PROTECTION DEVICES

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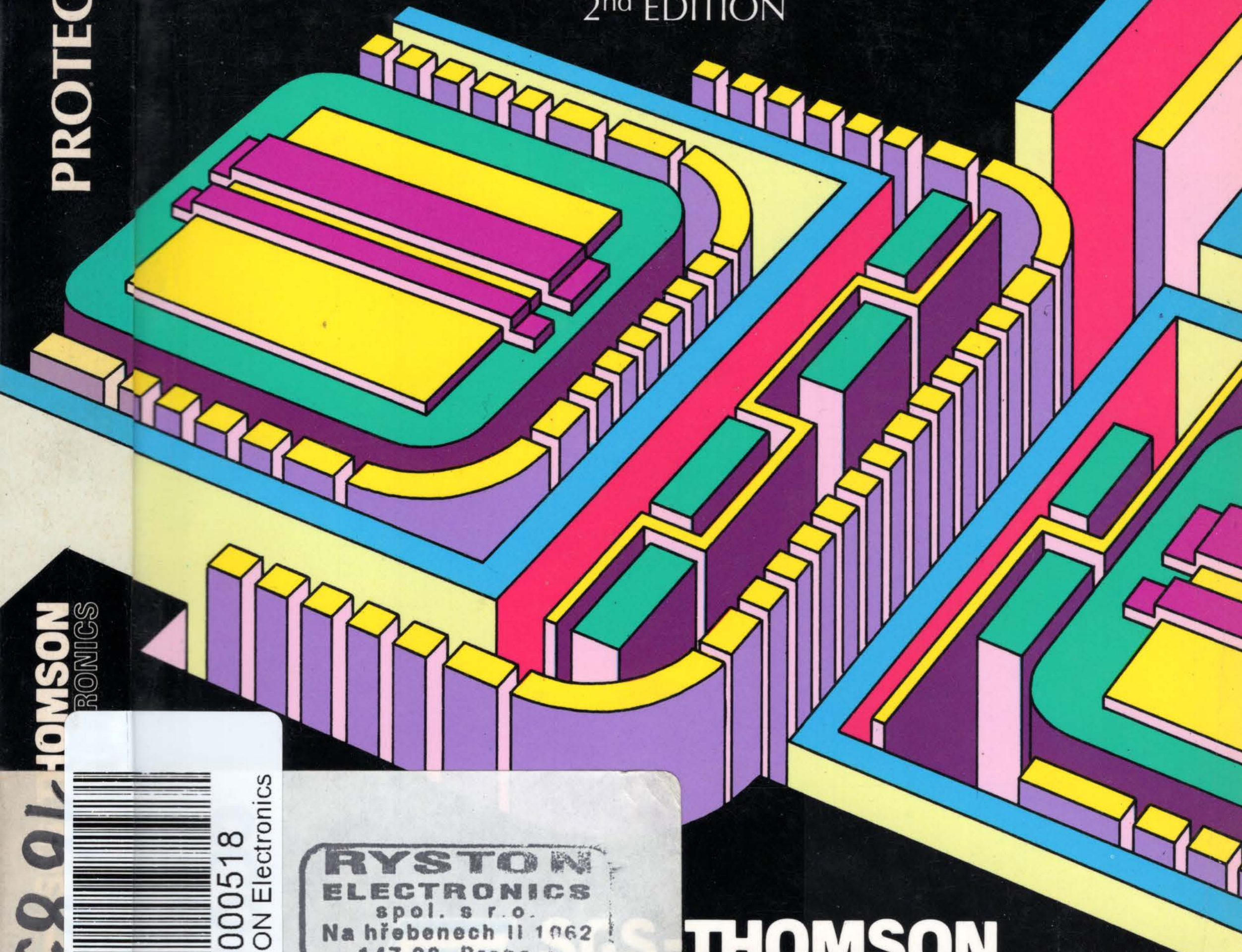
DATABOOK

2nd EDITION



SGS-THOMSON
MICROELECTRONICS

PROTECTION DEVICES

DATABOOK

2nd EDITION

FKS LEVEL s.r.o.
Ohradní 24, 145 00 Praha 4

MARCH 1993

USE IN LIFE SUPPORT DEVICES OR SYSTEMS MUST BE EXPRESSLY AUTHORIZED

SGS-THOMSON PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF SGS-THOMSON Microelectronics. As used herein:

1. Life support devices or systems are those which (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided with the product, can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can reasonably be expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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ALPHANUMERICAL INDEX

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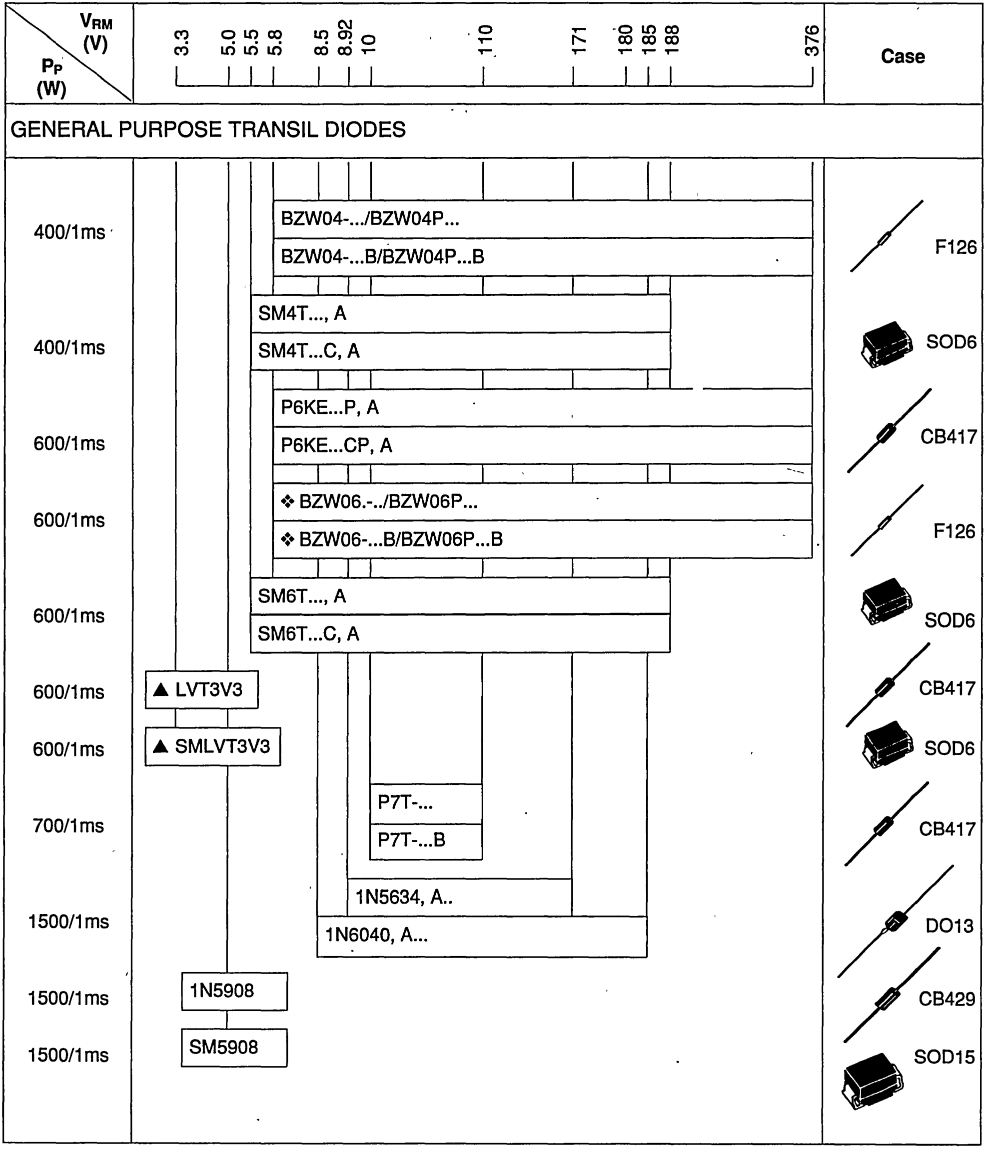
SELECTION GUIDE

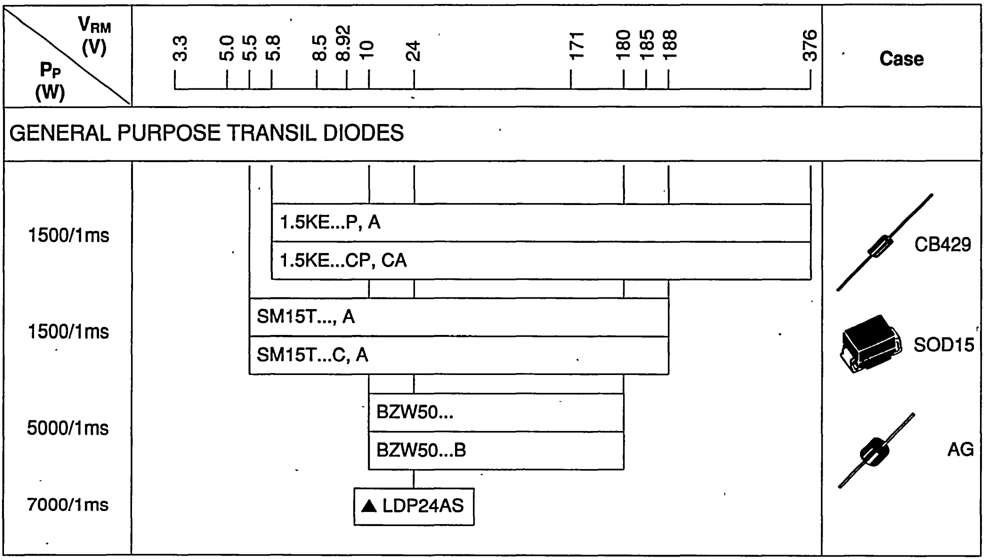
C	Capacitance
C_o	Junction capacitance (Transil)
dv/dt	Critical rate of rise of off-state voltage (Trisil)
f, F	Frequency
$I_{(BO)}$	Breakover current (Trisil)
I_{FM}	Peak forward current
I_{FSM}	Surge non repetitive forward current (Transil)
I_{GN}	Firing gate N current (Trisil)
I_{GP}	Firing gate P current (Trisil)
I_H	Continuous holding current (Trisil)
I_{PP}	Surge non repetitive reverse current
I_R	Continuous reverse current
I_{RM}	Peak reverse current
I_T	On-state current
I_{TSM}	Surge non repetitive on-state current (Trisil)
P	Power dissipation
P_p	Peak pulse power
P_{tot}	Total power dissipation
R_{th}	Thermal resistance
T_{amb}	Ambient temperature
T_{case}	Case temperature
T_j	Junction temperature
T_L	Maximum lead temperature for soldering
T_{oper}	Operating temperature (at zero dissipation)
t_P	Pulse width
T_{stg}	Storage temperature
$V_{(BO)}$	Breakover voltage (Trisil)
$V_{(BR)}$	Breakdown voltage
$V_{(CL)}$	Clamping voltage
V_{DRM}	Repetitive peak off-state voltage (Transil)
V_F	Forward voltage
V_{FM}	Forward transient voltage
V_{GN}	Gate voltage (Trisil)
V_R	Continuous reverse voltage
V_{RGN}	Reverse gate N voltage (Trisil)
V_{RM}	Maximum recommended stand-off voltage
V_T	On-state voltage
Z_{th}	Thermal impedance
αT	Temperature coefficient of $V_{(BR)}$ (Transil)
δ	Duty cycle of pulse

TRANSIENT VOLTAGE SUPPRESSOR "TRANSIL™"

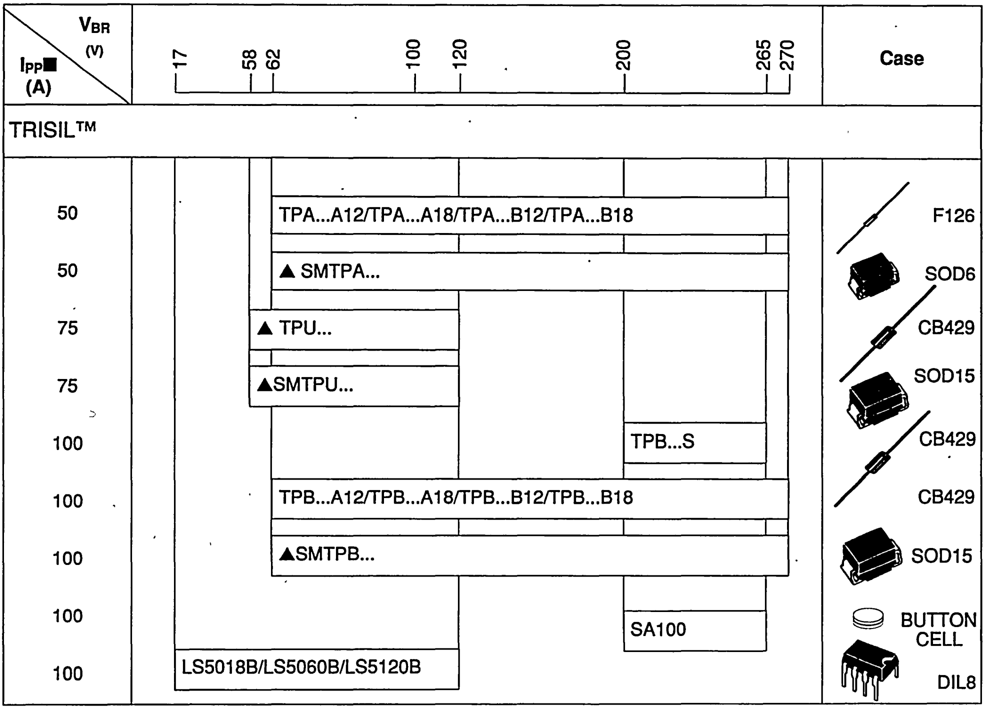


PP (W)	VRM (V)	Case
GENERAL PURPOSE TRANSIL DIODES		
400/1ms	BZW04-.../BZW04P... BZW04-...B/BZW04P...B	F126
400/1ms	SM4T..., A SM4T...C, A	SOD6
600/1ms	P6KE...P, A P6KE...CP, A	CB417
600/1ms	❖ BZW06.-../BZW06P... ❖ BZW06-...B/BZW06P...B	F126
600/1ms	SM6T..., A SM6T...C, A	SOD6
600/1ms	▲ LVT3V3	CB417
600/1ms	▲ SMLVT3V3	SOD6
700/1ms	P7T-... P7T-...B	CB417
1500/1ms	1N5634, A.. 1N6040, A...	DO13
1500/1ms	1N5908	CB429
1500/1ms	SM5908	SOD15

☐ UNIDIRECTIONAL ☐ BIDIRECTIONAL ▲ NEW ❖ Non preferred devices

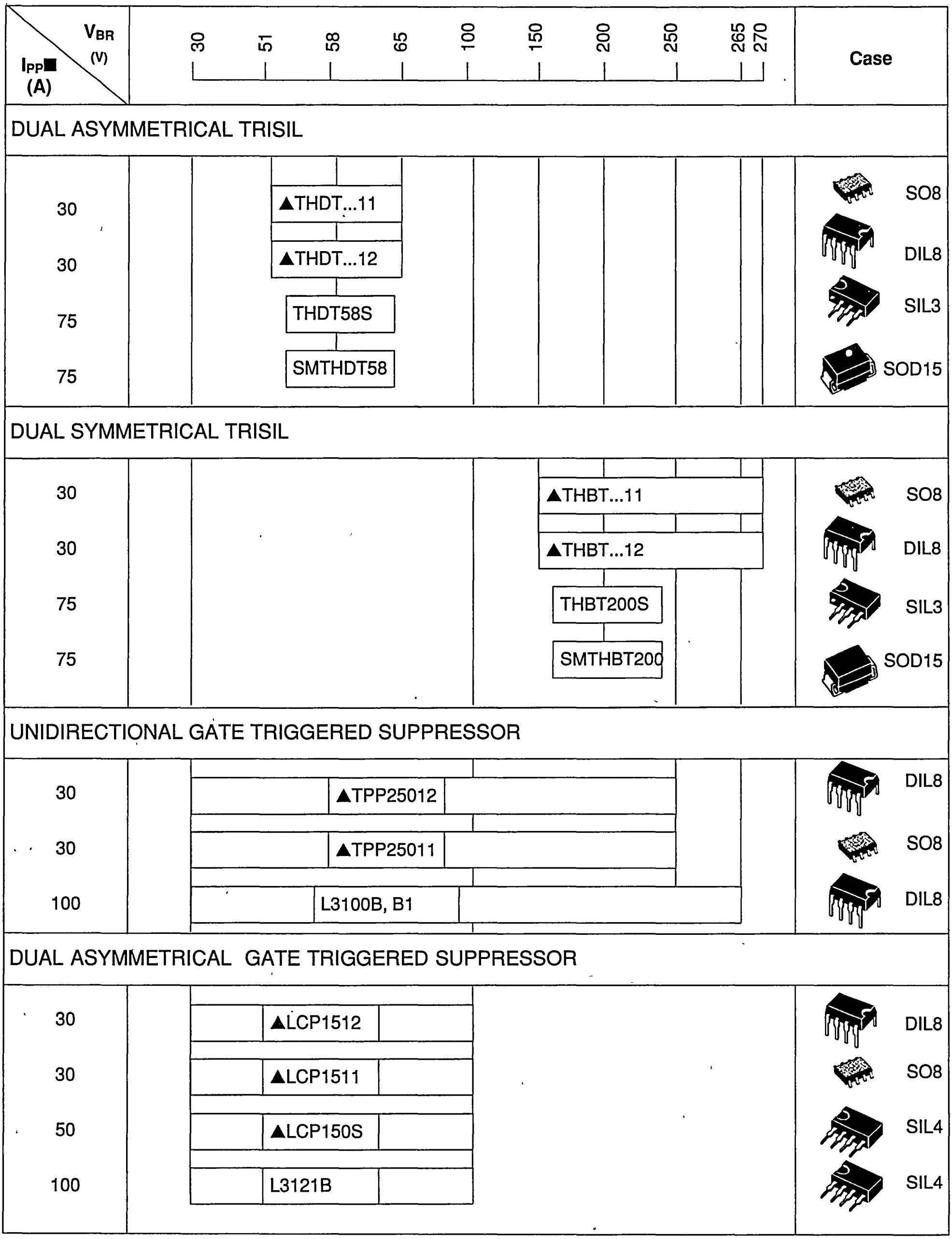


TELECOMUNICATIONS PROTECTION



▲NEW ■For 10-1000µs exponential wave

SELECTOR GUIDE



I_{PP}■ (A)	V_{BR} (V): 30, 51, 58, 65, 100, 150, 200, 250, 265, 270	Case
DUAL ASYMMETRICAL TRISIL		
30	▲THDT...11	SO8
30	▲THDT...12	DIL8
75	THDT58S	SIL3
75	SMTHDT58	SOD15
DUAL SYMMETRICAL TRISIL		
30	▲THBT...11	SO8
30	▲THBT...12	DIL8
75	THBT200S	SIL3
75	SMTHBT200	SOD15
UNIDIRECTIONAL GATE TRIGGERED SUPPRESSOR		
30	▲TPP25012	DIL8
30	▲TPP25011	SO8
100	L3100B, B1	DIL8
DUAL ASYMMETRICAL GATE TRIGGERED SUPPRESSOR		
30	▲LCP1512	DIL8
30	▲LCP1511	SO8
50	▲LCP150S	SIL4
100	L3121B	SIL4

▲NEW ■For 10-1000µs exponential wave ☐ V_{BO} or V_{BR} programming range

COMPUTER PROTECTION

DEVICE	FUNCTION	MAIN PARAMETER VALUES	PACKAGE
POWER SUPPLY PROTECTION			
LVT3V3	UNIDIRECTIONAL TRANSIL	V_{RM} = 3.3 Volt	CB417
SMLVT3V3	UNIDIRECTIONAL TRANSIL	V_{RM} = 3.3 Volt	SOD6
1N5908	UNIDIRECTIONAL TRANSIL	V_{RM} = 5 Volt	CB429
SM5908	UNIDIRECTIONAL TRANSIL	V_{RM} = 5 Volt	SOD15
DATA LINE INTERFACE PROTECTION = TRANSIL ARRAYS			
ITA6V1U1	6 x UNIDIRECTIONAL TRANSIL	V_{BR} = 6.1 Volt	SO8
ITA6V1U3	8 x UNIDIRECTIONAL TRANSIL	V_{BR} = 6.1 Volt	SO20
ITA6V1M3	18 x UNIDIRECTIONAL TRANSIL	V_{BR} = 6.1 Volt	SO20
LCTA6V1M3	18 x UNIDIRECTIONAL TRANSIL (Low Capacitance)	V_{BR} = 6.1 Volt	SO20
ITA...B1	4 x BIDIRECTIONAL TRANSIL	V_{BR} = 6.1 V ⇒ 25 Volt	SO8
ITA...B3	8 x BIDIRECTIONAL TRANSIL	V_{BR} = 6.1 V ⇒ 25 Volt	SO20
ITA...B4 (1)	8 x BIDIRECTIONAL TRANSIL	V_{BR} = 6.1 V ⇒ 25 Volt	DIL20
HTAM1B4 (1)	8 x BIDIRECTIONAL TRANSIL	3 x V_{BR} = 25 Volt, 5 x V_{BR} = 25 Volt	DIL20

AUTOMOTIVE PROTECTION

DEVICE	FUNCTION	APPLICATION	MAIN PARAMETER VALUES	PACKAGE
PL360D	TRANSIL	IGNITION	V_{BR} = 360 Volt	F126
▲LDP24AS	TRANSIL	DECENTRALISED LOAD DUMP	V_{BR} = 24 Volt	AG
▲RBO...	DIODE + TRANSIL COMBINATION	REVERSED BATTERY AND OVERVOLTAGE	I_F = 8 A or I_F = 40 A	TO220AB

▲NEW (1) UNDER REQUEST.

CROSS REFERENCE

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
1N5635,A	1N5635,A
↓	↓
1N5665,A	1N5665,A
1N5908	1N5908
1N6042,A	1N6042,A
↓	↓
1N6072,A	1N6072,A
1N6103,A	P6KE6V8CP,CA
1N6104,A	P6KE7V5CP,CA
1N6105,A	P6KE8V2CP,CA
1N6106,A	P6KE9V1CP,CA
1N6107,A	P6KE10CP,CA
1N6108,A	P6KE11CP,CA
1N6109,A	P6KE12CP,CA
1N6110,A	P6KE13CP,CA
1N6111,A	P6KE15CP,CA
1N6112,A	P6KE16CP,CA
1N6113,A	P6KE18CP,CA
1N6114,A	P6KE20CP,CA
1N6115,A	P6KE22CP,CA
1N6116,A	P6KE25CP,CA
1N6117,A	P6KE27CP,CA
1N6118,A	P6KE30CP,CA
1N6119,A	P6KE33CP,CA
1N6120,A	P6KE36CP,CA
1N6121,A	P6KE39CP,CA
1N6122,A	P6KE43CP,CA
1N6123,A	P6KE47CP,CA
1N6124,A	P6KE51CP,CA
1N6125,A	P6KE56CP,CA
1N6126,A	P6KE62CP,CA
1N6127,A	P6KE68CP,CA
1N6128,A	P6KE75CP,CA
1N6129,A	P6KE82CP,CA
1N6130,A	P6KE91CP,CA
1N6131,A	P6KE100CP,CA
1N6132,A	P6KE110CP,CA
1N6133,A	P6KE120CP,CA
1N6134,A	P6KE130CP,CA
1N6135,A	P6KE150CP,CA
1N6136,A	P6KE160CP,CA
1N6137,A	P6KE180CP,CA
1N6139,A	1.5KE6V8CP,CA
1N6140,A	1.5KE7V5CP,CA
1N6141,A	1.5KE8V2CP,CA
1N6142,A	1.5KE9V1CP,CA
1N6143,A	1.5KE10CP,CA
1N6144,A	1.5KE11CP,CA

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
1N6145,A	1.5KE12CP,CA
1N6146,A	1.5KE13CP,CA
1N6147,A	1.5KE15CP,CA
1N6148,A	1.5KE16CP,CA
1N6149,A	1.5KE18CP,CA
1N6150,A	1.5KE20CP,CA
1N6151,A	1.5KE22CP,CA
1N6152,A	1.5KE25CP,CA
1N6153,A	1.5KE27CP,CA
1N6154,A	1.5KE30CP,CA
1N6155,A	1.5KE33CP,CA
1N6156,A	1.5KE36CP,CA
1N6157,A	1.5KE39CP,CA
1N6158,A	1.5KE43CP,CA
1N6159,A	1.5KE47CP,CA
1N6160,A	1.5KE51CP,CA
1N6161,A	1.5KE56CP,CA
1N6162,A	1.5KE62CP,CA
1N6163,A	1.5KE68CP,CA
1N6164,A	1.5KE75CP,CA
1N6165,A	1.5KE82CP,CA
1N6166,A	1.5KE91CP,CA
1N6167,A	1.5KE100CP,CA
1N6168,A	1.5KE110CP,CA
1N6169,A	1.5KE120CP,CA
1N6170,A	1.5KE130CP,CA
1N6171,A	1.5KE150CP,CA
1N6172,A	1.5KE160CP,CA
1N6173,A	1.5KE180CP,CA
1N6267,A	1.5KE6V8P,A
1N6268,A	1.5KE7V5P,A
1N6269,A	1.5KE8V2P,A
1N6270,A	1.5KE9V1P,A
1N6271,A	1.5KE10P,A
1N6272,A	1.5KE11P,A
1N6273,A	1.5KE12P,A
1N6274,A	1.5KE13P,A
1N6275,A	1.5KE15P,A
1N6276,A	1.5KE16P,A
1N6277,A	1.5KE18P,A
1N6278,A	1.5KE20P,A
1N6279,A	1.5KE22P,A
1N6280,A	1.5KE25P,A
1N6281,A	1.5KE27P,A
1N6282,A	1.5KE30P,A
1N6283,A	1.5KE33P,A
1N6284,A	1.5KE36P,A
1N6285,A	1.5KE39P,A
1N6286,A	1.5KE43P,A
1N6287,A	1.5KE47P,A

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
1N6288,A	1.5KE51P,A
1N6289,A	1.5KE56P,A
1N6290,A	1.5KE62P,A
1N6291,A	1.5KE68P,A
1N6292,A	1.5KE75P,A
1N6293,A	1.5KE82P,A
1N6294,A	1.5KE91P,A
1N6295,A	1.5KE100P,A
1N6296,A	1.5KE110P,A
1N6297,A	1.5KE120P,A
1N6298,A	1.5KE130P,A
1N6299,A	1.5KE150P,A
1N6300,A	1.5KE160P,A
1N6301,A	1.5KE170P,A
1N6302,A	1.5KE180P,A
1N6303,A	1.5KE200P,A
1N6268C	1.5KE7V5CP
1N6269C	1.5KE8V2CP
1N6270C	1.5KE9V1CP
1N6271C	1.5KE10CP
1N6272C	1.5KE11CP
1N6273C	1.5KE12CP
1N6274C	1.5KE13CP
1N6275C	1.5KE15CP
1N6276C	1.5KE16CP
1N6277C	1.5KE18CP
1N6278C	1.5KE20CP
1N6279C	1.5KE22CP
1N6280C	1.5KE25CP
1N6281C	1.5KE27CP
1N6282C	1.5KE30CP
1N6283C	1.5KE33CP
1N6284C	1.5KE36CP
1N6285C	1.5KE39CP
1N6286C	1.5KE43CP
1N6287C	1.5KE47CP
1N6288C	1.5KE51CP
1N6289C	1.5KE56CP
1N6290C	1.5KE62CP
1N6291C	1.5KE68CP
1N6292C	1.5KE75CP
1N6293C	1.5KE82CP
1N6294C	1.5KE91P,A
1N6295C	1.5KE100P,A
1N6296C	1.5KE110P,A
1N6297C	1.5KE120P,A
1N6298C	1.5KE130P,A
1N6299C	1.5KE150P,A
1N6300C	1.5KE160P,A
1N6301C	1.5KE170P,A

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
1N6302C	1.5KE180P,A
1N6303C	1.5KE200CP
1N6356	1N5908
1N6373	1N5908
1N6402,A	P6KE6V8P,A
↓	↓
1N6456,A	P6KE400P,A
1N6462	P6KE6V8A
↓	↓
1N6468	P6KE62A
1N6470	1.5KE6V8A
↓	↓
1N6476	1.5KE62A
1SMB6.0,A	SM6T6V8,A
1SMB6.5,A	SM6T7V5,A
1SMB8.5,A	SM6T10,A
1SMB10,A	SM6T12,A
1SMB13,A	SM6T15,A
1SMB16,A	SM6T18,A
1SMB24,A	SM6T27,A
1SMB26,A	SM6T30,A
1SMB28,A	SM6T33,A
1SMB33,A	SM6T39,A
1SMB58,A	SM6T68,A
1SMB60,A	SM6T68,A
1SMB85,A	SM6T100,A
1SMB130,A	SM6T150,A
1SMB170,A	SM6T200,A
1SMC6.0A	SM15T6V8,A
1SMC6.5,A	SM15T7V5,A
1SMC8.5,A	SM15T10,A
1SMC10,A	SM15T12,A
1SMC13,A	SM15T15,A
1SMC16,A	SM15T18,A
1SMC24,A	SM15T27,A
1SMC26,A	SM15T30,A
1SMC28,A	SM15T33,A
1SMC33,A	SM15T39,A
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1SMC60,A	SM15T68,A
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↓	↓
1.0KE170,A	1.5KE200P,A
1.0KE5.0C,CA	1.5KE6V8CP,CA
↓	↓

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
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↓	↓
1.2KE170C,CA	1.5KE200CP,CA
1.5K11,A	1N5634,A
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1.5KA6.8,A	1.5KE6V8P,A
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1.5KA43,A	1.5KE43P,A
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1.5KE6.8,A	1.5KE6V8P,A
↓	↓
1.5KE440,A	1.5KE440P,A
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1.5SMC6.8A	SM15T6V8A
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3A120	TPB91A18
3A133	TPB180A18
3A138	TPB62B18
3A139	TPB75B18
3A140	TPB120B18
3A143	TPB200B18
3A249	THDT58S
3A258	THDT58S
5KP10,A	BZW50-10
↓	↓
5KP110,A	BZW50-100
5KP10C,CA	BZW50-10B
↓	↓
5KP110C,CA	BZW50-100B
BR210-100	TPB91B18

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
BR210-120	TPB110B18
BR210-140	TPB130B18
BR210-160	TPB150B18
BR210-180	TPB160B18
BR210-200	TPB180B18
BR210-220	TPB200B18
BR210-240	TPB220B18
BR210-260	TPB240B18
BR210-280	TPB270B18
BR211-100	TPA91B18
BR211-120	TPA110B18
BR211-140	TPA130B18
BR211-160	TPA150B18
BR211-180	TPA160B18
BR211-200	TPA180B18
BR211-220	TPA200B18
BR211-240	TPA220B18
BR211-260	TPA240B18
BR211-280	TPA270B18
BR220-100	2 * TPB91B18
BR220-120	2 * TPB110B18
BR220-140	2 * TPB130B18
BR220-160	2 * TPB150B18
BR220-180	2 * TPB160B18
BR220-200	2 * TPB180B18
BR220-220	2 * TPB200B18
BR220-240	2 * TPB220B18
BR220-260	THBT200S
BR220-280	2 * TPB270B18
BZW03-C7V5	BZW04-6V4
BZW03-C8V2	BZW04-7V0
BZW03-C9V1	BZW04-7V8
BZW03-C10	BZW04-8V5
BZW03-C11	BZW04-9V4
BZW03-C12	BZW04-10
BZW03-C13	BZW04-11
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BZW03-C18	BZW04-15
BZW03-C20	BZW04-17
BZW03-C22	BZW04-19
BZW03-C24	BZW04-20
BZW03-C27	BZW04-23
BZW03-C30	BZW04-26
BZW03-C33	BZW04-28
BZW03-C36	BZW04-31
BZW03-C39	BZW04-33
BZW03-C43	BZW04-37
BZW03-C47	BZW04-40
BZW03-C51	BZW04-44

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
BZW03-C56	BZW04-48
BZW03-C62	BZW04-53
BZW03-C68	BZW04-58
BZW03-C75	BZW04-64
BZW03-C82	BZW04-70
BZW03-C91	BZW04-78
BZW03-C100	BZW04-85
BZW03-C110	BZW04-94
BZW03-C120	BZW04-102
BZW03-C130	BZW04-111
BZW03-C150	BZW04-128
BZW03-C160	BZW04-136
BZW03-C180	BZW04-154
BZW03-C200	BZW04-171
BZW03-C220	BZW04-188
BZW03-C240	BZW04-213
BZW03-C270	BZW04-239
BZW04-5V8,B	BZW04-5V8,B
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BZW04-376,B	BZW04-376,B
BZW04P5V8,B	BZW04P5V8,B
↓	↓
BZW04P376,B	BZW04P376,B
BZW06-5V8,B	BZW06-5V8,B
↓	↓
BZW06-376,B	BZW06-376,B
BZW06P5V8,B	BZW06P5V8,B
↓	↓
BZW06P376,B	BZW06P376,B
BZW50-8V2,B	BZW50-8V2,B
↓	↓
BZW50-180,B	BZW50-180,B
CP2009	1.5KE9V1CP
↓	↓
CP2440	1.5KE440CP
CP3012	BZW50-10B
↓	↓
CP3220	BZW50-100B
DL2-5,A	ITA6V1U3
DLTS-5,A	ITA6V1U3
FP1006,A	P6KE6V8CP,CA
↓	↓
FP1400,A	P6KE280CP,CA
FP2006,A	1.5KE6V8CP,CA
↓	↓
FP2275,A	1.5KE280CP,CA
FP3012,A	BZW50-10B
↓	↓
FP3180,A	BZW50-180B
ICT-5	1N5908
ICTA-5	1N5908
ITA6V1U1	ITA6V1U1
ITA6V1U3	ITA6V1U3
ITA6V1M3	ITA6V1M3
ITA6V5B1	ITA6V5B1
ITA6V5B3	ITA6V5B3
ITA10B1	ITA10B1
ITA10B3	ITA10B3
ITA18B1	ITA18B1
ITA18B3	ITA18B3
ITA25B1	ITA25B1
ITA25B3	ITA25B3
L3100B	L3100B
L3100B1	L3100B1
L3121B	L3121B
LCP150S	LCP150S
LCP1511	LCP1511
LCP1512	LCP1512
LCTA6V1M3	LCTA6V1M3
LS5018B	LS5018B
LS5060B	LS5060B
LS5120B	LS5120B
LVT3V3	LVT3V3
MPT-5	1N5908
MPTE-5	1N5908
MR2520L	LDP24AS
P0800EA	TPA68A18
P1050EA	TPA82A18
P1100EA	TPA91B18
P1200EA	TPA100B18
P1300EA	TPA110B18
P1400EA	TPA120B18
P1500EA	TPA120A18
P1602AA	2 * TPA62A18
P1602AB	2 * TPB62A18
P2000AA	TPA160A18
P2200AA	TPA180B18
P2202AA	2 * TPA91A18
P2202AB	2 * TPB91A18
P2400AA	TPA200B18

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
P2500AA	TPA220B18
P2702AA	2 * TPA110A18
P2702AB	2 * TPB110A18
P3000AA	TPA240B18
P3002AA	2 * TPA120A18
P3002AB	2 * TPB120A18
P3300AA	TPA270A18
P4KA6.8,C	BZW04P5V8,B
P4KA7.5,C	BZW04P6V4,B
P4KA8.2,C	BZW04P7V0,B
P4KA9.1,C	BZW04P7V8,B
P4KA10,C	BZW04P8V5,B
P4KA11,C	BZW04P9V4,B
P4KA12,C	BZW04P10,B
P4KA13,C	BZW04P11,B
P4KA15,C	BZW04P13,B
P4KA16,C	BZW04P14,B
P4KA18,C	BZW04P15,B
P4KA20,C	BZW04P17,B
P4KA22,C	BZW04P19,B
P4KA24,C	BZW04P20,B
P4KA27,C	BZW04P23,B
P4KA30,C	BZW04P26,B
P4KA33,C	BZW04P28,B
P4KA36,C	BZW04P31,B
P4KA39,C	BZW04P33,B
P4KA43,C	BZW04P37,B
P4KA6.8A,CA	BZW04-5V8,B
P4KA7.5A,CA	BZW04-6V4,B
P4KA8.2A,CA	BZW04-7V0,B
P4KA9.1A,CA	BZW04-7V8,B
P4KA10A,CA	BZW04-8V5,B
P4KA11A,CA	BZW04-9V4,B
P4KA12A,CA	BZW04-10,B
P4KA13A,CA	BZW04-11,B
P4KA15A,CA	BZW04-13,B
P4KA16A,CA	BZW04-14,B
P4KA18A,CA	BZW04-15,B
P4KA20A,CA	BZW04-17,B
P4KA22A,CA	BZW04-19,B
P4KA24A,CA	BZW04-20,B
P4KA27A,CA	BZW04-23,B
P4KA30A,CA	BZW04-26,B
P4KA33A,CA	BZW04-28,B
P4KA36A,CA	BZW04-31,B
P4KA39A,CA	BZW04-33,B
P4KA43A,CA	BZW04-37,B
P4KE6.8,C	BZW04P5V8,B
P4KE7.5,C	BZW04P6V4,B
P4KE8.2,C	BZW04P7V0,B

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
P4KE9.1,C	BZW04P7V8,B
P4KE10,C	BZW04P8V5,B
P4KE11,C	BZW04P9V4,B
P4KE12,C	BZW04P10,B
P4KE13,C	BZW04P11,B
P4KE15,C	BZW04P13,B
P4KE16,C	BZW04P14,B
P4KE18,C	BZW04P15,B
P4KE20,C	BZW04P17,B
P4KE22,C	BZW04P19,B
P4KE24,C	BZW04P20,B
P4KE27,C	BZW04P23,B
P4KE30,C	BZW04P26,B
P4KE33,C	BZW04P28,B
P4KE36,C	BZW04P31,B
P4KE39,C	BZW04P33,B
P4KE43,C	BZW04P37,B
P4KE47,C	BZW04P40,B
P4KE51,C	BZW04P44,B
P4KE56,C	BZW04P48,B
P4KE62,C	BZW04P53,B
P4KE68,C	BZW04P58,B
P4KE75,C	BZW04P64,B
P4KE82,C	BZW04P70,B
P4KE91,C	BZW04P78,B
P4KE100,C	BZW04P85,B
P4KE110,C	BZW04P94,B
P4KE120,C	BZW04P102,B
P4KE130,C	BZW04P111,B
P4KE150,C	BZW04P128,B
P4KE160,C	BZW04P136,B
P4KE170,C	BZW04P145,B
P4KE180,C	BZW04P154,B
P4KE200,C	BZW04P171,B
P4KE220,C	BZW04P188,B
P4KE250,C	BZW04P213,B
P4KE300,C	BZW04P256,B
P4KE350,C	BZW04P299,B
P4KE400,C	BZW04P342,B
P4KE6.8A,CA	BZW04-5V8,B
P4KE7.5A,CA	BZW04-6V4,B
P4KE8.2A,CA	BZW04-7V0,B
P4KE9.1A,CA	BZW04-7V8,B
P4KE10A,CA	BZW04-8V5,B
P4KE11A,CA	BZW04-9V4,B
P4KE12A,CA	BZW04-10,B
P4KE13A,CA	BZW04-11,B
P4KE15A,CA	BZW04-13,B
P4KE16A,CA	BZW04-14,B
P4KE18A,CA	BZW04-15,B

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
P4KE20A,CA	BZW04-17,B
P4KE22A,CA	BZW04-19,B
P4KE24A,CA	BZW04-20,B
P4KE27A,CA	BZW04-23,B
P4KE30A,CA	BZW04-26,B
P4KE33A,CA	BZW04-28,B
P4KE36A,CA	BZW04-31,B
P4KE39A,CA	BZW04-33,B
P4KE43A,CA	BZW04-37,B
P4KE47A,CA	BZW04-40,B
P4KE51A,CA	BZW04-44,B
P4KE56A,CA	BZW04-48,B
P4KE62A,CA	BZW04-53,B
P4KE68A,CA	BZW04-58,B
P4KE75A,CA	BZW04-64,B
P4KE82A,CA	BZW04-70,B
P4KE91A,CA	BZW04-78,B
P4KE100A,CA	BZW04-85,B
P4KE110A,CA	BZW04-94,B
P4KE120A,CA	BZW04-102,B
P4KE130A,CA	BZW04-111,B
P4KE150A,CA	BZW04-128,B
P4KE160A,CA	BZW04-136,B
P4KE170A,CA	BZW04-145,B
P4KE180A,CA	BZW04-154,B
P4KE200A,CA	BZW04-171,B
P4KE220A,CA	BZW04-188,B
P4KE250A,CA	BZW04-213,B
P4KE300A,CA	BZW04-256,B
P4KE350A,CA	BZW04-299,B
P4KE400A,CA	BZW04-342,B
P4802AB	2 * TPB200B18
P5KE5.0,A	P6KE6V8P,A
P5KE6.0,A	P6KE6V8P,A
P5KE6.5,A	P6KE7V5P,A
P5KE7.0,A	P6KE8V2P,A
P5KE7.5,A	P6KE9V1P,A
P5KE8.0,A	P6KE9V1P,A
P5KE8.5,A	P6KE10P,A
P5KE9.0,A	P6KE11P,A
P5KE10,A	P6KE12P,A
P5KE11,A	P6KE13P,A
P5KE12,A	P6KE15P,A
P5KE13,A	P6KE15P,A
P5KE14,A	P6KE16P,A
P5KE15,A	P6KE18P,A
P5KE16,A	P6KE18P,A
P5KE17,A	P6KE20P,A
P5KE18,A	P6KE22P,A
P5KE20,A	P6KE25P,A

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
P5KE22,A	P6KE27P,A
P5KE24,A	P6KE27P,A
P5KE26,A	P6KE30P,A
P5KE28,A	P6KE33P,A
P5KE30,A	P6KE36P,A
P5KE33,A	P6KE39P,A
P5KE36,A	P6KE43P,A
P5KE40,A	P6KE47P,A
P5KE43,A	P6KE51P,A
P5KE45,A	P6KE51P,A
P5KE48,A	P6KE56P,A
P5KE51,A	P6KE62P,A
P5KE54,A	P6KE62P,A
P5KE58,A	P6KE68P,A
P5KE60,A	P6KE68P,A
P5KE64,A	P6KE75P,A
P5KE70,A	P6KE82P,A
P5KE75,A	P6KE91P,A
P5KE78,A	P6KE91P,A
P5KE85,A	P6KE100P,A
P5KE90,A	P6KE110P,A
P5KE100,A	P6KE120P,A
P5KE110,A	P6KE130P,A
P5KE120,A	P6KE150P,A
P5KE130,A	P6KE150P,A
P5KE150,A	P6KE180P,A
P5KE160,A	P6KE180P,A
P5KE170,A	P6KE200P,A
P5KE5.0C,CA	P6KE6V8CP,CA
P5KE6.0C,CA	P6KE6V8CP,CA
P5KE6.5C,CA	P6KE7V5CP,CA
P5KE7.0C,CA	P6KE8V2CP,CA
P5KE7.5C,CA	P6KE9V1CP,CA
P5KE8.0C,CA	P6KE9V1CP,CA
P5KE8.5C,CA	P6KE10CP,CA
P5KE9.0C,CA	P6KE11CP,CA
P5KE10C,CA	P6KE12CP,CA
P5KE11C,CA	P6KE13CP,CA
P5KE12C,CA	P6KE15CP,CA
P5KE13C,CA	P6KE15CP,CA
P5KE14C,CA	P6KE16CP,CA
P5KE15C,CA	P6KE18CP,CA
P5KE16C,CA	P6KE18CP,CA
P5KE17C,CA	P6KE20CP,CA
P5KE18C,CA	P6KE22CP,CA
P5KE20C,CA	P6KE25CP,CA
P5KE22C,CA	P6KE27CP,CA
P5KE24C,CA	P6KE27CP,CA
P5KE26C,CA	P6KE30CP,CA
P5KE28C,CA	P6KE33CP,CA

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
P5KE30C,CA	P6KE36CP,CA
P5KE33C,CA	P6KE39CP,CA
P5KE36C,CA	P6KE43CP,CA
P5KE40C,CA	P6KE47CP,CA
P5KE43C,CA	P6KE51CP,CA
P5KE45C,CA	P6KE51CP,CA
P5KE48C,CA	P6KE56CP,CA
P5KE51C,CA	P6KE62CP,CA
P5KE54C,CA	P6KE62CP,CA
P5KE58C,CA	P6KE68CP,CA
P5KE60C,CA	P6KE68CP,CA
P5KE64C,CA	P6KE75CP,CA
P5KE70C,CA	P6KE82CP,CA
P5KE75C,CA	P6KE91CP,CA
P5KE78C,CA	P6KE91CP,CA
P5KE85C,CA	P6KE100CP,CA
P5KE90C,CA	P6KE110CP,CA
P5KE100C,CA	P6KE120CP,CA
P5KE110C,CA	P6KE130CP,CA
P5KE120C,CA	P6KE150CP,CA
P5KE130C,CA	P6KE150CP,CA
P5KE150C,CA	P6KE180CP,CA
P5KE160C,CA	P6KE180CP,CA
P5KE170C,CA	P6KE200CP,CA
P6002AB	2 * TPB240A18
P6KA6.8,A	P6KE6V8P,A
↓	↓
P6KA43,A	P6KE43P,A
P6KA6.8C,CA	P6KE6V8CP,CA
↓	↓
P6KA43C,CA	P6KE43CP,CA
P6KE6V8,A	P6KE6V8P,A
↓	↓
P6KE440,A	P6KE440P,A
P6KE6V8C,CA	P6KE6V8CP,CA
↓	↓
P6KE440C,CA	P6KE440CP,CA
P6SMB6.8A	SM6T6V8A
↓	↓
P6SMB200A	SM6T200A
P7KE10,C	P7T-10,B
↓	↓
P7KE100,C	P7T-110,B
P7T-10,B	P7T-10,B

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
P7T-27,B	P7T-27,B
P7T-43,B	P7T-43,B
P7T-110,B	P7T-110,B
RBO08-40	RBO08-40
RBO40-40	RBO40-40
S5KP10,C	BZW50-10,B
↓	↓
S5KP100,C	BZW50-100,B
SA5.0,A	P6KE6V8P,A
SA6.0,A	P6KE6V8P,A
SA6.5,A	P6KE7V5P,A
SA7.0,A	P6KE8V2P,A
SA7.5,A	P6KE9V1P,A
SA8.0,A	P6KE9V1P,A
SA8.5,A	P6KE10P,A
SA9.0,A	P6KE11P,A
SA10,A	P6KE12P,A
SA11,A	P6KE13P,A
SA12,A	P6KE15P,A
SA13,A	P6KE15P,A
SA14,A	P6KE16P,A
SA15,A	P6KE18P,A
SA16,A	P6KE18P,A
SA17,A	P6KE20P,A
SA18,A	P6KE22P,A
SA20,A	P6KE25P,A
SA22,A	P6KE27P,A
SA24,A	P6KE27P,A
SA26,A	P6KE30P,A
SA28,A	P6KE33P,A
SA30,A	P6KE36P,A
SA33,A	P6KE39P,A
SA36,A	P6KE43P,A
SA40,A	P6KE47P,A
SA43,A	P6KE51P,A
SA45,A	P6KE51P,A
SA48,A	P6KE56P,A
SA51,A	P6KE62P,A
SA54,A	P6KE62P,A
SA58,A	P6KE68P,A
SA60,A	P6KE68P,A
SA64,A	P6KE75P,A
SA70,A	P6KE82P,A
SA75,A	P6KE91P,A
SA78,A	P6KE91P,A
SA85,A	P6KE100P,A
SA90,A	P6KE110P,A
SA100,A	P6KE120P,A
SA110,A	P6KE130P,A

CROSS REFERENCE

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
SA120,A	P6KE150P,A
SA130,A	P6KE150P,A
SA150,A	P6KE180P,A
SA160,A	P6KE180P,A
SA170,A	P6KE200P,A
SA5.1C,CA	P6KE6V8CP,CA
SA6.0C,CA	P6KE6V8CP,CA
SA6.5C,CA	P6KE7V5CP,CA
SA7.0C,CA	P6KE8V2CP,CA
SA7.5C,CA	P6KE9V1CP,CA
SA8.0C,CA	P6KE9V1CP,CA
SA8.5C,CA	P6KE10CP,CA
SA9.0C,CA	P6KE11CP,CA
SA10C,CA	P6KE12CP,CA
SA11C,CA	P6KE13CP,CA
SA12C,CA	P6KE15CP,CA
SA13C,CA	P6KE15CP,CA
SA14C,CA	P6KE16CP,CA
SA15C,CA	P6KE18CP,CA
SA16C,CA	P6KE18CP,CA
SA17C,CA	P6KE20CP,CA
SA18C,CA	P6KE22CP,CA
SA20C,CA	P6KE25CP,CA
SA22C,CA	P6KE27CP,CA
SA24C,CA	P6KE27CP,CA
SA26C,CA	P6KE30CP,CA
SA28C,CA	P6KE33CP,CA
SA30C,CA	P6KE36CP,CA
SA33C,CA	P6KE39CP,CA
SA36C,CA	P6KE43CP,CA
SA40C,CA	P6KE47CP,CA
SA43C,CA	P6KE51CP,CA
SA45C,CA	P6KE51CP,CA
SA48C,CA	P6KE56CP,CA
SA51C,CA	P6KE62CP,CA
SA54C,CA	P6KE62CP,CA
SA58C,CA	P6KE68CP,CA
SA60C,CA	P6KE68CP,CA
SA64C,CA	P6KE75CP,CA
SA70C,CA	P6KE82CP,CA
SA75C,CA	P6KE91CP,CA
SA78C,CA	P6KE91CP,CA
SA85C,CA	P6KE100CP,CA
SA90C,CA	P6KE110CP,CA
SA100C,CA	P6KE120CP,CA
SA110C,CA	P6KE130CP,CA
SA120C,CA	P6KE150CP,CA
SA130C,CA	P6KE150CP,CA
SA150C,CA	P6KE180CP,CA
SA160C,CA	P6KE180CP,CA

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
SA170C,CA	P6KE200CP,CA
SA100-230	SA100-230
SA100-265	SA100-265
SAB5.0	P6KE6V8A
SAB10	P6KE12A
SAB12	P6KE15A
SAB15	P6KE18A
SAB18	P6KE22A
SAB24	P6KE27A
SAB28	P6KE30A
SBL10,C	P7T-10,B
SBL25,C	P7T-27,B
SBL43,C	P7T-43,B
SBL100,C	P7T-110,B
SGT06U13	TPB62A12
SGT23B13	TPB220B18
SGT23U13	TPB220B18
SGT27B13	TPB270B18
SM5908	SM5908
SM4T6V8A,CA	SM4T6V8A,CA
↓	↓
SM4T220A,CA	SM4T220A,CA
SM6T6V8A,CA	SM6T6V8A,CA
↓	↓
SM6T220A,CA	SM6T220A,CA
SM15T6V8A,CA	SM15T6V8A,CA
↓	↓
SM15T220A,CA	SM15T220A,CA
SMBJ6.0,A	SM6T6V8,A
SMBJ6.5,A	SM6T7V5,A
SMBJ8.5,A	SM6T10,A
SMBJ10,A	SM6T12,A
SMBJ13,A	SM6T15,A
SMBJ16,A	SM6T18,A
SMBJ24,A	SM6T27,A
SMBJ26,A	SM6T30,A
SMBJ28,A	SM6T33,A
SMBJ33,A	SM6T39,A
SMBJ58,A	SM6T68,A
SMBJ60,A	SM6T68,A
SMBJ85,A	SM6T100,A
SMBJ130,A	SM6T150,A
SMBJ170,A	SM6T200,A
SMBJ6.5C,CA	SM6T7V5C,CA
SMBJ8.5C,CA	SM6T10C,CA
SMBJ10C,CA	SM6T12C,CA
SMBJ24C,CA	SM6T27C,CA

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
SMBJ26C,CA	SM6T30C,CA
SMBJ33C,CA	SM6T39C,CA
SMCJ6.0,A	SM15T6V8,A
SMCJ6.5,A	SM15T7V5,A
SMCJ8.5,A	SM15T10,A
SMCJ10,A	SM15T12,A
SMCJ13,A	SM15T15,A
SMCJ16,A	SM15T18,A
SMCJ24,A	SM15T27,A
SMCJ26,A	SM15T30,A
SMCJ28,A	SM15T33,A
SMCJ33,A	SM15T39,A
SMCJ58,A	SM15T68,A
SMCJ60,A	SM15T68,A
SMCJ85,A	SM15T100,A
SMCJ130,A	SM15T150,A
SMCJ170,A	SM15T200,A
SMCJ6.5C,CA	SM15T7V5C,CA
SMCJ8.5C,CA	SM15T10C,CA
SMCJ10C,CA	SM15T12C,CA
SMCJ24C,CA	SM15T27C,CA
SMCJ26C,CA	SM15T30C,CA
SMCJ33C,CA	SM15T39C,CA
SMLVT3V3	SMLVT3V3
SMTHBT200	SMTHBT200
SMTHDT58	SMTHDT58
SMTHDT80	SMTHDT80
SMTHDT120	SMTHDT120
SMTPA62A12,A18	SMTPA62A12,A18
↓	↓
SMTPA270A12,A18	SMTPA270A12,A18
SMTPA62B12,B18	SMTPA62B12,B18
↓	↓
SMTPA270B12,B18	SMTPA270B12,B18
SMTPB62A12,A18	SMTP62A12,A18
↓	↓
SMTPB270A12,A18	SMTPB270A12,A18
SMTPB62B12,B18	SMTPB62B12,B18
↓	↓
SMTPB270B12,B18	SMTPB270B12,B18
SMTPU58	SMTPU58
SMTPU80	SMTPU80
SMTPU120	SMTPU120
TCM1030	LCP1512
TCM1060	LCP1512
THBT200S	THBT200S

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
THBT15011	THBT15011
THBT15012	THBT15012
THBT20011	THBT20011
THBT20012	THBT20012
THBT27011	THBT27011
THBT27012	THBT27012
THDT58S	THDT58S
THDT5111	THDT5111
THDT5112	THDT5112
THDT6511	THDT6511
THDT6512	THDT6512
TISP1082	THDT58S
TISP3290	THBT200S
TISP4082	TPB62A12
TISP4180	TPB150B12
TISP5160	TPA120A12
TISP5180	TPA150A12
TISP5290	TPA200A12
TISP8290	THBT200S
TISP9180	TPA150A12
TISP9290	TPA200A12
TM1030	LCP1511
TM1060	LCP1511
TPA62A12,A18	TPA62A12,A18
↓	↓
TPA270A12,A18	TPA270A12,A18
TPA62B12,B18	TPA62B12,B18
↓	↓
TPA270B12,B18	TPA270B12,B18
TPB62A12,A18	TP62A12,A18
↓	↓
TPB270A12,A18	TPB270A12,A18
TPB62B12,B18	TPB62B12,B18
↓	↓
TPB270B12,B18	TPB270B12,B18
TPI8011	TPI8011
TPI8012	TPI8012
TPI12011	TPI12011
TPI12012	TPI12012
TPP25011	TPP25011
TPP25012	TPP25012
TPU58	TPU58
TPU80	TPU80
TPU120	TPU120
TVS505	P6KE6V8A
↓	↓

CROSS REFERENCE

INDUSTRY PART NUMBER	SGS-THOMSON REPLACEMENT
TVS528	P6KE33A
ZP1006,A	P6KE6V8P,A
↓	↓
ZP1400,A	P6KE400P,A
ZP2006,A	1.5KE6V8P,A
↓	↓
ZP2275,A	1.5KE400P,A
ZP3012A	BZW50-10
↓	↓
FP3200A	BZW50-180
ZP5027S	LDP24AS
ZP5028S	LDP24AS
ZP5030S	LDP24AS
ZZ-16	P7T-10,B
ZZ-36	P7T-27,B
ZZ-62	P7T-43,B
ZZ-160	P7T-110,B
ZZY-16	P7T-10,B
ZZY-36	P7T-27,B
ZZY-62	P7T-43,B
ZZY-160	P7T-110,B

TRANSIL DATASHEETS

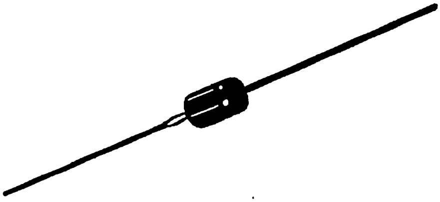
SGS-THOMSON
MICROELECTRONICS

1N5634A/1N5665A
1N6040A/1N6072A

TRANSIL

FEATURES

- PEAK PULSE POWER= 1500 W @ 1ms.
- BREAKDOWN VOLTAGE RANGE : From 11V to 200 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: Tclamping : 1ps (0 V to VBR).



DO 13
(Metal Case)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values).

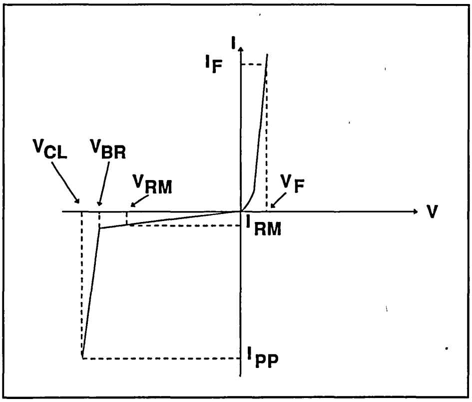
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	1500	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	5	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types	Tamb = 25°C t =10 ms	250	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	20	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. L_{lead} = 10 mm	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop VF < 3.5V @ IF = 100 A.



TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	Bidirectional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
1N5634 A	1N6040 A	5	9.4	10.5	11	11.6	1	15.6	96	20.3	493	7.5	6400
1N5635 A	1N6041 A	5	10.2	11.4	12	12.6	1	16.7	90	21.7	461	7.8	6000
1N5636 A	1N6042 A	5	11.1	12.4	13	13.7	1	18.2	82	23.6	423	8.1	5500
1N5637 A	1N6043 A	5	12.8	14.3	15	15.8	1	21.2	71	27.2	368	8.4	5000
1N5638 A	1N6044 A	5	13.6	15.2	16	16.8	1	22.5	67	28.9	346	8.6	4700
1N5639 A	1N6045 A	5	15.3	17.1	18	18.9	1	25.2	59.5	32.5	308	8.8	4300
1N5640 A	1N6046 A	5	17.1	19	20	21	1	27.7	54	36.1	277	9.0	4000
1N5641 A	1N6047 A	5	18.8	20.9	22	23.1	1	30.6	49	39.3	254	9.2	3700
1N5642 A	1N6048 A	5	20.5	22.8	24	25.2	1	33.2	45	42.8	234	9.4	3500
1N5643 A	1N6049 A	5	23.1	25.7	27	28.4	1	37.5	40	48.3	207	9.6	3200
1N5644 A	1N6050 A	5	25.6	28.5	30	31.5	1	41.5	36	53.5	187	9.7	2900
1N5645 A	1N6051 A	5	28.2	31.4	33	34.7	1	45.7	33	59.0	169	9.8	2700
1N5646 A	1N6052 A	5	30.8	34.2	36	37.8	1	49.9	30	64.3	156	9.9	2500
1N5647 A	1N6053 A	5	33.3	37.1	39	41.0	1	53.9	28	69.7	143	10.0	2400
1N5648 A	1N6054 A	5	36.8	40.9	43	45.2	1	59.3	25.3	76.8	130	10.1	2200
1N5649 A	1N6055 A	5	40.2	44.7	47	49.4	1	64.8	23.2	84	119	10.1	2050
1N5650 A	1N6056 A	5	43.6	48.5	51	53.6	1	70.1	21.4	91	110	10.2	1950
1N5651 A	1N6057 A	5	47.8	53.2	56	58.8	1	77	19.5	100	100	10.3	1800
1N5652 A	1N6058 A	5	53.0	58.9	62	65.1	1	85	17.7	111	90	10.4	1700
1N5653 A	1N6059 A	5	58.1	64.6	68	71.4	1	92	16.3	121	83	10.4	1550
1N5654 A	1N6060 A	5	64.1	71.3	75	78.8	1	103	14.6	134	75	10.5	1450
1N5655 A	1N6061 A	5	70.1	77.9	82	86.1	1	113	13.3	146	69	10.5	1350
1N5656 A	1N6062 A	5	77.8	86.5	91	95.5	1	125	12	162	62	10.6	1250
1N5657 A	1N6063 A	5	85.5	95.0	100	105	1	137	11	178	56	10.6	1150
1N5658 A	1N6064 A	5	94.0	105	110	116	1	152	9.9	195	51	10.7	1050

TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
1N5659 A	1N6065 A	5	102	114	120	126	1	65	9.1	212	47	10.7	1000
1N5660 A	1N6066 A	5	111	124	130	137	1	179	8.4	230	43	10.7	950
1N5661 A	1N6067 A	5	128	143	150	158	1	207	7.2	265	38	10.8	850
1N5662 A	1N6068 A	5	136	152	160	168	1	219	6.8	282	35	10.8	800
1N5663 A	1N6069 A	5	145	161	170	179	1	234	6.4	301	33	10.8	750
1N5664 A	1N6070 A	5	154	171	180	189	1	246	6.1	317	31.5	10.8	725
1N5665 A	1N6071 A	5	171	190	200	210	1	274	5.5	353	28	10.8	675
	1N6072 A	5	188	209	220	231	1	328	4.6	388	26	10.8	625

All parameters tested at 25 °C, except where indicated.

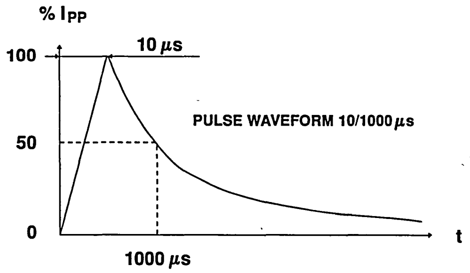
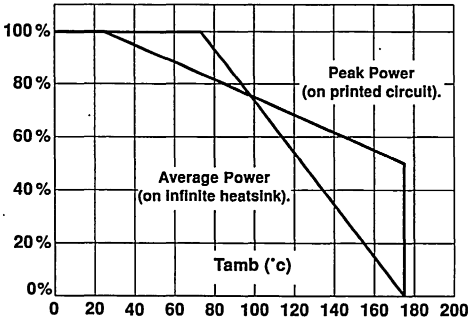


Figure 1: Power dissipation derating versus ambient temperature.



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (T_a - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 2 : Peak pulse power versus exponential pulse duration.

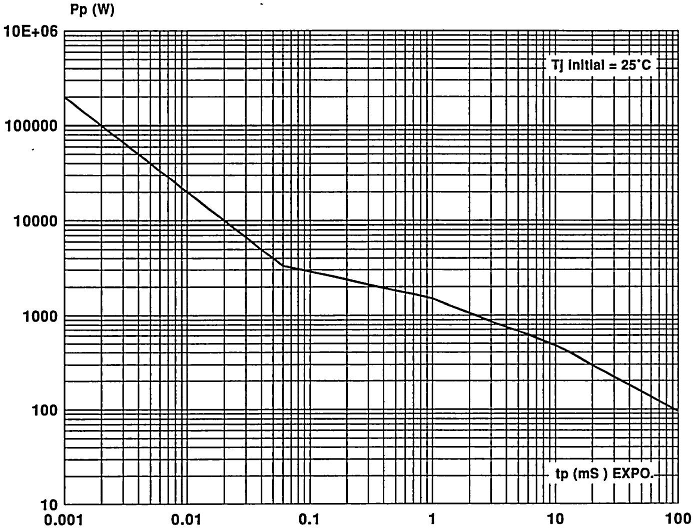
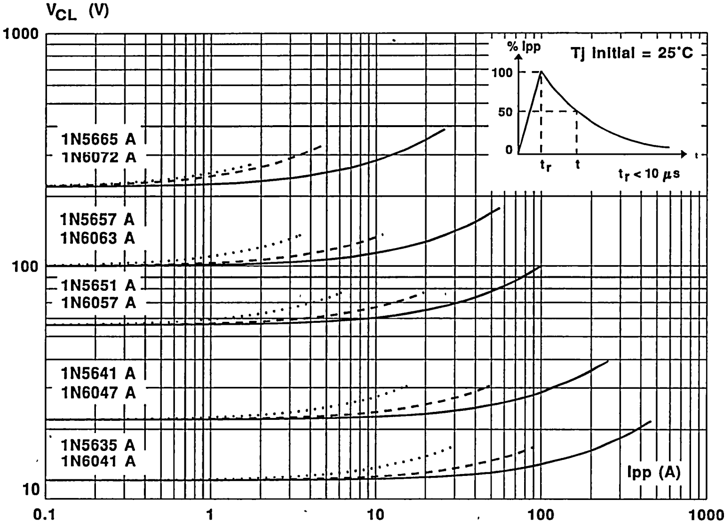


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms ------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

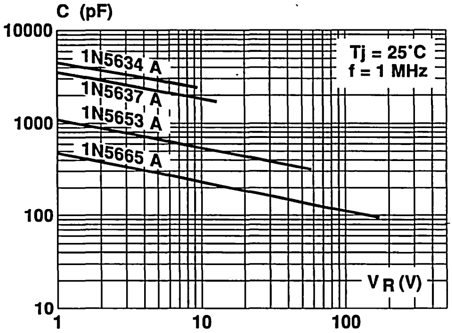


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values).

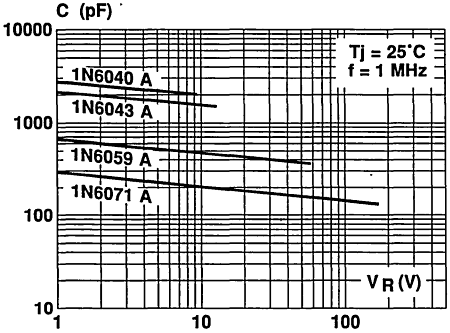


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

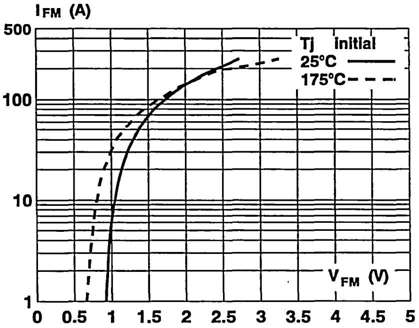
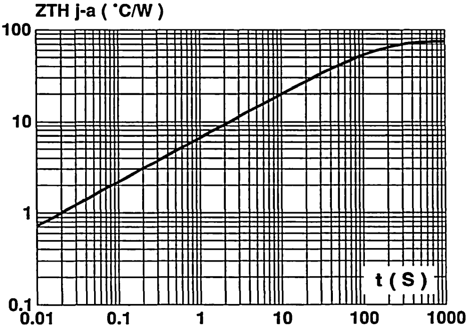


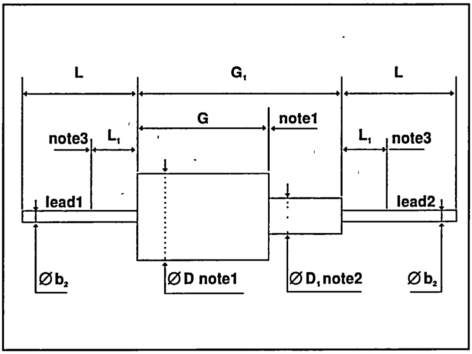
Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with L $_{lead}$ = 10mm.



MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

DO 13



Ref	Millimeters		Inches	
	min	max	min	max
Ø b_2	0.64	0.88	0.025	0.035
Ø D	5.47	5.96	0.215	0.235
Ø D_1	1.15	2.54	0.045	0.100
G	7.45	9.06	0.293	0.357
G_1	-	14.47	-	0.570
L	25.4	41.2	1.000	1.625
L_1	-	4.77	-	0.188

note1: Ø D is substantially constant along the length G.
note2: This dimension limits any pinch or seal deformation along the tabulation.
note3: The lead diameter Ø b_2 is not controlled over zone L_1

Weight = 1.45 g.

Packaging : standard packaging is in bulk.

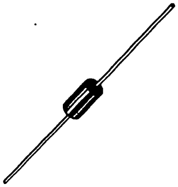
SGS-THOMSON
MICROELECTRONICS

1N5908
SM5908

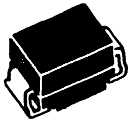
TRANSIL

FEATURES

- UNDIRECTIONAL TRANSIL DIODE
- PEAK PULSE POWER= 1500 W @ 1ms.
- REVERSE STAND OFF VOLTAGE =5 V.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME:
  T**clamping** : 1ps (0 V to V_{BR})



CB429
(Plastic)



SOD15
(Plastic)

DESCRIPTION

The 1N5908 and SM5908 are dedicated to the 5-Volt logic circuit protection (TTL and CMOS technologies).
Their low clamping voltage at high current level guarantee excellent protection for sensitive components.

MECANICAL CHARACTERISTICS

- Body marked with Logo, Type Code and Cathode Band.
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values).

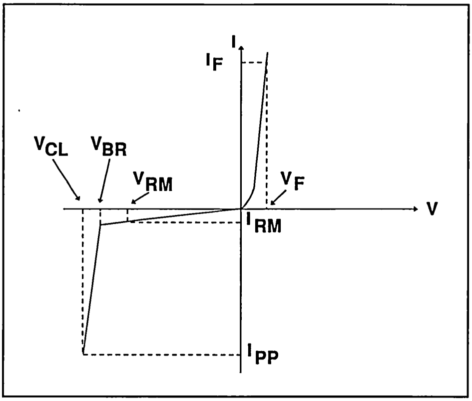
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	1500	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	5	W
I_{FSM}	Non repetitive surge peak forward current	Tamb = 25°C t =10 ms	250	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.	CB429 SOD15	230 260	°C °C

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	CB429 SOD15	20 10	°C/W °C/W
R_{th} (j-a)	Junction to ambient. on printed circuit.			
	L_{lead} = 10 mm	CB429	75	°C/W
	Mounting on standard footprint dimensions.	SOD15	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ I_F = 100 A.



TYPES	I_{RM} @ V_{RM} max		V_{BR} @ I_R min		V_{CL} @ I_{PP} max 10/1000µs		V_{CL} @ I_{PP} max 10/1000µs		V_{CL} @ I_{PP} max 10/1000µs		αT max note2
	µA	V	V	mA	V	A	V	A	V	A	$10^{-4}/°C$
1N5908 SMS5908	300	5	6	1	7.6	30	8	60	8.5	120	5.7

All parameters tested at 25 °C, except where indicated.

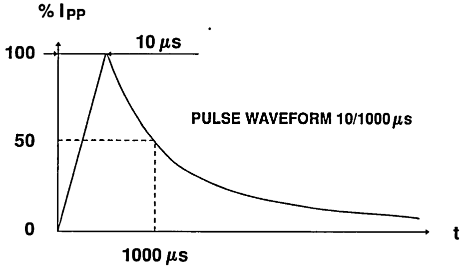
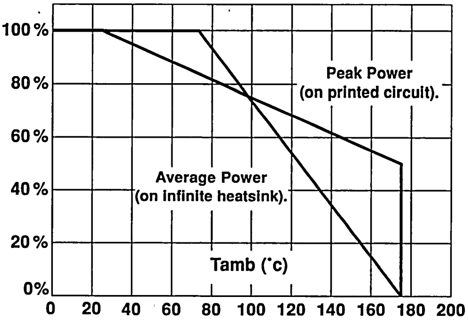


Figure 1: Power dissipation derating versus ambient temperature



Note 1 :	For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.
Note 2 :	$\Delta V_{BR} = \alpha T \cdot (Ta-25) \cdot V_{BR\,(25°C)}$.

Figure 2 : Peak pulse power versus exponential pulse duration.

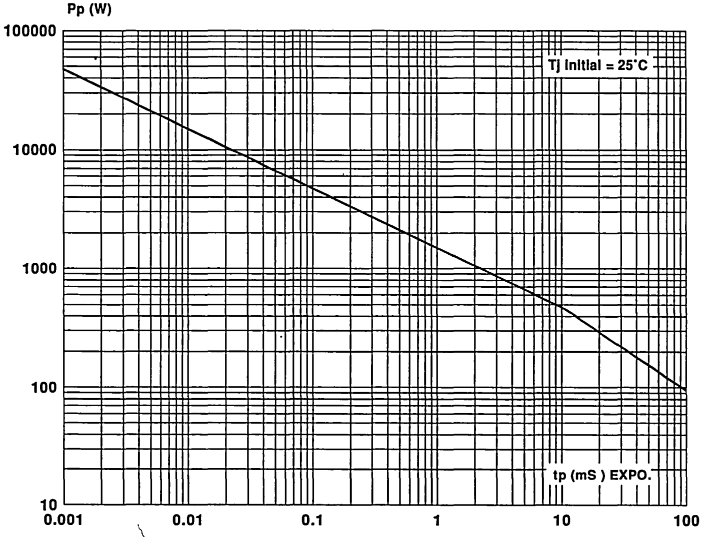
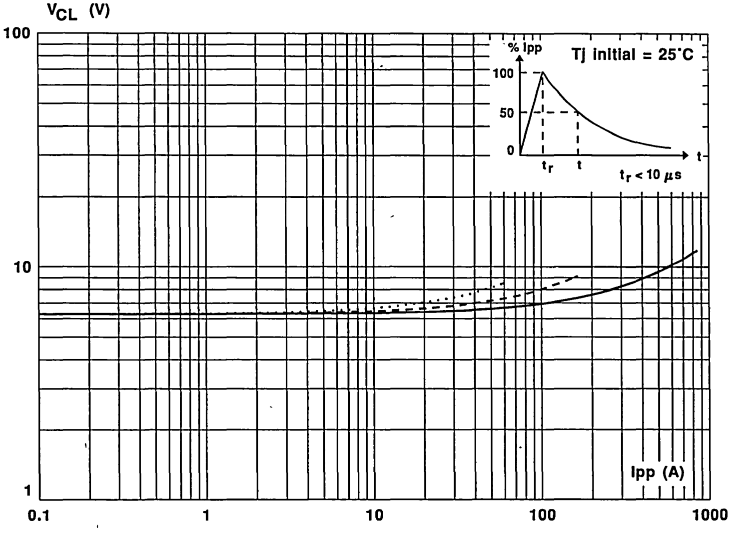


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ....
t = 1 ms -------------
t =10 ms ________



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4 : Capacitance versus reverse applied voltage (typical values).

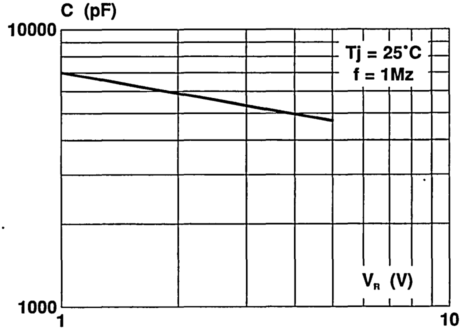


Figure 5 : Peak forward voltage drop versus peak forward current.

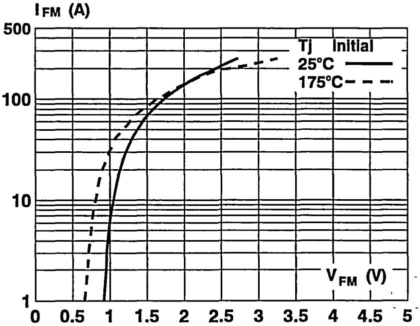


Figure 6a/6b : Transient thermal impedance junction-ambient versus pulse duration.

Figure 6a : CB429 Package.
Mounting on PC board (L_{lead} = 10 mm).

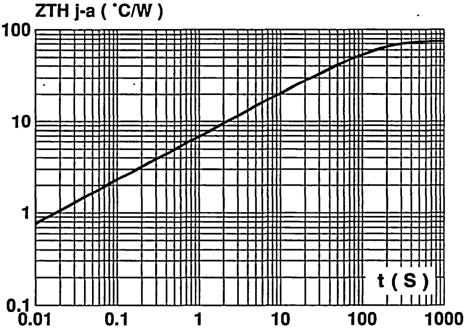
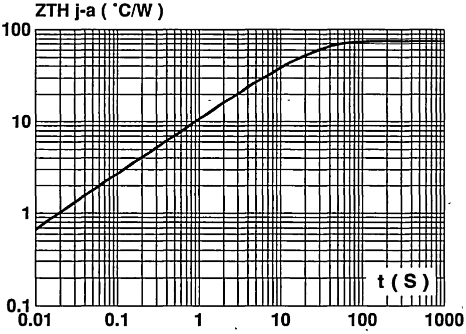
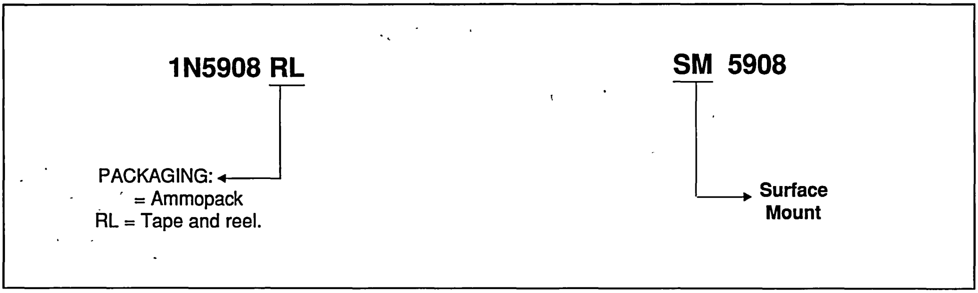


Figure 6b : SOD15 Package.
Mounting on PC board with standard footprint dimensions.



ORDER CODE



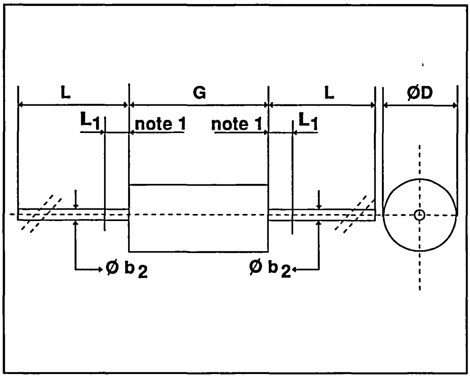
MARKING

Package	Type	Marking
CB429	1N5908	1N5908
A white band indicates the cathode		

Package	Type	Marking
SOD15	SM5908	MDC
A white band indicates the cathode		

PACKAGE MECHANICAL DATA

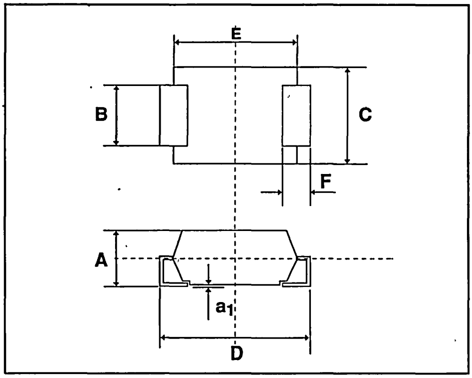
CB429



Ref	Millimeters		Inches	
	min	max	min	max
Øb_2	-	1.06	-	0.042
ØD	-	5.1	-	0.20
G	-	9.8	-	0.386
L	26	-	1.024	-
L_1	-	1.27	-	0.050
note1:The diameter Ø b_2 is not controlled over zone L_1.				

Weight = 0.85 g.

SOD15



Ref	Millimeters		Inches	
	min	max	min	max
A	2.5	3.1	0.098	0.122
a_1	-	0.2	-	0.008
B	2.9	3.1	0.114	0.122
C	4.8	5.2	0.190	0.200
D	7.6	8.0	0.300	0.315
E	6.3	6.6	0.248	0.259
F	1.3	1.7	0.051	0.067

Weight = 0.25 g.

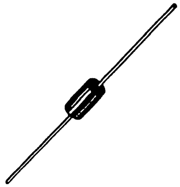
Packaging : Axial Diode CB429 = Products Supplied in Tape and Reel.
SOD15 =Standard packaging is in Film.

1.5KE6V8P,A/440P,A
1.5KE6V8CP,CA/440CP,CA

TRANSIL

FEATURES

- PEAK PULSE POWER= 1500 W @ 1ms.
- BREAKDOWN VOLTAGE RANGE : From 6V8 to 440 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: Tclamping : 1ps (0 V to V_{BR}).
- UL RECOGNIZED.



CB429
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code, and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

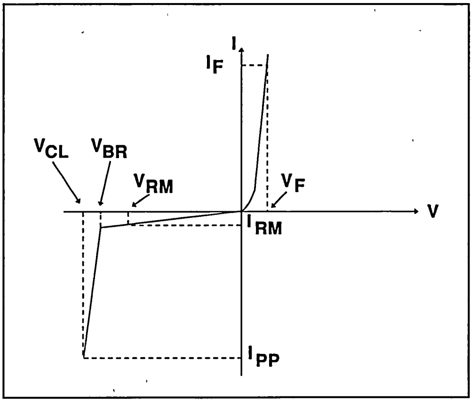
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	1500	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	5	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types.	Tamb = 25°C t =10 ms	250	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	20	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. L_{lead} = 10 mm	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ I_F = 100 A.



TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	Bidirectional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P 1.5KE6V8P	P 1.5KE6V8CP	1000	5.8	6.45	6.8	7.48	10	10.5	143	13.4	746	5.7	9500
P 1.5KE6V8A	P 1.5KE6V8CA	1000	5.8	6.45	6.8	7.14	10	10.5	143	13.4	746	5.7	9500
P 1.5KE7V5P	1.5KE7V5CP	500	6.4	7.13	7.5	8.25	10	11.3	132	14.5	690	6.1	8500
1.5KE7V5A	P 1.5KE7V5CA	500	6.4	7.13	7.5	7.88	10	11.3	132	14.5	690	6.1	8500
1.5KE8V2P	1.5KE8V2CP	200	7.02	7.79	8.2	9.02	10	12.1	124	15.5	645	6.5	8000
P 1.5KE8V2A	P 1.5KE8V2CA	200	7.02	7.79	8.2	8.61	10	12.1	124	15.5	645	6.5	8000
1.5KE9V1P	1.5KE9V1CP	50	7.78	8.65	9.1	10	1	13.4	112	17.1	585	6.8	7500
1.5KE9V1A	1.5KE9V1CA	50	7.78	8.65	9.1	9.55	1	13.4	112	17.1	585	6.8	7500
1.5KE10P	1.5KE10CP	10	8.55	9.5	10	11	1	14.5	103	18.6	538	7.3	7000
P 1.5KE10A	P 1.5KE10CA	10	8.55	9.5	10	10.5	1	14.5	103	18.6	538	7.3	7000
1.5KE11P	1.5KE11CP	5	9.4	10.5	11	12.1	1	15.6	96	20.3	493	7.5	6400
1.5KE11A	1.5KE11CA	5	9.4	10.5	11	11.6	1	15.6	96	20.3	493	7.5	6400
1.5KE12P	P 1.5KE12CP	5	10.2	11.4	12	13.2	1	16.7	90	21.7	461	7.8	6000
P 1.5KE12A	P 1.5KE12CA	5	10.2	11.4	12	12.6	1	16.7	90	21.7	461	7.8	6000
1.5KE13P	1.5KE13CP	5	11.1	12.4	13	14.3	1	18.2	82	23.6	423	8.1	5500
P 1.5KE13A	P 1.5KE13CA	5	11.1	12.4	13	13.7	1	18.2	82	23.6	423	8.1	5500
P 1.5KE15P	P 1.5KE15CP	5	12.8	14.3	15	16.5	1	21.2	71	27.2	368	8.4	5000
P 1.5KE15A	P 1.5KE15CA	5	12.8	14.3	15	15.8	1	21.2	71	27.2	368	8.4	5000
1.5KE16P	1.5KE16CP	5	13.6	15.2	16	17.6	1	22.5	67	28.9	346	8.6	4700
1.5KE16A	1.5KE16CA	5	13.6	15.2	16	16.8	1	22.5	67	28.9	346	8.6	4700
P 1.5KE18P	P 1.5KE18CP	5	15.3	17.1	18	19.8	1	25.2	59.5	32.5	308	8.8	4300
P 1.5KE18A	P 1.5KE18CA	5	15.3	17.1	18	18.9	1	25.2	59.5	32.5	308	8.8	4300
P 1.5KE20P	P 1.5KE20CP	5	17.1	19	20	22	1	27.7	54	36.1	277	9.0	4000
P 1.5KE20A	1.5KE20CA	5	17.1	19	20	21	1	27.7	54	36.1	277	9.0	4000
1.5KE22P	1.5KE22CP	5	18.8	20.9	22	24.2	1	30.6	49	39.3	254	9.2	3700

P = Prefered device

TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
						note2		10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
1.5KE22A	1.5KE22CA	5	18.8	20.9	22	23.1	1	30.6	49	39.3	254	9.2	3700
1.5KE24P	1.5KE24CP	5	20.5	22.8	24	26.4	1	33.2	45	42.8	234	9.4	3500
P 1.5KE24A	1.5KE24CA	5	20.5	22.8	24	25.2	1	33.2	45	42.8	234	9.4	3500
P 1.5KE27P	1.5KE27CP	5	23.1	25.7	27	29.7	1	37.5	40	48.3	207	9.6	3200
1.5KE27A	1.5KE27CA	5	23.1	25.7	27	28.4	1	37.5	40	48.3	207	9.6	3200
1.5KE30P	P 1.5KE30CP	5	25.6	28.5	30	33	1	41.5	36	53.5	187	9.7	2900
P 1.5KE30A	P 1.5KE30CA	5	25.6	28.5	30	31.5	1	41.5	36	53.5	187	9.7	2900
P 1.5KE33P	P 1.5KE33CP	5	28.2	31.4	33	36.3	1	45.7	33	59.0	169	9.8	2700
P 1.5KE33A	1.5KE33CA	5	28.2	31.4	33	34.7	1	45.7	33	59.0	169	9.8	2700
P 1.5KE36P	P 1.5KE36CP	5	30.8	34.2	36	39.6	1	49.9	30	64.3	156	9.9	2500
P 1.5KE36A	P 1.5KE36CA	5	30.8	34.2	36	37.8	1	49.9	30	64.3	156	9.9	2500
P 1.5KE39P	P 1.5KE39CP	5	33.3	37.1	39	42.9	1	53.9	28	69.7	143	10.0	2400
P 1.5KE39A	P 1.5KE39CA	5	33.3	37.1	39	41.0	1	53.9	28	69.7	143	10.0	2400
1.5KE43P	1.5KE43CP	5	36.8	40.9	43	47.3	1	59.3	25.3	76.8	130	10.1	2200
P 1.5KE43A	P 1.5KE43CA	5	36.8	40.9	43	45.2	1	59.3	25.3	76.8	130	10.1	2200
1.5KE47P	1.5KE47CP	5	40.2	44.7	47	51.7	1	64.8	23.2	84	119	10.1	2050
P 1.5KE47A	P 1.5KE47CA	5	40.2	44.7	47	49.4	1	64.8	23.2	84	119	10.1	2050
1.5KE51P	1.5KE51CP	5	43.6	48.5	51	56.1	1	70.1	21.4	91	110	10.2	1950
P 1.5KE51A	1.5KE51CA	5	43.6	48.5	51	53.6	1	70.1	21.4	91	110	10.2	1950
1.5KE56P	1.5KE56CP	5	47.8	53.2	56	61.6	1	77	19.5	100	100	10.3	1800
P 1.5KE56A	1.5KE56CA	5	47.8	53.2	56	58.8	1	77	19.5	100	100	10.3	1800
1.5KE62P	1.5KE62CP	5	53.0	58.9	62	68.2	1	85	17.7	111	90	10.4	1700
P 1.5KE62A	P 1.5KE62CA	5	53.0	58.9	62	65.1	1	85	17.7	111	90	10.4	1700
P 1.5KE68P	P 1.5KE68CP	5	58.1	64.6	68	74.8	1	92	16.3	121	83	10.4	1550
P 1.5KE68A	P 1.5KE68CA	5	58.1	64.6	68	71.4	1	92	16.3	121	83	10.4	1550
1.5KE75P	1.5KE75CP	5	64.1	71.3	75	82.5	1	103	14.6	134	75	10.5	1450
P 1.5KE75A	P 1.5KE75CA	5	64.1	71.3	75	78.8	1	103	14.6	134	75	10.5	1450
P 1.5KE82P	P 1.5KE82CP	5	70.1	77.9	82	90.2	1	113	13.3	146	69	10.5	1350
P 1.5KE82A	P 1.5KE82CA	5	70.1	77.9	82	86.1	1	113	13.3	146	69	10.5	1350
1.5KE91P	1.5KE91CP	5	77.8	86.5	91	100	1	125	12	162	62	10.6	1250
P 1.5KE91A	P 1.5KE91CA	5	77.8	86.5	91	95.5	1	125	12	162	62	10.6	1250
1.5KE100P	1.5KE100CP	5	85.5	95.0	100	110	1	137	11	178	56	10.6	1150
P 1.5KE100A	1.5KE100CA	5	85.5	95.0	100	105	1	137	11	178	56	10.6	1150
1.5KE110P	P 1.5KE110CP	5	94.0	105	110	121	1	152	9.9	195	51	10.7	1050
1.5KE110A	1.5KE110CA	5	94.0	105	110	116	1	152	9.9	195	51	10.7	1050
1.5KE120P	1.5KE120CP	5	102	114	120	132	1	165	9.1	212	47	10.7	1000
P 1.5KE120A	P 1.5KE120CA	5	102	114	120	126	1	165	9.1	212	47	10.7	1000
1.5KE130P	P 1.5KE130CP	5	111	124	130	143	1	179	8.4	230	43	10.7	950
P 1.5KE130A	P 1.5KE130CA	5	111	124	130	137	1	179	8.4	230	43	10.7	950
1.5KE150P	1.5KE150CP	5	128	143	150	165	1	207	7.2	265	38	10.8	850
P 1.5KE150A	P 1.5KE150CA	5	128	143	150	158	1	207	7.2	265	38	10.8	850
P 1.5KE160P	P 1.5KE160CP	5	136	152	160	176	1	219	6.8	282	35	10.8	800
P 1.5KE160A	P 1.5KE160CA	5	136	152	160	168	1	219	6.8	282	35	10.8	800
1.5KE170P	1.5KE170CP	5	145	161	170	187	1	234	6.4	301	33	10.8	750
P 1.5KE170A	1.5KE170CA	5	145	161	170	179	1	234	6.4	301	33	10.8	750
1.5KE180P	P 1.5KE180CP	5	154	171	180	198	1	246	6.1	317	31.5	10.8	725
P 1.5KE180A	P 1.5KE180CA	5	154	171	180	189	1	246	6.1	317	31.5	10.8	725
P 1.5KE200P	P 1.5KE200CP	5	171	190	200	220	1	274	5.5	353	28	10.8	675
P 1.5KE200A	P 1.5KE200CA	5	171	190	200	210	1	274	5.5	353	28	10.8	675
1.5KE220P	P 1.5KE220CP	5	188	209	220	242	1	328	4.6	388	26	10.8	625
P 1.5KE220A	P 1.5KE220CA	5	188	209	220	231	1	328	4.6	388	26	10.8	625
P 1.5KE250P	P 1.5KE250CP	5	213	237	250	275	1	344	5.0	442	23	11	560
P 1.5KE250A	P 1.5KE250CA	5	213	237	250	263	1	344	5.0	442	23	11	560
1.5KE280P	1.5KE280CP	5	239	266	280	308	1	384	5.0	494	20	11	520
1.5KE280A	1.5KE280CA	5	239	266	280	294	1	384	5.0	494	20	11	520

P = Prefered device

TYPES		I_{RM} @ V_{RM} max		V_{BR} @ I_R min nom max note2				V_{CL} @ I_{PP} max 10/1000µs		V_{CL} @ I_{PP} max 8/20µs		αT max note3	C typ note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
1.5KE300P	P 1.5KE300CP	5	256	285	300	330	1	414	5.0	529	19	11	500
P 1.5KE300A	1.5KE300CA	5	256	285	300	315	1	414	5.0	529	19	11	500
1.5KE320P	1.5KE320CP	5	273	304	320	352	1	438	4.5	564	18	11	460
P 1.5KE320A	1.5KE320CA	5	273	304	320	336	1	438	4.5	564	18	11	460
P 1.5KE350P	P 1.5KE350CP	5	299	332	350	385	1	482	4.0	618	16	11	430
1.5KE350A	1.5KE350CA	5	299	332	350	368	1	482	4.0	618	16	11	430
P 1.5KE400P	P 1.5KE400CP	5	342	380	400	440	1	548	4.0	706	14	11	390
1.5KE400A	1.5KE400CA	5	342	380	400	420	1	548	4.0	706	14	11	390
P 1.5KE440P	P 1.5KE440CP	5	376	418	440	484	1	603	3.5	776	13	11	360
1.5KE440A	1.5KE440CA	5	376	418	440	462	1	603	3.5	776	13	11	360

All parameters tested at 25 °C, except where indicated.

P = Prefered device

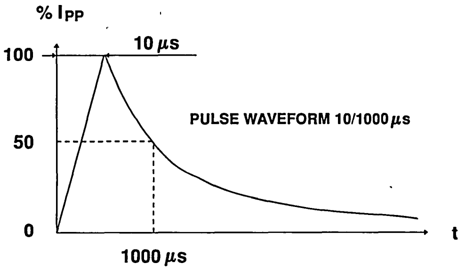
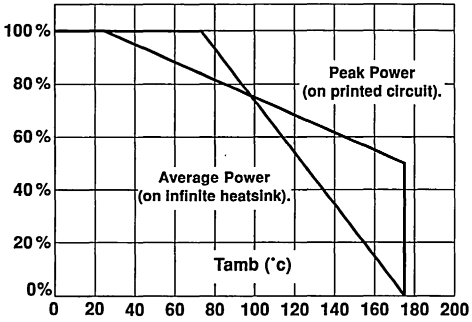


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 2 : Peak pulse power versus exponential pulse duration.

