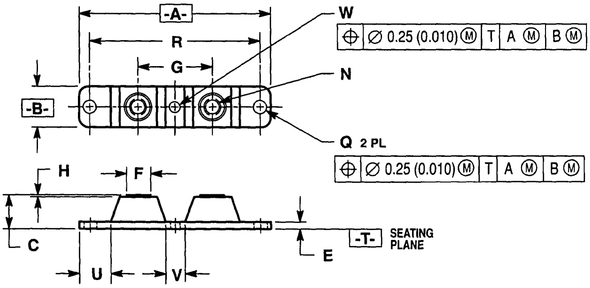


STEP 4:
Tighten the center bolt between 8 to 10 in-lb.



STEP 5:
Finally, tighten the end bolts between 30 to 40 in-lb.



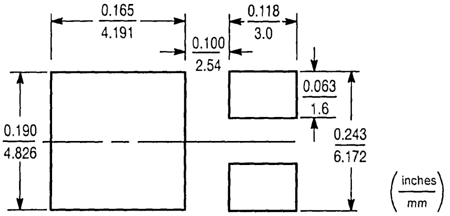


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. TERMINAL PENETRATION: 5.97 (0.235) MAXIMUM.

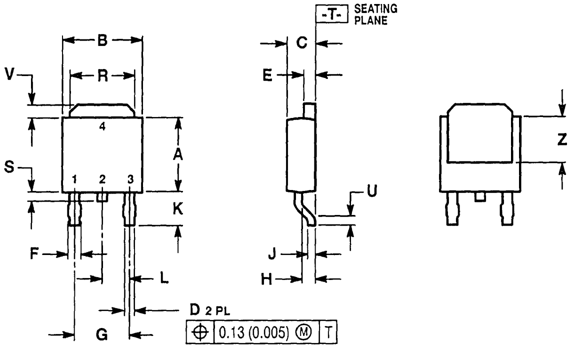
DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	3 450	3.635	87.63	92.33
B	0.700	0.810	17.78	20 57
C	0 615	0.640	15.53	16.26
E	0.120	0 130	3 05	3.30
F	0.435	0.445	11.05	11.30
G	1.370	1.380	34 80	35.05
H	0.007	0.030	0.18	0.76
N	1/4–20UNC 2B		1/4–20UNC 2B	
Q	0 270	0 285	6.86	7.32
R	31.50 BSC		80.01 BSC	
U	0 600	0 630	15.24	16 00
V	0.330	0.375	8.39	9.52
W	0.170	0.190	4.32	4 82

CASE 357C–03
ISSUE C

9



DPAK FOOTPRINT



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.250	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.033	0.040	0.84	1.01
F	0.037	0.047	0.94	1.19
G	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
R	0.175	0.215	4.45	5.46
S	0.020	0.050	0.51	1.27
U	0.020	—	0.51	—
V	0.030	0.050	0.77	1.27
Z	0.138	—	3.51	—

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

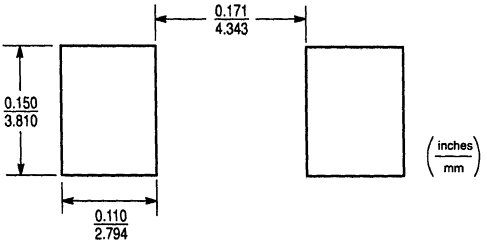
STYLE 3:
PIN 1. ANODE
2. N/A
3. ANODE
4. CATHODE

STYLE 4:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

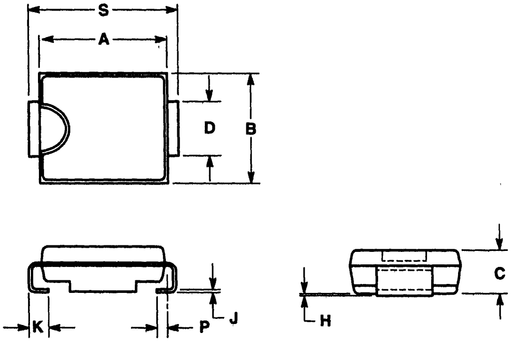
STYLE 5:
PIN 1. GATE
2. ANODE
3. CATHODE
4. ANODE

CASE 369A-13
(DPAK)
ISSUE W

9



SMC FOOTPRINT

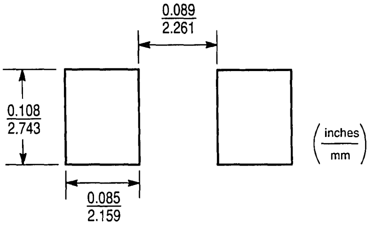


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.