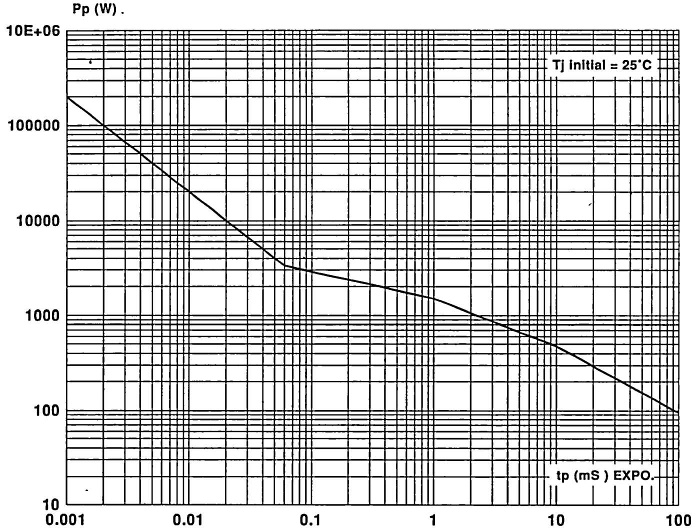
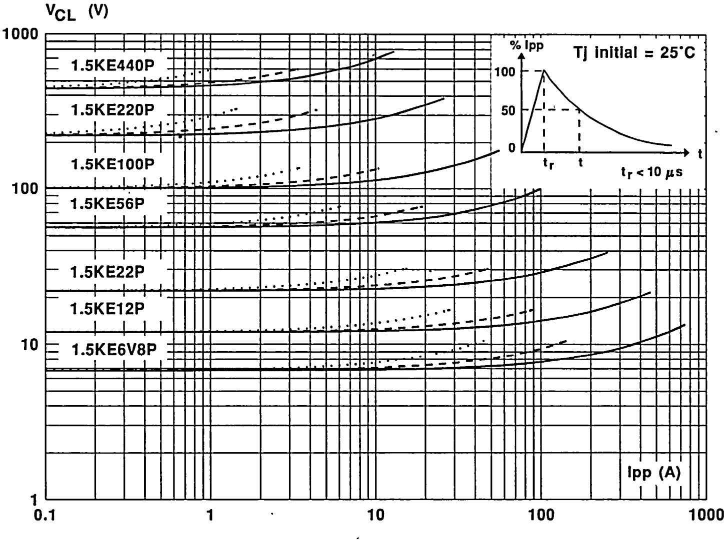


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

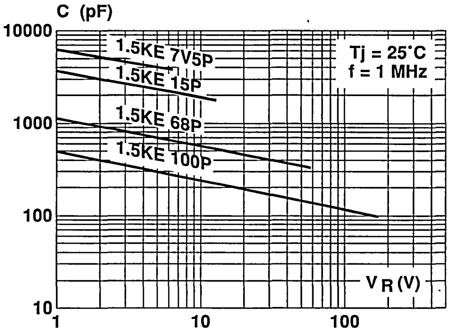


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

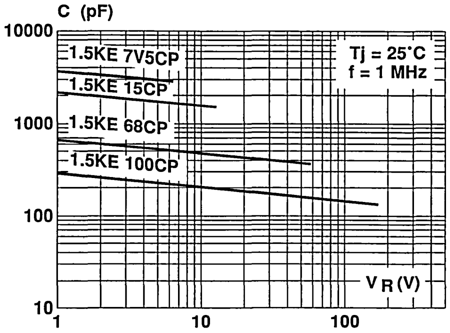


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

Note : For units with $V_{BR} > 200$ V
V_F is twice than shown.

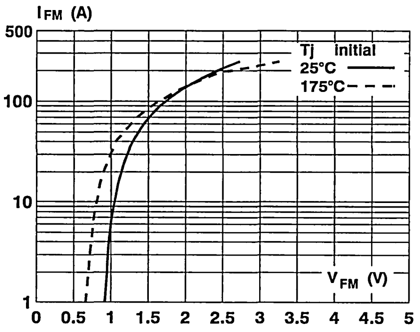
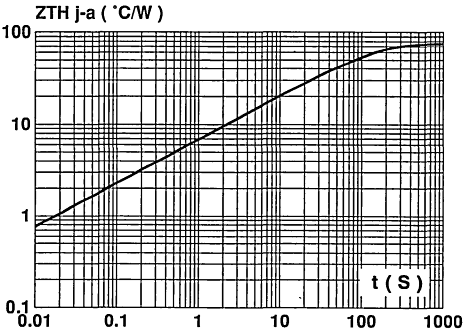


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with L_{lead} = 10mm.



ORDER CODE

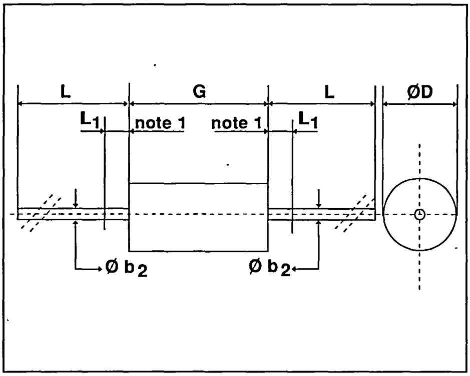
1.5 KE 100 C A RL

1500 W
BREAKDOWN VOLTAGE
BIDIRECTIONAL
PACKAGING:
= Ammopack
RL = Tape and reel.
TOLERANCE :
A = +/- 5%
P = -5%, +10%.

MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

CB429



Ref.	Millimeters		Inches	
	min	max	min	max
Ø b2	-	1.06	-	0.042
Ø D	-	5.1	-	0.20
G	-	9.8	-	0.386
L	26	-	1.024	-
L1	-	1.27	-	0.050
note1 :The diameter Ø b2 is not controlled over zone L1.				

Weight = 0.85 g.

Packaging : standard packaging is in tape and reel.

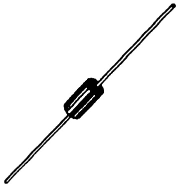
SGS-THOMSON
MICROELECTRONICS

BZW04-5V8,B/376,B
BZW04P5V8,B/376,B

TRANSIL

FEATURES

- PEAK PULSE POWER= 400 W @ 1ms.
- STAND-OFF VOLTAGE RANGE : From 5V8 to 376 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: $T_{clamping}$: 1ps (0 V to V_{BR}).
- UL RECOGNIZED



F126
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

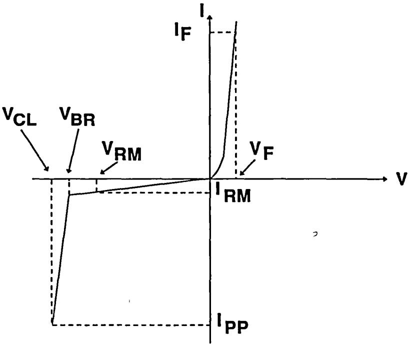
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	400	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	1.7	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types	Tamb = 25°C t =10 ms	50	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	60	°C/W
R_{th} (j-a)	Junction to ambiant. on printed circuit. L_{lead} = 10 mm	100	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ I_F = 25 A.



TYPES		I_{RM} @ V_{RM}		V_{BR} @			I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	Bidirectional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P BZW04P5V8	P BZW04P5V8B	1000	5.8	6.45	6.8	7.48	10	10.5	38	13.4	174	5.7	3500
BZW04-5V8	BZW04-5V8B	1000	5.8	6.45	6.8	7.14	10	10.5	38	13.4	174	5.7	3500
BZW04P6V4	P BZW04P6V4B	500	6.4	7.13	7.5	8.25	10	11.3	35.4	14.5	160	6.1	3100
BZW04-6V4	BZW04-6V4B	500	6.4	7.13	7.5	7.88	10	11.3	35.4	14.5	160	6.1	3100
BZW04P7V0	BZW04P7V0B	200	7.02	7.79	8.2	9.02	10	12.1	33	15.5	148	6.5	2700
BZW04-7V0	BZW04-7V0B	200	7.02	7.79	8.2	8.61	10	12.1	33	15.5	148	6.5	2700
BZW04P7V8	BZW04P7V8B	50	7.78	8.65	9.1	10	1	13.4	30	17.1	134	6.8	2300
BZW04-7V8	BZW04-7V8B	50	7.78	8.65	9.1	9.55	1	13.4	30	17.1	134	6.8	2300
BZW04P8V5	BZW04P8V5B	10	8.55	9.5	10	11	1	14.5	27.6	18.6	124	7.3	2000
BZW04-8V5	BZW04-8V5B	10	8.55	9.5	10	10.5	1	14.5	27.6	18.6	124	7.3	2000
P BZW04P9V4	BZW04P9V4B	5	9.4	10.5	11	12.1	1	15.6	25.7	20.3	113	7.5	1750
BZW04-9V4	BZW04-9V4B	5	9.4	10.5	11	11.6	1	15.6	25.7	20.3	113	7.5	1750
P BZW04P10	P BZW04P10B	5	10.2	11.4	12	13.2	1	16.7	24	21.7	106	7.8	1550
BZW04-10	BZW04-10B	5	10.2	11.4	12	12.6	1	16.7	24	21.7	106	7.8	1550
P BZW04P11	P BZW04P11B	5	11.1	12.4	13	14.3	1	18.2	22	23.6	97	8.1	1450
BZW04-11	BZW04-11B	5	11.1	12.4	13	13.7	1	18.2	22	23.6	97	8.1	1450
P BZW04P13	P BZW04P13B	5	12.8	14.3	15	16.5	1	21.2	19	27.2	85	8.4	1200
P BZW04-13	P BZW04-13B	5	12.8	14.3	15	15.8	1	21.2	19	27.2	85	8.4	1200
P BZW04P14	BZW04P14B	5	13.6	15.2	16	17.6	1	22.5	17.8	28.9	80	8.6	1100
BZW04-14	BZW04-14B	5	13.6	15.2	16	16.8	1	22.5	17.8	28.9	80	8.6	1100
P BZW04P15	P BZW04P15B	5	15.3	17.1	18	19.8	1	25.2	16	32.5	71	8.8	975
P BZW04-15	P BZW04-15B	5	15.3	17.1	18	18.9	1	25.2	16	32.5	71	8.8	975
BZW04P17	BZW04P17B	5	17.1	19	20	22	1	27.7	14.5	36.1	64	9.0	850
BZW04-17	BZW04-17B	5	17.1	19	20	21	1	27.7	14.5	36.1	64	9.0	850
BZW04P19	P BZW04P19B	5	18.8	20.9	22	24.2	1	30.6	13	39.3	59	9.2	800

P = Prevered device

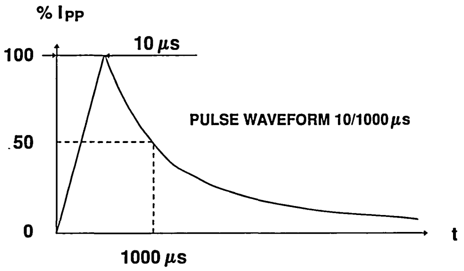
TYPES		IRM @ VRM		VBR	@		IR	VCL @ IPP		VCL @ IPP		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
BZW04-19	BZW04-19B	5	18.8	20.9	22	23.1	1	30.6	13	39.3	59	9.2	800
BZW04P20	P BZW04P20B	5	20.5	22.8	24	26.4	1	33.2	12	42.8	54	9.4	725
BZW04-20	BZW04-20B	5	20.5	22.8	24	25.2	1	33.2	12	42.8	54	9.4	725
BZW04P23	P BZW04P23B	5	23.1	25.7	27	29.7	1	37.5	10.7	48.3	48	9.6	625
BZW04-23	BZW04-23B	5	23.1	25.7	27	28.4	1	37.5	10.7	48.3	48	9.6	625
P BZW04P26	BZW04P26B	5	25.6	28.5	30	33	1	41.5	9.6	53.5	43	9.7	575
BZW04-26	BZW04-26B	5	25.6	28.5	30	31.5	1	41.5	9.6	53.5	43	9.7	575
P BZW04P28	P BZW04P28B	5	28.2	31.4	33	36.3	1	45.7	8.8	59.0	39	9.8	510
BZW04-28	BZW04-28B	5	28.2	31.4	33	34.7	1	45.7	8.8	59.0	39	9.8	510
BZW04P31	BZW04P31B	5	30.8	34.2	36	39.6	1	49.9	8	64.3	36	9.9	480
P BZW04-31	BZW04-31B	5	30.8	34.2	36	37.8	1	49.9	8	64.3	36	9.9	480
P BZW04P33	P BZW04P33B	5	33.3	37.1	39	42.9	1	53.9	7.4	69.7	33	10.0	450
P BZW04-33	BZW04-33B	5	33.3	37.1	39	41.0	1	53.9	7.4	69.7	33	10.0	450
BZW04P37	BZW04P37B	5	36.8	40.9	43	47.3	1	59.3	6.7	76.8	30	10.1	400
BZW04-37	P BZW04-37B	5	36.8	40.9	43	45.2	1	59.3	6.7	76.8	30	10.1	400
BZW04P40	BZW04P40B	5	40.2	44.7	47	51.7	1	64.8	6.2	84	27	10.1	370
BZW04-40	BZW04-40B	5	40.2	44.7	47	49.4	1	64.8	6.2	84	27	10.1	370
BZW04P44	BZW04P44B	5	43.6	48.5	51	56.1	1	70.1	5.7	91	25	10.2	350
BZW04-44	BZW04-44B	5	43.6	48.5	51	53.6	1	70.1	5.7	91	25	10.2	350
BZW04P48	P BZW04P48B	5	47.8	53.2	56	61.6	1	77	5.2	100	23	10.3	320
P BZW04-48	P BZW04-48B	5	47.8	53.2	56	58.8	1	77	5.2	100	23	10.3	320
BZW04P53	BZW04P53B	5	53.0	58.9	62	68.2	1	85	4.7	111	21	10.4	290
BZW04-53	BZW04-53B	5	53.0	58.9	62	65.1	1	85	4.7	111	21	10.4	290
P BZW04P58	P BZW04P58B	5	58.1	64.6	68	74.8	1	92	4.3	121	19	10.4	270
BZW04-58	BZW04-58B	5	58.1	64.6	68	71.4	1	92	4.3	121	19	10.4	270
BZW04P64	BZW04P64B	5	64.1	71.3	75	82.5	1	103	3.9	134	17	10.5	250
P BZW04-64	BZW04-64B	5	64.1	71.3	75	78.8	1	103	3.9	134	17	10.5	250
BZW04P70	BZW04P70B	5	70.1	77.9	82	90.2	1	113	3.5	146	16	10.5	230
BZW04-70	P BZW04-70B	5	70.1	77.9	82	86.1	1	113	3.5	146	16	10.5	230
BZW04P78	BZW04P78B	5	77.8	86.5	91	100	1	125	3.2	162	14	10.6	210
BZW04-78	BZW04-78B	5	77.8	86.5	91	95.5	1	125	3.2	162	14	10.6	210
P BZW04P85	P BZW04P85B	5	85.5	95.0	100	110	1	137	2.9	178	13	10.6	200
BZW04-85	BZW04-85B	5	85.5	95.0	100	105	1	137	2.9	178	13	10.6	200
BZW04P94	BZW04P94B	5	94.0	105	110	121	1	152	2.6	195	12	10.7	185
BZW04-94	BZW04-94B	5	94.0	105	110	116	1	152	2.6	195	12	10.7	185
BZW04P102	BZW04P102B	5	102	114	120	132	1	165	2.4	212	11	10.7	170
BZW04-102	BZW04-102B	5	102	114	120	126	1	165	2.4	212	11	10.7	170
BZW04P111	P BZW04P111B	5	111	124	130	143	1	179	2.2	230	10	10.7	165
BZW04-111	BZW04-111B	5	111	124	130	137	1	179	2.2	230	10	10.7	165
P BZW04P128	P BZW04P128B	5	128	143	150	165	1	207	2.0	265	9	10.8	145
BZW04-128	BZW04-128B	5	128	143	150	158	1	207	2.0	265	9	10.8	145
P BZW04P136	P BZW04P136B	5	136	152	160	176	1	219	1.8	282	8	10.8	140
P BZW04-136	P BZW04-136B	5	136	152	160	168	1	219	1.8	282	8	10.8	140
P BZW04P145	P BZW04P145B	5	145	161	170	187	1	234	1.7	301	7.5	10.8	135
BZW04-145	BZW04-145B	5	145	161	170	179	1	234	1.7	301	7.5	10.8	135
BZW04P154	BZW04P154B	5	154	171	180	198	1	246	1.6	317	7	10.8	125
BZW04-154	BZW04-154B	5	154	171	180	189	1	246	1.6	317	7	10.8	125
BZW04P171	BZW04P171B	5	171	190	200	220	1	274	1.5	353	6.5	10.8	120
BZW04-171	BZW04-171B	5	171	190	200	210	1	274	1.5	353	6.5	10.8	120
BZW04P188	P BZW04P188B	5	188	209	220	242	1	328	1.4	388	6	10.8	110
BZW04-188	BZW04-188B	5	188	209	220	231	1	328	1.4	388	6	10.8	110
BZW04P213	P BZW04P213B	5	213	237	250	275	1	344	1.5	442	5.2	11	100
BZW04-213	BZW04-213B	5	213	237	250	263	1	344	1.5	442	5.2	11	100
P BZW04P239	P BZW04P239B	5	239	266	280	308	1	384	1.5	494	4.6	11	95
BZW04-239	BZW04-239B	5	239	266	280	294	1	384	1.5	494	4.6	11	95

P = Prevered device

TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
BZW04P256	BZW04P256B	5	256	285	300	330	1	414	1.2	529	4.3	11	90
BZW04-256	BZW04-256B	5	256	285	300	315	1	414	1.2	529	4.3	11	90
BZW04P273	BZW04P273B	5	273	304	320	352	1	438	1.2	564	4	11	85
BZW04-273	BZW04-273B	5	273	304	320	336	1	438	1.2	564	4	11	85
BZW04P299	P BZW04P299B	5	299	332	350	385	1	482	0.9	618	3.7	11	80
P BZW04-299	P BZW04-299B	5	299	332	350	368	1	482	0.9	618	3.7	11	80
BZW04P342	P BZW04P342B	5	342	380	400	440	1	548	0.9	706	3.2	11	75
BZW04-342	P BZW04-342B	5	342	380	400	420	1	548	0.9	706	3.2	11	75
P BZW04P376	P BZW04P376B	5	376	418	440	484	1	603	0.8	776	3	11	70
BZW04-376	P BZW04-376B	5	376	418	440	462	1	603	0.8	776	3	11	70

All parameters tested at 25 °C, except where indicated.

P = Prefered device



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 1: Power dissipation derating versus ambient temperature

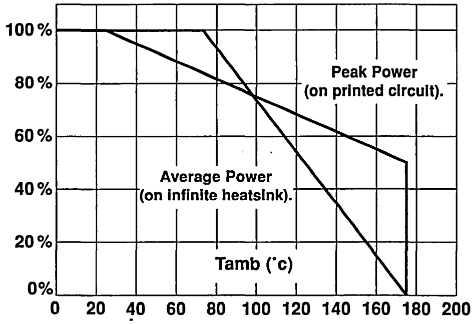


Figure 2 : Peak pulse power versus exponential pulse duration.

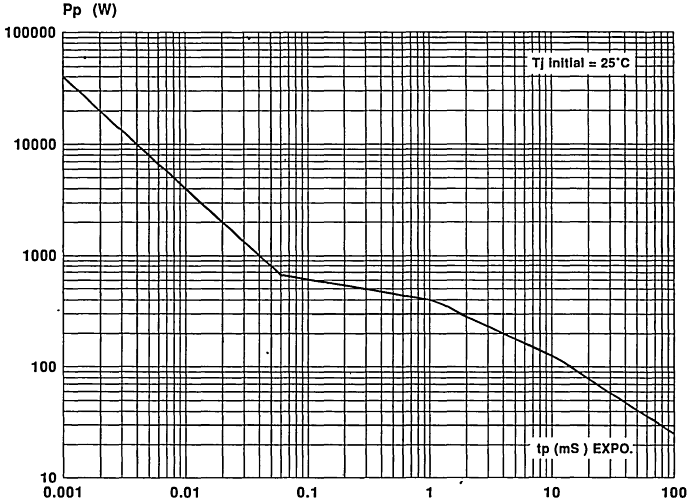
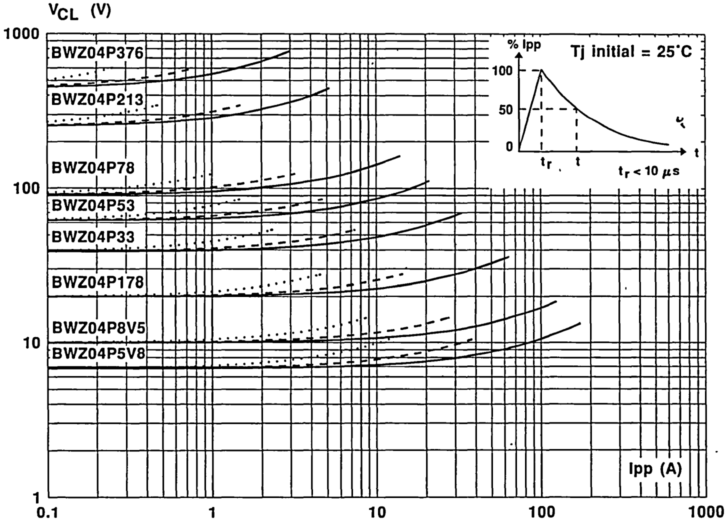


Figure 3 : Clamping voltage versus peak pulse current.

exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

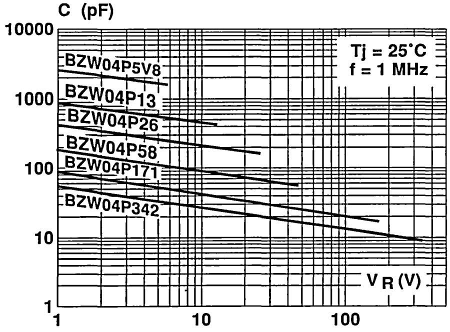


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

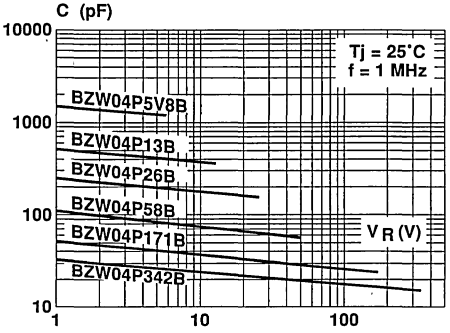


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

Note : For units with V_{BR} > 200 V
V_F is twice than shown.

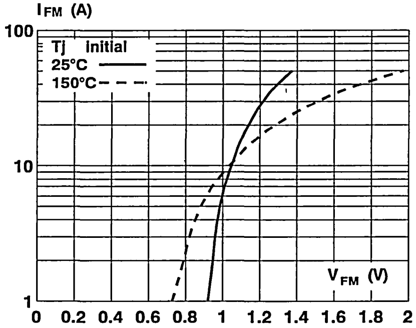
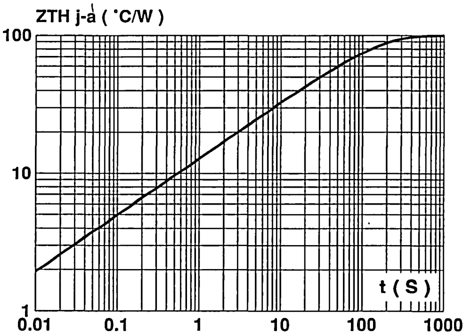


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with L lead = 10mm.



ORDER CODE

BZW 04 - 10 B RL

400 W ← 04

TOLERANCE : ← -
- = +/- 5%
P = -5%, +10%.

RL → PACKAGING:
= Ammopack
RL = Tape and reel.

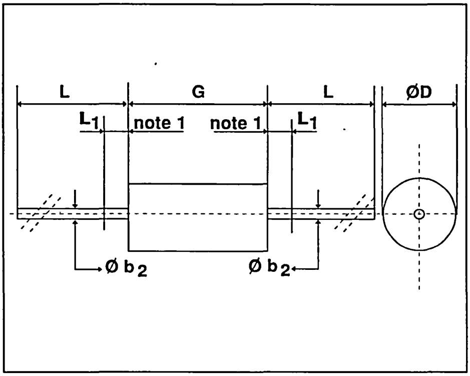
B → BIDIRECTIONAL

10 → STAND-OFF VOLTAGE

MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

F 126 (Plastic).



Ref	Millimeters		Inches	
	min	max	min	max
Ø b2	0.76	0.86	0.029	0.034
Ø D	2.95	3.05	0.116	0.120
G	6.05	6.35	0.238	0.250
L	26	-	1.024	-
L1	-	1.27	-	0.050

note1:The diameter Ø b2 is not controlled over zone L1.

Weight = 0.4 g.

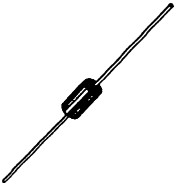
Packaging : standard packaging is in tape and reel.

BZW06-5V8,B/376,B
BZW06P5V8,B/376,B

TRANSIL

FEATURES

- PEAK PULSE POWER= 600 W @ 1ms.
- STAND-OFF VOLTAGE RANGE : From 5V8 to 376 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: Tclamping : 1ps (0 V to V_{BR}).



F126
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

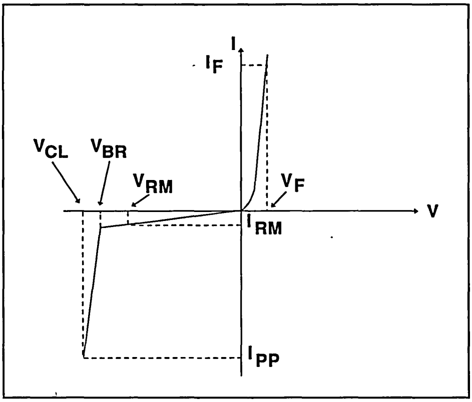
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	600	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	1.7	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types.	Tamb = 25°C t =10 ms	100	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	60	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. L_{lead} = 10 mm	100	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop V_F < 3.5V @ I_F = 50 A.



TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max note2		max 10/1000µs		max 8/20µs		max note3	typ note4
Unidirectional	Bidirectional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P BZW06P5V8	P BZW06P5V8B	1000	5.8	6.45	6.8	7.48	10	10.5	57	13.4	298	5.7	4000
P BZW06-5V8	P BZW06-5V8B	1000	5.8	6.45	6.8	7.14	10	10.5	57	13.4	298	5.7	4000
BZW06P6V4	BZW06P6V4B	500	6.4	7.13	7.5	8.25	10	11.3	53	14.5	276	6.1	3700
P BZW06-6V4	BZW06-6V4B	500	6.4	7.13	7.5	7.88	10	11.3	53	14.5	276	6.1	3700
BZW06P7V0	BZW06P7V0B	200	7.02	7.79	8.2	9.02	10	12.1	50	15.5	258	6.5	3400
BZW06-7V0	P BZW06-7V0B	200	7.02	7.79	8.2	8.61	10	12.1	50	15.5	258	6.5	3400
BZW06P7V8	BZW06P7V8B	50	7.78	8.65	9.1	10	1	13.4	45	17.1	234	6.8	3100
BZW06-7V8	BZW06-7V8B	50	7.78	8.65	9.1	9.55	1	13.4	45	17.1	234	6.8	3100
BZW06P8V5	BZW06P8V5B	10	8.55	9.5	10	11	1	14.5	41	18.6	215	7.3	2800
BZW06-8V5	BZW06-8V5B	10	8.55	9.5	10	10.5	1	14.5	41	18.6	215	7.3	2800
P BZW06P9V4	BZW06P9V4B	5	9.4	10.5	11	12.1	1	15.6	38	20.3	197	7.5	2500
BZW06-9V4	BZW06-9V4B	5	9.4	10.5	11	11.6	1	15.6	38	20.3	197	7.5	2500
P BZW06P10	BZW06P10B	5	10.2	11.4	12	13.2	1	16.7	36	21.7	184	7.8	2300
P BZW06-10	BZW06-10B	5	10.2	11.4	12	12.6	1	16.7	36	21.7	184	7.8	2300
BZW06P11	BZW06P11B	5	11.1	12.4	13	14.3	1	18.2	33	23.6	169	8.1	2150
BZW06-11	BZW06-11B	5	11.1	12.4	13	13.7	1	18.2	33	23.6	169	8.1	2150
BZW06P13	BZW06P13B	5	12.8	14.3	15	16.5	1	21.2	28	27.2	147	8.4	1900
P BZW06-13	P BZW06-13B	5	12.8	14.3	15	15.8	1	21.2	28	27.2	147	8.4	1900
P BZW06P14	BZW06P14B	5	13.6	15.2	16	17.6	1	22.5	27	28.9	138	8.6	1800
BZW06-14	BZW06-14B	5	13.6	15.2	16	16.8	1	22.5	27	28.9	138	8.6	1800
P BZW06P15	P BZW06P15B	5	15.3	17.1	18	19.8	1	25.2	24	32.5	123	8.8	1600
P BZW06-15	P BZW06-15B	5	15.3	17.1	18	18.9	1	25.2	24	32.5	123	8.8	1600
BZW06P17	BZW06P17B	5	17.1	19	20	22	1	27.7	22	36.1	111	9.0	1500
BZW06-17	P BZW06-17B	5	17.1	19	20	21	1	27.7	22	36.1	111	9.0	1500
BZW06P19	BZW06P19B	5	18.8	20.9	22	24.2	1	30.6	20	39.3	102	9.2	1350

TYPES		I_{RM} @	V_{RM}	V_{BR}	@		I_R	V_{CL} @	I_{PP}	V_{CL} @	I_{PP}	αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	Bidirectional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P BZW06-19	P BZW06-19B	5	18.8	20.9	22	23.1	1	30.6	20	39.3	102	9.2	1350
P BZW06P20	BZW06P20B	5	20.5	22.8	24	26.4	1	33.2	18	42.8	93	9.4	1250
BZW06-20	BZW06-20B	5	20.5	22.8	24	25.2	1	33.2	18	42.8	93	9.4	1250
BZW06P23	BZW06P23B	5	23.1	25.7	27	29.7	1	37.5	16	48.3	83	9.6	1150
P BZW06-23	BZW06-23B	5	23.1	25.7	27	28.4	1	37.5	16	48.3	83	9.6	1150
P BZW06P26	BZW06P26B	5	25.6	28.5	30	33	1	41.5	14.5	53.5	75	9.7	1075
P BZW06-26	P BZW06-26B	5	25.6	28.5	30	31.5	1	41.5	14.5	53.5	75	9.7	1075
BZW06P28	BZW06P28B	5	28.2	31.4	33	36.3	1	45.7	13.1	59.0	68	9.8	1000
P BZW06-28	P BZW06-28B	5	28.2	31.4	33	34.7	1	45.7	13.1	59.0	68	9.8	1000
BZW06P31	BZW06P31B	5	30.8	34.2	36	39.6	1	49.9	12	64.3	62	9.9	950
P BZW06-31	P BZW06-31B	5	30.8	34.2	36	37.8	1	49.9	12	64.3	62	9.9	950
P BZW06P33	BZW06P33B	5	33.3	37.1	39	42.9	1	53.9	11.1	69.7	57	10.0	900
P BZW06-33	P BZW06-33B	5	33.3	37.1	39	41.0	1	53.9	11.1	69.7	57	10.0	900
BZW06P37	P BZW06P37B	5	36.8	40.9	43	47.3	1	59.3	10.1	76.8	52	10.1	850
P BZW06-37	P BZW06-37B	5	36.8	40.9	43	45.2	1	59.3	10.1	76.8	52	10.1	850
BZW06P40	BZW06P40B	5	40.2	44.7	47	51.7	1	64.8	9.3	84	48	10.1	800
BZW06-40	BZW06-40B	5	40.2	44.7	47	49.4	1	64.8	9.3	84	48	10.1	800
BZW06P44	BZW06P44B	5	43.6	48.5	51	56.1	1	70.1	8.6	91	44	10.2	750
BZW06-44	BZW06-44B	5	43.6	48.5	51	53.6	1	70.1	8.6	91	44	10.2	750
BZW0P48	BZW06P48B	5	47.8	53.2	56	61.6	1	77	7.8	100	40	10.3	700
BZW06-48	P BZW06-48B	5	47.8	53.2	56	58.8	1	77	7.8	100	40	10.3	700
BZW06P53	BZW06P53B	5	53.0	58.9	62	68.2	1	85	7.1	111	36	10.4	650
BZW06-53	BZW06-53B	5	53.0	58.9	62	65.1	1	85	7.1	111	36	10.4	650
P BZW06P58	BZW06P58B	5	58.1	64.6	68	74.8	1	92	6.5	121	33	10.4	625
BZW06-58	P BZW06-58B	5	58.1	64.6	68	71.4	1	92	6.5	121	33	10.4	625
BZW06P64	BZW06P64B	5	64.1	71.3	75	82.5	1	103	5.8	134	30	10.5	575
P BZW06-64	BZW06-64B	5	64.1	71.3	75	78.8	1	103	5.8	134	30	10.5	575
BZW06P70	BZW06P70B	5	70.1	77.9	82	90.2	1	113	5.3	146	27	10.5	550
BZW06-70	BZW06-70B	5	70.1	77.9	82	86.1	1	113	5.3	146	27	10.5	550
BZW06P78	BZW06P78B	5	77.8	86.5	91	100	1	125	4.8	162	25	10.6	525
BZW06-78	BZW06-78B	5	77.8	86.5	91	95.5	1	125	4.8	162	25	10.6	525
BZW06P85	BZW06P85B	5	85.5	95.0	100	110	1	137	4.4	178	22.5	10.6	500
BZW06-85	BZW06-85B	5	85.5	95.0	100	105	1	137	4.4	178	22.5	10.6	500
BZW06P94	BZW06P94B	5	94.0	105	110	121	1	152	3.9	195	20.5	10.7	470
BZW06-94	BZW06-94B	5	94.0	105	110	116	1	152	3.9	195	20.5	10.7	470
BZW06P102	BZW06P102B	5	102	114	120	132	1	165	3.6	212	19	10.7	450
BZW06-102	BZW06-102B	5	102	114	120	126	1	165	3.6	212	19	10.7	450
BZW06P111	BZW06P111B	5	111	124	130	143	1	179	3.4	230	17.5	10.7	420
BZW06-111	BZW06-111B	5	111	124	130	137	1	179	3.4	230	17.5	10.7	420
BZW06P128	BZW06P128B	5	128	143	150	165	1	207	2.9	265	15	10.8	400
P BZW06-128	BZW06-128B	5	128	143	150	158	1	207	2.9	265	15	10.8	400
BZW06P136	BZW06P136B	5	136	152	160	176	1	219	2.7	282	14	10.8	380
BZW06-136	BZW06-136B	5	136	152	160	168	1	219	2.7	282	14	10.8	380
BZW06P145	BZW06P145B	5	145	161	170	187	1	234	2.6	301	13	10.8	370
BZW06-145	BZW06-145B	5	145	161	170	179	1	234	2.6	301	13	10.8	370
BZW06P154	BZW06P154B	5	154	171	180	198	1	246	2.4	317	12.6	10.8	360
BZW06-154	BZW0-154B	5	154	171	180	189	1	246	2.4	317	12.6	10.8	360
BZW06P171	BZW06P171B	5	171	190	200	220	1	274	2.2	353	11.3	10.8	350
P BZW06-171	P BZW06-171B	5	171	190	200	210	1	274	2.2	353	11.3	10.8	350
BZW06P188	BZW06P188B	5	188	209	220	242	1	328	2	388	10.3	10.8	330
BZW06-188	BZW06-188B	5	188	209	220	231	1	328	2	388	10.3	10.8	330
BZW06P213	BZW06P213B	5	213	237	250	275	1	344	2	442	9	11	310
BZW06-213	BZW06-213B	5	213	237	250	263	1	344	2	442	9	11	310
BZW06P239	BZW0P239B	5	239	266	280	308	1	384	2	494	8	11	300
BZW06-239	BZW06-239B	5	239	266	280	294	1	384	2	494	8	11	300

TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
BZW06P256	BZW06P256B	5	256	285	300	330	1	414	1.6	529	7.6	11	290
BZW06-256	BZW06-256B	5	256	285	300	315	1	414	1.6	529	7.6	11	290
BZW06P273	BZW06P273B	5	273	304	320	352	1	438	1.6	564	7.1	11	280
BZW06-273	P BZW06-273B	5	273	304	320	336	1	438	1.6	564	7.1	11	280
BZW06P299	BZW06P299B	5	299	332	350	385	1	482	1.6	618	6.5	11	270
P BZW06-299	BZW06-299B	5	299	332	350	368	1	482	1.6	618	6.5	11	270
P BZW06P342	P BZW06P342B	5	342	380	400	440	1	548	1.3	706	5.7	11	360
P BZW06-342	P BZW06-342B	5	342	380	400	420	1	548	1.3	706	5.7	11	360
P BZW06P376	P BZW06P376B	5	376	418	440	484	1	603	1.3	776	5.2	11	350
P BZW06-376	P BZW06-376B	5	376	418	440	462	1	603	1.3	776	5.2	11	350

All parameters tested at 25 °C, except where indicated.

P = Prefered device

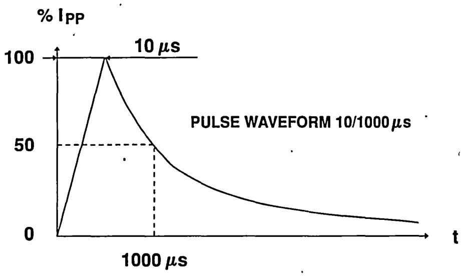
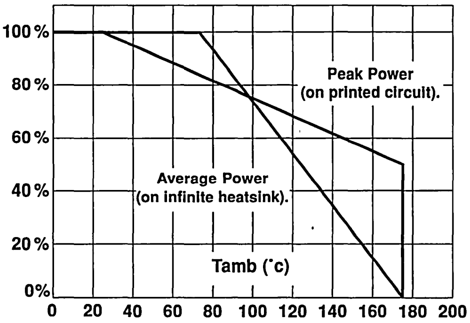


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: T_P < 50 ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 2 : Peak pulse power versus exponential pulse duration.

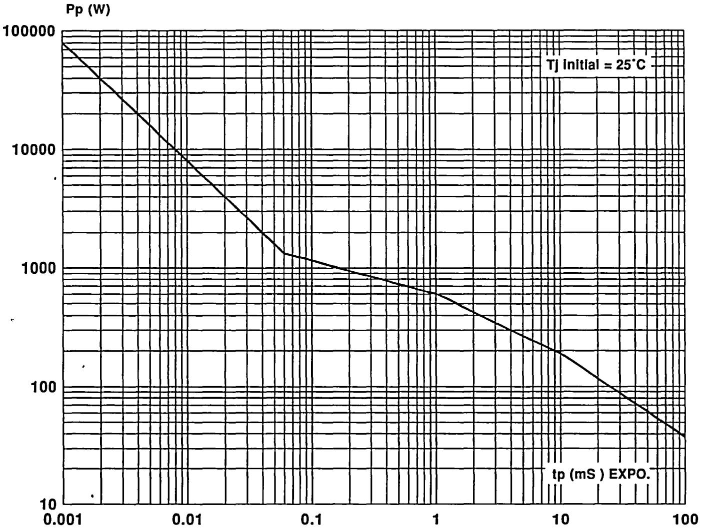
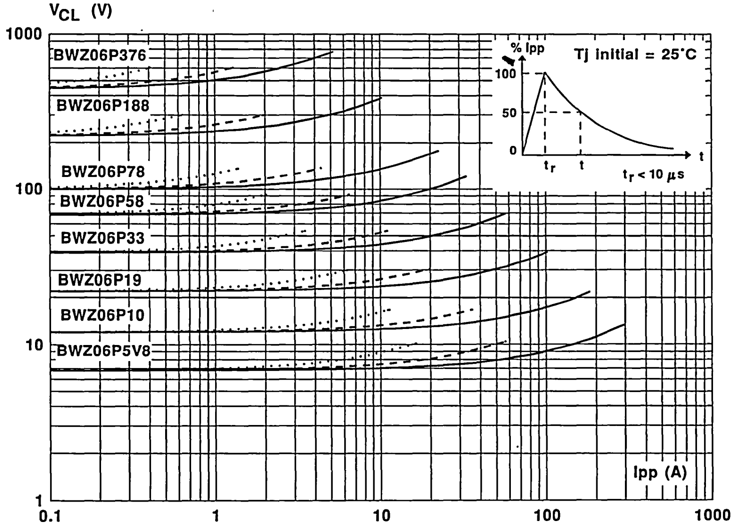


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms ------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

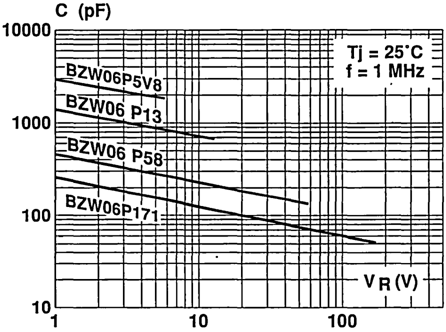


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

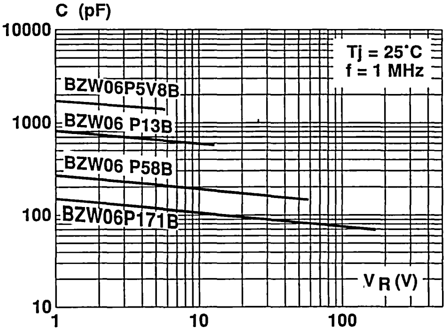


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

Note : For units with V_{BR} > 200 V V_F is twice than shown.

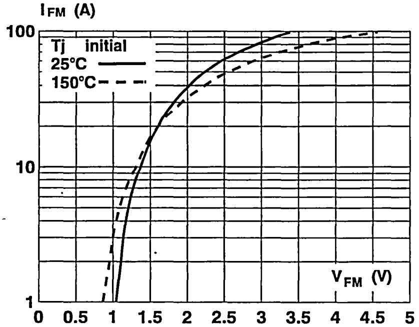
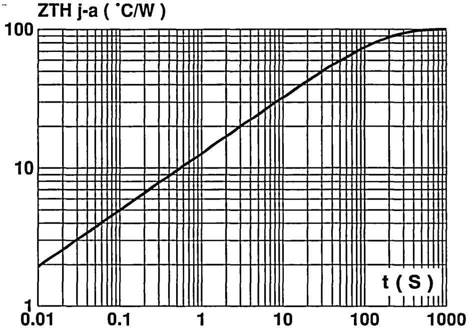
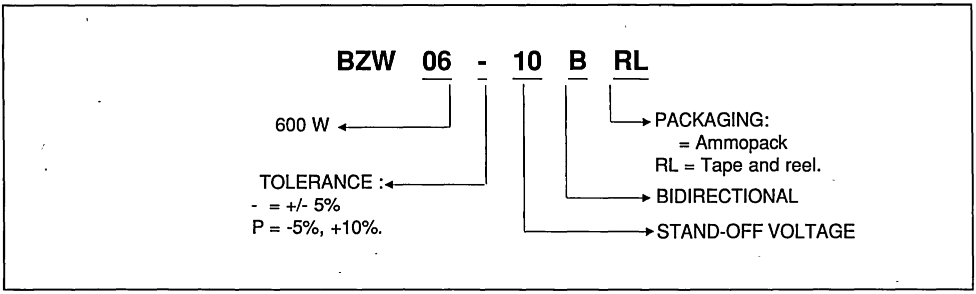


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with L lead = 10mm.



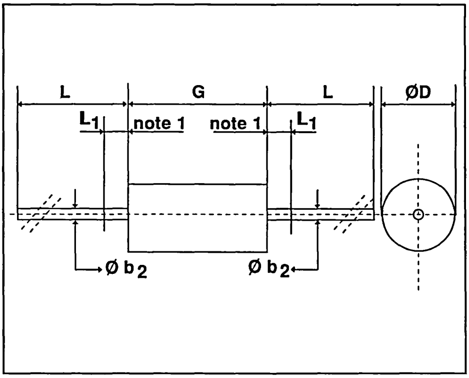
ORDER CODE



MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

F 126 (Plastic).



Ref	Millimeters		Inches	
	min	max	min	max
Ø b_2	0.76	0.86	0.029	0.034
Ø D	2.95	3.05	0.116	0.120
G	6.05	6.35	0.238	0.250
L	26	-	1.024	-
L_1	-	1.27	-	0.050

note1:The diameter Ø b_2 is not controlled over zone L_1.

Weight = 0.4 g.

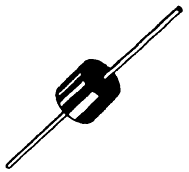
Packaging : standard packaging is in tape and reel.

BZW50-10,B/180,B

TRANSIL

FEATURES

- PEAK PULSE POWER= 5000 W @ 1ms.
- STAND-OFF VOLTAGE RANGE :
  From 10V to 180 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME:
  Tclamping : 1ps (0 V to VBR).



AG
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

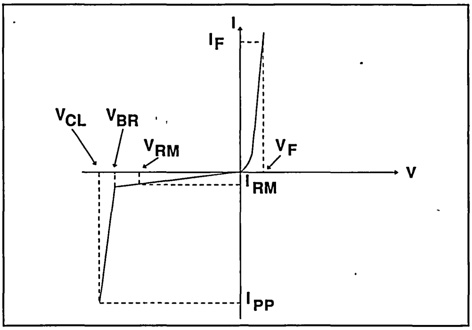
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	5000	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	6.5	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types.	Tamb = 25°C t =10 ms	500	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	15	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. L_{lead} = 10 mm	65	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.



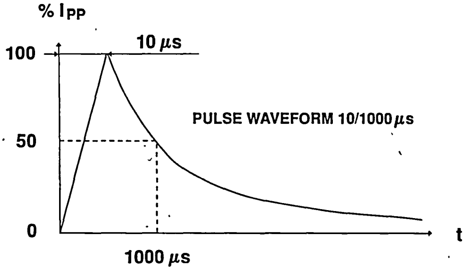
TYPES		I_{RM} @ V_{RM}		V_{BR} @ I_R				V_{CL}@ I_{PP}		V_{CL}@ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
BZW50-10	BZW50-10B	5	10	11.1	12.4	13.6	1	18.8	266	23.4	2564	7.8	24000
BZW50-12	BZW50-12B	5	12	13.3	14.8	16.3	1	22	227	28	2143	8.4	18500
BZW50-15	BZW50-15B	5	15	16.6	18.5	20.4	1	26.9	186	35	1714	8.8	13500
BZW50-18	BZW50-18B	5	18	20	22.2	24.4	1	32.2	155	41.5	1446	9.2	11500
BZW50-22	BZW50-22B	5	22	24.4	27.1	29.8	1	39.4	127	51	1177	9.6	8500
BZW50-27	BZW50-27B	5	27	30	33.3	36.6	1	48.3	103	62	968	9.8	7000
BZW50-33	BZW50-33B	5	33	36.6	40.7	44.7	1	59	85	76	789	1.0	5750
BZW50-39	BZW50-39B	5	39	43.3	48.1	53	1	69.4	72	90	667	10.1	4800
BZW50-47	BZW50-47B	5	47	52	57.8	63.6	1	83.2	60.1	108	556	10.3	4100
BZW50-56	BZW50-56B	5	56	62.2	69.1	76	1	99.6	50	129	465	10.4	3400
BZW50-68	BZW50-68B	5	68	75.6	84	92.4	1	121	41	157	382	10.5	3000
BZW50-82	BZW50-82B	5	82	91	101.2	111	1	145	34	189	317	10.6	2600
BZW50-100	BZW50-100B	5	100	111	123.5	136	1	179	28	228	263	10.7	2300
BZW50-120	BZW50-120B	5	120	133	148.1	163	1	215	23	274	219	10.8	1900
BZW50-150	BZW50-150B	5	150	166	185.2	204	1	269	19	343	175	10.8	1700
BZW50-180	BZW50-180B	5	180	200	222	244	1	322	16	410	146	10.8	1500

All parameters tested at 25 °C, except where indicated.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Figure 1: Power dissipation derating versus ambient temperature

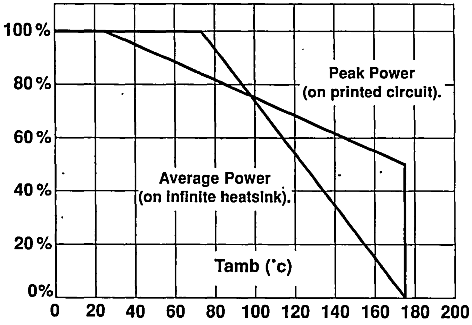


Figure 2 : Peak pulse power versus exponential pulse duration.

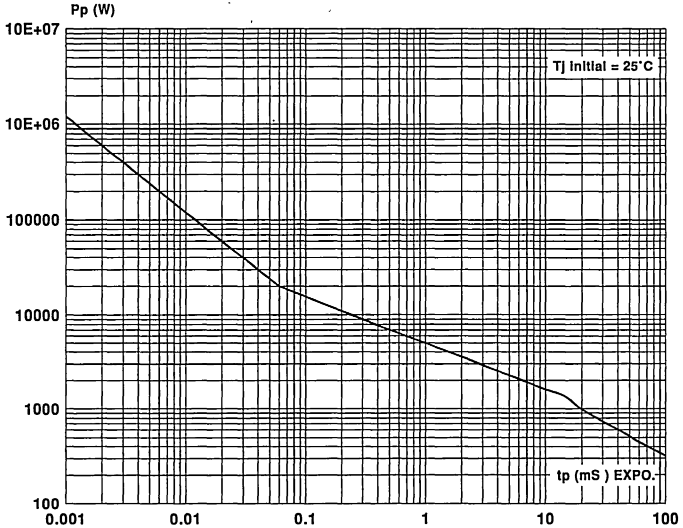
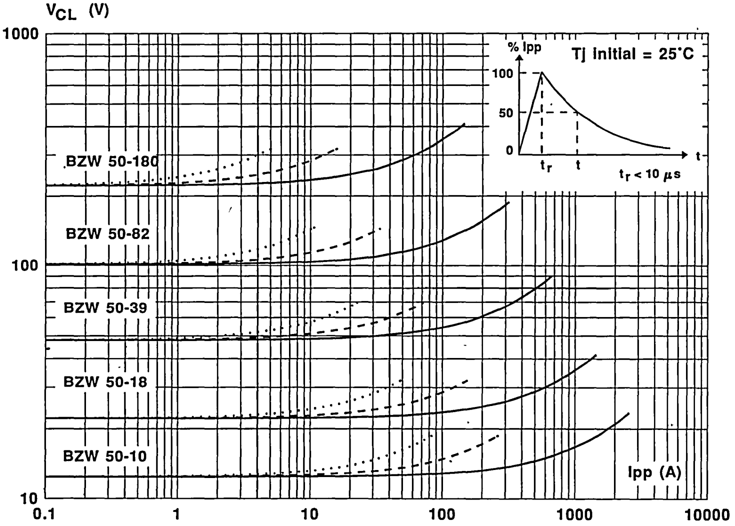


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

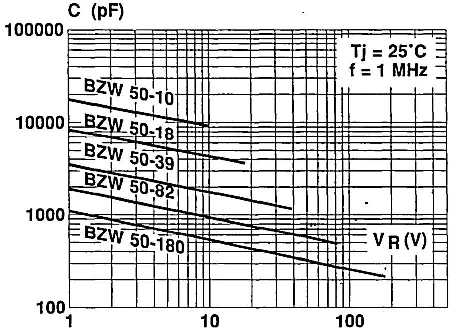


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

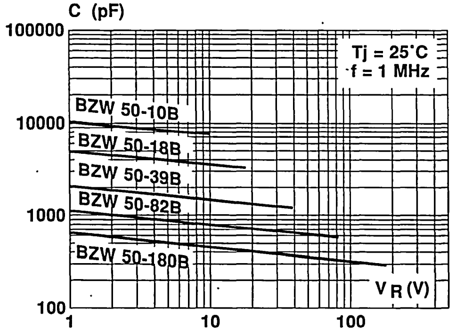


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

Note : For units with V_{BR} > 200 V
V_F is twice than shown.

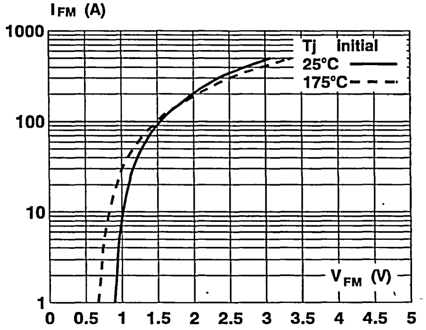
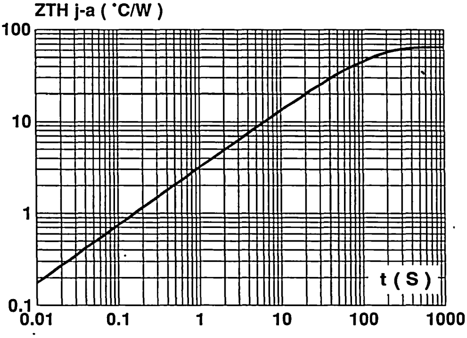
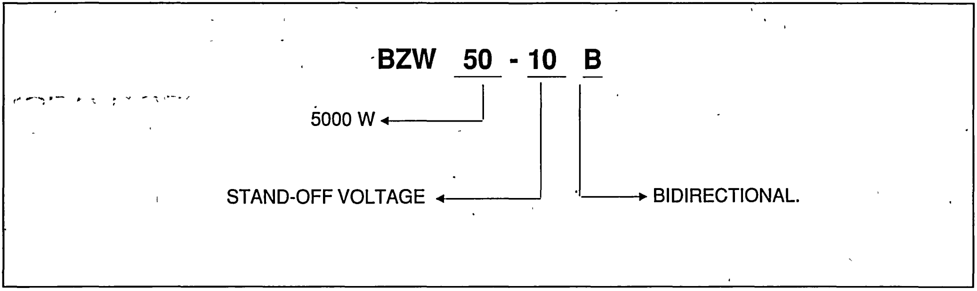


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with L $_{lead}$ = 10mm.



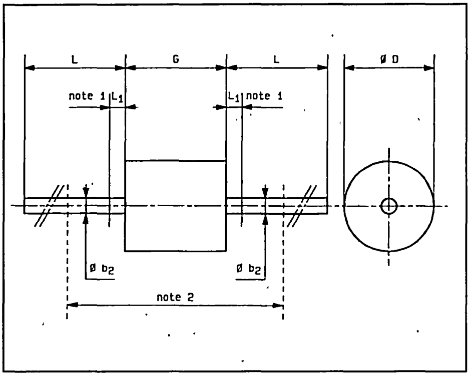
ORDER CODE



MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

AG plastic.



Ref	Millimeters		Inches	
	min	max	min	max
$\varnothing b_2$	1.35	1.45	0.053	0.057
Ø D	-	8	-	0.315
G	-	9.8	-	0.354
L	20	-	0.787	-
L_1	-	1.27	-	0.050

note 1 : The lead diameter $\varnothing b_2$ is not controlled over zone L_1.
note 2 : 20mm minimum between bendings.

Weight = 1.6 g.

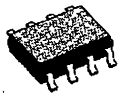
Packaging : standard packaging is in bulk.

ITA6V5B1 / ITA10B1
ITA18B1 / ITA25B1

MONOLITHIC TRANSIL® ARRAY FOR DATA LINE PROTECTION

FEATURES

- HIGH SURGE CAPABILITY TRANSIL ARRAY I_{PP} = 40 A 8/20µs
- UP TO 5 BIDIRECTIONAL TRANSIL FUNCTIONS
- BREAK DOWN VOLTAGE AND MAXIMUM DIFFERENTIAL VOLTAGE BETWEEN TWO INPUT PINS :
  ITA6V5 = 6.5 V
  ITA10 = 10 V
  ITA18 = 18 V
  ITA25 = 25 V
- LOW CLAMPING FACTOR (V_{CL} / V_{BR}) AT HIGH CURRENT LEVEL
- LOW LEAKAGE CURRENT
- LOW INPUT CAPACITANCE



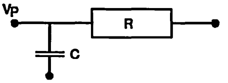
SO8
(Plastic)

DESCRIPTION

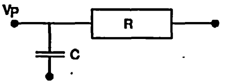
This is a specific transil array for RS232, RS423 interface protection developed in monolithic chip form in order to provide a high surge capability and a low clamping voltage

IN ACCORDANCE WITH :

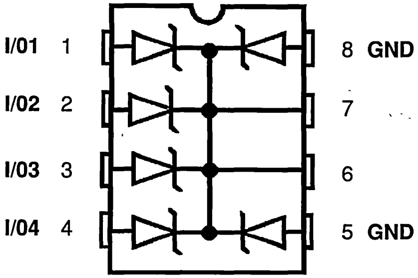
- ESD standard :
. IEC 801-2 15kV 5ns / 50ns
. IEC 801-4 40A 5ns / 50ns
. IEC 801-5 1kV 1.2 / 50µs
25A 8 / 20µs
. MIL STD 883C - Method 3015-2
V_P = 25kV
C = 150pF
R = 150Ω
5 s duration



- Human body test :
V_P = 4kV
C = 150pF
R = 150Ω



FUNCTIONAL DIAGRAM

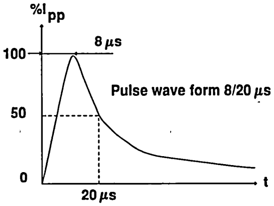


EQUIVALENT TO 4 BIDIRECTIONAL TRANSILS

ABSOLUTE RATINGS (limiting values) (0°C ≤ Tamb ≤ 70°C)

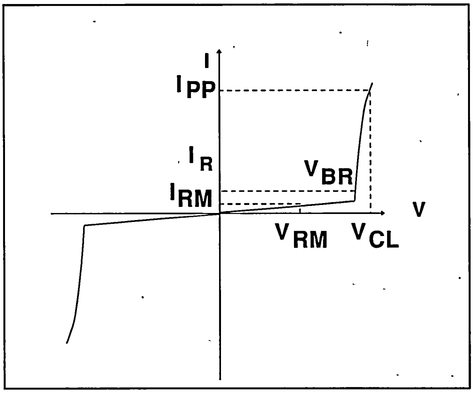
Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current for 8/20 µsexponential pulse	See note	40	A
I^2t	Wire I^2 t value	See note	0.6	A^2s
T_{stg} T_j	Storage and Junction Temperature Range		- 55 to + 150 125	°C °C

Note : For surges greater than the maximum value specified, the input/output will present first a short circuit to the common bus line and after an open circuit caused by the wire.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
I_{RM}	Leakage Current @ V_{RM}
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{CL}	Clamping Voltage
I_{PP}	Surge Current
C	Input Capacitance



Types	I_{RM} max	@ V_{RM}	V_{BR} min Note 1	@ I_R	V_{CL} Note 1	@ I_{PP} 8/20µs	V_{CL} max Note 1	@ I_{PP} 8/20µs	C1 max Note 2	C2 max Note 3	αT max
	µA	V	V	mA	V	A	V	A	pF	pF	10^{-4}/°C
ITA6V5B1	50	5	6.5	1	10	10	12	25	750	550	4
ITA10B1	10	8	10	1	15	10	19	25	570	260	8
ITA18B1	4	15	18	1	25	10	28	25	350	180	9
ITA25B1	4	24	25	1	33	10	38	25	300	100	12

All parameters tested at 25ÉC, except where indicated.

Note 1 : Between I/O pin and ground.
Note 2 : Between two input Pins at 0 V Bias.
Note 3 : Between two input Pins at V_{RM}.

Figure1 : Typical Peak pulse power versus exponential pulse duration.

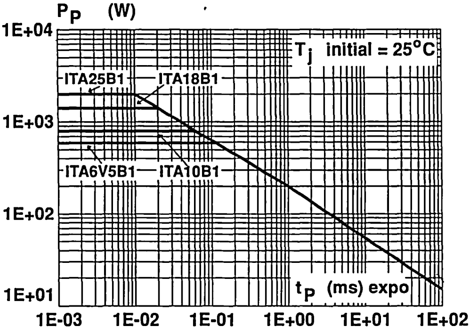


Figure 2 : Clamping voltage versus peak pulse current exponential waveform 8/20 µs.

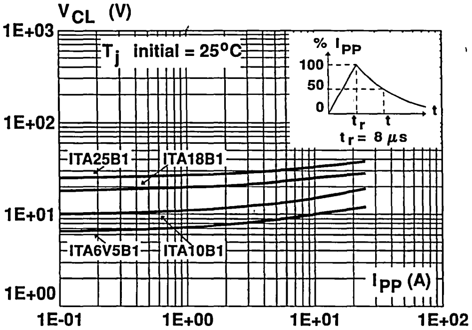


Figure 3 : Peak current IDC inducing open circuit of the wire for one input/output versus pulse duration (typical values).

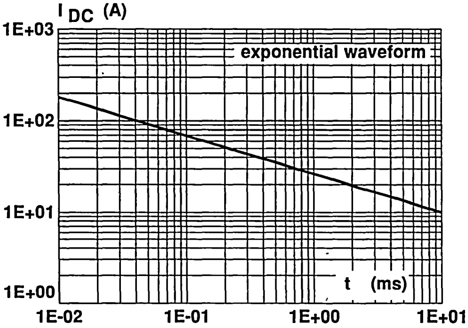
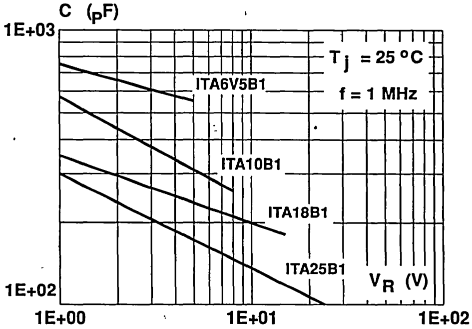


Figure 4 : Junction capacitance versus reverse applied voltage for one input/output (typical values).



Note : The curve of the figure 2 is specified for a junction temperature of 25°C before surge.

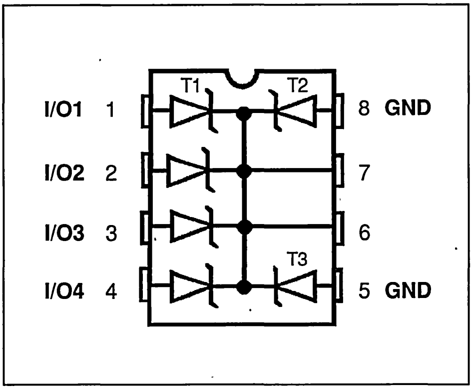
APPLICATION NOTICE

Types	Maximum differential voltage between two input pins at 25°C
	V
ITA6V5B1	6.5
ITA10B1	10
ITA18B1	18
ITA25B1	25

INSTRUCTION GUIDE

This monolithic Transil Array is based on 6 Unidirectional Transils with a common cathode and can be configurated to offer 4 or 5 bidirectional functions, according to the following customer application.

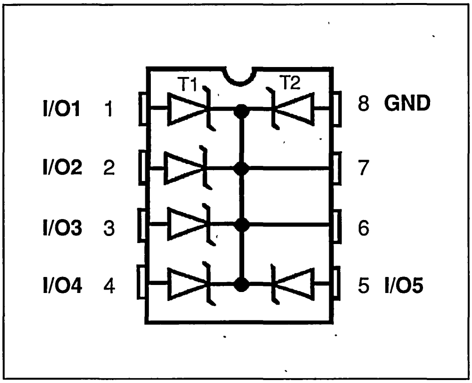
Figure 5 : Equivalent to 4 Bidirectional Transils



UTILIZATION AS A BIDIRECTIONAL TRANSIL ARRAY WITH 4 I/Os.
The main application of this device is to be configurated as a 4, bidirectional Transil Array as per the Pin-out of Fig 5.
Pins 5 and 8 are connected to ground.
INPUTS/OUTPUTS are from Pin 1 to Pin 4.

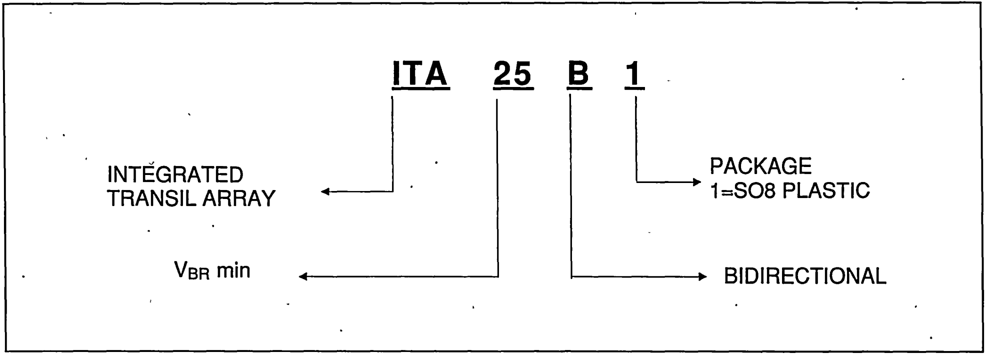
Note : The bidirectional function is made with 2 unidirectional Transils. One (T1) is connected to the INPUT/OUTPUT, the other one (T2) is connected to the ground (see Fig 5).
Ground is connected via 2 diodes T2 and T3 .
This allows to withstand 2 specified surges on 2 different lines at the same time.

Figure 6 : Equivalent to 5 Bidirectional Transils



UTILIZATION AS A BIDIRECTIONAL TRANSIL ARRAY WITH 5 I/Os.
The ITAxxB1 can be used as a 5 bidirectional Transil Array.
Ground can be connected to any pin (except 6 and 7).
The other pins are used as INPUTS and OUTPUTS.
The bidirectional function is made with 2 unidirectional Transils T1 and T2. One example with ground on Pin 8 is shown in Fig 6.
This configuration allows to withstand only one specified surge at the same time.

ORDER CODE

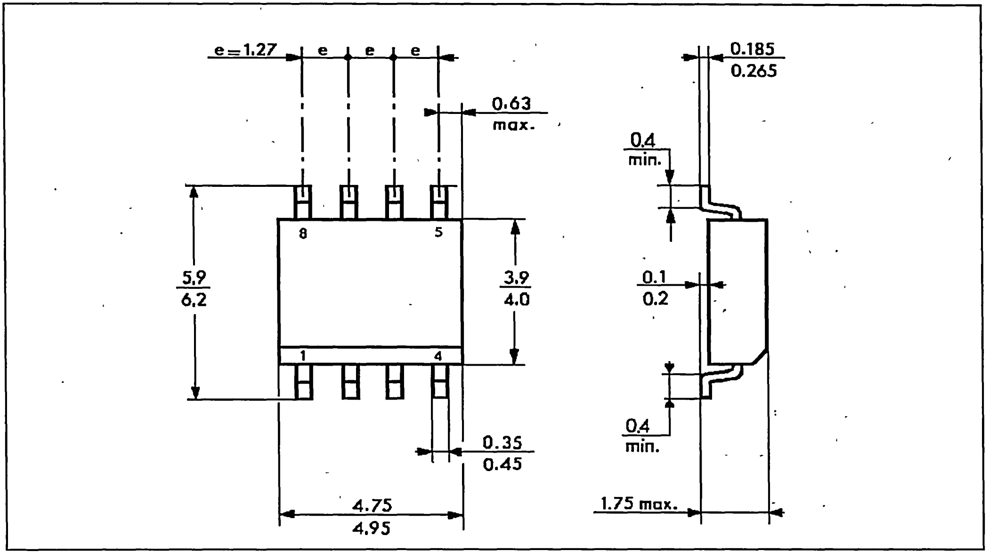


MARKING

TYPE	MARKING
ITA6V5B1	6V5B1
ITA10B1	10B1
ITA18B1	18B1
ITA25B1	25B1

PACKAGE MECHANICAL DATA (in millimeters)

SO8 Plastic



Packaging : Products supplied in antistatic tubes.

SGS-THOMSON
MICROELECTRONICS

ITA6V5B3 / ITA10B3
ITA18B3 / ITA25B3

MONOLITHIC TRANSIL® ARRAY FOR DATA LINE PROTECTION

FEATURES

- HIGH SURGE CAPABILITY TRANSIL ARRAY IPP = 40 A 8/20µs
- UP TO 9 BIDIRECTIONAL TRANSIL FUNCTIONS
- BREAKDOWN VOLTAGE AND MAXIMUM DIFFERENTIAL VOLTAGE BETWEEN TWO INPUT PINS :
  ITA 6V5 = 6,5 V
  ITA10 = 10 V
  ITA18 = 18 V
  ITA25 = 25 V
- AVAILABLE IN SO 20 PACKAGES

DESCRIPTION

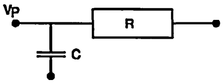
Specially developed for RS 232, RS 423 interface protection, this monolithic chip component offers a high surge capability and a low clamping voltage.

The internal wire bonding, "4 points connection", ensures a reliable protection against very fast transient overvoltages like ESD.

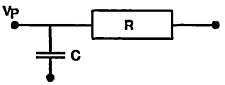
A low clamping voltage is guaranteed,eliminating all spikes due to the perturbation itself and also spikes induced by parasitic inductances created by external wiring.

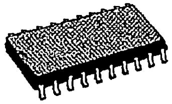
IN ACCORDANCE WITH :

- ESD standard :
  . IEC 801-2 15kV 5ns / 50ns
  . IEC 801-4 40A 5ns / 50ns
  . IEC 801-5 1kV 1.2 / 50µs
  25A 8/20µs
  . MIL STD 883C - Methode 3015-2
  VP = 25kV
  C = 150pF
  R = 150Ω
  5 s duration



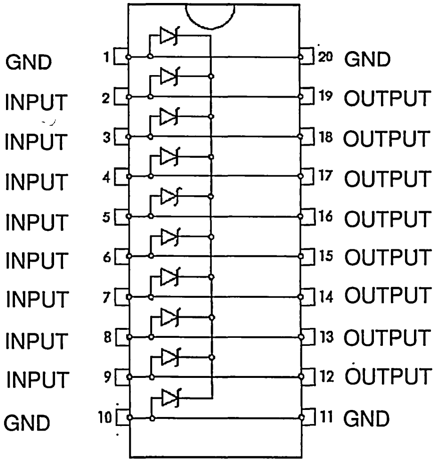
- Human body test :
  VP = 4kV
  C = 150pF
  R = 150Ω





SO 20
(Plastic)

FUNCTIONAL DIAGRAM

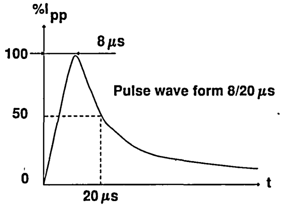


EQUIVALENT TO 8 BIDIRECTIONAL TRANSILS

ABSOLUTE RATINGS (limiting values) (0°C ≤ Tamb ≤ 70°C)

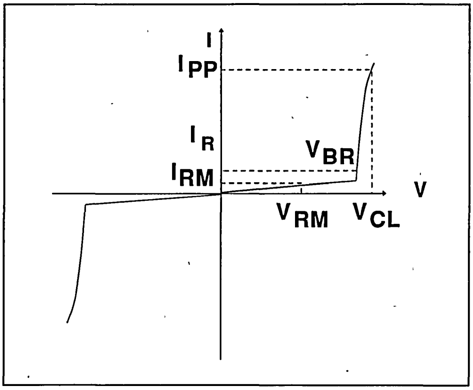
Symbol	Parameter		Value	Unit
Ipp	Peak pulse current for 8/20 µs exponential pulse	See note	40	A
I^2t	Wire I^2t value	See note	0.6	A^2s
T_{stg} T_j	Storage and Junction Temperature Range		- 55 to + 150 125	°C °C

Note : For surges greater than the maximum value specified, the input/output will present first a short circuit to the common bus line and after an open circuit caused by the wire.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
I_{RM}	Leakage Current @ V_{RM}
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{CL}	Clamping Voltage
I_{PP}	Surge Current
C	Input Capacitance



Types	I_{RM} @	V_{RM}	V_{BR} @	I_R	V_{CL} @	I_{PP}	V_{CL}	I_{pp}	C1	C2	α_T
	max		min Note 1		max Note 1	8/20µs	max Note 1	8/20µs	max Note2	max Note3	max
	µA	V	V	mA	V	A	V	A	pf	pf	10^{-4}/°C
ITA6V5B3	50	5	6.5	1	9,5	10	11	25	1100	800	4
ITA10B3	10	8	10	1	13	10	17	25	800	360	8
ITA18B3	4	15	18	1	23	10	26	25	500	250	9
ITA25B3	4	24	25	1	31	10	36	25	420	140	12

All parameters tested at 25°C, except where indicated.

Note 1 : Between I/O pin and ground
Note 2 : Between two input Pins at 0 V Bias
Note 3 : Between one input Pin at 0 V and one input Pin at V_{RM}.

Figure 1 : Typical. Peak pulse power versus exponential pluse duration.

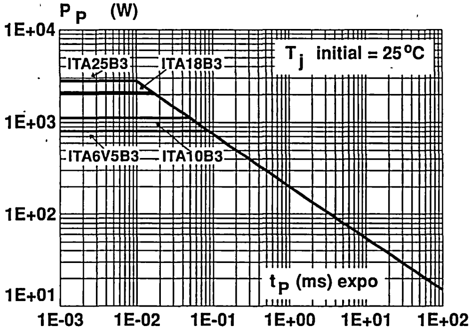


Figure 2 : Clampling voltage versus peak pulse current exponential waveform 8/20 µs.

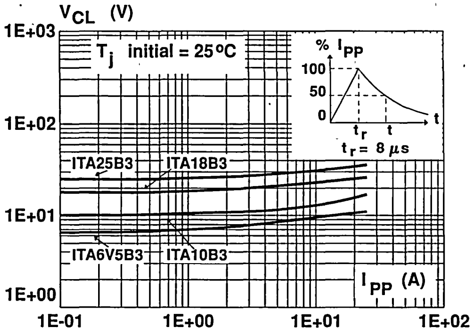


Figure 3 : Peak current IPC inducing open circuit of the wire for one input/output versus pulse duration (typical values).

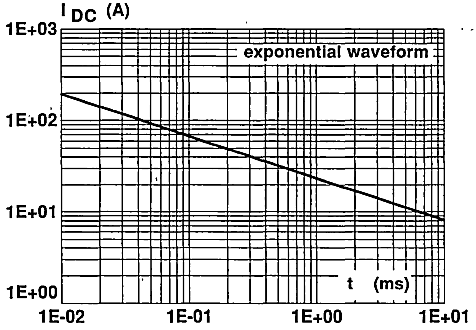
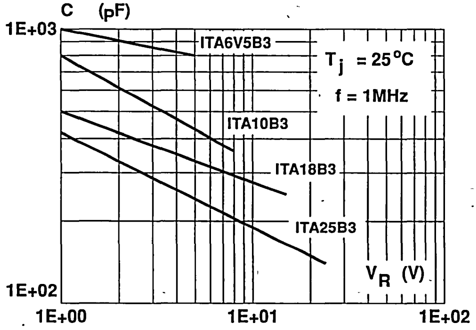


Figure 4 : Junction capacitance versus reverse applied voltage for one input/output (typical values).



Note : The curve of the figure 2 is specified for a junction temperature of 25°C before surge.

APPLICATION NOTICE

TYPES	Maximum differential voltage between two input pins at 25 °C
	V
ITA6V5B	6.5
ITA10B3	10
ITA18B3	18
ITA25B3	25

This monolithic Transil Array is based on 10 Unidirectional Transils with a common cathode and can be configured to offer 8 or 9 bidirectional functions following the customer application.

Figure 5 : Equivalent to 8 Bidirectional Transils

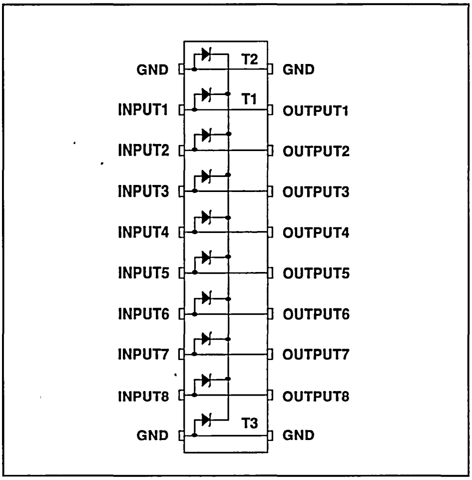
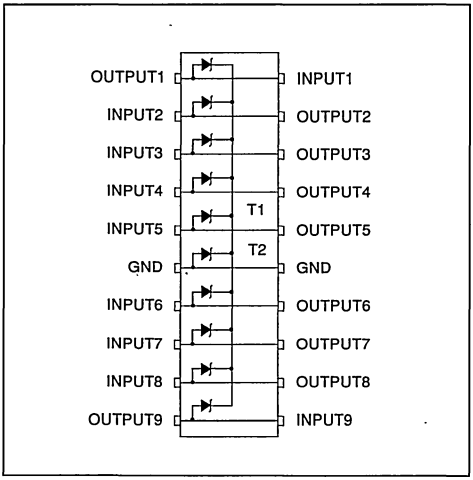


Figure 6 : Equivalent to 9 Bidirectional Transils



UTILIZATION AS OCTAL BIDIRECTIONAL TRANSIL ARRAY.

The main application of this device is to be configured as a 8 bidirectional Transil Array as per the Pin-out of Fig 6.
Pin 1 - 20 and Pin 10 - 11 are connected to ground.
INPUTS are from Pin 2 to Pin 9 and
OUTPUTS are from Pin 12 to Pin 19.

Note : INPUTS and OUTPUTS are symmetrical and can be reversed following application layout requests.
The bidirectional function is made with 2 unidirectional Transils. One (T1) is connected to the INPUT/OUTPUT, the other one (T2) is connected to the ground (see Fig 5).
Ground is connected via 2 diodes T2 and T3. This allows it to withstand 2 specified surges on 2 different lines at the same time.

UTILIZATION AS 9 BIDIRECTIONAL TRANSIL ARRAY.

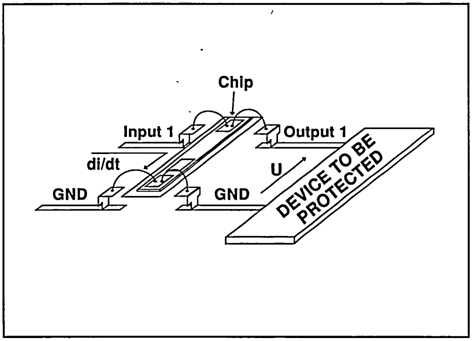
The ITAxxB can be also used as a 9 bidirectional Transil Array.
Ground can be connected to the couple Pin 1 - 20 or 2 - 19 or 3 - 18 or 4 -17 up to 10-11.
The other Pins are used as INPUTS and OUTPUTS.
The bidirectional function is made with 2 unidirectional Transil T1 and T2. One example with ground Pins 6-15 is given Fig 6.
This configuration allows to withstand only one specified surge at the same time.

APPLICATION NOTICE

Design advantage of ITAxxxB3 used with 4 - points Structure.

The ITAxxxB3 has been designed with a 4 - points structure (Isolated Input/output) in order to efficiently protect against disturbances with very high (di/dt) rates, such as ESD.
The purpose is to eliminate the overvoltage introduced by the parasitic inductances of the wiring (L.di/dt).
But efficient protection depends not only on the component itself, but also on the schematic layout.

Figure 7 : 4 Point structure layout



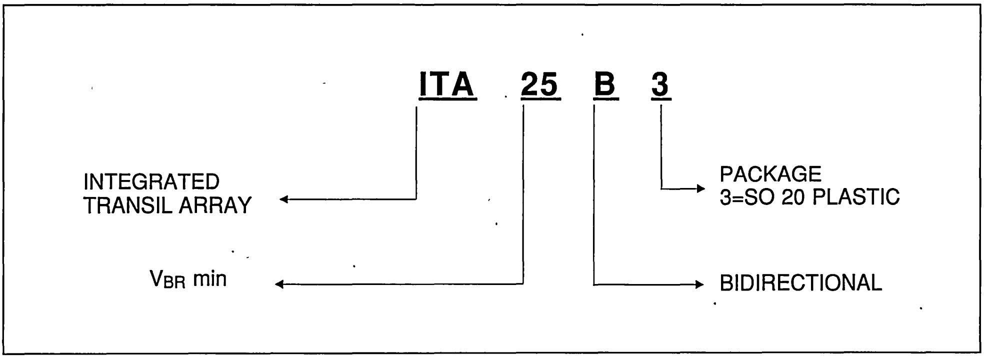
The schema given in fig. 7, shows the lay-out to be used in order to take advantage of the 4 - points structure of the ITAxxxB3.

With this lay-out, each of the lines to be protected passes through the protection device.

In this case, it works as an interface between the data line and the circuit to be protected, guaranteeing an isolation between its inputs and outputs.

The surge currrent is deviated through the input stage of the protection device.
The component to be protected is no longer exposed to any L.di/dt overvoltages.

ORDER CODE

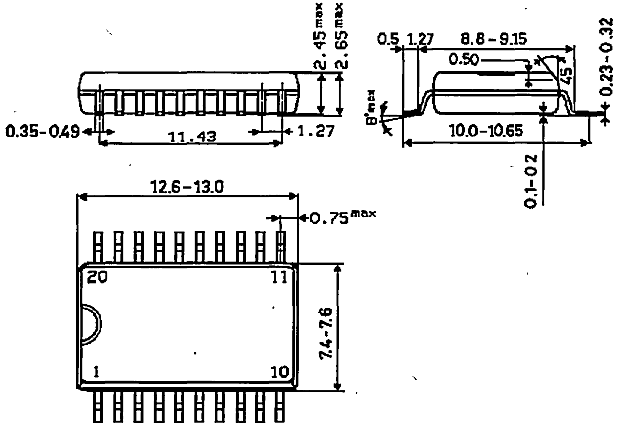


MARKING

TYPE	MARKING
ITA6V5B3	ITA6V5B3
ITA10B3	ITA10B3
ITA18B3	ITA18B3
ITA25B3	ITA25B3

PACKAGE MECHANICAL DATA (in millimeters)

SO 20 Plastic



Packaging : Products supplied in antistatic tubes.

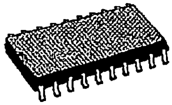
SGS-THOMSON
MICROELECTRONICS

ITA6V1M3

MONOLITHIC TRANSIL® ARRAY FOR DATA LINE PROTECTION

FEATURES

- HIGH SURGE CAPABILITY TRANSIL ARRAY
  I_{PP} = 40A 8/20µs
- UP TO 18 UNIDIRECTIONAL TRANSIL FUNCTIONS
- BREAKDOWN VOLTAGE = 6V1
- LOW CLAMPING FACTOR (V_{CL}/V_{BR}) AT HIGH CURRENT LEVEL.



SO 20
(Plastic)

DESCRIPTION

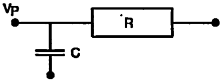
This is a specific Transil Array for Centronics interface protection developed in monolithic chip form in order to provide a high surge capability and a low clamping voltage.

IN ACCORDANCE WITH :

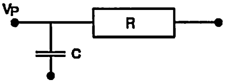
- ESD standard :

. IEC 801-2	15kV	ns / 50ns
. IEC 801-4	40A	5ns / 50ns
. IEC 801-5	1KV	1.2 / 50µs
	25A	8/20µs

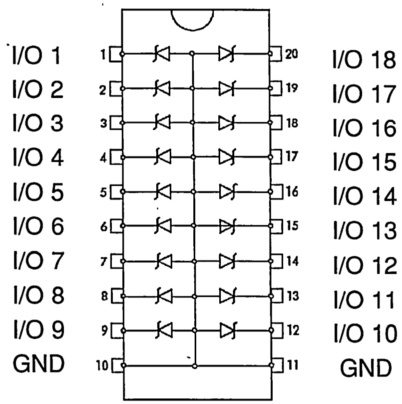
. MIL STD 883C - Methode 3015-2
V_P = 25kV
C = 150pF
R = 150Ω
5 s duration



- Human body test :
V_P = 4kV
C = 150pF
R = 150Ω



FUNCTIONAL DIAGRAM

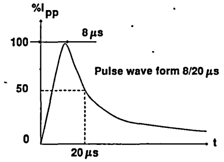


EQUIVALENT TO 18 UNIDIRECTIONAL TRANSILS

ABSOLUTE RATINGS (limiting values) (0°C ≤ Tamb ≤ 70°C)

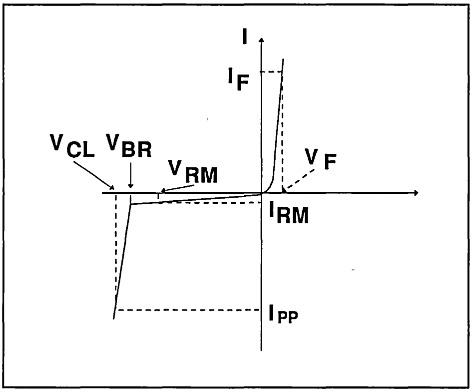
Symbol	Parameter		Value	Unit
Ipp	Peak pulse current-8/20 µs	See note	40	A
I_{FSM}	Non repetitive surge peak forward current	t_p= 10 ms	6	
I^2t	Wire I2t value	See note	0.6	A^2s
T_{stg} T_j	Storage and Junction Temperature Range		- 55 to + 150 125	°C °C

Note : For surges greater than the maximum value specified, the device will present first a short circuit to the common bus line and after an open circuit caused by the wire.
These values are for each integrated diode.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{CL}	Clamping Voltage
I_{RM}	Leakage Current @ VRM
I_{PP}	Surge Current
C	Input Capacitance
I_F	Forward Current
V_F	Forward Voltage Drop



Types	I_{RM} @ V_{RM} max		V_{BR} @ I_R min note 1		V_{CL} @ I_{pp} max 8/20µs note 1		V_{CL} @ I_{PP} max 8/20µs		V_F @ I_F max	
	µA	V	V	mA	V	A	V	A	V	A
ITA6V1M3	50	5	6.1	1	12	10	14	25	1.5	1

Types	C 1 max note 2	C 2 max note 3	α_T max
	pF	pF	10^{-4}/°C
ITA6V1M3	1100	700	4

All parameters tested at 25°C, except where indicated
Note 1 : Between I/0 pin and ground
Note 2 : Between one input Pin at 0 V Bias and ground pin.
Note 3 : Between one input pin at V_{RM} ,and ground pin.

Figure 1 : Peak pulse power versus exponential pulse duration.

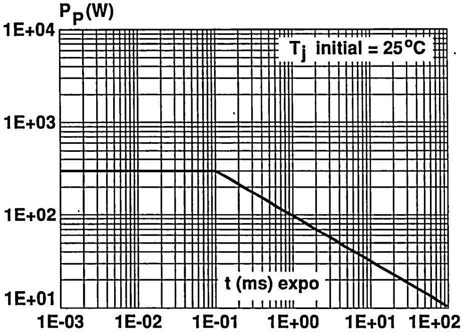


Figure 2 : Clamping voltage versus peak pulse current exponential waveform 8/20µs

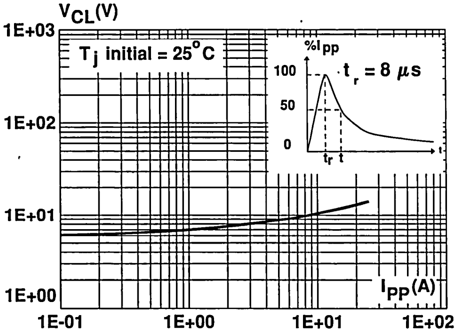


Figure 3 : Peak current I_{DC} inducing open circuit of the wire for one input/output versus pulse duration (typical values) .

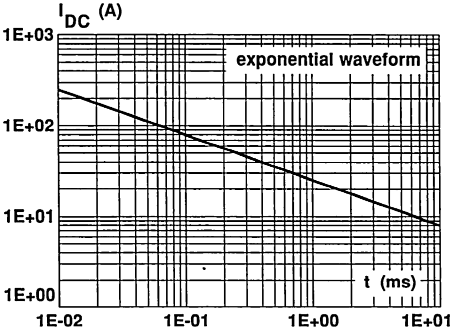
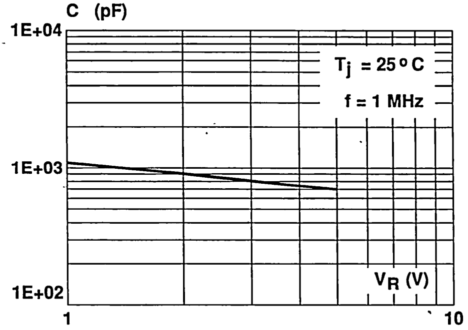
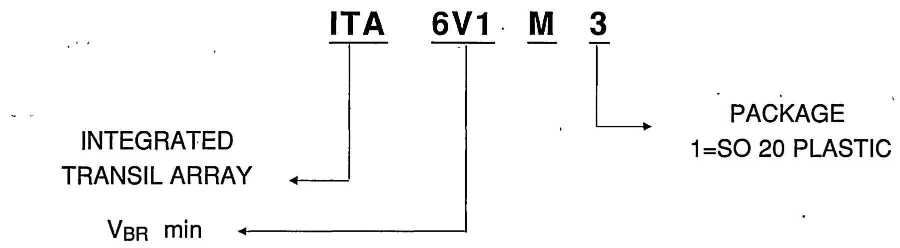


Figure 4 : Junction capacitance versus reverse applied voltage for one input/output (typical values) .



Note : The curve of the figure 2 is specified for a junction temperature of 25° C before the surge

ORDER CODE

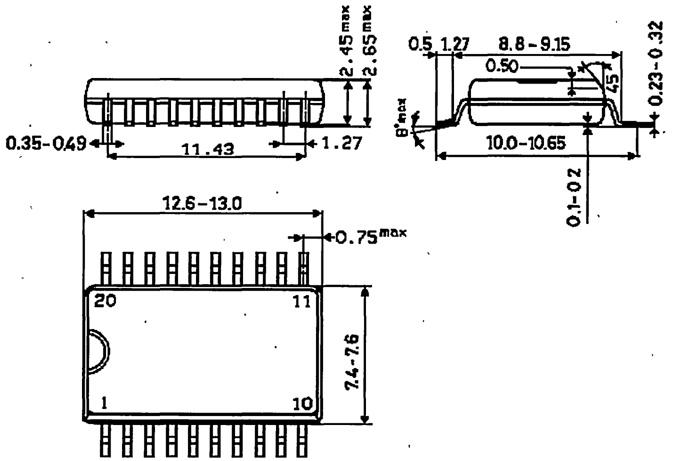


MARKING

TYPE	MARKING
ITA6V1M3	ITA6V1M3

PACKAGE MECHANICAL DATA (in millimeters)

SO 20 Plastic



Packaging : Products supplied in antistatic tubes.

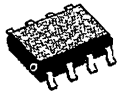
SGS-THOMSON
MICROELECTRONICS

ITA6V1U1

MONOLITHIC TRANSIL® ARRAY FOR DATA LINE PROTECTION

FEATURES

- HIGH SURGE CAPABILITY TRANSIL ARRAY I_{PP} = 40 A 8/20µs
- UP TO 6 UNIDIRECTIONAL TRANSIL FUNCTIONS
- BREAK DOWN VOLTAGE : V_{BR}= 6V1
- LOW CLAMPING FACTOR (V_{CL} / V_{BR}) AT HIGH CURRENT LEVEL
- LOW LEAKAGE CURRENT



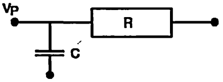
SO8
(Plastic)

DESCRIPTION

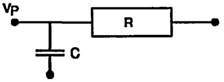
This is a specific transil array for RS422, RS485 interface protection developed in monolithic chip form in order to provide a high surge capability and a low clamping voltage.

IN ACCORDANCE WITH :

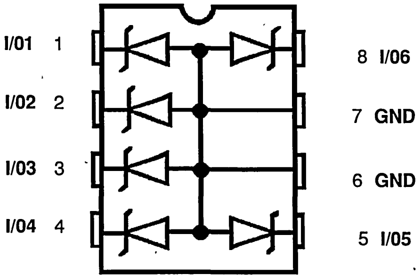
- ESD standard :
  . IEC 801-2 15kV 5ns / 50ns
  . IEC 801-4 40A 5ns / 50ns
  . IEC 801-5 1kV 1.2 / 50µs
  25A 8/20µs
  . MIL STD 883C - Methode 3015-2
  V_P = 25kV
  C = 150pF
  R = 150Ω
  5 s duration



- Human body test :
  V_P = 4kV
  C = 150pF
  R = 150Ω



FUNCTIONAL DIAGRAM

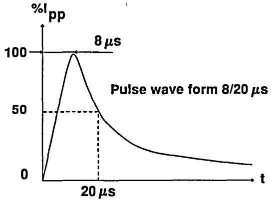


EQUIVALENT TO 6 UNIDIRECTIONAL TRANSILS

ABSOLUTE RATINGS (limiting values) (0°C ≤ Tamb ≤ 70°C)

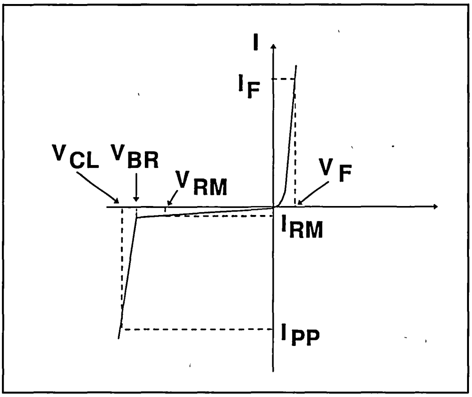
Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current 8/20µs	See note	40	A
I_{FSM}	Non repetitive surge peak forward current	T_p= 10 ms	8	A
I^2t	Wire I^2t value	See note	0.6	A^2s
T_{stg} T_j	Storage and Junction Temperature Range		- 55 to + 150 125	°C °C

Note : For surges greater than the maximum value specified, the input/output will present first a short circuit to the common bus line and after an open circuit caused by the wire.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{CL}	Clamping Voltage
I_{RM}	Leakage Current @ VRM
I_{PP}	Surge Current
C	Input Capacitance
I_F	Forward Current
V_F	Forward Voltage Drop



Types	I_{RM} @ V_{RM} max		V_{BR} @ I_R min Note 1		V_{CL} @ I_{PP} max 8/20µs Note 1		VCL @ I_{PP} max 8/20µs Note 1	
	µA	V	V	mA	V	A	V	A
ITA6V1U1	50	5	6.1	1	10	10	12	25

Types	V_F @ I_F max		C 1 max Note 2	C 2 max Note 3	α_T max
	V	A	pF	pF	10^{-4}/°C
ITA6V1U1	1.3	1	1500	1000	4

All parameters tested at 25°C, except where indicated
Note 1 : Beetween I/O pin and ground.
Note 2 : Between one input Pins at 0 V Bias, and ground.
Note 3 : Between one input pin at V_{RM}, and ground.

Figure 1 : Peak pulse power versus exponential pulse duration.

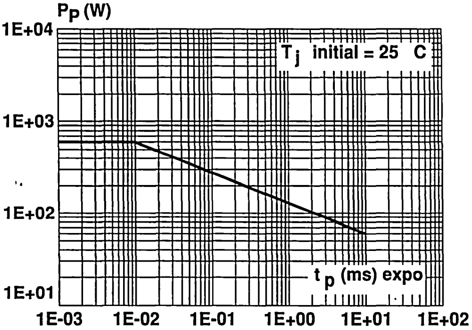


Figure 2 : Clamping voltage versus peak pulse current exponential waveform 8/20 µs.

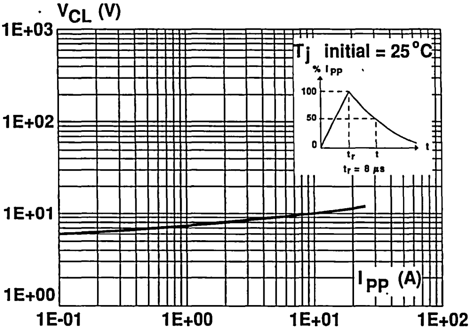


Figure 3 : Peak current I_{DC} inducing open circuit of the wire for one input/output versus pulse duration (typical values).

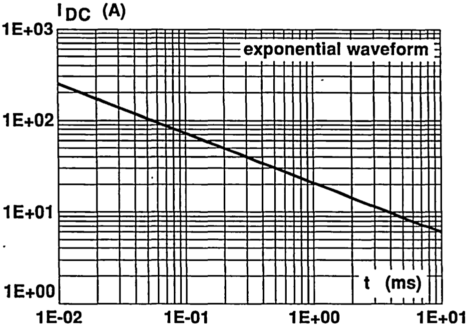
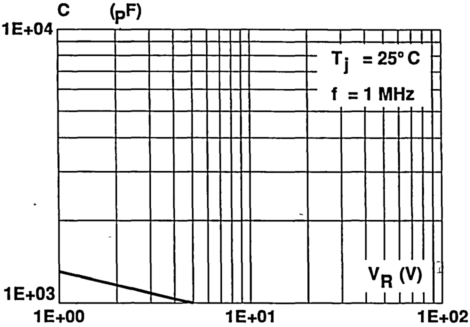


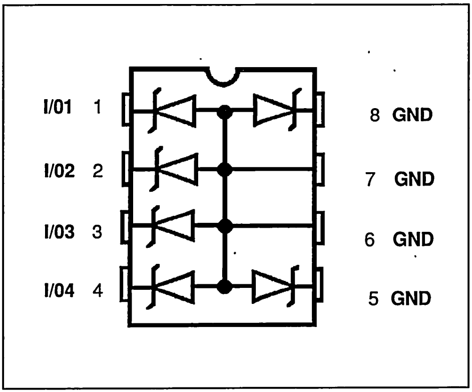
Figure 4 : Junction capacitance versus reverse applied voltage for one input/output (typical values) .



INSTRUCTION GUIDE

This monolithic Transil Array is based on 6 Unidirectional Transils with a common anode and can be configured to offer 4 or 6 monodirectional functions following the customer application.

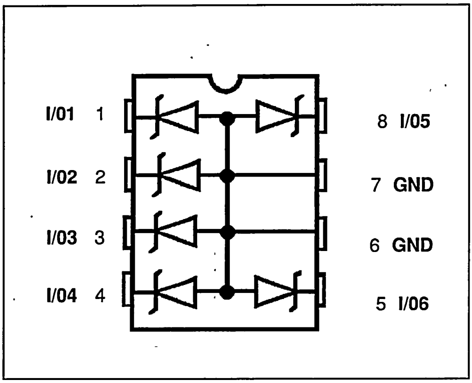
Figure 5 : Equivalent to 4 Unidirectional Transils



UTILIZATION AS 4 I/Os UNIDIRECTIONAL TRANSIL ARRAY.

When a common ground is connected to pins 5 to 8, the ITA6V1U1 can be used as a 4 unidirectional Transil Array.

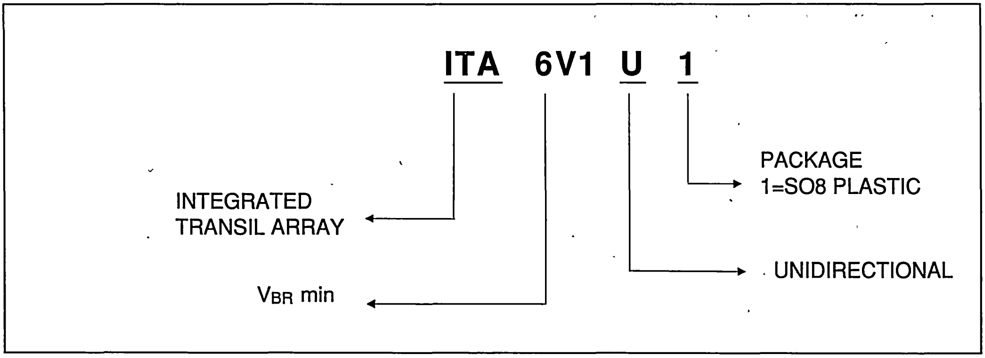
Figure 6 : Equivalent to 6 Unidirectional Transils



UTILIZATION AS 6 I/Os UNIDIRECTIONAL TRANSIL ARRAY.

The ITA6V1U1 can be also used as a 6 unidirectional Transil Array with Ground connected to Pins 6 and 7 (see Fig 6).

ORDER CODE

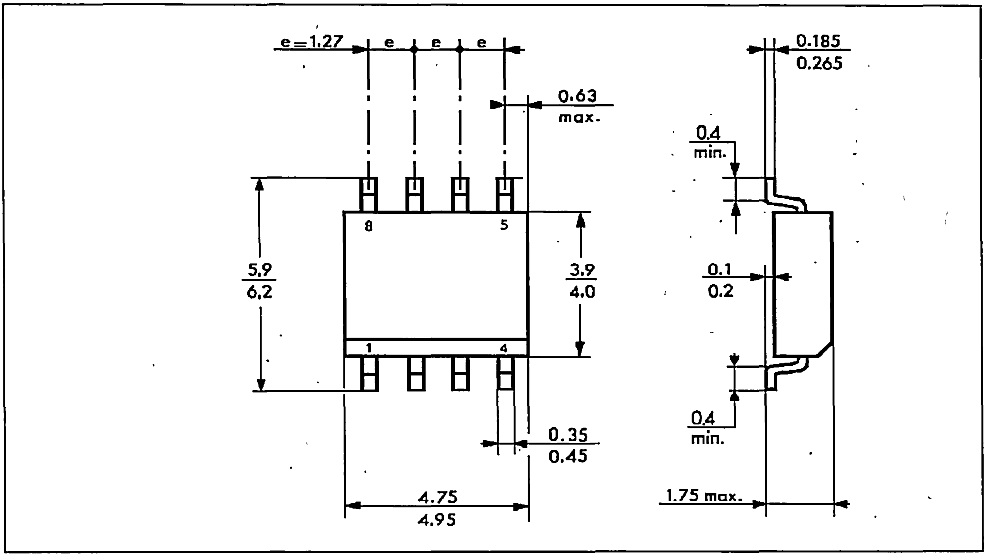


MARKING

TYPE	MARKING
ITA6V1U1	6V1U1

PACKAGE MECHANICAL DATA (in millimeters)

SO8 Plastic



Packaging : Products are supplied in antistatic tubes.

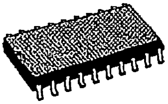
SGS-THOMSON
MICROELECTRONICS

ITA6V1U3

MONOLITHIC TRANSIL® ARRAY FOR DATA LINE PROTECTION

FEATURES

- HIGH SURGE CAPABILITY TRANSIL ARRAY
  I_{PP} = 40 A 8/20μs
- UP TO 8 UNIDIRECTIONAL TRANSIL FUNCTIONS
- BREAKDOWN VOLTAGE= 6V1
- LOW LEAKAGE CURRENT
- LOW CLAMPING FACTOR (V_{CL}/ V_{BR}) AT HIGH CURRENT LEVEL.



SO 20
(Plastic)

DESCRIPTION

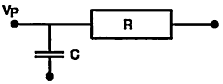
Specially developed for RS 422 , RS 485 interface protection, this monolithic chip component offers a high surge capability and a low clamping voltage.

The internal wire bonding, "4 points connection", ensures a reliable protection against very fast transient overvoltages like ESD.

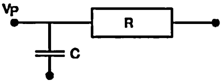
A low clamping voltage is guaranteed, eliminating all spikes due to the perturbation itself and also spikes induced by parasitic inductances created by external wiring.

IN ACCORDANCE WITH :

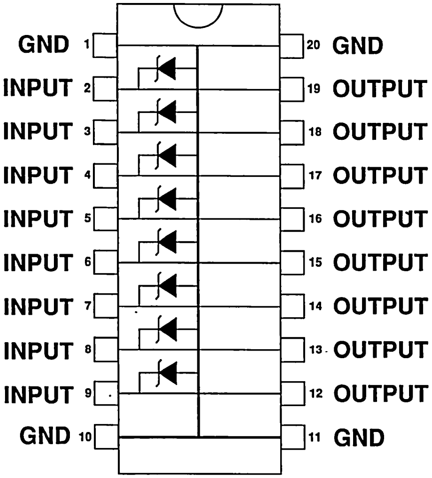
- ESD standard :
  . IEC 801-2 15kV 5ns / 50ns
  . IEC 801-4 40A 5ns / 50ns
  . IEC 801-5 1kV 1.2 / 50μs
  25A 8/20μs
  . MIL STD 883C - Methode 3015-2
  V_P = 25kV
  C = 150pF
  R = 150Ω
  5 s duration



- Human body test :
  V_P = 4kV
  C = 150pF
  R = 150Ω



FUNCTIONAL DIAGRAM

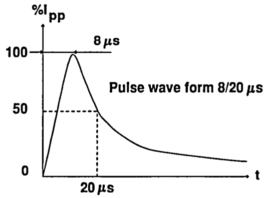


EQUIVALENT TO 8 UNIDIRECTIONAL TRANSILS

ABSOLUTE RATINGS (limiting values) (0°C ≤ Tamb ≤ 70°C)

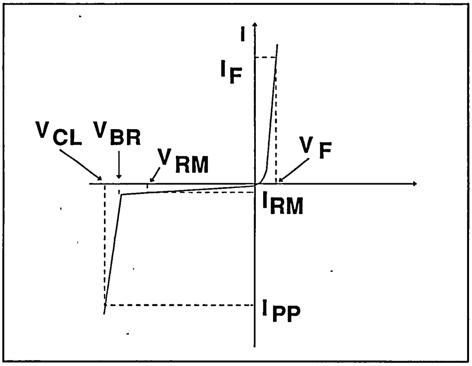
Symbol	Parameter		Value	Unit
Ipp	Peak pulse current - 8/20 µs	See note	40	A
I_{FSM}	Non repetitive surge peak forward current	tp= 10 ms	6	A
I^2t	Wire I^2t value	see note	0.6	A^2s
Tstg Tj	Storage and Junction Temperature Range		-55 to +150 125	°C °C

Note : For surges greater than the maximum value specified, the input/output will present first a short circuit to the common bus line and after an open circuit caused by the wire.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{CL}	Clamping Voltage
I_{RM}	Leakage Current @ VRM
I_{PP}	Surge Current
C	Input Capacitance
I_F	Forward Current
V_F	Forward Voltage Drop



Types	I_{RM} @ max	V_{RM}	V_{BR} @ min	I_R	V_{CL} @	I_{PP} 8/20µs	V_{CL} @ max See Note 1	I_{PP} 8/20µs
	µA	V	V	mA	V	A	V	A
ITA6V1U3	50	5	6.1	1	10	10	12	25

Types	V_F max @	I_F	C 1 max Note 2	C 2 max Note 3	α_T max
	V	A	pF	pF	10^{-4}/°C
ITA6V1U3	1.5	1	1100	700	4

All parameters tested at 25°C, except where indicated.

Note 1 : Between I/O pin and ground.
Note 2 : Between one input Pins at 0 V Bias, and ground.
Note 3 : Between one input Pin at V_{RM}, and ground.

Figure 1 : Peak pulse power versus exponential pluse duration.

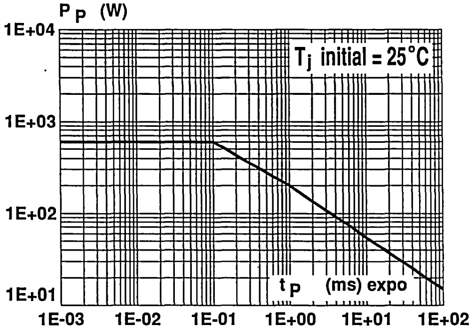


Figure 2 : Clampling voltage versus peak pulse current exponential waveform 8/20 ms.

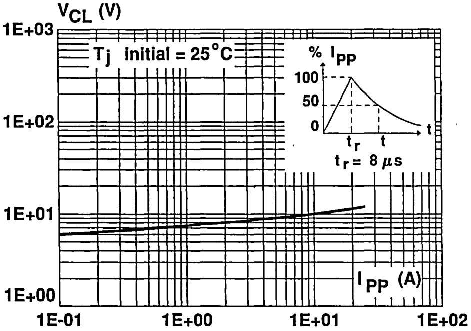


Figure 3 : Peak current IDC inducing open circuit of the wire for one input/output versus pulse duration (typical values).

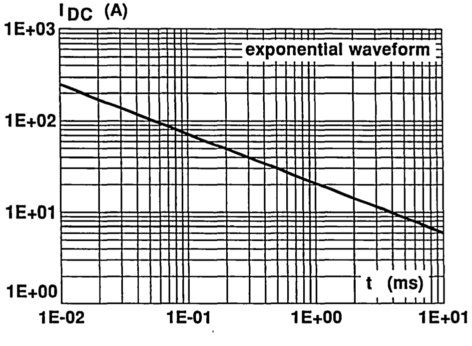
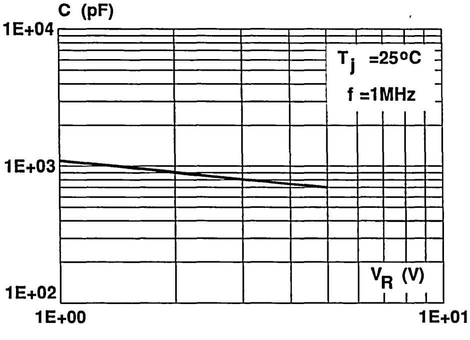


Figure 4 : Junction capacitance versus reverse applied voltage for one input/output (typical values).



Note : The curve of the figure 2 is specified for a junction temperature of 25°C before surge.

APPLICATION NOTICE

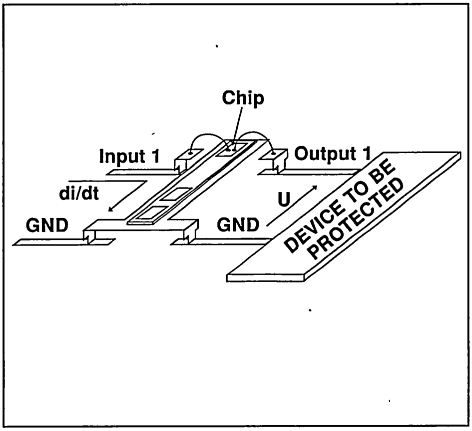
Design advantage of ITA6V1U3 used with 4 - points Structure.

The ITA6V1U3 has been designed with a 4 - points structure (Isolated Input/output) in order to efficiently protect against disturbances with very high (di/dt) rates, such as ESD.

The purpose is to eliminate the overvoltage introduced by the parasitic inductances of the wiring (L.di/dt).

But efficient protection depends not only on the component itself, but also on the schematic layout.

Figure 5 : 4 Point structure layout



The schema given in fig. 5, shows the lay-out to be used in order to take advantage of the 4 - points structure of the ITA6V1U3.

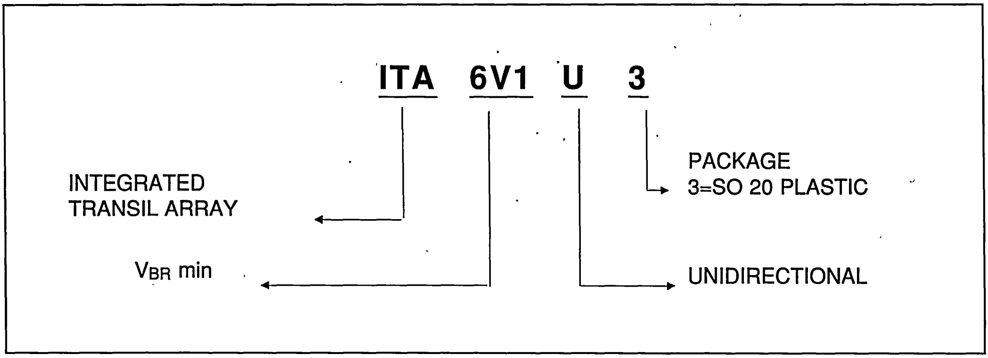
With this lay-out, each of the lines to be protected passes through the protection device.

In this case, it works as an interface between the data line and the circuit to be protected, guaranteeing an isolation between its inputs and outputs.

The surge currrent is deviated through the input stage of the protection device.

The component to be protected is no longer exposed to any L.di/dt overvoltages.

ORDER CODE

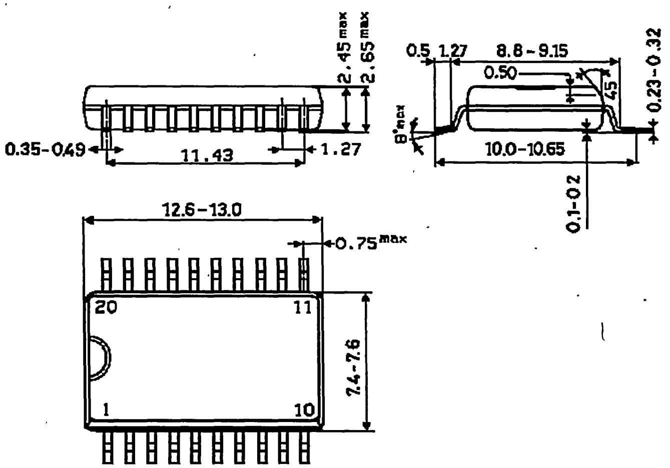


MARKING

TYPE	MARKING
ITA6V1U3	ITA6V1U3

PACKAGE MECHANICAL DATA (in millimeters)

SO 20 Plastic



Packaging : Products supplied in antistatic tubes.

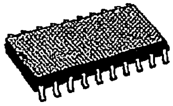
LCTA6V1M3

MONOLITHIC TRANSIL® ARRAY

PRELIMINARY DATA

FEATURES

- HIGH SURGE CAPABILITY TRANSIL ARRAY I_{PP} = 15 A 8/20µs
- UP TO 18 UNIDIRECTIONAL TRANSIL FONCTIONS
- BREAKDOWN VOLTAGE = 6V1
- VERY LOW CAPACITANCE ; C = 8pF at V_R = 5 V



SO 20
(Plastic)

DESCRITION

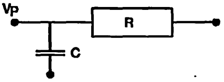
The LCTA6V1M3 is a low capacitance transil array specially developed for centronics interface protection. Its very low capacitance between line and ground makes it mandatory for high rates data transmition up to 2 Mbit/sec.

IN ACCORDANCE WITH :

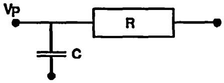
- ESD standard :

. IEC 801-2	15kV	5ns / 50ns
. IEC 801-4	40A	5ns / 50ns
. IEC 801-5	0.5KV	1.2 / 50µs
	12A	8/20µs

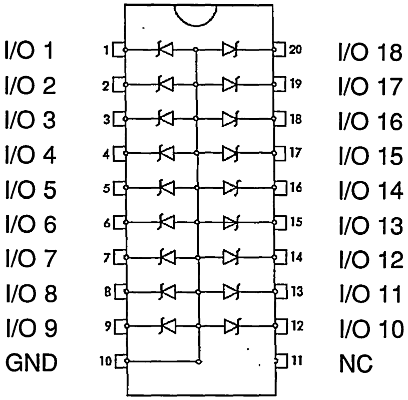
. MIL STD 883C - Methode 3015-2
V_P = 25kV
C = 150pF
R = 150Ω
5 s duration



- Humam body test :
V_P = 4kV
C = 150pF
R = 150Ω



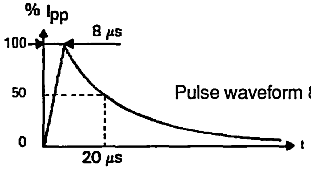
FUNCTIONAL DIAGRAM



ABSOLUTE RATINGS (limiting values) (0°C ≤ Tamb ≤ 70°C)

Symbol	Parameter		Value	Unit
Ipp	Peak pulse current for 8/20 µs pulse	See note	15	A
I_{FSM}	Non repetitive surge peak forward current	tp = 8.3 ms	10	A
T_{stg} T_j	Storage and Junction Temperature Range		- 55 to + 150 125	°C °C

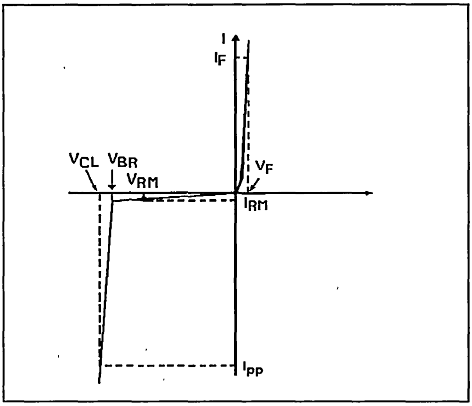
Note : For surges greater than the maximum value specified, the device will present first a short circuit to the common bus line and after an open circuit caused by the wire.
These values are for each integrated diode.



Pulse waveform 8/20 µs

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{CL}	Clamping Voltage
I_{RM}	Leakage Current @ VRM
I_{PP}	Surge Current
C	Input Capacitance
I_F	Forward Current
V_F	Forward Voltage Drop



Types	I_{RM} @ V_{RM} max		V_{BR} @ I_R min		V_{CL} @ I_{PP} max 8/20µs		V_F @ I_F max		C 1 max V_R=0V F=1Mz	C 2 max V_R=5V F=1Mz
	µA	V	V	mA	V	A	V	A	pF	pF
	20	5	6.1	1	12	10	1.5	1	30	8

All parameters tested at 25°C, except where indicated (characteristics for each integrated diode)

ORDER CODE

LCTA 6V1 M 3

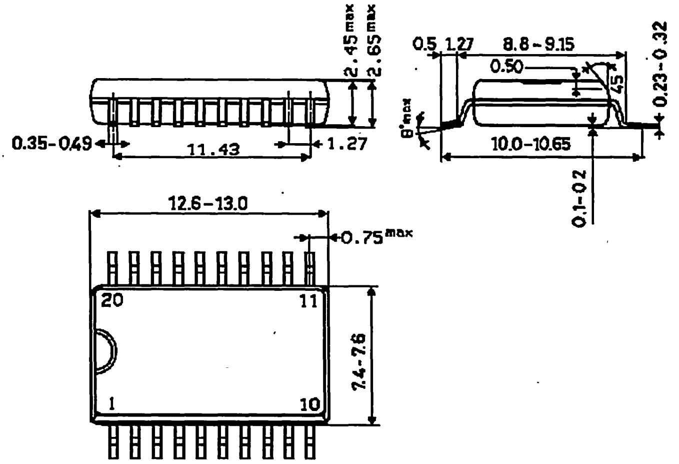
LCTA: LOW CAPACITANCE TRANSIL ARRAY

6V1: V_{BR} min

M 3: PACKAGE 3=SO 20 PLASTIC

PACKAGE MECHANICAL DATA (in millimeters)

SO 20 Plastic



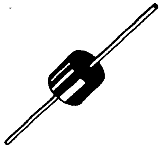
Packaging : Products are supplied antistatic tubes.

LDP24AS

TRANSIL
LOAD DUMP PROTECTION

FEATURES

- TRANSIENT VOLTAGE SUPPRESSOR DIODE ESPECIALLY DESIGNED FOR LOAD DUMP EFFECT PROTECTION
- HIGH SURGE CURRENT CAPABILITY : 40 A / 40 ms EXPONENTIAL WAVE
- COMPLIANT WITH MAIN STANDARDS SUCH AS:
  -ISO / DTR 7637
  -SAEJ 1113A ...



AG
(Plastic)

DESCRIPTION

Transient voltage suppressor diode especially developed for sensitive circuit protection in automotive systems such as dash board, car radios etc.

Its high surge current capability and instantaneous response to transients provide an efficient protection against the load dump effect.

ABSOLUTE RATINGS (limiting values)

Symbol	Parameter		Value	Unit
V_{PP}	Peak pulse load dump overvoltage See note 1 - 2	T_{amb} = 85°C	120	V
P	Power dissipation on infinite heatsink	T_{amb} = 100°C	5	W
I_{FSM}	Non repetitive surge peak forward current.	T_j initial = 25°C t = 10 ms	200	A
T_{stg} T_j	Storage and junction temperature range.		- 65 to + 175 170	°C °C
T_L	Maximum lead temperature for soldering during 10 sec at 4 mm from case.		230	°C

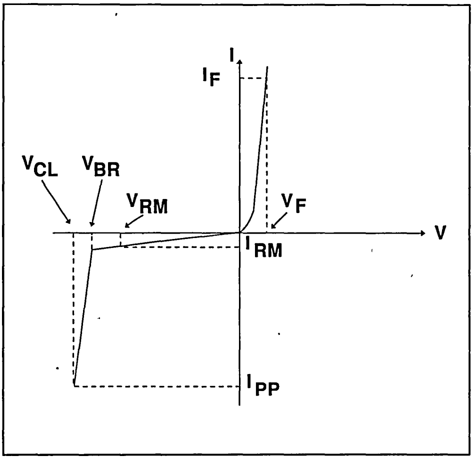
THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	15	°C/W
R_{th} (j-a)	Junction to ambient on printed circuit. L_{lead} = 10 mm	50	°C/W

Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{PP}	Peak pulse current.
αT	Temperature coefficient of V_{BR}.
C	Capacitance
t clamping	Clamping time (0V to V_{BR}): tp = 1ps



Symbol	Test Conditions		Min.	Typ.	Max.	Unit
I_{RM}	T_C = -40°C T_C = 25°C T_C = 85°C	V_{RM} = 24V			10 50 300	µA
V_{BR}	T_C = 25°C	I_R = 1mA	25		32	V
V_{CL}	T_C = -40°C T_C = 25°C T_C = 85°C	I_{PP} = 40A (Note 2)			36 38 40	V
αT	T_C = 25°C				9.6	10^{-4}/°C
C	F = 1MHz	V_R = 0V		8000		pF

Note 2 : Surge generator

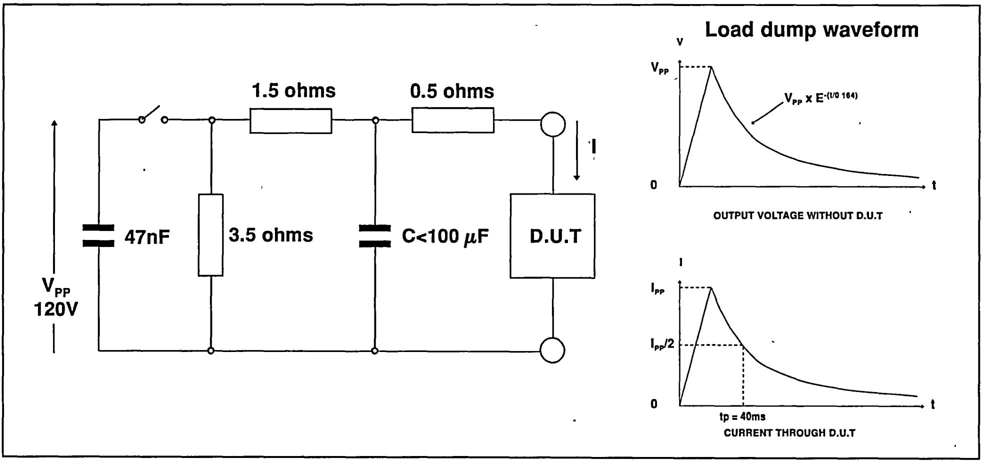


Figure 1 : Peak pulse power versus exponential pulse duration (T_j initial =85°C).

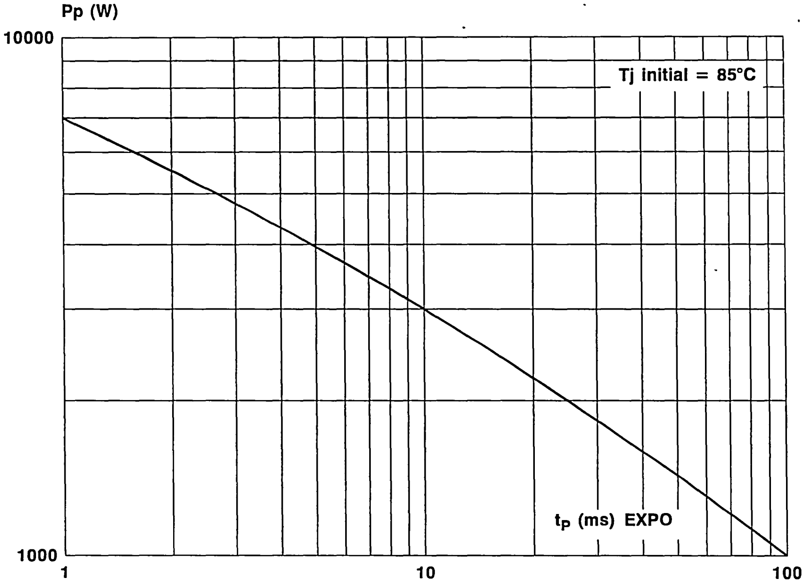


Figure 2 : Clamping voltage versus peak pulse current (T_j initial =85°C).
exponential waveform t = 40 ms -------------
t = 1 ms ________

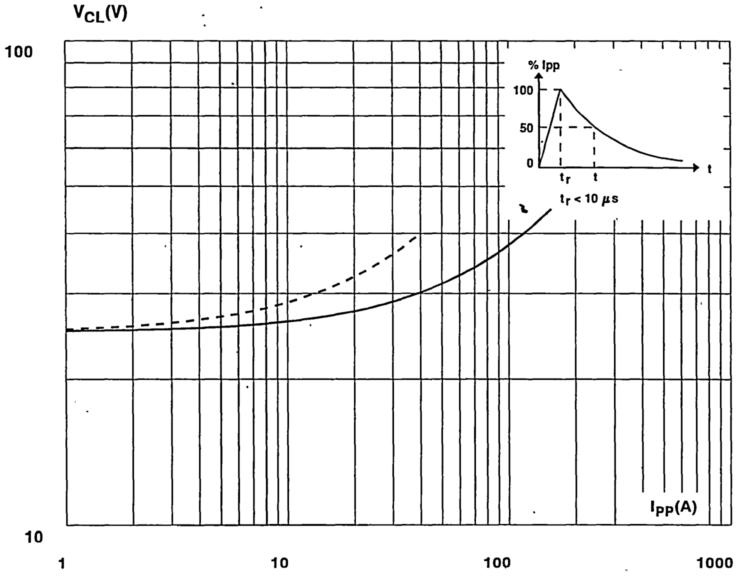


Figure 3 : Peak pulse current versus exponential pulse duration (T_j initial =85°C).

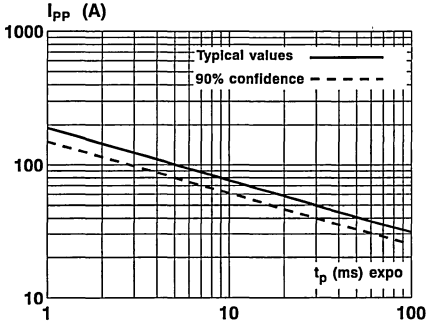


Figure 4 : Peak pulse power versus junction temperature.

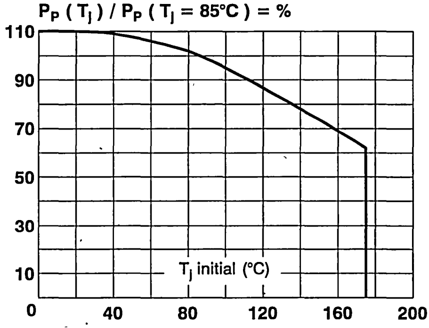


Figure 5 : Transient thermal impedance junction-ambient versus pulse duration (device mounted on PC Board with L_{lead} = 10mm).

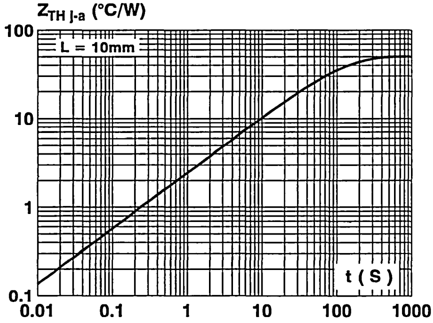
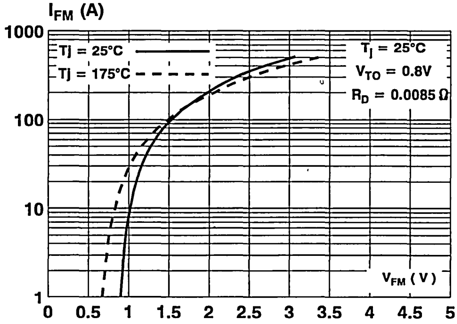
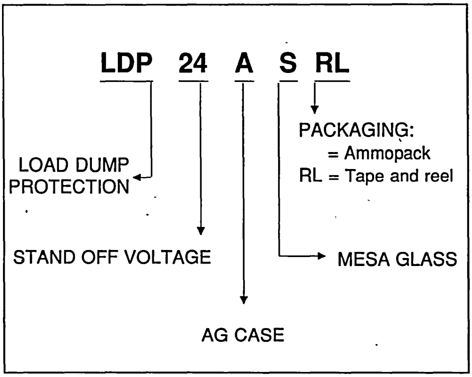


Figure 6 : Peak forward current versus peak forward voltage drop (typical values).



ORDER CODE



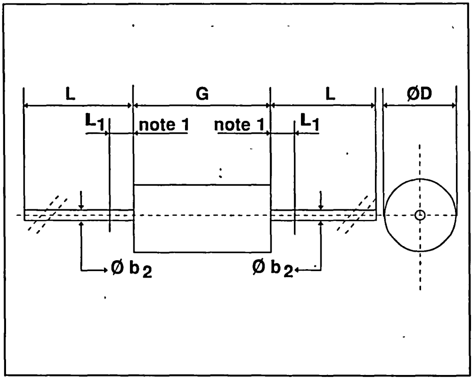
MARKING : Logo, Date Code, Type Code, Cathode Band.

Weight = 1 g.

Packaging : standard packaging is in tape and reel.

PACKAGE MECHANICAL DATA

AG (Plastic).



Ref	Millimeters		Inches	
	min	max	min	max
Ø b2	1.35	1.45	0.053	0.057
Ø D	-	8	-	0.315
G	-	9	-	0.354
L	20	-	0.787.	-
L1	-	1.27	-	0.050

Note1: The diameter Ø b2 is not controlled over zone L1.
Cooling method : by convection (method A).

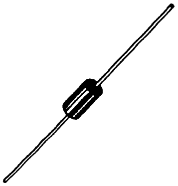
SGS-THOMSON
MICROELECTRONICS

LVT3V3
SMLVT3V3

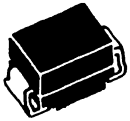
TRANSIL

FEATURES

- UNDIRECTIONAL TRANSIL DIODE.
- PEAK PULSE POWER= 600 W @ 1ms.
- REVERSE STAND OFF VOLTAGE = 3.3 V.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME:
  Tclamping : 1ps (0 V to VBR).



CB417
(Plastic)



SOD 6
(Plastic)

DESCRIPTION

The LVT3V3 and SMLVT3V3 are dedicated to the protection of the new 3V3 - supplied CMOS and BICMOS technologies.
Their low clamping voltage at high current level guarantee an excellent protection for sensitive components.

MECHANICAL CHARACTERISTICS

- Body Marked With Logo, Type Code And Cathode Band.
- Tinned Copper Leads.
- High Temperature Soldering.

ABSOLUTE RATINGS (limiting values)

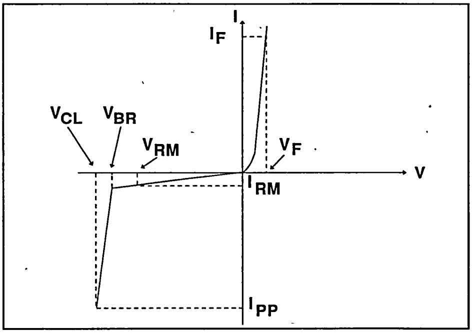
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	600	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	1.7	W
I_{FSM}	Non repetitive surge peak forward current	Tamb = 25°C t =10 ms	50	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.	CB417 SOD 6	230 260	°C °C

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	CB417 SOD 6	20 20	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.



TYPES	I_{RM} @ V_{RM} max		V_{BR} @ I_R min		V_{CL} @ I_{PP} max 10/1000µs		V_{CL} @ I_{PP} max 8/20µs		C max note2	C max note3
	µA	V	V	mA	V	A	V	A	pF	pF
LVT3V3 SMLVT3V3	200	3.3	4.1	1	7.3	50	10	200	5200	3300

All parameters tested at 25 °C, except where indicated.

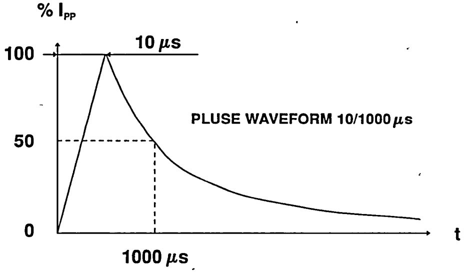
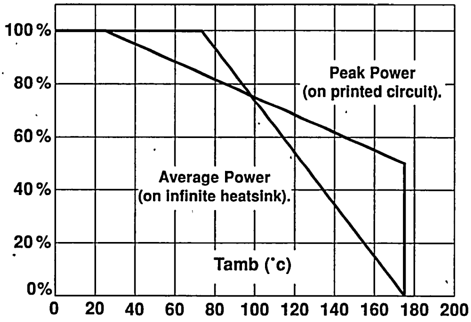


Figure 1 : Power dissipation derating versus ambient temperature



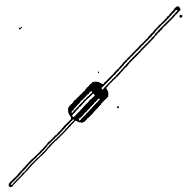
Note 1 : For Surges Greater Than The Maximum Values, the Diode Will Present A Short-circuit Anode - Cathode.
Note 2 : V_R = 0V , F = 1MHz.
Note 3 : V_R = 3V3 , F = 1MHz.

P6KE6V8P,A/440P,A
P6KE6V8CP,A/440CP,CA

TRANSIL

FEATURES

- PEAK PULSE POWER= 600 W @ 1ms.
- BREAKDOWN VOLTAGE RANGE : From 6V8 to 440 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: Tclamping : 1ps (0 V to V_{BR}).
- UL RECOGNIZED.



CB417
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code, and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

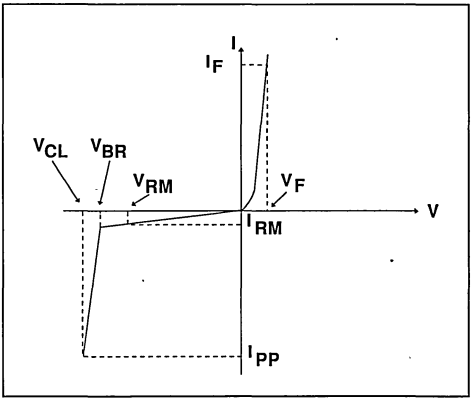
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	600	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	5	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types.	Tamb = 25°C t =10 ms	100	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	20	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. L_{lead} = 10 mm	85	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ $I_F = 50$ A.



TYPES		I_{RM} @ V_{RM}		V_{BR} @ I_R				V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	**µA**	**V**	**V**	**V**	**V**	**mA**	**V**	**A**	**V**	**A**	**10^{-4}/°C**	**(pF)**
P6KE6V8P	P P6KE6V8CP	1000	5.8	6.45	6.8	7.48	10	10.5	57	13.4	298	5.7	4000
P P6KE6V8A	P P6KE6V8CA	1000	5.8	6.45	6.8	7.14	10	10.5	57	13.4	298	5.7	4000
P6KE7V5P	P6KE7V5CP	500	6.4	7.13	7.5	8.25	10	11.3	53	14.5	276	6.1	3700
P6KE7V5A	P P6KE7V5CA	500	6.4	7.13	7.5	7.88	10	11.3	53	14.5	276	6.1	3700
P6KE8V2P	P P6KE8V2CP	200	7.02	7.79	8.2	9.02	10	12.1	50	15.5	258	6.5	3400
P P6KE8V2A	P6KE8V2CA	200	7.02	7.79	8.2	8.61	10	12.1	50	15.5	258	6.5	3400
P6KE9V1P	P6KE9V1CP	50	7.78	8.65	9.1	10	1	13.4	45	17.1	234	6.8	3100
P6KE9V1A	P6KE9V1CA	50	7.78	8.65	9.1	9.55	1	13.4	45	17.1	234	6.8	3100
P P6KE10P	P6KE10CP	10	8.55	9.5	10	11	1	14.5	41	18.6	215	7.3	2800
P6KE10A	P6KE10CA	10	8.55	9.5	10	10.5	1	14.5	41	18.6	215	7.3	2800
P6KE11P	P6KE11CP	5	9.4	10.5	11	12.1	1	15.6	38	20.3	197	7.5	2500
P6KE11A	P6KE11CA	5	9.4	10.5	11	11.6	1	15.6	38	20.3	197	7.5	2500
P P6KE12P	P P6KE12CP	5	10.2	11.4	12	13.2	1	16.7	36	21.7	184	7.8	2300
P6KE12A	P6KE12CA	5	10.2	11.4	12	12.6	1	16.7	36	21.7	184	7.8	2300
P6KE13P	P6KE13CP	5	11.1	12.4	13	14.3	1	18.2	33	23.6	169	8.1	2150
P P6KE13A	P P6KE13CA	5	11.1	12.4	13	13.7	1	18.2	33	23.6	169	8.1	2150
P P6KE15P	P P6KE15CP	5	12.8	14.3	15	16.5	1	21.2	28	27.2	147	8.4	1900
P6KE15A	P6KE15CA	5	12.8	14.3	15	15.8	1	21.2	28	27.2	147	8.4	1900
P6KE16P	P6KE16CP	5	13.6	15.2	16	17.6	1	22.5	27	28.9	138	8.6	1800
P6KE16A	P6KE16CA	5	13.6	15.2	16	16.8	1	22.5	27	28.9	138	8.6	1800
P P6KE18P	P P6KE18CP	5	15.3	17.1	18	19.8	1	25.2	24	32.5	123	8.8	1600
P P6KE18A	P P6KE18CA	5	15.3	17.1	18	18.9	1	25.2	24	32.5	123	8.8	1600
P6KE20P	P P6KE20CP	5	17.1	19	20	22	1	27.7	22	36.1	111	9.0	1500
P P6KE20A	P P6KE20CA	5	17.1	19	20	21	1	27.7	22	36.1	111	9.0	1500
P6KE22P	P P6KE22CP	5	18.8	20.9	22	24.2	1	30.6	20	39.3	102	9.2	1350

P = Prefered device

TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P6KE22A	P6KE22CA	5	18.8	20.9	22	23.1	1	30.6	20	39.3	102	9.2	1350
P6KE24P	P6KE24CP	5	20.5	22.8	24	26.4	1	33.2	18	42.8	93	9.4	1250
P P6KE24A	P6KE24CA	5	20.5	22.8	24	25.2	1	33.2	18	42.8	93	9.4	1250
P P6KE27P	P P6KE27CP	5	23.1	25.7	27	29.7	1	37.5	16	48.3	83	9.6	1150
P6KE27A	P6KE27CA	5	23.1	25.7	27	28.4	1	37.5	16	48.3	83	9.6	1150
P P6KE30P	P P6KE30CP	5	25.6	28.5	30	33	1	41.5	14.5	53.5	75	9.7	1075
P P6KE30A	P P6KE30CA	5	25.6	28.5	30	31.5	1	41.5	14.5	53.5	75	9.7	1075
P6KE33P	P6KE33CP	5	28.2	31.4	33	36.3	1	45.7	13.1	59.0	68	9.8	1000
P P6KE33A	P P6KE33CA	5	28.2	31.4	33	34.7	1	45.7	13.1	59.0	68	9.8	1000
P P6KE36P	P P6KE36CP	5	30.8	34.2	36	39.6	1	49.9	12	64.3	62	9.9	950
P P6KE36A	P6KE36CA	5	30.8	34.2	36	37.8	1	49.9	12	64.3	62	9.9	950
P P6KE39P	P P6KE39CP	5	33.3	37.1	39	42.9	1	53.9	11.1	69.7	57	10.0	900
P P6KE39A	P P6KE39CA	5	33.3	37.1	39	41.0	1	53.9	11.1	69.7	57	10.0	900
P6KE43P	P6KE43CP	5	36.8	40.9	43	47.3	1	59.3	10.1	76.8	52	10.1	850
P6KE43A	P6KE43CA	5	36.8	40.9	43	45.2	1	59.3	10.1	76.8	52	10.1	850
P6KE47P	P P6KE47CP	5	40.2	44.7	47	51.7	1	64.8	9.3	84	48	10.1	800
P6KE47A	P P6KE47CA	5	40.2	44.7	47	49.4	1	64.8	9.3	84	48	10.1	800
P6KE51P	P P6KE51CP	5	43.6	48.5	51	56.1	1	70.1	8.6	91	44	10.2	750
P6KE51A	P P6KE51CA	5	43.6	48.5	51	53.6	1	70.1	8.6	91	44	10.2	750
P6KE56P	P P6KE56CP	5	47.8	53.2	56	61.6	1	77	7.8	100	40	10.3	700
P6KE56A	P6KE56CA	5	47.8	53.2	56	58.8	1	77	7.8	100	40	10.3	700
P6KE62P	P6KE62CP	5	53.0	58.9	62	68.2	1	85	7.1	111	36	10.4	650
P6KE62A	P6KE62CA	5	53.0	58.9	62	65.1	1	85	7.1	111	36	10.4	650
P6KE68P	P P6KE68CP	5	58.1	64.6	68	74.8	1	92	6.5	121	33	10.4	625
P6KE68A	P6KE68CA	5	58.1	64.6	68	71.4	1	92	6.5	121	33	10.4	625
P6KE75P	P6KE75CP	5	64.1	71.3	75	82.5	1	103	5.8	134	30	10.5	575
P6KE75A	P6KE75CA	5	64.1	71.3	75	78.8	1	103	5.8	134	30	10.5	575
P6KE82P	P P6KE82CP	5	70.1	77.9	82	90.2	1	113	5.3	146	27	10.5	550
P6KE82A	P6KE82CA	5	70.1	77.9	82	86.1	1	113	5.3	146	27	10.5	550
P6KE91P	P6KE91CP	5	77.8	86.5	91	100	1	125	4.8	162	25	10.6	525
P6KE91A	P6KE91CA	5	77.8	86.5	91	95.5	1	125	4.8	162	25	10.6	525
P6KE100P	P6KE100CP	5	85.5	95.0	100	110	1	137	4.4	178	22.5	10.6	500
P6KE100A	P6KE100CA	5	85.5	95.0	100	105	1	137	4.4	178	22.5	10.6	500
P6KE110P	P6KE110CP	5	94.0	105	110	121	1	152	3.9	195	20.5	10.7	470
P6KE110A	P6KE110CA	5	94.0	105	110	116	1	152	3.9	195	20.5	10.7	470
P6KE120P	P6KE120CP	5	102	114	120	132	1	165	3.6	212	19	10.7	450
P6KE120A	P6KE120CA	5	102	114	120	126	1	165	3.6	212	19	10.7	450
P6KE130P	P P6KE130CP	5	111	124	130	143	1	179	3.4	230	17.5	10.7	420
P6KE130A	P6KE130CA	5	111	124	130	137	1	179	3.4	230	17.5	10.7	420
P6KE150P	P P6KE150CP	5	128	143	150	165	1	207	2.9	265	15	10.8	400
P P6KE150A	P P6KE150CA	5	128	143	150	158	1	207	2.9	265	15	10.8	400
P6KE160P	P P6KE160CP	5	136	152	160	176	1	219	2.7	282	14	10.8	380
P6KE160A	P6KE160CA	5	136	152	160	168	1	219	2.7	282	14	10.8	380
P6KE170P	P6KE170CP	5	145	161	170	187	1	234	2.6	301	13	10.8	370
P6KE170A	P6KE170CA	5	145	161	170	179	1	234	2.6	301	13	10.8	370
P6KE180P	P P6KE180CP	5	154	171	180	198	1	246	2.4	317	12.6	10.8	360
P6KE180A	P6KE180CA	5	154	171	180	189	1	246	2.4	317	12.6	10.8	360
P6KE200P	P P6KE200CP	5	171	190	200	220	1	274	2.2	353	11.3	10.8	350
P P6KE200A	P P6KE200CA	5	171	190	200	210	1	274	2.2	353	11.3	10.8	350
P6KE220P	P6KE220CP	5	188	209	220	242	1	328	2	388	10.3	10.8	330
P6KE220A	P6KE220CA	5	188	209	220	231	1	328	2	388	10.3	10.8	330
P6KE250P	P P6KE250CP	5	213	237	250	275	1	344	2	442	9	11	310
P6KE250A	P6KE250CA	5	213	237	250	263	1	344	2	442	9	11	310
P6KE280P	P6KE280CP	5	239	266	280	308	1	384	2	494	8	11	300
P6KE280A	P6KE280CA	5	239	266	280	294	1	384	2	494	8	11	300

P = Prefered device

TYPES		I_{RM} @ V_{RM}		V_{BR} @			I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	**Bidirectional**	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P6KE300P	P6KE300CP	5	256	285	300	330	1	414	1.6	529	7.6	11	290
P6KE300A	P6KE300CA	5	256	285	300	315	1	414	1.6	529	7.6	11	290
P6KE320P	P6KE320CP	5	273	304	320	352	1	438	1.6	564	7.1	11	280
P6KE320A	P6KE320CA	5	273	304	320	336	1	438	1.6	564	7.1	11	280
P6KE350P	P6KE350CP	5	299	332	350	385	1	482	1.6	618	6.5	11	270
P P6KE350A	P6KE350CA	5	299	332	350	368	1	482	1.6	618	6.5	11	270
P P6KE400P	P P6KE400CP	5	342	380	400	440	1	548	1.3	706	5.7	11	360
P6KE400A	P6KE400CA	5	342	380	400	420	1	548	1.3	706	5.7	11	360
P P6KE440P	P P6KE440CP	5	376	418	440	484	1	603	1.3	776	5.2	11	350
P6KE440A	P6KE440CA	5	376	418	440	462	1	603	1.3	776	5.2	11	350

All parameters tested at 25 °C, except where indicated.

P = Prefered device

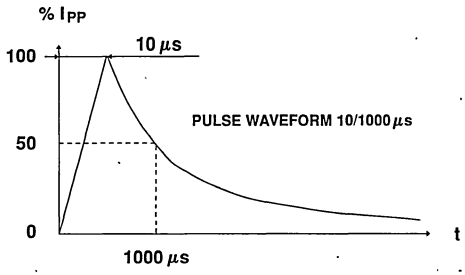
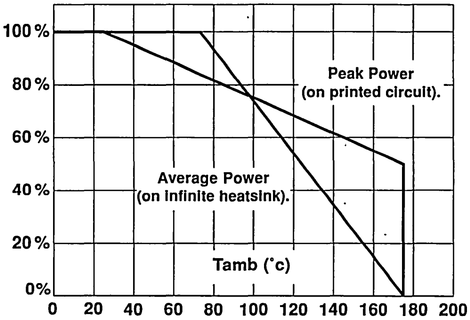


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 2 : Peak pulse power versus exponential pulse duration.

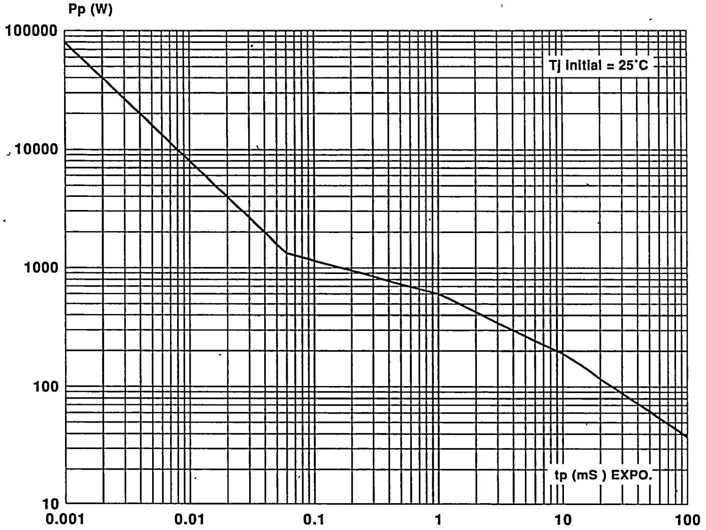
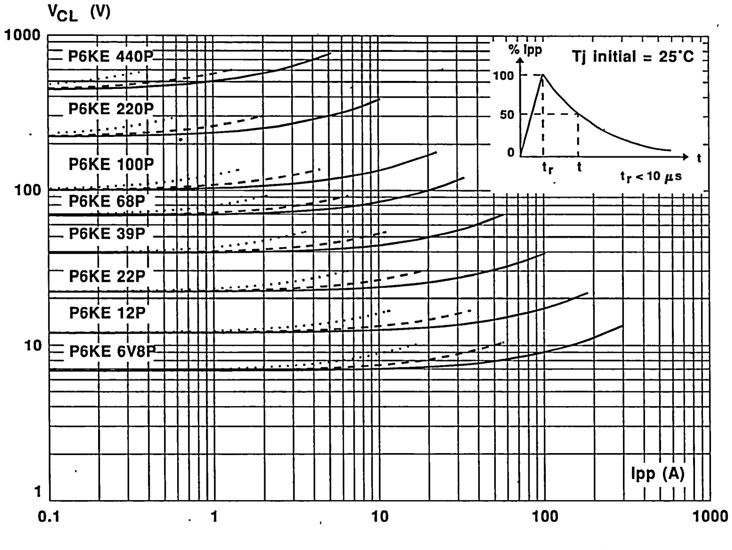


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

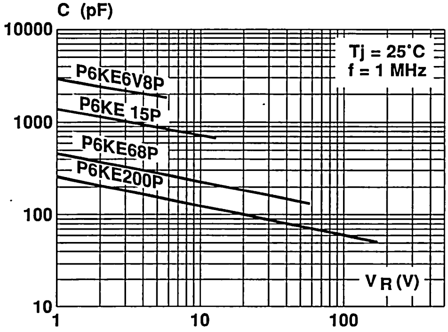


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

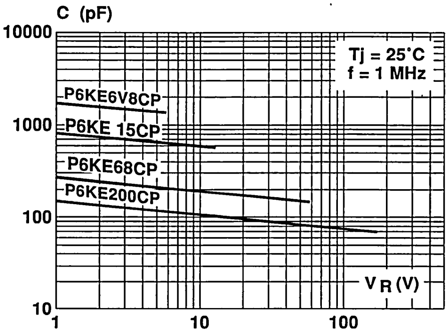


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

Note : For units with $V_{BR} > 200$ V
V_F is twice than shown.

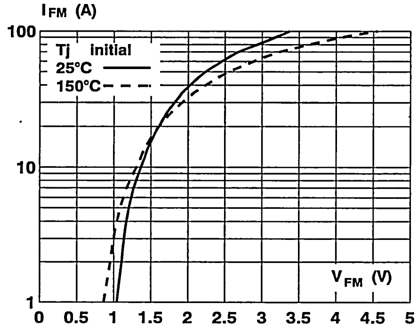
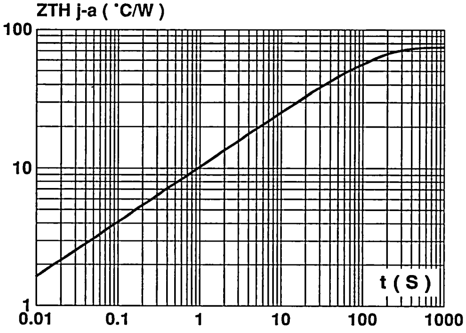


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with $L_{lead} = 10$mm.



ORDER CODE

P6 KE 100 C A RL

600 W ← P6

BREAKDOWN VOLTAGE ← 100

BIDIRECTIONAL ← C

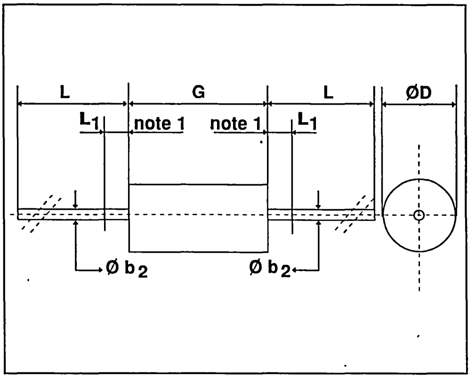
TOLERANCE : ← A
A = +/- 5%
P = -5%, +10%.

PACKAGING: ← RL
= Ammopack
RL = Tape and reel.

MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

CB417 (Plastic).



Ref	Millimeters		Inches	
	min	max	min	max
Ø b_2	-	1.092	-	0.043
Ø D	-	3.683	-	0.145
G	-	8.89	-	0.350
L	25.4	-	1.000	-
L_1	-	1.25	-	0.049
note1:The diameter Ø b_2 is not controlled over zone L_1.				

Weight = 0.65 g.

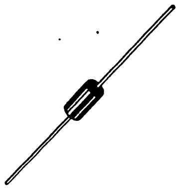
Packaging : standard packaging is in tape and reel.

P7T-10,B/110,B

TRANSIL

FEATURES

- PEAK PULSE POWER= 700 W @ 1ms.
- STAND-OFF VOLTAGE RANGE :
  From 10 V to 110 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME:
  Tclamping : 1ps (0 V to VBR).



CB417
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

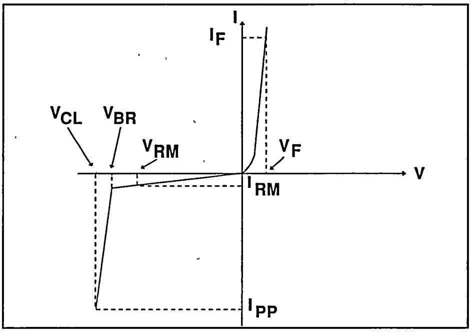
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	700	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	5	W
I_{FSM}	Non repetitive surge peak forward current For Unidirectional types.	Tamb = 25°C t =10 ms	120	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 175	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	20	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. L_{lead} = 10 mm	85	°C/W

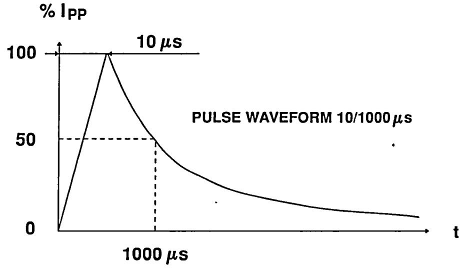
ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.



TYPES		I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
					note2			10/1000µs		8/20µs		note3	note4
Unidirectional	Bidirectional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
P7T-10	P7T-10B	5	10	13	18	20	5	25	30	32	265	8.4	2600
P7T-27	P7T-27B	5	27	29.6	36	43.5	5	53	13	68	125	9.6	1100
P7T-43	P7T-43B	5	43	50	62	75	5	90	8	115	74	10.3	620
P7T-110	P7T-110B	5	110	130	160	200	5	235	3	300	28	10.8	370

All parameters tested at 25 °C, except where indicated.



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.
Note 2 : Pulse test: T_P < 50 ms.
Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.
Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 1: Power dissipation derating versus ambient temperature

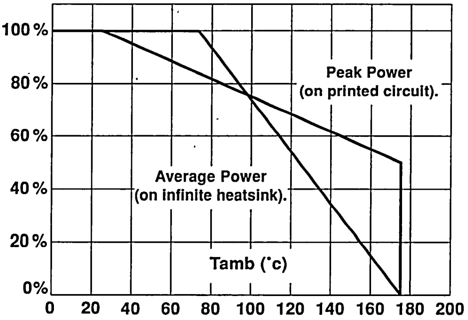


Figure 2 : Peak pulse power versus exponential pulse duration.

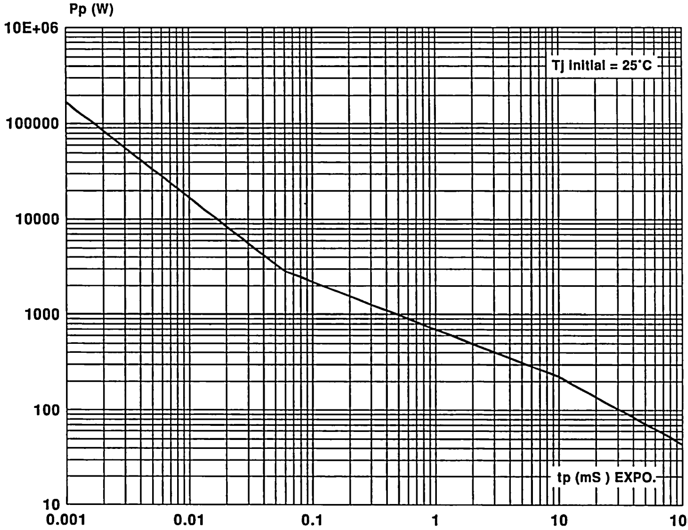
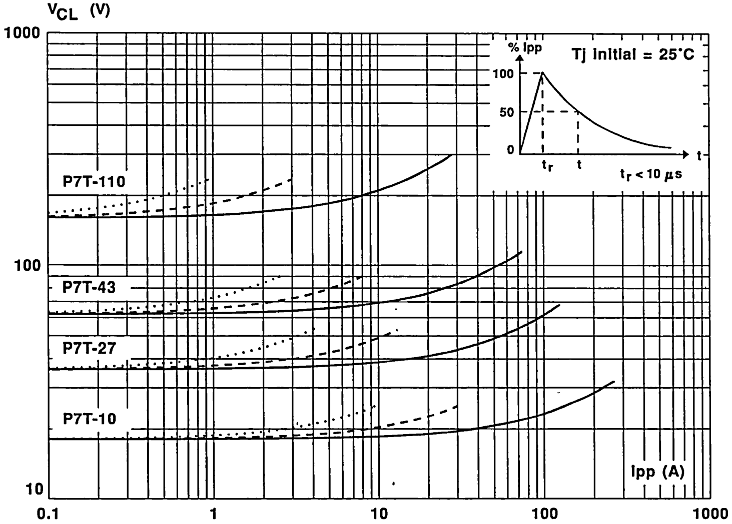


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} \cdot [T_a - 25] \cdot V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

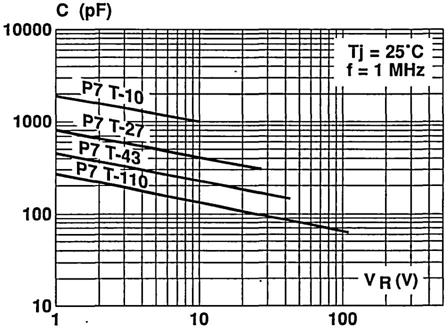


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

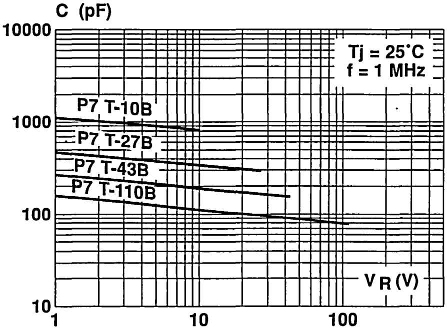


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

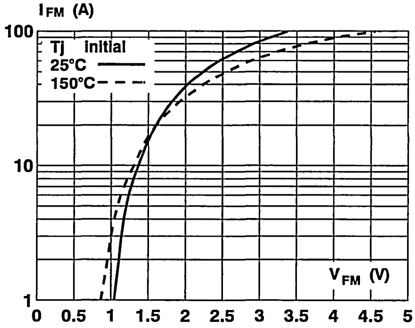
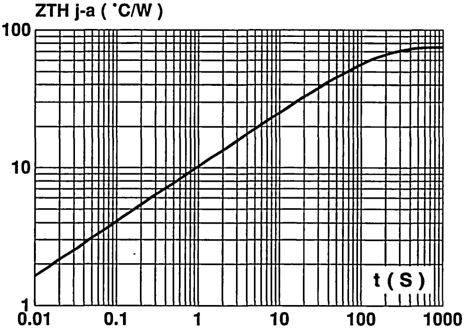


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with L lead = 10mm.



ORDER CODE

P7T - 10 , B RL

700 W

STAND-OFF VOLTAGE

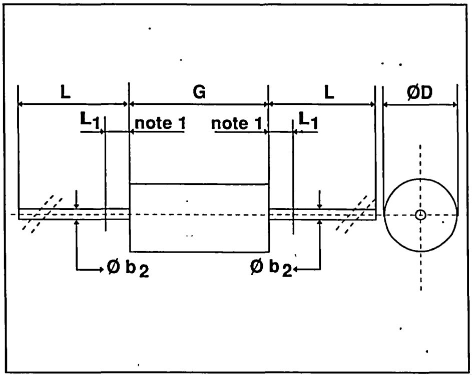
PACKAGING:
= Ammopack
RL = Tape and reel.

BIDIRECTIONAL

MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

CB417



Ref	Millimeters		Inches	
	min	max	min	max
Ø b2	-	1.092	-	0.043
Ø D	-	3.683	-	0.145
G	-	8.89	-	0.350
L	25.4	-	1.000	-
L1	-	1.25	-	0.049

note 1 : The diameter Ø b_2 is not controlled over zone L_1.

Weight = 0.65 g.

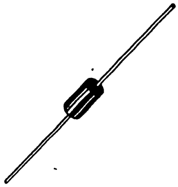
Packaging : standard packaging is in tape and reel.

PL360D

TRANSIL

FEATURES

- PEAK PULSE POWER= 300 W @ 1ms.
- BREAKDOWN VOLTAGE = 330 V min.
- UNIDIRECTIONAL TRANSIL.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME:
  $T_{clamping}$: 1ps (0 V to V_{BR}).



F126
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action.
The PL360D has been especially designed for transistor protection in electronic ignition circuits. Connected across collector and base, it avoids any transistor damage when a spark plug is fouled or disconnected.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band .
- Tinned copper leads.
- High temperature soldering.

ABSOLUTE RATINGS (limiting values)

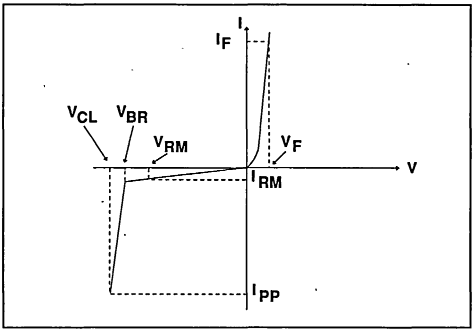
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	300	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 75°C	1.7	W
I_{ZM}	Continuous reverse current.	Tamb = 50°C	3.5	mA
T_{oper}	Operation temperature.		- 55 to 150	°C
T_{stg} T_j	Storage and junction temperature range.		- 55 to + 150 150	°C °C
T_L	Maximum lead temperature for soldering during 3 sec at 5 mm from case.		300	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	60	°C/W
R_{th} (j-a)	Junction to ambient on printed circuit. L_{lead} = 10 mm	100	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.



ELECTRICAL CHARACTERISTICS

Type	I_{RM} @ V_{RM}		V_{BR} @ T_j = 25 °C		V_{BR} @ T_j = 120 °C		IR	I_{ZM}	αT
	max		min	max	min	max			max
	µA	V	V		V		mA	mA	10^{-4}/°C
PL360D	0.35	270	330	370	358	416	2	3.5	11

All parameters tested at 25 °C, except where indicated.

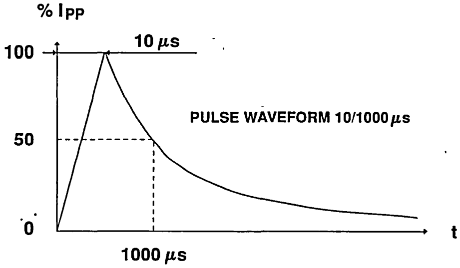
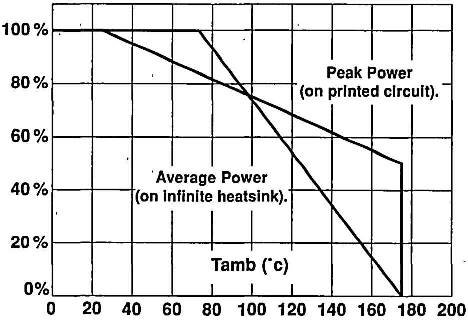


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Figure 2 : Peak pulse power versus exponential pulse duration.

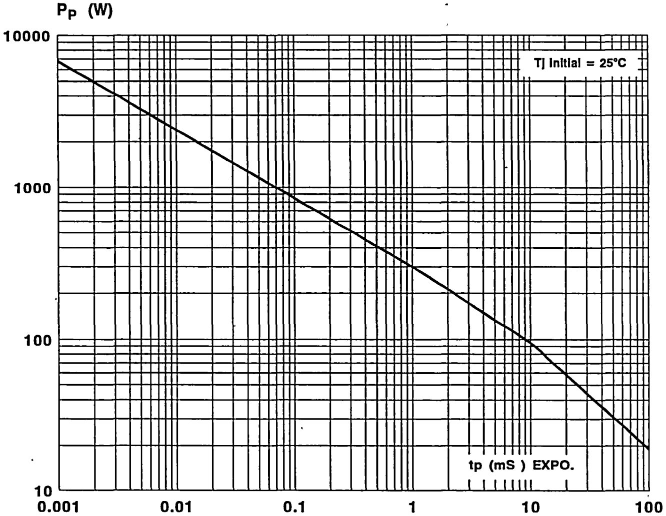
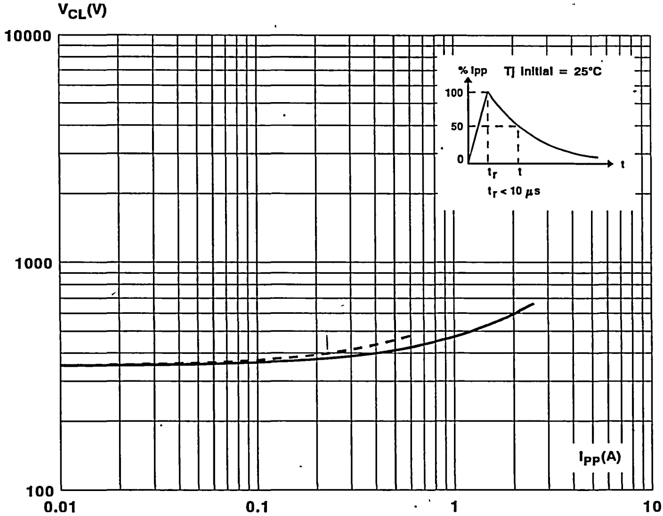


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} \cdot [T_a - 25] \cdot V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4 : Capacitance versus reverse applied voltage.

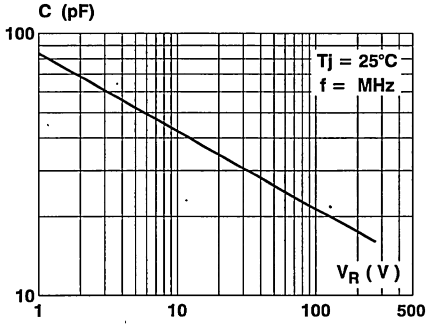
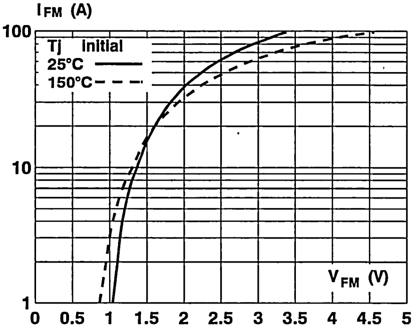
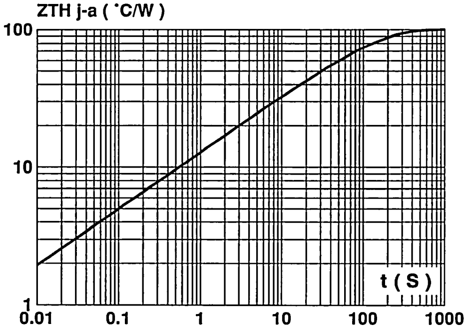


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).



Note : For units with V_{BR} > 200 V
V_F is twice than shown.

Figure 6 : Transient thermal impedance junction-ambient versus pulse duration (device mounted on PC Board with L $_{lead}$ = 10mm).



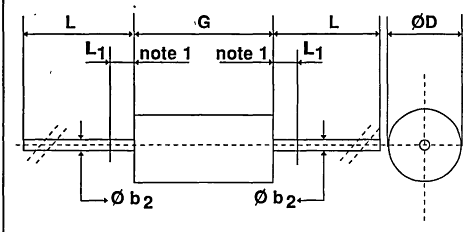
ORDER CODE

PL360D RL

PACKAGING:
 = Ammopack
RL = Tape and reel.

PACKAGE MECHANICAL DATA

F 126 (Plastic).



MARKING : Logo, Date Code, Type Code, Cathode Band.

Ref	Millimeters		Inches	
	min	max	min	max
Ø b$_2$	0.76	0.86	0.029	0.034
Ø D	2.95	3.05	0.116	0.120
G	6.05	6.35	0.238	0.250
L	26	-	1.024	-
L$_1$	-	1.27	-	0.050

note1:The diameter Ø b$_2$ is not controlled over zone L$_1$

Packaging : standard packaging is in tape and reel.

Weight = 0.4 g.

SGS-THOMSON
MICROELECTRONICS

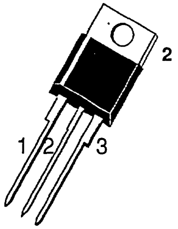
RBO08-40

REVERSED BATTERY AND OVERVOLTAGE PROTECTION CIRCUIT (RBO)

PRELIMINARY DATA

FEATURES

- DISSIPATION THROUGH PIN 2 : TAB CONNECTED TO GROUND
- MONOLITHIC SILICON CHIP
- NEGATIVE OVERVOLTAGE PROTECTION BY CLAMPING (COMPONENT T1)
- BREAKDOWN VOLTAGE : 24 V min
- CLAMPING VOLTAGE : ± 40 V max
- AVERAGE FORWARD CURRENT (COMPONENT D1) : 8 A



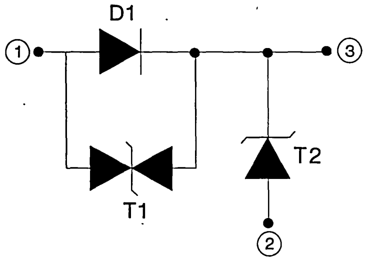
TO 220 AB
(Plastic)

DESCRIPTION

Developed especially for automotive reversed battery operation and overvoltage protection, this monolithic component chip offers multiple functions in the same package (see page 3) :

D1 : reversed battery protection
T1 : clamping function to negative overvoltage effect
T2 : Transil function to positive overvoltage effect

FUNCTIONAL DIAGRAM



ABSOLUTE RATINGS (limiting values)

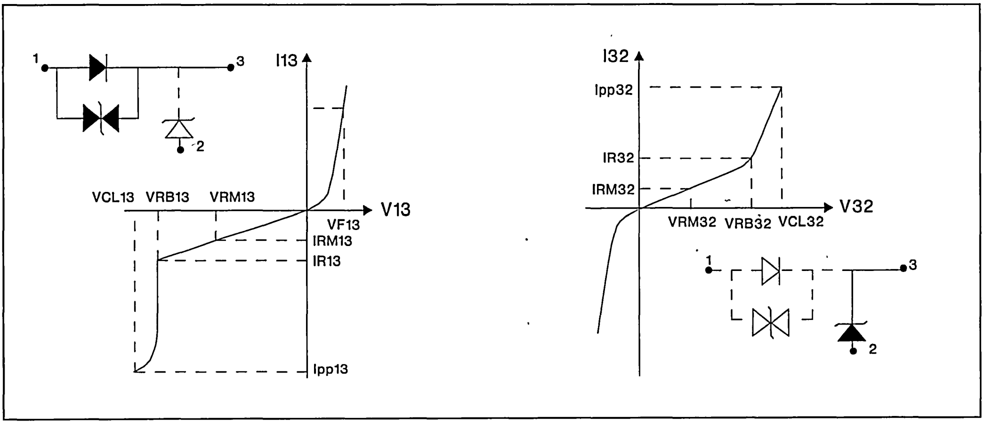
Symbol	Parameter		Value	Unit
I_{FSM}	Non repetitive surge peak forward current between Pins 1 and 3 @ T= 10 µs	Tj = 25°C	80	A
$I_{F(AV)}$	Average forward current between Pins 1 and 3	Tc = 85°C	8	A
P_P	Peak pulse between Pins 1 and 3 @ T= 1 ms (see note 1)	Tc = 85°C	600	W
P_{PP}	Peak pulse power between Pins 2 and 3 @ T= 1 ms	Tc = 85°C	1500	W
P	Total power dissipation	Tc = 85°C	25	W
Tstg Tj	Storage and junction temperature range		- 40 to + 150	°C
T_L	Maximum lead temperature for soldering during 10 s at 4.5 mm from case		230	°C

Note 1 : for a surge greater than the maximum value, the source will present a short circuit.

November 1992

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
Rth (j-c)	Junction to case	2.4	°C/W

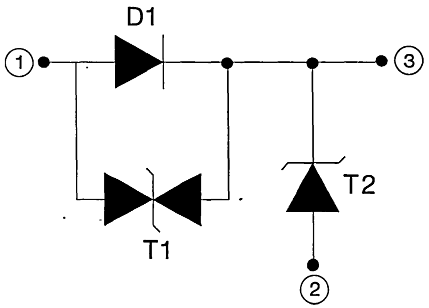


ELECTRICAL CHARACTERISTICS

Symbol	Test Conditions			Value	Unit
V_F 13	Maximum forward voltage @ I_F = 8 A	Tj=25°C	MAX	1.7	V
		Tj=85°C			
V_F 13	Maximum forward voltage @ IF = 4 A	Tj=25°C	MAX	1.35	V
		Tj=85°C			
V_F 13	Maximum forward voltage @ IF = 1 A	Tj=85°C	MAX	0.9	V
V_{BR} 31	Breakdown voltage @ IR = 1 mA	Tj=25°C	MIN	24	V
			MAX	32	
I_{RM} 31	Leakage current @ V_{RM} = 20 V	Tc=25°C	MAX	10	µA
		Tc=85°C		100	
V_{CL} 31	Clamping voltage @ I_{PP} = 15 A @ T= 1 ms	Tc=25°C	MAX	40	V
V_{BR} 32	Breakdown voltage @ I_R = 1 mA	Tj=25°C	MIN	24	V
			MAX	32	
I_{RM} 32	Leakage current @ V_{RM} = 20 V	Tc=25°C	MAX	10	µA
		Tc=85°C		50	
V_{CL} 32	Clamping voltage @ IPP = 37.5 A @ T= 1 ms	Tc=25°C	MAX	40	V
α t	Temperature coefficient	Tc=25°C	MAX	10^{-4}	/°C
C 13	Capacitance at 0 V	Tc=25°C	TYP	1000	pF
C 32	Capacitance at 0 V	Tc=25°C	TYP	2000	pF

Note : 13 and 32
Ex : V_F 13 . between Pin 1 and Pin 3
V_{BR} 32 . between Pin 3 and Pin 2

PRODUCT DESCRIPTION



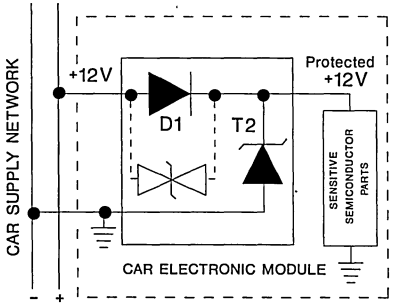
The RBO has 3 functions integrated on the same chip.

D1 : "Rectifier function" in order to protect against reversed battery operation.

T2 : "Transil function" in order to protect against positive surge generated by electric systems (ignition, relay. ...).

T1 : Protection for motor drive application (See below).

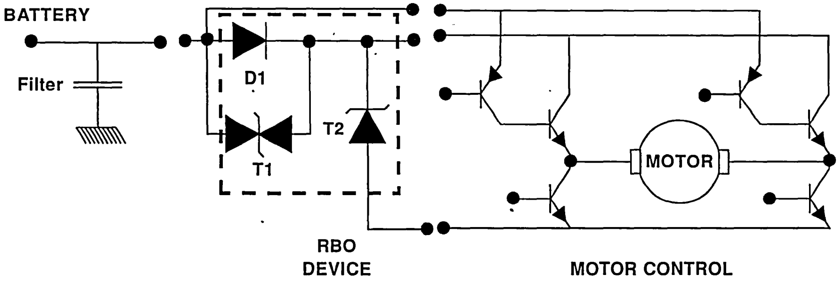
BASIC APPLICATION



*The monolithic multi function protection (RBO) has been developed to protect sensitive semiconductors in the car electronic module against both overvoltage and battery reverse.

*In addition, the RBO circuit prevents overvoltages generated by the module affecting the car supply network.

MOTOR DRIVER APPLICATION



In this application, one half of the motor drive circuit is supplied through the "RBO" and is thus protected as per its basic function application.
The second part is connected directly to the "car supply network" and is protected as follows :

- For positive surges : T2 (clamping phase) and D1 in forward-biased.
- For negative surges : T1 (clamping phase) and T2 in forward-biased.

ORDERING INFORMATION

RBO 08 - 40 T

RBO: Reversed Battery &
Overvolage protection

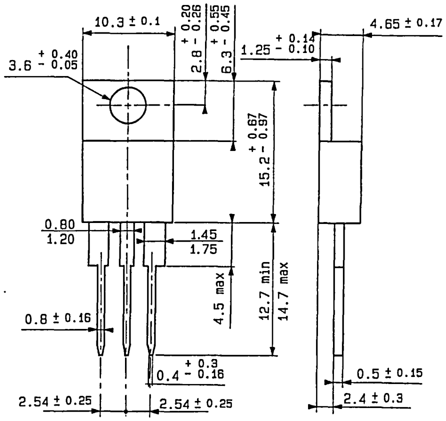
08: $I_{F(AV)}$ = 8 A

40: V_{CL} = 40V

T: Packages :
T = TO 220 AB

PACKAGE MECHANICAL DATA (in millimeters)

TO 220 AB Plastic



Cooling method : C
Marking : type number
Weight : 2 g
Polarity : N A
Stud torque : N A

SGS-THOMSON
MICROELECTRONICS

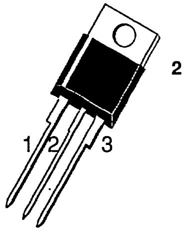
RBO40-40

REVERSED BATTERY AND OVERVOLTAGE PROTECTION CIRCUIT (RBO)

PRELIMINARY DATA

FEATURES

- DISSIPATION THROUGH PIN 2 : TAB CONNECTED TO GROUND
- MONOLITHIC SILICON CHIP
- NEGATIVE OVERVOLTAGE PROTECTION BY CLAMPING (COMPONENT T1)
- BREAKDOWN VOLTAGE : 24 V min
- CLAMPING VOLTAGE : ± 40 V max
- AVERAGE FORWARD CURRENT (COMPONENT D1) : 40 A



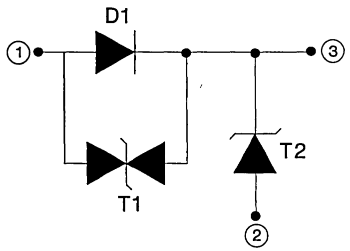
TO 220 AB
(Plastic)

DESCRIPTION

Developed especially for automotive reversed battery operation and overvoltage (load dump) protection, this monolithic component chip offers multiple functions in the same package (see page 4) :

D1 : reversed battery protection
T1 : clamping function to negative overvoltage effect
T2 : Transil function to Load Dump effect

FUNCTIONAL DIAGRAM



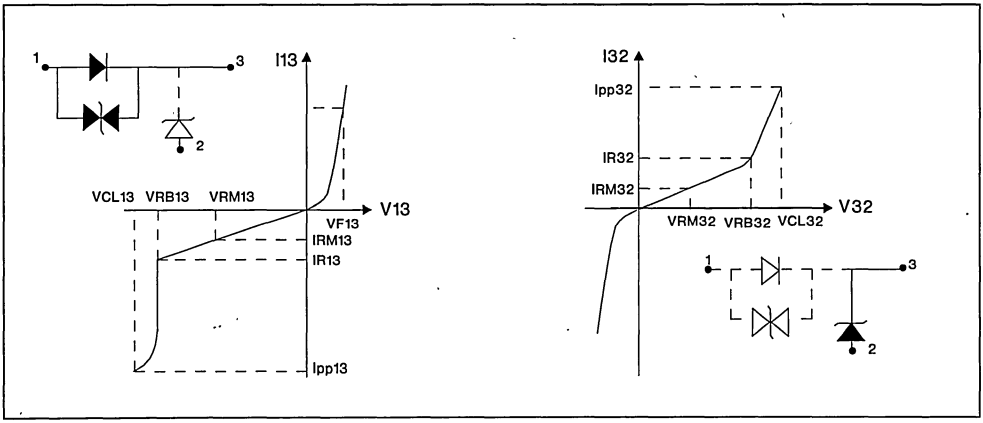
ABSOLUTE RATINGS (limiting values)

Symbol	Parameter		Value	Unit
I_{FSM}	Non repetitive surge peak forward current between Pins 1 and 3 @ T= 10 µs	Tj = 25°C	400	A
$I_{F(AV)}$	Average forward current between Pins 1 and 3	Tc = 80°C	40	A
V_{PP}	Peak load dump voltage (see note 1 and 2)	Tc = 85°C	80	V
P_{PP}	Peak pulse power between Pins 1 and 3 @ T= 1 ms	Tc = 85°C	1500	W
P	Total power dissipation	Tc = 80°C	70	W
Tstg Tj	Storage and junction temperature range		- 40 to + 150	°C
T_L	Maximum lead temperature for soldering during 10 s at 4.5 mm from case		230	°C

Notes 1 : for a surge greater than the maximum value, the source will present a short circuit.
Notes 2 : see schaffner circuit page 3

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
Rth (j-c)	Junction to case	1	°C/W

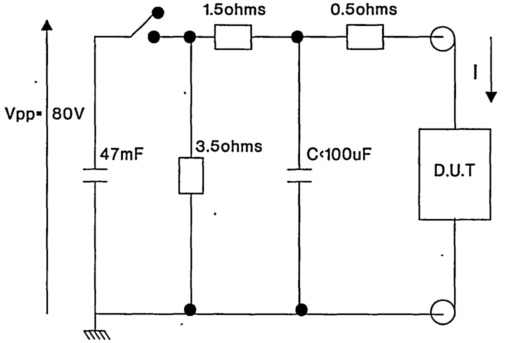


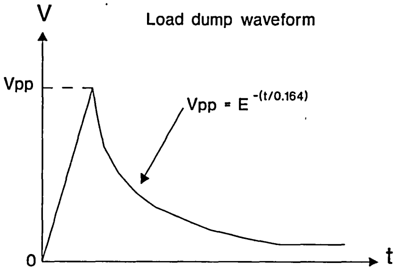
ELECTRICAL CHARACTERISTICS

Symbol	Test Conditions			Value	Unit
V_F 13	Maximum forward voltage @ I_F = 40 A	Tj=25°C	MAX	1.7	V
		Tj=85°C			
V_F 13	Maximum forward voltage @ IF = 20 A	Tj=25°C	MAX	1.35	V
		Tj=85°C			
V_F 13	Maximum forward voltage @ IF = 1A	Tj=85°C	MAX	0.9	V
V_{BR} 31	Breakdown voltage @ I_R = 1 mA	Tj=25°C	MIN	24	V
			MAX	32	
I_{RM} 31	Leakage current @ V_{RM} = 20 V	Tc=25°C	MAX	50	µA
		Tc=85°C		300	
V_{CL} 31	Clamping voltage @ I_{PP} = 37.5 A @ T= 1 ms	Tc=25°C	MAX	40	V
V_{BR} 32	Breakdown voltage @ I_R = 1 mA	Tj=25°C	MIN	24	V
			MAX	32	
I_{RM} 32	Leakage current @ V_{RM} = 20 V	Tc=25°C	MAX	10	µA
		Tc=85°C		100	
V_{CL} 32	Clamping voltage @ IPP = 20 A	Tc=25°C	MAX	40	V
αt	Temperature coefficient	Tc=25°C	MAX	10^{-4}	/°C
C 13	Capacitance at 0 V	Tc=25°C	TYP	3000	pF
C 32	Capacitance at 0 V	Tc=25°C	TYP	7000	pF

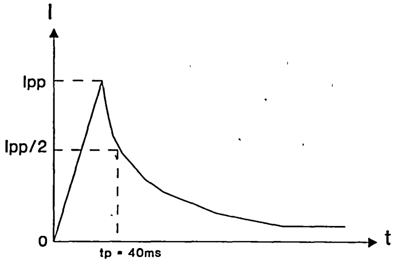
Note : 13 and 32
Ex : V_F 13 . between Pin 1 and Pin 3
V_{BR} 32 . between Pin 3 and Pin 2

SCHAFFNER CIRCUIT



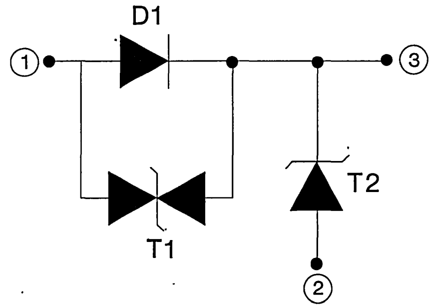


OUTPUT VOLTAGE WITHOUT D.U.T



CURRENT THROUGH D.U.T

PRODUCT DESCRIPTION



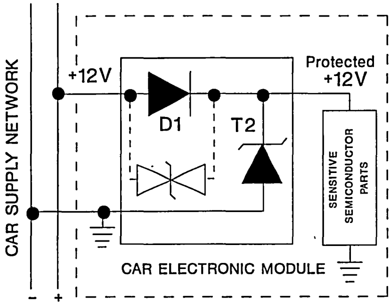
The RBO has 3 integrated functions on the same chip.

D1 : "Rectifier function" in order to protect against reversed battery operation.

T2 : "Transil function" in order to protect against Load dump generated by the alternator.

T1 : Protection for motor driver application (See below).

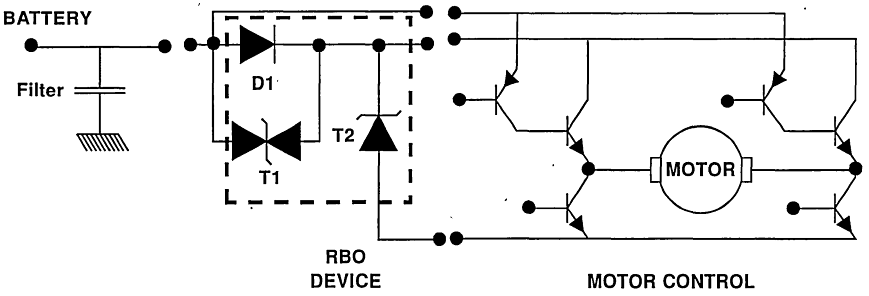
BASIC APPLICATION



*The monolithic multi function protection (RBO) has been developed to protect sensitive semiconductors in the car electronic module against both overvoltage and battery reverse.

*In addition, this RBO circuit prevents overvoltages generated by the module affecting the car supply network.

MOTOR DRIVER APPLICATION



In this application, one half of the motor drive circuit is supplied through the "RBO" and is thus protected as per its basic function application.
The second part is connected directly to the "car supply network" and is protected as follows :
- For positive surges : T2 (clamping phase) and D1 forward-biased.
- For negative surges : T1 (clamping phase) and T2 forward-biased.

ORDERING INFORMATION

RBO 40 - 40 T

RBO: Reversed Battery & Overvolage protection

40: $I_{F(AV)}$ = 40 A

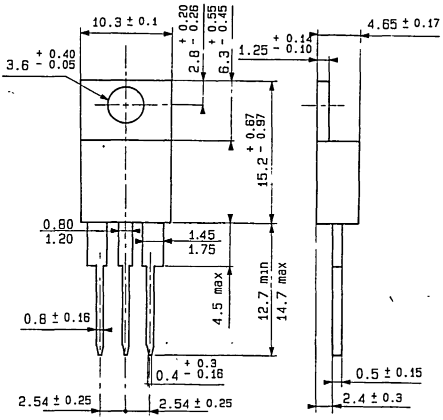
40: V_{CL} = 40V

T: Packages :
T = TO 220 AB
M = SOP 10 (Power SO) *

* To be announced later on

PACKAGE MECHANICAL DATA (in millimeters)

TO 220 AB Plastic



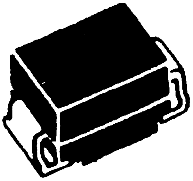
Cooling method : C
Marking : type number
Weight : 2 g
Polarity : N A
Stud torque : N A

SM4T6V8,A/220,A
SM4T6V8C,CA/220C,CA

TRANSIL

FEATURES

- PEAK PULSE POWER= 400 W @ 1ms.
- BREAKDOWN VOLTAGE RANGE : From 6V8 to 220 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: Tclamping : 1ps (0 V to V_{BR}).
- JEDEC REGISTRED.



SOD 6
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them praticularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Full compatibility with both gluing and paste soldering technologies.
- Excellent on board stability.
- Tinned copper leads.
- High temperature resistant resin.

ABSOLUTE RATINGS (limiting values)

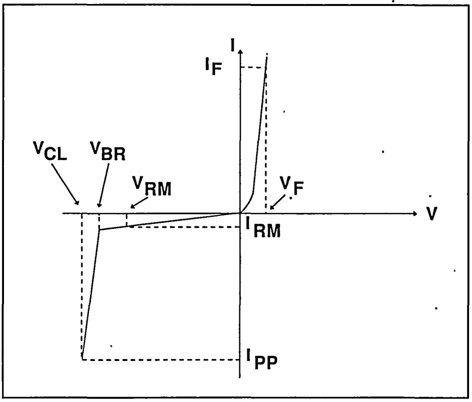
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	400	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 50°C	5	W
I_{FSM}	Non repetitive surge peak forward current. For unidirectional types.	Tamb = 25°C t =10 ms	50	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	20	°C/W
R_{th} (j-a)	Junction to ambiant. on printed circuit. With standard footprint dimensions.	100	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ $I_F = 25$ A.