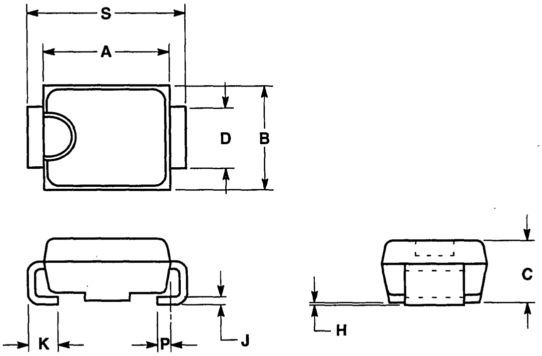
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.260	0.280	6.60	7.11
B	0.220	0.240	5.59	6.10
C	0.075	0.095	1.90	2.41
D	0.115	0.121	2.92	3.07
H	0.0020	0.0060	0.051	0.152
J	0.006	0.012	0.15	0.30
K	0.030	0.050	0.76	1.27
P	0.020 REF		0.51 REF	
S	0.305	0.320	7.75	8.13

CASE 403-03
(SMC)
ISSUE B

9



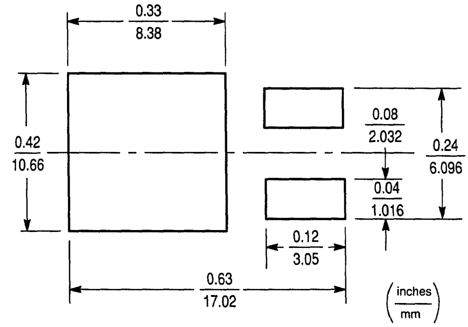
**SMB
FOOTPRINT**



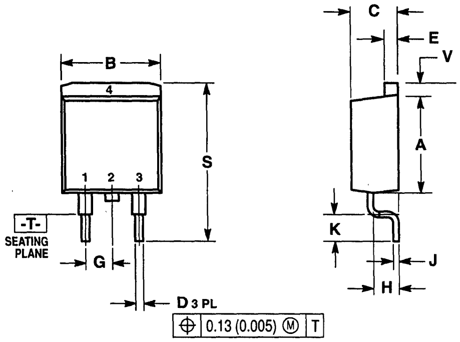
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.160	0.180	4.06	4.57
B	0.130	0.150	3.30	3.81
C	0.075	0.095	1.90	2.41
D	0.077	0.083	1.96	2.11
H	0.0020	0.0060	0.051	0.152
J	0.006	0.012	0.15	0.30
K	0.030	0.050	0.76	1.27
P	0.020 REF		0.51 REF	
S	0.205	0.220	5.21	5.59

**CASE 403A-03
(SMB)
ISSUE B**



D^2PAK
FOOTPRINT



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0 035	0.51	0.89
E	0.045	0.055	1.14	1 40
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0 090	0.110	2 29	2.79
S	0.575	0.625	14.60	15 88
V	0.045	0.055	1.14	1.40

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

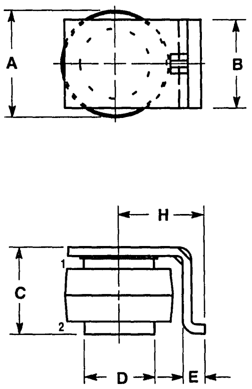
STYLE 2:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 3:
PIN 1. ANODE
2. N/A
3. ANODE
4. CATHODE

CASE 418B-02
D^2PAK
ISSUE B

9

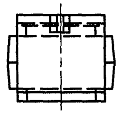
PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



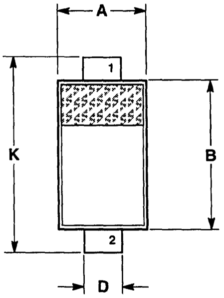
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

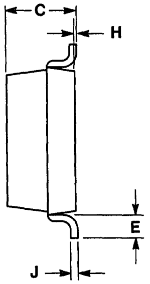
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0 330	0 342	8.38	8.69
B	0.270	0.090	6 86	7.37
C	0 275	0 290	6.98	7.37
D	0.218	0.223	5.54	5.66
E	0 060	0.080	1 52	2.03
H	0.255	0.275	6.48	6.98