TYPES				I_{RM} @ V_{RM} max		V_{BR} @ I_R				V_{CL} @ I_{PP} max 10/1000µs		V_{CL} @ I_{PP} max 8/20µs		αT max note3	C typ note4
						min	nom	max note2							
Uni directional	*	Bi directional	*	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
SM4T6V8	QD	SM4T6V8C	VD	1000	5.8	6.45	6.8	7.48	10	10.5	38	13.4	174	5.7	3500
SM4T6V8A	QE	SM4T6V8CA	VE	1000	5.8	6.45	6.8	7.14	10	10.5	38	13.4	174	5.7	3500
SM4T7V5	QF	SM4T7V5C	VF	500	6.4	7.13	7.5	8.25	10	11.3	35.4	14.5	160	6.1	3100
SM4T7V5A	QG	SM4T7V5CA	VG	500	6.4	7.13	7.5	7.88	10	11.3	35.4	14.5	160	6.1	3100
SM4T10	QN	SM4T10C	VN	10	8.55	9.5	10	11	1	14.5	27.6	18.6	124	7.3	2000
SM4T10A	QP	SM4T10CA	VP	10	8.55	9.5	10	10.5	1	14.5	27.6	18.6	124	7.3	2000
SM4T12	QS	SM4T12C	VS	5	10.2	11.4	12	13.2	1	16.7	24	21.7	106	7.8	1550
SM4T12A	QT	SM4T12CA	VT	5	10.2	11.4	12	12.6	1	16.7	24	21.7	106	7.8	1550
SM4T15	QW	SM4T15C	VW	5	12.8	14.3	15	16.5	1	21.2	19	27.2	85	8.4	1200
SM4T15A	QX	SM4T15CA	VX	5	12.8	14.3	15	15.8	1	21.2	19	27.2	85	8.4	1200
SM4T18	RD	SM4T18C	UD	5	15.3	17.1	18	19.8	1	25.2	16	32.5	71	8.8	975
SM4T18A	RE	SM4T18CA	UE	5	15.3	17.1	18	18.9	1	25.2	16	32.5	71	8.8	975
SM4T22	RH	SM4T22C	UH	5	18.8	20.9	22	24.2	1	30.6	13	39.3	59	9.2	800
SM4T22A	RK	SM4T22CA	UK	5	18.8	20.9	22	23.1	1	30.6	13	39.3	59	9.2	800
SM4T24	RL	SM4T24C	UL	5	20.5	22.8	24	26.4	1	33.2	12	42.8	54	9.4	725
SM4T24A	RM	SM4T24CA	UM	5	20.5	22.8	24	25.2	1	33.2	12	42.8	54	9.4	725
SM4T27	RN	SM4T27C	UN	5	23.1	25.7	27	29.7	1	37.5	10.7	48.3	48	9.6	625
SM4T27A	RP	SM4T27CA	UP	5	23.1	25.7	27	28.4	1	37.5	10.7	48.3	48	9.6	625
SM4T30	RQ	SM4T30C	UQ	5	25.6	28.5	30	33	1	41.5	9.6	53.5	43	9.7	575
SM4T30A	RR	SM4T30C4	UR	5	25.6	28.5	30	31.5	1	41.5	9.6	53.5	43	9.7	575
SM4T33	RS	SM4T33C	US	5	28.2	31.4	33	36.3	1	45.7	8.8	59.0	39	9.8	510
SM4T33A	RT	SM4T33CA	UT	5	28.2	31.4	33	34.7	1	45.7	8.8	59.0	39	9.8	510
SM4T36	RU	SM4T36C	UU	5	30.8	34.2	36	39.6	1	49.9	8	64.3	36	9.9	480
SM4T36A	RV	SM4T36CA	UV	5	30.8	34.2	36	37.8	1	49.9	8	64.3	36	9.9	480
SM4T39	RW	SM4T39C	UW	5	33.3	37.1	39	42.9	1	53.9	7.4	69.7	33	10.0	450
SM4T39	RX	SM4T39	UX	5	33.3	37.1	39	41.0	1	53.9	7.4	69.7	33	10.0	450

TYPES				I_{RM} @ V_{RM}		V_{BR} @ I_R				V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
				max		min	nom	max		max		max		max	typ
							note2			10/1000µs		8/20µs		note3	note4
Uni directional	*****	**Bi directional**	*****	**µA**	**V**	**V**	**V**	**V**	**mA**	**V**	**A**	**V**	**A**	**10^{-4}/°C**	**(pF)**
SM4T68	SN	SM4T68C	WN	5	58.1	64.6	68	74.8	1	92	4.3	121	19	10.4	270
SM4T68A	SP	SM4T68CA	WP	5	58.1	64.6	68	71.4	1	92	4.3	121	19	10.4	270
SM4T100	SW	SM4T100C	WW	5	85.5	95.0	100	110	1	137	2.9	178	13	10.6	200
SM4T100A	SX	SM4T100CA	WX	5	85.5	95.0	100	105	1	137	2.9	178	13	10.6	200
SM4T150	TH	SM4T150C	XH	5	128	143	150	165	1	207	2.0	265	9	10.8	145
SM4T150A	TK	SM4T150CA	XK	5	128	143	150	158	1	207	2.0	265	9	10.8	145
SM4T200	TS	SM4T200C	XS	5	171	190	200	220	1	274	1.5	353	6.5	10.8	120
SM4T200A	TT	SM4T200CA	XT	5	171	190	200	210	1	274	1.5	353	6.5	10.8	120
SM4T220	TU	SM4T220C	XU	5	188	209	220	242	1	328	1.4	388	6	10.8	110
SM4T220A	TV	SM4T220CA	XV	5	188	209	220	231	1	328	1.4	388	6	10.8	110

All parameters tested at 25 °C, except where indicated.

*** = Marking**

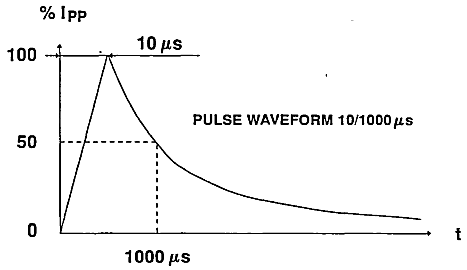
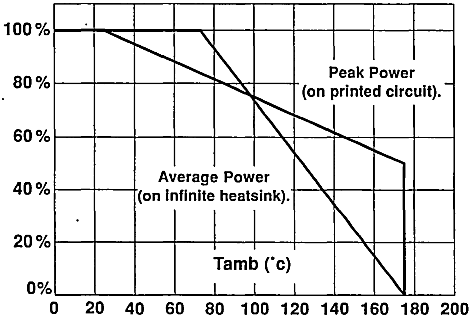


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : For surges greater than the maximum values,
the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 2 : Peak pulse power versus exponential pulse duration.

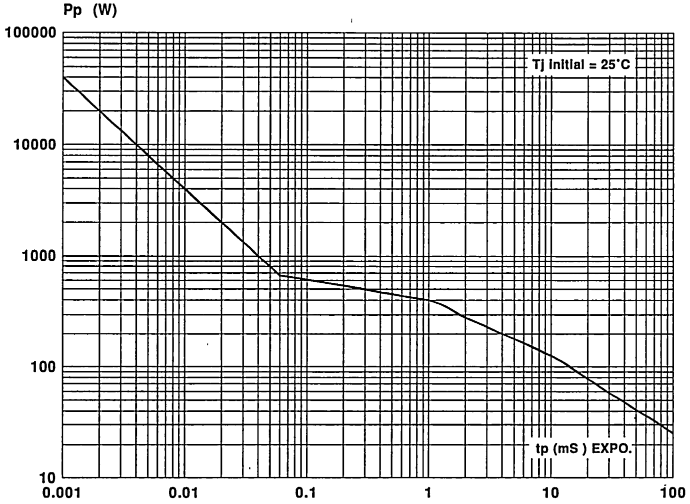
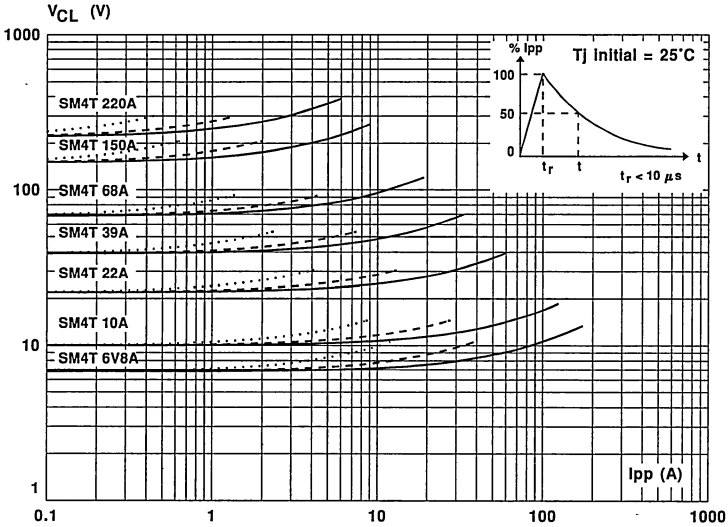


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

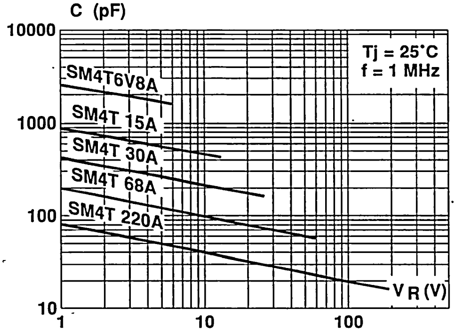


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

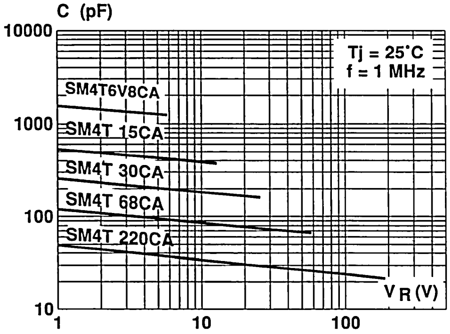


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

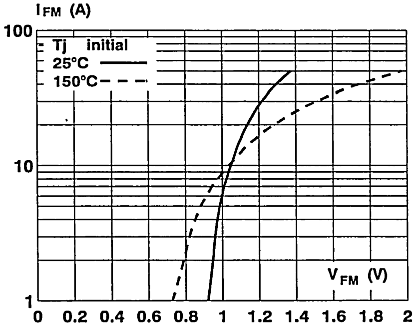
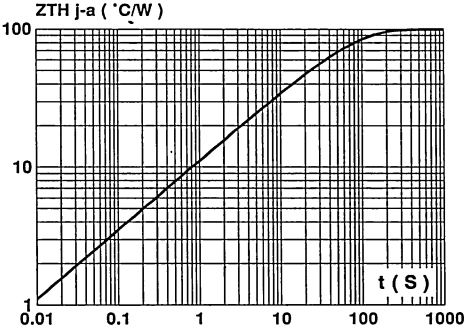
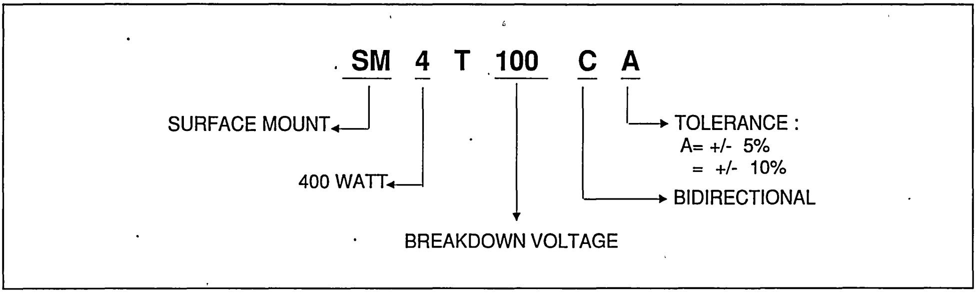


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with standard footprint dimensions.



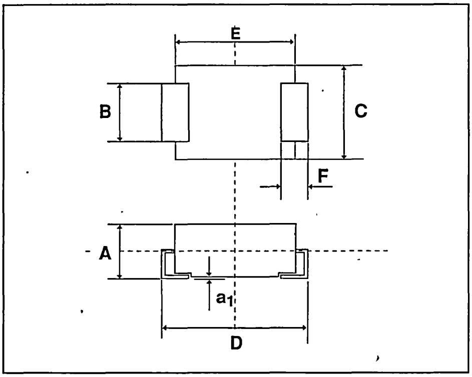
ORDER CODE



MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

SOD 6 (Plastic).

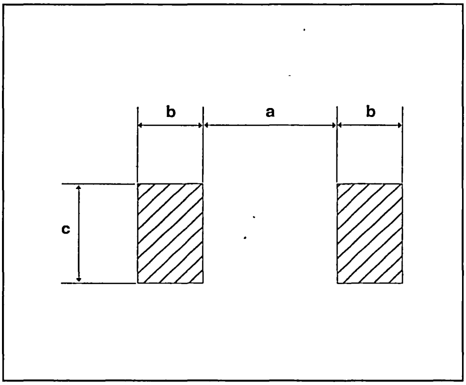


Ref	Millimeters		Inches	
	min	max	min	max
A	2.48	2.61	0.096	0.103
a1	0.10	0.20	0.004	0.008
B	1.96	2.11	0.077	0.083
C	3.65	3.93	0.143	0.155
D	5.39	5.59	0.212	0.220
E	4.15	4.30	0.163	0.170
F	1.00	1.27	0.039	0.050

Weight = 0.12 g.

FOOTPRINT DIMENSIONS (Millimeter).

SOD 6 Plastic.



Ref	Millimeters
a	2.75
b	1.52
c	2.30

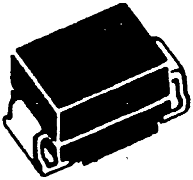
Packaging : standard packaging is in film.

SM6T6V8,A/220,A
SM6T6V8C,CA/220C,CA

TRANSIL

FEATURES

- PEAK PULSE POWER= 600 W @ 1ms.
- BREAKDOWN VOLTAGE RANGE :
  From 6V8 to 220 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME:
  Tclamping : 1ps (0 V to VBR).
- JEDEC REGISTRED.



SOD 6
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code and Cathode Band (for unidirectional types only).
- Full compatibility with both gluing and paste soldering technologies.
- Excellent on board stability.
- Tinned copper leads.
- High temperature resistant resin.

ABSOLUTE RATINGS (limiting values)

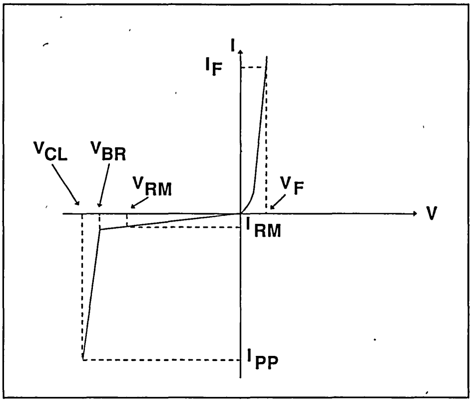
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	600	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 50°C	5	W
I_{FSM}	Non repetitive surge peak forward current. For unidirectional types.	Tamb = 25°C t =10 ms	100	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	20	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. With standard footprint dimensions.	100	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ $I_F = 50$ A.



TYPES				I_{RM} @ V_{RM}		V_{BR}	@		I_R	V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
				max		min	nom	max		max		max		max	typ
							note2			10/1000µs		8/20µs		note3	note4
Uni directional	*	Bi directional	*	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
SM6T6V8	DD	SM6T6V8C	LD	1000	5.8	6.45	6.8	7.48	10	10.5	57	13.4	298	5.7	4000
SM6T6V8A	DE	SM6T6V8CA	LE	1000	5.8	6.45	6.8	7.14	10	10.5	57	13.4	298	5.7	4000
SM6T7V5	DF	SM6T7V5C	LF	500	6.4	7.13	7.5	8.25	10	11.3	53	14.5	276	6.1	3700
SM6T7V5A	DG	SM6T7V5CA	LG	500	6.4	7.13	7.5	7.88	10	11.3	53	14.5	276	6.1	3700
SM6T10	DN	SM6T10C	LN	10	8.55	9.5	10	11	1	14.5	41	18.6	215	7.3	2800
SM6T10A	DP	SM6T10CA	LP	10	8.55	9.5	10	10.5	1	14.5	41	18.6	215	7.3	2800
SM6T12	DS	SM6T12C	LS	5	10.2	11.4	12	13.2	1	16.7	36	21.7	184	7.8	2300
SM6T12A	DT	SM6T12CA	LT	5	10.2	11.4	12	12.6	1	16.7	36	21.7	184	7.8	2300
SM6T15	DW	SM6T15C	LW	5	12.8	14.3	15	16.5	1	21.2	28	27.2	147	8.4	1900
SM6T15A	DX	SM6T15CA	LX	5	12.8	14.3	15	15.8	1	21.2	28	27.2	147	8.4	1900
SM6T18	ED	SM6T18C	MD	5	15.3	17.1	18	19.8	1	25.2	24	32.5	123	8.8	1600
SM6T18A	EE	SM6T18CA	ME	5	15.3	17.1	18	18.9	1	25.2	24	32.5	123	8.8	1600
SM6T22	EH	SM6T22C	MH	5	18.8	20.9	22	24.2	1	30.6	20	39.3	102	9.2	1350
SM6T22A	EK	SM6T22CA	MK	5	18.8	20.9	22	23.1	1	30.6	20	39.3	102	9.2	1350
SM6T24	EL	SM6T24C	ML	5	20.5	22.8	24	26.4	1	33.2	18	42.8	93	9.4	1250
SM6T24A	EM	SM6T24CA	MM	5	20.5	22.8	24	25.2	1	33.2	18	42.8	93	9.4	1250
SM6T27	EN	SM6T27C	MN	5	23.1	25.7	27	29.7	1	37.5	16	48.3	83	9.6	1150
SM6T27A	EP	SM6T27CA	MP	5	23.1	25.7	27	28.4	1	37.5	16	48.3	83	9.6	1150
SM6T30	EQ	SM6T30C	MQ	5	25.6	28.5	30	33	1	41.5	14.5	53.5	75	9.7	1075
SM6T30A	ER	SM6T30CA	MR	5	25.6	28.5	30	31.5	1	41.5	14.5	53.5	75	9.7	1075
SM6T33	ES	SM6T33C	MS	5	28.2	31.4	33	36.3	1	45.7	13.1	59.0	68	9.8	1000
SM6T33A	ET	SM6T33CA	MT	5	28.2	31.4	33	34.7	1	45.7	13.1	59.0	68	9.8	1000
SM6T36	EU	SM6T36C	MU	5	30.8	34.2	36	39.6	1	49.9	12	64.3	62	9.9	950
SM6T36A	EV	SM6T36CA	MV	5	30.8	34.2	36	37.8	1	49.9	12	64.3	62	9.9	950
SM6T39	EW	SM6T39C	MW	5	33.3	37.1	39	42.9	1	53.9	11.1	69.7	57	10.0	900
SM6T39	EX	SM6T39	MX	5	33.3	37.1	39	41.0	1	53.9	11.1	69.7	57	10.0	900

TYPES				I_{RM} @ V_{RM}		V_{BR} @ I_R				V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
				max		min	nom	max		max		max		max	typ
								note2		10/1000µs		8/20µs		note3	note4
Uni directional	*	Bi directional	*	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
SM6T68	FP	SM6T68C	NP	5	58.1	64.6	68	74.8	1	92	6.5	121	33	10.4	625
SM6T68A	FQ	SM6T68CA	NQ	5	58.1	64.6	68	71.4	1	92	6.5	121	33	10.4	625
SM6T100	FX	SM6T100C	NX	5	85.5	95.0	100	110	1	137	4.4	178	22.5	10.6	500
SM6T100A	FY	SM6T100CA	NY	5	85.5	95.0	100	105	1	137	4.4	178	22.5	10.6	500
SM6T150	GK	SM6T150C	OK	5	128	143	150	165	1	207	2.9	265	15	10.8	400
SM6T150A	GL	SM6T150CA	OL	5	128	143	150	158	1	207	2.9	265	15	10.8	400
SM6T200	GT	SM6T200C	OT	5	171	190	200	220	1	274	2.2	353	11.3	10.8	350
SM6T200A	GU	SM6T200CA	OU	5	171	190	200	210	1	274	2.2	353	11.3	10.8	350
SM6T220	GV	SM6T220C	OV	5	188	209	220	242	1	328	2	388	10.3	10.8	330
SM6T220A	GW	SM6T220CA	OW	5	188	209	220	231	1	328	2	388	10.3	10.8	330

All parameters tested at 25 °C, except where indicated.

*** = Marking**

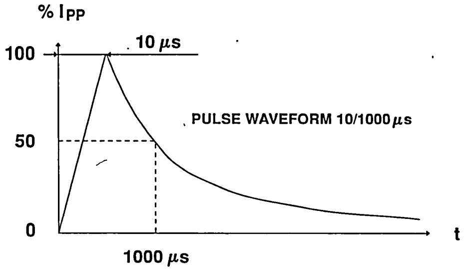
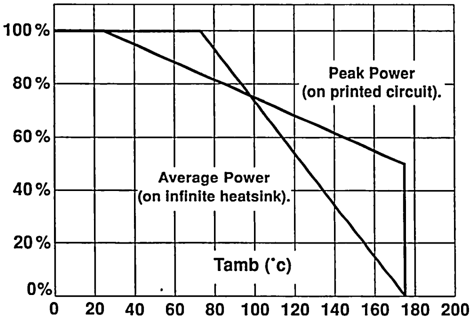


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.

Note 2 : Pulse test: $T_P < 50$ ms.

Note 3 : $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.

Note 4 : VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

Figure 2 : Peak pulse power versus exponential pulse duration.

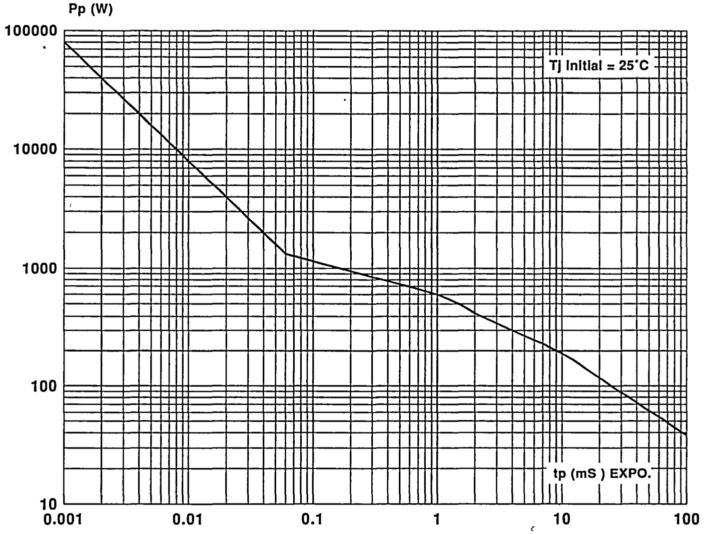
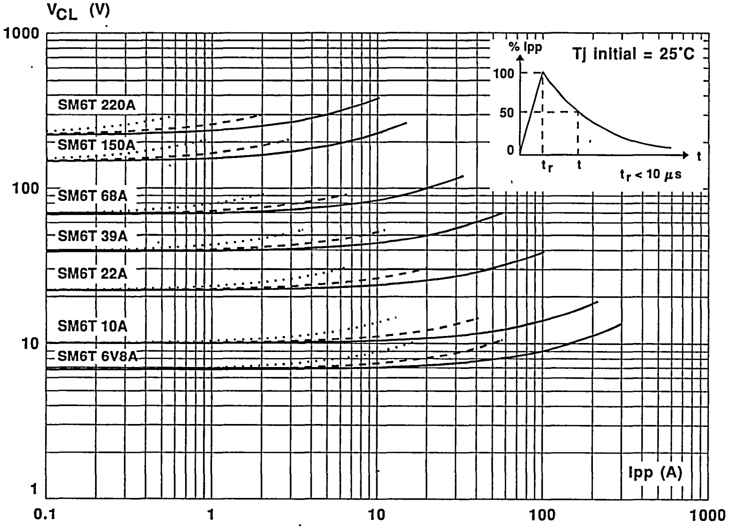


Figure 3 : Clamping voltage versus peak pulse current.

exponential waveform t = 20 µs ________
t = 1 ms ------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

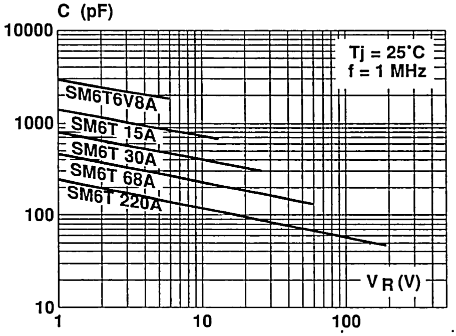


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

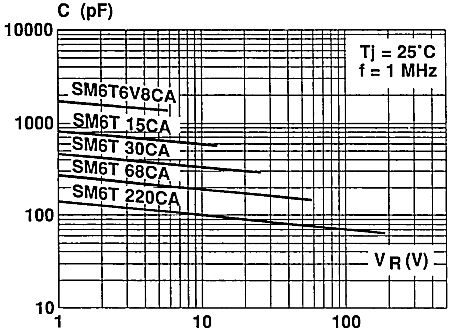


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

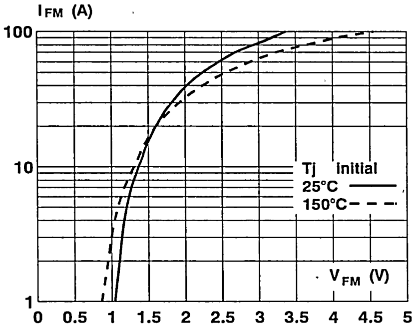
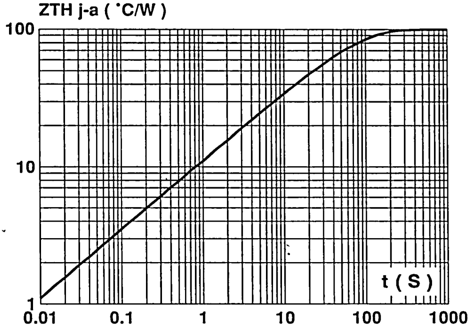
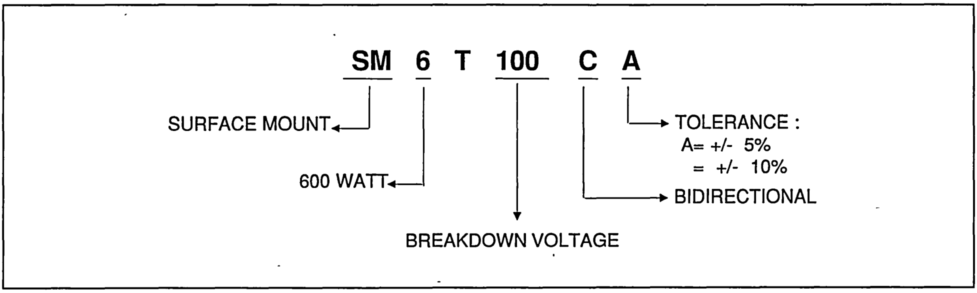


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with standard footprint dimensions.



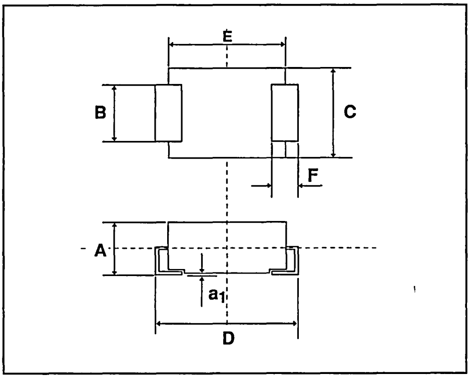
ORDER CODE



MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

SOD 6 (Plastic).

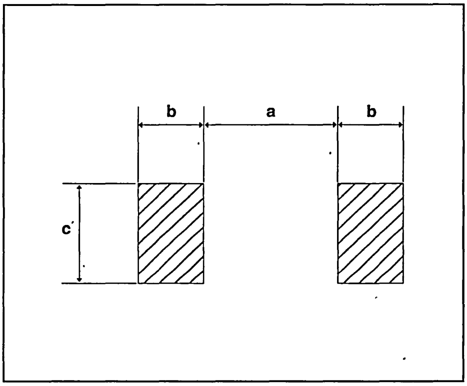


Ref	Millimeters		Inches	
	min	max	min	max
A	2.48	2.61	0.096	0.103
a1	0.10	0.20	0.004	0.008
B	1.96	2.11	0.077	0.083
C	3.65	3.93	0.143	0.155
D	5.39	5.59	0.212	0.220
E	4.15	4.30	0.163	0.170
F	1.00	1.27	0.039	0.050

Weight = 0.12 g.

FOOTPRINT DIMENSIONS (Millimeter).

SOD 6 Plastic.



Ref	Millimeters
a	2.75
b	1.52
c	2.30

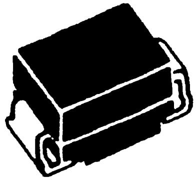
Packaging : standard packaging is in film.

SM15T6V8,A/220,A
SM15T6V8C,CA/220C,CA

TRANSIL

FEATURES

- PEAK PULSE POWER= 1500 W @ 1ms.
- BREAKDOWN VOLTAGE RANGE : From 6V8 to 220 V.
- UNI AND BIDIRECTIONAL TYPES.
- LOW CLAMPING FACTOR.
- FAST RESPONSE TIME: Tclamping : 1ps (0 V to V_{BR}).



SOD 15
(Plastic)

DESCRIPTION

Transil diodes provide high overvoltage protection by clamping action. Their instantaneous reponse to transients makes them particularly suited to protect voltage sensitive devices such as MOS Technology and low voltage supplied IC's.

MECHANICAL CHARACTERISTICS

- Body marked with : Logo, Date Code, Type Code, and Cathode Band (for unidirectional types only).
- Full compatibility with both gluing and paste soldering technologies.
- Excellent on board stability.
- Tinned copper leads.
- High temperature resistant resin.

ABSOLUTE RATINGS (limiting values)

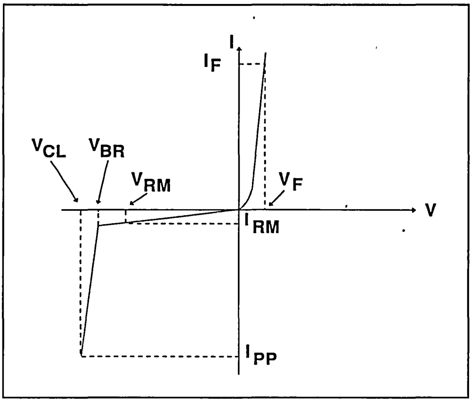
Symbol	Parameter		Value	Unit
P_p	Peak pulse power dissipation See note 1 and derating curve Fig 1.	Tamb = 25°C	1500	W
P	Power dissipation on infinite heatsink See note 1 and derating curve Fig 1.	Tlead = 50°C	10	W
I_{FSM}	Non repetitive surge peak forward current. For unidirectional types.	Tamb = 25°C t =10 ms	250	A
T_{stg} T_j	Storage and junction temperature range		- 65 to + 175 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction-leads on infinite heatsink	10	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. With standard footprint dimensions.	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage.
V_{BR}	Breakdown voltage.
V_{CL}	Clamping voltage.
I_{RM}	Leakage current @ VRM.
I_{PP}	Surge current.
αT	Voltage temperature coefficient.
V_F	Forward Voltage drop $V_F < 3.5V$ @ $I_F = 100$ A.



TYPES		I_{RM} @ V_{RM}		V_{BR} @ I_R				V_{CL} @ I_{PP}		V_{CL} @ I_{PP}		αT	C
		max		min	nom	max		max		max		max	typ
						note2		10/1000µs		8/20µs		note3	note4
Uni directional	Bi directional	µA	V	V	V	V	mA	V	A	V	A	$10^{-4}/°C$	(pF)
SM15T6V8	SM15T6V8C	1000	5.8	6.45	6.8	7.48	10	10.5	143	13.4	746	5.7	9500
SM15T6V8A	SM15T6V8CA	1000	5.8	6.45	6.8	7.14	10	10.5	143	13.4	746	5.7	9500
SM15T7V5	SM15T7V5C	500	6.4	7.13	7.5	8.25	10	11.3	132	14.5	690	6.1	8500
SM15T7V5A	SM15T7V5CA	500	6.4	7.13	7.5	7.88	10	11.3	132	14.5	690	6.1	8500
SM15T10	SM15T10C	10	8.55	9.5	10	11.0	1	14.5	103	18.6	538	7.3	7000
SM15T10A	SM15T10CA	10	8.55	9.5	10	10.5	1	14.5	103	18.6	538	7.3	7000
SM15T12	SM15T12C	5	10.2	11.4	12	13.2	1	16.7	90	21.7	461	7.8	6000
SM15T12A	SM15T12CA	5	10.2	11.4	12	12.6	1	16.7	90	21.7	461	7.8	6000
SM15T15	SM15T15C	5	12.8	14.3	15	16.5	1	21.2	71	27.2	368	8.4	5000
SM15T15A	SM15T15CA	5	12.8	14.3	15	15.8	1	21.2	71	27.2	368	8.4	5000
SM15T18	SM15T18C	5	15.3	17.1	18	19.8	1	25.2	59.5	32.5	308	8.8	4300
SM15T18A	SM15T18CA	5	15.3	17.1	18	18.9	1	25.2	59.5	32.5	308	8.8	4300
SM15T22	SM15T22C	5	18.8	20.9	22	24.2	1	30.6	49	39.3	254	9.2	3700
SM15T22A	SM15T22CA	5	18.8	20.9	22	23.1	1	30.6	49	39.3	254	9.2	3700
SM15T24	SM15T24C	5	20.5	22.8	24	26.4	1	33.2	45	42.8	234	9.4	3500
SM15T24A	SM15T24CA	5	20.5	22.8	24	25.2	1	33.2	45	42.8	234	9.4	3500
SM15T27	SM15T27C	5	23.1	25.7	27	29.7	1	37.5	40	48.3	207	9.6	3200
SM15T27A	SM15T27CA	5	23.1	25.7	27	28.4	1	37.5	40	48.3	207	9.6	3200
SM15T30	SM15T30C	5	25.6	28.5	30	33.0	1	41.5	36	53.5	187	9.7	2900
SM15T30A	SM15T30CA	5	25.6	28.5	30	31.5	1	41.5	36	53.5	187	9.7	2900
SM15T33	SM15T33C	5	28.2	31.4	33	36.3	1	45.7	33	59.0	169	9.8	2700
SM15T33A	SM15T33CA	5	28.2	31.4	33	34.7	1	45.7	33	59.0	169	9.8	2700
SM15T36	SM15T36C	5	30.8	34.2	36	39.6	1	49.9	30	64.3	156	9.9	2500
SM15T36A	SM15T36CA	5	30.8	34.2	36	37.8	1	49.9	30	64.3	156	9.9	2500
SM15T39	SM15T39C	5	33.3	37.1	39	42.9	1	53.9	28	69.7	143	10.0	2400
SM15T39	SM15T39	5	33.3	37.1	39	41.0	1	53.9	28	69.7	143	10.0	2400

TYPES		I_{RM} @ V_{RM} max		V_{BR} @ I_R min nom max note2				V_{CL} @ I_{PP} max 10/1000µs		V_{CL} @ I_{PP} max 8/20µs		αT max note3	C typ note4
Uni directional	Bi directional	µA	V	V	V	V	mA	V	A	V	A	10^{-4}/°C	(pF)
SM15T68	SM15T68C	5	58.1	64.6	68	74.8	1	92	16.3	121	83	10.4	1550
SM15T68A	SM15T68CA	5	58.1	64.6	68	71.4	1	92	16.3	121	83	10.4	1550
SM15T100	SM15T100C	5	85.5	95.0	100	110	1	137	11	178	56	10.6	1150
SM15T100A	SM15T100CA	5	85.5	95.0	100	105	1	137	11	178	56	10.6	1150
SM15T150	SM15T150C	5	128	143	150	165	1	207	7.2	265	38	10.8	850
SM15T150A	SM15T150CA	5	128	143	150	158	1	207	7.2	265	38	10.8	850
SM15T200	SM15T200C	5	171	190	200	220	1	274	5.5	353	28	10.8	675
SM15T200A	SM15T200CA	5	171	190	200	210	1	274	5.5	353	28	10.8	675
SM15T220	SM15T220C	5	188	209	220	242	1	328	4.6	388	26	10.8	625
SM15T220A	SM15T220CA	5	188	209	220	231	1	328	4.6	388	26	10.8	625

All parameters tested at 25 °C, except where indicated.

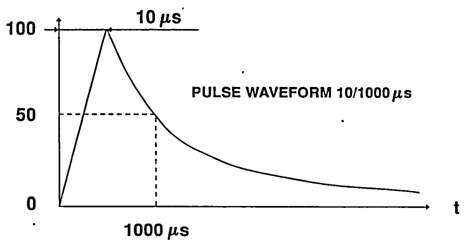
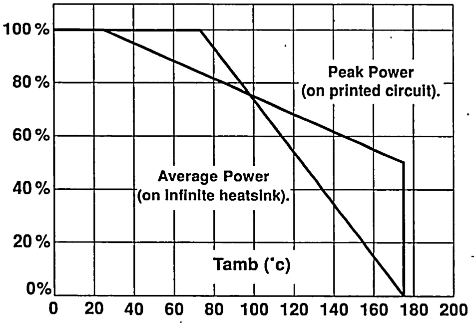


Figure 1: Power dissipation derating versus ambient temperature



Note 1 : - For surges greater than the maximum values, the diode will present a short-circuit Anode - Cathode.
Note 2 : - Pulse test: $T_P < 50$ ms.
Note 3 : - $\Delta V_{BR} = \alpha T \cdot (Ta - 25) \cdot V_{BR(25°C)}$.
Note 4 : - VR = 0 V, F = 1 MHz. For bidirectional types, capacitance value is divided by 2.

TYPES		TYPES		TYPES		TYPES	
Unidirectional	Marking	Bidirectional	Marking	Unidirectional	Marking	Bidirectional	Marking
SM15T6V8	MDD	SM15T6V8C	BDD	SM15T30	MEQ	SM15T30C	BEQ
SM15T6V8A	MDE	SM15T6V8CA	BDE	SM15T30A	MER	SM15T30CA	BER
SM15T7V5	MDF	SM15T7V5C	BDF	SM15T33	MES	SM15T33C	BES
SM15T7V5A	MDG	SM15T7V5CA	BDG	SM15T33A	MET	SM15T33CA	BET
SM15T10	MDN	SM15T10C	BDN	SM15T36	MEU	SM15T36C	BEU
SM15T10A	MDP	SM15T10CA	BDP	SM15T36A	MEV	SM15T36CA	BEV
SM15T12	MDS	SM15T12C	BDS	SM15T39	MEW	SM15T39C	BEW
SM15T12A	MDT	SM15T12CA	BDT	SM15T39A	MEX	SM15T39CA	BEX
SM15T15	MDW	SM15T15C	BDW	SM15T68	MFN	SM15T68C	BFN
SM15T15A	MDX	SM15T15CA	BDX	SM15T68A	MFP	SM15T68CA	BFP
SM15T18	MED	SM15T18C	BED	SM15T100	MFW	SM15T100C	BFW
SM15T18A	MEE	SM15T18CA	BEE	SM15T100A	MFX	SM15T100CA	BFX
SM15T22	MEH	SM15T22C	BEH	SM15T150	MGH	SM15T150C	BGH
SM15T22A	MEK	SM15T22CA	BEK	SM15T150A	MGK	SM15T150CA	BGK
SM15T24	MEL	SM15T24C	BEL	SM15T200	MGU	SM15T200C	BGU
SM15T24A	MEM	SM15T24CA	BEM	SM15T200A	MGV	SM15T200CA	BGV
SM15T27	MEN	SM15T27C	BEN	SM15T220	MGW	SM15T220C	BGW
SM15T27A	MEP	SM15T27CA	BEP	SM15T220A	MGVX	SM15T220CA	BGX

Figure 2 : Peak pulse power versus exponential pulse duration.

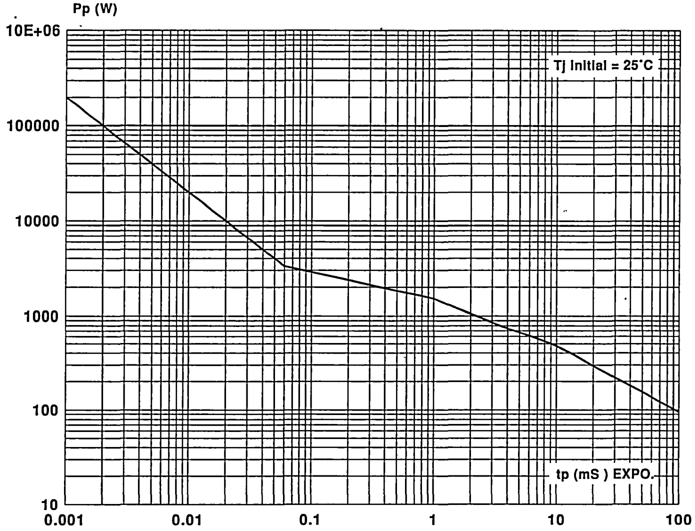
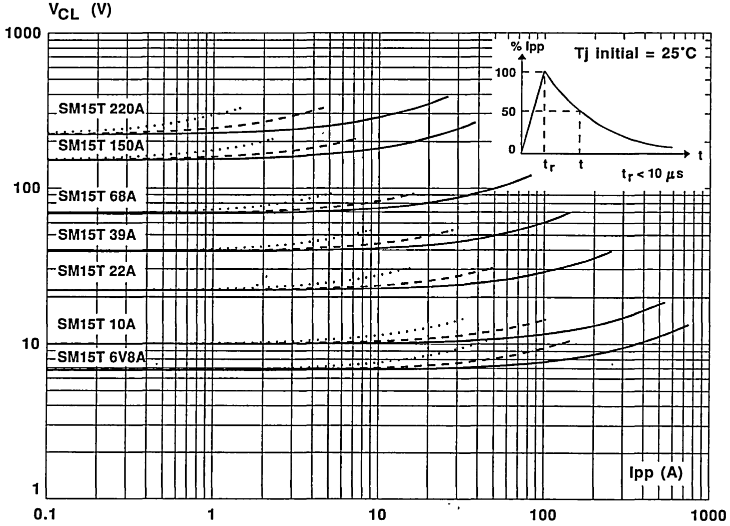


Figure 3 : Clamping voltage versus peak pulse current.
exponential waveform t = 20 µs ________
t = 1 ms -------------
t =10 ms ....



Note : The curves of the figure 3 are specified for a junction temperature of 25 °C before surge.
The given results may be extrapolated for other junction temperatures by using the following formula :
$\Delta V_{(BR)} = \alpha T_{(V(BR))} * [T_a - 25] * V_{(BR)}$.
For intermediate voltages, extrapolate the given results.

Figure 4a : Capacitance versus reverse applied voltage for unidirectional types (typical values).

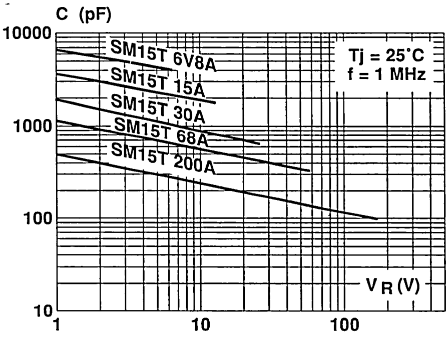


Figure 4b : Capacitance versus reverse applied voltage for bidirectional types (typical values)

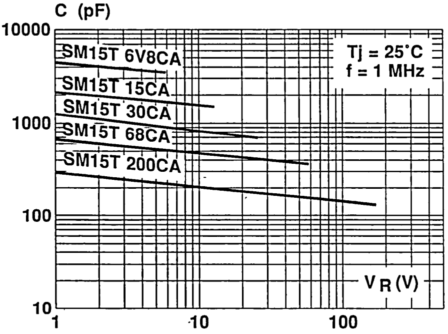


Figure 5 : Peak forward voltage drop versus peak forward current (typical values for unidirectional types).

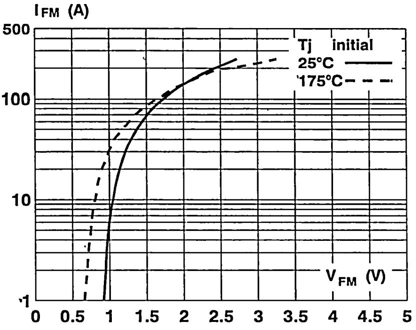
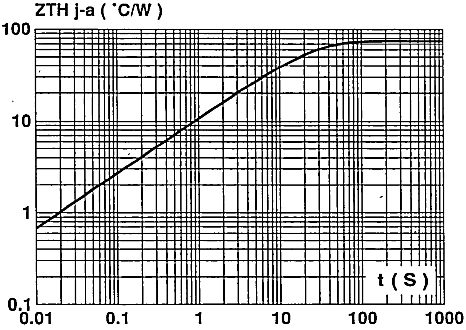
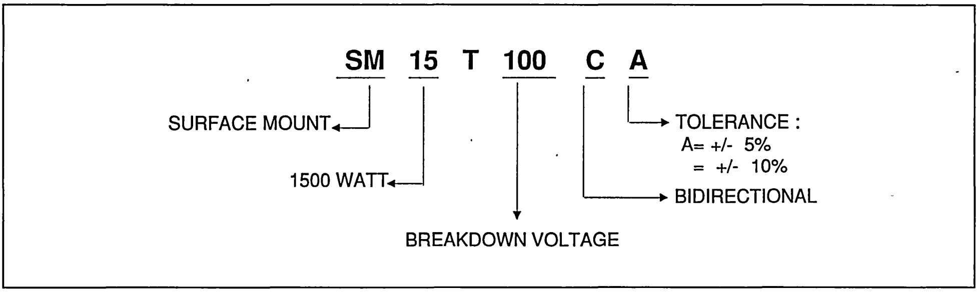


Figure 6 : Transient thermal impedance junction-ambient versus pulse duration. For a mounting on PC Board with standard footprint dimensions.



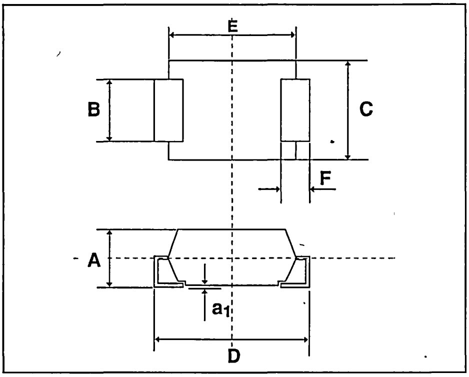
ORDER CODE



MARKING : Logo, Date Code, Type Code, Cathode Band (for unidirectional types only).

PACKAGE MECHANICAL DATA

SOD 15 (Plastic).

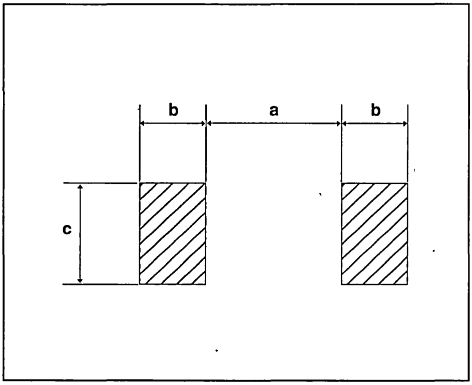


Ref	Millimeters		Inches	
	min	max	min	max
A	2.5	3.1	0.098	0.122
a1	-	0.2	-	0.008
B	2.9	3.1	0.114	0.122
C	4.8	5.2	0.190	0.200
D	7.6	8.0	0.300	0.315
E	6.3	6.6	0.248	0.259
F	1.3	1.7	0.051	0.067

Weight = 0.25 g.

FOOTPRINT DIMENSIONS (Millimeter).

SOD 15 Plastic.



Ref	Millimeters
a	4.2
b	2
c	3.3

Packaging : standard packaging is in film.

TRISIL DATASHEETS

SGS-THOMSON
MICROELECTRONICS

L3100B
L3100B1

PROGRAMMABLE TRANSIENT VOLTAGE SUPPRESSOR AND CURRENT LIMITER

FEATURES

- UNIDIRECTIONAL FUNCTION
- PROGRAMMABLE BREAKDOWN VOLTAGE UP TO 265 V
- PROGRAMMABLE CURRENT LIMITATION FROM 50 mA TO 550 mA
- HIGH SURGE CURRENT CAPABILITY I_{PP} = 100A 10/1000 µs

DESCRIPTION

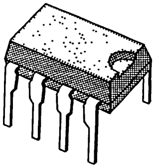
Dedicated to sensitive telecom equipment protection, this device can provide both voltage protection and current limitation with a very tight tolerance.

Its high surge current capability makes the L3100B a reliable protection device for very exposed equipment, or when series resistors are very low.

The breakdown voltage can be easily programmed by using an external zener diode.

A multiple protection mode can also be performed when using several zener diodes, providing each line interface with an optimized protection level.

The current limiting function is achieved with the use of a resistor between the gate and the cathode. The value of the resistor will determine the level of the desired current.

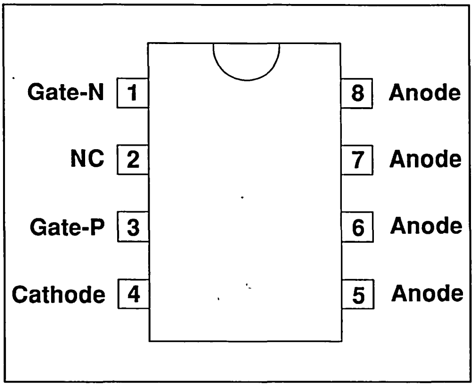


DIL 8
(Plastic)

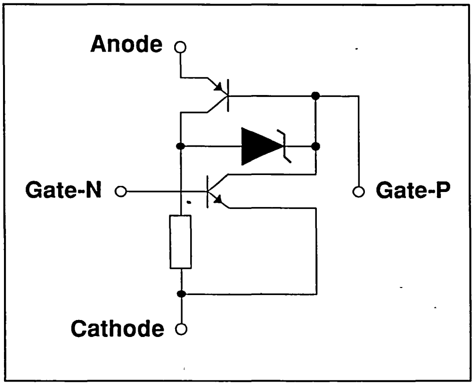
IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

CONNECTION DIAGRAM

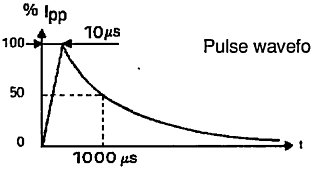


SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (- 40°C ≤ T_{amb} ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	100 250	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 10 ms	50	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C



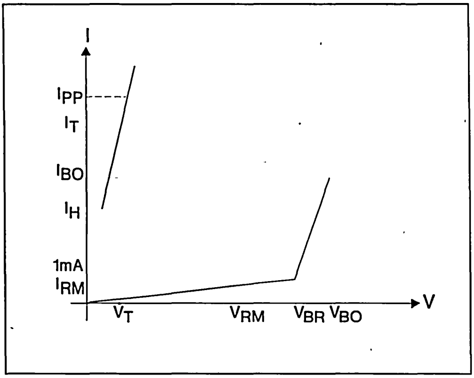
Pulse waveform 10/1000µs

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R_{th} (j-a)	Junction-to-ambient	80	°C/W

ELECTRICAL CHARACTERISTICS.

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage @ I_T
I_{BO}	Breakover current
I_{PP}	Peak pulse current
V_G	Gate voltage
I_G	Firing gate current



OPERATION WITHOUT GATE.

Type	I_{RM} @ V_{RM} max		V_{BR} @ I_R min		V_{BO}	@	I_{BO}	I_H	V_T	C
					max	min note 1	max	min note 1	max note 2	max note 3
	µA	V	V	mA	V	mA	mA	mA	V	pF
L3100B	6 40	60 250	265	1	350	200	500	280	2	100
L3100B1	6 40	60 250	255	1	350	200	500	210	2	100

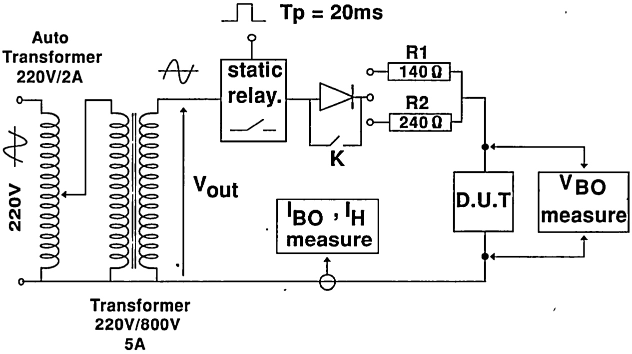
OPERATION WITH GATES.

Type	V_{GN} @ I_{GN} = 200 mA		I_{GN} @ V_{AC} = 100V		V_{RGN} @ I_G = 1mA	I_{GP} @ V_{AC} = 100V
	min	max	min	max	min	max
	V	V	mA	mA	V	mA
L3100B/B1	0.6	1.8	30	200	0.7	150

All parameters tested at 25°C, except where indicated otherwise.

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse T_P= 500µs - I_T = 1A.
Note 3 : V_R = 5 V, f = 1MHz.

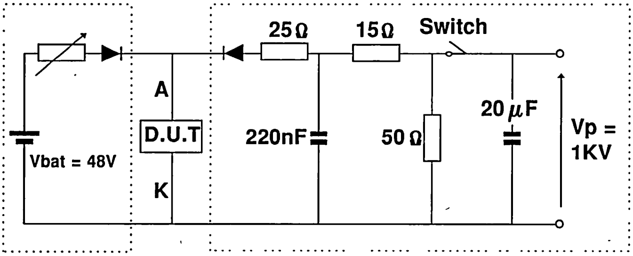
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Non-repetitive surge peak on state current versus number of cycles. (with sinusoïdal pulse: F = 50 Hz).

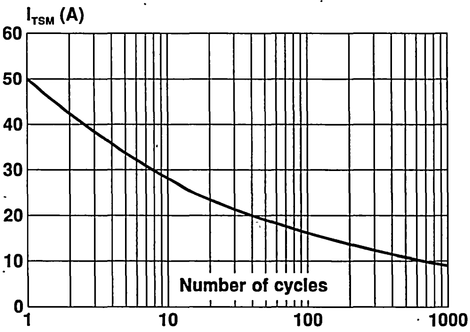


Figure 2 : Relative variation of holding current versus junction temperature.

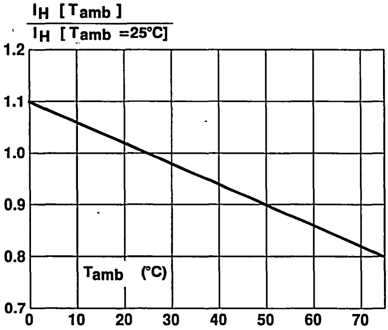


Figure 3 : Relative variation of breakdown voltage versus ambient temperature.

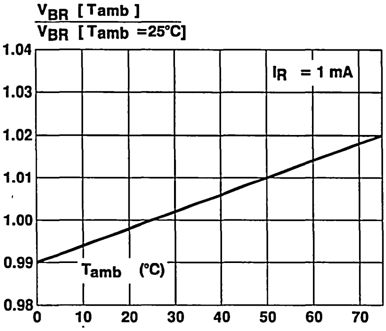
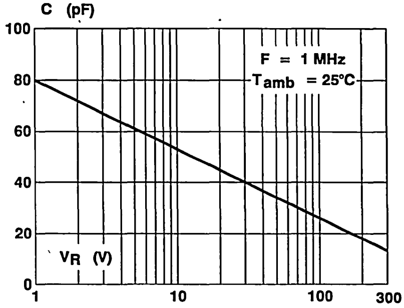


Figure 4 : Junction capacitance versus reverse applied voltage.



APPLICATION CIRCUIT

Overvoltage Protection and Current limitation

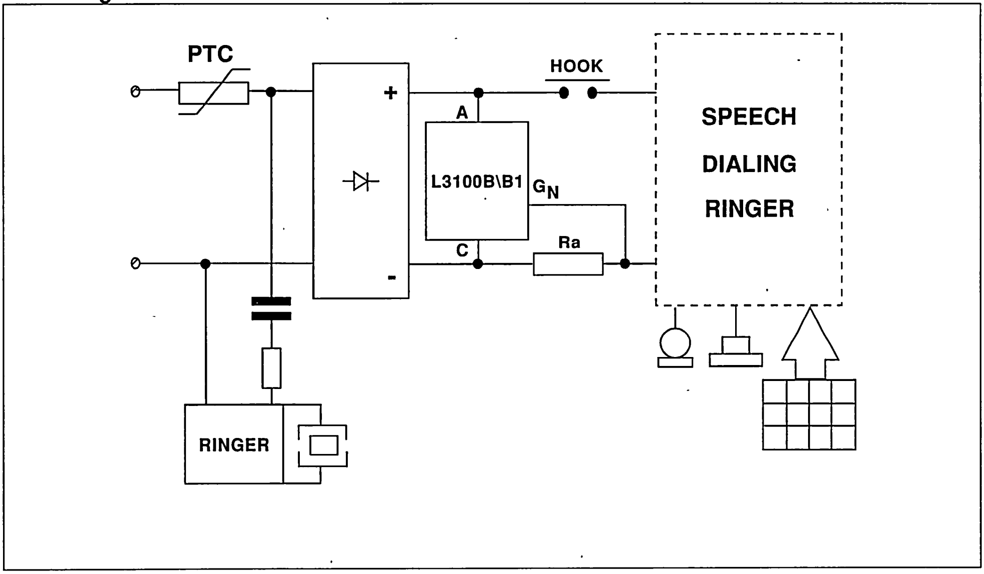
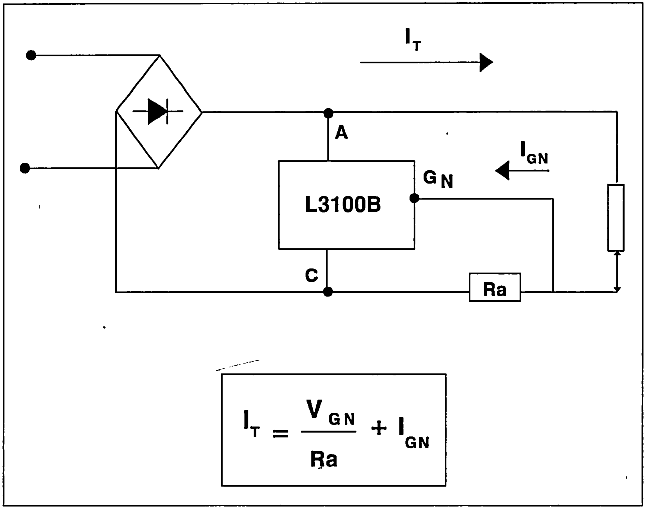


Table below gives the tolerance of the limited current I_T for each standardized resistor value.
The formula (1) has been used with V_{GN} values specified at the typical gate current level I_{GN}.

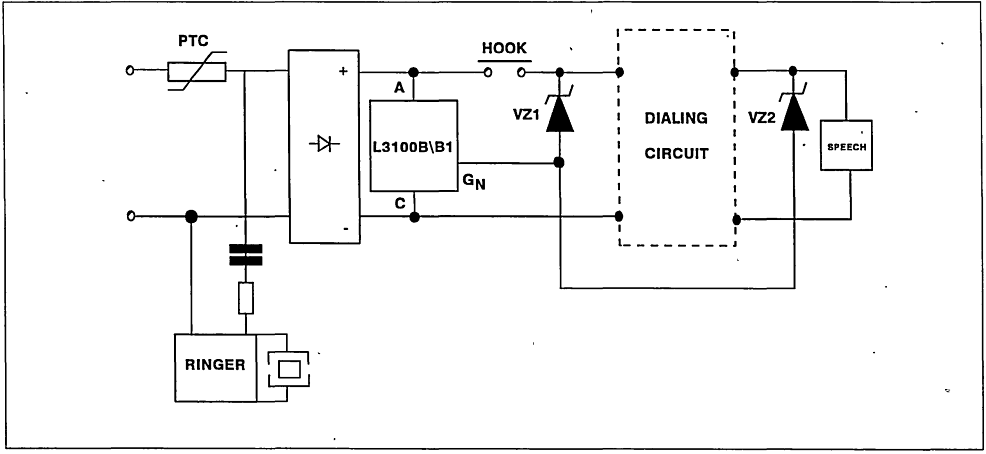
CURRENT TOLERANCE		
R Ω (± 5%)	I_T mA min	I_T mA max
3.00	268	533
3.30	246	503
3.60	228	478
3.90	213	456
4.30	196	433
4.70	181	413
5.10	170	396
5.60	158	379
6.20	145	361
6.80	135	347
7.50	152	333
8.20	117	322
9.10	108	310
10.10	101	299
11.00	95	291
12.00	90	283
13.00	85	277
15.00	78	266
16.00	75	263
18.00	70	256
20.00	66	250
22.00	62	245
24.00	60	242
27.00	56	237
30.00	54	233



$$I_T = \frac{V_{GN}}{Ra} + I_{GN}$$

V_{GN} @ I_{GN}		
Min	Max	Typ.
V	V	mA
0.75	0.95	100

Ground key telephone set Protection



PROTECTION MODES :

OFF HOOK = Ringer circuit protection is ensured with breakdown voltage at 265 V.

ON HOOK = In dialing mode and in conversation mode, the breakdown voltage of L3100B can be adapted to different levels with two zener diodes.

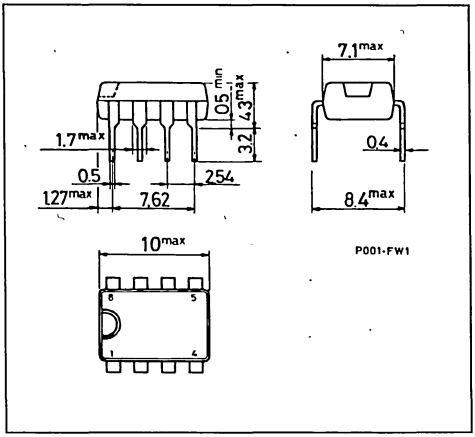
ORDER CODE

L3100 B 1

VERSION.
= VBR = 265 V
1 = VBR = 255 V

PACKAGE MECHANICAL DATA (in millimeters).

DIL 8 Plastic



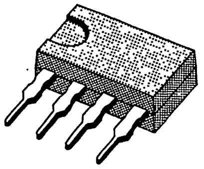
MARKING : Logo, Date Code,part Number.

PACKAGING : Products supplied in antistatic tubes.

PROGRAMMABLE TRANSIENT VOLTAGE SUPPRESSOR

FEATURES

- BIDIRECTIONAL FUNCTION WITH VOLTAGE PROGRAMMABILITY IN BOTH POSITIVE AND NEGATIVE POLARITIES.
- PROGRAMMABLE BREAKDOWN VOLTAGE UP TO 100 V.
- HOLDING CURRENT = 150 mA min.
- HIGH SURGE CURRENT CAPABILITY.
  I_{PP} = 100A , 10/1000 µs



SIP 4
(Plastic)

DESCRIPTION

This device has been especially designed to protect a subscriber line card interface (SLIC) with a integrated ring generator.

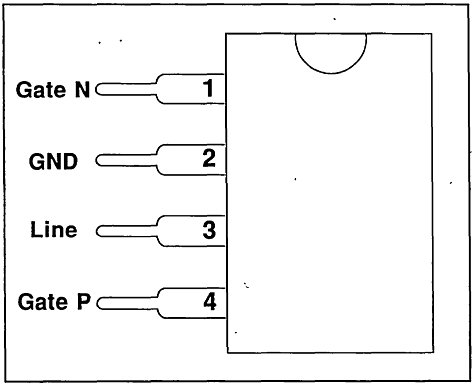
Used with the recommended application circuit, each line (TIP and RING) is protected against positive and negative surges. In the positive polarity, the breakdown voltage is referenced to the + VB , and in the negative polarity, the breakdown voltage is referenced to the -Vbat .

Its high surge current capability makes the L3121B a reliable protection device for very exposed equipment, or when series resistors are very low.

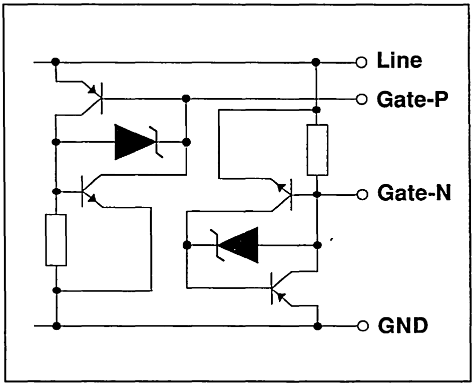
IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs 5/310 µs	1.5 kV 38 A
VDE 0433	10/700 µs 5/200 µs	2 kV 50 A
CNET	0.5/700 µs 0.2/310 µs	1.5 kV 38 A

CONNECTION DIAGRAM

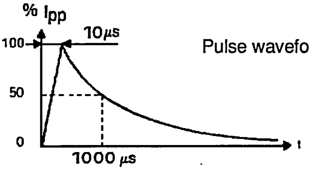


SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (- 40°C ≤ T_{amb} ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	100 250	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 10 ms	50	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
V_{MLG} V_{MGL}	Maximum voltage LINE/GND. Maximum voltage GATE/LINE.		100 80	V V
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 150	°C °C



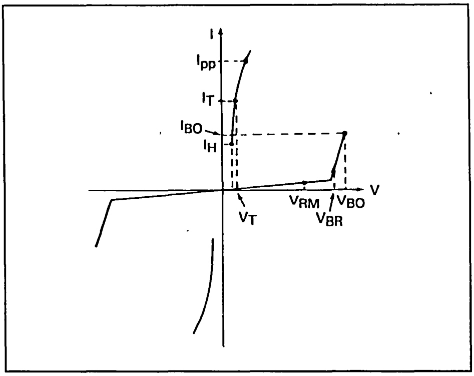
Pulse waveform 10/1000µs

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R_{th} (j-a)	Junction-to-ambient	80	°C/W

ELECTRICAL CHARACTERISTICS.

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage @ I_T
I_{BO}	Breakover current
I_{PP}	Peak pulse current
V_G	Gate voltage
I_G	Firing gate current



OPERATION WITHOUT GATE.

Type	I_{RM} @ V_{RM} max		V_{BR} @ I_R min		V_{BO} max	@ Typ note 1	I_{BO} max	I_H min note 1	V_T max note 2	C max note 3
	µA	V	V	mA	V	mA	mA	mA	V	pF
L3121B	5 8	60 90	100	1	180	200	500	150	2	200

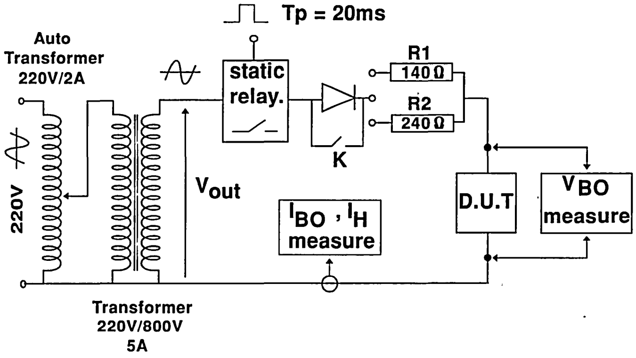
OPERATION WITH GATES.

Type	V_{GN} @ I_{GN} = 200mA min	max	I_{GN} @ V_{AC} = 60V min	max	I_{GP} @ V_{AC} = 60V max
	V	V	mA	mA	mA
L3121B	0.6	1.8	80	200	180

All parameters tested at 25°C, except where indicated.

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse T_P= 500µs - I_T = 1A.
Note 3 : V_R = 5 V, F = 1MHz.

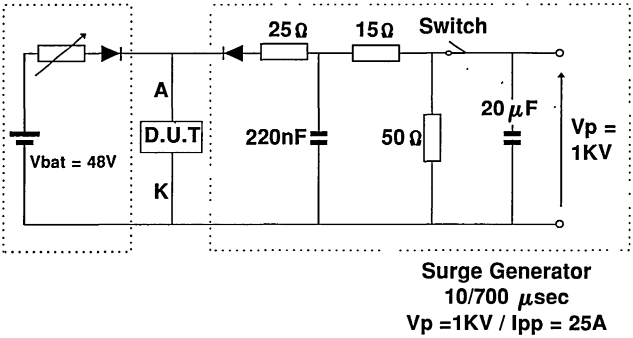
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Non-repetitive surge peak on state current versus number of cycles. (with sinusoïdal pluse: F = 50 Hz).

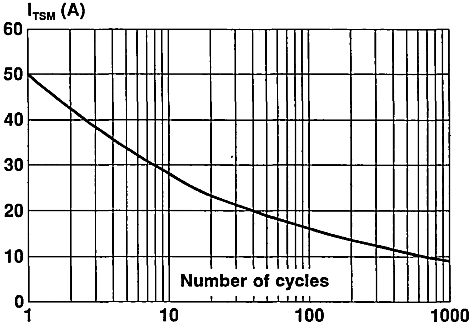


Figure 2 : Relative variation of holding current versus junction temperature.

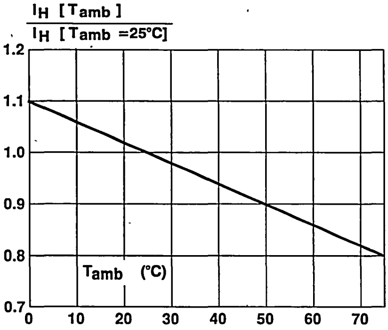


Figure 3 : Relative variation of breakdown voltage versus ambient temperature.

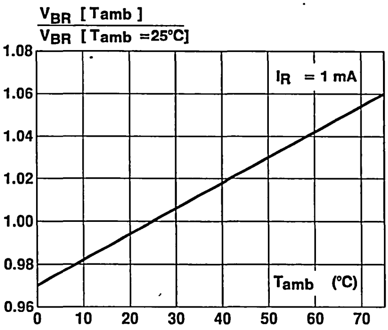
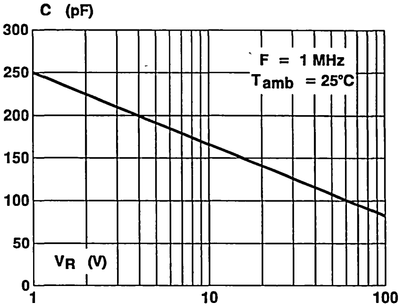
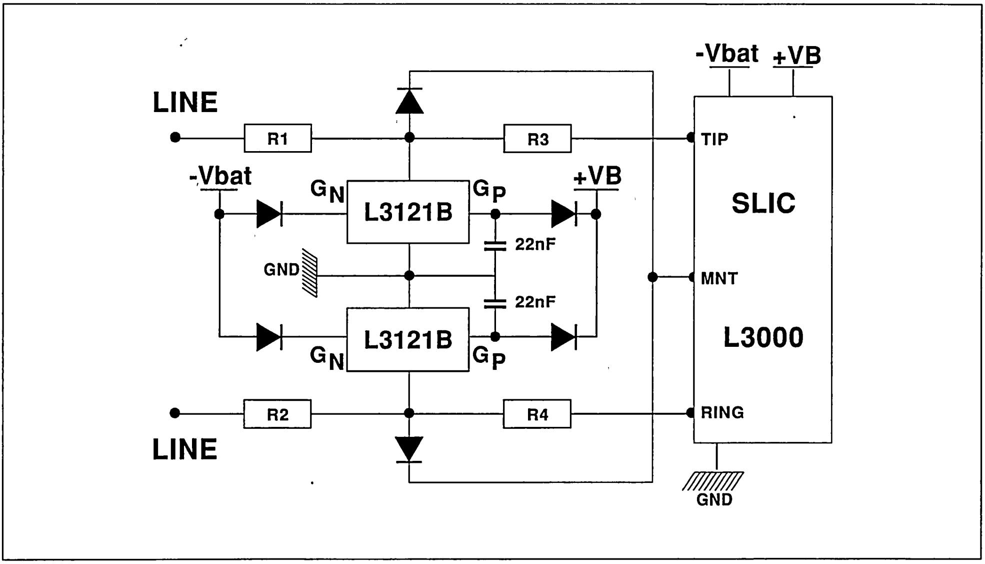


Figure 4 : Junction capacitance versus reverse applied voltage.



APPLICATION CIRCUIT

Typical Slic Protection Concept.

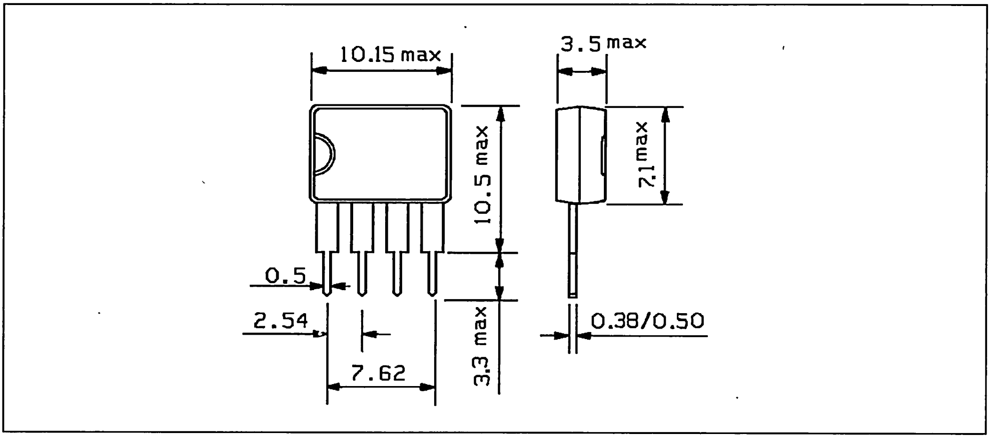


MARKING : Logo, Date Code,part Number.

PACKAGING : Products supplied in antistatic tubes.

PACKAGE MECHANICAL DATA (in millimeters).

SIP 4 Plastic

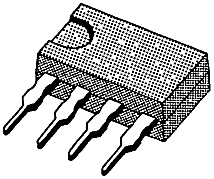


LCP150S

PROGRAMMABLE TRANSIENT VOLTAGE SUPPRESSOR FOR SLIC PROTECTION

FEATURES

- DUAL PROGRAMMABLE TRANSIENT SUPPRESSOR.
- HIGH SURGE CURRENT CAPABILITY
  - I_{PP} = 50 A, 10/1000 µs.
  - I_{PP} = 60 A, 5/320 µs.
  - I_{PP} = 150 A, 2/10 µs.
- WIDE NEGATIVE FIRING VOLTAGE RANGE: V_{MGL} = -80 V max
- HOLDING CURRENT = 150 mA min.
- LOW GATE TRIGGERING CURRENT: I_{GT} = 15 mA max.



SIP 4
(Plastic)

DESCRIPTION

This device has been especially designed to protect subscriber line card interfaces (SLIC) against transient overvoltages.

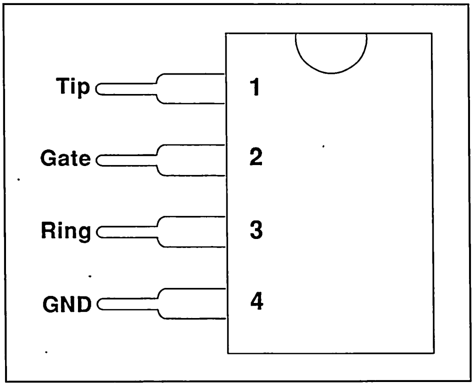
Positive overloads are clipped with two diodes. When negative surges are suppressed by two protection thyristors, the breakdown voltage of which is referenced to the -Vbat.

This component presents a very low gate triggering current (I_{GT}) in order to reduce the current comsumption on PC board during the firing phase.

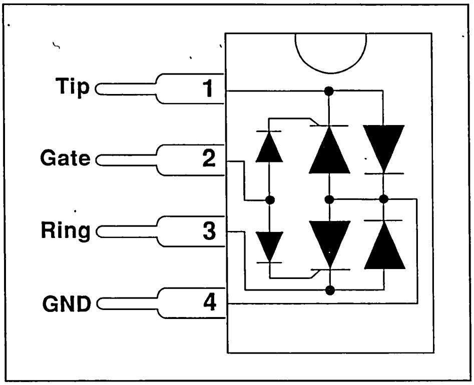
IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs 5/310 µs	1.5 kV 38 A
VDE 0433	10/700 µs 5/200 µs	2 kV 50 A
CNET	0.5/700 µs 0.2/310 µs	1.5 kV 38 A

CONNECTION DIAGRAM



SCHEMATIC DIAGRAM

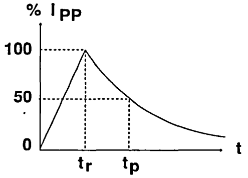


ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current see note 1.	10/1000 µs 5/320 µs 2/10 µs	50 60 150	A
I_{TSM}	Non repetitive surge peak on-state current F = 50 Hz	tp = 10 ms tp = 1 s	25 8	A
I_{GSM}	Maximum gate current (hall sine wave 10 ms)		2	A
V_{MLG} V_{MGL}	Maximum Voltage LINE/GND Maximum Voltage GATE/LINE		- 100 - 80	V
T_{stg} T_j	Storage and operating junction temperature range		- 55 to + 150 150	°C °C

Note 1: **Pulse waveform**

10/1000 µs	tr = 10 µs	tp = 1000 µs
5/320 µs	tr = 5 µs	tp = 320 µs
2/10 µs	tr = 2 µs,	tp = 10 µs

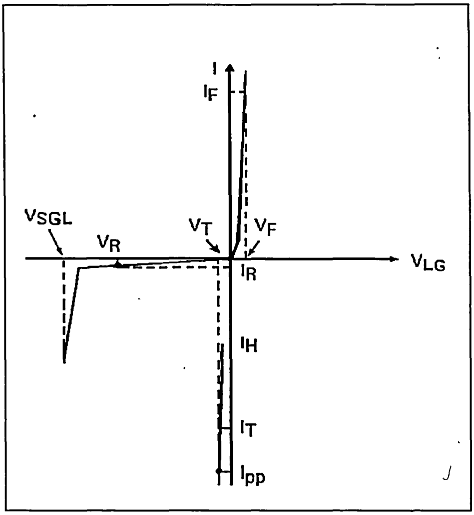


THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R_{th} (j-a)	Junction-to-ambient	80	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
I_{GT}	Gate Trigger Current
I_H	Holding Current
I_R	Reverse Leakage Current LINE/GND
I_{RG}	Reverse Leakage Current GATE/LINE
V_R	Reverse Voltage LINE/GND
V_F	Forward Voltage LINE/GND
V_{GT}	Gate Trigger Voltage
V_{FP}	Peak Forward Voltage LINE/GND
V_{SGL}	Dynamic Switching Voltage GND/LINE
V_{gate}	GATE/GND Voltage
V_{LG}	LINE/GND Voltage
dv/dt	Critical Rate of rise of off State Voltage
V_T	On State Voltage
C_{off}	Off State Capacitance LINE/GND



PARAMETERS RELATED TO THE DIODE LINE/GND

Symbol	Test Conditions	Max.	Unit
V_F	Square pulse, Tp = 500 µs, I_F = 5 A	3	V
V_{FP}	Ipp = 40 A, 10/1000 µs.	15	V

PARAMETERS RELATED TO PROTECTION THYRISTOR

Symbol	Tests Conditions	Min.	Max.	Unit
I_{GT}	$V_{GND/LINE}$ = -48 V	0.2	15	mA
I_H	V_{GATE}= -48 V Note 2.	150		mA
V_{GT}	at I_{GT}		2.5	V
I_{RG}	Tc = 25°C V_{RG} = -75 V Tc = 70°C V_{RG} = -75 V		5 50	µA µA
V_{SGL}	V_{GATE}= -48 V Note 2.		- 63	V
V_T	Square pulse, Tp = 500 µs, I_T = 0.5 A Square pulse, Tp = 500 µs, I_T = 3 A		3 4	V V

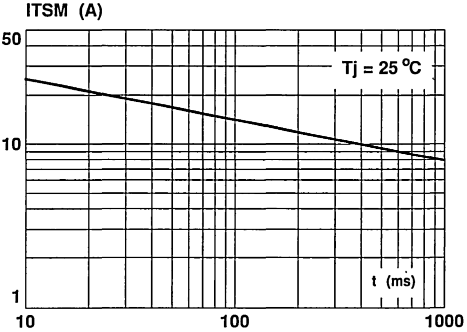
PARAMETERS RELATIVE TO DIODE AND PROTECTION THYRISTOR

Symbol	Tests Conditions	Min.	Max.	Unit
I_R	Tc = 25°C -1 < V_{GL} < -Vbat V_R = - 85 V Tc = 70°C -1 < V_{GL} < -Vbat V_R = - 85 V		5 50	µA µA
C_{off}	V_R = - 3 V F < 1MHz V_R = - 48 V F < 1MHz		150 80	pF pF

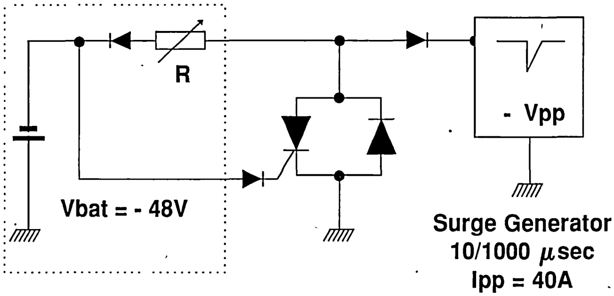
All Parameters Tested at 25 °C except when indicated.

Note 2 : See test circuit for I_H and V_{SGL}.

Figure 1 : Non repetitive surge peak on-state current. (with sinusoidal pulse : f =50Hz)



TEST CIRCUIT FOR I_H AND V_{SGL} PARAMETERS.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level, and to measure the dynamic switching voltage (V_{SGL}).

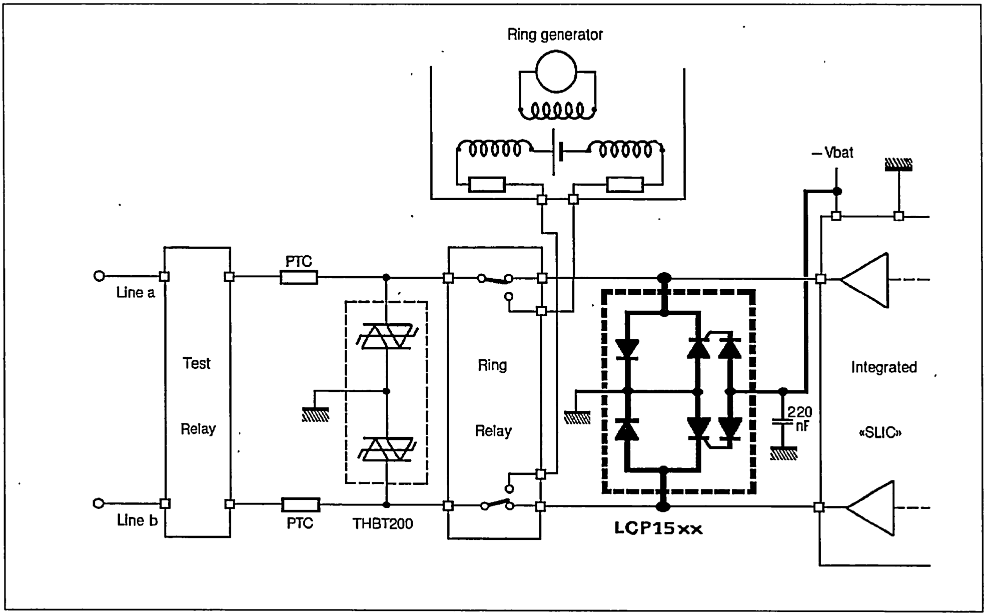
TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 40A , 10/1000 μs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

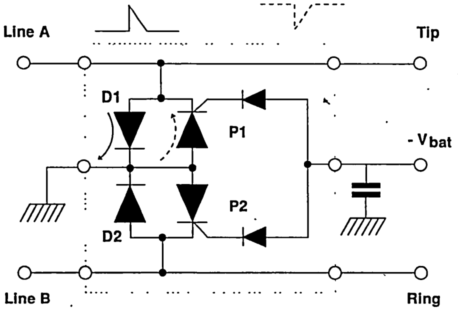
- The V_{SGL} is measured just before firing.

APPLICATION CIRCUIT

Typical slic protection concept



FUNCTIONAL DESCRIPTION



LINE A PROTECTION:

- For positive surges versus GND, the diode D1 will conduct.
- For negative surges versus GND, the protection device P1 will trigger at a voltage fixed by the -VBAT reference.

LINE B PROTECTION:

- For surges on Line B, the operating mode is the same , D2 or P2 is activated.

- A capacitor (C = 220nF) can be added close to the gate of the LCP15xx, in order to speed up the triggering.

ORDER CODE

LCP 150 S

LINE CARD PROTECTION ← LCP

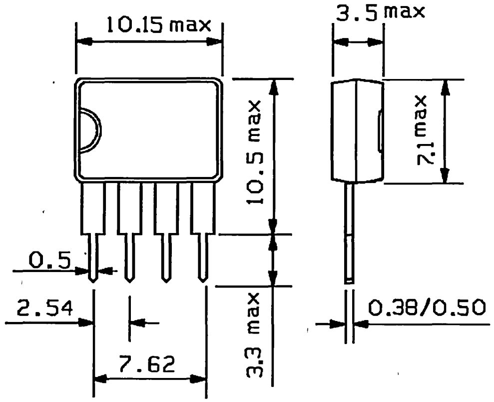
HOLDING CURRENT : 150 mA ← 150

S → PACKAGE
S = SIP4 PLASTIC

MARKING = Logo, date code, LCP150S.

PACKAGE MECHANICAL DATA (in millimeters)

SIP 4 Plastic



Packaging : Products supplied in antistatic tubes.

SGS-THOMSON
MICROELECTRONICS

LCP1511
LCP1512

PROGRAMMABLE TRANSIENT VOLTAGE SUPPRESSOR FOR SLIC PROTECTION

FEATURES

- DUAL PROGRAMMABLE TRANSIENT SUPPRESSOR.
- WIDE NEGATIVE FIRING VOLTAGE RANGE: V_{MGL} = -80 V max
- HOLDING CURRENT = 150 mA.
- LOW GATE TRIGGERING CURRENT: I_{GT} = 15 mA max.
- PEAK PULSE CURRENT : I_{PP} = 30 A , 10/1000 µs
- AVAILABLE IN SO 8 AND DIP 8.

DESCRIPTION

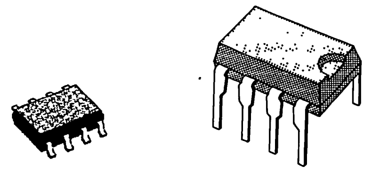
This device has been especially designed to protect subscriber line card interfaces (SLIC) against transient overvoltages.

Positive overloads are clipped with two diodes. When negative surges are suppressed by two protection thyristors, the breakdown voltage of which is referenced to the -Vbat.

This component presents a very low gate triggering current (I_{GT}) in order to reduce the current comsumption on PC board during the firing phase .
A particular attention has been given to the internal wire bonding . A "4-points configuration" ensures a reliable protection, eliminating the overvoltage introduced by the parasitic inductances of the wiring (Ldi/dt) especially for very fast transients.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

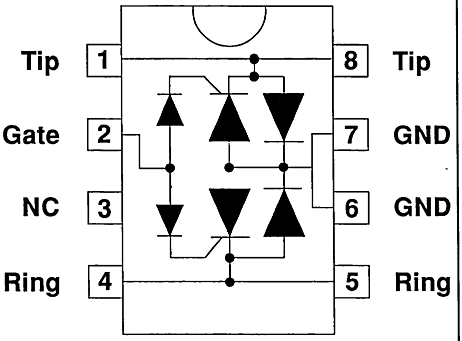
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A



SO 8
(Plastic)

DIL 8
(Plastic)

SCHEMATIC DIAGRAM

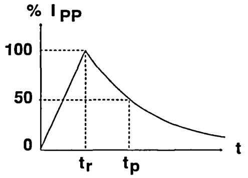


ABSOLUTE RATINGS (limiting values) (-40°C ≤ Tamb ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current see note 1.	10/1000 µs 5/320 µs 2/10 µs	30 40 90	A
I_{TSM}	Non repetitive surge peak on-state current f = 50 Hz	tp = 10 ms tp = 1 s	5 3.5	A
I_{GSM}	Maximum gate current (hall sine wave 10 ms)		2	A
V_{MLG} V_{MGL}	Maximum Voltage LINE/GND Maximum Voltage GATE/LINE		- 100 - 80	V
T_{stg} T_j	Storage and operating junction temperature range		- 55 to + 150 150	°C °C

Note 1: **Pulse waveform**

10/1000 µs	tr = 10 µs	tp = 1000 µs
5/320 µs	tr = 5 µs	tp = 320 µs
2/10 µs	tr = 2 µs,	tp = 10 µs

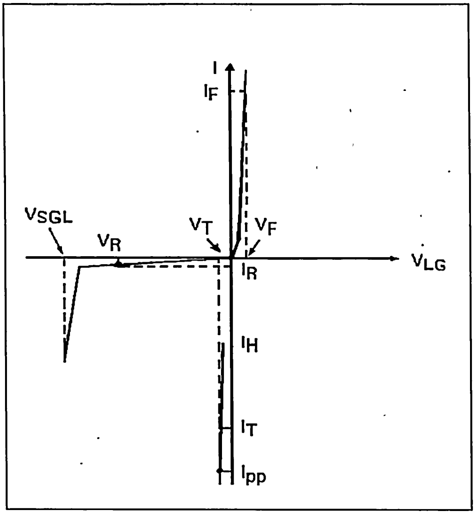


THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-a)	Junction-to-ambient	DIL 8 SO 8	125 171	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
I_{GT}	Gate Trigger Current
I_H	Holding Current
I_R	Reverse Leakage Current LINE/GND
I_{RG}	Reverse Leakage Current GATE/LINE
V_R	Reverse Voltage LINE/GND
V_F	Forward Voltage LINE/GND
V_{GT}	Gate Trigger Voltage
V_{FP}	Peak Forward Voltage LINE/GND
V_{SGL}	Dynamic Switching Voltage GND/LINE
V_{gate}	GATE/GND Voltage
V_{LG}	LINE/GND Voltage
dv/dt	Critical Rate of rise of off State Voltage
V_T	On State Voltage
C_{off}	Off State Capacitance LINE/GND



PARAMETERS RELATED TO THE DIODE LINE/GND

Symbol	Test Conditions	Max.	Unit
V_F	Square pulse, tp = 500 µs, I_F = 5 A	3	V
V_{FP}	Ipp = 30 A, 10/1000 µs.	15	V

PARAMETERS RELATED TO PROTECTION THYRISTOR

Symbol	Tests Conditions	Min.	Max.	Unit
I_{GT}	$V_{GND/LINE}$ = -48 V	0.2	15	mA
I_H	V_{GATE}= -48 V Note 2.	150		mA
V_{GT}	at I_{GT}		2.5	V
I_{RG}	Tc = 25°C V_{RG} = -75 V Tc = 70°C V_{RG} = -75 V		5 50	µA µA
V_{SGL}	V_{GATE}= -48 V Note 2.		- 63	V
V_T	Square pulse, Tp = 500 µs, I_T = 0.5 A Square pulse, Tp = 500 µs, I_T = 3 A		3 4	V V

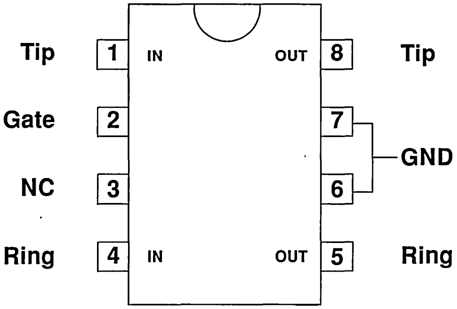
PARAMETERS RELATIVE TO DIODE AND PROTECTION THYRISTOR

Symbol	Tests Conditions	Min.	Max.	Unit
I_R	Tc = 25°C -1 < V_{GL} < -Vbat V_R = - 85 V Tc = 70°C -1 < V_{GL} < -Vbat V_R = - 85 V		5 50	µA µA
C_{off}	V_R = - 3 V F < 1MHz V_R = - 48 V F < 1MHz		100 50	pF pF

All Parameters Tested at 25 °C except when indicated.

Note 2 : See test circuit for I_H and V_{SGL}.

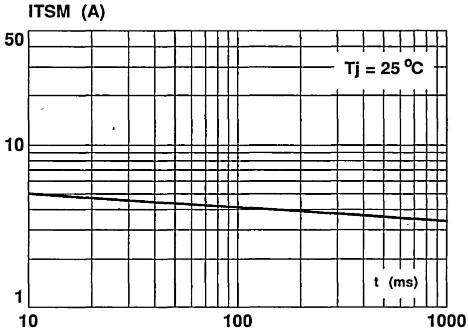
APPLICATION NOTE



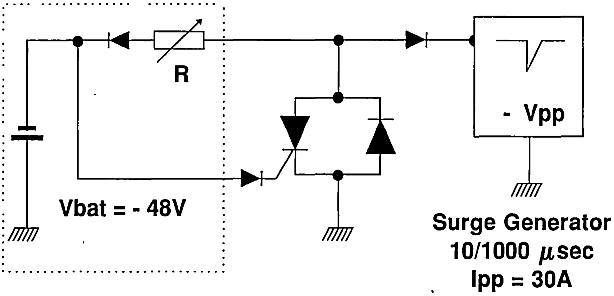
4- points structure lay-out.

In order to take advantage of the "4-points structure" of the LCPxxxx, the tip and Ring lines have to cross through the device. In this case, the device will eliminate the overvoltages generated by the parasitic inductances of the wiring (Ldi/dt), especially for very fast Transients.

Figure 1 : Non repetitive surge peak on-state current. (with sinusoidal pulse : F =50Hz)



TEST CIRCUIT FOR I_H AND V_{SGL} PARAMETERS



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level, and to measure the dynamic switching voltage (V_{SGL}).

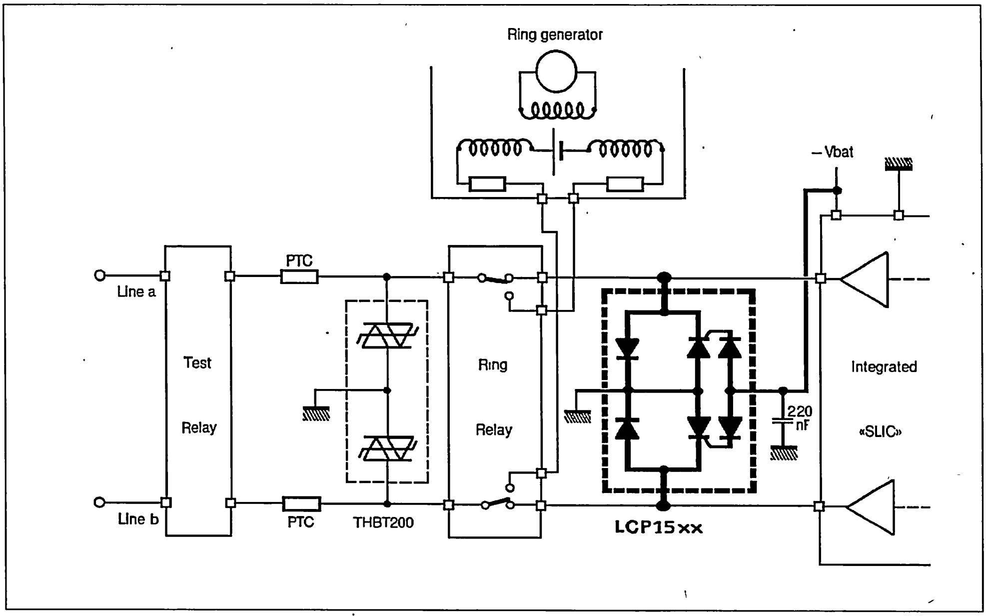
TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 30A , 10/1000 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

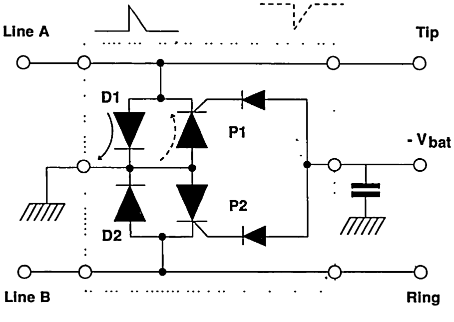
- The V_{SGL} is measured just before firing.

APPLICATION CIRCUIT

Typical slic protection concept



FUNCTIONAL DESCRIPTION



LINE A PROTECTION:
- For positive surges versus GND, the diode D1 will conduct.
- For negative surges versus GND, the protection device P1 will trigger at a voltage fixed by the -VBAT reference.

LINE B PROTECTION:
- For surges on Line B, the operating mode is the same , D2 or P2 is activated.

- A capacitor (C = 220nF) can be added close to the gate of the LCP15xx, in order to speed up the triggering.

ORDER CODE

LCP 15 1 1

- LCP → LINE CARD PROTECTION
- 15 → HOLDING CURRENT : 150 mA
- 1 → VERSION
- 1 → PACKAGE
  - 1=SO 8 PLASTIC
  - 2=DIL 8 PLASTIC

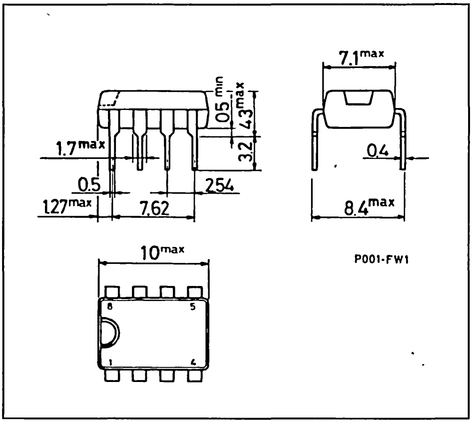
MARKING

Package	Type	Marking
SO8	LCP1511	CP1511
DIL8	LCP1512	CP1512

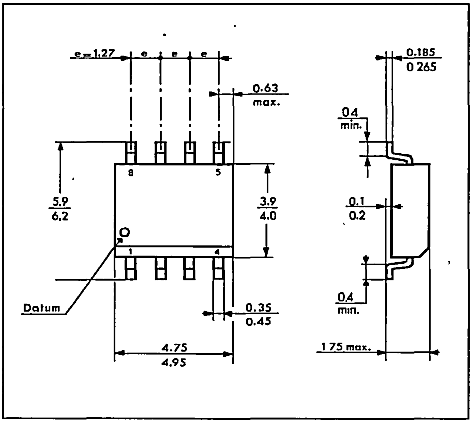
Packaging : Products supplied in antistatic tubes.

PACKAGE MECHANICAL DATA (in millimeters)

DIL 8 Plastic

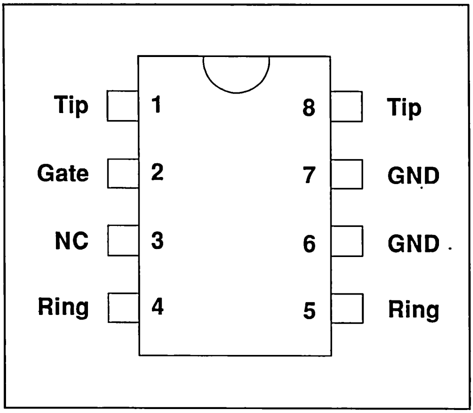


SO 8 Plastic

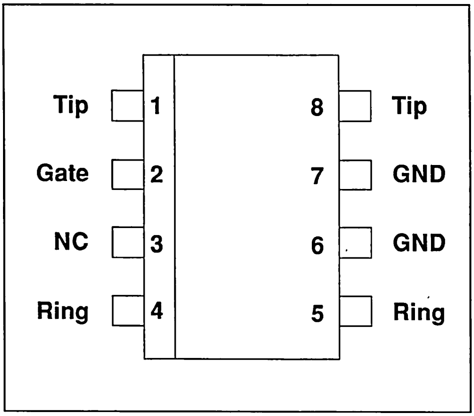


CONNECTION DIAGRAMS

DIL 8 Plastic



SO 8 Plastic



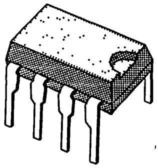
SGS-THOMSON
MICROELECTRONICS

LS5018B
LS5060B/LS5120B

TRISIL

FEATURES

- BIDIRECTIONAL CROWBAR PROTECTION.
- BREAKDOWN VOLTAGE RANGE:
  FROM 18 V To 120 V.
- HOLDING CURRENT = 200 mA min.
- HIGH SURGE CURRENT CAPABILITY
  I_{PP} = 100A 10/1000 µs



DIL 8
(Plastic)

DESCRIPTION

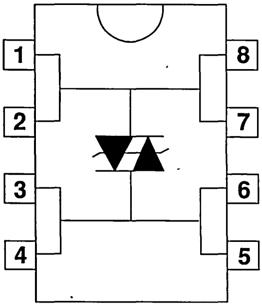
The LS50xxB series has been designed to protect telecommunication equipment against lightning and transients induced by AC power lines.

Its high surge current capability makes the LS50xxB a reliable protection device for very exposed equipment, or when series resistors are very low.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (- 40°C ≤ T_{amb} ≤ +85°C)

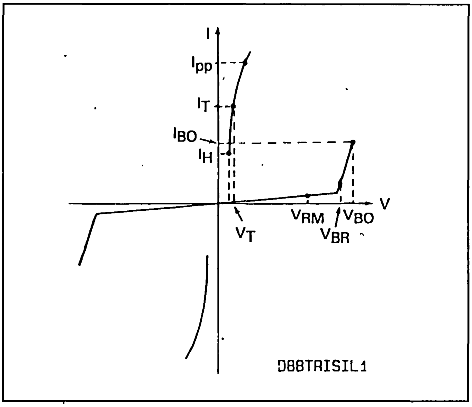
Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	100 250	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	50	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 150	°C °C

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R_{th} (j-a)	Junction-to-ambient	80	°C/W

ELECTRICAL CHARACTERISTICS.

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage @ I_T
I_{BO}	Breakover current
I_{PP}	Peak pulse current

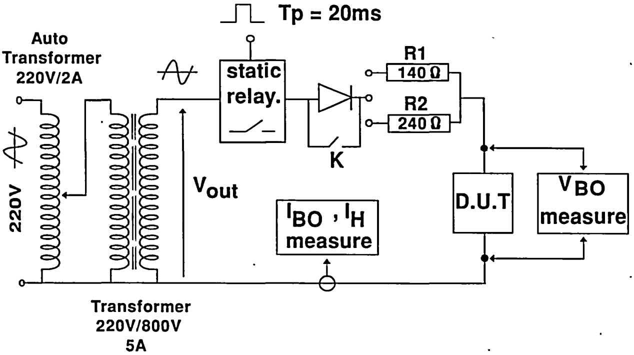


Type	I_{RM} @ V_{RM} max		V_{BR} @ I_R min		V_{BO} max	@ min note 1	I_{BO} max	I_H min note 1	V_T max note 2	C max note 3
	µA	V	V	mA	V	mA	mA	mA	V	pF
LS5018B	5	16	17	1	22		1300	200	3	150
LS5060B	10	50	60	1	85		1000	200	3	150
LS5120B	20	100	120	1	180	500	1250	250	3	150

All parameters tested at 25°C, except where indicated.

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse T_P= 500µs - I_T= 1A.
Note 3 : V_R = 5 V, F = 1MHz.

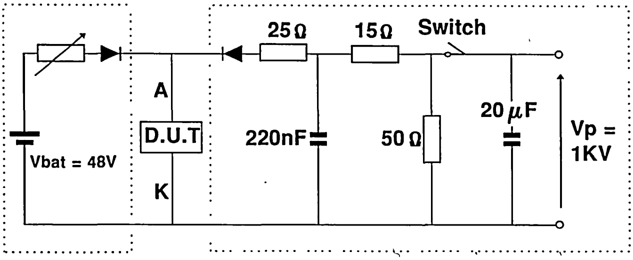
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on state current versus number of cycles. (with sinusoïdal pluse: F = 50 Hz).

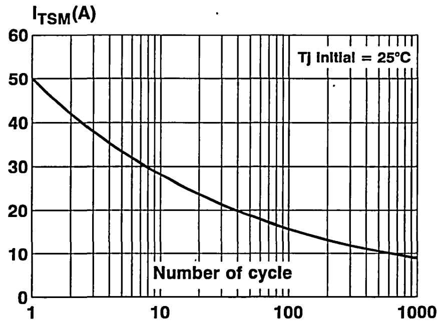


Figure 2 : Relative variation of holding current versus ambient temperature.

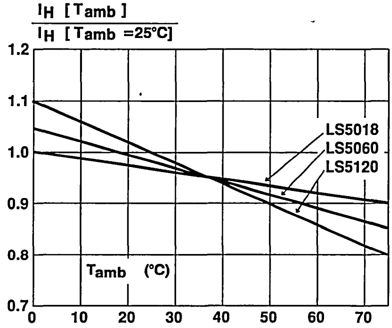


Figure 3 : Relative variation of breakdown voltage versus ambient temperature.

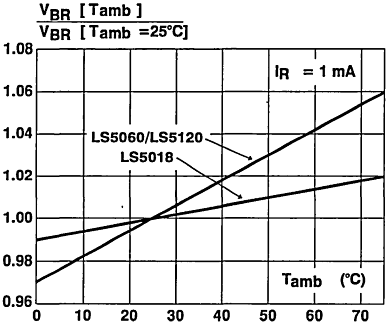
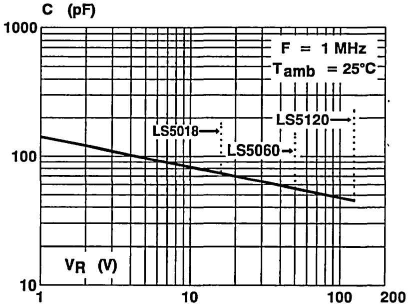
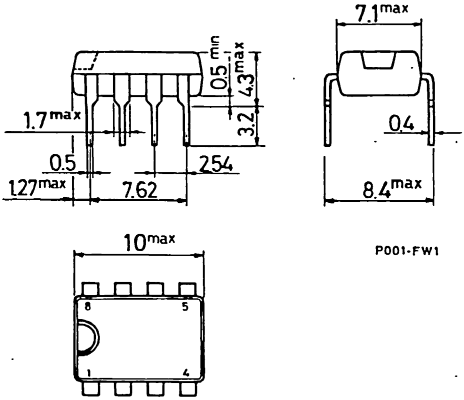


Figure 4 : Junction capacitance versus reverse applied voltage.



PACKAGE MECHANICAL DATA (in millimeters).

DIL 8 Plastic



MARKING : Logo, Date Code,part Number.

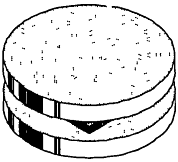
PACKAGING : Products supplied in antistatic tubes.

SA100 SERIES

SURGE ARRESTORS

FEATURES

- SOLID STATE SURGE ARRESTOR
- VOLTAGE RANGE = 200 V TO 265 V
- TIGHT VOLTAGE TOLERANCE
- FAST RESPONSE TIME
- VERY LOW AND STABLE LEAKAGE CURRENT
- REPETITIVE SURGE CAPABILITY Ipp = 100 A, 10/1000 µs
- FAIL-SAFE WHEN DESTROYED



BUTTON CELL

DESCRIPTION

Bidirectional device used for primary protection in telecom equipments.

Providing long service life, and adapted for sensitive electronic equipments protection.

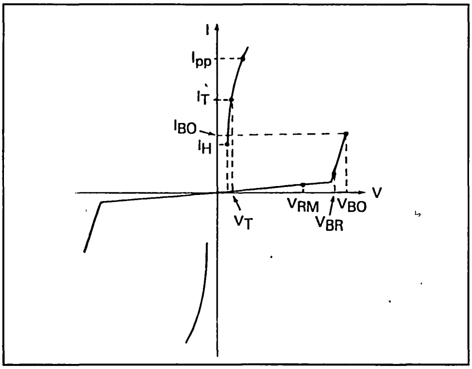
If destroyed the component will continue to guarantee a protection with a permanent short circuit, meaning "fail save criteria". This particular behaviour will also allow an easy failure detection on the line.

ABSOLUTE RATINGS (limiting values) - 40°C < T_{amb} < +80°C

Symbol	Parameter		Value	Unit
I_{PP}	Peak Pulse Current.	10/1000 µs	100	A
		8/20 µs	200	A
	Fail Save Criteria.	8/20 µs	10	kA
I_{TSM}	Non Repetitive Surge Peak on-state Current One cycle.	60 Hz	30	A
		50Hz	25	A
	Non Repetitive Surge Peak on-state Current F = 50 Hz.	1s	14	A
		2s	10	A
dv/dt	Critical Rate of Rise of on-state Voltage.	67% V_{BR}	10	kV/µs
T_L	Maximum Lead Temperature to Soldering During 10 s.		250	°C

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off Voltage
V_{BR}	Breakdown Voltage
V_{BO}	Breakover Voltage
I_H	Holding Current
V_T	On-state Voltage
I_{BO}	Breakover Current

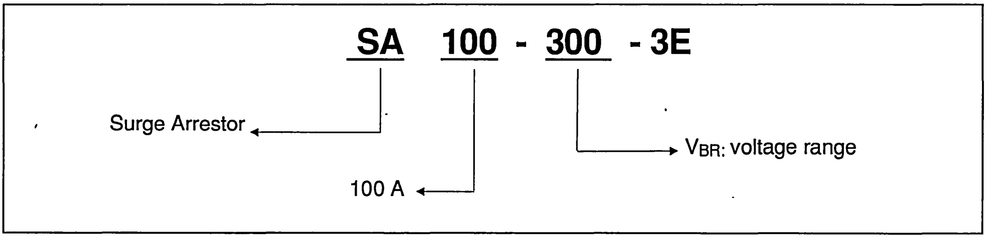


Type	I_{RM} @ V_{RM} max		V_{BR} @ I_R min.		V_{BO} max. note 1	VBO max. note 2	VBO max. note 3	I_{BO} min. note 1	I_H min. note 1	V_T max. note 4	C max. note 5
	(µA)	(V)	(V)	(mA)	(V)	(V)	(V)	(mA)	(mA)	(V)	pF
SA100-230	10	170	200	1	265	350	350	200	260	3.5	200
SA100-300	10	225	265	1	400	400	400	200	260	3.5	200

All parameters tested at 25°C, except where indicated.

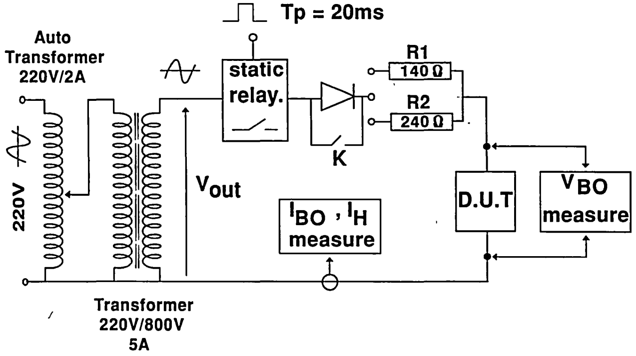
Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters
Note 2 : $V_{RISE} = 100V/\mu s$.
Note 3 : $V_{RISE} = 1KV/\mu s$, $di/dt < 10A/\mu s$, $I_{PP} = 10A$.
Note 4 : Square pulse, $T_P = 500\ \mu s$, $I_T = 5$ A.
Note 5 : $V_R = 0$ V, F = 1 MHz..

ORDER CODE



Product Availability is Submitted to Restricted Conditions- Consult Factory.

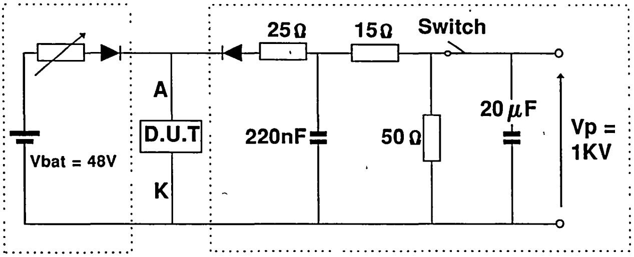
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



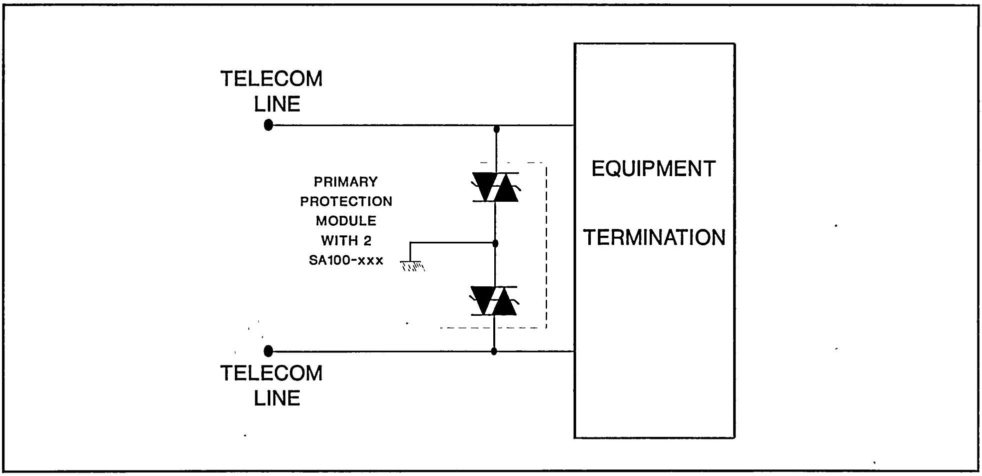
Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. this test can be performed if the reference test circuit can't be implemented.

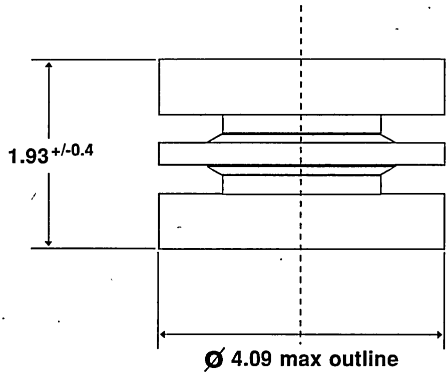
TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

APPLICATION DIAGRAM



MECHANICAL DATA
BUTTON CELL (Millimeters)



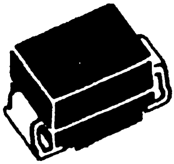
Packaging : Products are supplied in tubes.

SMTHBT200

TRISIL FOR LINE CARD PROTECTION

FEATURES

- BIDIRECTIONAL CROWBAR PROTECTION.
- PEAK PULSE CURRENT :
  - I$_{PP}$ = 75 A, 10/1000 µs.
- HOLDING CURRENT = 150 mA min
- BREAKDOWN VOLTAGE = 200 V min.
- BREAKOVER VOLTAGE = 290 V max.



SOD 15
(Plastic)

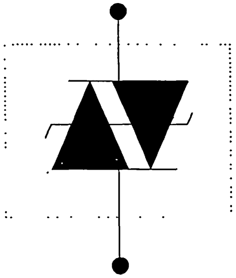
DESCRIPTION

This protection device has been especially designed to protect subscriber line cards using SLICS without integrated ring generators. The SMTHBT200 device protects ring generator relays against transient overvoltages.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

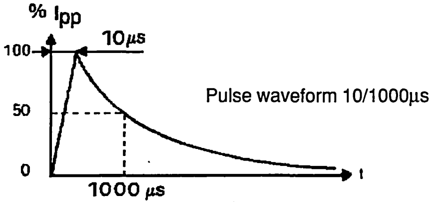
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) ($-40°C \leq T_{amb} \leq +85°C$)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	75 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

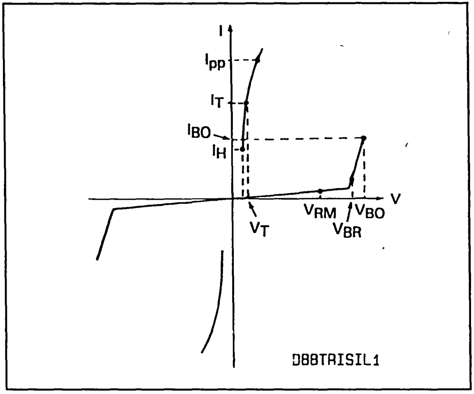


THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction to leads.	10	°C/W
R_{th} (j-a)	Junction-to-ambient.	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current

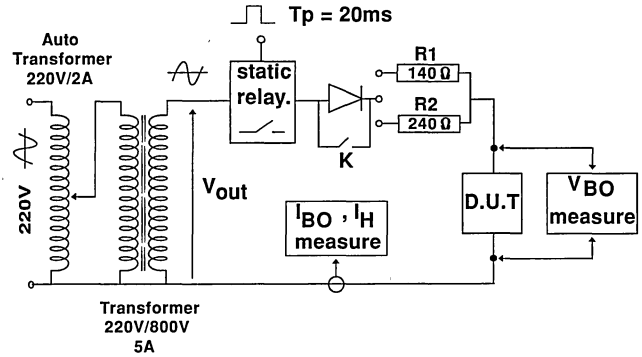


TYPE	I_{RM} @ V_{RM}		VBR @ I_R		V_{BO} @ I_{BO}			I_H	V_T	C
	max		min		max	min	max	min	max	max
						note1		note1	note2	note3
	µA	V	V	mA	V	mA	mA	mA	V	pF
SMTHBT200	10	180	200	1	290	150	800	150	8	200

All parameters tested at 25°C, except where indicated

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

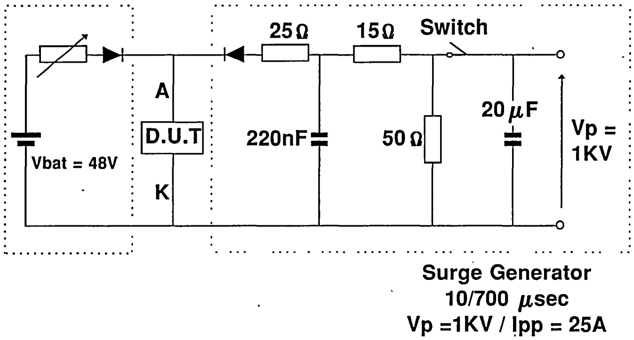
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - V_{OUT} = 250 V_{RMS}, R_1 = 140 Ω.
  - Device with $V_{BR} \geq 150$ Volt
    - V_{OUT} = 480 V_{RMS}, R_2 = 240 Ω.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT =GO - NOGO TEST.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Relative variation of holding current versus junction temperature.

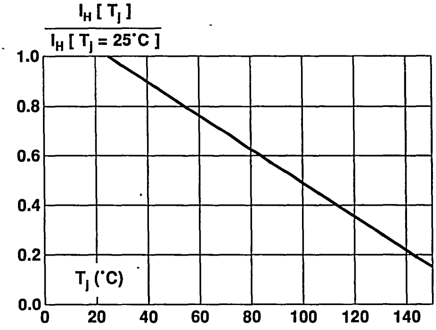


Figure 2 : Non repetitive surge peak on state current versus number of cycles (1 cycle = 20

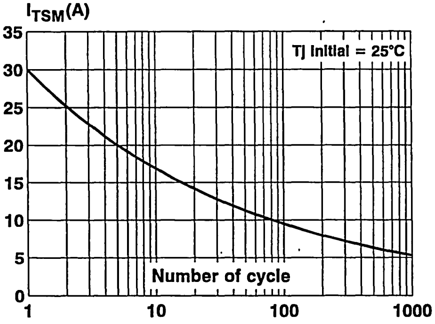


Figure 3 : Peak on state voltage versus peak on state current (typical values).

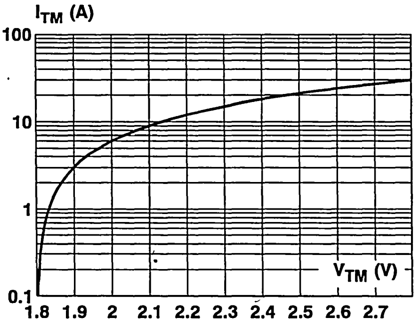
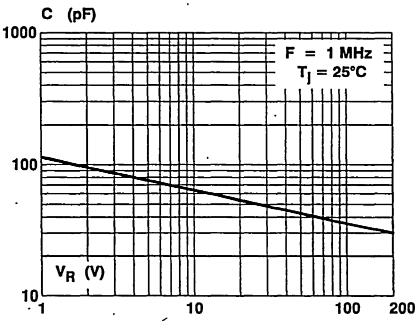
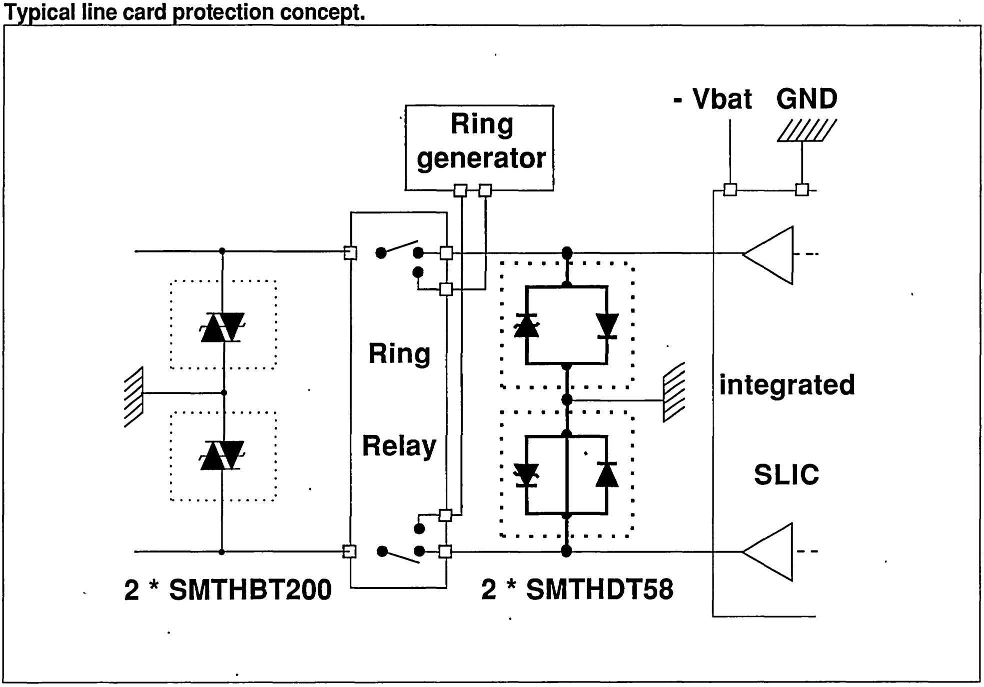


Figure 5 : Capacitance versus reverse applied voltage (typical values).

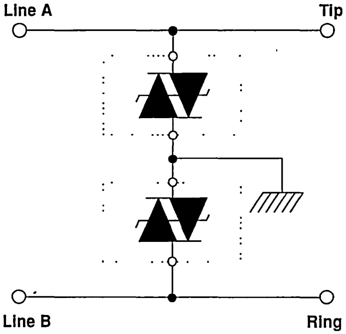


APPLICATION CIRCUIT

Typical line card protection concept.



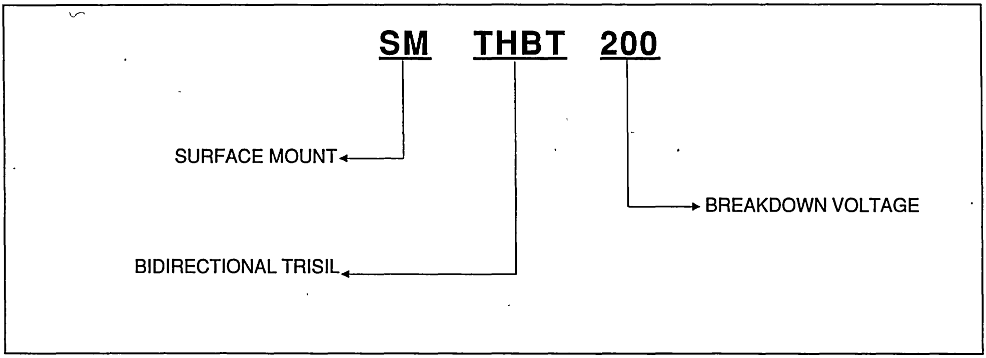
FUNCTIONAL DESCRIPTION



LINE A AND LINE B PROTECTION.

Each line (TIP and RING) is protected by the bidirectional Trisil, which triggers at a maximum voltage equal to the V_{BO}.

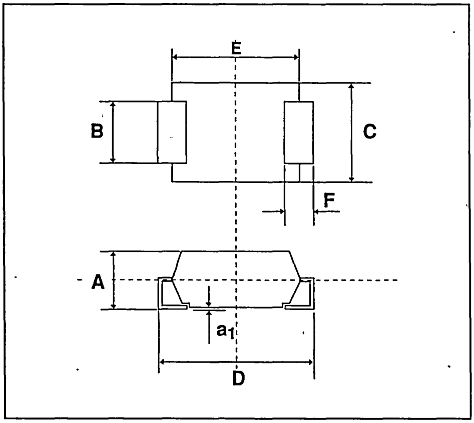
ORDER CODE



MARKING = Logo, WO4

PACKAGE MECHANICAL DATA .

SOD 15 Plastic.



Ref	Millimeters		Inches	
	min	max	min	max
A	2.5	3.1	0.098	0.122
a_1	-	0.2	-	0.008
B	2.9	3.1	0.114	0.122
C	4.8	5.2	0.190	0.200
D	7.6	8.0	0.300	0.315
E	6.3	6.6	0.248	0.259
F	1.3	1.7	0.051	0.067

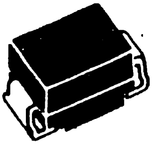
Packaging : Standard packaging is in film.

SMTHDT58

TRISIL FOR SLIC PROTECTION

FEATURES

- CROWBAR PROTECTION.
- ASYMETRICAL TRANSIENT SUPPRESSOR
- PEAK PULSE CURRENT :
  - I_{PP} = 75 A, 10/1000 µs.
- HOLDING CURRENT = 150 mA min
- BREAKDOWN VOLTAGE = 58 V.
- BREAKOVER VOLTAGE = 80V max.



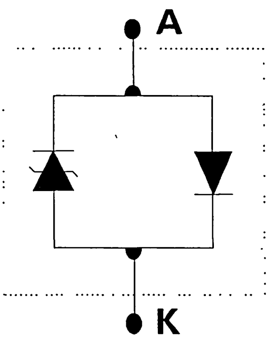
SOD 15
(Plastic)

DESCRIPTION

This device has been especially designed to protect subscriber line card interfaces (SLIC) and terminals against transient overvoltages.

A diode clips positive overloads and a crowbar device protects againts negative surges.

SCHEMATIC DIAGRAM

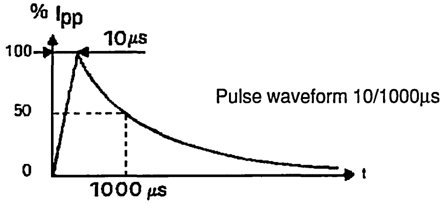


IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ + 85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	75 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
I_{FSM}	Non repetitive surge peak forward current	tp = 20 ms	30	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

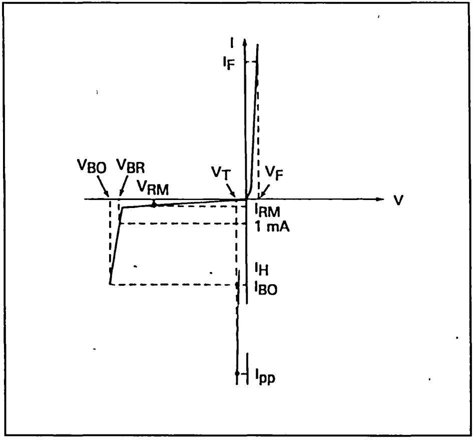


THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction to leads	10	°C/W
R_{th} (j-a)	Junction-to-ambiant	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
V_F	Forward Voltage Drop
I_{BO}	Breakover current
I_{PP}	Peak pulse current



PARAMETER RELATED TO THE DIODE.

Symbol	Test conditions	Value	Unit
V_F	Square pulse, tp = 500 µs, I_F = 5 A.	5	V

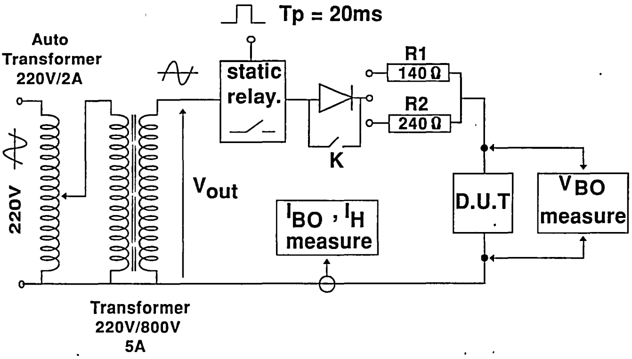
PARAMETERS RELATED TO THE PROTECTION THYRISTOR.

TYPE	I_{RM} @ V_{RM}		VBR @ I_R		V_{BO} @ I_{BO}			I_H	V_T	C
	max		min		max	min	max	min	max	max
						note1		note1	note2	note3
	µA	V	V	mA	V	mA	mA	mA	V	pF
SMTHDT58	10	56	58	1	80	150	800	150	5	400

All parameters tested at 25°C, except where indicated

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

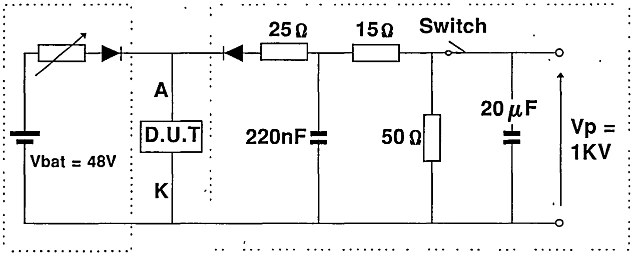
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit This test can be performed if the reference test circuit cant't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State withing a duration of 50 ms max.

Figure 1 : Relative variation of holding current versus junction temperature.

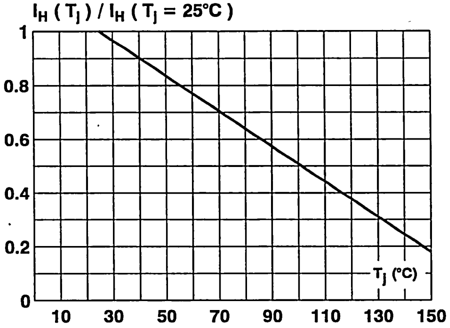


Figure 2 : Non repetitive surge peak on state current versus number of cycles (1 cycle = 20

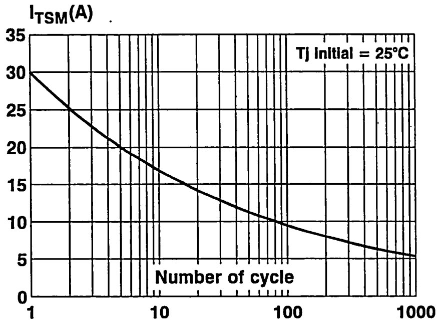


Figure 3 : Peak on state voltage versus peak on state current (typical values).

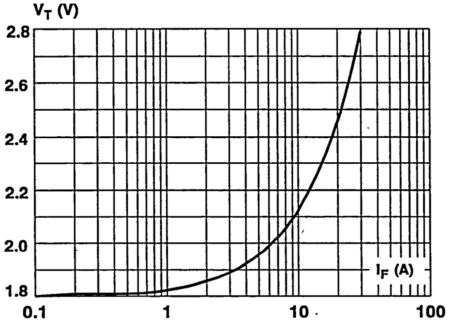


Figure 4 : Peak forward voltage drop versus peak forward current (typical values).

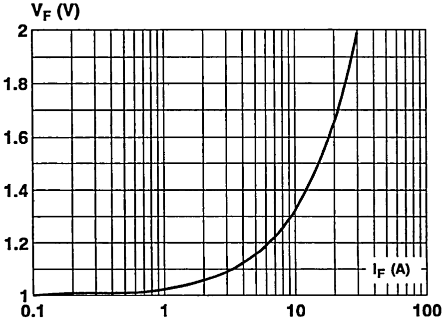
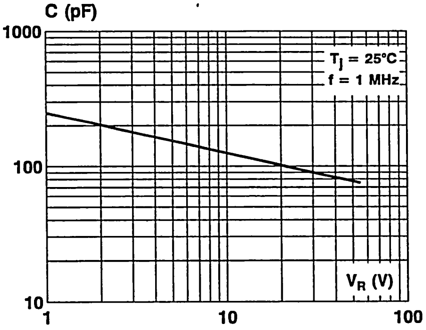
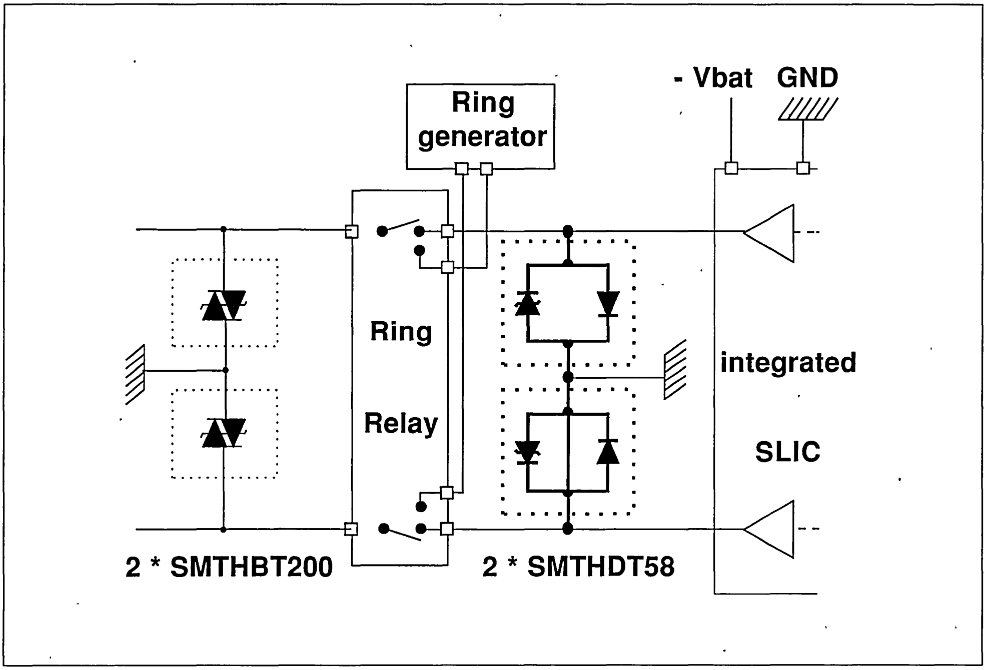


Figure 5 : Capacitance versus reverse applied voltage (typical values).

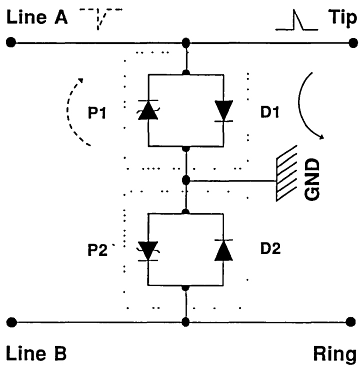


APPLICATION CIRCUIT

Typical slic protection concept



FUNCTIONAL DESCRIPTION



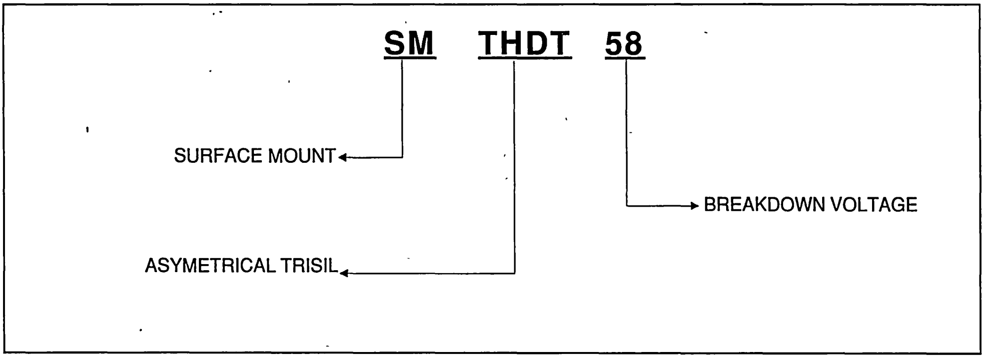
Line A Protection =

- For positive Surges versus GND, the diode D1 will conduct
- For negative Surges versus GND, the Protection device P1 will trigger at a maximum voltage equal to the V_{BO}.

Line B Protection =

- For Surges on line B, the operating mode is the same, D2 or P2 is activated.

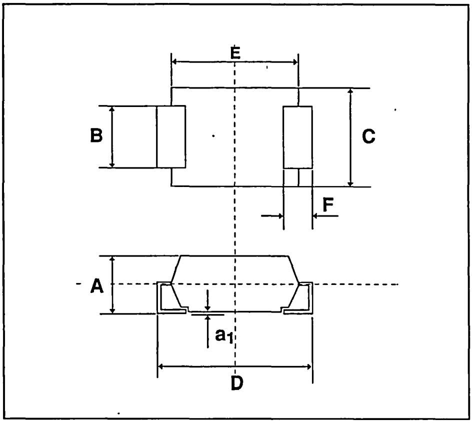
ORDER CODE



MARKING = Logo, WO1
A white band indicates the cathode.

PACKAGE MECHANICAL DATA .

SOD 15 Plastic.



Ref	Millimeters		Inches	
	min	max	min	max
A	2.5	3.1	0.098	0.122
a1	-	0.2	-	0.008
B	2.9	3.1	0.114	0.122
C	4.8	5.2	0.190	0.200
D	7.6	8.0	0.300	0.315
E	6.3	6.6	0.248	0.259
F	1.3	1.7	0.051	0.067

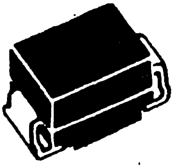
Packaging : Standard packaging is in film.

SMTPA SERIES

TRISIL

FEATURES

- BIDIRECTIONAL CROWBAR PROTECTION.
- BREAKDOWN VOLTAGE RANGE:
  From 62 V To 270 V.
- HOLDING CURRENT = 150 mA min
- PEAK PULSE CURRENT :
  I_{PP} = 50 A, 10/1000 µs.



SOD 6
(Plastic)

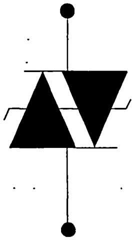
DESCRIPTION

The SMTPAxx series has been designed to protect telecommunication equipments against lightning and transient induced by AC power lines.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ + 85°C)

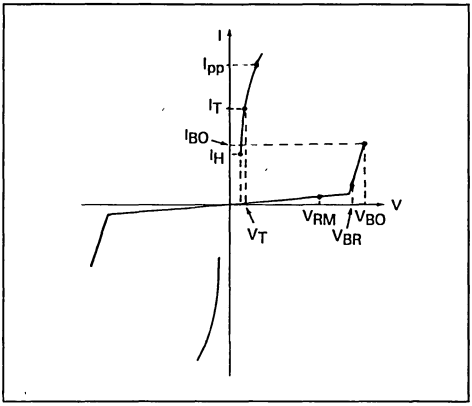
Symbol	Parameter		Value	Unit
P	Power dissipation on infinite heatsink	T_{lead} = 50 °C	5	W
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	50 100	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction to leads. on infinite heatsink.	20	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit with standard footprint dimensions.	100	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current

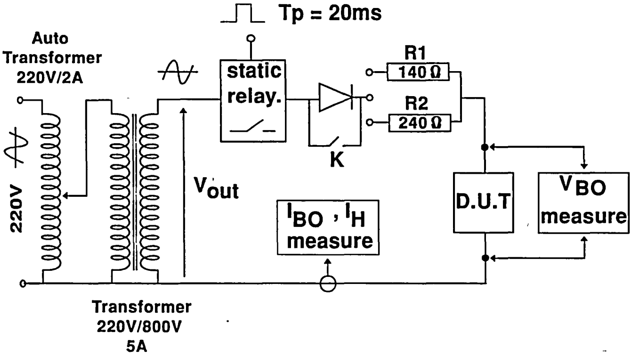


Type	Marking	I_{RM} @	V_{RM}	V_{BR} @	I_R	V_{BO} @	I_{BO}	I_H	V_T	C
		max		min		max note1	max	min note1	max note2	max note3
	Laser	µA	V	V	mA	V	mA	mA	V	pF
SMTPA62	U01	2	56	62	1	82	800	150	2	150
SMTPA68	U05	2	61	68	1	90	800	150	2	150
SMTPA100	U13	2	90	100	1	133	800	150	2	100
SMTPA120	U17	2	108	120	1	160	800	150	2	100
SMTPA130	U19	2	117	130	1	173	800	150	2	100
SMTPA180	U25	2	162	180	1	240	800	150	2	100
SMTPA200	U27	2	180	200	1	267	800	150	2	100
SMTPA220	U31	2	198	220	1	293	800	150	2	100
SMTPA240	U35	2	216	240	1	320	800	150	2	100
SMTPA270	U39	2	243	270	1	360	800	150	2	100

All parameters tested at 25°C, except where indicated.

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 1 ms - I_T = 3A.
Note 3 : V_R = 1V, F = 1MHz.

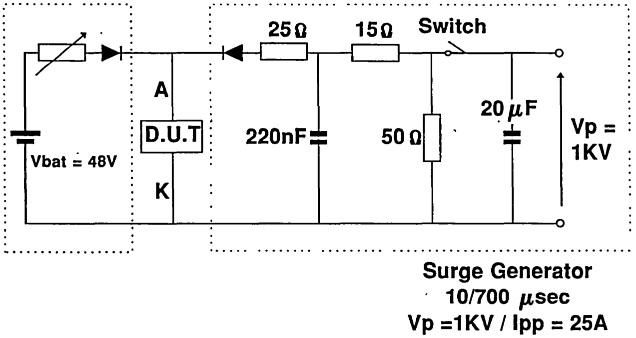
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch.K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250$ V_{RMS}, $R_1 = 140$ Ω.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480$ V_{RMS}, $R_2 = 240$ Ω.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State withing a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on state current versus number of cycles. (with sinusoidal pulse: F= 50 Hz).

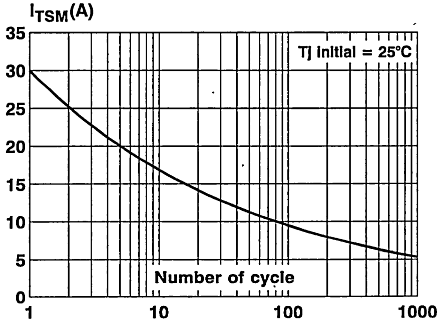


Figure 2 : On state characteristics (typical values).

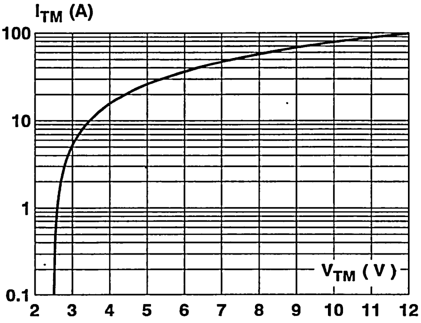
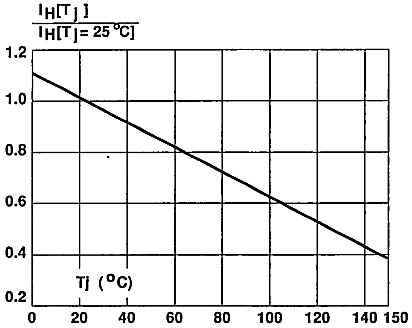
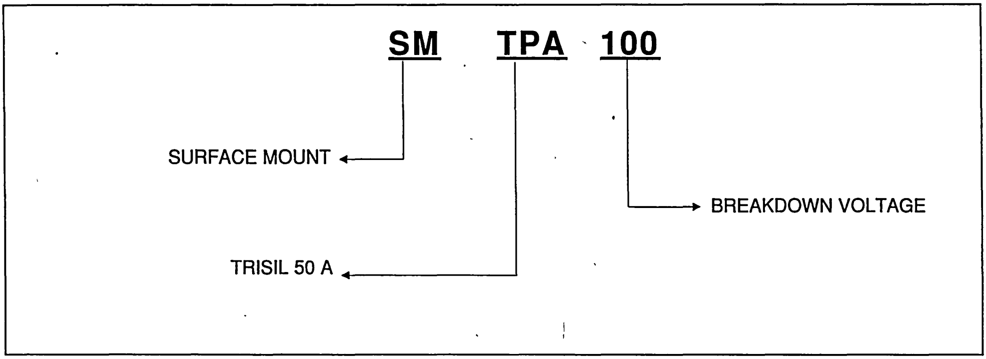


Figure 3 : Relative variation of holding current versus junction temperature.



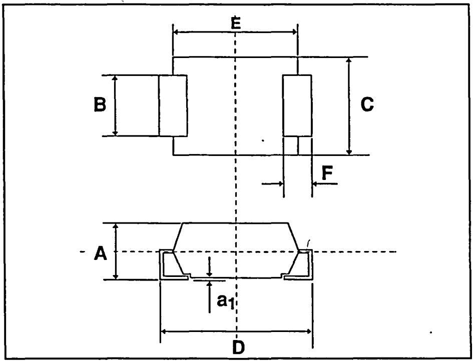
ORDER CODE



MARKING : Logo, date code, type code.

PACKAGE MECHANICAL DATA.

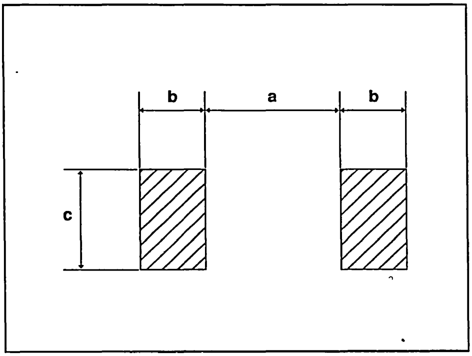
SOD 6 Plastic.



Ref	Millimeters		Inches	
	min	max	min	max
A	2.48	2.61	0.096	0.103
a_1	0.10	0.20	0.004	0.008
B	1.96	2.11	0.077	0.083
C	3.65	3.93	0.143	0.155
D	5.39	5.59	0.212	0.220
E	4.15	4.30	0.163	0.170
F	1.00	1.27	0.039	0.050

FOOTPRINT DIMENSIONS (Millimeters)

SOD 6 Plastic.



Ref	Millimeters
a	2.75
b	1.52
c	2.30

Packaging : Standard packaging is in film.

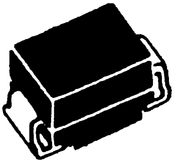
SGS-THOMSON
MICROELECTRONICS

SMTPB SERIES

TRISIL

FEATURES

- BIDIRECTIONAL CROWBAR PROTECTION.
- BREAKDOWN VOLTAGE RANGE:
  From 62 V To 270 V.
- HOLDING CURRENT = 150 mA min
- PEAK PULSE CURRENT :
  I_{PP} = 90 A, 10/1000 µs.

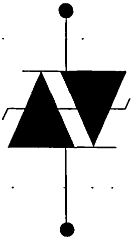


SOD 15
(Plastic)

DESCRIPTION

The SMTPBxx series has been designed to protect telecommunication equipment against lightning and transient induced by AC power lines.

SCHEMATIC DIAGRAM



IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ + 85°C)

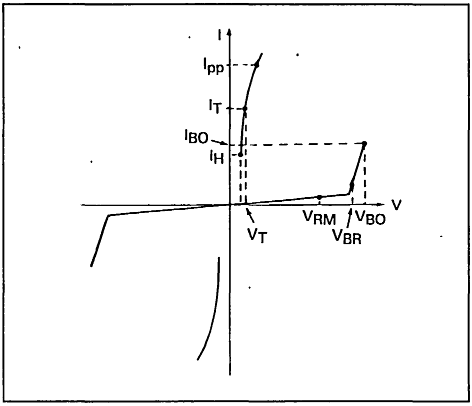
Symbol	Parameter		Value	Unit
P	Power dissipation on infinite heatsink	T_{lead} = 50 °C	10	W
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	90 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	50	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		+ 260	°C

THERMAL RESISTANCES

Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction to leads. On infinite heatsink.	10	°C/W
R_{th} (j-a)	Junction to ambient. On printed circuit with standard footprint dimensions.	75	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current

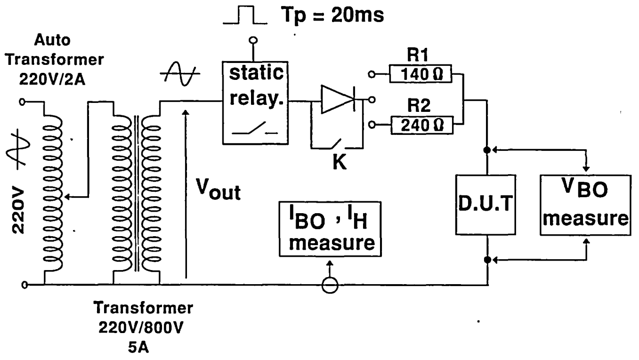


Type	Marcking	I_{RM} @	V_{RM}	V_{BR} @	I_R	V_{BO} @	I_{BO}	I_H	V_T	C
		max		min		max note1	max	min note1	max note2	max note3
	Laser	µA	V	V	mA	V	mA	mA	V	pF
SMTPB62	W07	2	56	62	1	82	800	150	3.5	350
SMTPB68	W11	2	61	68	1	90	800	150	3.5	350
SMTPB100	W17	2	90	100	1	133	800	150	3.5	200
SMTPB120	W21	2	108	120	1	160	800	150	3.5	200
SMTPB130	W23	2	117	130	1	173	800	150	3.5	200
SMTPB180	W29	2	162	180	1	240	800	150	3.5	200
SMTPB200	W31	2	180	200	1	267	800	150	3.5	200
SMTPB220	W35	2	198	220	1	293	800	150	3.5	200
SMTPB240	W39	2	216	240	1	320	800	150	3.5	200
SMTPB270	W43	2	243	270	1	360	800	150	3.5	200

All parameters tested at 25°C, except where indicated.

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 1 ms - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

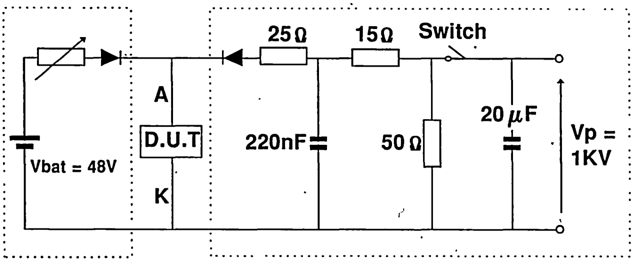
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250$ V_{RMS}, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480$ V_{RMS}, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State withing a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on state current versus number of cycles. (with sinusoïdal pluse: F= 50 Hz).

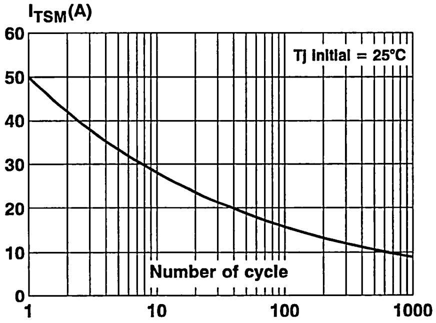


Figure 2 : On - state characteristics (typical values).

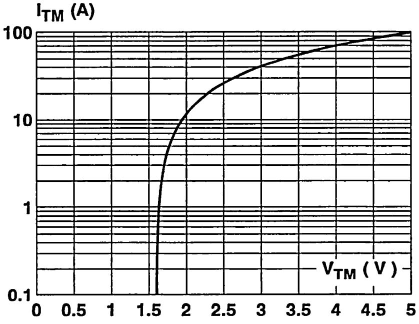
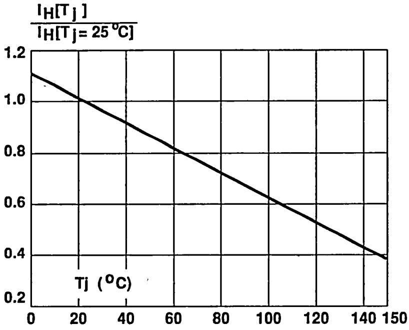
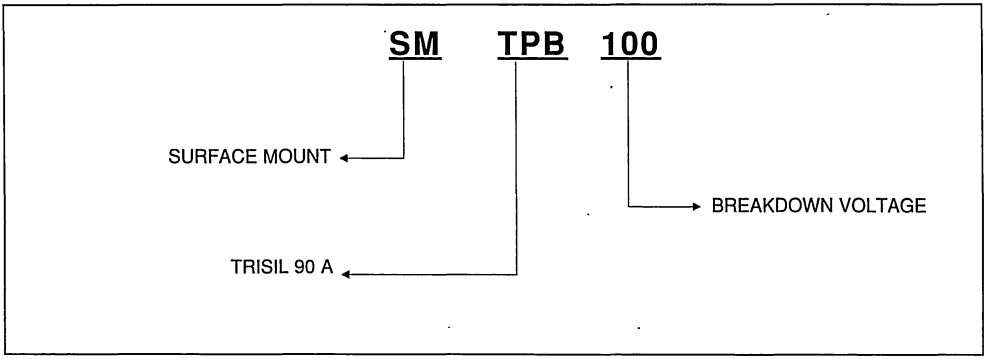


Figure 3 : Relative variation of holding current versus junction temperature.



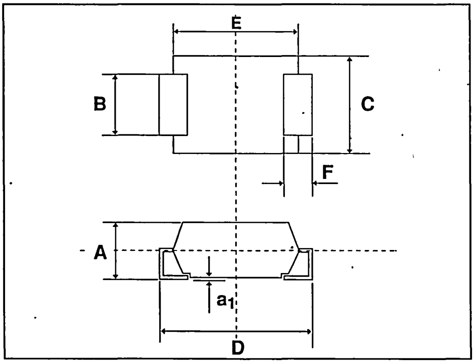
ORDER CODE :



MARKING : Logo, date code, type code.

PACKAGE MECHANICAL DATA.

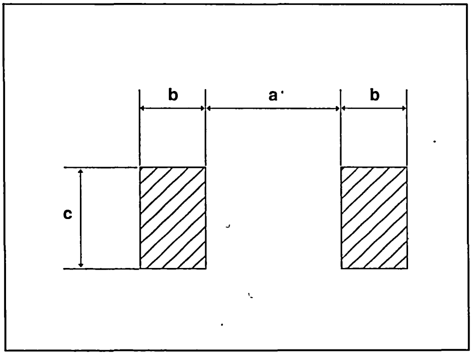
SOD 15 Plastic.



Ref	Millimeters		Inches	
	min	max	min	max
A	2.5	3.1	0.098	0.122
a_1	-	0.2	-	0.008
B	2.9	3.1	0.114	0.122
C	4.8	5.2	0.190	0.200
D	7.6	8.0	0.300	0.315
E	6.3	6.6	0.248	0.259
F	1.3	1.7	0.051	0.067

FOOTPRINT DIMENSIONS.

SOD 15 Plastic.



Ref	Millimeters
a	4.2
b	2
c	3.3

Packaging : Standard packaging is in film.

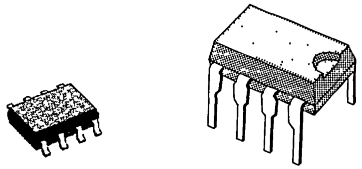
SGS-THOMSON
MICROELECTRONICS

THBT150
THBT200 / THBT270

TRISIL

FEATURES

- BIDIRECTIONAL TRIPLE PROTECTION
- CROWBAR PROTECTION
- PEAK PULSE CURRENT :
  I_{PP} = 30 A , 10/1000 µs
- HOLDING CURRENT = 150 mA min
- AVAILABLE IN DIP 8 AND SO 8 PACKAGES



SO 8
(Plastic)

DIL 8
(Plastic)

DESCRIPTION

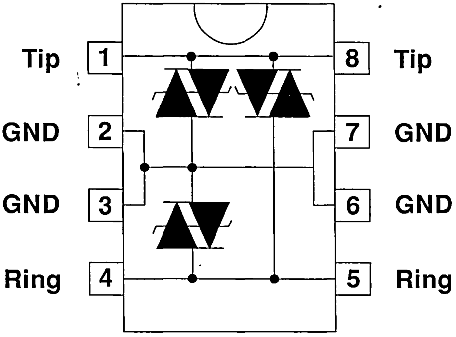
Dedicated to telecommunication equipment protection, these devices provide a triple bidirectional protection function.
They ensure the same protection capability with the same breakdown voltage both in common mode and in differential mode.

Particular attention has been given to the internal wire bonding . A 4-point configuration ensures reliable protection, eliminating the overvoltage introduced by the parasitic inductances of the wiring (Ldi/dt) especially for very fast transients.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

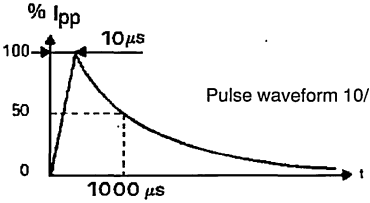
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 5/320 µs 2/10 µs	30 40 75	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 10 ms tp = 1 s	5 3.5	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C



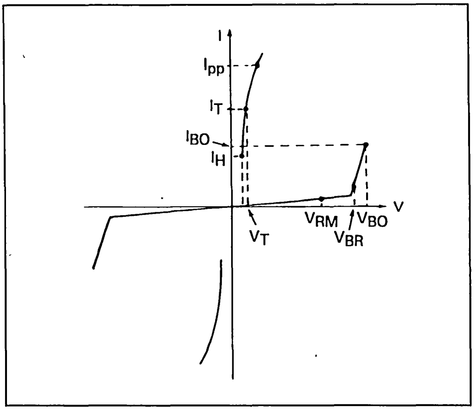
Pulse waveform 10/1000µs

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-a)	Junction-to-ambient	DIL 8 SO 8	125 171	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current



STATIC PARAMETERS

Types	I_R @	V_{RM}	V_{BR} @	I_R	V_{BO} @	I_{BO}		I_H	V_T	C
	max		min		max	min	max	min	max	max
						note1		note1	note2	note3
	µA	V	V	mA	V	mA	mA	mA	V	pF
THBT150	5	135	150	1	210	50	400	150	8	200
THBT200	5	180	200	1	290	50	400	150	8	200
THBT270	5	240	270	1	380	50	400	150	8	200

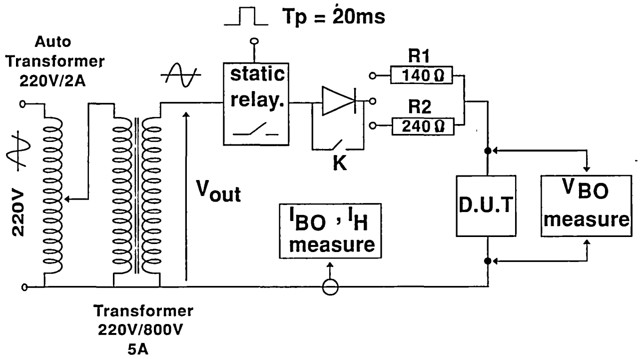
DYNAMIC PARAMETERS

Types	V_{BO} dyn Typical Value note 4
	(V)
THBT150	290
THBT200	380
THBT270	420

All parameters tested at 25°C, except where indicated

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.
Note 4 : The dynamic breakover voltage is meassured
with following surge test : CCITT - 1.5 KV 10/700 µs

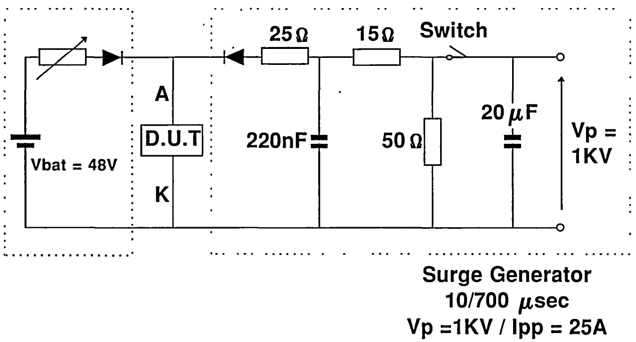
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST

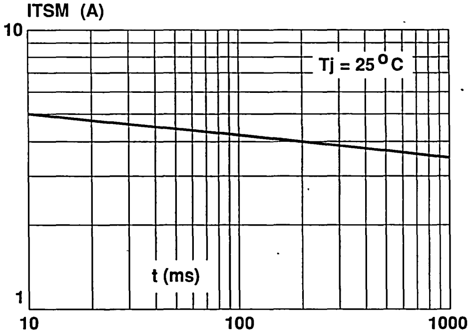


This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

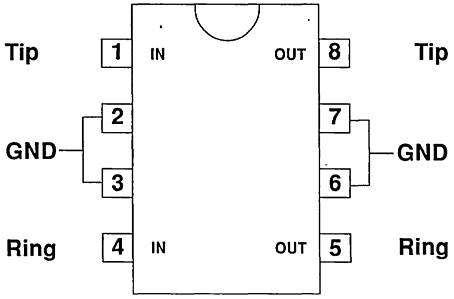
TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on-state current. (with sinusoidal pulse : F =50Hz)



APPLICATION NOTE



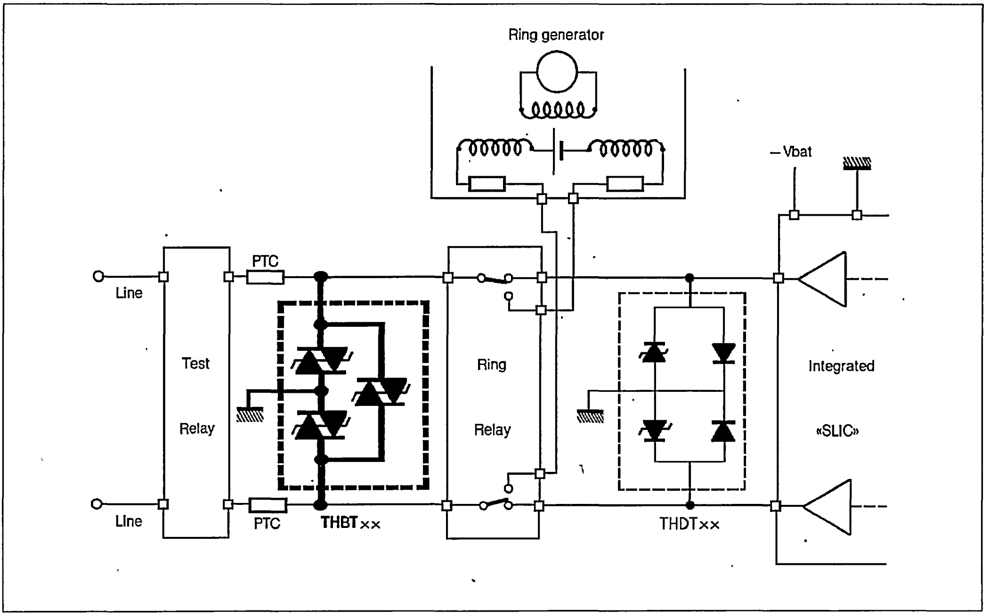
4- points structure lay-out.

1) Connect pins 2, 3, 6 and 7 to ground in order to guarantee a good surge current capability for long duration disturbances.

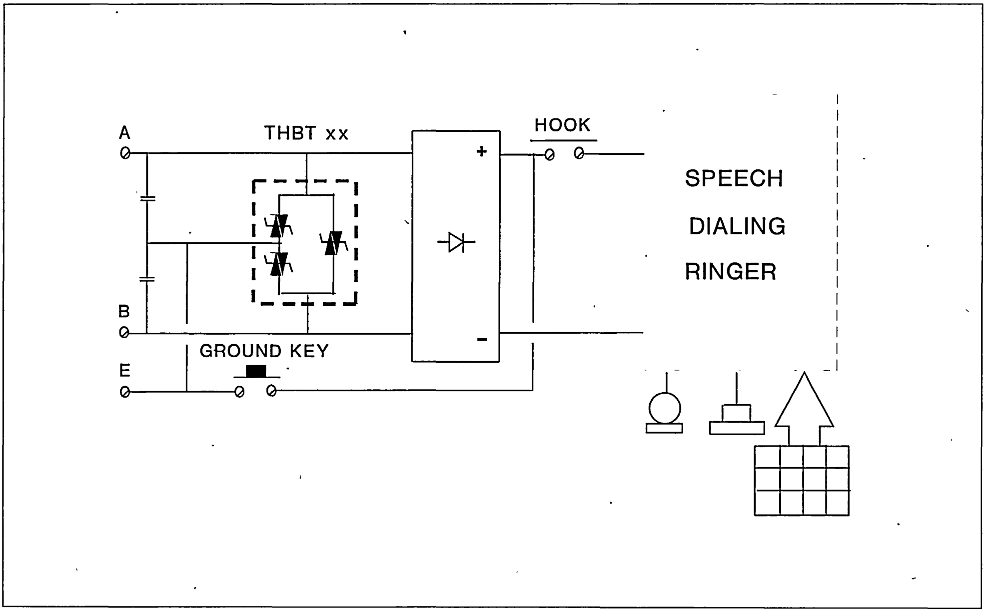
2) In order to take advantage of the "4-points structure" of the THBTxxx, the tip and Ring lines have to cross through the device. In this case, the device will eliminate the overvoltages generated by the parasitic inductances of the wiring (Ldi/dt), especially for very fast Transients.

APPLICATION CIRCUIT

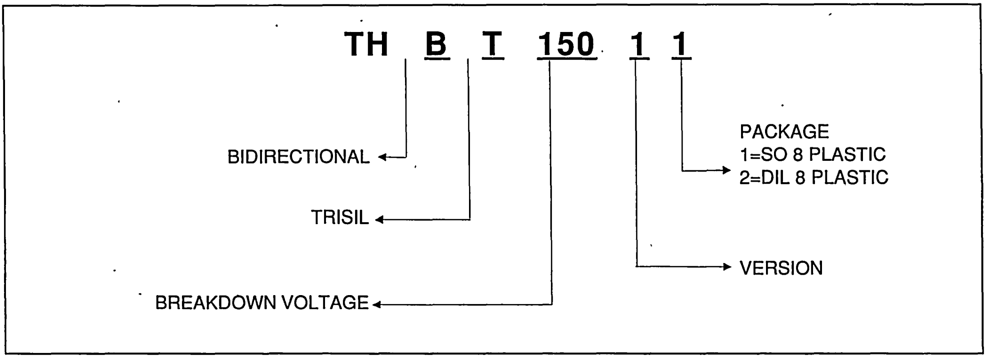
Line card protection



Ground key telephone set protection



ORDER CODE



MARKING

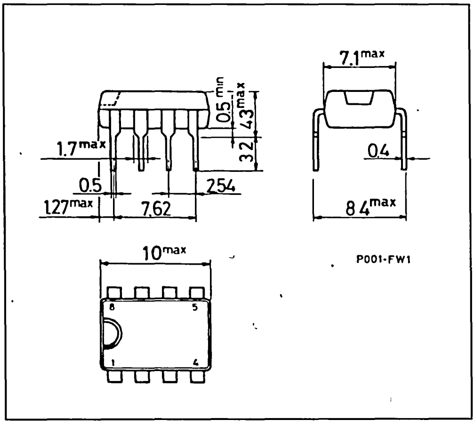
Package	Type	Marking
SO8	THBT15011 THBT20011 THBT27011	BT1511 BT2011 BT2711

Package	Type	Marking
DIL8	THBT15012 THBT20012 THBT27012	BT1512 BT2012 BT2712

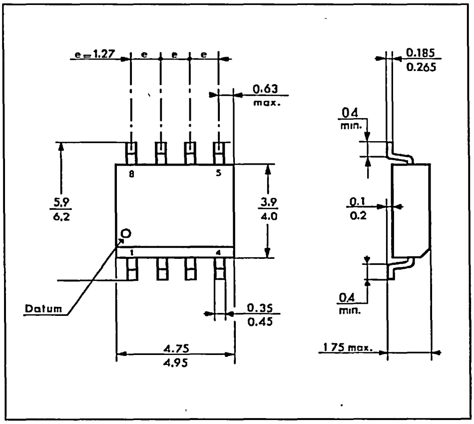
Packaging : Products supplied in antistatic tubes.

PACKAGE MECHANICAL DATA (in millimeters)

DIL 8 Plastic

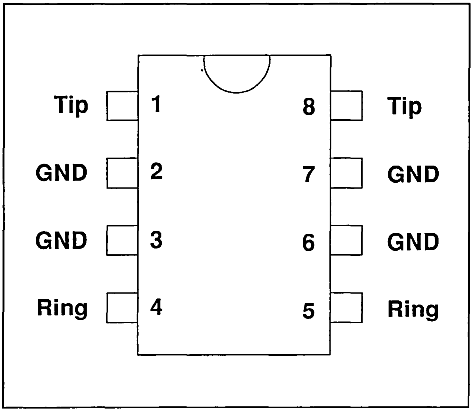


SO 8 Plastic

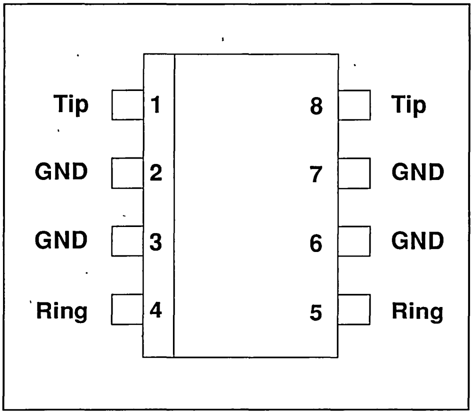


CONNECTION DIAGRAM

DIL 8 Plastic



SO 8 Plastic

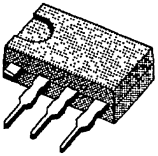


THBT200S

TRISIL FOR LINE CARD PROTECTION

FEATURES

- DUAL BIDIRECTIONAL CROWBAR PROTECTION.
- PEAK PULSE CURRENT :
  - I_{PP} = 75 A, 10/1000 µs.
- HOLDING CURRENT = 150 mA min
- BREAKDOWN VOLTAGE = 200 V min.
- BREAKOVER VOLTAGE = 290 V max.

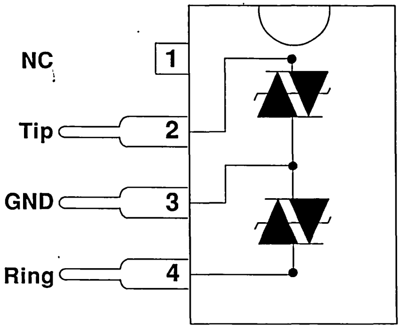


SIP 3
(Plastic)

DESCRIPTION

This protection device has been especially designed to protect subscriber line cards using SLICS without integrated ring generator. THBT200 device protects ring generator relays against transient overvoltages.

SCHEMATIC DIAGRAM

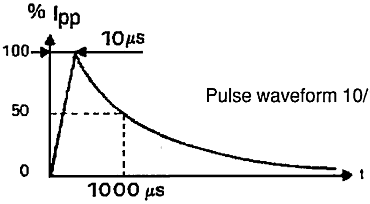


IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ + 85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	75 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C



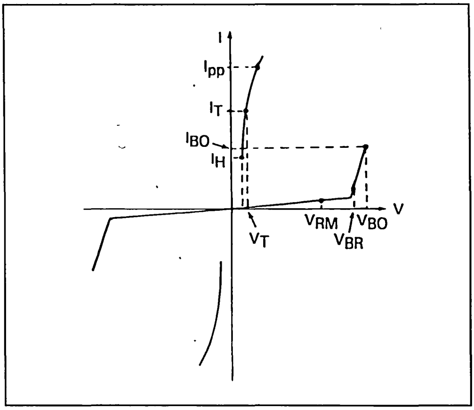
Pulse waveform 10/1000µs

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R_{th} (j-a)	Junction-to-ambient	70	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current



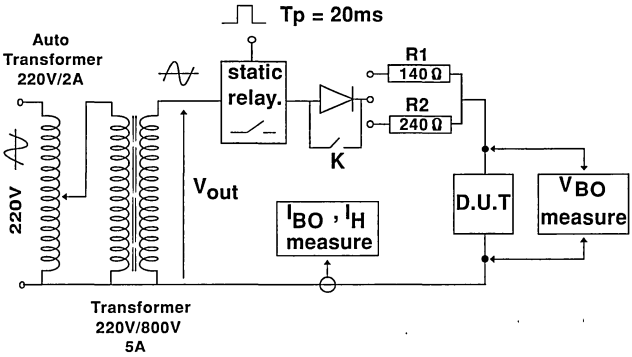
PARAMETERS RELATED TO ONE TRISIL.

Type	I_{RM} @ V_{RM}		VBR @ I_R		V_{BO} @ I_{BO}			I_H	V_T	C
	max		min		max	min	max	min	max	max
						note1		note1	note2	note3
	µA	V	V	mA	V	mA	mA	mA	V	pF
THBT200S	10	180	200	1	290	150	800	150	8	200

All parameters tested at 25°C, except where indicated

Note 1 : See test reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

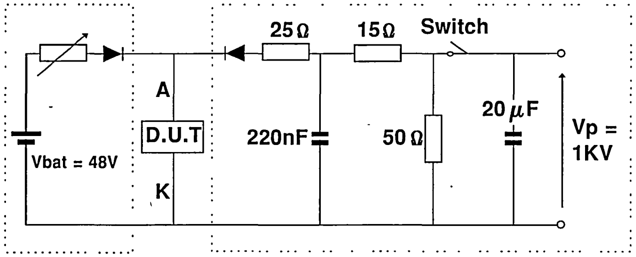
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Relative variation of holding current versus junction temperature.

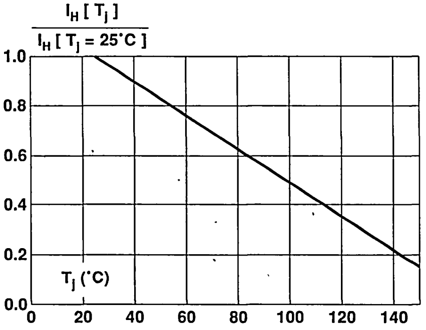


Figure 2 : Non repetitive surge peak on state current versus number of cycles (1 cycle = 20

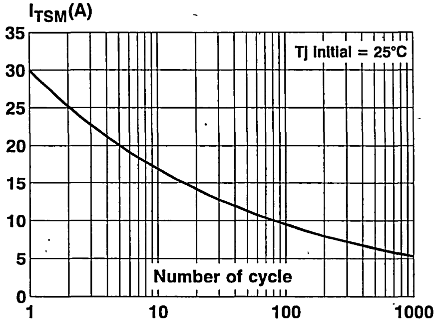


Figure 3 : Peak on state voltage versus peak on state current (typical values).

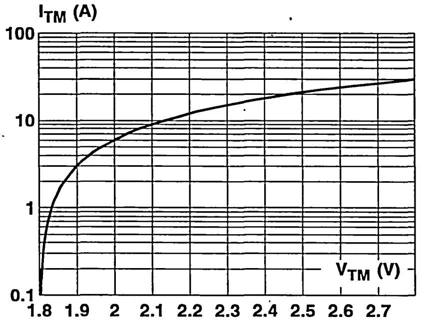
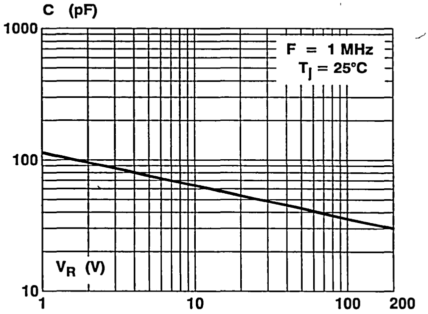
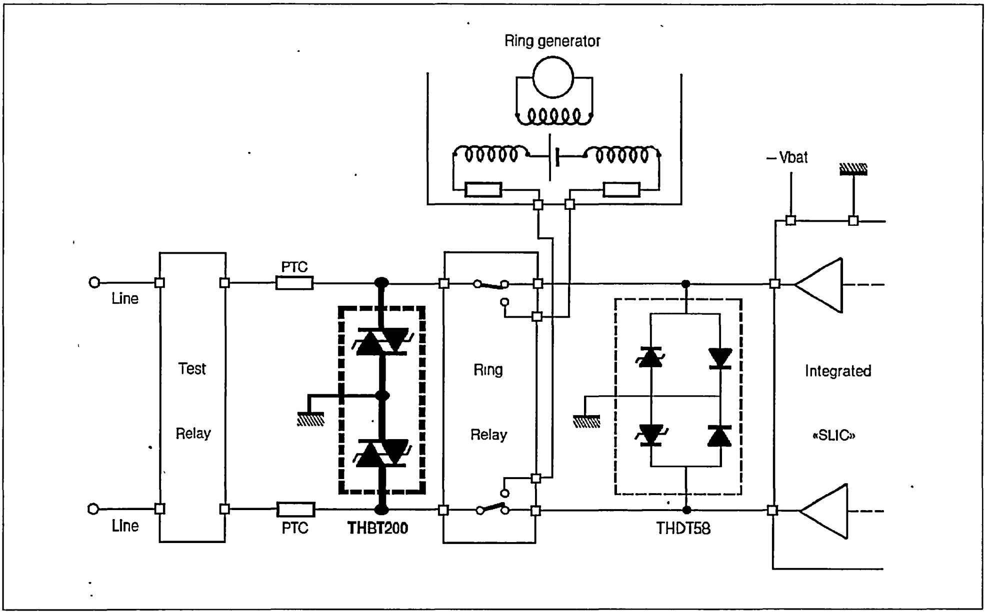


Figure 4 : Capacitance versus reverse applied voltage (typical values).

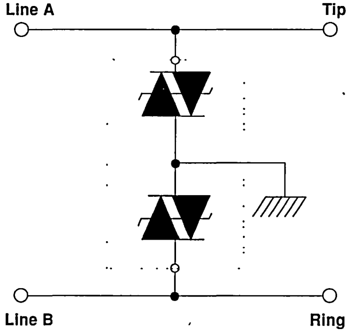


APPLICATION CIRCUIT

Typical line card protection concept



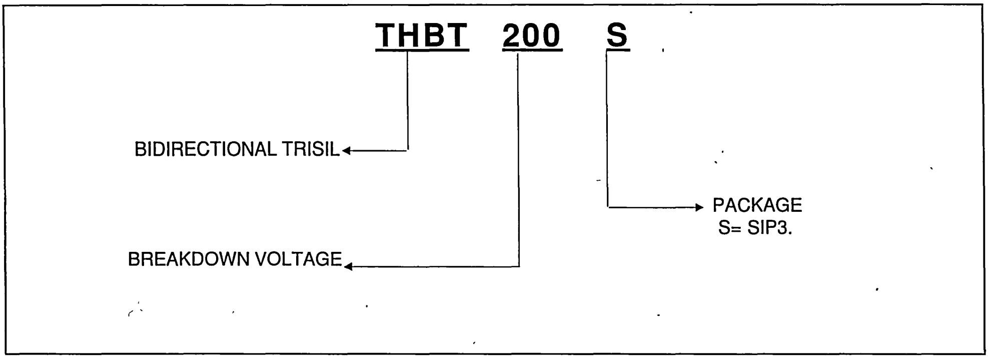
FUNCTIONAL DESCRIPTION



LINE A AND LINE B PROTECTION.

Each line (TIP and RING) is protected by a bidirectional Trisil, which triggers at a maximum voltage equal to the V_{BO}.

ORDER CODE

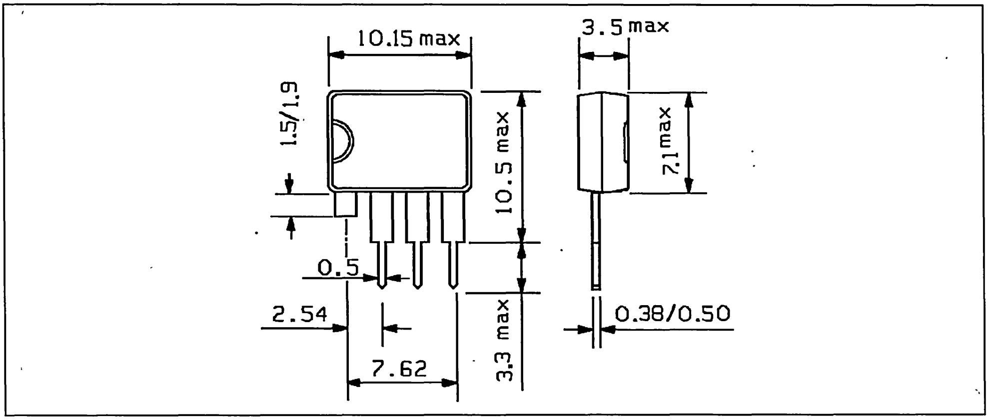


MARKING

Package	Type	Marking
SIP3	THBT200S	THBT200S

PACKAGE MECHANICAL DATA (in millimeters)

SIP 3 Plastic.



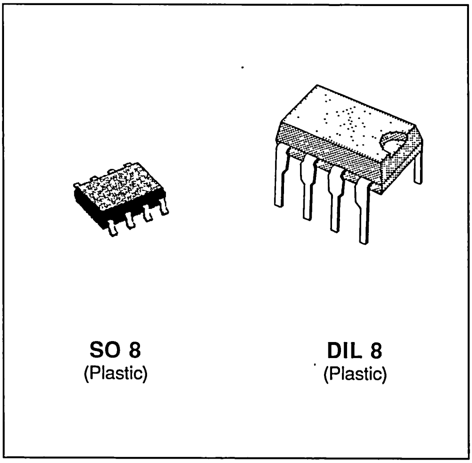
Packaging : Products supplied in antistatic tubes.

THDT51
THDT65

TRISIL FOR SLIC PROTECTION

FEATURES

- DUAL ASYMETRICAL TRANSIENT SUPPRESSOR
- PEAK PULSE CURRENT : I_{PP} = 30 A, 10/1000 µs.
- HOLDING CURRENT = 150 mA min
- BREAKDOWN VOLTAGE
  - THDT51 = 51 V
  - THDT65 = 65 V.
- LOW DYNAMIC CHARACTERISTICS
- AVAILABLE IN SO8 AND DIL8.



DESCRIPTION

These devices have been especially designed to protect subscriber line card interfaces (SLIC) against transient overvoltages.

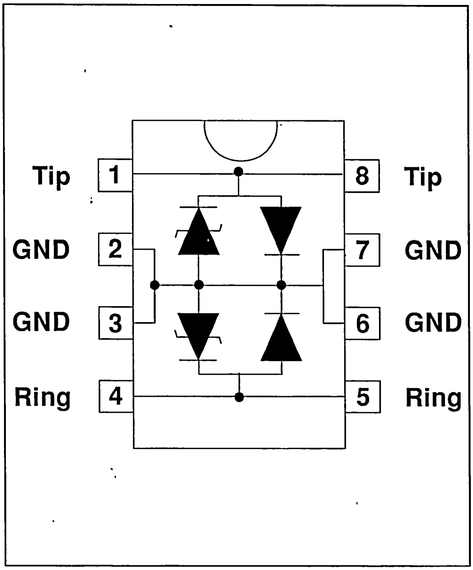
A particular attention has been given to the internal wire bonding . A 4-points configuration ensures a reliable protection, eliminating the overvoltage introduced by the parasitic inductances of the wiring (Ldi/dt) especially for very fast transients.

This new product generation, is providing very high surge current capability, in small packages like SO 8 and DIL 8. Dynamic characteristics have also been defined in order to meet SLIC max rating.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

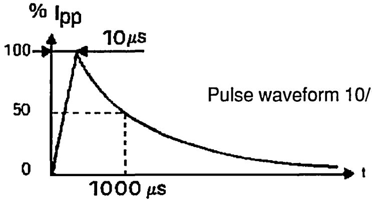
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) ($-40°C \leq T_{amb} \leq +85°C$)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 5/320 µs 2/10 µs	30 40 90	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 10 ms tp = 1 s	10 5	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 55 to + 150 + 150	°C °C



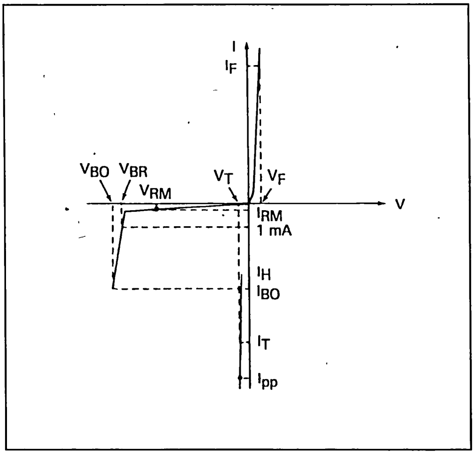
Pulse waveform 10/1000µs

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-a)	Junction-to-ambient	DIL 8 SO 8	125 170	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
V_F	Forward Voltage Drop
I_{BO}	Breakover current
I_{PP}	Peak pulse current



PARAMETERS RELATED TO DIODE LINE/GND

Symbol	Test conditions	Value	Unit
V_F	Square pulse, t_p = 500 μs, I_F = 3 A.	3	V
V_{FP}	I_{PP} = 30A, 10/1000μs	7	V

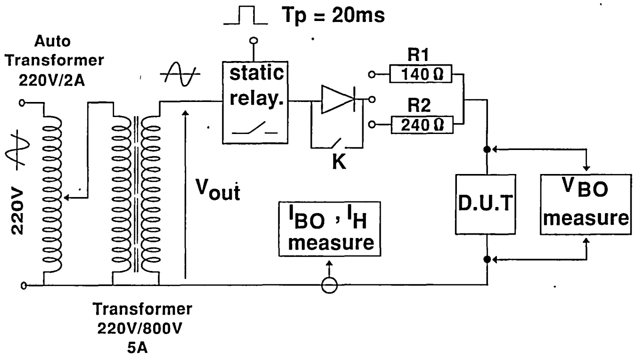
PARAMETERS RELATED TO PROTECTION THYRISTOR

Types	I_{RM} @	V_{RM}	V_{BR} @	I_R	V_{BO}	@	I_{BO}	I_H	V_T	C
	max		min		max	min	max	min	max	max
						note1		note1	note2	note3
	μA	V	V	mA	V	mA	mA	mA	V	pF
THDT51	10	50	51	1	70	50	500	150	4	200
THDT65	10	56	65	1	85	50	500	150	4	200

All parameters tested at 25°C, except where indicated

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 μs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

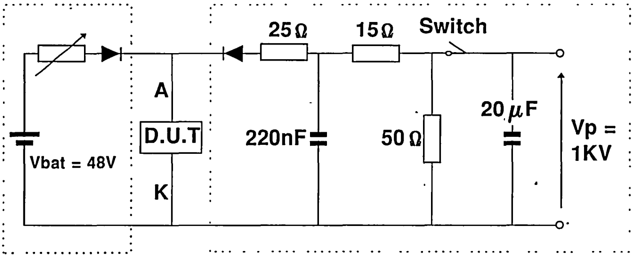
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250$ V_{RMS}, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480$ V_{RMS}, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



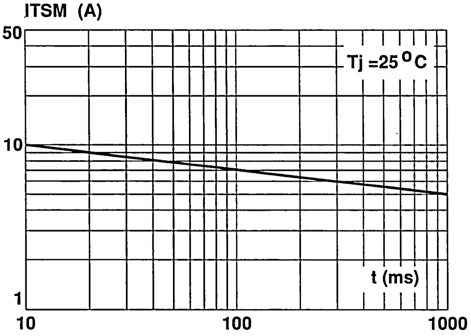
Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented

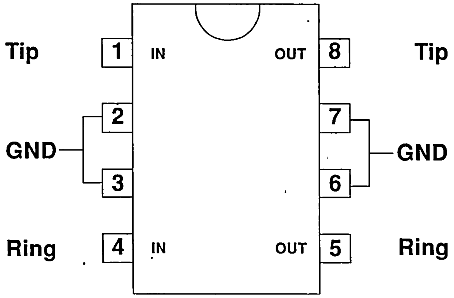
TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on-state current. (with sinusoidal pulse : F =50Hz)



APPLICATION NOTE.