STYLE 1:
PIN 1. CATHODE
2. ANODE



CASE 421A–01
ISSUE O





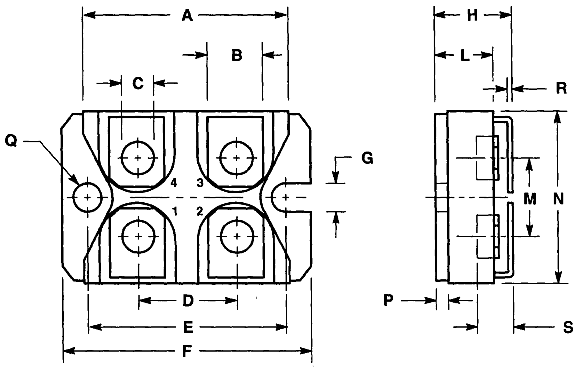
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.055	0.071	1.40	1.80
B	0.100	0.112	2.55	2.85
C	0.037	0.053	0 95	1.35
D	0.020	0 028	0 50	0.70
E	0.010	—	0 25	—
H	0.000	0 004	0 00	0.10
J	—	0 006	—	0.15
K	0.140	0.152	3 55	3 85

STYLE 1:
PIN 1. CATHODE
2. ANODE

CASE 425-04
(SOD–123)
ISSUE C

9



Recommended screw torque: 1.3 ± 0.2 Nm
Maximum screw torque: 1.5 Nm

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14 5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	31.50	31.70	1.240	1.248
B	7.80	8 20	0.307	0.322
C	4.10	4.30	0 161	0.169
D	14.90	15.10	0.586	0.590
E	30 10	30.30	1 185	1.193
F	38.00	38 20	1.496	1.503
G	4 00	—	0.157	—
H	11.80	12 20	0.464	0.480
L	8 90	9.10	0.350	0 358
M	12.60	12.80	0.496	0.503
N	25.20	25 40	0.992	1 000
P	1.95	2.05	0.076	0.080
Q	4 10	—	0.157	—
R	0.75	0.85	0.030	0.033
S	5 50	—	0 217	—

STYLE 1:
PIN 3. SOURCE
4. GATE
5. DRAIN
6. SOURCE 2

STYLE 2.
PIN 1. CATHODE 1
2. ANODE 1
3. ANODE 2
4. CATHODE 2

STYLE 3:
PIN 1. CATHODE 1
2. ANODE 2
3. CATHODE 2
4 ANODE 1

SOT-227B

9

Section 10

AR598: Avalanche Capability of Today's Power Semiconductors

10

AVALANCHE CAPABILITY OF TODAY'S POWER SEMICONDUCTORS

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MOTOROLA Semiconductors, France, USA*
Paper published at the EPE Conference '93, Brighton 9/93.

Abstract. Power semiconductors are used to switch high currents in fractions of a second and therefore belong inherently to a world of voltage spikes. To avoid unnecessary breakdown voltage guardbands, new generations of semiconductors are now avalanche rugged and characterized in avalanche energy.

This characterization is often far from application conditions and thus quite useless to the designer. It is easy to verify that an energy rating is not the best approach to a ruggedness quantification because of avalanche energy fluctuations with test conditions.

A physical and thermal analysis of the failure mechanisms leads to a new characterization method generating easy–to–use data for safe designs. The short–term avalanche capability will be discussed with an insight of the different technologies developed to meet these new ruggedness requirements.

Keywords. Avalanche, breakdown, unclamped inductive switching energy, safe operating areas.

INTRODUCTION

One obvious trend for new power electronic designs is to work at very high switching frequencies in order to reduce the volume and weight of all the capacitive and inductive elements. The consequence is that most applications today require switching very high currents in fractions of a microsecond and therefore generate L x dI/dt voltage spikes due to parasitic inductance. Unfortunately these undesirable voltage levels sometimes reach the breakdown voltage of power semiconductors that are not intended to be used in avalanche.

The necessity for avalanche rugged power semiconductors has clearly been perceived by many semiconductor manufacturers who have come up with avalanche–energy rated devices.

This paper will show the limits of an energy–based characterization model. It will concentrate on three different devices: Ultra Fast recovery Rectifiers, Schottky Barrier Rectifiers and MOSFETs. It will study their main failure mechanisms and show the technological improvements that guarantee an enhanced ruggedness.