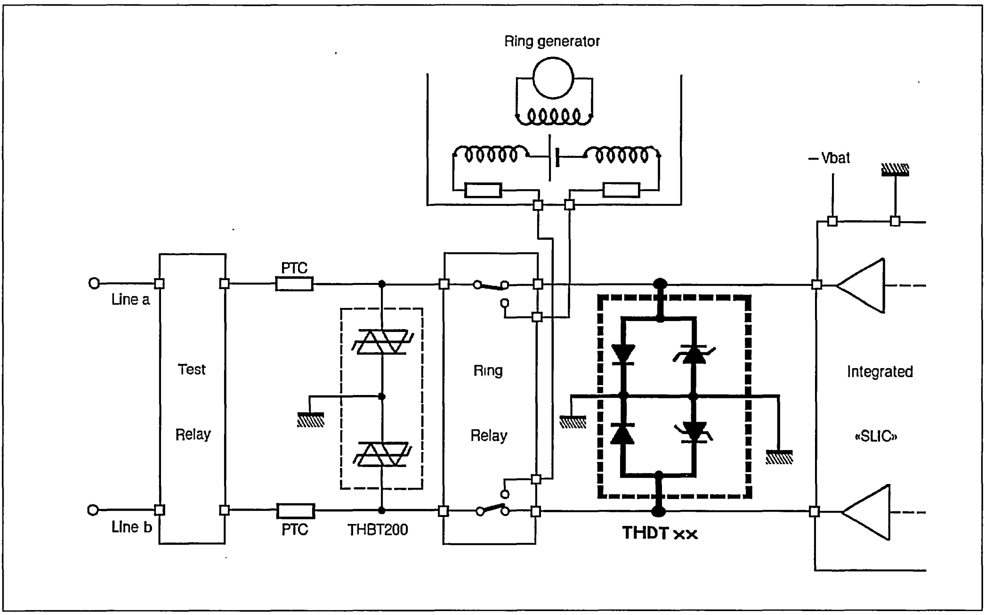
4- points structure lay-out.

1) Connect pins 2, 3, 6 and 7 to ground in order to guarantee a good surge current capability for long duration disturbances.

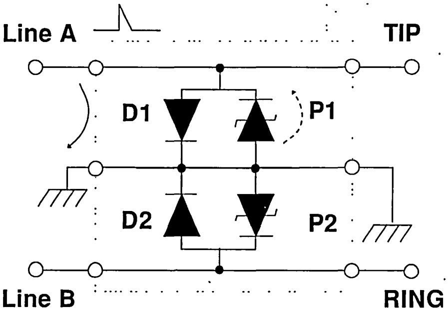
2) In order to take advantage of the "4-points structure" of the THDTxx, the tip and Ring lines have to cross through the device. in this case, the device will eliminate the overvoltages generated by the parasitic inductances of the wiring (Ldi/dt), especially for very fast Transients.

APPLICATION CIRCUIT

Typical slic protection concept



FUNCTIONAL DESCRIPTION



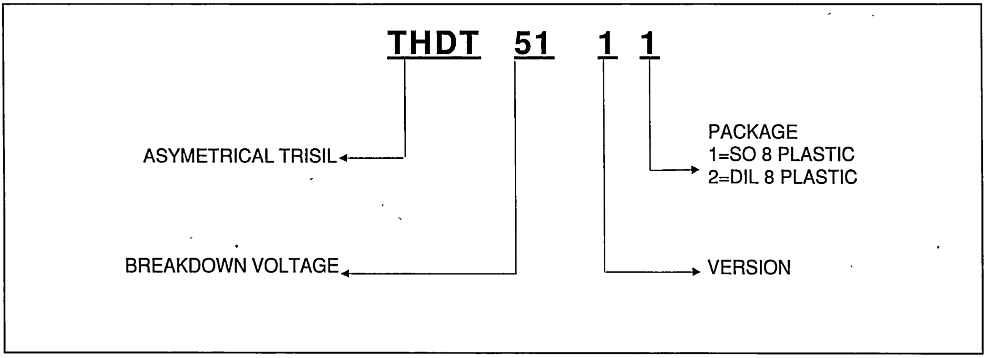
Line A Protection =

- For positive Surges versus GND, the diode D1 will conduct
- For negative Surges versus GND, the Protection device P1 will trigger at a maximum voltage equal to the V_{BO}.

Line B Protection =

- For Surges on line B, the operating mode is the same, D2 or P2 is activated.

ORDER CODE



MARKING

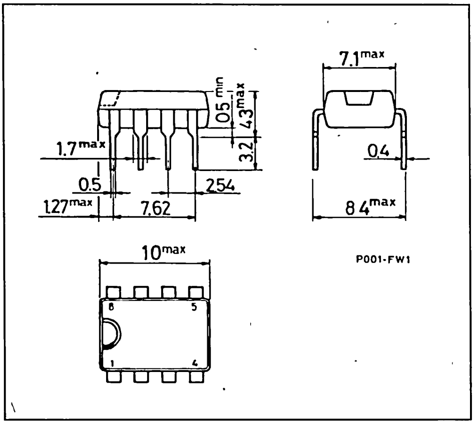
Package	Type	Marking
SO8	THDT5111	DT5111
	THDT6511	DT6511

Package	Type	Marking
DIL8	THDT5112	DT5112
	THDT6512	DT6512

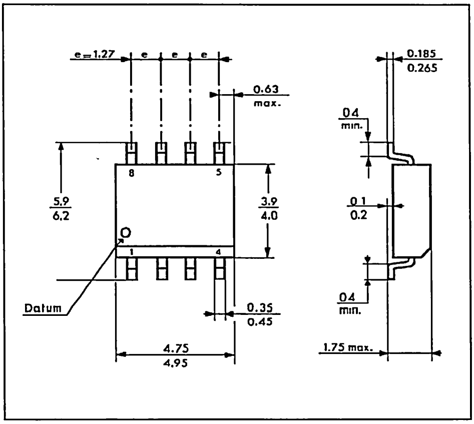
Packaging : Products supplied in antistatic tubes.

PACKAGE MECHANICAL DATA (in millimeters)

DIL 8 Plastic

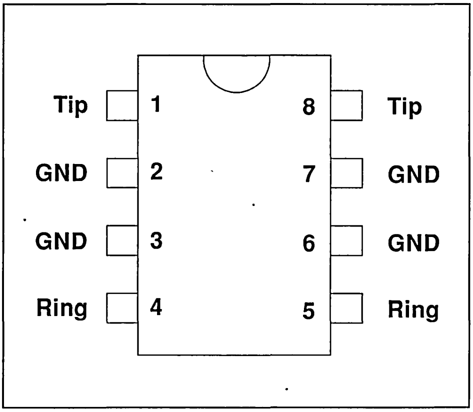


SO 8 Plastic

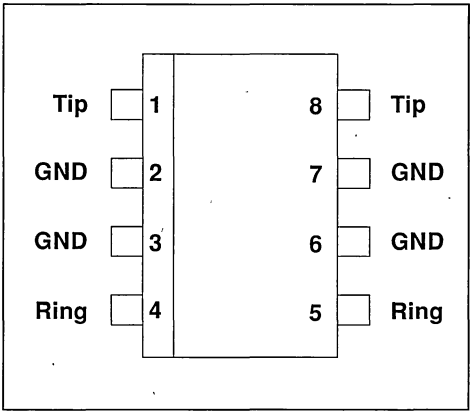


CONNECTION DIAGRAM

DIL 8 Plastic



SO 8 Plastic



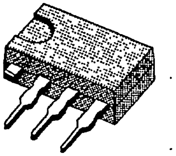
SGS-THOMSON
MICROELECTRONICS

THDT58S

TRISIL FOR SLIC PROTECTION

FEATURES

- CROWBAR PROTECTION
- DUAL ASYMETRICAL TRANSIENT SUPPRESSOR
- PEAK PULSE CURRENT :
  - I_{PP} = 75 A, 10/1000 µs.
- HOLDING CURRENT = 150 mA min
- BREAKDOWN VOLTAGE = 58 V.
- BREAKOVER VOLTAGE = 80V max.



SIP 3
(Plastic)

DESCRIPTION

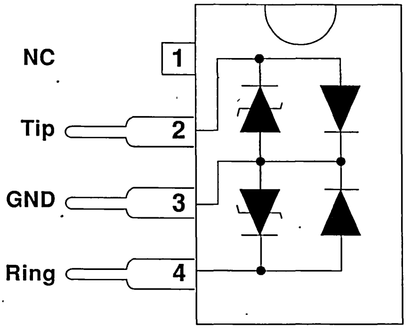
This device has been especially designed to protect subscriber line card interfaces (SLIC) against transient overvoltages.

Its ion-implanted technology confers excellent electrical characteristics on it.
This is why this device easily fits the main protection standards which are related to the overvoltages on telecom lines.
This product is compatible with TO202 and TO220 packages.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

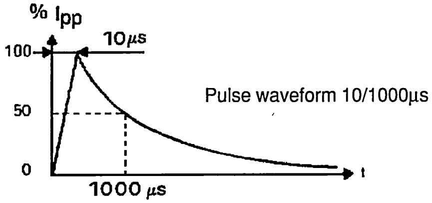
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) ($-40°C \leq T_{amb} \leq +85°C$)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	75 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
I_{FSM}	Non repetitive surge peak forward current	tp = 20 ms	30	A
di/dt	Critical rate of rise of off-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		260	°C

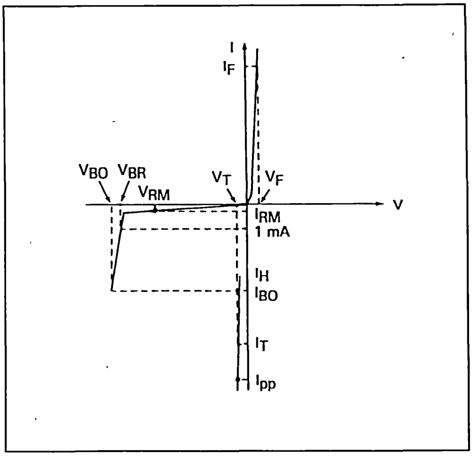


THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
R_{th} (j-a)	Junction-to-ambient	70	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
V_F	Forward Voltage Drop
I_{BO}	Breakover current
I_{PP}	Peak pulse current



PARAMETER RELATED TO THE DIODE LINE/GND

Symbol	Test conditions	Value	Unit
V_F	Square pulse, tp = 500 µs I_F = 5 A.	5	V

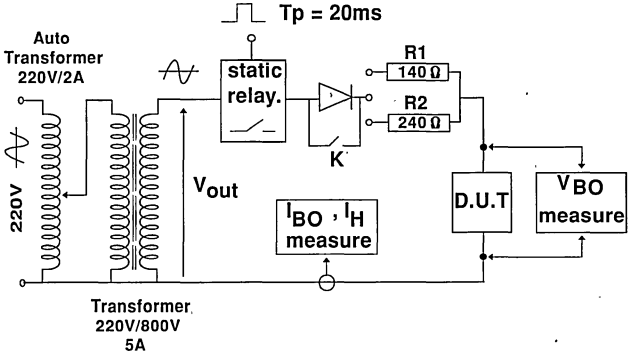
PARAMETERS RELATED TO THE PROTECTION THYRISTOR

Type	I_{RM} @	V_{RM}	V_{BR} @	I_R	V_{BO}	@	I_{BO}	I_H	V_T	C
	max		min		max	min	max	min	max	max
						note1		note1	note2	note3
	µA	V	V	mA	V	mA	mA	mA	V	pF
THDT58S	10	56	58	1	80	150	800	150	5	400

All parameters tested at 25°C, except where indicated

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

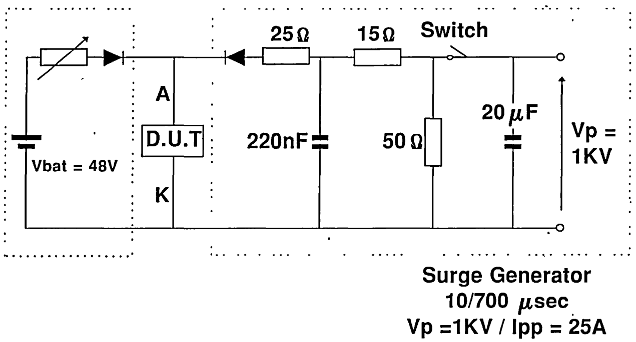
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State withing a duration of 50 ms max.

Figure 1 : Relative variation of holding current versus junction temperature.

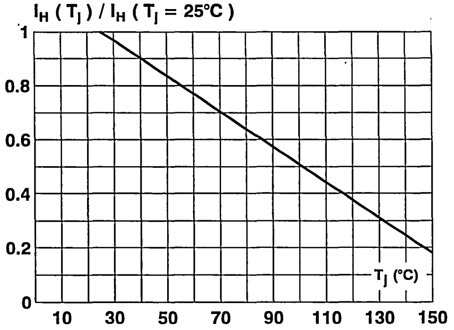


Figure 2 : Non repetitive surge peak on state current versus number of cycles (1 cycle = 20 ms.

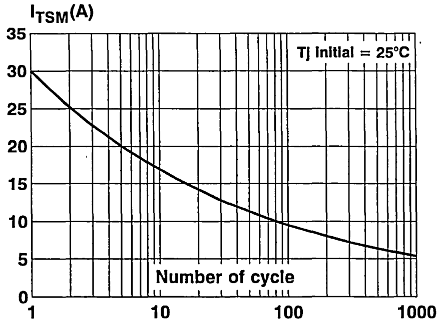


Figure 3 : Peak on state voltage versus peak on state current (typical values).

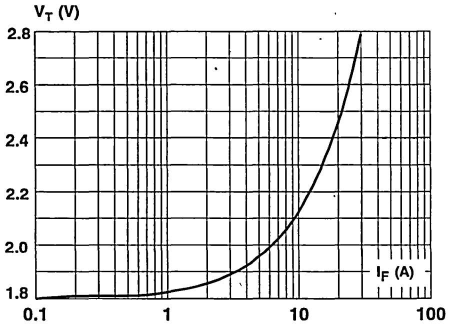


Figure 4 : Peak forward voltage drop versus peak forward current (typical values).

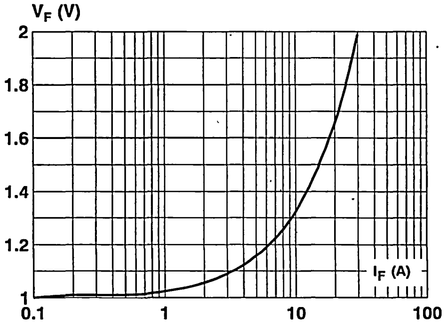
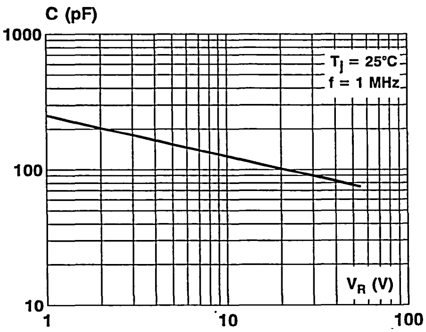
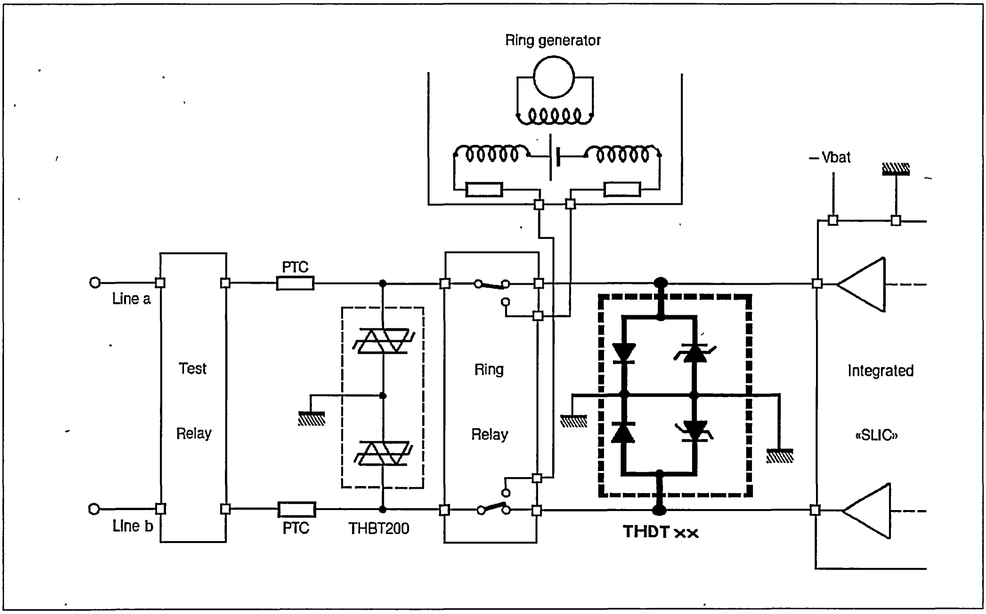


Figure 5 : Capacitance versus reverse applied voltage (typical values).

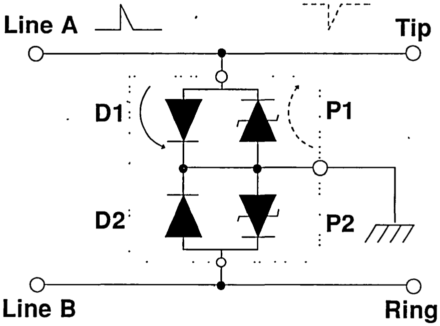


APPLICATION CIRCUIT

Typical slic protection concept



FUNCTIONAL DESCRIPTION



Line A Protection =

- For positive Surges versus GND, the diode D1 will conduct
- For negative Surges versus GND, the Protection device P1 will trigger at a maximum voltage equal to the V_{BO}.

Line B Protection =

- For Surges on line B, the operating mode is the same, D2 or P2 is activated.

ORDER CODE

THDT 58 S

THDT → ASYMETRICAL TRISIL

58 → BREAKDOWN VOLTAGE

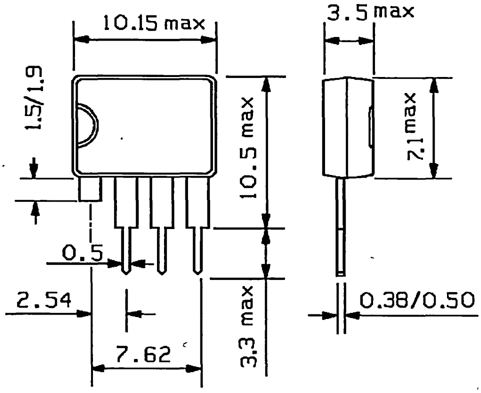
S → PACKAGE
S = SIP 3.

MARKING

Package	Type	Marking
SIP3	THDT58S	THDT58S

PACKAGE MECHANICAL DATA (in millimeters)

SIP 3 Plastic.



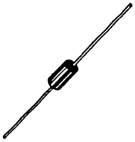
Packaging : Products supplied in antistatic tubes.

TPA SERIES

TRISIL

FEATURES

- BIDIRECTIONAL CROWBAR PROTECTION.
- BREAKDOWN VOLTAGE RANGE:
  From 62 V To 270 V.
- HOLDING CURRENT = I_H
  Suffix 12 = 120mA min.
  Suffix 18 = 180mA min.
- PEAK PULSE CURRENT :
  I_{PP} = 50 A, 10/1000 µs.

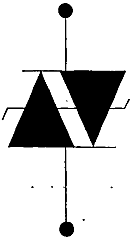


F 126
(Plastic)

DESCRIPTION

The TPAxx series has been designed to protect telecommunication equipments against lightning and transient induced by AC power lines.

SCHEMATIC DIAGRAM



IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

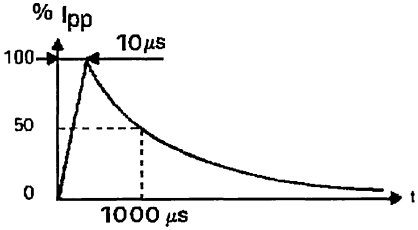
ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ + 85°C)

Symbol	Parameter		Value	Unit
P	Power dissipation on infinite heatsink	T_{amb} = 50 °C	1.7	W
I_{PP}	Peak pulse current See note1	10/1000 µs 8/20 µs	50 100	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

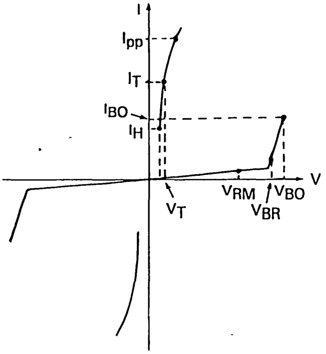
Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction to leads on infinite heatsink.	60	°C/W
R_{th} (j-a)	Junction to ambient. on printed circuit. Llead = 10 mm	100	°C/W

Note 1: 10/1000 µs wave form.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current



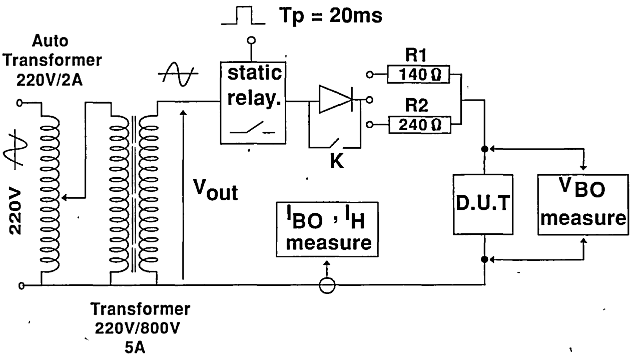
ELECTRICAL CHARACTERISTICS

Type	I_{RM} @	V_{RM}	V_{BR} @	I_R	V_{BO} @	I_{BO}	V_T	C	I_H
	max		min		max note2	max	max note3	max note4	min note2
	µA	V	V	mA	V	mA	V	pF	mA
P TPA62A - 12 or 18	2	56	62	1	82	300	2	150	
TPA62B - 12 or 18	2	56	62	1	75	300	2	150	
P TPA68A - 12 or 18	2	61	68	1	90	300	2	150	
TPA68B - 12 or 18	2	61	68	1	82	300	2	150	
(1) TPA75A - 12 or 18	2	67	75	1	100	300	2	150	
(1) TPA75B - 12 or 18	2	67	75	1	91	300	2	150	
(1) TPA82A - 12 or 18	2	74	82	1	109	300	2	150	
(1) TPA82B - 12 or 18	2	74	82	1	99	300	2	150	Suffix 12 for 120 mA.
(1) TPA91A - 12 or 18	2	82	91	1	121	300	2	150	
(1) TPA91B - 12 or 18	2	82	91	1	110	300	2	150	
P TPA100A - 12 or 18	2	90	100	1	133	300	2	100	
TPA100B - 12 or 18	2	90	100	1	121	300	2	100	
P TPA110A - 12 or 18	2	99	110	1	147	300	2	100	
TPA110B - 12 or 18	2	99	110	1	133	300	2	100	
P TPA120A - 12 or 18	2	108	120	1	160	300	2	100	Suffix 18 for 180 mA.
TPA120B - 12 or 18	2	108	120	1	145	300	2	100	
P TPA130A - 12 or 18	2	117	130	1	173	300	2	100	
TPA130B - 12 or 18	2	117	130	1	157	300	2	100	
(1) TPA150A - 12 or 18	2	135	150	1	200	300	4	75	
(1) TPA150B - 12 or 18	2	135	150	1	181	300	4	75	
(1) TPA160A - 12 or 18	2	144	160	1	213	300	4	75	
(1) TPA160B - 12 or 18	2	144	160	1	193	300	4	75	
P TPA180A - 12 or 18	2	162	180	1	240	300	4	75	
TPA180B - 12 or 18	2	162	180	1	217	300	4	75	
P TPA200A - 12 or 18	2	180	200	1	267	300	4	75	
TPA200B - 12 or 18	2	180	200	1	241	300	4	75	
P TPA220A - 12 or 18	2	198	220	1	293	300	4	75	
TPA220B - 12 or 18	2	198	220	1	265	300	4	75	
P TPA240A - 12 or 18	2	216	240	1	320	300	4	75	
TPA240B - 12 or 18	2	216	240	1	289	300	4	75	
P TPA270A - 12 or 18	2	243	270	1	360	300	4	75	
TPA270B - 12 or 18	2	243	270	1	325	300	4	75	

All parameters tested at 25°C, except where indicated.

P :	Preferred device.
(1):	These voltages are on request.
Note 2 :	See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 3 :	Square pulse Tp = 1 ms - I_T = 3A.
Note 4 :	V_R = 1V, F = 1MHz.

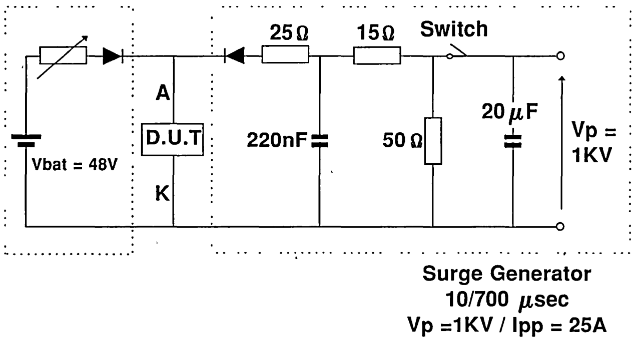
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 μs.
3) The D.U.T will come back to the OFF-State withing a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on state current versus number of cycles. (with sinusoidal

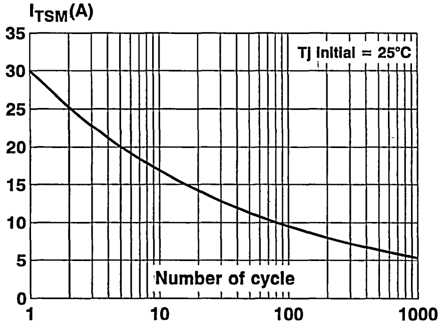
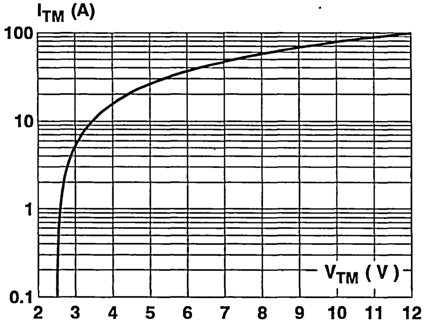
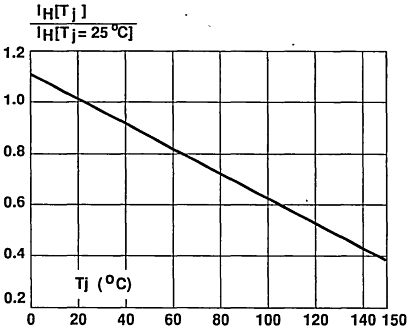


Figure 2 : On - state characteristics (typical values).

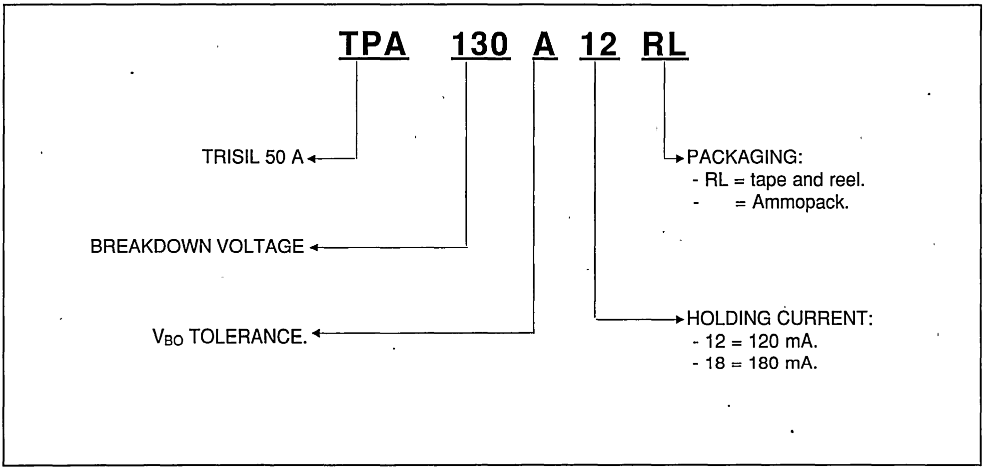


Note : For device with V_{BR} > 150 Volt
The V_T value is twice that shown.

Figure 3 : Relative variation of holding current versus junction temperature.



ORDER CODE



TPA 130 A 12 RL

TRISIL 50 A

BREAKDOWN VOLTAGE

V_{BO} TOLERANCE.

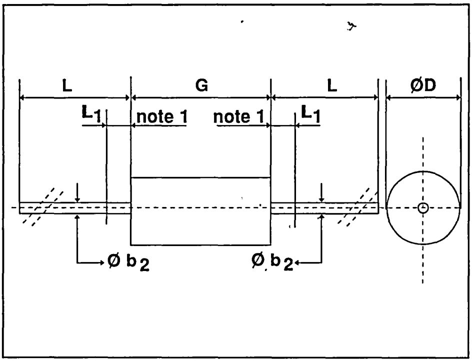
PACKAGING:
- RL = tape and reel.
-   = Ammopack.

HOLDING CURRENT:
- 12 = 120 mA.
- 18 = 180 mA.

MARKING : Logo, Date Code, Part Number.

PACKAGE MECHANICAL DATA.

F 126 Plastic.



Ref	Millimeters		Inches	
	min	max	min	max
Ø b_2	0.76	0.86	0.03	0.034
Ø D	-	3.05	-	0.12
G	-	6.35	-	0.25
L	26	-	1.02	-
L_1	-	1.27	-	0.05

note 1:The diameter Ø b_2 is not controlled over zone L_1.

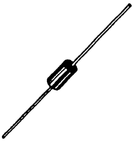
Packaging : Standard packaging is in tape and reel.

TPB SERIES

TRISIL

FEATURES

- BIDIRECTIONAL CROWBAR PROTECTION.
- BREAKDOWN VOLTAGE RANGE:
  From 62 V To 270 V.
- HOLDING CURRENT = I_H
  Suffix 12 = 120mA min.
  Suffix 18 = 180mA min.
- PEAK PULSE CURRENT :
  I_{PP} = 90 A, 10/1000 µs.

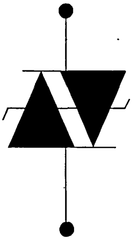


CB 429
(Plastic)

DESCRIPTION

The TPBxx series has been designed to protect telecommunication equipments against lightning and transient induced by AC power lines.

SCHEMATIC DIAGRAM



IN ACCORDANCE WITH FOLLOWING STANDARDS :

CCITT K17 - K20	10/700 µs 5/310 µs	1.5 kV 38 A
VDE 0433	10/700 µs 5/200 µs	2 kV 50 A
CNET	0.5/700 µs 0.2/310 µs	1.5 kV 38 A

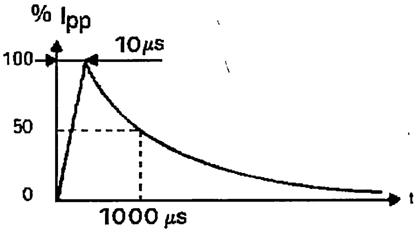
ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ + 85°C)

Symbol	Parameter		Value	Unit
P	Power dissipation on infinite heatsink	T_{amb} = 50 °C	5	W
I_{PP}	Peak pulse current See note1	10/1000 µs 8/20 µs	90 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	50	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C
T_L	Maximum lead temperature for soldering during 10 s.		230	°C

THERMAL RESISTANCES

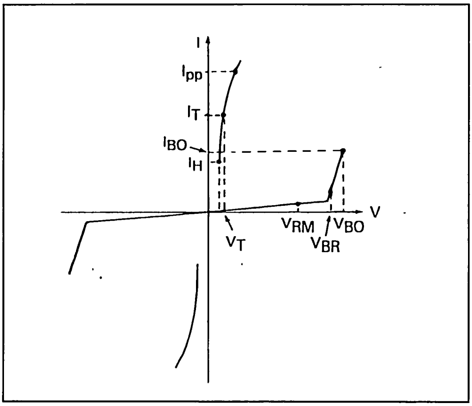
Symbol	Parameter	Value	Unit
R_{th} (j-l)	Junction to leads. On infinite heatsink.	20	°C/W
R_{th} (j-a)	Junction to ambient. On printed circuit. L_{lead} = 10 mm	75	°C/W

Note 1: 10/1000 µs wave form.



ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current



ELECTRICAL CHARACTERISTICS

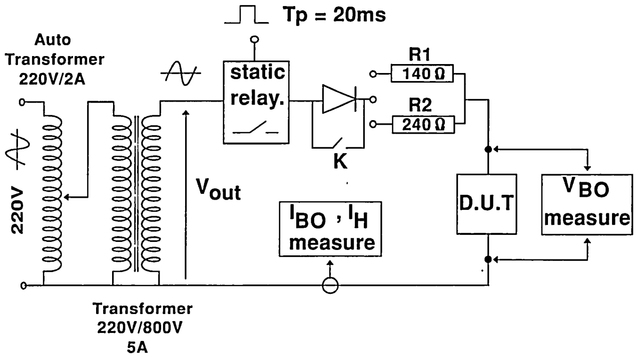
Type	I_{RM} @ V_{RM}		V_{BR} @ I_R		V_{BO} @ I_{BO}		V_T	C	I_H
	max		min		max note2	max	max note3	max note4	min note2
	µA	V	V	mA	V	mA	V	pF	mA
P TPB62A - 12 or 18	2	56	62	1	82	300	3.5	300	
TPB62B - 12 or 18	2	56	62	1	75	300	3.5	300	
P TPB68A - 12 or 18	2	61	68	1	90	300	3.5	300	
TPB68B - 12 or 18	2	61	68	1	82	300	3.5	300	
(1) TPB75A - 12 or 18	2	67	75	1	100	300	3.5	300	
(1) TPB75B - 12 or 18	2	67	75	1	91	300	3.5	300	
(1) TPB82A - 12 or 18	2	74	82	1	109	300	3.5	300	
(1) TPB82B - 12 or 18	2	74	82	1	99	300	3.5	300	Suffix 12 for 120 mA.
(1) TPB91A - 12 or 18	2	82	91	1	121	300	3.5	300	
(1) TPB91B - 12 or 18	2	82	91	1	110	300	3.5	300	
P TPB100A - 12 or 18	2	90	100	1	133	300	3.5	200	
TPB100B - 12 or 18	2	90	100	1	121	300	3.5	200	
P TPB110A - 12 or 18	2	99	110	1	147	300	3.5	200	
TPB110B - 12 or 18	2	99	110	1	133	300	3.5	200	
P TPB120A - 12 or 18	2	108	120	1	160	300	3.5	200	Suffix 18 for 180 mA.
TPB120B - 12 or 18	2	108	120	1	145	300	3.5	200	
P TPB130A - 12 or 18	2	117	130	1	173	300	3.5	200	
TPB130B - 12 or 18	2	117	130	1	157	300	3.5	200	
(1) TPB150A - 12 or 18	2	135	150	1	200	300	7	150	
(1) TPB150B - 12 or 18	2	135	150	1	181	300	7	150	
(1) TPB160A - 12 or 18	2	144	160	1	213	300	7	150	
(1) TPB160B - 12 or 18	2	144	160	1	193	300	7	150	
P TPB180A - 12 or 18	2	162	180	1	240	300	7	150	
TPB180B - 12 or 18	2	162	180	1	217	300	7	150	
P TPB200A - 12 or 18	2	180	200	1	267	300	7	150	
TPB200B - 12 or 18	2	180	200	1	241	300	7	150	
P TPB220A - 12 or 18	2	198	220	1	293	300	7	150	
TPB220B - 12 or 18	2	198	220	1	265	300	7	150	
P TPB240A - 12 or 18	2	216	240	1	320	300	7	150	
TPB240B - 12 or 18	2	216	240	1	289	300	7	150	
P TPB270A - 12 or 18	2	243	270	1	360	300	7	150	
TPB270B - 12 or 18	2	243	270	1	325	300	7	150	

All parameters tested at 25°C, except where indicated.

P : Preferred device.
(1): These voltages are on request.

Note 2 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 3 : Square pulse Tp = 1 ms - I_T = 5A.
Note 4 : V_R = 1V, F = 1MHz.

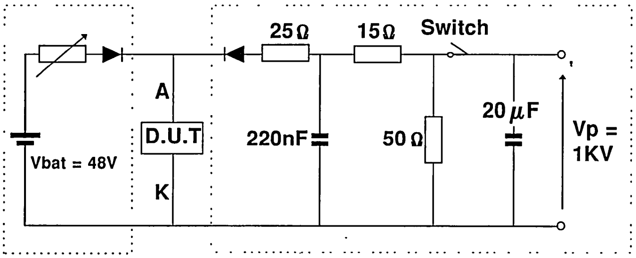
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State withing a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on state current versus number of cycles. (with sinusoïdal

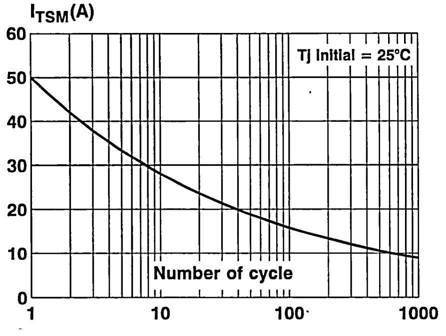
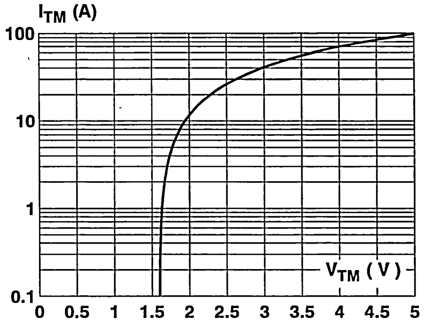
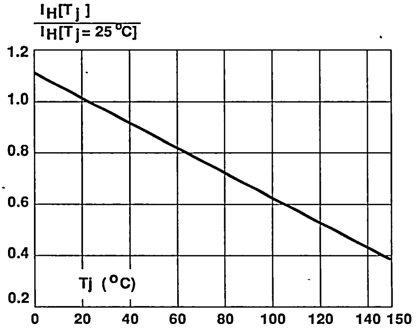


Figure 2 : On - state characteristics (typical values).



Note : For devices with V_{BR} > 150 V
The V_T value is twice that shown.

Figure 3 : Relative variation of holding current versus junction temperature.



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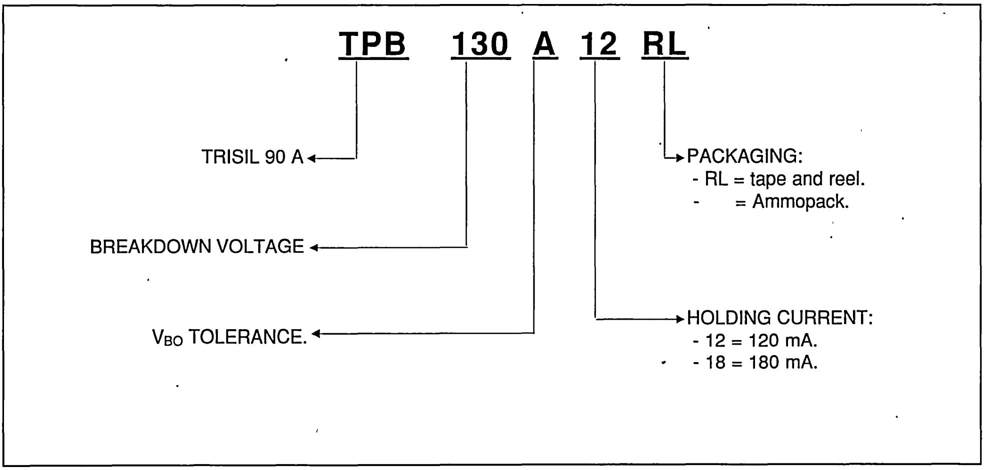


TPB 130 A 12 RL

TRISIL 90 A

BREAKDOWN VOLTAGE

V_{BO} TOLERANCE.

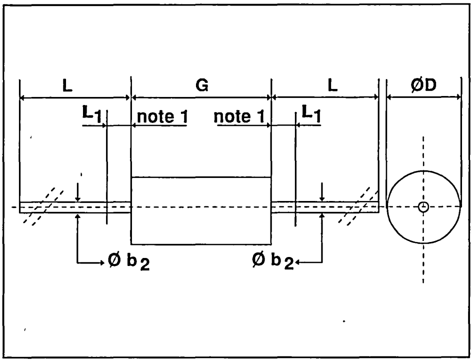
PACKAGING:
- RL = tape and reel.
- = Ammopack.

HOLDING CURRENT:
- 12 = 120 mA.
- 18 = 180 mA.

MARKING : Logo, Date Code, Part Number.

PACKAGE MECHANICAL DATA.

CB 429 Plastic.



Ref	Millimeters		Inches	
	min	max	min	max
Ø b2	-	1.06	-	0.042
Ø D	-	5.1	-	0.20
G	-	9.8	-	0.386
L	26	-	1.024	-
L_1	-	1.27	-	0.050

note 1:The diameter Ø b_2 is not controlled over zone L_1.

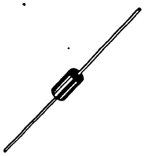
Packaging .: Standard packaging is in tape and reel.

TPB200S
TPB245S/TPB265S

SURGE ARRESTORS

FEATURES

- SOLID STATE SURGE ARRESTOR PACKAGED IN AXIAL DIODE.
- VOLTAGE RANGE = 200 V TO 265 V
- TIGHT VOLTAGE TOLERANCE
- FAST RESPONSE TIME
- VERY LOW AND STABLE LEAKAGE CURRENT
- REPETITIVE SURGE CAPABILITY I_{PP} = 100 A, 10/1000 µs.
- FAIL-SAFE WHEN DESTROYED



CB429
Plastic

DESCRIPTION

Bidirectional device used for primary protection in telecom equipments.
Providing long service life, and adapted for sensitive electronic equipments protection.
If destroyed the component will continue to guarantee a protection with a permanent short circuit, meaning "fail save criteria" . This particular behaviour will also allow an easy failure detection on the line.

ABSOLUTE RATINGS (limiting values) - 40°C < T_{amb} < +80°C

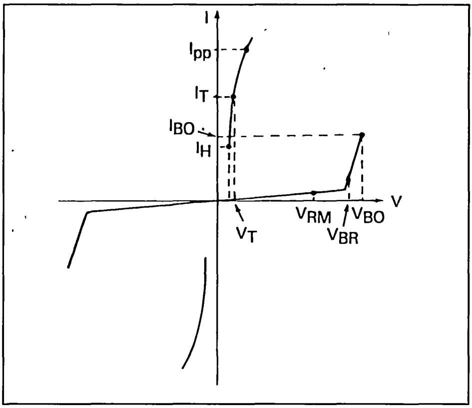
Symbol	Parameter		Value	Unit
I_{PP}	Peak Pulse Current.	10/1000 µs	100	A
		8/20 µs	200	A
	Fail Save Criteria.	8/20 µs	10	kA
I_{TSM}	Non Repetitive Surge Peak on-state Current. One cycle.	60 Hz	30	A
		50Hz	25	A
	Non Repetitive Surge Peak on-state Current F = 50 Hz.	1s	14	A
		2s	10	A
dv/dt	Critical Rate of Rise of on-state Voltage.	67% V_{BR}	10	kV/µs
T_L	Maximum Lead Temperature to Soldering During 10 s.		250	°C

THERMAL RESISTANCE

Symbol	Parameter	Value	Unit
RTH (j-a)	Junction-leads Thermal Resistance	20	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
VRM	Stand-off voltage
VBR	Breakdown voltage
VBO	Breakover voltage
IH	Holding current
VT	On-state voltage
IBO	Breakover current
IPP	Peak pulse current

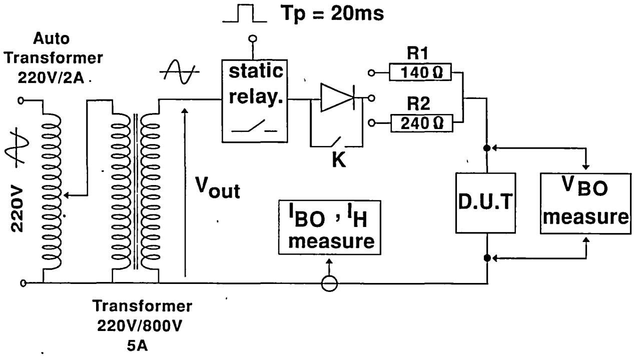


Types	I_R @	V_{RM}	VBR @	I_R	V_{BO} @	I_{BO}	I_H	V_T	C
	max		min		max	max	min	max	max
					note1		note1	note2	note3
	µA	V	V	mA	V	mA	mA	V	pF
TPB200S	10	170	200	1	265	600	260	3.5	200
TPB245S	10	210	245	1	350	600	260	3.5	200
TPB265S	10	225	265	1	400	600	260	3.5	200

All parameters tested at 25°C, except where indicated

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

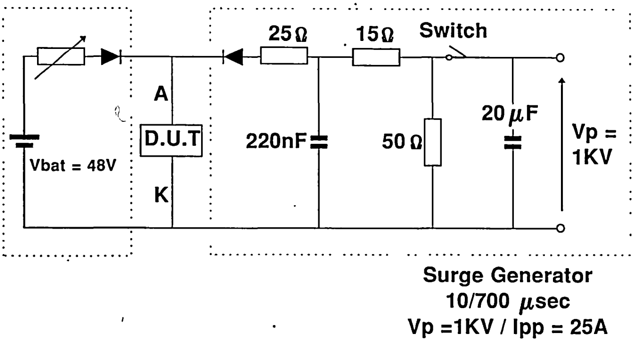
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250 \cdot V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT GO - NOGO TEST.

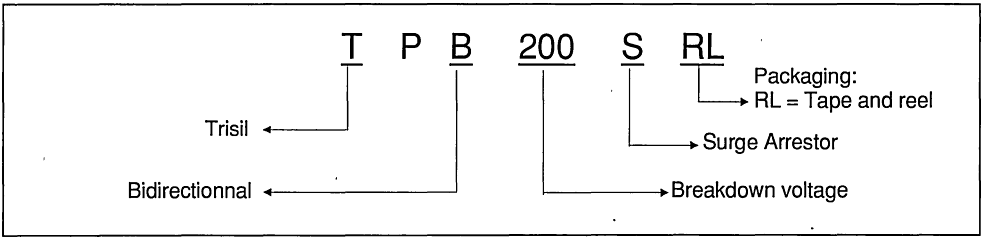


This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

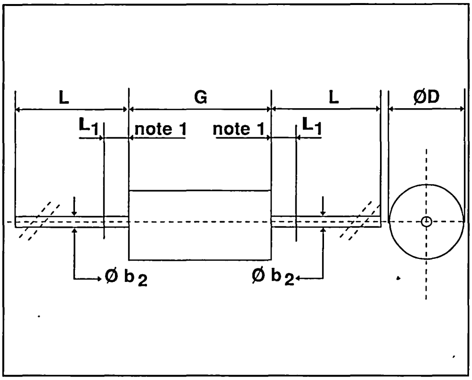
ORDER CODE



MARKING

Type	Marking
TPB200S TPB245S TPB265S	TPB200S TPB245S TPB265S

PACKAGE MECHANICAL DATA



Packaging : Products are supplied in tape and reel.

Ref	Millimeters		Inches	
	min	max	min	max
Ø b2	-	1.06	-	0.042
Ø D	-	5.1	-	0.20
G	-	9.8	-	0.386
L	26	-	1.024	-
L1	-	1.27	-	0.050

note 1:The diameter Ø b2 is not controllec over zone L1.

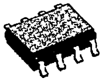
SGS-THOMSON
MICROELECTRONICS

TPI80xxP/TPI120xxP

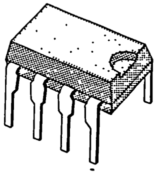
TRIBALANCED PROTECTION FOR ISDN INTERFACES

FEATURES

- BIDIRECTIONAL TRIPOLE PROTECTION.
- CROWBAR PROTECTION.
- PEAK PULSE CURRENT :
  I_{PP} = 30 A , 10/1000 µs.
- BREAKDOWN VOLTAGE:
  TPI80 = 80V
  TPI120 = 120V.
- AVAILABLE IN DIL8 AND SO8 PACKAGES.



SO 8
(Plastic)



DIL 8
(Plastic)

DESCRIPTION: TRIBALANCED PROTECTION

Dedicated devices for ISDN interface and high speed data telecom lines protection.

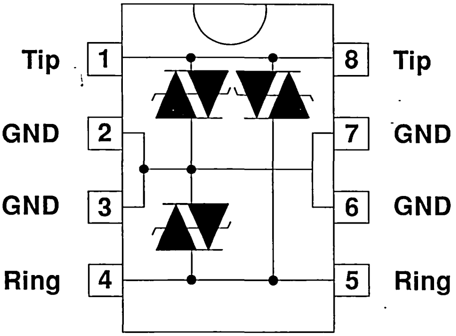
It's a tripole TRISIL with low capacitance providing:

- Low capacitances from lines to ground : allowing high speed transmission without signal attenuation.
- Good capacitance balance (Line A/Line B) in order to insure the longitudinal balance of the line.
- Fixed breakdown voltage in both common and differential modes.
- The same surge current capability in both common and differential modes.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

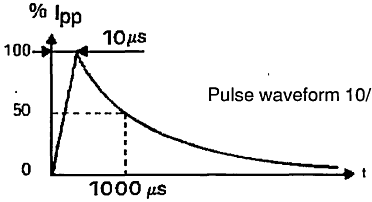
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (-40°C ≤ T_{amb} ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 5/320 µs 2/10 µs	30 40 90	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 10 ms tp = 1 s	5 3.5	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C



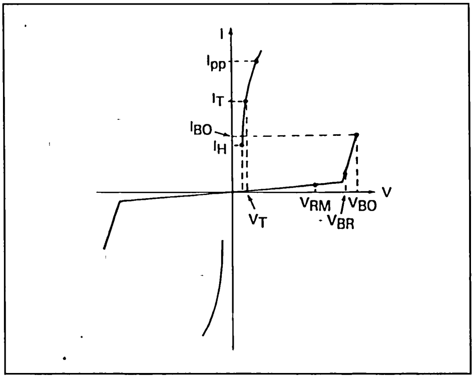
Pulse waveform 10/1000µs

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-a)	Junction-to-ambient	DIL 8 SO 8	125 171	°C/W °C/W

ELECTRICAL CHARACTERISTICS

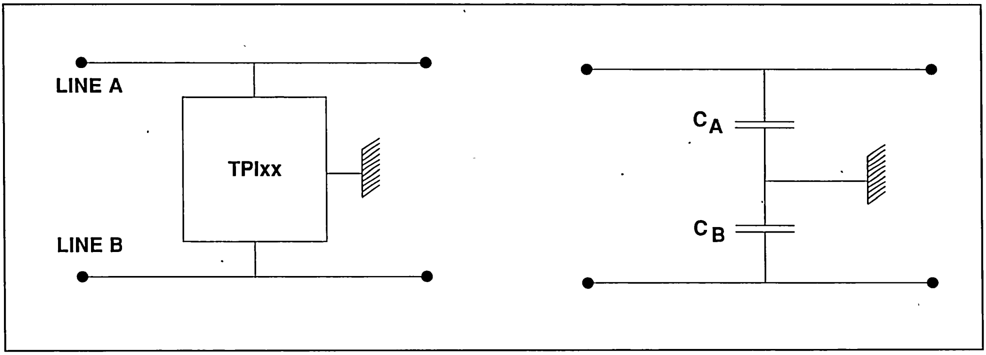
Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
I_{BO}	Breakover current
I_{PP}	Peak pulse current



Types	I_R @ V_{RM} max		V_{BR} @ I_R min		V_{BO} max note1	IBO max note1	IH min note1	VT max note2
	µA	V	V	mA	V	mA	mA	V
TPI80xxP	10	70	80	1	120	800	150	8
TPI120xxP	10	105	120	1	180	800	150	8

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A..

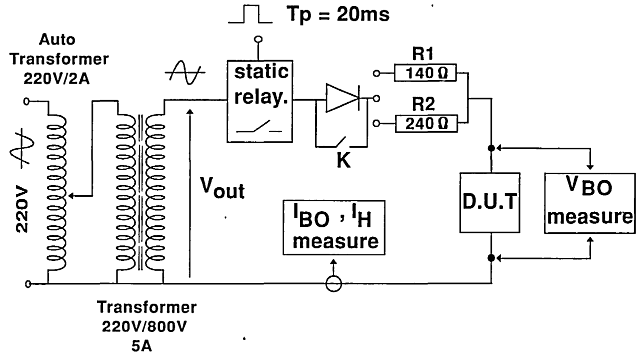
CAPACITANCES CHARACTERISTICS



CONFIGURATION	C_A (pf) max	C_B (pf) max	C_A - C_B (pf) max
V_A =1V V_B =56V	70	50	30
V_A = 56V V_B= 1V	50	70	30

All parameters tested at 25°C, except where indicated

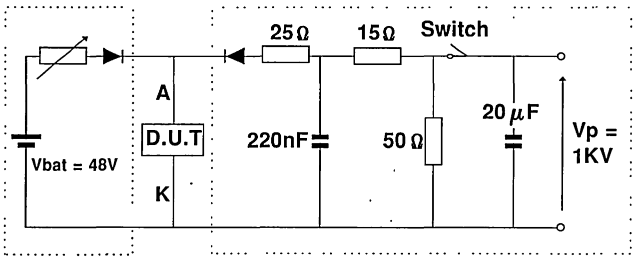
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



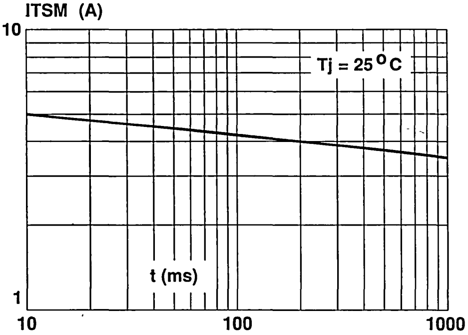
Surge Generator
10/700 µsec
Vp =1KV / Ipp = 25A

This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

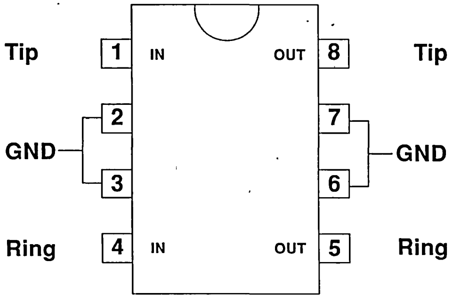
TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

Figure 1 : Non repetitive surge peak on-state current. (with sinusoidal pulse : F =50Hz)



APPLICATION NOTE.



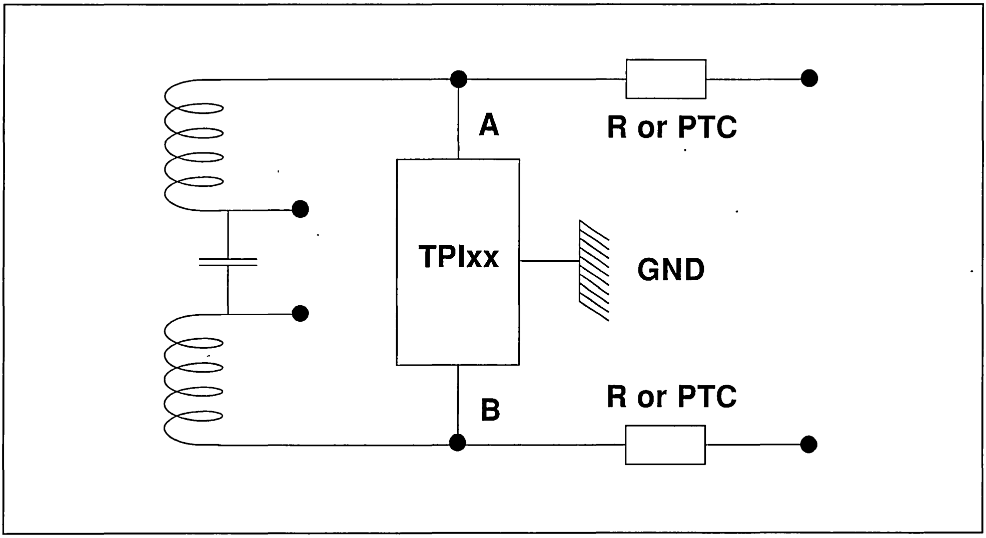
4- points structure lay-out.

1) Connect pins 2, 3, 6 and 7 to ground in order to guarantee a good surge current capability for long duration disturbances.

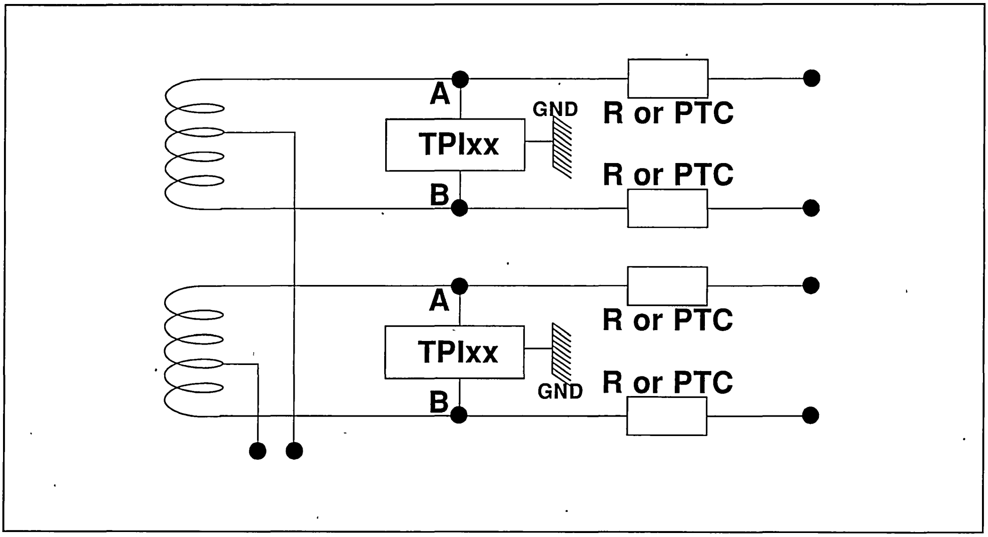
2) In order to take advantage of the "4-points structure" of the TPIxxxP, the tip and Ring lines have to cross through the device. in this case, the device will eliminate the overvoltages generated by the parasitic inductances of the wiring (Ldi/dt), especially for very fast Transients.

APPLICATION NOTE

U Interface Protection



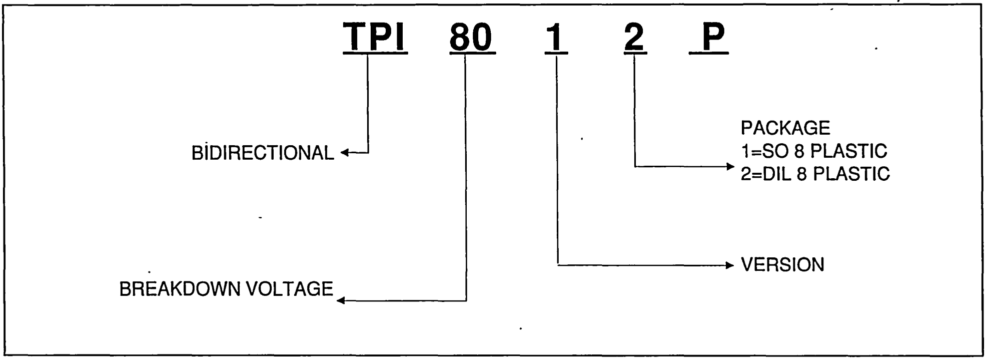
S Interface Protection



This component use an intemal diagram which allows to have symetrical characteristics with a good balanced behaviour.

This topology insures the same breakdown voltage level in positive and negative for differential or common mode surge.

ORDER CODE



MARKING

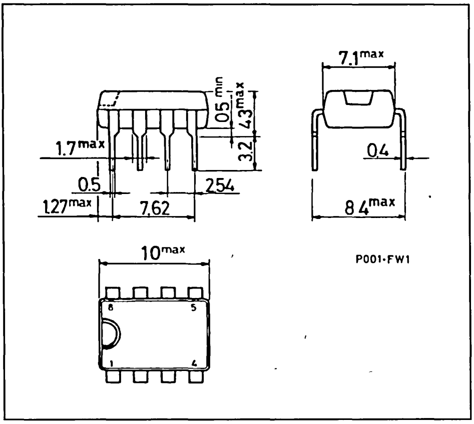
Package	Type	Marking
SO8	TPI8011 TPI12011	TPI80 TPI120

Package	Type	Marking
DIL8	TPI8012 TPI12012	TPI80 TPI120

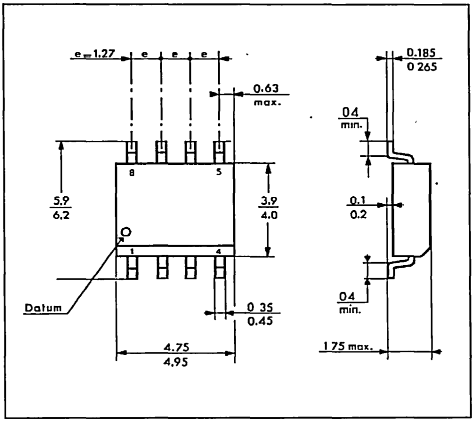
Packaging : Products supplied in antistatic tubes.

PACKAGE MECHANICAL DATA (in millimeters)

DIL 8 Plastic

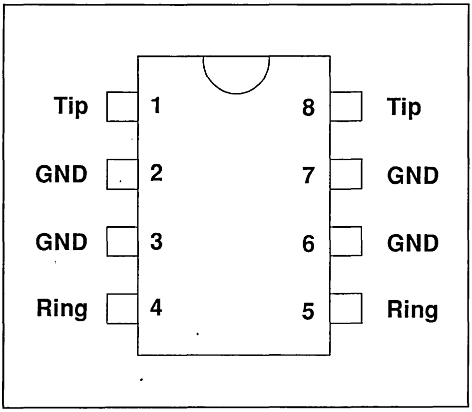


SO 8 Plastic

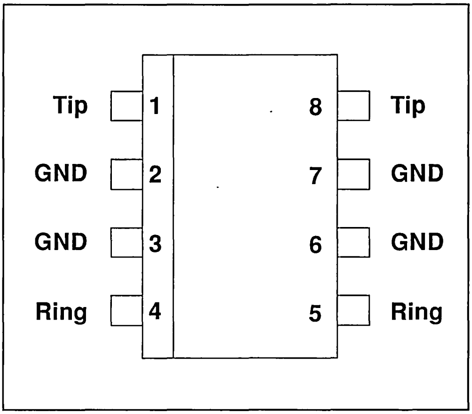


CONNECTION DIAGRAM

DIL 8 Plastic



SO 8 Plastic



SGS-THOMSON
MICROELECTRONICS

TPP25011
TPP25012

PROGRAMMABLE TRANSIENT VOLTAGE SUPPRESSOR AND CURRENT REGULATION

FEATURES

- UNIDIRECTIONAL FUNCTION
- PROGRAMMABLE BREAKDOWN VOLTAGE UP TO 250 V
- PROGRAMMABLE CURRENT LIMITATION FROM 40 mA TO 500 mA
- HIGH SURGE CURRENT CAPABILITY
  I_{PP} = 30A 10/1000 µs
- AVAILABLE IN DIL 8 AND SO 8 PACKAGES

DESCRIPTION

Dedicated to sensitive telecom equipment protection, this device can provide both voltage protection and current limitation with a very tight tolerance.

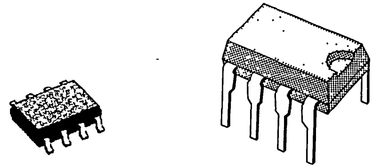
The breakdown voltage can be easily programmed by using an external zener diode.

A multiple protection mode can be also performed when using several zener diodes, providing to each line interface an optimized protection level.

The current limiting function is achieved with the use of a resistor between the gate and the cathode. The value of the resistor will determine the level of the desired current.

IN ACCORDANCE WITH FOLLOWING STANDARDS :

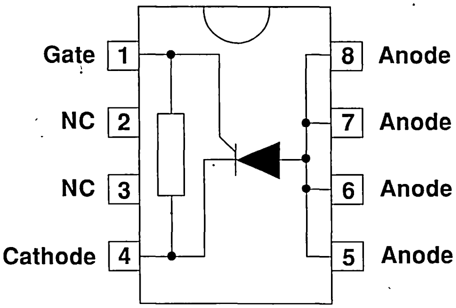
CCITT K17 - K20	10/700 µs	1.5 kV
	5/310 µs	38 A
VDE 0433	10/700 µs	2 kV
	5/200 µs	50 A
CNET	0.5/700 µs	1.5 kV
	0.2/310 µs	38 A



SO 8
(Plastic)

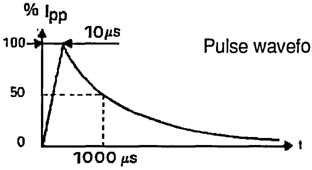
DIL 8
(Plastic)

SCHEMATIC DIAGRAM



ABSOLUTE RATINGS (limiting values) (- 40°C ≤ T_{amb} ≤ +85°C)

Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 5/320 µs 2/10 µs	30 40 75	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 10 ms tp = 1 s	5 3.5	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C



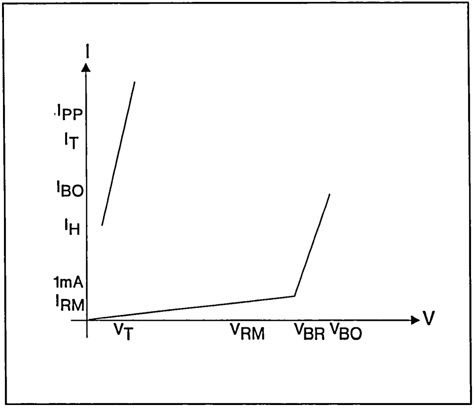
Pulse waveform 10/1000µs

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-a)	Junction-to-ambient	DIL 8 SO 8	125 171	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage @ I_T
I_{BO}	Breakover current
I_{PP}	Peak pulse current
V_G	Gate voltage
I_G	Firing gate current



OPERATION WITHOUT GATE (0°C ≤ T_{amb} ≤ 70°C)

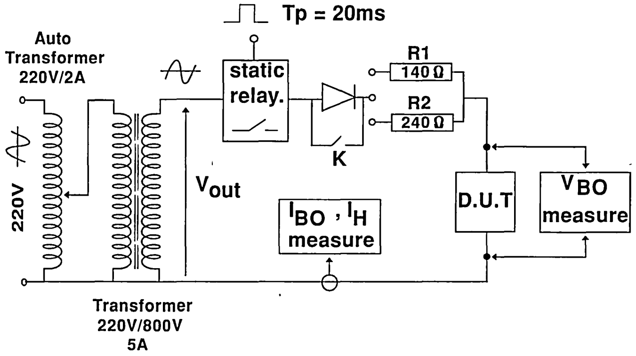
TYPE	I_{RM} @ V_{RM}		V_{BR} @ I_R		V_{BO}	@	I_{BO}	I_H	V_T	C
	max		min		max	min	max	min	max	max
						note 1		note 1	note 2	note 3
	µA	V	V	mA	V	mA	mA	mA	V	pF
TPP250	6	60	250	1	340	15	200	180	5	100

OPERATION WITH GATE (T_{amb} = 25°C)

Types	V_{GN} @ I_{GN} =30 mA		IG	
	min	max	min	max
	note 4		V_{A-C} = 100 V	
	V	V	mA	mA
TPP250	1.05	1.35	5	40

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse T_P= 500µs - I_T= 1A.
Note 3 : V_R = 5 V, F = 1MHz.
Note 4 : V_{GN} limits are given at the typical I_{GN} value.

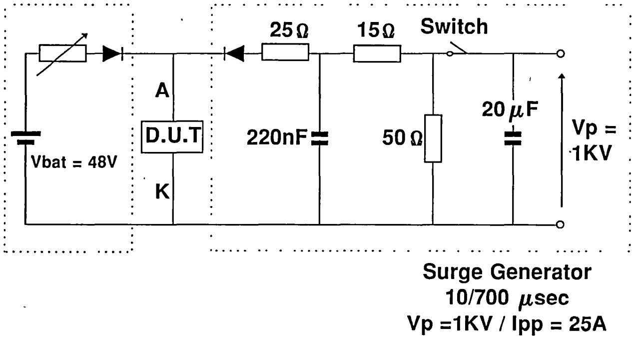
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 μs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

APPLICATION CIRCUIT

Overvoltage protection and current limitation

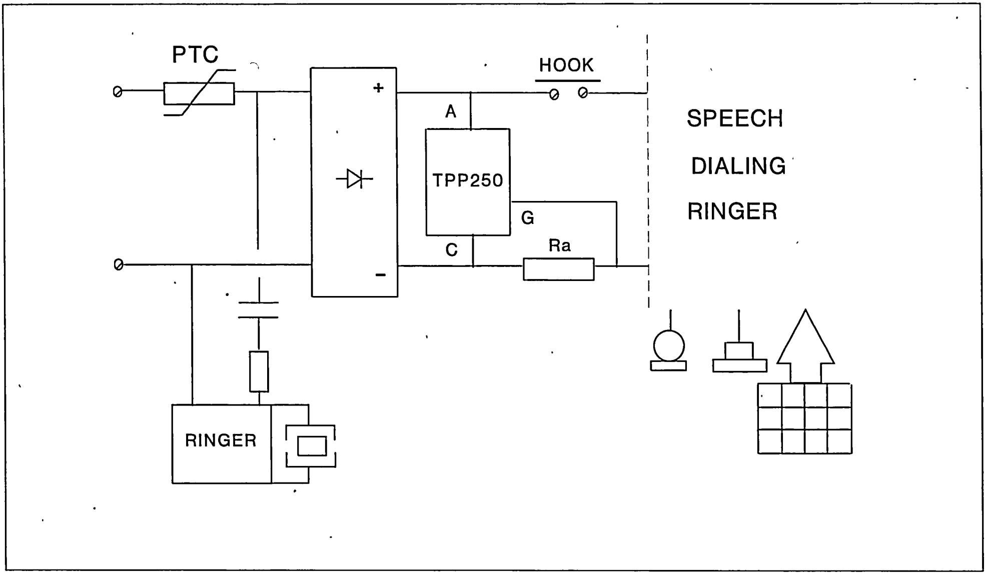
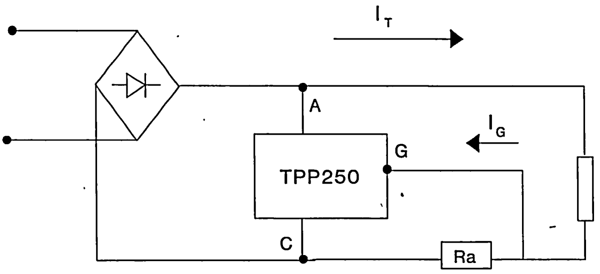


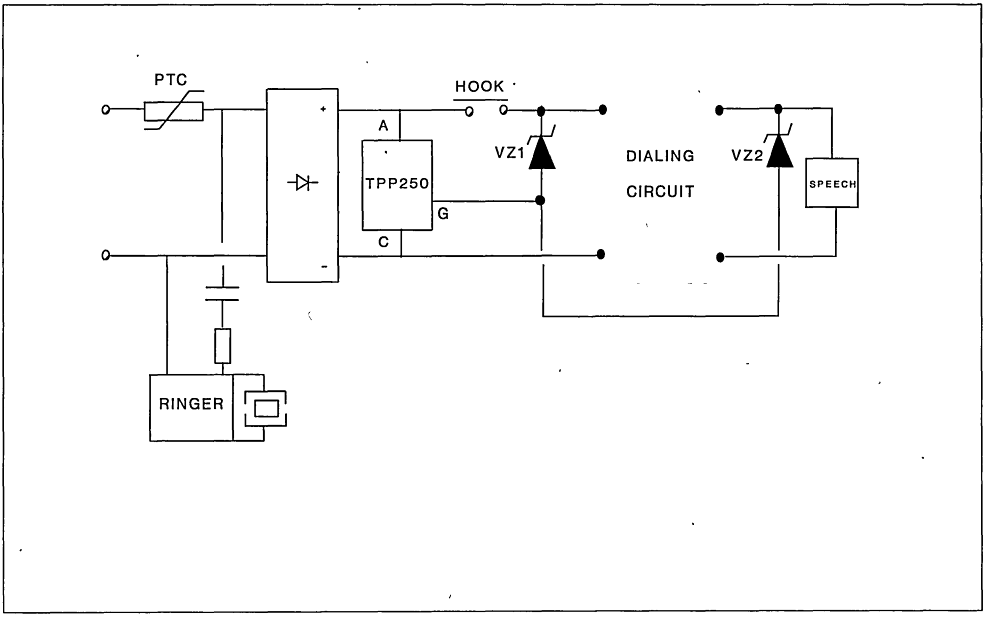
Table below gives the tolerance of the limited current I_T for each standardized resistor value.

CURRENT TOLERANCE		
R Ω (± 5%)	I_T mA min	I_T mA max
3.00	338	514
3.30	308	471
3.60	283	435
3.90	261	404
4.30	238	370
4.70	218	342
5.10	201	319
5.60	184	294
6.20	166	269
6.80	152	249
7.50	138	229
8.20	127	213
9.10	115	196
10.10	104	181
11.00	96	169
12.00	88	158
13.00	82	149
15.00	72	135
16.00	68	129
18.00	61	119
20.00	55	111
22.00	50	105
24.00	47	99
27.00	42	93
30.00	38	87



$$I_T = \frac{V_G}{Ra} + I_G$$

Ground key telephone set protection

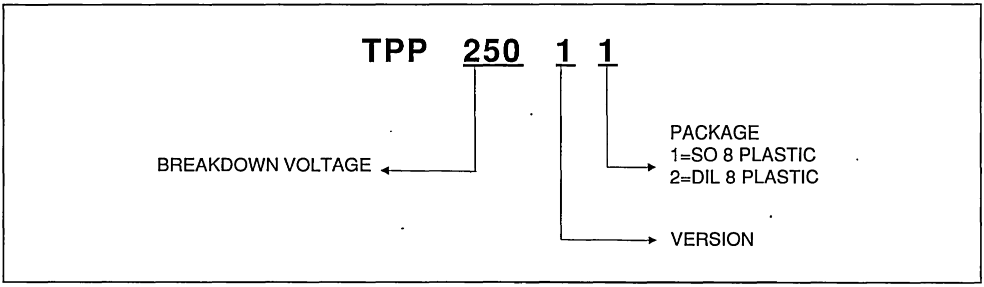


PROTECTION MODES :

OFF HOOK = Ringer circuit protection is insured with breakdown voltage at 250 V.

ON HOOK = In dialing mode and in conversation mode, the breakdown voltage of TPP250 can be adapted at different levels with two zener diodes.

ORDER CODE

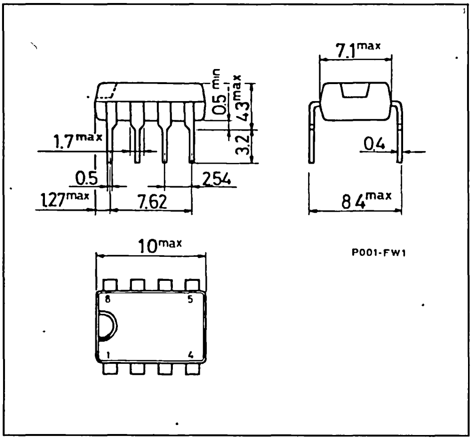


MARKING

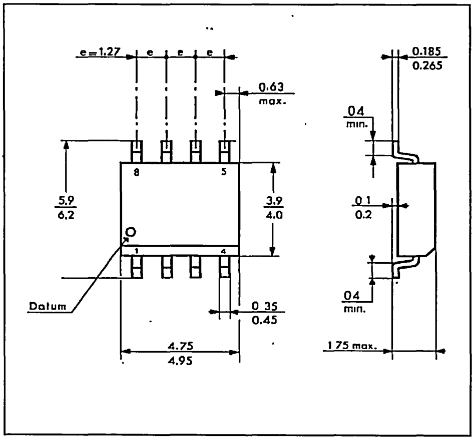
Package	Type	Marking
SO 8 DIL 8	TPP25011 TPP25012	TPP250 TPP250

PACKAGE MECHANICAL DATA (in millimeters)

DIL 8 Plastic

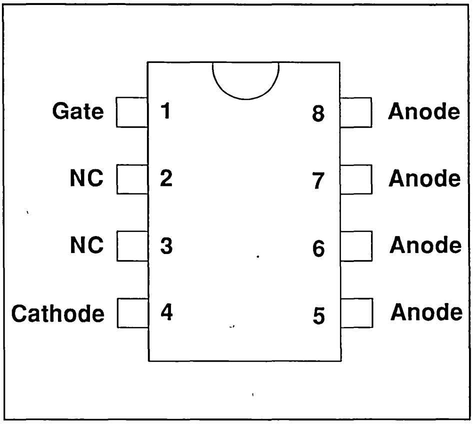


SO 8 Plastic

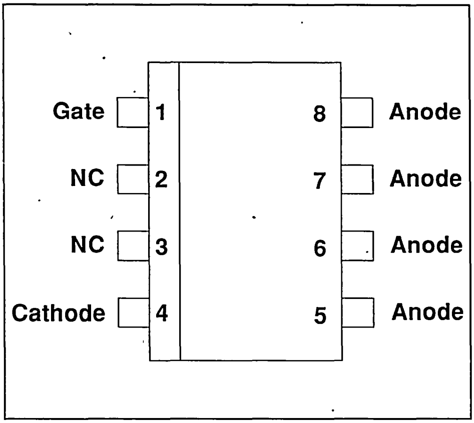


CONNECTION DIAGRAM

DIL 8 Plastic



SO 8 Plastic



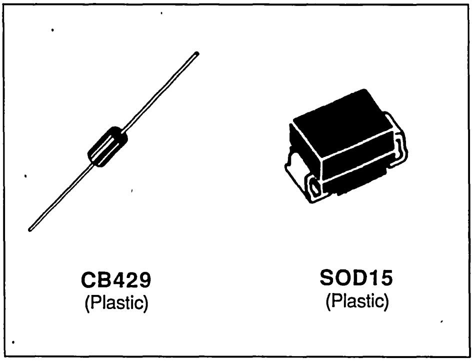
Packaging : Products supplied in antistatic tubes.

TPUxx/SMTHDTxx

TRISIL
DISCRETE SOLUTION FOR ISDN PROTECTION

FEATURES

- UNDIRECTIONAL CROWBAR PROTECTION.
- PEAK PULSE CURRENT : I_{PP} = 75 A , 10/1000 µs.
- HOLDING CURRENT = 150mA.
- BREAKDOWN VOLTAGE:
  TPU58/SMTHDT58 = 58V.
  TPU80/SMTHDT80 = 80V.
  TPU120/SMTHDT120 = 120V.
- PACKAGES:
  TPUxx = AXIAL DIODE.
  SMTHDTxx = SURFACE MOUNT PACKAGE.



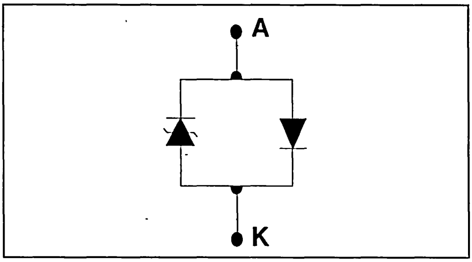
DESCRIPTION: TRIBALANCED PROTECTION

Dedicated protection devices for ISDN LINE CARD and high speed data telecom lines.

Used with the recommended configuration using 3 components, they will provide =

- Dual bidirectionnal protection, with fixed breakdown voltage in both common and differential modes.
- Low capacitances from lines to ground.
- Very good capacitance balance : ΔC= 30 pF.

FUNCTIONAL DIAGRAM.



ABSOLUTE RATINGS (limiting values) ($-40°C \leq T_{amb} \leq +85°C$)

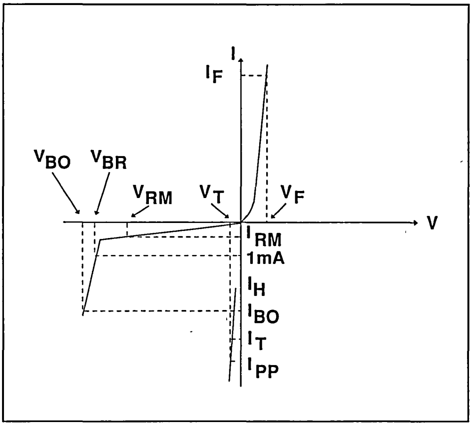
Symbol	Parameter		Value	Unit
I_{PP}	Peak pulse current	10/1000 µs 8/20 µs	75 150	A
I_{TSM}	Non repetitive surge peak on-state current	tp = 20 ms	30	A
di/dt	Critical rate of rise of on-state current	Non repetitive	100	A/µs
dv/dt	Critical rate of rise of off-state voltage	67% V_{BR}	5	KV/µs
T_{stg} T_j	Storage and operating junction temperature range		- 40 to + 150 + 150	°C °C

THERMAL RESISTANCES

Symbol	Parameter		Value	Unit
R_{th} (j-l)	Junction-leads Thermal Resistance	CB429 SOD15	20 20	°C/W °C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter
V_{RM}	Stand-off voltage
V_{BR}	Breakdown voltage
V_{BO}	Breakover voltage
I_H	Holding current
V_T	On-state voltage
VF	Forward Voltage Drop
I_{BO}	Breakover current
I_{PP}	Peak pulse current



PARAMETERS RELATED TO THE DIODE.

Parameter	Test conditions	Value	Unit
V_F	I_F = 5A, T_P = 500 µs	5	V

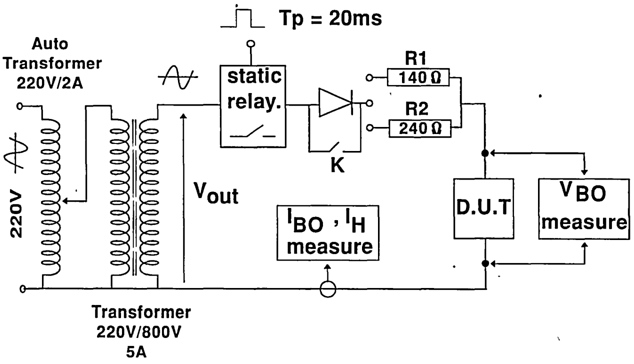
PARAMETERS RELATED TO THE PROTECTION TRISIL.

Types	I_R @ V_{RM}		V_{BR} @ I_R		V_{BO}	I_{BO}		IH	VT	C
	max		min		max	min	max	min	max	max
					note1	note1	note1	note1	note2	note3
	µA	V	V	mA	V	mA	mA	mA	V	pF
TPU58/SMTHDT58	10	56	58	1	80	150	800	150	5	400
TPU80/SMTHDT80	10	68	80	1	120	150	800	150	5	250
TPU120/SMTHDT120	10	102	120	1	180	150	800	150	5	200

All parameters tested at 25 °C, except where indicated.

Note 1 : See the reference test circuit for I_H, I_{BO} and V_{BO} parameters.
Note 2 : Square pulse Tp = 500 µs - I_T = 5A.
Note 3 : V_R = 1V, F = 1MHz.

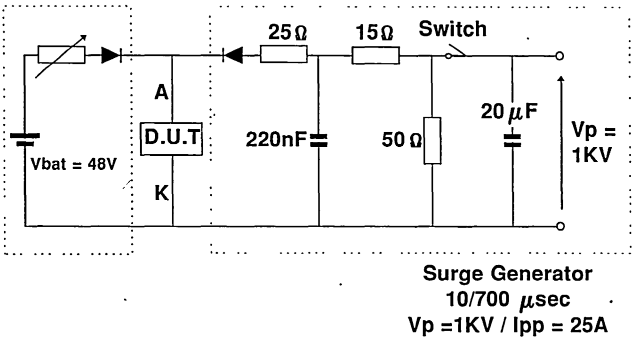
REFERENCE TEST CIRCUIT FOR I_H, I_{BO} and V_{BO} parameters :



TEST PROCEDURE :

- Pulse Test duration (Tp = 20ms):
  - For Bidirectional devices = Switch K is closed
  - For Unidirectional devices = Switch K is open.
- V_{OUT} Selection
  - Device with $V_{BR} \leq 150$ Volt
    - $V_{OUT} = 250\ V_{RMS}$, $R_1 = 140\ \Omega$.
  - Device with $V_{BR} \geq 150$ Volt
    - $V_{OUT} = 480\ V_{RMS}$, $R_2 = 240\ \Omega$.

FUNCTIONAL HOLDING CURRENT (I_H) TEST CIRCUIT = GO - NOGO TEST.



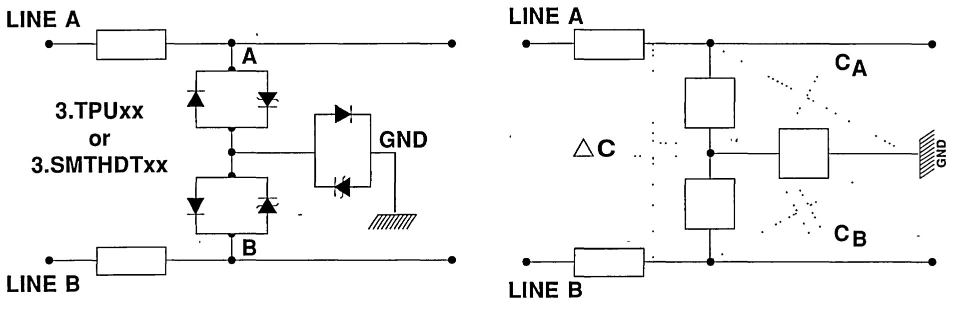
This is a GO-NOGO Test which allows to confirm the holding current (I_H) level in a functional test circuit. This test can be performed if the reference test circuit can't be implemented.

TEST PROCEDURE :

1) Adjust the current level at the I_H value by short circuiting the AK of the D.U.T.
2) Fire the D.U.T with a surge Current : Ipp = 25A , 10/700 µs.
3) The D.U.T will come back to the OFF-State within a duration of 50 ms max.

APPLICATION NOTE

ISDN PROTECTION.



TRIPOLE PROTECTION

FULL BALANCED PROTECTION

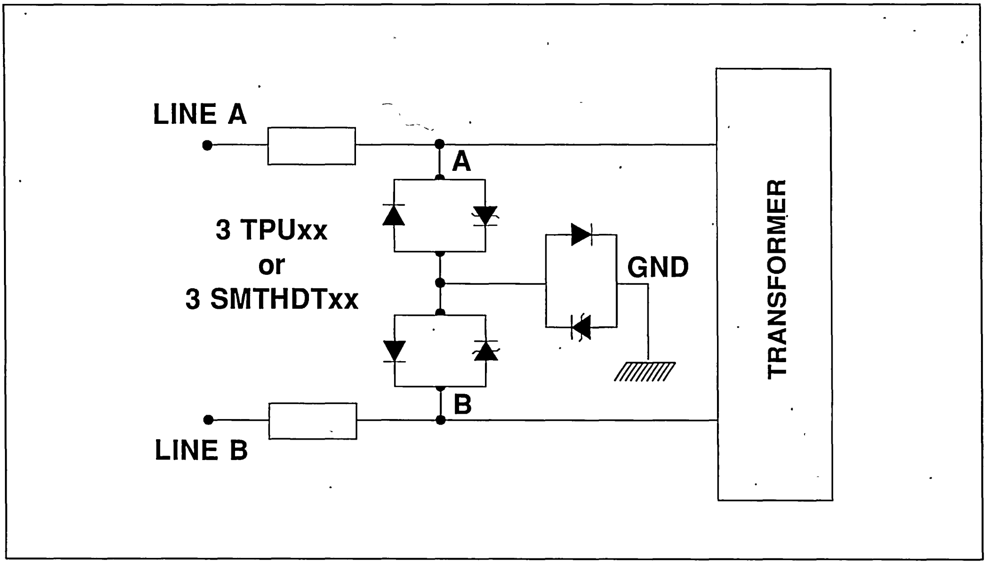
RECOMMENDED CONFIGURATION FOR TRIBALANCED PROTECTION MODE.

CAPACITANCE CHARACTERISTICS

Type	CONFIGURATION		C_A pF	C_B pF	ΔC pF
	LINE A	LINE B	Max	Max	Max
TPU58/SMTHDT58	48	0	80	60	30
TPU80/SMTHDT80	56	0	70	50	30
TPU120/SMTHDT120	110	0	70	50	30

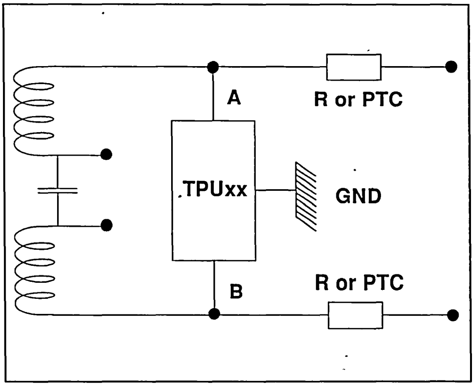
APPLICATION NOTE

Discrete ISDN Protection solution

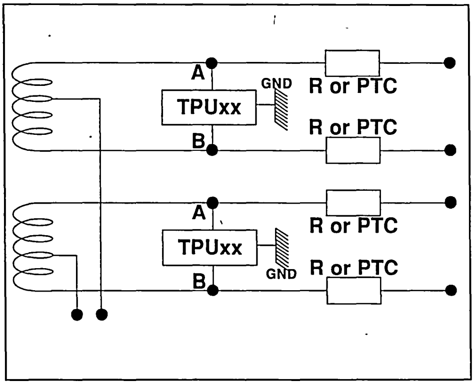


EQUIVALENT PROTECTION FUNCTION

U Interface Protection

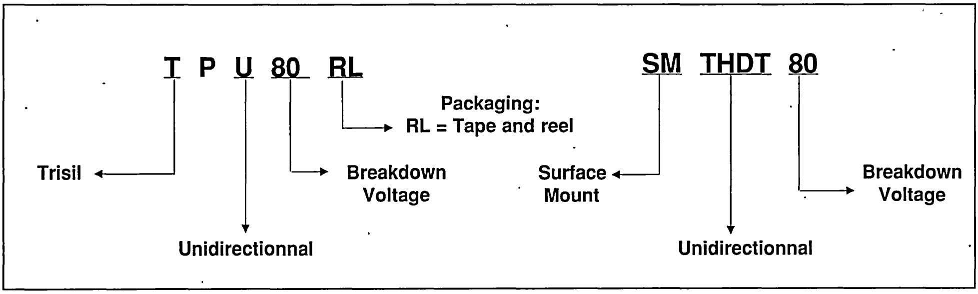


S Interface Protection



This topology assumes the same breakdown voltage level in positive and negative for differential or common mode surge.

ORDER CODE



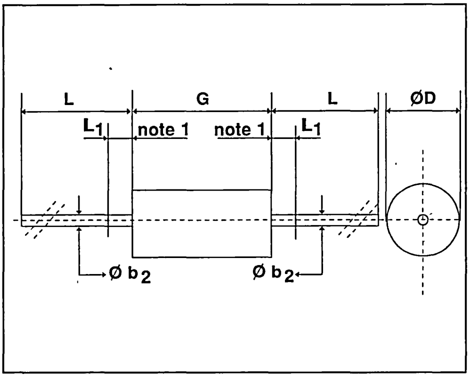
MARKING

Package	Type	Marking
CB429	TPU58 TPU80 TPU120	TPU58 TPU80 TPU120
A white band indicates the cathode		

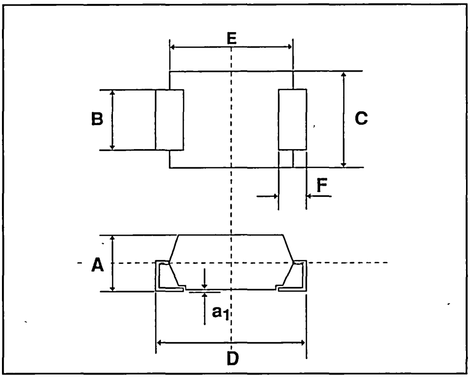
Package	Type	Marking
SOD15	SMTHDT58 SMTHDT80 SMTHDT120	W01 W03 W05
A white band indicates the cathode		

PACKAGE MECHANICAL DATA

CB429



SOD15



Ref	Millimeters		Inches	
	min	max	min	max
Ø b_2	-	1.06	-	0.042
Ø D	-	5.1	-	0.20
G	-	9.8	-	0.386
L	26	-	1.024	-
L_1	-	1.27	-	0.050
note1: The diameter Ø b_2 is not controlled over zone L_1.				

Ref	Millimeters		Inches	
	min	max	min	max
A	2.5	3.1	0.098	0.122
a_1	-	0.2	-	0.008
B	2.9	3.1	0.114	0.122
C	4.8	5.2	0.190	0.200
D	7.6	8.0	0.300	0.315
E	6.3	6.6	0.248	0.259
F	1.3	1.7	0.051	0.067

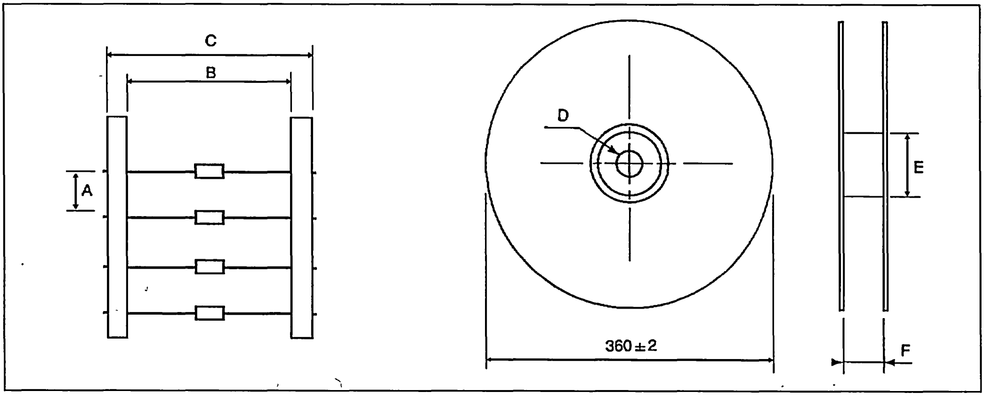
Packaging : Axial Diode CB429 = Products Supplied in Tape and Reel.
SOD15 =Standard packaging is in Film.