This will lead to a new characterization that will help the designer choose correctly between overall cost and reliability.

LIMITS OF AN AVALANCHE ENERGY CHARACTERIZATION

Practically all the characterizations are based on the following Unclamped Inductive Switching (UIS) test circuit (fig 1) :

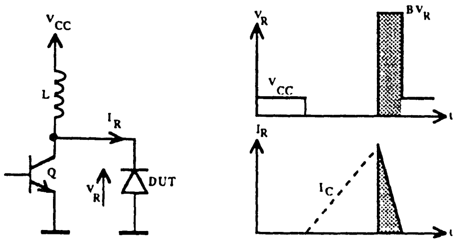

Figure 1. Standard UIS Characterization Circuit.

The energy is first stored in inductor L by turning on transistor Q for a period of time proportional to the peak current desired in the inductor. When Q is turned off, the inductor reverses its voltage and avalanches the Device Under Test until all its energy is transferred. The DUT can be a rectifier or a MOSFET (the gate should always be shorted to the source).

The standard characterization method consists in increasing the peak current in the inductor until the device fails. The energy that the device can sustain without failing becomes a figure of merit of the ruggedness to avalanche :

$$Waval = 1/2\ L\ I_{peak}^2\ BV_{(DUT)} / (BV_{(DUT)} - V_{CC}) \quad [1]$$

The main limit of this method is that the energy level that causes a failure in the DUT is not a constant but a function of L and Vcc. This results of the fact that the avalanche duration is function of the current decay slope $(BV_{(DUT)}-V_{CC})/L$:

Table 1. Peak Current and Energy Causing Failures in a 1A, 1000V Ultra Fast Recovery Rectifier.

Inductor Value :	10mH	50mH	100mH
Peak Current :	1.7A	0.9A	0.8A
Energy :	14mJ	20mJ	32mJ

Table 1 indicates that the failure is not caused by an energy (i.e. it is not independent of the avalanche duration) but rather by a current level that has to be derated versus time : the devices can sustain a low current for a long period of time (high energy) but at high avalanche currents they will fail after a few microseconds (low energy).

Therefore, unless the designer has a parasitic inductance of value L in his circuit, the standard characterization data will be useless, or worse, it might lead to an overestimate of the ruggedness of his application : because parasitic inductances are often an order of magnitude less than the test circuit inductance, the expected energy capability leads to excessive current levels.

The UIS test circuit is very easy to implement : the only important point is that the transistor has to have a breakdown voltage higher than the DUT. For low breakdown voltage devices, a MOSFET might be preferred to the bipolar transistor.

The advantages of using a MOSFET are multiple : it is a more rugged device, it is much easier to drive and its switching characteristics can be controlled by adding a resistor in series with the gate. It is mandatory to limit this switching speed to avoid having an avalanche energy measurement dependent on the gate drive (i.e. gate resistor and gate to source voltage values).

Anyhow, it is possible to generate very useful information with this UIS test circuit by varying the inductor value. It is also very important to present the data independently of the values of Vcc and L. One solution can be to plot the maximum peak current versus the avalanche duration (fig 2) :

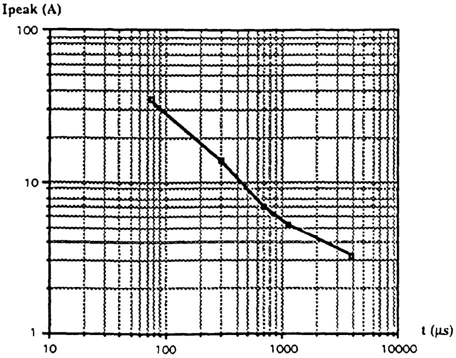

Figure 2. Maximum Peak Current versus Avalanche Duration for a 15A, 60V MOSFET in an UIS Test Circuit.

The advantage of this new graph is that the designer can easily calculate the safety margin of his application and he will not be mislead by an energy value that depends on too many different parameters. If he knows the value of the parasitic inductance in his circuit he will be able to determine its maximum peak current.

For instance, let us assume that the designer uses the 15A, 60V MOSFET characterized in figure 2. This device sustains 500mJ with an inductor of 75mH according to equation [1]. Its typical breakdown voltage is 80V.

If the supply voltage Vdd is 12V and the parasitic inductance L is 250μH, then the avalanche duration and maximum peak current are related by

$$I_{peak} = t\,(BV_{DSS} - V_{DD}) / L \qquad [2]$$

This relationship can be added to figure 2 (see fig 3) :

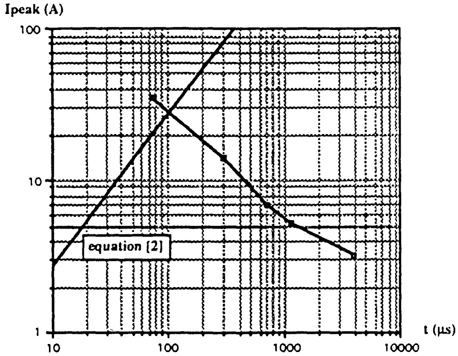

Figure 3. figure 2 + equation [2].

Thus the maximum peak current that can flow through the parasitic inductance L is approximately 28A instead of 58A that would have resulted of using equation [1].

UNDERSTANDING THE FAILURE MECHANISMS

Physical Approach

The following microscope photographs show the failure locations for an Ultra Fast Recovery Rectifier (UFR), a Schottky Barrier Rectifier (SBR) and a MOSFET :

Figure 4. 4A, 1000V UFR Avalanche Failure.

10

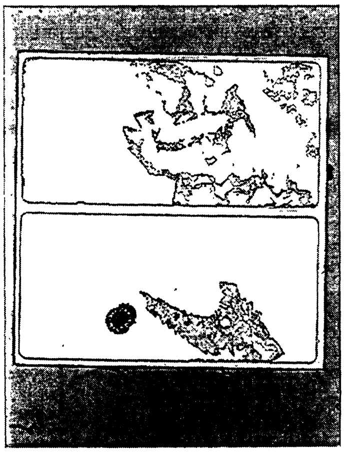

Figure 5. 25A, 35V SBR Avalanche Failure.

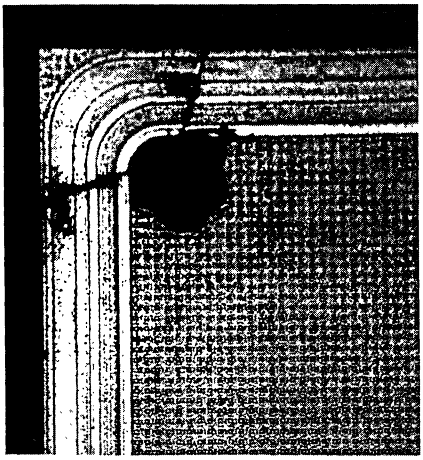

Figure 6. 20A, 500V MOSFET Avalanche Failure.

These photographs show that the failure is generally a punchthrough. The melt–through hole dimensions depend on the current level and avalanche duration.

A close look at the electrical characteristics of failed rectifiers on a curve tracer show three levels of degradation : low stressed diodes have a normal forward characteristic but show an unusual leakage current before entering breakdown as if they had a high–value resistor in parallel : this resistance can be explained by a small punchthrough. For medium degradation levels, the value of this pseudo–resistance decreases and becomes visible in the forward characteristic of the diode. Finally, when the punchthrough reaches considerable dimensions, the device looks very similar to a low value resistor.

The failure does not always appear in the same region of the die. For instance, high voltage UFRs have their punchthrough always located in a corner, MOSFETs often fail in the corners or on the sides whereas SBRs have randomly located failures.

Thermal Approach

Transient thermal response graphs generated by a standard ΔV_{DS} method show the junction temperature evolution for forward and avalanche constant current conduction in a MOSFET. These graphs (fig 7) prove that the silicon efficiency during avalanche and forward currents are similar.

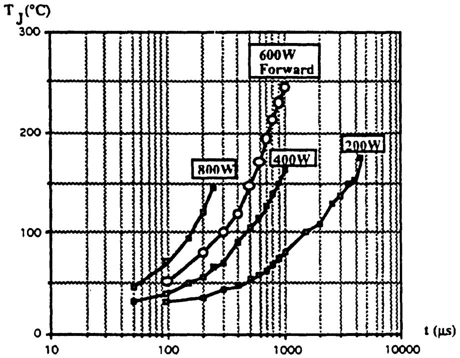

Figure 7. 15A, 60V MOSFET Transient Thermal Response for 800W, 400W, 200W Avalanche and 600W Forward Conduction.