PACKAGING

TAPE AND REEL PACKAGING

Case	Base QTY	Component Spacing	Tape Spacing		Reel Dimensions		
		A	B	C	D	E	F
F126	6000	5 ± 0.5	53 ± 2	65 ± 2	31.5	86	75 min
CB417	5000	5 ± 0.5	53 ± 2	65 ± 2	31.5	86	75 min
CB429	1900	10 ± 0.5	53 ± 2	65 ± 2	31.5	86	75 min
DO13	1000	10 ± 0.5	53 ± 2	65 ± 2	31.5	86	81 min
AG	1000	10 ± 0.5	43 ± 2	55 ± 2	31.5	86	75 min

All dimensions are in millimetres.

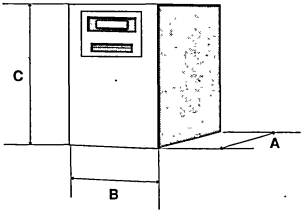


Note : All polarised components are oriented with their cathode tape coloured red and their anode tape white. Unpolarised components have both tapes coloured red.

MATCHBOX PACKAGING

Case	Base QTY	Box Dimensions		
		A	B	C
DO13	100	149	62	80
AG	100	149	62	80

All dimensions are in millimetres.

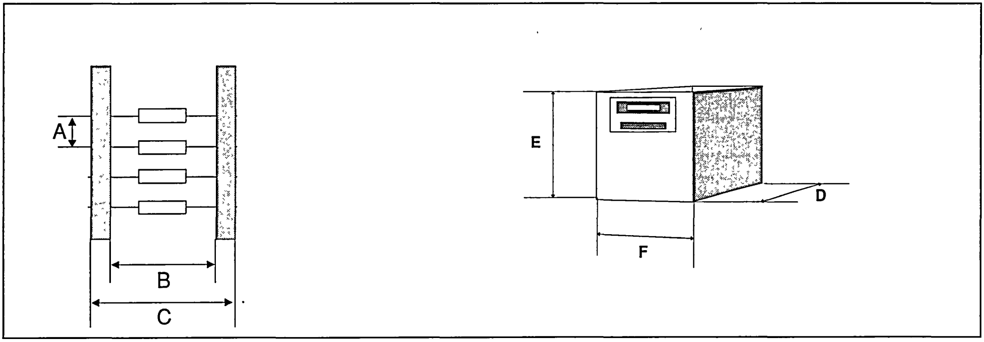


PACKAGING STANDARDS

FAN FOLD BOX PACKAGING

Case	Base QTY	Component Spacing	Tape Spacing		Reel Dimensions		
		A	B	C	D	E	F
F126	1000	5 ± 0.5	53 ± 2	65 ± 2	255	85	82
CB417	1000	5 ± 0.5	53 ± 2	65 ± 2	255	85	82
CB429	600	10 ± 0.5	53 ± 2	65 ± 2	255	85	82

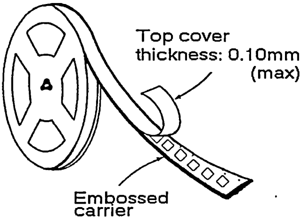
All dimensions are in millimetres.

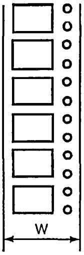


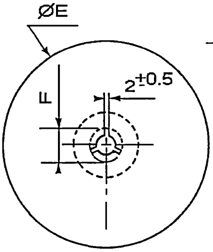
Note : All polarised components are oriented with their cathode tape coloured red and their anode tape white. Unpolarised components have both tapes coloured red.

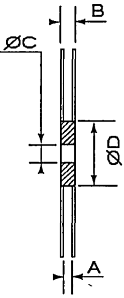
SURFACE MOUNT PACKAGING (FILM AND REEL)

Case	Base QTY	Film Width	Reel Dimensions					
		W	A	B	C	D	E	F
SOD6 [(1)]	2500	12 ± 0.2	12.4 ± 2	18.4 Max	13	60 ± 2	330	20.2
SOD15 [(1)]	2500	16 ± 0.2	16.4 ± 2	22.4 Max	13	60 ± 2	330	20.2
SO8	2500	12 ± 0.2	12.4 ± 2	18.4 Max	13	50 Min	330	20.2
SO20	1000	24 ± 0.2	24.4 ± 2	30.4 Max	13	50 Min	330	20.2









All dimensions are in millimetres.

(1) Also known as *CB472.*

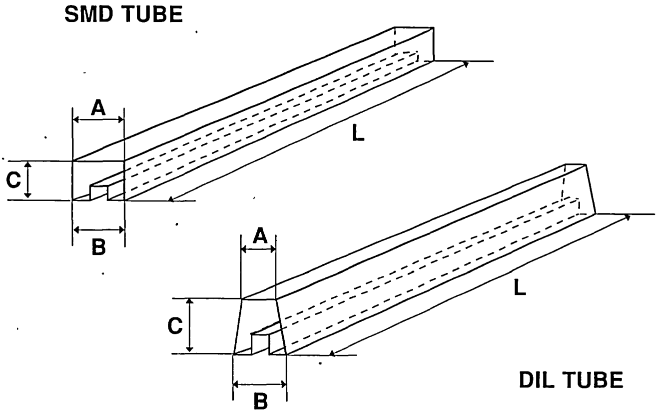
(1) Also known as *CB473.*

Note : Polarized devices have their cathode lead oriented toward the perforated side of the film.

TUBE PACKAGING

Case	Base QTY	Tube Dimensions			
		L	A	B	C
SO8	100	532 ± 1	7.80 ± 0.1	7.80 ± 0.1	3.80 ± 0.1
SO20	40	532 ± 1	15 ± 0.1	15 ± 0.1	4.70 ± 0.1
DIL8	50	532 ± 1	8.40 ± 0.15	15.20 ± 0.25	11.20 ± 0.25
DIL20	20	532 ± 1	8.40 ± 0.15	15.20 ± 0.25	11.20 ± 0.25
SIL3	50	532 ± 1	28.9 ± 0.1	28.9 ± 0.1	5.55 ± 0.1
SIL4	50	532 ± 1	28.9 ± 0.1	28.9 ± 0.1	5.55 ± 0.1
TO220AB	50	532 ± 1	31.4 ± 0.1	31.4 ± 0.1	5.5 ± 0.2

All dimensions are in millimetres.



GENERAL APPLICATION NOTES

TRANSIL
CLAMPING PROTECTION MODE

By Jean Marie Peter

INTRODUCTION

The Transil is an avalanche diode specially designed to clamp overvoltages and dissipate high transient power. A Transil has to be selected in two steps :

A) Check that the circuit operating conditions do not exceed the specified limit of the component.
. For non-repetitive "shock" operation,
. For repetitive load operation,
. For continuous operation.

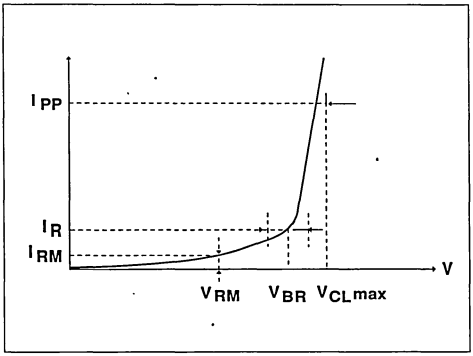
B) Check that the maximum value of the clamped voltage under the most adverse conditions corresponds to the specification of the circuit, i.e. there is no danger for the protected circuits.

REVIEW OF TRANSIL CHARACTERISTICS

1. THE PEAK REVERSE VOLTAGE V_{RM} is the voltage which the Transil can withstand in continuous operation.

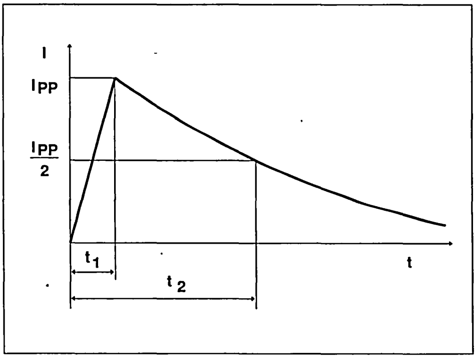
2. THE BREAKDOWN VOLTAGE OR KNEE VOLTAGE V_{BR} is the voltage value above which the current in the Transil increases very fast for a slight increase in voltage. The breakdown voltage V_{BR} is specified at 25°C and its temperature coefficent is positive. The V_{BR} tolerance is normally ± 5% or - 5% + 10%, however it is important to note that Transil technology results in much lower tolerance in mass production than other technologies.

Figure 1 : Main Characteristics of a Transil.



3. THE CLAMPING VOLTAGE V_{CL} as specified in the data-sheets is the maximum value for a "standard" current pulse with a peak value of I_{PP}, specified for any type of Transil (fig.2). If the Transil is subjected to a different pulse, the value of V_{CL} can be calculated using the application note "CALCULATION OF TRANSIL APPARENT DYNAMIC RESISTANCE". The clamping factor is represented by V_{CL}/V_{BR}. This ratio between the maximum value of overvoltage for a given current and the maximum voltage which the diode can withstand in continuous operation characterizes the degree of protection.

Figure 2 : Standard Exponential Pulse. This type of pulse corresponds to most of the standards used for the protection device.



	t1 µs	t2 µs
WAVE "8/20µs"	8	20
WAVE "10/1000µs"	10	1000

4. TRANSIL PEAK POWER DISSIPATION

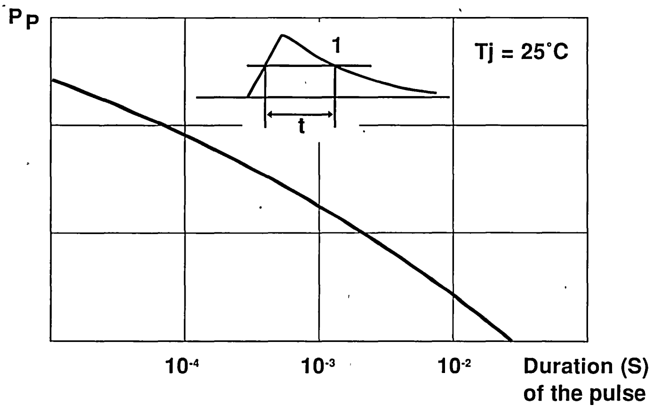
The first protection devices, designed to meet electrotechnical standards, were mostly used for overvoltages of short duration (1/50 µs waves of the type shown in fig.2) encountered on high voltage lines.

Research carried out by CNET (French Telecommunications Agency), confirmed by other organisations, tends to show that low-power electronic equipment is subjected to over voltages of a much longer duration, better represented by a 10/1000 µs exponential wave.

Transils are meant to protect electronic equipment and hence have been designed to perform well for over voltages which last several tens of milliseconds.

The performance of Transils has thus been determined with reference to the standard exponential wave 10/1000 µs.

Figure 3 : Maximum Power for an Exponential Pulse of Duration t.



The peak power dissipated in the Transil is given by :

$$P_P = V_{CL} \times I_{PP}$$

This maximum corresponds to non-repetitive operation. If the pulse has a different duration, a curve similar to that in fig.3, provided in the datasheets, enables the specifications of the Transil to be determined.

If the initial temperature exceeds 25°C, the power (Pp) should be reduced in accordance with the curve of fig.4 which is the same for all Transils.

If the current surge through the Transil is not exponential, the diagrams of fig.5 should enable the equivalent exponential pulse to be calculated.

Figure 4 : Varation of Peak Power as a Function of the Initial Temperature.

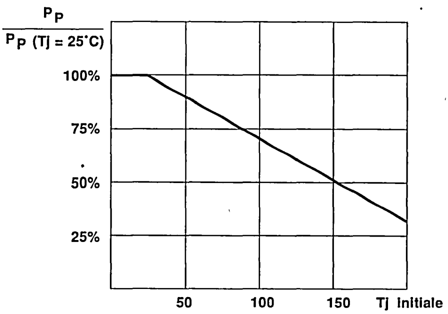
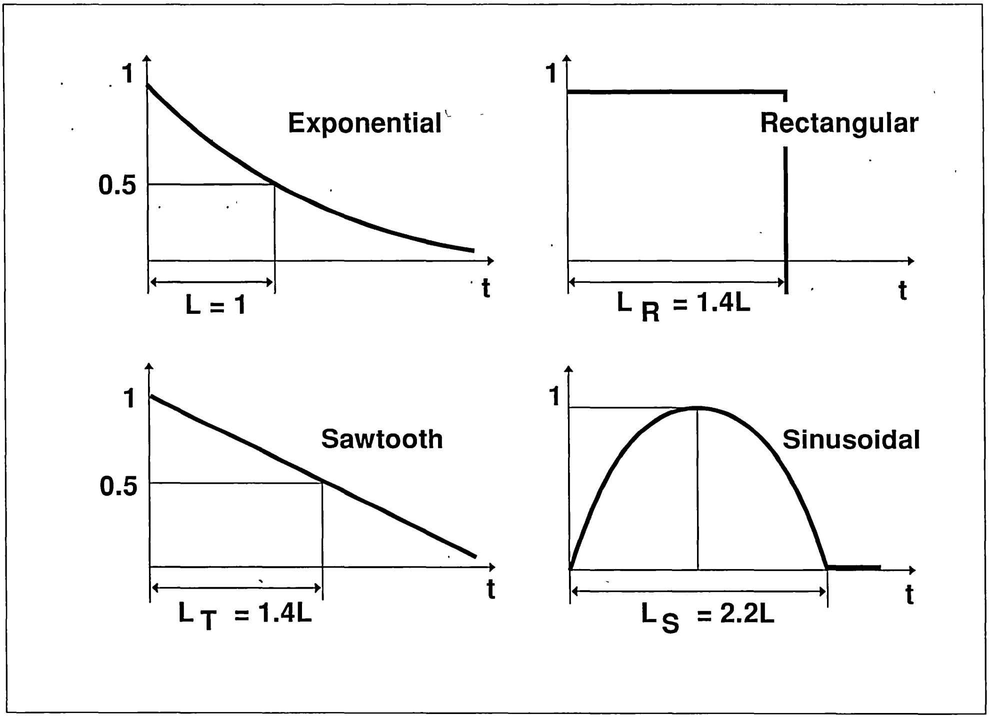


Figure 5 : The four pulses shown below, each of the same peak value, result in identical power being dissipated in a Transil. For example, the rectangular pulse which gives the same dissipation as the exponential pulse of the same peak value is 1.4 times longer in duration.



5. TRANSIL MEAN POWER DISSIPATION

In repetitive operation, the specification to be considered is mean power P_{AV}.

$$P_{AV} = f \times W$$

(f : frequency, W : energy dissipated at each pulse)

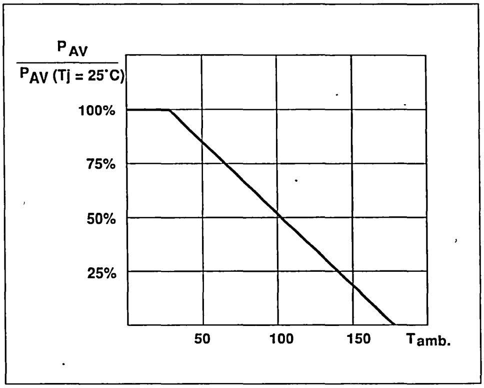
The junction temperature calculated from this power should never exceed the specified maximum junction temperature.

This temperature is calculated from the thermal resistance, exactly like for a diode.

$$T_j = Tamb + R_{th} \times P_{AV}$$

$R_{th} = R_{th\,(j\text{-}a)}$ for *axial lead Transil*

Figure 6 : Maximum Average Power as a Function of Ambient Temperature.



6. SPEED

The primary purpose of a Transil is to clamp overvoltages produced by current surges.

A conventional lightning arrester system only responds with a certain delay which can reach 2 µs. A metal oxide varistor does not respond immediately either (delay of about 25 ns).

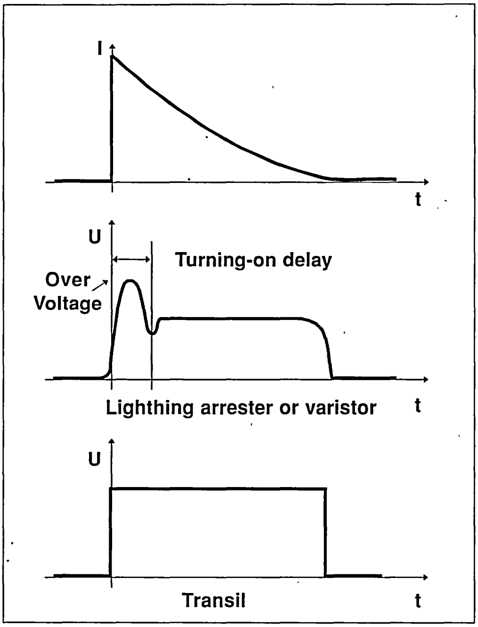
If a current with a very low rise time flows through these components, an overvoltage could appear before the device reacts.

In the case of a Transil, the avalanche phenomenon of a silicon diode is extremely fast (theoretical value about one picosecond).

Laboratory tests have never succeeded in producing overvoltages across Transils, even by using special devices producing very steep current gradients (dischargers, mercury relays).

In conclusion it can be said that Transils respond instantaneously in clamping, on condition that di/dt overvoltages are not introduced by connection inductances.

Figure 7 : Voltage Response of a Classical Component used for Protection and a Transil.



The low capacitance Transil and the bidirectional models have clamping times of about 5 ns. These times remain negligible for practically all applications.

7. SPEED IN "DIODE" OPERATION.

A Transil operating as a rectifier is not a fast recovery diode (it has a high stored charge). As a result, Transils cannot be used for the rectifier function instead of fast recovery diodes.

On the other hand, a Transil operating as a diode has very low forward recovery time (and a very low forward peak voltage VFP). This property can be used for particular applications since no other existing diode has a lower turn-on time for a given VBR (or VRM) voltage.

8. CALCULATION EXAMPLE

Figure 8 : Behaviour of a Transil Operating as a Diode at Turn-off.

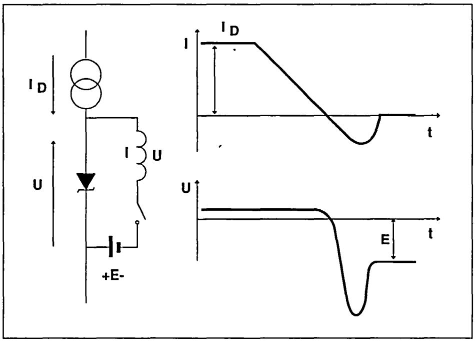
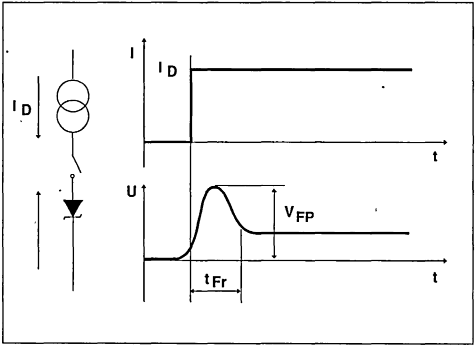


Figure 9 : Behaviour of a Transil Operating as a Diode at Turn-on.

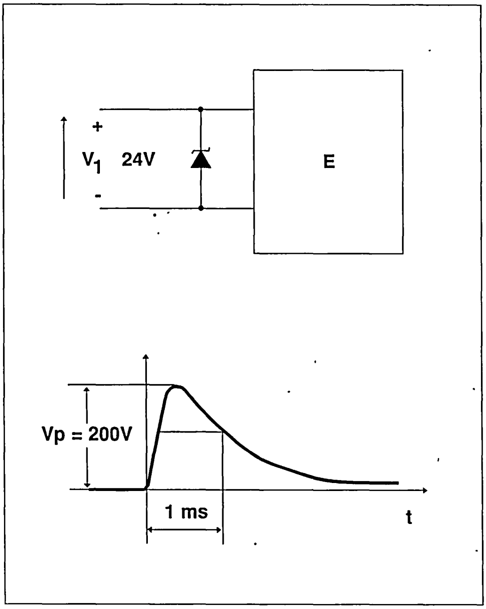


8.1. NON-REPETITIVE SURGES.

A source (V_1) with a rated voltage of 24 V supplies equipment E which is to be protected against overvoltages. This source is subjected to random non repetitive exponential overvoltages with amplitudes of 200 V and a duration of 1 ms at 50% (standard wave) (see fig.10). The equivalent internal impedance Φ of the source with respect to 1 ms exponential waves is 13 Ω.

The maximum ambient temperature is 80°C. In no circumstances should equipment E be subjected to a voltage higher than 50 V.

Figure 10 : Protected Equipement And Surge



8.1.1. Selection of the protection voltage

In the absence of specific information, we assume that voltage V1 varies by ± 20%, ie between 20 V and 29 V.

The protection voltage V_{RM} of the Transil should then be greater than or equal to 29 V.

8.1.2. Predetermination of the peak power Pp

The equipment E cannot withstand a voltage above 50 V → $V_{CL} \leq$ 50 V.

Assuming that there is a Transil which meets this criterion, an initial calculation of the Transil power can be made.

$$P_P = V_{CL} \times I_P \text{ where } I_P = \frac{V_P - V_{CL}}{\Phi}$$

$$I_P = \frac{+200-50}{13} = 11.5A$$

$$P_P = 50 \times 11.5 = 575W$$

This power corresponds to an operating temperature of 80°C. The data sheets indicate power at 25°C so we have to correct the power according to the curves of admissible power versus initial temperature.

So we obtain :

$$P_P(25^\circ C) = \frac{P_P(80^\circ C)}{0.8}$$

$$P_P(25^\circ C) = \frac{575}{0.8} = 719W$$

8.1.3. Selection of the Transil.

We can now establish an initial specification of the Transil to use.

$$V_{RM} \geq 29V$$

$$V_{CL} \leq 50V \text{ for } I_P = 11.5V$$

$$P_P(25^\circ C) = 719W/1ms$$

The type corresponding to these characteristics is the 1.5 KE 36 P.

$$V_{RM} = 30.8\ V$$

$$V_{BR}\,nom = 36\ V\,;\ min\ 34.2\ V\,;\ max\ 39.6\ V$$

$$V_{CL}\,max = 49.9\ V \quad I_{PP} = 30\ A$$

$$P_P = 1500W/1ms$$

$$\alpha_T = 9.9 \times 10^{-3}$$

8.1.4. Determination of the clamping voltage V_{CL}.

To determine the voltage V_{CL} at 11.5 A, we can use the I_{PP}/V_{CL} parameters included in the 1.5 KE data sheets.

$$V_{CL} \text{ at } I_P \approx V_{BR}\max + R_D \times I_P$$

$$R_D \leq \frac{V_{CL} - V_{BR}}{I_{PP}}$$

$$V_{CL}\ at\ 11.5A \approx 39.6 + \frac{49.9 - 36}{30} \times 11.5 = 44.9V$$

8.1.5. Temperature correction

The voltage at 80°C is :

$$V_{CL}(80^\circ C) = V_{CL}(25^\circ C)\,[1 + \alpha_T(T_j - 25^\circ)]$$
$$V_{CL}(80^\circ C) = 44.9\,[1 + 9.9\,10^{-4}(80 - 25)]$$
$$V_{CL}(80^\circ C) \approx 47.3V$$

This value is below the 50 V limit. The Transil ensures the protection.

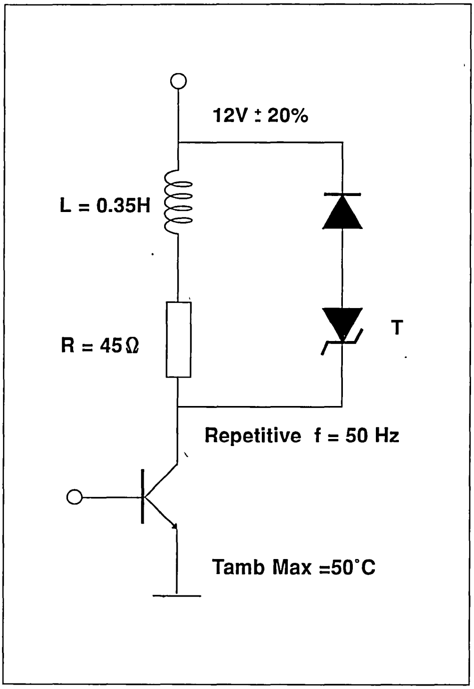
8.2. REPETITIVE SURGE.

We have to protect the transistor shown in fig.11 with a Transil whose clamping voltage, Vcl, does not exceed 85 V.

Calculation method

To avoid a long calculation, we assume :

Figure 11 : Transistor Protection



$V_{CL} \approx V_{BR}$ only true in the case of repetitive surges.

Experience shows this hypothesis is confirmed in most cases with a Transil, therefore a Transil ought to be selected initially according to its thermal characteristics.

8.2.1. P_{AV}

An approximate value can be obtained by supposing that all the energy contained in the inductance is absorbed by the Transil. This hypothesis is close to reality when the ratio

$$\frac{V_{BR}}{V}\ is\ significant.$$

$$P_{AV} = \frac{1}{2} \times LI^2 f = \frac{1}{2} \times 0.35 \left[\frac{12 + 2.4}{45}\right]^2 \times 50$$
$$= 0.9\ W$$

8.2.2. First choice

We choose the type BZW O4P64

$$V_{BR}\ \max = 82.5\ V$$
$$Rth = 100^\circ C/W$$

8.2.3. Tj calculation

$$T_j = T_{amb} + P_{AV} \times R_{th} = 50 + 90 = 140^\circ C$$

This value is compatible with the Transil characteristics.

8.2.4. Determination of V_{CL}

We see on the data sheets that for such a low current level $V_{CL} \approx V_{BR}$ max

8.2.5. Temperature correction

$$V_{CL}(140^\circ C) = V_{CL}(25^\circ C)\,[1 + \alpha_T(140 - 25)]$$
$$V_{CL}(140^\circ C) = 92.5\ V$$

This value is too high.

8.2.6. Second choice

BZW04P58 V_{BR} max = 74.8 V
V_{CL}(140C) = 83.5 V

The Transil BZW04P58 is suitable for this application.

N.B: This example shows that due to the component dispersion, we have to add the variation due to the temperature.

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

TRISIL
CROWBAR TYPE PROTECTION DIODE

By A. Bernabe - J.P. Noguier - P. Rault

I - INTRODUCTION

In the field of parallel protection, the devices used have two main functions in transient operation : **to limit the voltage and to deviate the surge current.**

If the first function is perfectly carried out by an avalanche junction, confirmed by the success of the TRANSIL series, the second is limited by voltage permanently present across the diode terminals.

Utilization of increasingly sophisticated but fragile electronic components and publication of new standards do not allow the use of TRANSIL diodes in certain applications.

This problem is solved by the use of a **semiconductor device** with **two conducting states** such as the thyristor (or the triac in the bidirectional version).

From 1983, **SGS-THOMSON Microelectronics** has developed this type of component under the trade name of **TRISIL.**

This paper is meant to explain its operation and applications and help to choose the model which is most suitable to each specific requirement.

II - TRISIL CHARACTERISTICS

II.1 - ELECTRICAL CHARACTERISTIC

The electrical characteristic of the TRISIL is similar to that of a TRIAC (figure 1) except that the component has only two terminals. Triggering in this case is not done via a gate but by **an internal mechanism dependent on the current flowing through it.**

II.2 - OPERATION SEEN FROM THE OUTSIDE

At rest, the TRISIL is biased at a voltage lower than or equal to the standby voltage (V_{RM}). At that point of the characteristic, the leakage current is about ten nanoamperes and the presence of the TRISIL connected across the equipment to be protected does not disturb its operation (Figure 2).

The characteristic data at this point includes : **the leakage current, the electrical capacity and the reliability of the component in blocking mode.**

As the voltage increases beyond V_{BR}, the TRISIL impedance drops from practically infinite to a few

Figure 1 : I / V Characteristic of a Trisil.

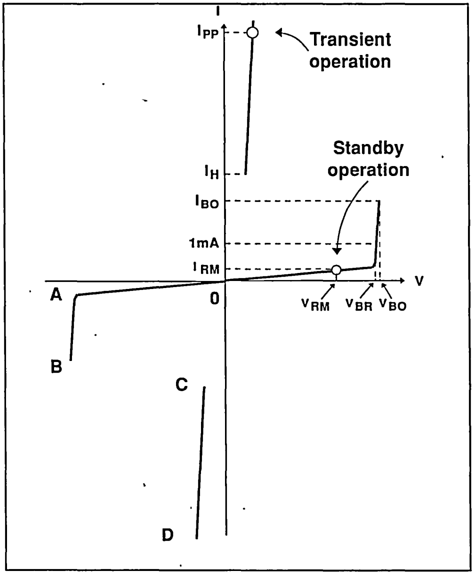
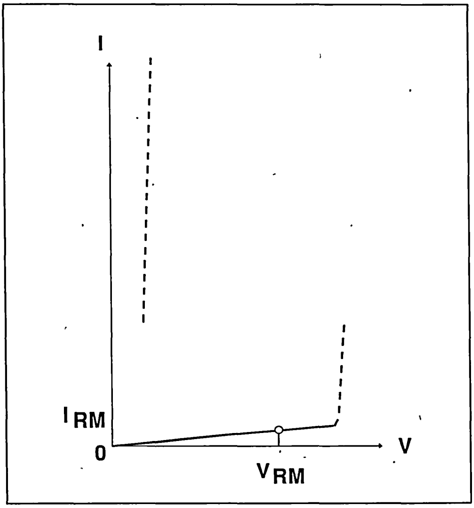


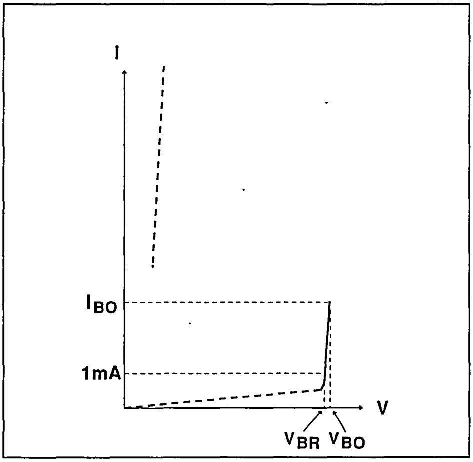
Figure 2 : Low Level Characteristics.



ohms. The TRISIL remains biased at its avalanche voltage and its operation is then identical to that of a TRANSIL diode (Figure 3).

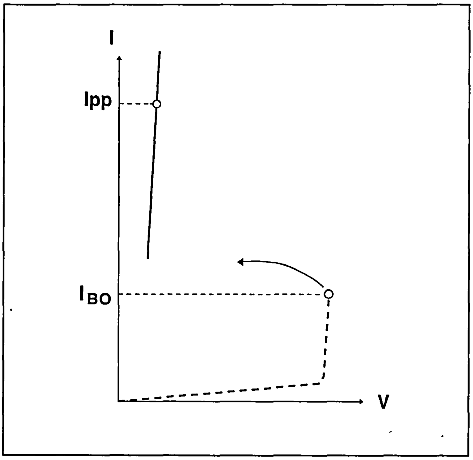
The characteristic parameters at this level are **the limiting voltage** (breakover voltage of the component, V_{BO}) **and the time for switching between the blocked and conducting states.**

Figure 3 : Avalanche Characteristic of the Trisil.



For current values higher than I_{BO}, the voltage across the TRISIL drops to a few volts and the high currents permitted without damage are possible due to the low value of this voltage, since the physical limit is dependent on the dissipated power (Figure 4).

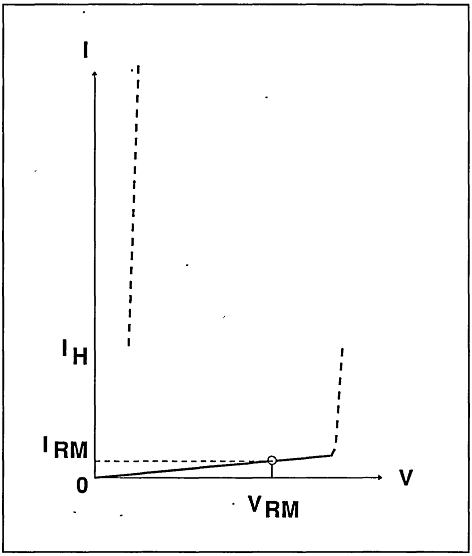
Figure 4 : Triggering Characteristics.



The characteristic parameters are then the possibility **of withstanding surge currents** (peak-point current, I_{PP}).

Return to standby operation by turning off the TRISIL takes place when the current flowing through it drops below I_H. This is the characteristic parameter for switching from the conducting to the blocked state (Figure 5).

Figure 5 : Return to Standby Operation.



The surge current associated with the disturbance is diverted to the TRISIL as soon as it begins to operate in the avalanche mode (figure 3) and the limiting results from the electrical characteristic at this point. The behaviour of the TRISIL is here identical to that of the TRANSIL. The difference depends on the level of the breakover current, I_{BO}, where the triggering of the thyristor structures take place. This phenomenon results in absolute limiting independent of the current level, and a capacity to deviate currents much higher than those possible for an avalanche diode (TRANSIL). Furthermore, this limiting is independent of the avalanche voltage of the device.

II.3 - LIMITING PROPERTY

Because of its operating mode, the TRISIL results in **absolute limiting, independent of the surge current level** (figure 6) **and of the slope of the applied voltage ramp** (figure 7).

Figure 6 : Correlation Between the Voltage and the Surge Current.

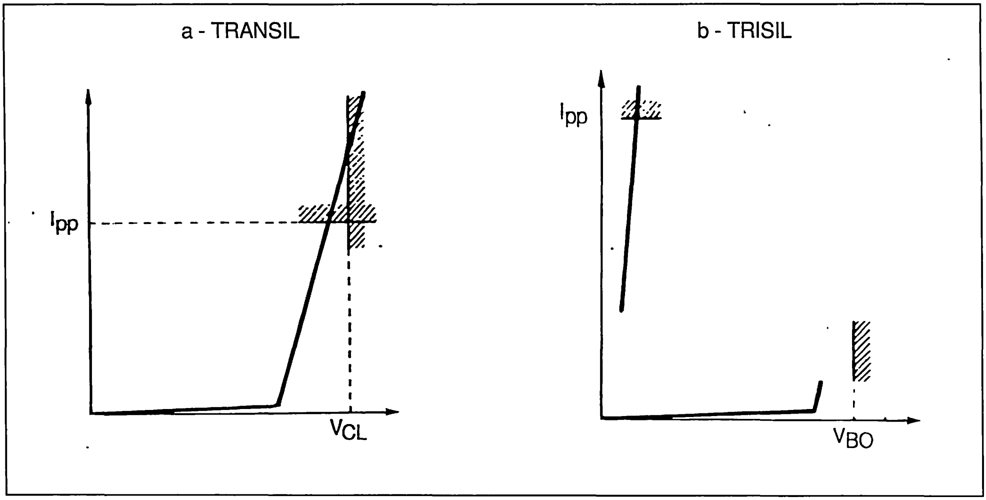
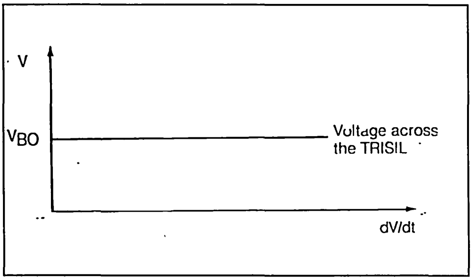


Figure 7 : Correlation Between the Limiting Voltage and the Surge Voltage Ramp.



In particular, if the surge current is higher than the guaranteed value in the catalogue, without however exceeding the physical limits of the component, the voltage across a TRANSIL could reach the critical value destroying the equipment to be protected. For a TRISIL, this risk is excluded.

Finally, for a surge current much higher than the guaranteed value, destruction of the TRISIL always results in a short-circuit thus providing absolute protection for the equipment located downstream.

II.4 - BEHAVIOUR IN CASE OF CURRENT SURGES

The ability of semiconductor components to withstand high currents in transient operation is limited for pulses longer than 10 nano-seconds by a second breakdown due to heat. This phenomenon, although not destructive, is considered as the normal utilization limit in so far as the behaviour of the component depends on the external circuit.

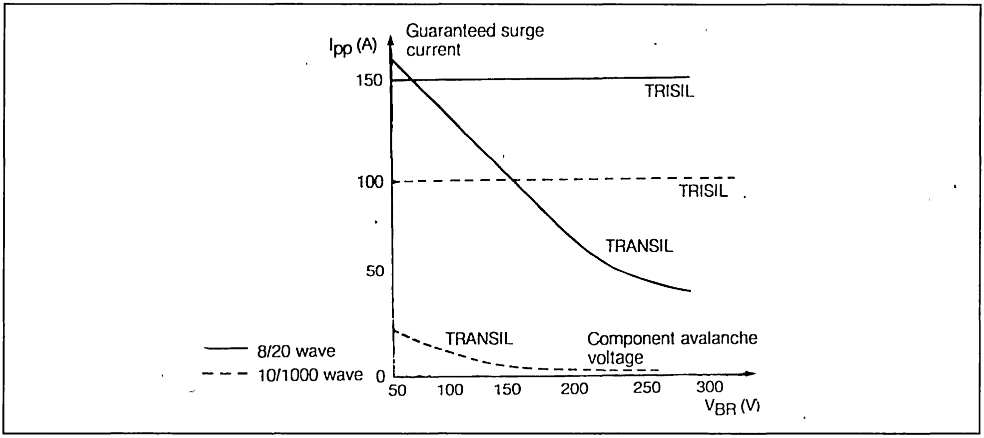
The temperature rise within the semiconductor is thus the parameter which defines the behaviour of the component and its capacity to withstand current surges. It is given by equation (1) :

$$\boxed{T_j = T_a + Z_{th} V_{on} \times I_{RS}} \qquad (1)$$

With T_j : instant temperature at the junction level
T_a : ambient temperature
Z_{th} : transient thermal impedance (as a function of the duration of the pulse)
V_{on} : voltage across the terminals of the component in the conducting state
I_{RS} : transient current flowing through the component.

This equation clearly shows the advantage of the TRISIL : decrease in the voltage across its terminals enables it to conduct a **much higher current** than the avalanche diode, for example, for the same junction temperature. Since the voltage to be taken into consideration for the calculation is that in the conducting state, the permitted current levels in transient operation are independent of the avalanche voltage and the **guaranteed values are identical for all the types of a given series** (figure 8).

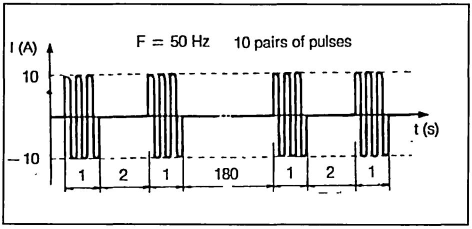
Figure 8 : Comparison of the Limit Transient Currents for a Transil and a Trisil in the Same Case (CB-429).



The maximum junction temperature taken into account in transient operation is not that given in the catalogues (junction temperature in operation or in storage) but corresponds, with a certain safety margin, to the second breakdown due to thermal causes, i.e. about 350 - 400 °C.

This high current capacity can be applied in AC operation at the 50 Hz industrial frequency (figure 9), which is particularly interesting in telephony where equipment should be protected against overvoltages resulting from accidental coupling of the telephone line with the power distribution network. This type of protection is required by certain standards used in telecommunications (Standard I3121 Type II for example).

Figure 9 : Long Duration Overload Test (Standard I3121 - Type II).



II.5 - RESPONSE TIME

The response time of the component is the time it **requires to limit the voltage.** From this point of view the TRISIL has exactly the same behaviour as a TRANSIL. The time is that required to switch from the standby operating point to the avalanche voltage. This is **quasi instantaneous.**

This time should not be confused with that required to pass from the breakover point (V_{BO}) to the conducting characteristic. This time is longer but does not influence the limiting.

II.6 - OPERATION WITHIN THE AVALANCHE AREA

This paragraph concerns the segment V_{BR} - V_{BO} (Figure 3) of the TRISIL characteristic between the blocked state and the conducting state at low V_{on}.

This portion of the characteristic is identical to that of an avalanche diode. Thus within this area, DC, AC or pulse-type operations are permitted. The currents are limited depending on the possibilities of junction-ambient air heat dissipation. The maximum current is defined by the following inequality (2) :

$$\boxed{T_j = T_a + R_{th} V_{BO} I_{max} \leq T_{jmax} = 150\ ^\circ C} \qquad (2)$$

and inequality (3) defining when the TRISIL is not triggered :

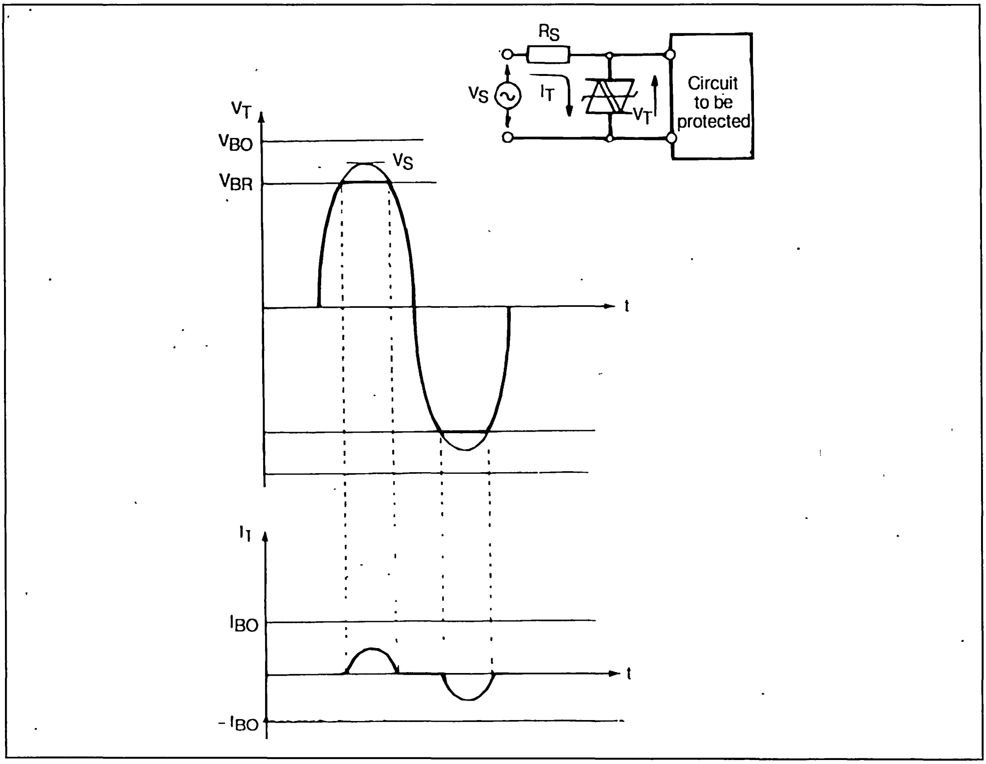
$$\boxed{I_{max} < I_{BO}} \qquad (3)$$

The main differences from equation (1) are the maximum junction temperature which is now that given by the catalogue, i.e. 150 °C, the voltage which is that of the avalanche mechanism and the continuous thermal resistance replacing the transient thermal impedance.

In AC operation, although the equation holds good, the voltage-current diagram as a function of the time (figure 10) is more clear.

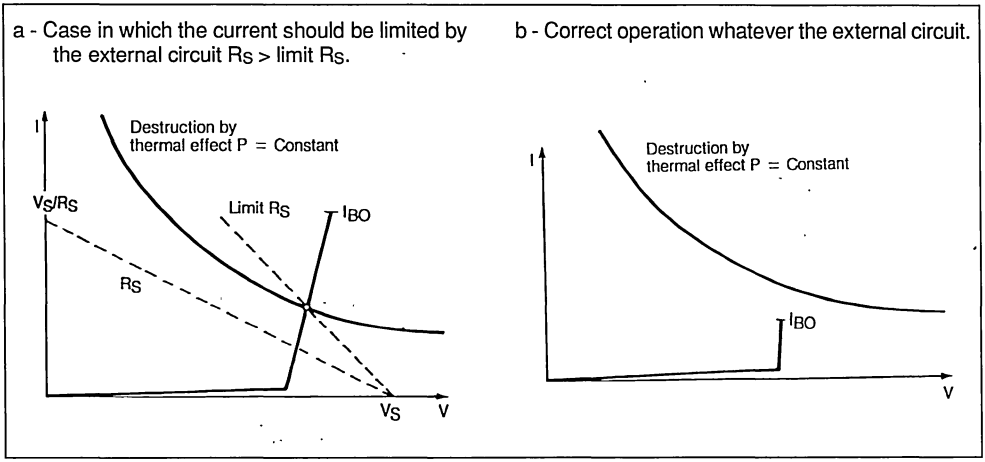
The value of the breakover current (I_{BO}) plays an important part in the capacity of the device in

Figure 10 : AC Operation in the Avalanche Mode.



avalanche operation.

Figure 11 : Conditions for non Destructive Operation in the Avalanche Mode.


a - Case in which the current should be limited by the external circuit R_S > limit R_S.

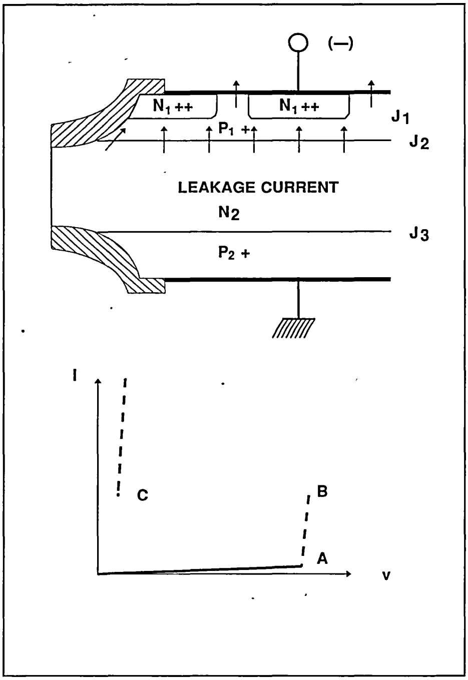
b - Correct operation whatever the external circuit.

If this value is high (figure 11.a), the current in the component must be limited by a suitable series resistor. For lower values, avalanche operation takes place without destruction whatever the external circuit.

III - PHYSICAL OPERATION

The TRISIL in fact consists of two thyristors connected in parallel head-to-tail. It will suffice to explain the operation of one thyristor. The other operates in the same way if the voltage across the component is reversed.

Figure 12 : Operation in the Blocked Mode.

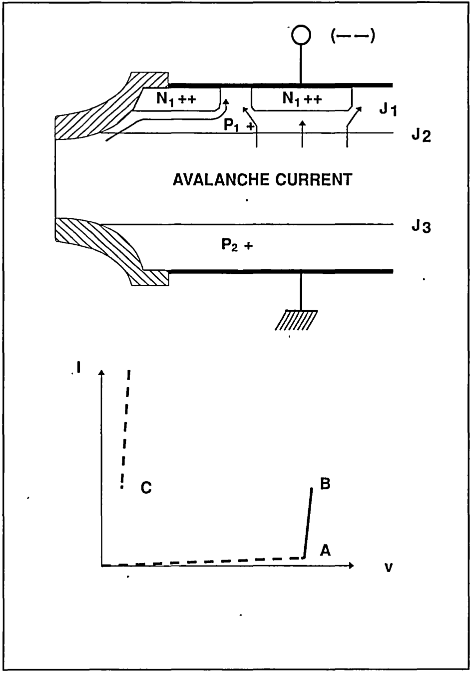


Application of a negative voltage on cathode N + + results in forward biasing of junctions J_1 and J_3 and reverse biasing of J_2.

The current observed is thus the leakage current of junction J_2.

When the voltage exceeds a certain value, junction J_2, which is reverse biased, begins to operate in the avalanche mode. Because of the profile of the groove associated with the type of passivation, this mechanism operates mainly in the area around the junction.

Figure 13 : Operation in the Avalanche Mode.



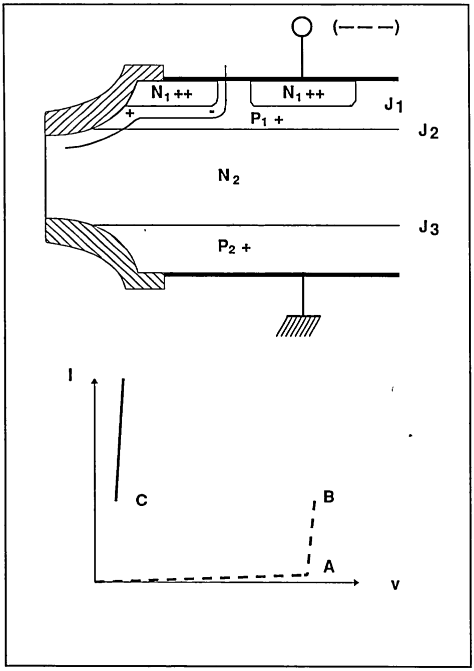
The structure up to this current level operates like a diode (junction J_2).

The side current biases the P_1 layer next to the N_1 part of the emitter. The highly dopped N_1 layer has the same potential.

The P_1 area at the surface is fored to the same potential as the N1 region by metallization.

The J_1 junction around the groove is biased by the lateral current.

Figure 14 : Thyristor Effect of the Trisil.



As the avalanche current increases this difference of potential can reach the threshold of 0.6 V, a value which is sufficient to create injection of electrons from the cathode towards the P_1 area and thus trigger thyristor N_1 P_1 N_2 P_2.

The electrons thus injected into P_1 in fact will reach J_2 by diffusion, and cross it under the effect of the electrical field operating in the space charge of the reverse biased J_2 junction.

In N_2, the electrons help to reduce the potential of this area compared with P_2 and as a result inject holes from P_2 towards N_2. These holes travel in the reverse direction because of their polarity. When they arrive at P_2 they help to increase the potential of P_1 with respect to N_1, this time resulting in the injection of electrons from N_1 to P_1.

The procedure is cumulative. The excess electrons in N_2 and the holes in P_1 will compensate the fixed charges of the space charge and will thus suppress it. Junction J_2 will act as a forward biased junction and the voltage across the component will drop.

TRANSIL/TRISIL COMPARISON

A. Bremond

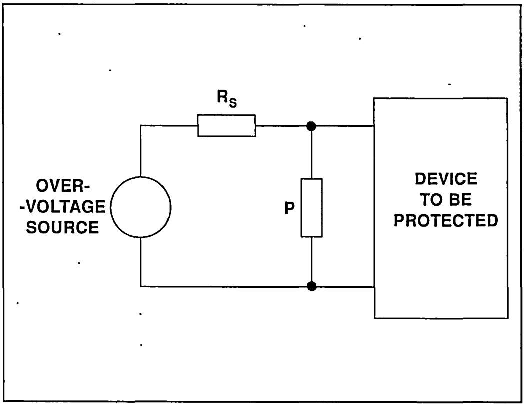
1. INTRODUCTION

To protect a sensitive device there are two different approaches.

The first one is to use series protectors, the second one parallel suppressors. The technologies used in both cases are such that the series devices are suitable for long duration surges, while parallel protectors are very efficient for the high current short duration stresses which represent the great majority of cases.

For the parallel protection solutions, two philosophies can be used. The first one is represented by a breakdown based device and the second one by a breakover based protector, respectively known as the Transil and the Trisil.

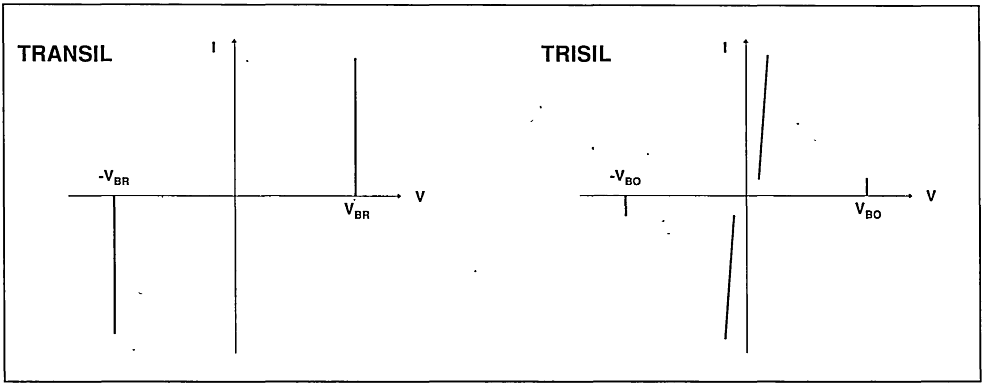
Figure1 : Classical schematic of parallel protection



2. TRANSIL / TRISIL COMPARISON

2.1. Electrical characteristics

Figure 1 : Electrical characteristics



The Transil is a clamping device which suppresses all overvoltages above the breakdown voltage (V_{BR})

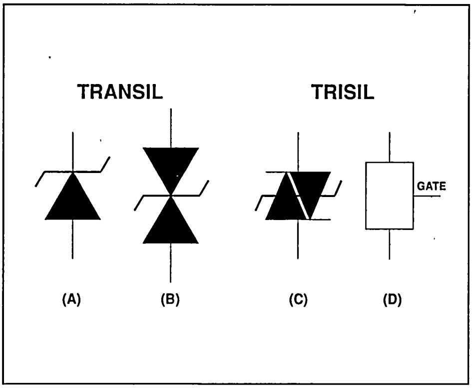
The Trisil is a crowbar device which switches on when overvoltages rise up to the breakover voltage (± V_{BO}).

2.3. Electrical Schematics.

The Transil may be unidirectional (Fig. 2 (A)) or bidirectional (Fig. 2 (B)). In unidirectional form, it operates as a clamping device in one sense and like a rectifier in the other.

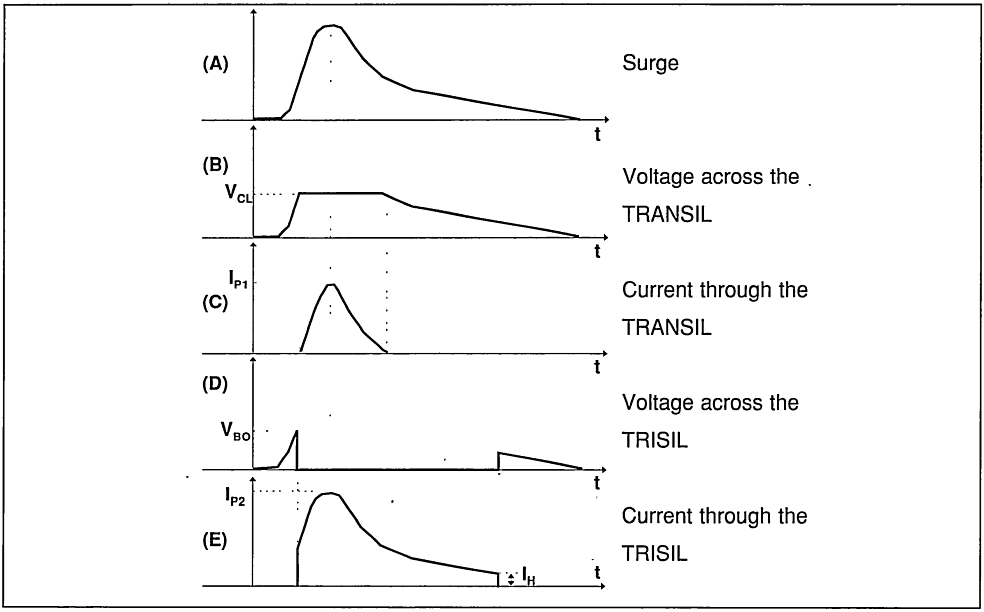
The Trisil may be designed to function with a fixed breakover value (fig. 2 (c)) or a value which can be programmed by the gate.

Figure 2 : Electrical Schematics



2.3. Electrical Behaviour.

Figure 3 : Electrical behaviour in a Transil and a Trisil



For the same surge (A) figure 3 shows the electrical behaviour of a Transil and a Trisil.

The parts (B) and (C) of figure 3 give the voltage across the Transil and the current through it. It is important to note that the current flows through the protection device only during the clamping phase. This fact has to be taken into account when the protector is chosen, because the current duration is always shorter than that of the overvoltage surge.

The parts (D) and (E) of figure 3 relate to the Trisil behaviour. In this case the device fires when the voltage across it reaches the breakdown voltage V_{BO} and remains in the on-state until the current falls under the holding value I_H. The current flows through the Trisil during all of the on-state phase.

2.4. Power dissipation

The dissipated power in both the Transil and the Trisil is due to the presence of voltage across and current through the protection device.

Note that for the same package, the current-handling capability of a Transil depends on the breakdown voltage, whereas this is not the case for a Trisil.

For example, with the CB429 package we have the Transil series 1.5 KE and the Trisil family TPB which have different behaviour in terms of current suppression.

Table 1 Current capabilities of Transil 1.5KE and Trisil TPB

	Current capability for 1ms wave			
	10V	62V	150V	220V
Transil 1.5KE	103A	17.7A	7.2A	4.6A
Trisil TPB		100A	100A	100A

As shown in table 1 the current rating of TPB devices is always 100 A whatever the V_{BR} value, while it depends on the V_{BR} for the 1.5KE series.

3. SUMMARY

Table 2 : Transil/Trisil Summary

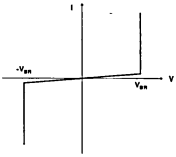
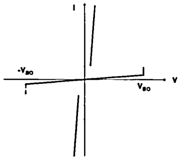
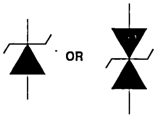
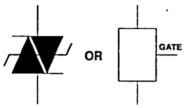
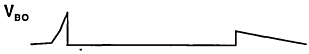
	TRANSIL	TRISIL
TYPE OF ACTION	CLAMPING	CROWBAR
ELECTRICAL CHARACTERISTICS		
SCHEMATICS		
ELECTRICAL BEHAVIOUR		
ACTION START	Vsurge > V_{BR}	Vsurge > V_{BO}
ACTION STOP	Vsurge < V_{BR}	I < Holding Current

Table 3 : Transil/Trisil advantages

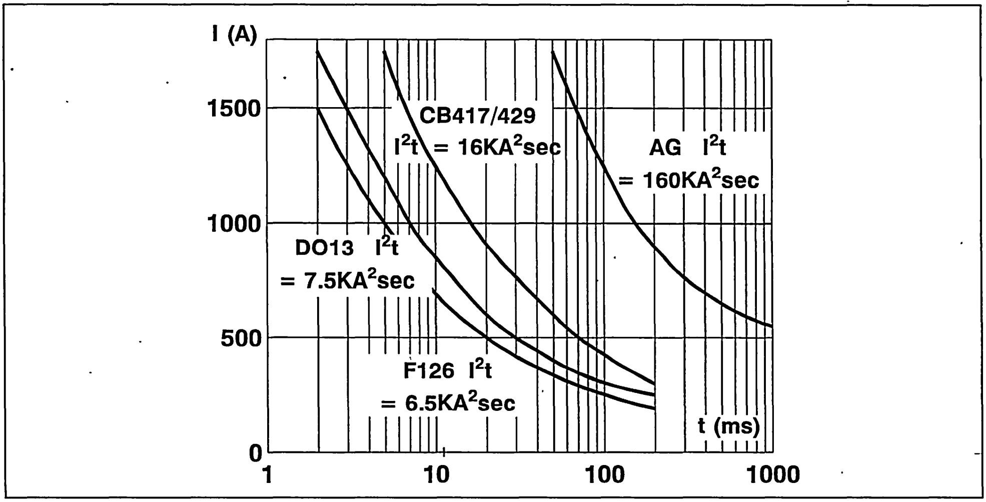
TRANSIL	TRISIL
No short - circuit across low - impedance lines , eg - power - supply.	Greater power handling due to lower voltage across terminals.
No need to ensure device switch - off after transient subsides.	Available with programmable breakover voltage.

Tables 2 and 3 summarize the different behaviour and advantages of both Transil and Trisil devices. It is not possible to say "Transils are better than Trisils" or the converse, only that their application areas are different. SGS-THOMSON produces both types of device so that the largest possible range of protection requirements can be satisfied.

PROTECTION BY TRANSIL
HOW TO ENSURE ABSOLUTE SAFETY

The function of a protection diode is to limit the voltage across the device being protected in case of accidental overloads. The accidents (atmospheric overvoltages, switching on the mains, failures of the equipment) are defined by standards. But selecting the ratings of a protection diode in accordance with the standards does not always guarantee satisfactory safety. In certain cases accidental overloads higher than those covered by the standards can destroy the protection diode. The user can accept this destruction due to an exceptional accident, but he requires ABSOLUTE SAFETY, i.e. the equipment can stop operating but in no case must it be destroyed. The protection diode should thus remain a short-circuit after the overload. The purpose of this publication is to provide the designer with the elements necessary to define this absolute safety. Fig. I gives the current limits below which TRANSIL diodes cannot be made open-circuits. By analogy with fuses, these limits can be characterized within the 10 µs to 1 s interval by I^2t (A^2sec).

Figure 1 : Values of I^2t for pulse durations less than a second



BEHAVIOUR OF TRANSIL DIODES IN CASE OF OVERLOADS

If an overload exceeds the limit Ipp specified for the Transil protection diode, it can be destroyed.

- Destruction **always** begins by an anode-cathode short-circuit.
- If a very high current then flows through the diode, the connections can melt and vaporize and the diode becomes an open circuit.

Numerous tests have been performed at the SGS-THOMSON characterization laboratory using current generators (3 to 1800 A) to determine the limits below which the user can be sure that the diode will remain a short-circuit after destuction of the silicon chip. The results of these tests are given for all TRANSIL diodes in figures 1 and 2.

Figure 2 gives the permanent short-circuit current I_{CP}.

It can be noted that Transil diodes withstand very high transient overloads. For example, a diode in a plastic case (CB-429) withstands an "I2t" of 16000 A2sec, i.e. more than the chip of a 150 A thyristor ! This is due to the particular technology of Transils in which the silicon chip is mounted between two piston- shaped leads with very high thermal capacity. By contrast, the current-handling capability of a Transil in continuous opertion is similar to that of a diode in the same package.

Figure 2 : Limits of the continuous rms current I_{CP} which do not result in the open-circuiting of a TRANSIL diode previously destroyed by an accidental overload

TRANSILS				
Case	**F126**	**DO13**	**CB417** **CB429**	**AG**
I_{CP} (A)	3	3.5	4.5	5

PRACTICAL CONSEQUENCES

A: NON-REPETITIVE PULSE OVERLOADS

In pulse operation (duration 1 second) the electromechanical capacity of the case is very much higher than that of the silicon chip (figure 1).

For example, if we consider the CB-429 case diodes of the "1.5 kW" series, the specifications of the maximum values Vcc and Ipp give an "I2t" for the silicon chip between 0.01 (high voltage) and 15 A^2s (low voltage). For the package, the value of "I^2t" is 16000 A^2sec, i.e. a THOUSAND TIMES higher.

The risk of a TRANSIL diode becoming an open circuit after a pulse overload is thus negligible in practice. The data in figure 1 thus enables the designer to check if his circuit falls within the absolute safety area.

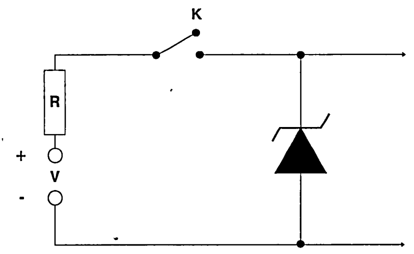
B: PROTECTION DIODES AFTER A VOLTAGE SOURCE

After an overload exceeding the limit Ipp, the Transil diode whose silicon chip has been destroyed is subjected to a current given by :

$$I_{CP} = \frac{V}{R}$$

In many cases this current can result in destruction of the Transil diode contacts, i.e. an open circuit which can have disastrous consequences.

To avoid this, it is necessary to add a device K which breaks the circuit after the failure. This device can be a fuse or a circuit-breaker. The data in figures 1 and 2 will enable the designer to determine the fuse (or circuit-breaker) which will break the circuit before the diode becomes an open circuit.



CONCLUSION

The specification of the new I2t and Icc parameters represents notable progress in the characterization of TRANSIL diodes. It enables the designer to define his protection with absolute safety, a vital precaution since the overloads encountered in practice do not always correspond with the standards. The building of absolutely safe equipment enables the damage due to unforeseeable accidents to be limited, which is considered important by SGS-THOMSON with our years of experience in the field of protection.

APPLICATION NOTE

CALCULATION OF TRANSIL APPARENT DYNAMIC RESISTANCE

B. Rivet

1 - INTRODUCTION

To estimate the clamping voltage V_{CL} and the dissipated power in a TRANSIL we need the apparent dynamic resistance of the device, rd.

This value depends on :

- The thermal impedance and therefore the package
- The breakdown voltage V_{BR}
- The pulse current duration tp (standard exponential pulse).

The purpose of this note is to explain the means of calculating rd.

2 - EXPRESSION OF THE DYNAMIC RESISTANCE Rd

rd is defined by the formula :

$$rd = (V_{CL}-V_{BR})/I_{pp},$$

Where V_{CL} is the peak voltage at Ipp and V_{BR} is the breakdown voltage of the TRANSIL measured at a low level of current (1mA)

There are two distinct cases :

- tp lower than 1 ms
- tp higher than 1 ms

a) rd (tp) with tp < 1 ms

In the data sheet V_{CL} max is specified at tp = 20 µs and 1 ms.

We can thus estimate $rd_{20\mu s}$ and rd_{1ms} with the following formula :

$$rd_{20\,\mu s} = \frac{V_{CL}\,max\,(\,20\,\mu s\,) - V_{BR}\,nom}{I_{pp}\,(\,20\,\mu s\,)} \qquad (\,1\,)$$

$$rd_{1ms} = \frac{V_{CL}\,max\,(\,1\,ms\,) - V_{BR}\,nom}{I_{pp}\,(\,1\,ms\,)} \qquad (\,2\,)$$

For tp between 20 µs and 1ms we can calculate rd (tp) as

$$(3) \quad \boxed{rd\,(\,tp\,) = \frac{rd_{1ms} - rd_{20\,\mu s}}{980}\,[\,tp - 20\,] + rd_{20\,\mu s}}$$

with rd in ohms and tp in µs.

The apparent dynamic resistance decreases when the duration decreases. For tp < 20 µs we can use a constant value equal to rd calculated for 20 µs (relation (1)). This is a pessimistic rule.

b) rd(tp) with tp > 1ms

SGS-THOMSON TRANSILS are built with one chip for the low voltage parts and with two chips in series for the high voltage ones. The two cases need to be considered separately.

b.1. Low voltage devices

(Up to 213 V for BZW series and up to 220 V for KE series).

Using thermal criteria we obtain the typical dynamic resistance rd $_{TYP}$ for tp higher than 1ms:

$$(4) \quad \boxed{rd_{typ} = \alpha_T\ Rth\,[\,1 - \exp\,(\,-\,tp/\tau\,)\,]^{\,B}\ V_{BR}{}^{2}nom}$$

Where:

- α_T is the temperature coefficient of V_{BR}. It can be found in the protection devices databook.
- Rth, τ, B define the transient thermal impedance Zth.

The curve Zth = f(tp) is given in the data sheet.

Rth, τ, B depend on the package. Their values, assuming that the device is mounted on a printed circuit board, are grouped together in the following table.

PACKAGE	FAMILY	B	T (s)	Rth (°C/W)
F126	BZW04	0.41	150	100
F126	BZW06	0.43	150	100
CB429	1.5KE	0.49	150	75
AG	BZW50	0.63	120	65

b.2. High voltage devices

(Over 213 V for BZW series and over 220 V for KE series)

In this case, the following formula is used :

$$\boxed{rd_{TYP} = \frac{\alpha_T}{2} R_{th} \left[1 - exp\left(\frac{-t_p}{T}\right)\right]^B V_{BR}{}^2 nom} \quad (5)$$

Note : To estimate the maximum value of V_{CL} and the peak power in the TRANSIL we have to use a coefficient k to take into account the dispersion of the various parameters (rd max = k rd $_{TYP}$). k = 2 is recommended.

3 - EXAMPLE OF APPLICATION : CHOICE OF A TRANSIL

Assume the surge current in the TRANSIL is an exponential pulse with I_{pp} = 3A and tp = 30ms. In the application (Fig.2) we have to check that $V_{RM} > V_{CC}$ = 30V and V_{CL} max < 55V with a maximum ambient temperature of 50 °C.

Try to use a 1.5KE36 P
The data sheet gives :

$$V_{RM} = 30.8V\ (>30V)$$
$$V_{BR}\ max = 39.6V$$
$$V_{BR}\ nom = 36V$$
$$\alpha_T = 9.9\ \times 10^{-4}\ /°C$$

The table Fig.1 gives :

$$R_{th} = 75°C/W$$
$$\tau = 150s$$
$$B\ = 0.49$$

With the relation (4) we find :

$$rd\ _{TYP} = 1.5\ Ohm$$
$$rd\ max = 3\ Ohms$$

$$V_{CL}\ max = V_{BR}\ max\ (1+\alpha_T\ (T_{amb}\ max\ -25)) + rd\ max\ I_{pp} = 50.2V$$

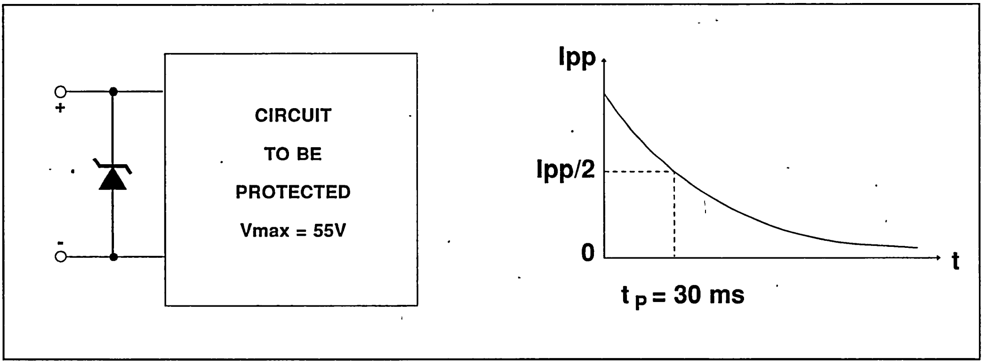
$$V_{CL}\ max = 50.2V < 55V$$

$$P_P = V_{CL}\ max\ x\ I_{pp} = 148.8W$$

The 1.5KE TRANSIL datasheet (curves Fig.1 and Fig.3) indicates (at 50C for a duration of 30ms) a maximum dissipation of 90% x 200W = 180W

So a 1.5KE36P can be used in this application.

Figure 2 : Application Diagram



SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

PCB LAYOUT OPTIMISATION

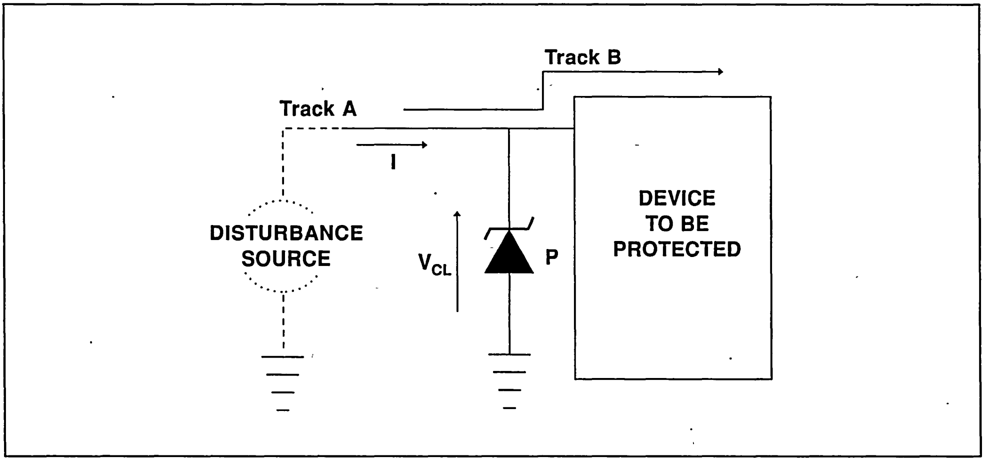
A. Bremond

1. INTRODUCTION

Protection requirements are becoming more and more well known and are often defined by rules or standards. To satisfy these requirements, there is, in the majority of cases, a standard solution or a dedicated product.

However, knowledge of the disturbances and the use of suitable protection devices are not sufficient in themselves to solve the problem. In many applications, the correct design of the PCB layout is essential for success.

Figure 1 : Classical protection location

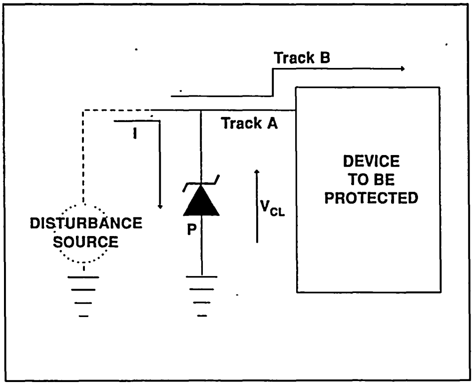


2. INFLUENCE OF THE PROTECTION LOCATION

The circuit presented in figure 1 shows the classical approach for the protection location. Here the protection device * is located close to the module to be protected. When a disturbance occurs on the track A the TRANSIL P clamps the surge at a maximum voltage V_{CL} and thus protects the sensitive part.

During this clamping action there is a current through P and also in the track A. This phenomenon induces a voltage on track B, where it is close to A. To avoid this undesirable parasitic overvoltage on track B, the circuit of figure 2 is recommended.

Figure 2 : Recommended protection location



In this case the current due to the clamping phase of P remains located in the disturbance area and the track B is not affected.

To summarize, it is recommended that the protection device is located as close as possible the disturbance source. For example, all the lines coming into the board ought to be protected close to the connector.

3. INFLUENCE OF THE PCB LAYOUT ON THE ESD PROTECTION

These days, printed circuit boards are often auto-routed by computer aided design and the track lengths are not optimized.

Figure 3 : Non-optimized LAYOUT for ESD

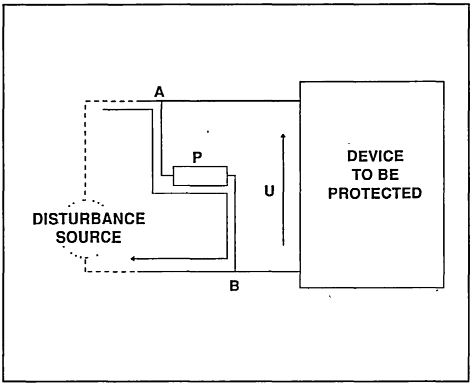
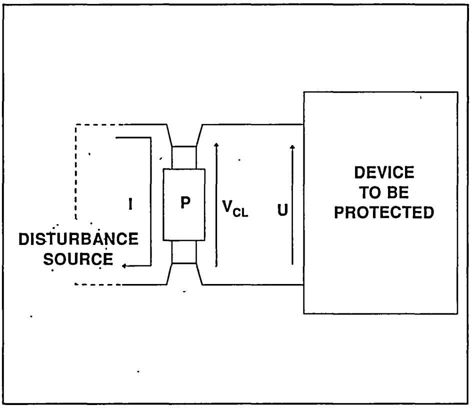


Figure 3 shows the classical non-optimized layout. When a surge occurs the protection device P acts and there is a clamping voltage V_{CL} across it. Due to the fast rise time of the ESD overvoltage there is a high di/dt between the points A and B. This di/dt generates, in the parasitic inductances located between A and P and between B and P, overvoltages up to several hundred volts. So the applied voltage V across the device to be protected is the sum of the clamping voltage and the voltage across the parasitic inductance : thus the sensitive module is not protected.

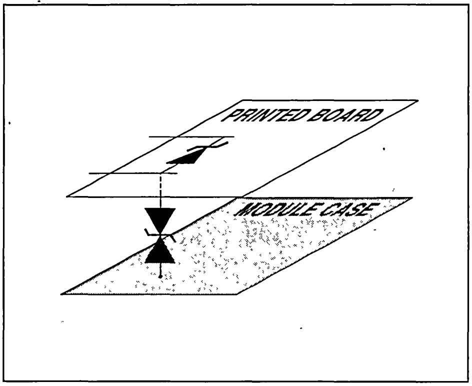
In the case of figure 4, the design topology is based on a 4 point circuit. When a surge occurs the Transil clamps at Vcl and due to the design the di/dt effects remain on the left hand side of P. Therefore the voltage V seen by the sensitive device is roughly equal to V_{CL}.

Figure 4 : Optimized layout for ESD



N.B. : The surface mount family SOD6 and SOD15 are particularly suited to this kind of application.

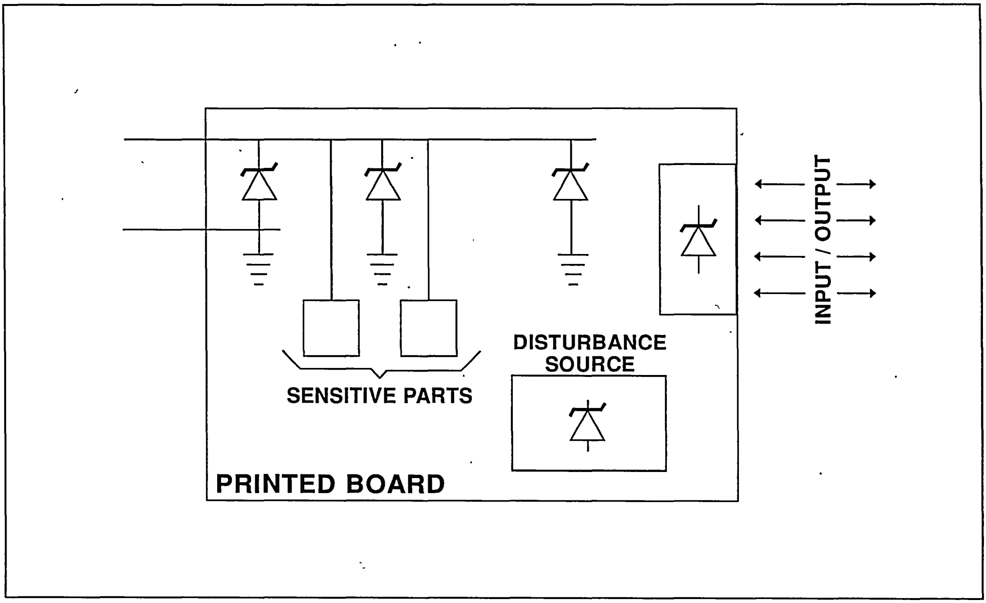
Figure 5 : Printer circuit board protection against ESD with case



These days most inputs are protected against ESD (though not always effectively) and so the voltage between the lines and ground never exceeds dangerous values.

However, this does not prevent the total electrical potential from increasing, possibly resulting in sparks between one point of the board and the module case. To avoid this problem we recommend a bidirectionnal Transil (BZW04P37B) between the printed circuit board ground and the metallic parts of the case.

Figure 6 : Distributed protection



4. DISTRIBUTED PROTECTION

The printed circuit board shown in figure 5 represents a general case. In this board the input/output lines are protected close to the connector and overvoltages are cancelled close to the disturbance sources. The other lines to be protected are the power supply wires which carry 3 kinds of disturbances :

- The overvoltages resulting from mains perturbations.

- The surges coming from the other boards supplied by these lines.

- The disturbances generated on the board by the normal operation of the resident module, for example the di/dt due to the fast switching of a buffer.

To suppress these surges we suggest a powerful Transil (1.5 KE for example) close to the power supply input on the board, and some lower power devices (e.g. BZW04) distributed around the board area.

5. CONCLUSION

Due to the parasitic inductance of PCB tracks, a protection device chosen purely according to disturbance standards does not assure immunity from surges. Carefully designed PCB layout plus correct device selection from the SGS-THOMSON range is essential to guarantee adequate protection.

* TRANSIL devices are used as examples throughout this document, but the same arguments are valid for TRISILS.

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

SURFACE MOUNT DEVICE SOD6/SOD15 PACKAGING AND SOLDERING METHOD

P. Rault

PACKAGING :

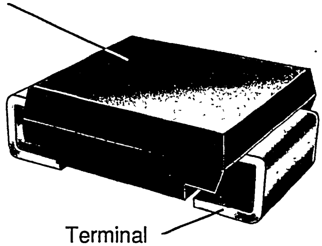
These devices are delivered in standard embossed 12 & 16 mm tapes and reels (E.I.A. 481A standards).

This packaging minimizes handling and is fully compatible with state-of-the-art assembly technology for hybrid circuits and printed circuit boards.

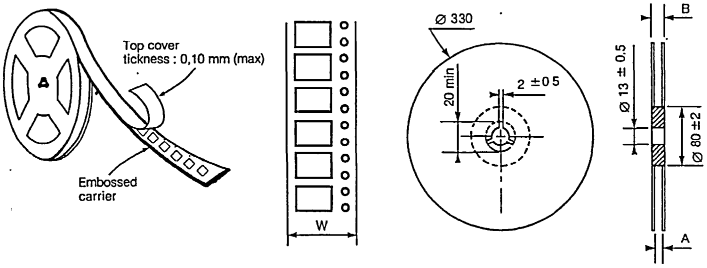
The diodes are pre-orientated and the tape can be used directly on automatic pick and place equipment.

Picking up is easy thanks to the rectangular parallelepiped shape. In particular, a vacuum chuck is very efficient due to the flatness of the upper side of the components, thus avoiding air leakage.

- Lead frame: copper alloy.
- Top connection: copper alloy.
- Die attach: Soft solder alloy.
- Encapsulation: high performance epoxy compound UL-94.
- Lead coating: Sn-Pb plating (10% Pb typical).
- Lead bending: suitable with surface mounting techniques (wave or re-flow)



Case	Quantity per reel	Film width	Reel dimensions	
			A	B
SOD 6	2500	12	12.4 ± 2	18.4 ± 2
SOD 15	2500	16	16.4 ± 2	22.4 ± 2



Note : Polarized devices have cathode lead oriented towards the perforated side of the film

SOLDERING METHODS :

SOD 6 & SOD 15 devices are suitable for mounting on various substrates (thick or thin films) and printed circuit boards.

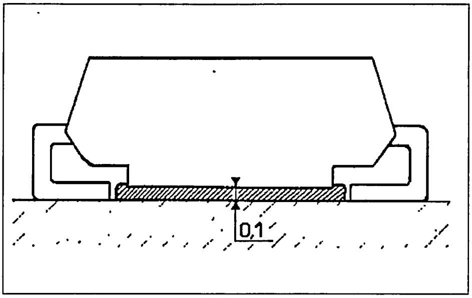
They are compatible with current soldering techniques.

1) WAVE SOLDERING :

This method is employed when surface mount components are used with conventional through-hole components on the same board. The through-hole mounting components are inserted from the top, and the SMD are attached to the under-side, using a suitable adhesive.

The lower part of the package allows a controlled thickness of the glue and ensures efficient adhesion.

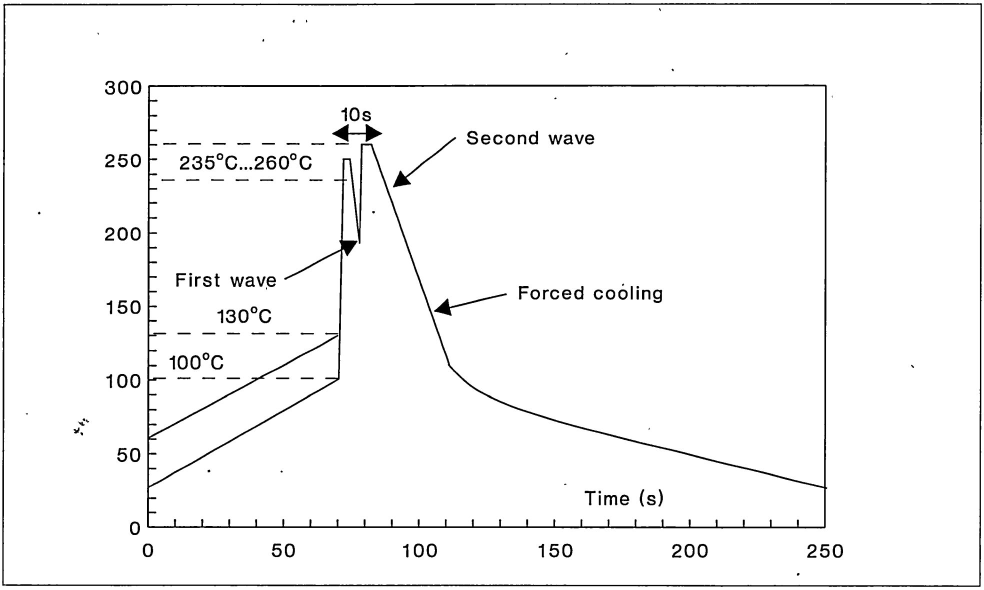
The height (2.6 mm) provides a very low "screen effect".



Recommendations :

- The assembly should be pre-heated to about 100°C to minimize the thermal shock.
- The maximum solder temperature is 260°C and the exposure time should not exceed 10 seconds.
- A dual wave process gives the best results.

Figure 1: Temperature -Time-Profile Double-Wave Soldering (Lead temperature)



Note : According to CECC Standard Method SMD 50301188 - Oct 89

2) REFLOW SOLDERING :

The epoxy resin specially designed for the molding of these components is suitable for all reflow soldering techniques used today :

- vapour phase
- infrared tunnel
- pulse-heat
- etc...

According to these methods, components are first positioned on the substrate and kept in place thanks to the adhesive properties of the solder paste applied to the soldering areas (footprints).

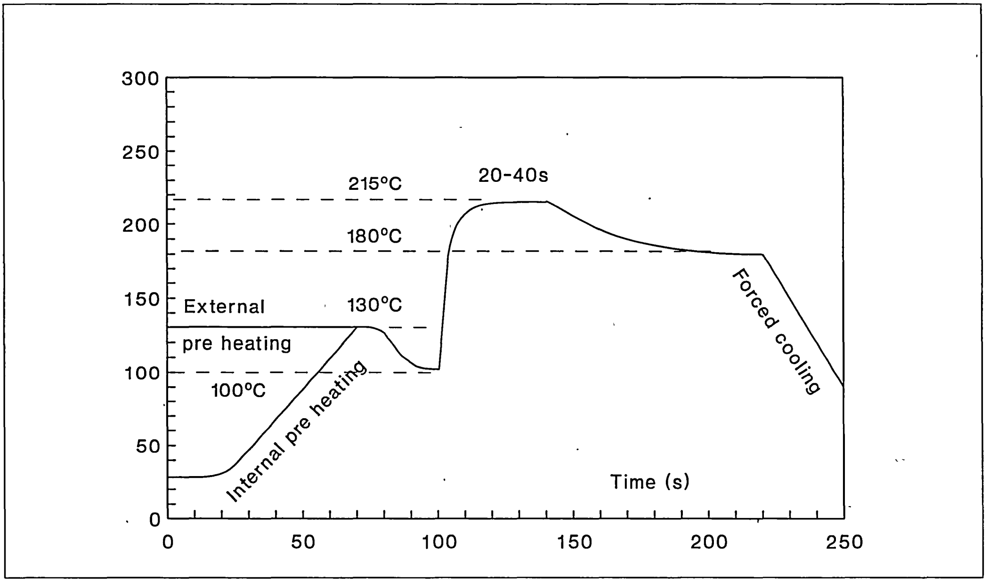
The wide surfaces of contact of SOD 6 & SOD 15 packages ensure a good stability of the assembly before reflowing process.

Recommendations :

The soldering temperature changes according to the method used. Pre-heating up to 100°C is required. The temperature during reflow should be limited in order to keep the plastic body of the device below 260°C. At this temperature, exposure time should be less than 10 seconds.

The vapour phase reflow soldering method provides the best control of the temperature and gives the most uniform results.

Figure 2 : In Line System with Preheating - Temp.-Time-Profile Vapour-Phase-Soldering (Lead Temperature)



Note : According to CECC Standard Method SMD 50301188 - Oct 89

3) PROTOTYPES :

In the laboratory, for low volume, reflow soldering using heat-plate can be implemented. The immersion method is also a possibility.

When the complete circuit board is immersed in a solder bath, the temperature should not exceed 260°C and the soldering cycle should not exceed 10 seconds. A forced cooling is then recommended.

APPLICATION NOTE

POWER CROSSING BEHAVIOUR OF LINE CARD PROTECTION

A. Bremond

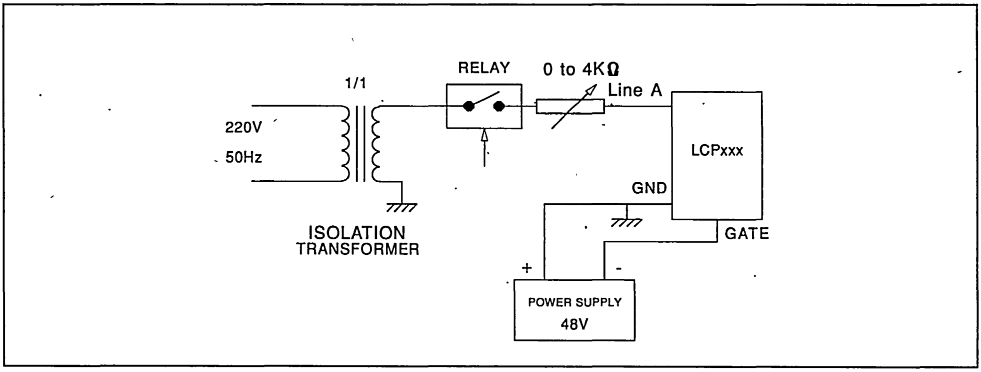
1 - INTRODUCTION

The purpose of this document is to explain the behaviour of LCP 150S/1511/1512 devices during the coupling between a telecommunication line and a mains line.

2 - TEST DIAGRAM

Figure 1 shows the test diagram. The mains 220 V 50 Hz is applied to the test assembly through an isolation transformer. A relay driven by a mono-pulse generator allows the conducting time to be adjusted. The current through the device is adjusted by a series resistor.

Figure 1 : Test Diagram

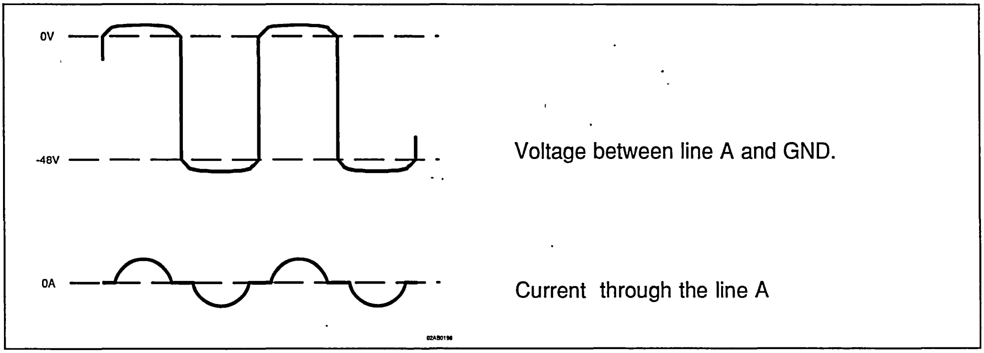


3 - MEASUREMENTS

During the tests three kinds of behaviour occur :

a) As shown in figure 2 the device acts as a clamping device (non-firing) due to the small value of the current which never exceeds the latching current of the structure.

Figure 2 : Voltage and current for a non-firing device



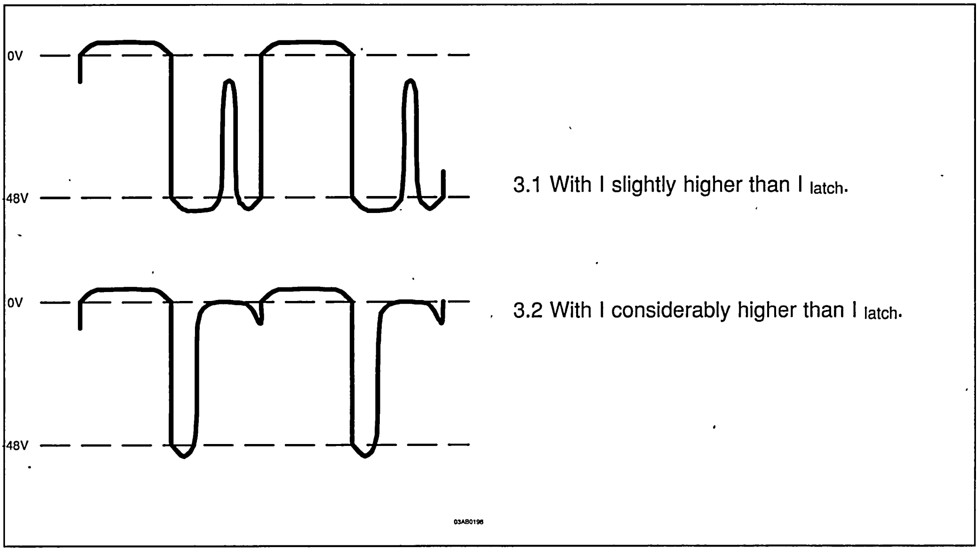
b) In the second operating region the LCPxxx fires and the piece under test is still functional after 15 minutes.

- Figure 3.1 shows the start of the firing (the peak of the current wave through the device is just over the latching limit).

- In figure 3.2 the amplitude of the current wave through the device is greater than in the precedent case, so the device is well fired after a few hundred microseconds.

c) In the third operating region the device has been destoyed in a time depending on the current through the LCPxxx.