Figure 7 can be used to generate a transient thermal resistance graph by plotting the temperature divided by the power : the four graphs should then normally match. Some slight differences show that the transient thermal resistance increases with the current level : i.e. the 800W curve (10A constant avalanche current) has a higher transient thermal resistance than the 200W (2.5A). Therefore the thermal efficiency in a MOSFET is not perfectly homogeneous versus the avalanche current.

A similar analysis on an UFR or an SBR shows poor thermal efficiency in avalanche. This can be shown by comparing the temperature rise after 1ms for forward and avalanche conduction pulses of same power (400W) :

MOSFET	ΔT_{direct}=160°C	$\Delta T_{avalanche}$=180°C	ratio=0.9
UFR	ΔT_{direct}=120°C	$\Delta T_{avalanche}$=175°C	ratio=0.7
SBR	ΔT_{direct}=100°C	$\Delta T_{avalanche}$=150°C	ratio=0.7

Electrical Approach

Considering the transient thermal responses of a device, it is possible to simulate the instantaneous junction temperature for any sort of power pulse.

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Conducting this simulation on the data generated by the UIS test it is possible to show that all the parts fail when they reach a "critical temperature" (fig 8) :

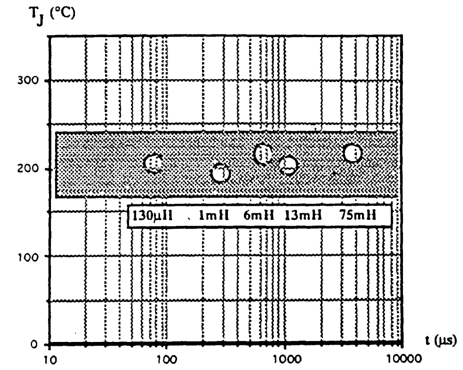

Figure 8. 15A, 60V MOSFET Failure Points and Critical Temperature for different Inductor Values.

At these critical temperatures the intrinsic carrier concentration, ni, reaches levels close to those of the doping concentrations :

ni is proportional to $T^{3/2} e^{-Eg/2kT}$ [3]

where T is the absolute temperature, Eg the energy bandgap and k is Boltzmann's constant.

At 200°C, ni exceeds 2 10^{14} cm^{-3} which corresponds to a 1000V material epitaxy concentration level. This means that when the junction temperature reaches 300°C, the rectifier looks more like a resistor than a diode. A local thermal runaway then generates a hot spot and a punchthrough as can be seen in figures 4, 5 and 6.

This failure analysis has shown that the failure mechanism is essentially thermal : the devices are heated by the BV_R x I_R power dissipation. Unfortunately, this power does not remain constant because the UIS circuit generates a linear current decay and also the breakdown voltage varies with the current level and with the junction temperature.

In order to have a complete characterization of the device it is interesting to see how it reacts to a constant avalanche current and different ambient temperatures.

NEW CHARACTERIZATION METHOD PROPOSAL

During the prototype phase, it is easier for the designer to measure the avalanche current and duration than the circuit's parasitic inductance. Therefore, the characterization should be based on easy to measure parameters. The failure analysis proves that the main cause of degradation is the inability to handle an excessive power (avalanche current I_R multiplied by breakdown voltage BV_R). A proper characterization should present the maximum power capability versus time.

As the avalanche voltage varies only slightly with the current level, the proposed method is based on avalanching a device at a constant current and presenting the maximum current capability versus time :

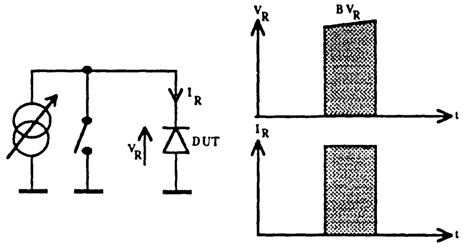

Figure 9. Constant Current Characterization Circuit.

Different test circuits similar to figure 9 have been proposed by Gauen (1) and Pshaenich (2). Some unexpected failures in MOSFETs suggest that the DUT should always be referenced to ground. Unlike UFRs and SBRs, MOSFETs react differently whether they are tied to ground or floating around a fluctuating voltage. Many floating transistors fail at very low stress levels probably due to capacitive coupled currents that turn–on the internal parasitic transistor.

The test circuit shown in figure 9 sets a constant avalanche current through the device until it fails, this duration can then be plotted for different current levels. This generates a graph similar to the UIS method, except that the current is constant instead of decreasing linearly.

This leads to the definition of a "Safe Avalanching Area" (fig 10) that will guarantee a short–term reliability if the device is used within this clearly defined area.

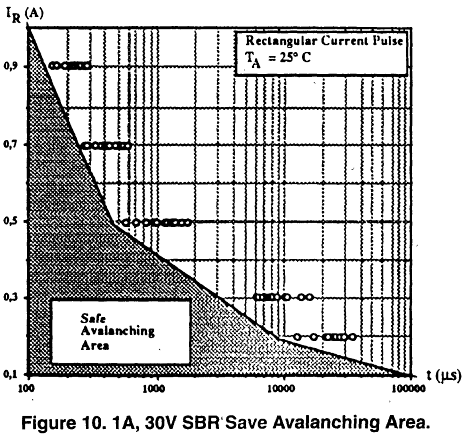

Figure 10. 1A, 30V SBR Save Avalanching Area.

This graph gives the maximum avalanche duration for any value of avalanche current.

The Safe Avalanching Area is generated by taking a safety margin from the failure points. Another approach would be to dynamically measure the temperature as in figure 7 and generate an area defined by a maximum allowable junction temperature.

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As the failure mechanism is related to a peak junction temperature, it is necessary to give Safe Avalanching Areas for different ambient temperatures (fig 11) :

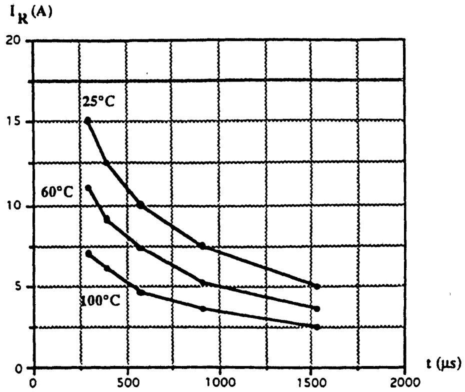

Figure 11. 25A, 35V SBR Safe Avalanching Areas for different ambient temperatures.

When the data in figures 10 and 11 is plotted on log/log axes instead of lin/log or lin/lin, an interesting feature appears (fig 12) :

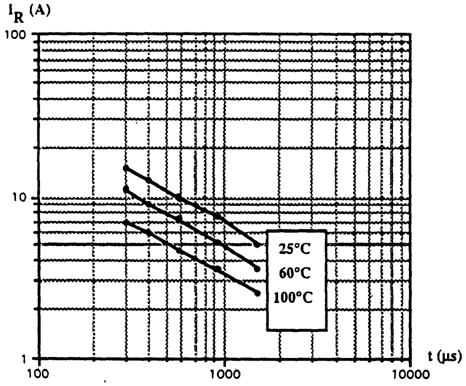

Figure 12. figure 12 on log/log axes.

Figure 12 shows a linear relationship between current and time on a log/log plot. This means that :

$$\log(I_R) = A \log(t) + B,$$
so
$$I_R = k\,T^A \qquad [4]$$

where k is a constant function of the die size, the breakdown voltage and other parameters. Constant A can be extracted from figure 12 and similar figures for UFRs and MOSFETs :

$$I_R = k\,T^{\mathbf{-0.55}} \qquad [5]$$

Relation [5] is a consequence of heat propagation laws which explain that the temperature in a semiconductor rises proportionally to t $^{0.5}$ (for a constant current pulse and as long as the temperature remains within the silicon die). This can be seen in any transient thermal resistance graph.

A standard thermal calculation shows that :

$$T_J = T_A + P_D\,Rth_{JA}(t),$$
or
$$P_D = (T_J - T_A) / Rth_{JA}(t) \qquad [6]$$

where :

T_J, T_A are the junction and ambient temperatures,
P_D is the power dissipation,
$Rth_{JA}(t)$ is the transient thermal resistance.

Given a constant power pulse and for values of t less than 1ms, [6] is equivalent to :

$$I_R\,B_{VR} = (T_J - T_A) / (\,k\,t^{0.5}\,)$$
so
$$I_R = k\,t^{-0.5} \qquad [7]$$

This relation is similar to [5]. For avalanche durations of less than 500µs the heat propagates within the silicon only. For longer durations the heat reaches the solder and the package so the propagation characteristics are modified . The devices heat faster or slower and therefore the I_R=f(t) slope changes. Empirical data shows that A in relation [4] remains within –0.5 to –0.6.

Relation [7] can also be expressed by :

$$I_R^2\,t = k \qquad \text{(k:constant)} \qquad [7bis]$$

This rule of thumb works out much better than the, unfortunately too common, 1/2 L I^2 law.

For example, when applied to the example following figure 2 (which is UIS and not Constant Current generated) to determine the maximum peak current in a 250µH inductor and by choosing for instance the 9A,500µs point, relation [7bis] can be written :

$$9A^2\ 500\mu s = Ipeak^2\ 100\mu s$$

This gives a conservative value of 20A instead of a real value of 28A whereas the 1/2 L I^2 method generates a catastrophic 58A value.

TECHNOLOGY TRADEOFFS

Ultra Fast Recovery Rectifiers

The UFR devices are based on a Mesa technology (fig 13) with a Phosphorus doped (n–type) substrate. The heavily doped N+ substrate is followed by a lighter N– epitaxial layer. The P+ is diffused into the epitaxy to form the P–N junction. The passivation follows the perimeter of the die.

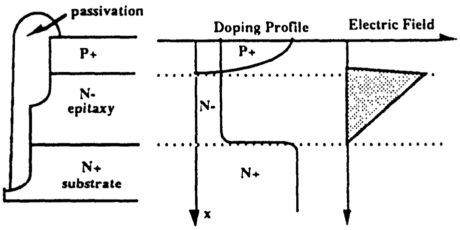

Figure 13. UFR Technology, Profile and Electric Field.

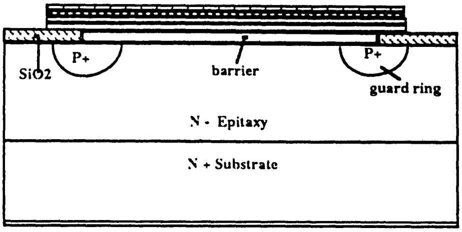

Figure 14. SBR Technology with P–N Guard Rings

The epitaxy characteristics determine the major electrical parameters of the device. A designed experiment was conducted varying the epitaxy thickness and resistivity. The output responses were the forward voltage, the breakdown voltage, the leakage current and the avalanche capability. A wide range of epitaxy materials was chosen to determine the general trends for all the effects.

Although the results were predictable for the static parameters, the avalanche capability results were not.

A key issue is the electric field extension. If it terminates before the substrate the avalanche capability increases by increasing the epitaxy resistivity. If the field extends into the N+ region (reach–through) the avalanche capability is considerably reduced.

The avalanche capability is proportional to the die size and not to the perimeter. This confirms that the avalanche current is vertical and not only a surface or passivation related phenomenon.

The failures always occur in the corners where the electric field is most critical. These failures are essentially function of the thermal characteristics of the device when conducting avalanche currents. Therefore the avalanche capability decreases when the ambient temperature increases and the failures can normally be predicted by Safe Avalanching Areas such as figure 12.

Some unexpected defects though can radically degrade the avalanche capability. Defects in the epi such as pipes cause premature failures but can often be screened by a leakage current test that eliminates soft breakdown devices. Defects in the passivation can generate parasitic oscillations during breakdown.

Schottky Rectifiers

Due to P–N junction guard rings, SBR devices are very similar to UFRs when conducting avalanche currents. These rectifiers have very low breakdown voltages and therefore very thin epitaxy layers. This probably explains that the avalanche–related failures occur anywhere on the die surface : the thin N– region is relatively more heterogeneous with respect to avalanche capability and thermal dissipation than a thick UFR epitaxy.

MOSFETs

MOSFETs can also be compared to UFRs as long as the internal parasitic bipolar transistor (due to the P–tub) does not turn–on. The latest MOSFET generations reduce the P–resistance to avoid biasing this NPN.

While analyzing different constant current test circuits, it appeared that devices used in a floating configuration can have very poor avalanche capabilities.

Due to their cellular technology, MOSFETs conduct very efficiently avalanche currents. They can sustain avalanche power levels close to those of forward conduction ratings.

CONCLUSION

The necessity of characterizing the avalanche capability of power semiconductors has been explained. An analysis of the standard UIS test circuit has shown the limits of a characterization based on energy ratings. Throughout a discussion of the main failure mechanisms, a new thermal approach has been proposed to help designers set safety levels in their designs. This paper sets new standards for characterizing avalanche ruggedness.

Acknowledgements

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