Figure 3 : Voltages for a firing device



3.1 With I slightly higher than I $_{latch}$.

3.2 With I considerably higher than I $_{latch}$.

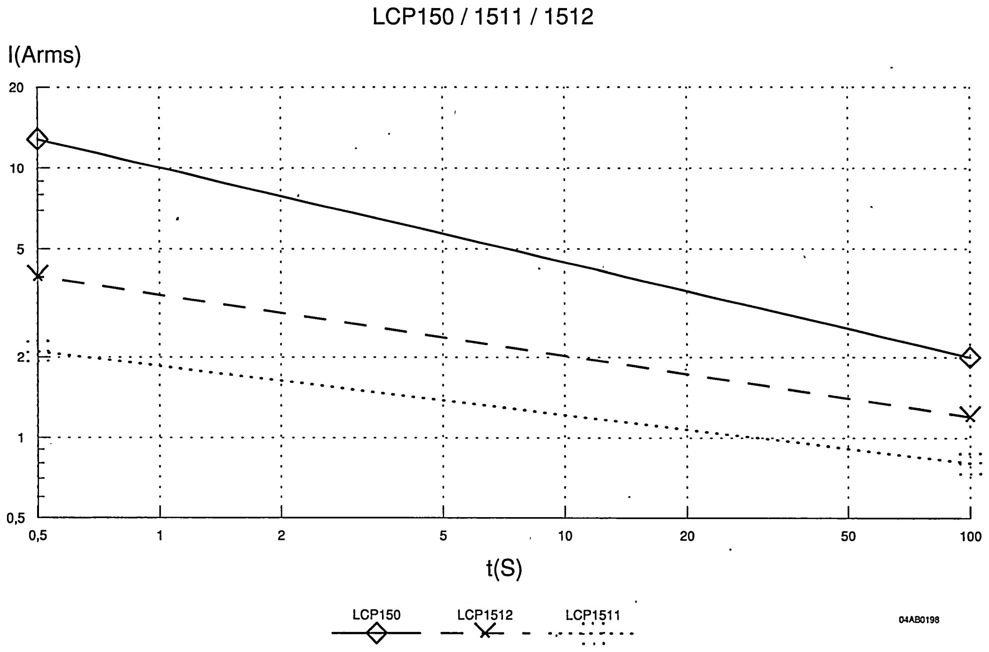
4 - ANALYSIS

OPERATING REGION	LCP 150	LCP 1512	LCP 1511
A/clamping	0 to 70 mA *	O to 70 mA *	O to 70 mA *
B/non destructive region	0.07 to 2 A *	0.07 to 1.2A*	0.07 to 0.8A *
C/destructive region	Over 2 A *	Over 1.2 A *	Over 0.8 A *
* RMS current			

Table 1: Operating Region Definition

Table 1 shows the range of the three operating regions, while figure 4, which illustrates region C, allows us to determine the destruction time limit of each device versus the current through the structure (RMS current at 25°C).

Figure 4 : Characteristics of Region C
(With Vgate = -48 V)



CONCLUSION

The devices in the LCPxxx family have common characteristics, divided into three regions :

a) Clamping mode, still functional after 15 minutes

b) Crowbar mode (firing) still functional after 15 minutes of test at 25°C

c) Crowbar mode, with a destruction time defined by figure 4.

The given curves enable the appropriate series elements to be chosen, for example a PTC device.

TELECOM APPLICATION NOTES

SGS-THOMSON
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APPLICATION NOTE

PROTECTION CONCEPTS IN TELECOMMUNICATIONS EQUIPMENT

A. Bremond

I INTRODUCTION

The goal of a telecommunication network (fig.1) is to permit data exchange (speech or digital) between two or more subscribers.

The network is made up of different parts which are subject to various disturbances.

The most susceptible elements are the lines, due to their length and their geographical location.

Disturbances strike the lines and are then propagated to the extremities of the lines at which lie telephone sets and the subscriber line interface cards (SLIC).

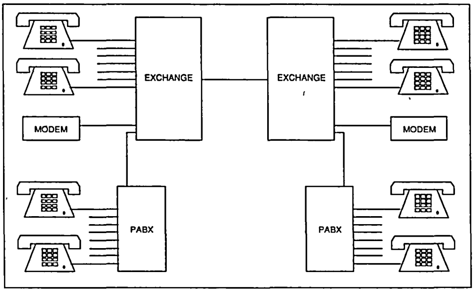
So the lines receive two kinds of overvoltages :

Surges of short duration with high peak voltage value (a few hundred micro-seconds for a few thousand volts). These are generated by atmospheric phenomena.

Surges of long duration with medium voltage value (greater than one second for a few hundred volts RMS) which are due to the mains AC power networks.

The purpose of this application note is to analyse these 2 kinds of overvoltages.

Figure 1 : Classical telecommunication network topology



II OVERVOLTAGES ACROSS TELECOMMUNICATION LINES :

II.1 Atmospheric effects :

Lightning phenomena are the most common surge causes. They are mainly due to a voltage difference between the ground and the clouds (a few 100 kV). Two kinds of strikes may occur:

1) Negative discharge with a peak current of 50 kA, rise time of 10µs to 15µs and 100µs duration.

2) Positive discharge with a peak value of 150 kA, rise time between 20µs and 50µs and a duration between 100ms and 200ms.

The lightning effect appears on the lines in two ways.

- Direct shock.
- Induced shock.

Figure 2 : Lightning phenomenon

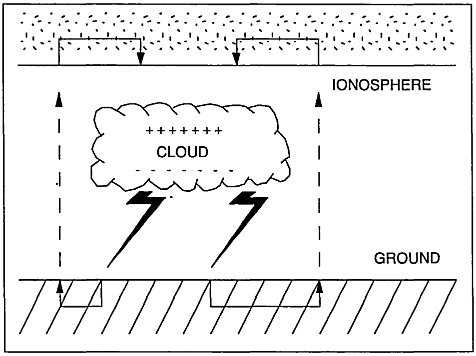


Figure 3 : Direct lightning strike

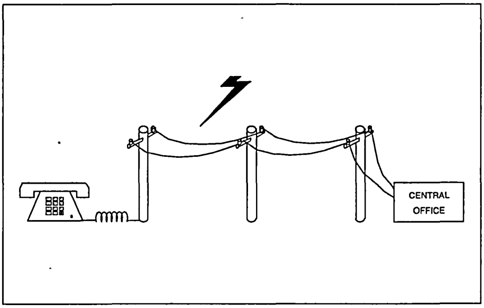
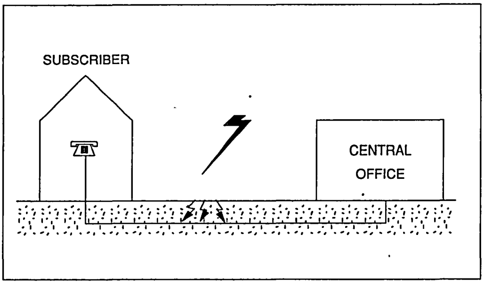


Fig.3 shows the first case which is produced mainly on overhead lines.

Induced shock is more frequent than a direct shock. Lightning strikes the ground and a current flows in the cable shield. This current produces a voltage gradient which in some places is above the insulation capability of the cable material (Fig.4).

Figure 4 : Induced strike



II.2 Proximity and crossing with AC mains lines :

For these kinds of surges two cases may be seen :

The first one is due to the falling of an AC mains cable on a telephone line.

The second case is produced by the proximity of a subcriber line with an AC mains line or equipment (mainly capacitive coupling).

It is interesting to note for these types of disturbances a RMS value of a few Amps for a duration of between 1 s and 15 mn.

III PRIMARY AND SECONDARY PROTECTION :

The figures in chapter II give us an idea of the energy which may appear on the lines. In the field these surge values are lower due to the losses of ground resistance, the capacitive coupling and so on, but are signifiant nevertheless.

We have to divide these disturbances into two families :

High peak value and short duration (lightning)

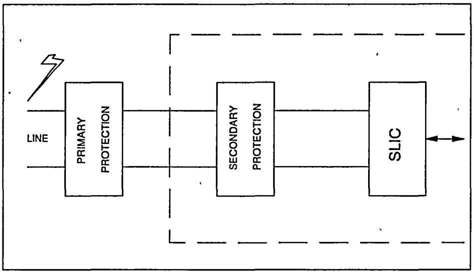
Short peak value and long duration (crossing with AC power).

For both cases the present state of the art of silicon protection devices does not permit the suppression of these levels of energy.

A second parameter to keep in mind is the very low clamping factor (1) needed by the IC's used to realize the line interface. This forces the designer to use a protection solution with silicon (fast response time/low clamping factor).

High energy values and low clamping factor impose two protection levels.

Figure 5 : Primary/secondary protection topology



The first level called primary protection (fig.5) located on the connecting terminal of the exchange, suppresses the major part of the disturbance. The second level called secondary protection reduces the remaining overvoltage.

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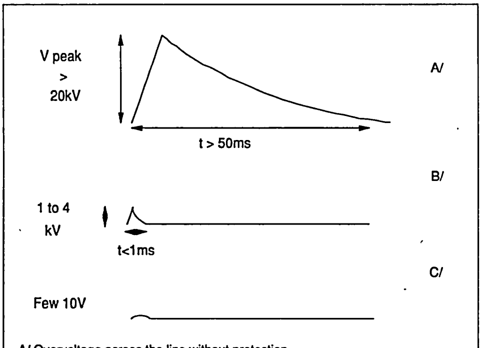
(1) the clamping factor is the ratio of the normal operating voltage over the maximum clamping voltage.

Figure 6 : Primary/secondary protection level effects



A/ Overvoltage across the line without protection.
B/ Remaining voltage after the primary level action.
C/ Remaining voltage after the secondary level action.

Figure 6 shows the goal of both protection levels.

In this example the surge across the line without protection will be several 10 kV peak value for several 10 ms duration (Fig.6A)

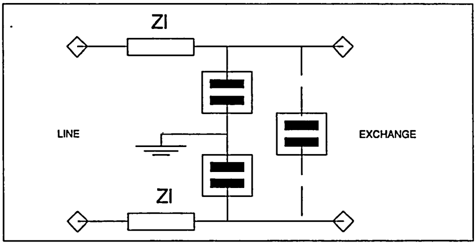
After the primary protection the major part of the energy is cancelled (Fig.6.B). The remaining overvoltage may be a few kV (depending on the dv/dt of the surge and the surge arrestor technology used).

Across the second level protection the voltage does not exceed a few 10 Volts.

III.1 Primary protection :

Actually two kinds of primary protection are used :
- carbon gaps.
- gas tubes.

Figure 7 : Carbon gap based primary protection

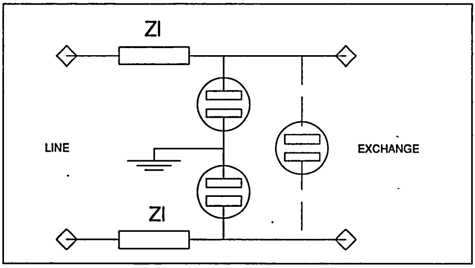


III.1.A Carbon gaps :

These components are made by two carbon electrodes. The carbon gap is a low cost primary protection but it has two major disadvantages :
- its short life duration
- its variable spark threshold.

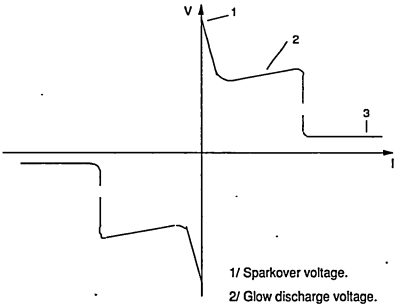
III.1.B Gas tubes :

Figure 8 : Gas tube based primary protection



These components are made by two metallic electrodes in a sealed case. Generally the sealed tub contains a low pressure gas.

Figure 9 : Gas tube characteristics



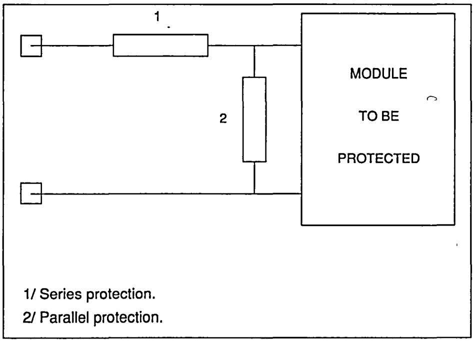
1/ Sparkover voltage.
2/ Glow discharge voltage.
3/ Remaining voltage in switch on mode.

The major disadvantage of this kind of device is its response time, in fact the maximum voltage across the gas tube depends on the dv/dt of the surge.

III.2 Secondary protection :

III.2.A Series and parallel protection :

Figure 10 : Series and parallel protection



The secondary protection level is generally achieved with two types of devices :

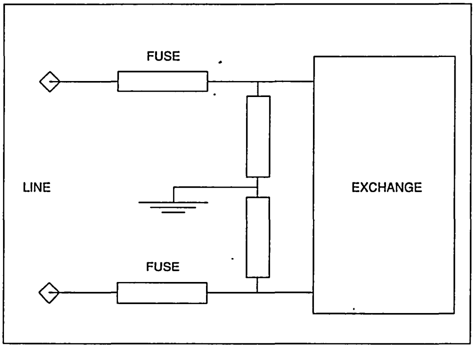
The series protection ensures protection against the proximity of or the crossing with AC power lines.

The parallel protection operates to suppress the overvoltages due to the lightning effects.

* Series devices :

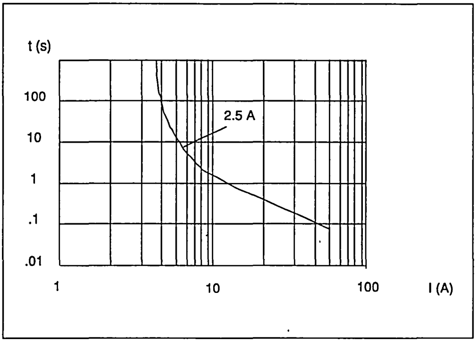
Series devices operate by opening the circuit or by an increment of the resistance.

Figure 11 : Fuse protection



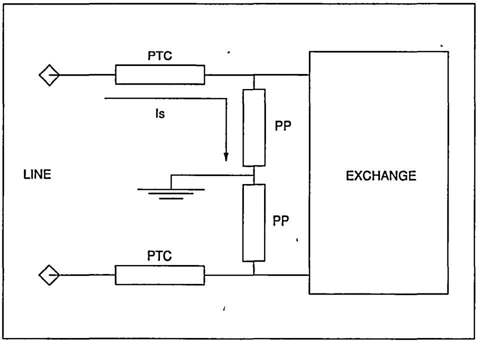
The fuse is a classical case of protection by opening the circuit. Figure 11 shows an exchange protected by fuses and figure 12 represents an example of the limit curve of the fusing action.

Figure 12 : Fuse blowing function



These components provide an absolute security after action, but their major disadvantage is the need for maintenance.

Figure 13 : PTC based protection

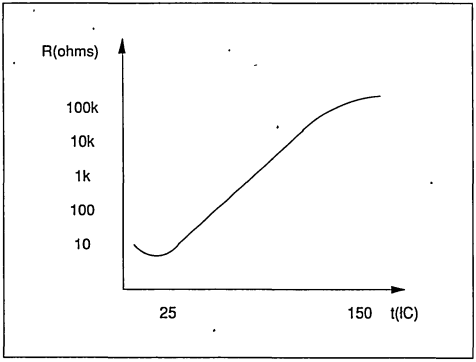


The PTC thermistor is a device which operates by very rapid resistance increase as a function of the temperature.

When the surge occurs across the line, the parallel protection PP is activated.

The surge current Is, generated by PP action, flows through the PTC device and increases its internal temperature. As shown in figure 14 the resistance value of the PTC device rises quickly with the temperature.

Figure 14 : Resistance versus temperature



The major disadvantage of the fuse does not exist with the PTC device. Unfortunately this kind of component has a large tolerance, a long time to return to its stand off point and a drift of its value.

Another series device is the resistance which limits the current through the parallel protector.

* Parallel devices :

The parallel protection function may be assumed by different devices based on different technologies.

In fact it is clear that the future in term of SLIC topology is based on the use of ICs. So the consequent requirement for good response times and high clamping factor necessitates the use of silicon protection.

Parallel silicon protection functions in two different modes.

- The clamping mode with the TRANSIL.
- The crowbar mode with the TRISIL.

IV CONCLUSION

Due to atmospheric effects and disturbances on mains networks, telecommunication lines have to be protected. Due to the improvement in telecommunication system technology, a need for fast and precise protection solutions results.

The choice of the protection diagram will be done considering local standards and the technology of the devices to be protected.

This protection will be assumed to be dual level

- Primary level to suppress high energy.
- Secondary level to optimize the remaining overvoltage.

VOLTAGE TO CURRENT WAVEFORM CONVERSION
(Example Of The 10/700 µs Surge)

A. Bremond

INTRODUCTION

CCITT members have generated a great deal of recommendations which have permitted national administrations to publish local standards. In particular they have defined a 10/700 µs surge waveform and its associated generator diagram (see fig.1).

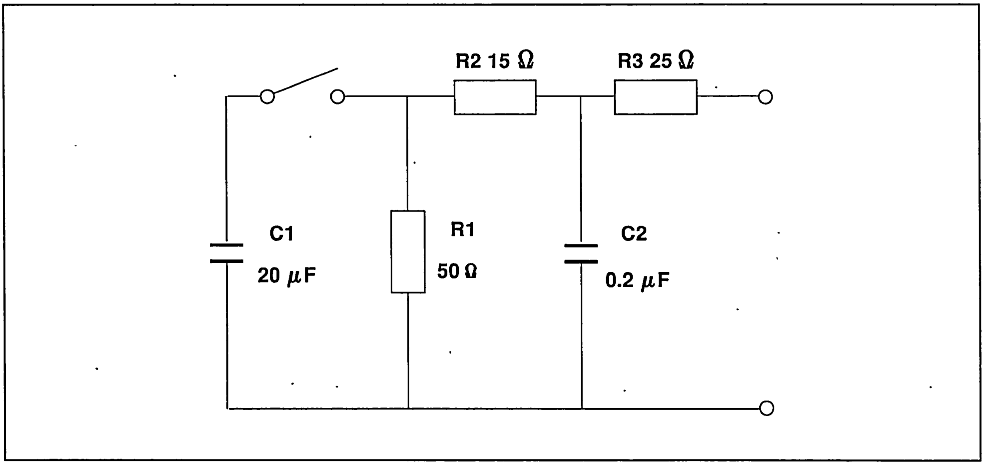
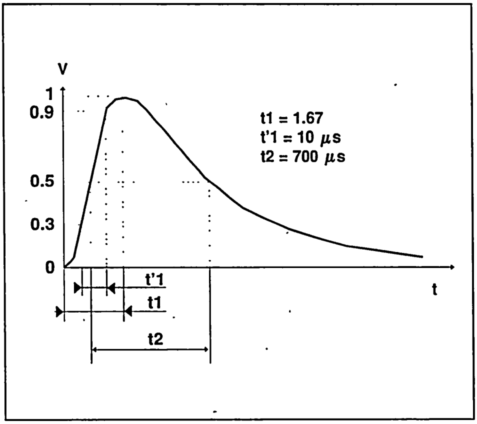


Figure 1 : CCITT 10/700 µs Surge Definition



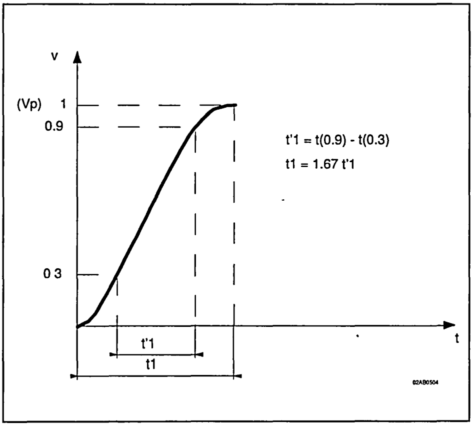
GENERATOR DIAGRAM
OPEN OUTPUT SURGE WAVEFORM

It is important to note that the given waveform is the generator output voltage without load. For a protection component user the most important parameter to take into account is the current waveform flowing through the surge suppressor. The goal of this paper is to give the current waveform parameters.

2 - WAVEFORM CALCULATION

2.1 : Generator output voltage without load.

Figure 2 : Voltage Rise time



2.1.1 : Rise time

The equation of this curve is :

$$v(t) = Vp\ (1 - \exp(-\ t/T))$$

$$\Rightarrow t = -\ T\ \log_n (1 - (v(t)/Vp)) \qquad (1)$$

In this case the time constant may be estimated as :

$$T = R_2\ C_2$$

So t(0.3) and t(0.9) will be calculated respectively with v(t)/Vp = 0.3 and 0.9

$t(0.3) = 1\ \mu s$.

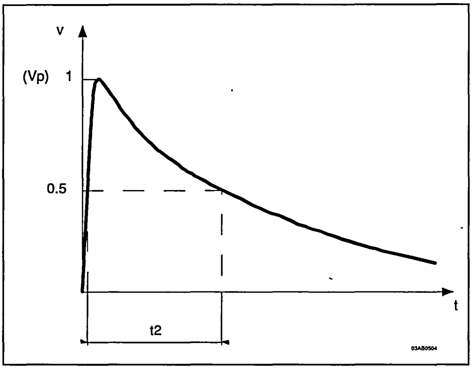
$t(0.9) = 6.9\ \mu s$

and then

$$t1 \quad = 1.67\ (t_{(0.9)} - t_{(0.1)})$$

$$= 9.8\ \mu s \approx \underline{\underline{\ 10\ \mu s}}$$

Figure 3 : Voltage duration



2.1.2 : Voltage surge duration

The equation of this curve is:

$$v(t) = Vp\ \exp(-\ t/T))$$

$$\Rightarrow t = -\ \log_n (v(t)/Vp)) \qquad (2)$$

with a time constant due essentially to R_1 and C_1

$$T = R_1\ C_1$$

So t_2 may be calculated with

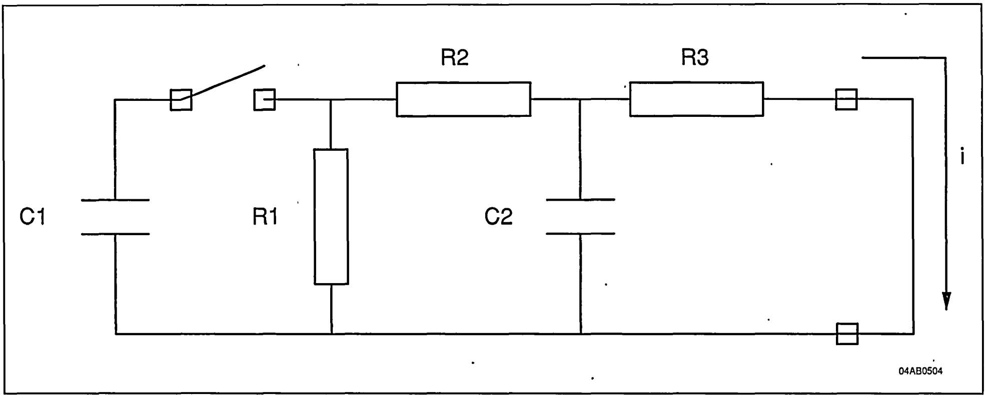
$v(t)/Vp = 0.5$

$$\Rightarrow t2 = 693\ \mu s \approx \underline{\underline{700\ \mu s}}$$

2.2 Generator short circuted output current.

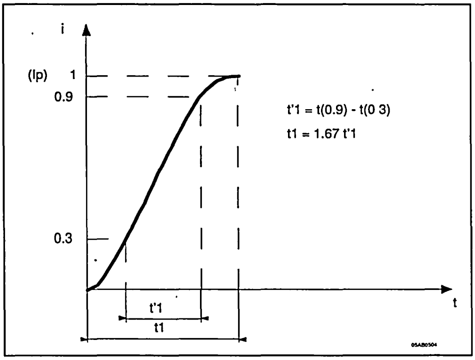
In this chapter we will do the calculations with the generator output in short circuit (see fig.4), this is generally the case during the surge suppressor action (for example the Trisil technogy devices from SGS THOMSON).

Figure 4 : CCITT 10/700 ms generator with output in short circuit



2.2.1 : Rise time

Figure 5 : Current rise time



The formula (1) given in the chapter 2.1.1. remains true, but the time constant must take into account R_3 and may be estimated as :

$$T = (R_2\ R_3/(R_2 + R_3))\ C_2$$

$$\text{So}\ t_{(0.3)} = 0.67\ \mu s$$

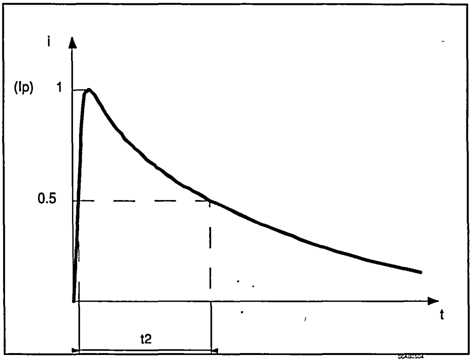
$$t_{(0.9)} = 4.3\ \mu s$$

$$\Rightarrow t1 = 1.67\ (t(0.9) - t(0.1))$$

$$= 6\ \mu s \approx \underline{\underline{5\ \mu s}}$$

2.1.2 : Current surge duration.

Figure 6 : Current duration



The formula (2) given in the chapter 2.1.2. remains true but the time constant is now due to the capacitor C_1 with the resistor R_1 in parallel with $R_2 + R_3$

$$T = (R_1\ (R_2 + R_3)/(R_1 + R_2 + R_3)\ C_1$$

$$\Rightarrow t2 = 308\ \mu s\ \approx \underline{\underline{310\ \mu s}}$$

3 - SUMMARY

The 10/700 µs surge waveform given by the CCITT recommendation is a voltage wave produced by the generator in open circuit. This curve is very important as a test reference for telecommunication equipment.

The protection function designers or users have to know the actual current waveform flowing through the protector in order to optimize it.

The 10/700 µs CCITT generator gives a 5/310 µs current wave when its outputs are in short circuit. (In the case of a crowbar device, for example Trisil).

For certain cases the resistor R3 is equal to zero and then the duration time becomes 160 µs.

Please note that in certain documents we find a 8/320 µs current wave which represents the same surge test.

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

PROTECTION STANDARDS APPLICABLE TO TERMINALS

C. Politano

1. INTRODUCTION

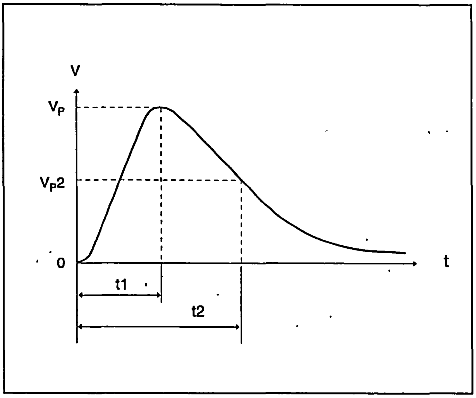
The purpose of this document is to summarize the main telecommunication standards with regard to the protection requirements against two types of overvoltage :

- lightning surges
- power crossing perturbations

2. LIGHTNING SURGES

The lightning overvoltage is simulated by a biexponentional wave, which is defined by the rise time t1 and the duration t2 between the start and the time at which the falling edge crosses half the peak value (fig.1)

Figure 1 : Standard wave



Each country publishes it standard, which can be summarized by the times t1 and t2, the peak voltage of the wave and the surge generator diagram. Table 1 gives on inexhaustive list of the standards :

Table 1 : Lightning surges standards.

COUNTRY	AUTHORITY	WAVEFORM (µs)
ENGLAND	CCITT-417 BRITISH TELECOM	10/700 10/700
FRANCE	PTT	0.5/700
GERMANY	BUNDESPOST	10/700
ITALY	SIP	10/700 1/1000
SPAIN	COMPANY TELEFONICA DE ESPANA	1/1000
SWEDEN	TELEVERKET	10/700
SWITZERLAND	PTT - BETRIEBE	10/700 1.2/50
USA	BELL	10/1000 10/360 2/10
	FCC	10/560 10/160 2/10
The peak voltage value varies from 1 kV to 2 kV according to the country.		

The following figures give the schematics of the surge generators mainly used :

Figure 2 : 10/700 µs wave generator

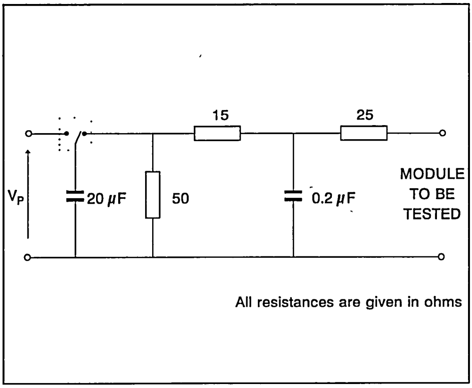


Figure 3 : 1.2/50 µs wave generator

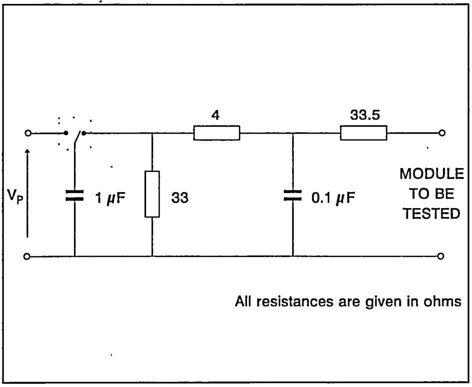


Figure 4 : 0.5/700 µs wave generator

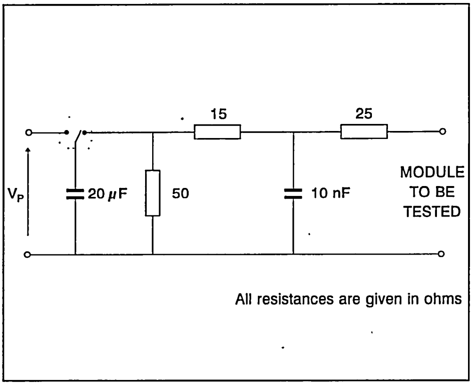


Figure 5 : 10/560 µs wave generator

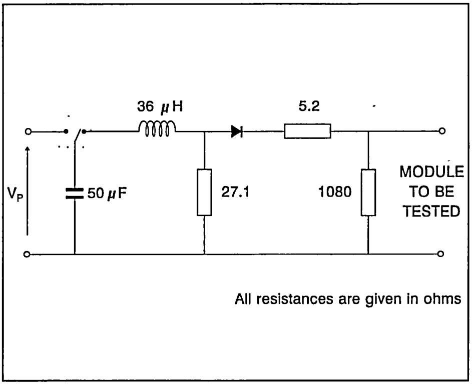


Figure 6 : 1/1000 µs wave generator

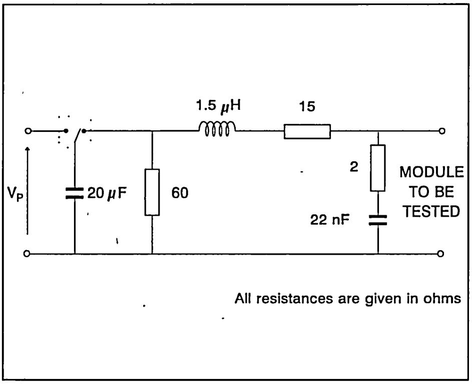


Figure 7 : 10/160 µs wave generator

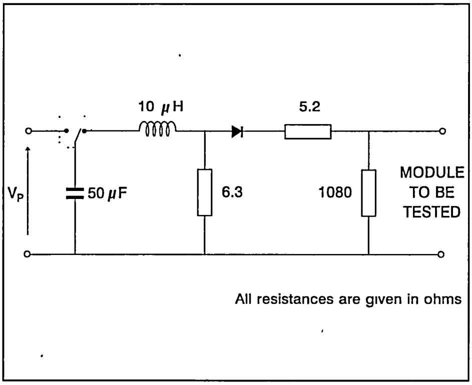
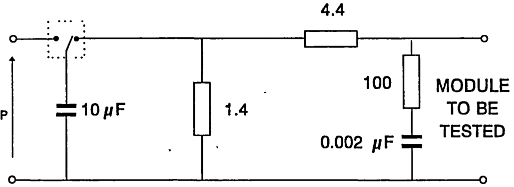


Figure 8 : 2/10 µs wave generator

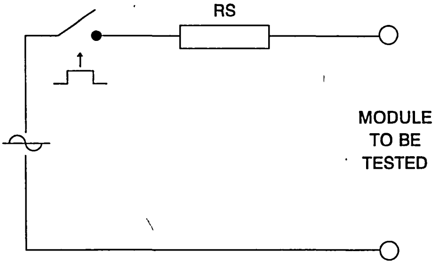


All resistances are given in ohms

3. CROSSING OR PROXIMITY WITH MAINS AC LINES :

Crossing or proximity is simulated by a sine wave generator (50 or 60 Hz) connected through a series resistor for a defined time (fig.9)

Figure 9 : Crossing simulation generator



For terminal applications this power crossing test is not widely required because only a few countries impose this standard.

The typical protection arrangement consists of a crowbar device plus a PTC.

4. CONCLUSION

Many different telecommunications protection standards are currently in use around the world. The SGS-THOMSON range of protection devices enables all of these to be covered.

PROTECTION SCHEMATICS FOR TELEPHONE SETS

C. Politano

INTRODUCTION

The type of telephone set that is being protected must first be identified.

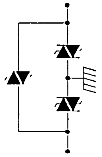
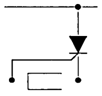
A telephone set connected to a public network must be able to withstand surges described in standards such as CCITTK17, VDE0433, I3121, etc.

A telephone set connected to a private network is subjected to much less severe surge conditions.

In each case, SGS-THOMSON offers a suitable protection solution based on crowbar devices which can provide a very high surge current capability (from 30 Amp. to 100 Amp., 10/1000µs pulse width).

Table 1 below shows the complete product range available for telephone set protection.

Table 1 : Telephone set protection product range

TRISIL			3 TERMINAL TRISIL		GATE TRIGGERED SUPPRESSOR (current limitation)	
						
AXIAL	**SOD**	**DIL8**	**SO8**	**DIL8**	**SO8**	**DIL8**
50A TPAxx 100A TPBxx	50A SMTPAxx 100A SMTPBxx	100A @10/1000µS LS5018B LS5060B LS5120B	THBT15011 THBT20011 THBT27011	THBT15012 THBT20012 THBT27012	30A @ 10/1000µS TPP25011	30A @ 10/1000µS TPP25012 100A@10/1000µS L3100B1

1. CHOICE OF THE PROTECTION DEVICE:

To choose the right protection device, the user will have to determine the following characteristics :

1) Surge current capability

2) Functional parameters

1.1. Surge current capability

There are two kinds of disturbances which have to be evaluated in order to define correctly the surge current capability of the protection device :

I.1.1. Protection against short duration disturbances :

These are transient overvoltages, which are specified in telecom standards such as CCITT k17, VDE04-33, I3121. The typical voltage waveforms are the 10/700µs and the 1.2/ 50µs types.

The user has to take care that the protection standard specifies voltage pulse waveforms, which have to be converted into pulse current waveforms. Thus he will obtain the peak surge current value Ipp which has to be withstood by the protection device.
(See application note 2.2 : Voltage to current waveform conversion).

I.1.2. Protection against long duration disturbances.

In this case, the standards can be very different from one country to another, and the duration of the superimposed mains on telephone lines can reach more than 10 minutes with a current of around 8A. Obviously, it is not possible to withstand such surges with a plastic component. An economical and reliable solution is to use a PTC (positive temperature coefficient thermistor). These PTC devices with 10 Ω resistance (at 25°C) can reach a few k during the surge. The switching time depends on the surge current and the PTC. Nevertheless, most PTCs tested with an alternating surge current of 8 A react in 10 to 100 ms. Such a device could therefore be combined with a TPA Trisil which is able to withstand 8 A for 150 ms without any problem (see data sheet). In case of higher current the TPB versions should be used.

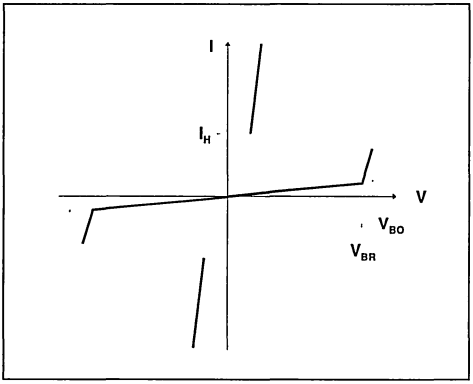
In conclusion, Trisil + PTC thermistor is the best performance / cost compromise for the subscriber telephone set protection.

1.2. Functional parameters :

To select the right CROWBAR protection, three main parameters have to be defined according to the application (see fig.1) :

- The minimum breakdown voltage : V_{BR}
- The maximum breakover voltage : V_{BO}
- The minimum holding current : I_H

Figure 1 : Crowbar protection electrical parameters



I.2.1. The breakdown voltage : V_{BR}

The V_{BR} has to be greater than the maximum voltage value which will be supplied in the line.

This condition will guarantee that the protection is not activated in the normal operating mode (no overvoltage).

I.2.2. The breakover voltage : V_{BO}

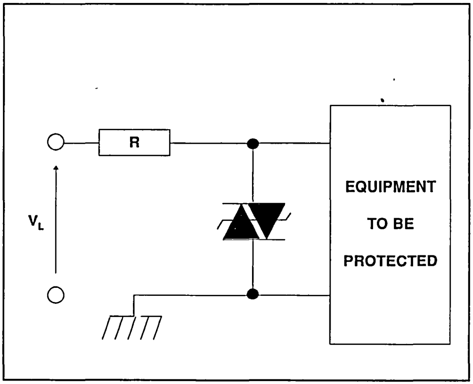
The breakover voltage (V_{BO}) has to be lower than the max-ratings of the component to be protected. This level is reached just before the protection device switches to the ON-STATE. The duration of the residual transient linked to the break-over voltage is very short : it does not exceed 1 us.

I.2.3. The holding current : I_H

When a crowbar device is used for protection, it is absolutely necessary to ensure that the holding current is higher than the maximum current available in the Telecom line. If this criterion is not obeyed, the Trisil triggers but does not return correctly to its blocked state after the disturbance.

Since the Trisil voltage in the conduction state is low, the condition can be expressed by the inequality $I_H > (V_L/R)$. See fig.2.

Figure 2 : Equipment protection by Trisil



This is shown in figure 3 where the current does not drop below the holding current. The Trisil cannot return to the blocked state and thus remains as a quasi short-circuit, preventing operation of the equipment to be protected.

In the case of figure 4, the current drops below the value of the holding current and the internal mechanism of the Trisil enables it to return to the blocked state after the current surge.

Figure 3 : Wrong choice of the Trisil

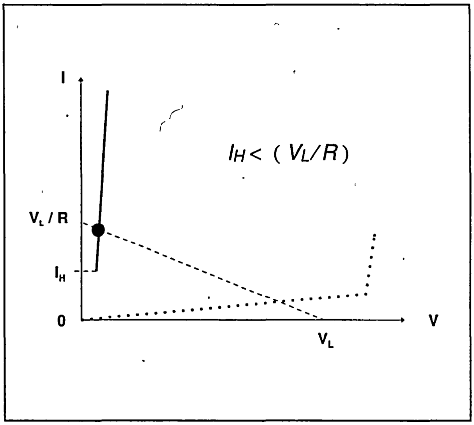
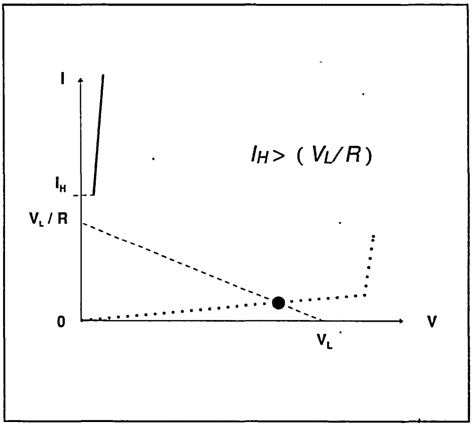


Figure 4 : Right choice of the Trisil



2. APPLICATION DIAGRAMMS :

Fig. 5 to 8 show typical protection solutions used for telephone sets and other terminals.

Figure 5 : Ring and speech circuit protection

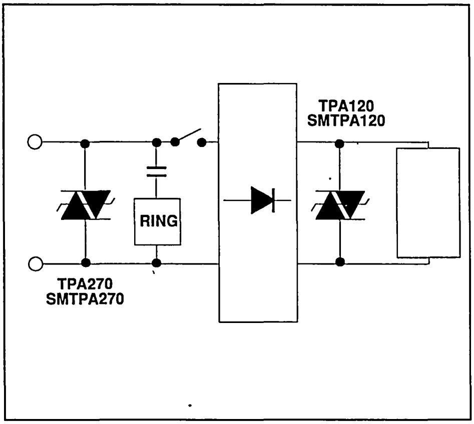


Figure 6 : Monochip circuit protection

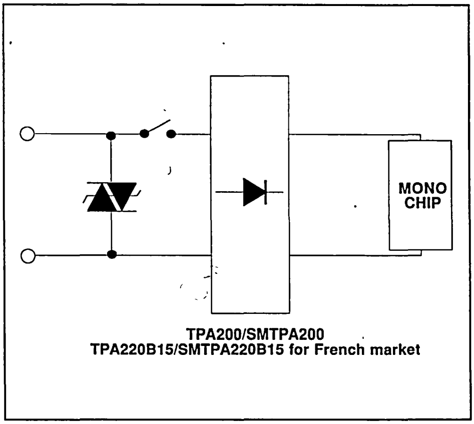


Figure 7a : Overvoltage protection and current limitation (I_{PP} = 100 A 10/1000 µs)

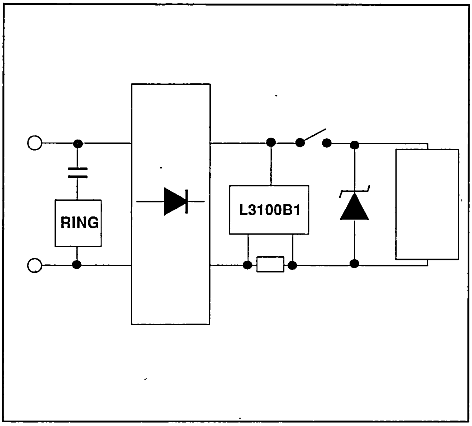


Figure 7b : Overvoltage portection and current limitation (IPP = 30 A 10/1000 ms)

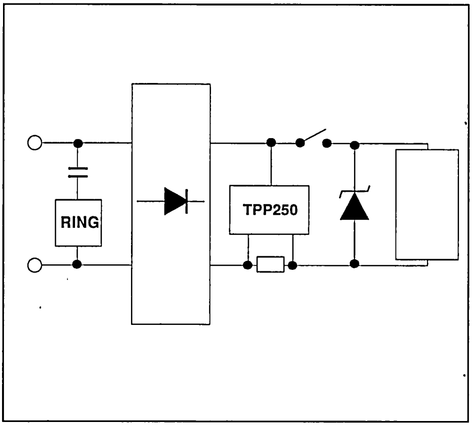


Figure 8a : Electronic hook switch protection

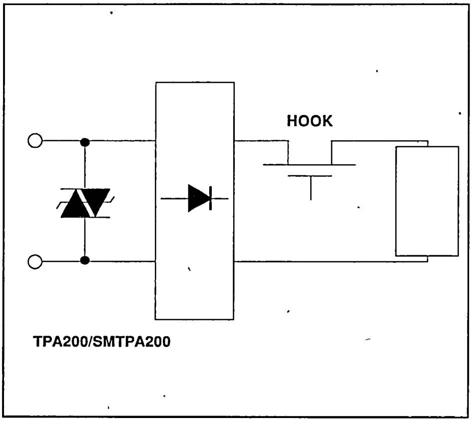


Figure 8b : Electronic hook switch protection

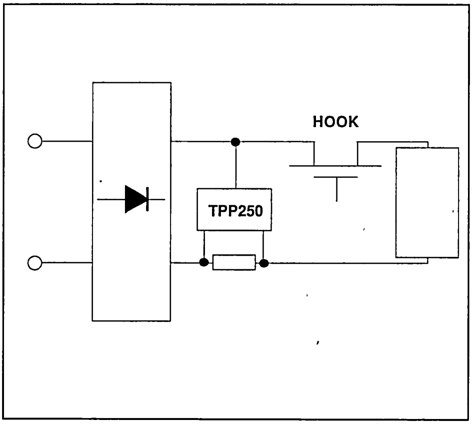
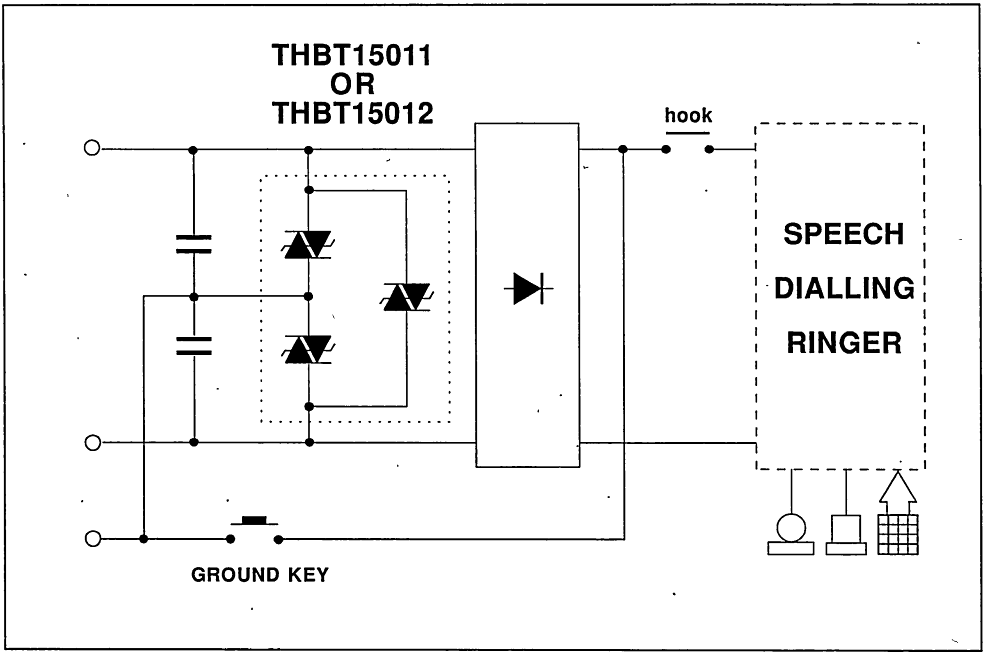


Figure 9 : German version with ground key



3. CONCLUSION

Whether the telephone set is connected to a public or private network, SGS-THOMSON offers a range of protection devices to cover all relevant standards.

APPLICATION NOTE

PROTECTION STANDARDS APPLICABLE TO SWITCHING EQUIPMENT

A. Bremond

1. INTRODUCTION

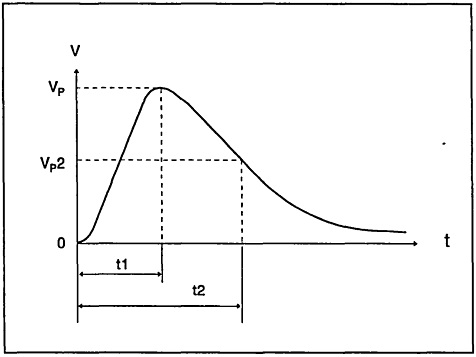
The purpose of this document is to summarize the main telecommunication standards with regard to the protection requirements against two types of overvoltage :

- lightning surges
- power crossing perturbations

2. LIGHTNING SURGES

The lightning overvoltage is simulated by a biexponentional wave, which is defined by the rise time t1 and the duration t2 between the start and the time at which the falling edge crosses half the peak value (fig.1)

Figure 1 : Standard wave



Each country publishes its standard, which can be summarized by the times t1 and t2, the peak voltage of the wave and the surge generator diagram. Table 1 gives on inexhaustive list of the standards .

Table 1 : Lightning surge standards

COUNTRY	AUTHORITY	WAVEFORM (µs)
ENGLAND	BRITISH TELECOM	10/700
FRANCE	PTT	0.5/700
GERMANY	BUNDESPOST	10/700
ITALY	SIP	10/700 1/1000
SPAIN	COMPANY TELEFONICA DE ESPANA	1/1000
SWEDEN	TELEVERKET	10/700
SWITZERLAND	PTT - BETRIEBE	10/700 1.2/50
USA	BELL	10/1000 10/360 2/10
	FCC	10/560 10/160 2/10

The following figures give the schematics of the surge generators mainly used :

Figure 2 : 10/700 µs wave generator

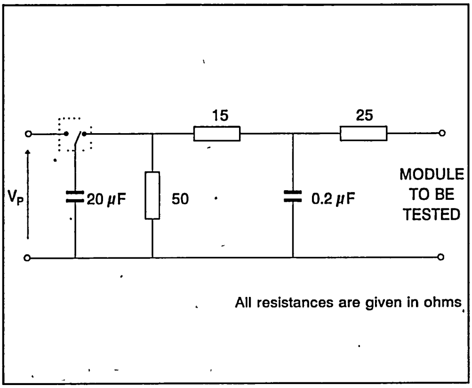


Figure 3 : 1.2/50 µs wave generator

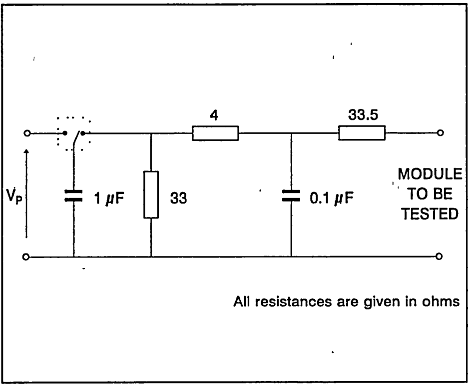


Figure 4 : 0.5/700 µs wave generator

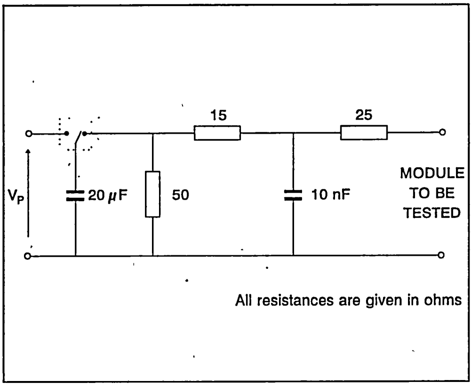


Figure 5 : 10/560 µs wave generator

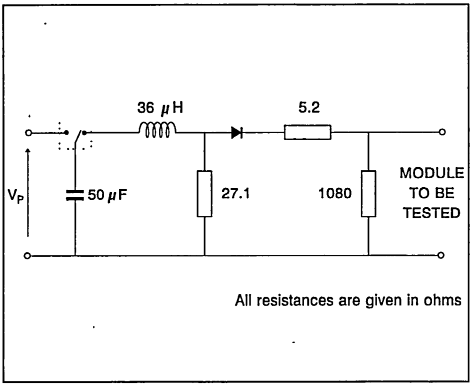


Figure 6 : 1/1000 µs wave generator

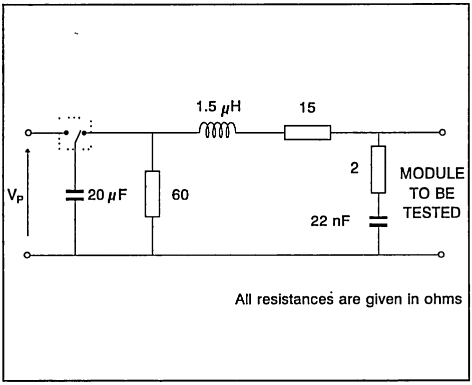


Figure 7 : 10/160 µs wave generator

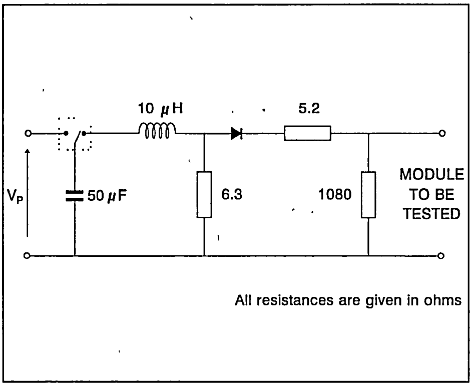
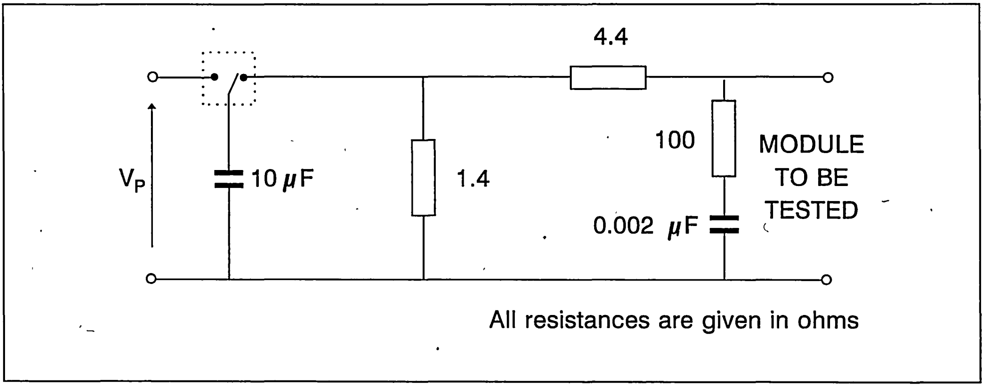


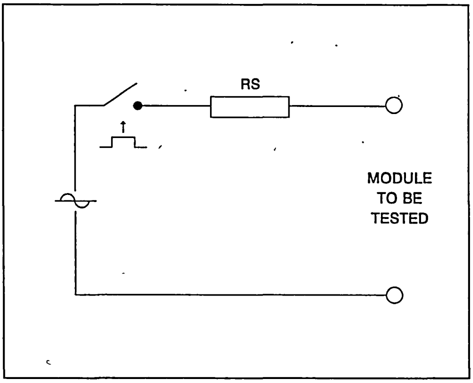
Figure 8 : 2/10 µs wave generator



3. CROSSING OR PROXIMITY WITH MAINS AC LINES :

Crossing or proximity is simulated by a sine wave generator (50 or 60 Hz) connected through a series resistor for a defined time (fig.9).

Figure 9 : Crossing simulation generator



4. CONCLUSION

Telecommunications is a field in which the protection against overvoltages is well defined by standards. The SGS-THOMSON range of protection devices enables all of these to be covered.

Table 2 give some example of crossing simulations.

Table 2 : Power crossing simulations

COUNTRY	VOLTAGE Volts RMS	SERIES RESISTOR (Ohms)	DURATION
ENGLAND	0 TO 250	40 TO 400	15mn
	0 TO 650	150	1s
	0 TO 430 (50 Hz)	150	2s
FRANCE	0 TO 1000	20	Trains of - 1s "on" - 1s "off" -1s "on" 10 times with 10mn between trains
	> 1000 (50 Hz)	3000	
GERMANY	300 (50 Hz or 16.6Hz)	600	200 ms
ITALY	300	600	500 ms
	650	200	500 ms
	220	10 or 600	15 mn
USA	0 - 50	150	15 mn
	50 - 100	600	15 mn
	100 - 600	600	60 x 1s application

Note : Protection resistors on the line card inputs decrase the peak surge current.
These elements have to be taken into account during the line card design to optimize the protection function.

PROTECTION SCHEMATICS FOR SWITCHING SYSTEMS

A. Bremond

1. INTRODUCTION

The aim of this note is to summarize the major characteristics of a SLIC and to propose protection solutions for each configuration.

2. SLIC FUNCTION

2.1. Slic generalities :

The Slic function is defined by the acronym BORCHT :

- Battery feeding
- Overvoltage protection
- Ringing
- Signalling
- Codec
- Hybrid
- Test

The important parameters to define the OVERVOLTAGE PROTECTION are the battery feeding and the ringing signal.

2.1.A/ battery feeding :

This sub-function of the Slic is characterized by:

- The battery voltage typical value (generally between 45 and 65 V)
- The tolerance of the voltage value
- The possibility to switch from one value to another one (line cards designed to operate equally on normal and long lines)

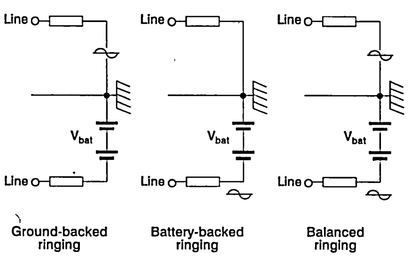
2.1.B/ Ringing signal :

For the ringing, two parameters need to be taken into account :
- The voltage value (generally between 70 and 100 V RMS)
- The ringing configuration (fig.1)

2.2. Different kinds of Slic :

There are two Slic families :
- The Slic without integrated ring generator
- The Slic with integrated ring generator

Figure 1 : Different ringing configurations

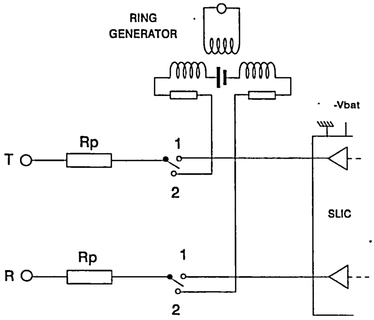


Ground-backed ringing

Battery-backed ringing

Balanced ringing

Figure 2a : Slic without integrated ring generator

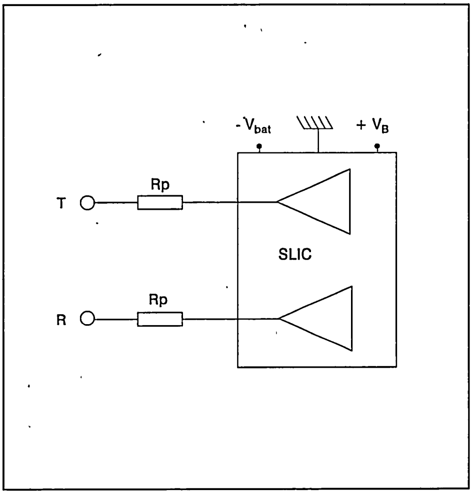


2.2.A/ Slic without integrated ring generator :

For this case the Slic IC is supplied between ground and the battery voltage (- V_{bat}).

The relay operates the selection of functions, ringing mode in position 2 and the other modes in position 1. (see fig 2a).

Figure 2b : Slic with integrated ring generator



2.2.B/ Slic with integrated ring generator :

This kind of Slic, e.g. the L3000 family of SGS-THOMSON, is supplied between ground, the battery (-V_{bat}) and a positive voltage (+V_B) up to +72 V. (see fig 2b).

2.3. Goal of the Slic protection :

The purpose of the protection is to suppress all overvoltages out of the normal operating voltage range of the Slic.

We have to take into account the two kinds of Slic described in section 2.2.

2.2.A/ Slic without integrated ring generator :

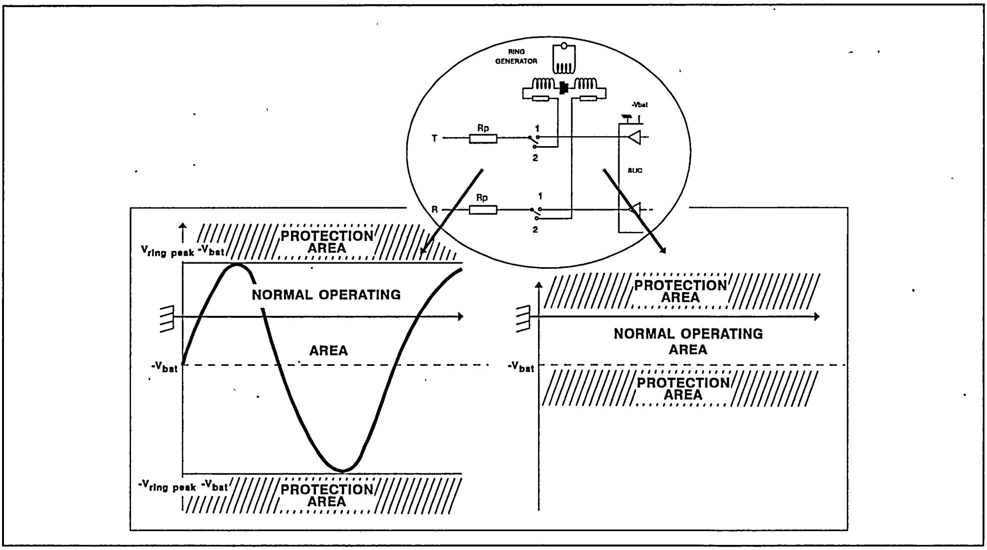
As shown in Fig.3, the protection areas are located differently before and after the ring relay.

Before the relay the protection must operate over the peak value of the ring signal (generally +90V and -190V). As the relay protection does not require a very precise clamping threshold, we usually use a symmetrical overvoltage suppressor (generally + or -200 V).

After the relay the protection acts to suppress all spikes above ground and below the battery voltage (-V_{bat}).

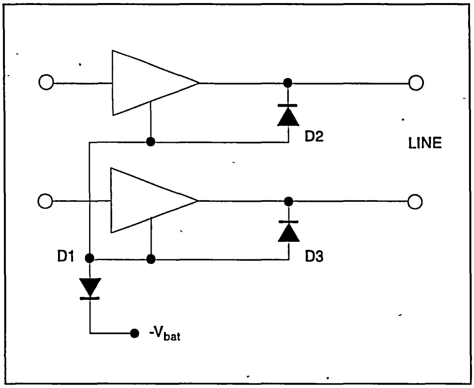
It is important to note that the integrated circuit needs a protection threshold as close as possible to the supply voltage.

Figure 3 : Goal of the protection for the SLIC without integrated ring generator



In certain cases an internal network of diodes allows the output stages of the Slic to be oversupplied (see fig.4).

Figure 4 : Internal diode network of the TDB7722

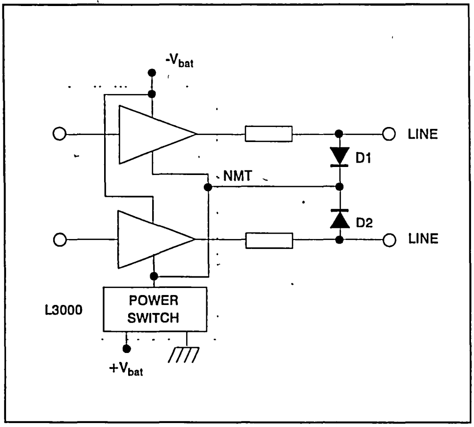


2.3.B/ Slic with integrated ring generator :

The integrated circuit L3000 of SGS-THOMSON is presently the only Slic of this kind. It operates between ground and the battery voltage for all the modes except for the ringing, where the operating area is located between $+V_B$ (up to 72 V) and the battery voltage ($-V_{Bat}$) (see Fig.5). The protection takes into account this fact and operates above $+V_B$ and below $-V_{Bat}$.

The diodes D1 and D2 (fig.5) act when the L3000 operates out of the ringing mode and when a positive overvoltage is clamped at $+V_B$. The output stages are then temporarily oversupplied at $+V_B$.

Figure 5 : External diode network used with the L3000



3. APPLICATION DIAGRAMS

3.1. Slic without integrated ring generator

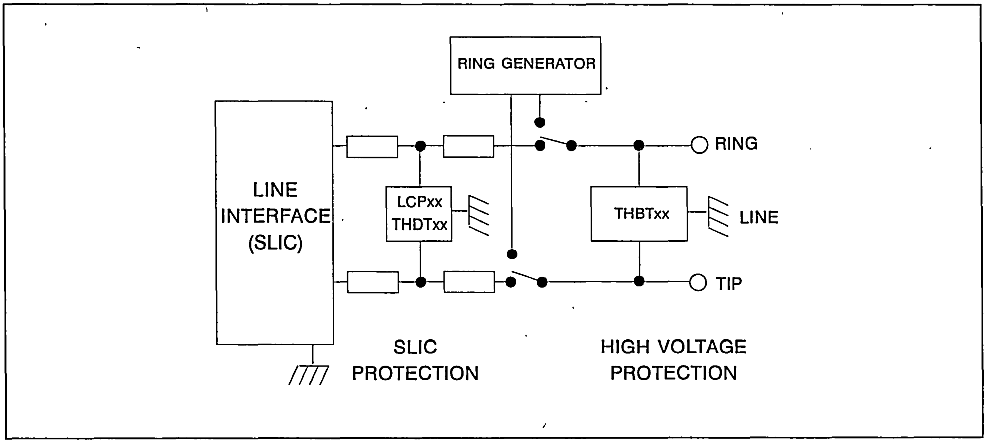
Fig.6 below shows the protection topology for line card protection. The protection is divided into two stages :

- The high voltage protection for ring relays (THBTxx series)

- The low voltage protection for the Slic. Here there are two possibilities :

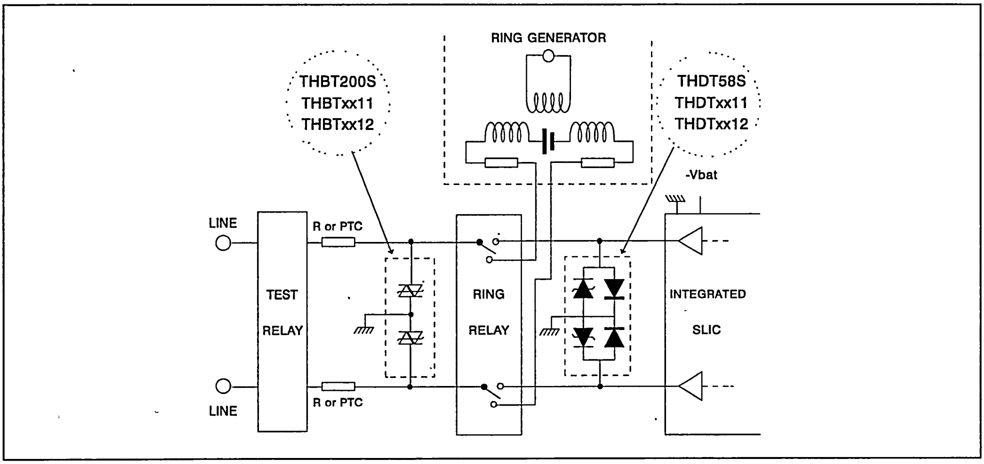
- Fixed breakdown voltage (THDTxx series).
- Programmable breakdown voltage (LCPXX series)

Figure 6 : Typical line card protection at PC board level



3.1.1. Slic protection with fixed breakdown voltage.

Figure 7 : Line card protection kit



A specific product range for line card protection is available with kit solutions (for ring relays and Slic protection) in S08, DIL8 and SIP3 packages. As shown in figure 7, they are bidirectional functions for relay protection and asymmetrical functions for Slic protection.

These solutions provide the following advantages :

- Different surge current capabilities are available.
- Area used by the protection on the PC board is reduced.
- Optimum cost/performance compromise is possible.

Fig. 8 and fig.9 show the product range offered by SGS-THOMSON, with versions available also in axial from or in the surface mount package SOD15.

Figure 8 : High voltage protection range = THBTxx

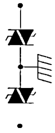
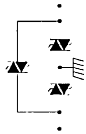
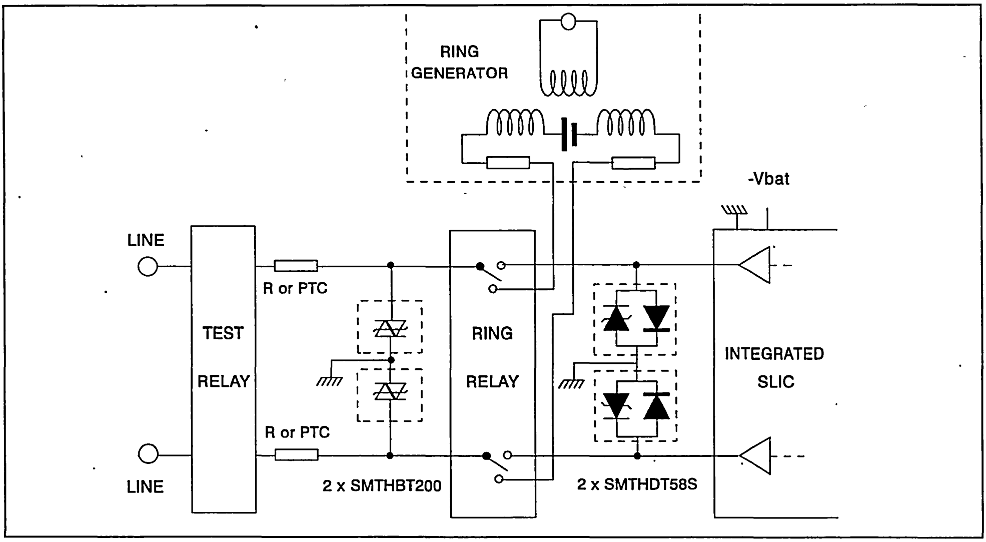
TRISIL	DUAL TRISIL	3 TERMINAL TRISIL	
			
SOD15	SIP3	SO8	DIL8
75A @ 10/1000 µsec		30A @ 10/1000 µsec	
SMTHBT 200	THBT200S	THBT15011 THBT20011 THBT27011	THBT15012 THBT20012 THBT27012

Figure 9 : Slic protection range fixed breakdown voltage = THDTxx

SOD15	CB429	SIL3	SO8	DIL8
HIGH SURGE CAPABILITY **75A @ 10/1000 µsec**			**MEDIUM SURGE CAPABILITY** **30A @ 10/1000 µsec**	
SINGLE FUNCTION		DUAL FUNCTION	DUAL FUNCTION	
SMTHBT58	TPU58	THDT58S	THBT5111 THBT6511	THBT5112 THBT6512

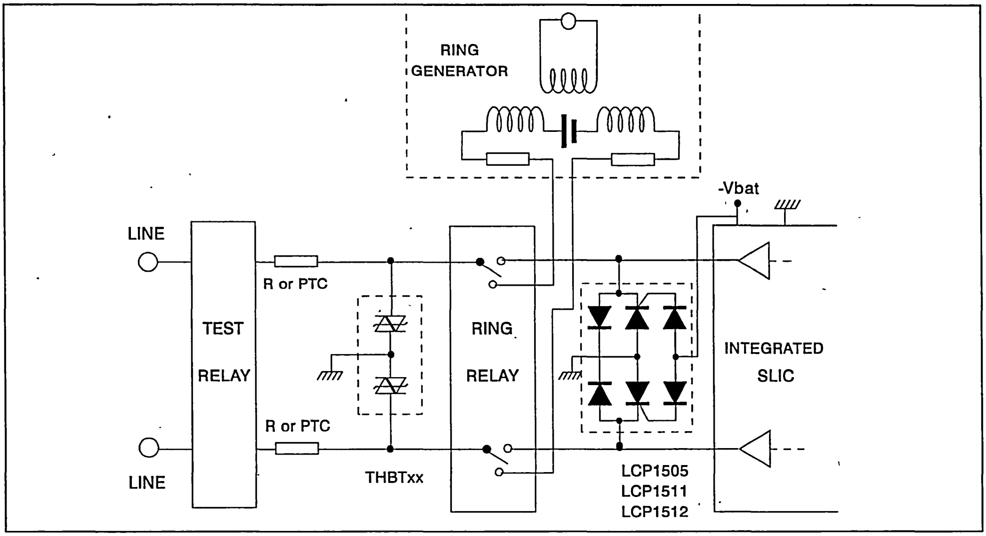
Figure 10 : Surface mount solution in SOD 15



This solution is mainly used to benefit from the high surge current capability of the SOD 15 package for AC tests. Such high surge performance can only be achieved with this SMD package.

3.1.2. Slic protection with programmable breakdown voltage

Figure 11 : Monochip programmable breakover voltage solution



With this solution, the protection performance is improved by the possibility of adjusting the breakdown voltage to the battery voltage. This function is well suited to variable battery voltage applications such as short / long line switching.

Figure 12 gives the product range with this function, available in SIL4, DIL8 and SO8 packages.

Figure 12 : Slic protection range LCPxx - Programmable breakdown voltage

SIL4	SO8	DIL8
HIGH SURGE CAPABILITY 75A @ 10/1000 µsec	**MEDIUM SURGE CAPABILITY** 30A @ 10/1000 µsec	
LCP150S	LCP1511	LCP1512

3.2. Slic with integrated ring generator : (Slic L3000)

Many types of Slic protection solutions exist, depending on :
- The battery voltage
- The PC board area available for the protection
- The cost / performance compromise

3.2.1. L3000 protection with 2 x L3121B

This topology (Fig.13) is the most efficient one for this kind of Slic.

3.2.2. L3000 protection with 2 x L3100B

Figure 13 : L3000 protection with 2 L3121B

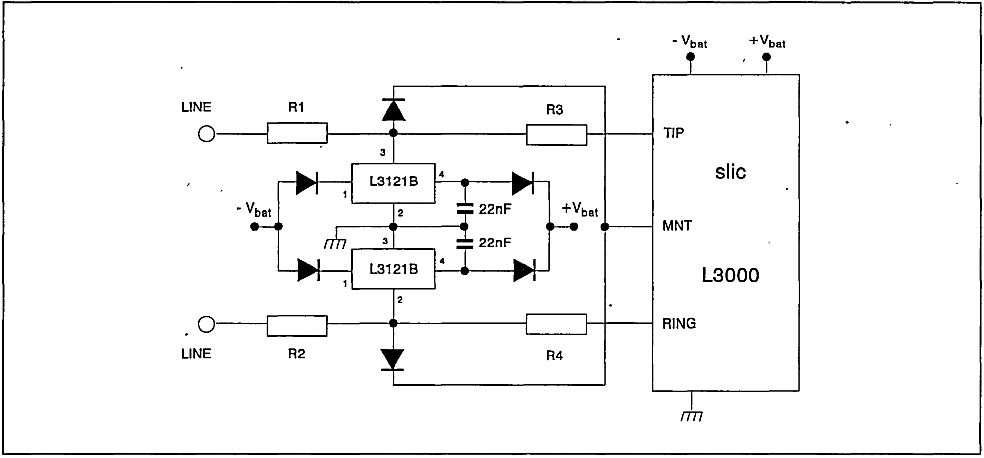


Figure 14 : L3000 protection with 2 L3100B

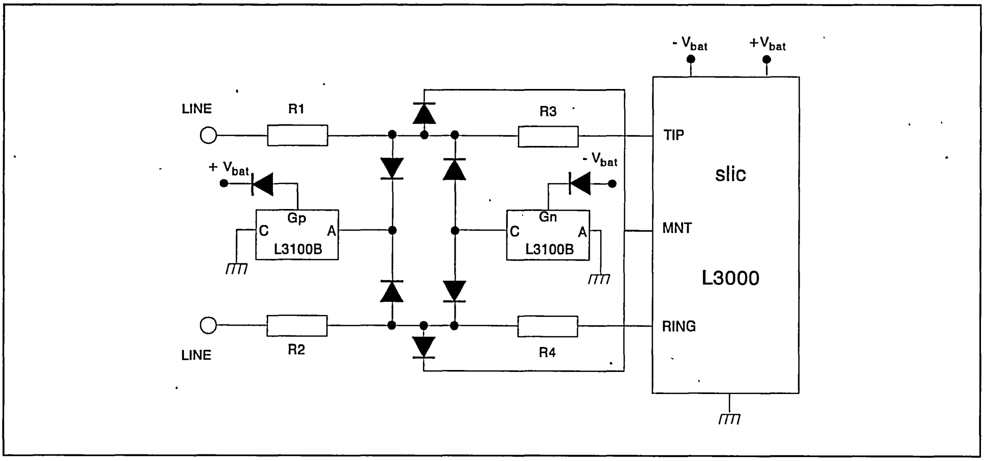


Figure 14 has the same electrical behaviour as the previous one but with lower cost.

3.2.3. Multiline common protection :

These types of application (Fig.15 and 16) decrease the cost of the protection per line. The major drawbacks of these solutions are :

- The short circuit across all the lines when the protection device fires.

- The current remaining through the protection device after the surge is too high to allow its automatic switch-off. This must then be effected by a software instruction, e.g. power-down.

4. CONCLUSION

The wide range of protection devices on offer from SGS-THOMSON makes an optimized protection solution possible for every application.

Figure 15 : Common protection for Slic without integrated ring generator

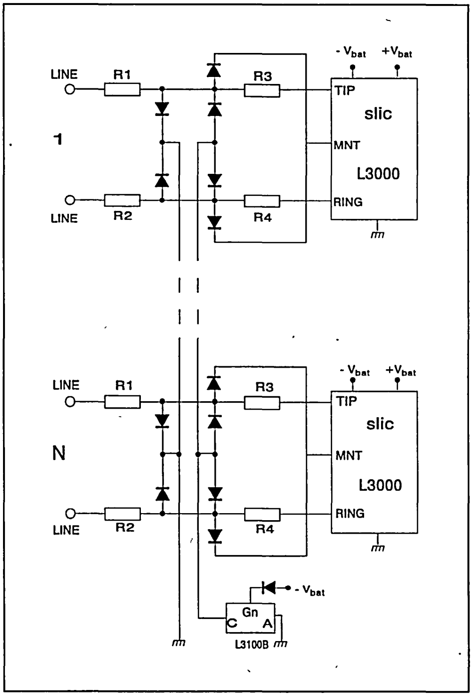
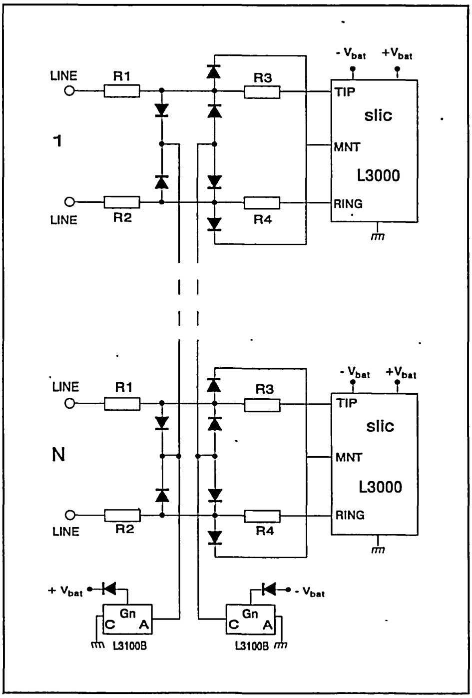


Figure 16 : Common protection for Slic with integrated ring generator



ISDN INTERFACE PROTECTION

C. Politano

I: INTRODUCTION

The choice of a suitable protection device for an ISDN line interface requires consideration of a parameter which is not critical in analogue line applications : the parasitic capacitance that the device introduces. Because of the high data rates used, parasitic capacitances must be minimized in order to ensure correct signal transmission. In particular, attention must be paid to the capacitance imbalance in the line which can cause considerable signal degradation. Such imbalance most frequently results from the presence of common-mode protection, in which the capacitance introduced between each line and earth is frequently unequal.

SGS-THOMSON has developed a complete range of specific protection devices for ISDN applications : the " TRIBALANCED PROTECTION " TPIxx series.

These devices introduce only a minimum of capacitance imbalance (30pF), which does not affect the transmission performance of the line.

2. TRIBALANCED PROTECTION = TPIxx SERIES

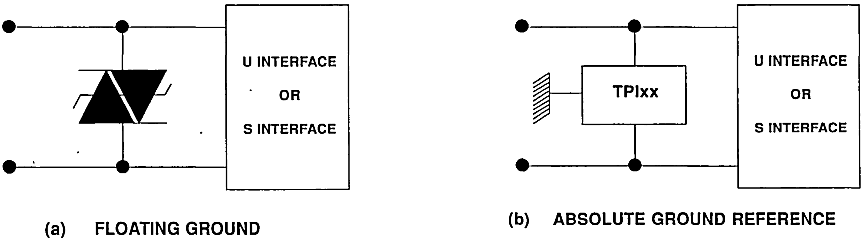
The use of TRIBALANCED protection is mandatory under the following conditions :

- The bias voltage on line A and line B is different (line A = GND, Line B = -Vbat)
- The protection is realized in common mode, as illustrated in fig.1 (b).

In this case, two conditions must be satisfied :

1) Low capacitance from line to ground → No signal attenuation
2) Good capacitance balance between line a and line b → Good longitudinal balance on the line.

Figure 1 : ISDN interface protection



(a) FLOATING GROUND

(b) ABSOLUTE GROUND REFERENCE

3. ISDN PROTECTION - PRODUCT RANGE :

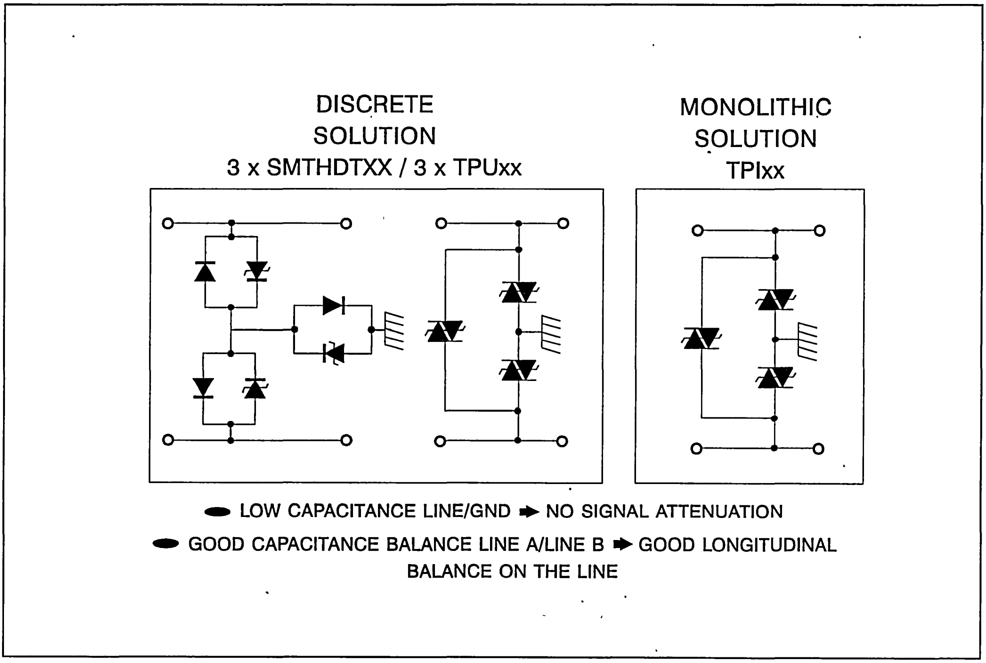
SGS-THOMSON offers specific protection devices for ISDN interface protection. The product range is given in fig.2, which shows that this function is available with different package versions.

Discrete and monolithic versions are available, in order to provide a wide choice of cost/performance compromises.
Depending on the solution chosen, different recommendations apply with regard to the optimum configuration to use. Fig.3 illustrates the typical application schematic for TRIBALANCED PROTECTION. When the discrete solution is used, three components per line are necessary.

Figure 2 : Tribalanced protection - product range

DISCRETE SOLUTION (3 devices per line)	**MONOLITHIC DEVICES**
SOD15 / CB429	SO8 / DIL8
HIGH SURGE CAPABILITY 75A 10/1000 msec	**MEDIUM SURGE CAPABILITY** 30A 10/1000 msec
SMTHDT58 / TPU58 SMTHDT80 / TPU80 SMTHDT120 / TPU120	TPI8011P / TPI8012P TPI12011P / TPI12012P

Figure 3 : Tribalanced protection - functional schematic



- LOW CAPACITANCE LINE/GND ➨ NO SIGNAL ATTENUATION
- GOOD CAPACITANCE BALANCE LINE A/LINE B ➨ GOOD LONGITUDINAL BALANCE ON THE LINE

4. APPLICATION SCHEMATICS

Fig.4 and 5 illustrate the use of tribalanced protection in a u-interface and an s-interface respectively. In each case there is the choice of a discrete solution (SMTHDTxx or TPUxx) where a high surge capability is required, or a single-chip solution for low cost (TPIxx). Thus cost and performance can be traded in a variety of combinations. All of these components are innovative and ideal for use in high-speed transmission lines.

Figure 4 : Central office / PABX - U-Interface protection

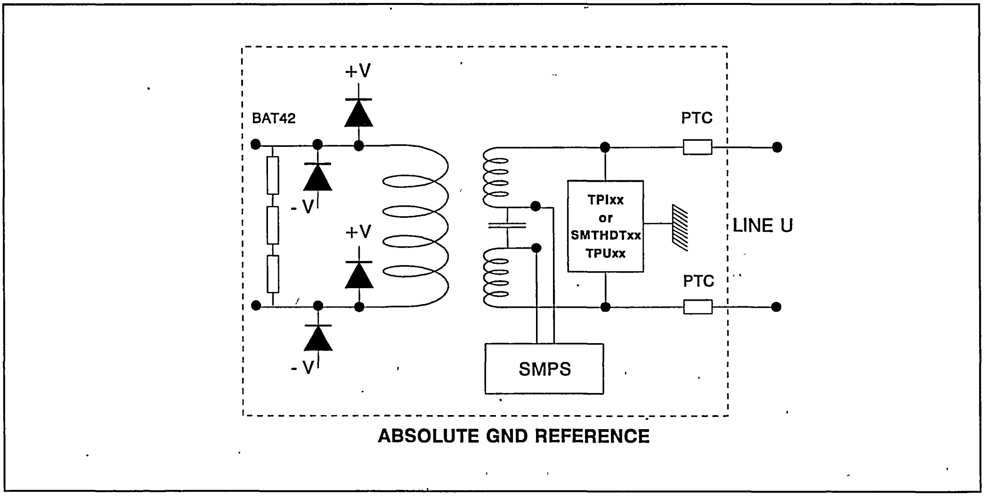
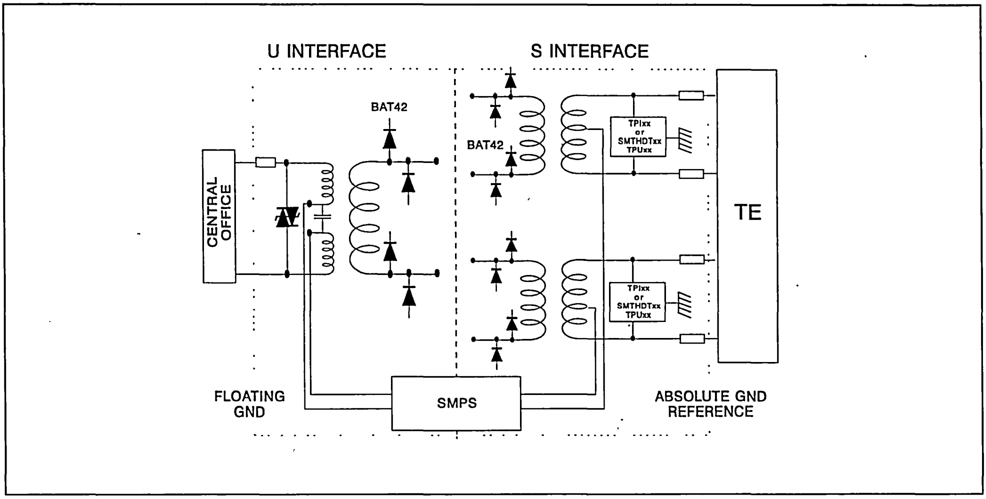


Figure 5 : NT1 = S-Interface protection



5. CONCLUSION

Due to the sensitivity of ISDN to capacitance imbalance on the lines, tribalanced protection has to be used where common-mode protection of lines with different bias voltages is required. SGS-THOMSON offers a wide range of devices designed specifically for ISDN protection, enabling this requirement to be satisfied.

INDUSTRIAL APPLICATION NOTES

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

USE OF TRANSILS AS RECTIFIER DIODES

Transils are diodes especially designed to dissipate high peak power in avalanche operation. In direct conduction they have the properties of very good conventional diodes (with the possibility of handling very high surge currents) and perform as well as rectifiers.

In general, there could be a voltage surge due either to the power supply or to the load. Power supply overvoltages can be clamped by means of a Transil on the ac side : see fig.1.

Wherever possible, it is more attractive to use Transils directly as rectifiers instead of protecting separate rectifiers with Transils since the number of components is reduced : see fig.2. The characteristics given in the data-sheets (I_{FSM}, forward voltage drop characteristic) enable calculations to be made in this mode of operation.

The following table gives the equivalence between Transils and common rectifiers.

TRANSIL	P6KE	1N5635A to 1N5665A	1.5KE	BZW50
Case	CB-417	DO 13	CB-429	AG
Rating of Equivalent Diode (A)	1	1.2	3	6

Neither of these two methods protects against overvoltages originating from the load. Fortunately, a study of bridge rectifier operation shows that it is sufficient to limit the voltage on the dc side to protect the bridge whatever the origin of the overvoltage : see fig.3. In all cases, a single Transil is sufficient to protect a single phase or a 3-phase bridge rectifier.

Figure 1 : The diodes are not protected from overvoltages due to the load

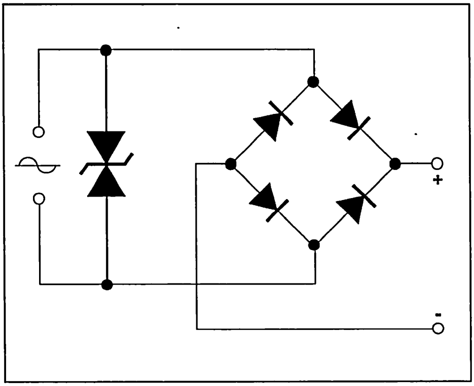


Figure 2 : Mixed Solution which reduces the component count. The 2 Transils work as rectifiers

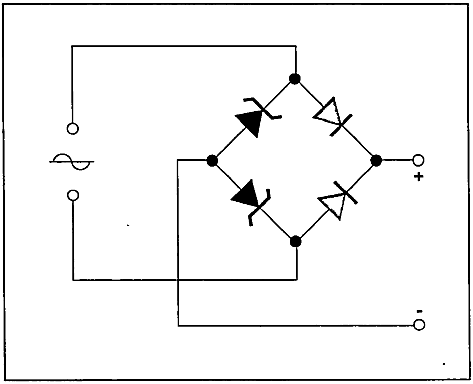
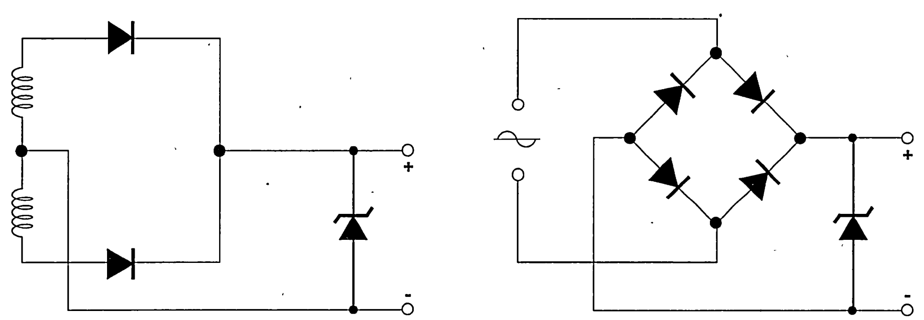


Figure 3 : A single Transil protects the rectifying components whatever the origin (power supply or load) of the overvoltages



RELAY DRIVE PROTECTION

A fast switch-off in an inductive circuit causes overvoltages and electromagnetic interferences that can damage peripheral elements. When a relay drive circuit is not protected, it is frequent to find some contacts destroyed by the arc due to the overvoltage or failed transistors after initial use. Various solutions exist which limit the voltage at the terminals of the switching circuit in order to prevent any damage.

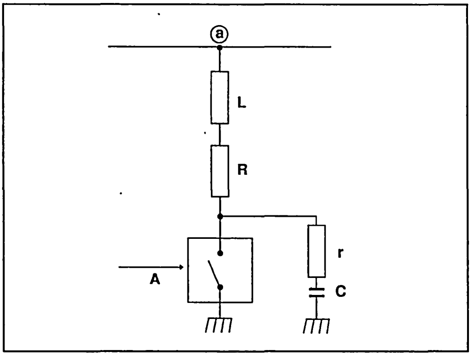
There follow some examples.

1. PASSIVE COMPONENTS

Resistive network, capacitor (circuit a, fig.1)

This is an efficient solution in many applications but generates current peaks that can be inconvenient at switch-on.

Figure 1 : Relay Drive Protection by R.C. Network



2. ELECTRONIC COMPONENTS

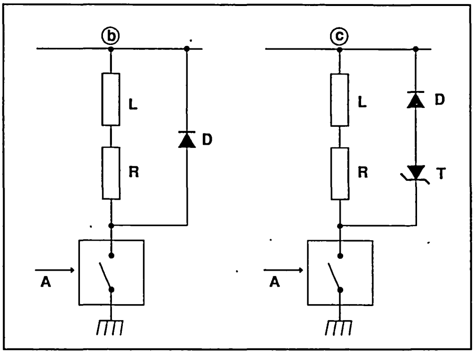
1) FAST DIODES AND TRANSIL

Standard protection which puts a diode in antiparallel with the inductive load (circuit b, fig.2) offers many advantages : negligible overvoltage at switch on (forward voltage of the diode) reduced space, low price, good reliability and negligible permanent losses.

Unfortunately the current through the inductor does not stop immediately at switch-off ; instead it decays with a time constant L/R. This is a disadvantage in some applications, for example a relay coil driver. The relay contacts will remain closed for some time after the switch is opened due to the current stored in the relay coil. It would be desirable to speed up the current decay rate while retaining the advantages of recovery diode protection.

A solution is shown in fig.2, circuit C, in which a Transil diode is put in series with the recovery device. A much higher voltage is developed across the diode-Transil combination than across a single diode, thus accelerating the current decay.

Figure 2 : Relay Drive Protection by :
b) Recovery Diode
c) Diode and Transil



2) TRANSIL

The Transil is an avalanche diode specially designed to clamp overvoltages and dissipate power in impulsive mode. It also offers the possibility of considerable average power absorption. It is available in different cases covering a wide range of voltages (5 to 600V). Moreover, all the necessary data to calculate power parameters and to carry out temperature evaluation (Zth, Rth, etc...) can be found in technical notes. So the Transil is perfectly suited to this application.

In the case of a steady state power supply we can consider three hypotheses :

- Circuit d (fig.3). This is an economic solution which requires a unidirectional Transil only, but the current released by the inductance goes through the power supply and may affect the ground points.

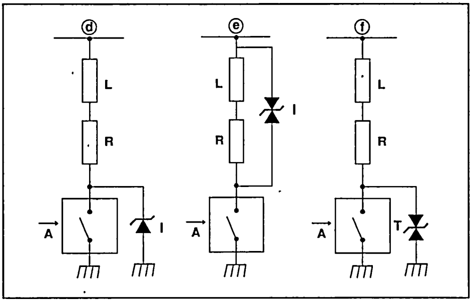
- Circuit c (fig.2) and circuit e (fig.3). The inductive discharge current only goes through the LRD loop, thus is does not create disturbances in the ground points. This is a more expensive solution since two diodes or one bidirectional Transil are necessary. In the case of an alternating sinusoidal supply for low power, circuits e and f (fig.3) are well suited to limit inductive overvoltages.

3) COMPARISON OF THE CURRENT DECAY TIME IN THE INDUCTIVE LOAD BETWEEN THE RECOVERY DIODE AND THE TRANSIL DIODE SCHEMATICS (fig.4)

The ratio t_2/t_1 represents the reduction in current decay time when a Transil is used.

$$t_2/t_1 = \frac{1}{1+1.4\ V_{CL}/V_{CC}}$$

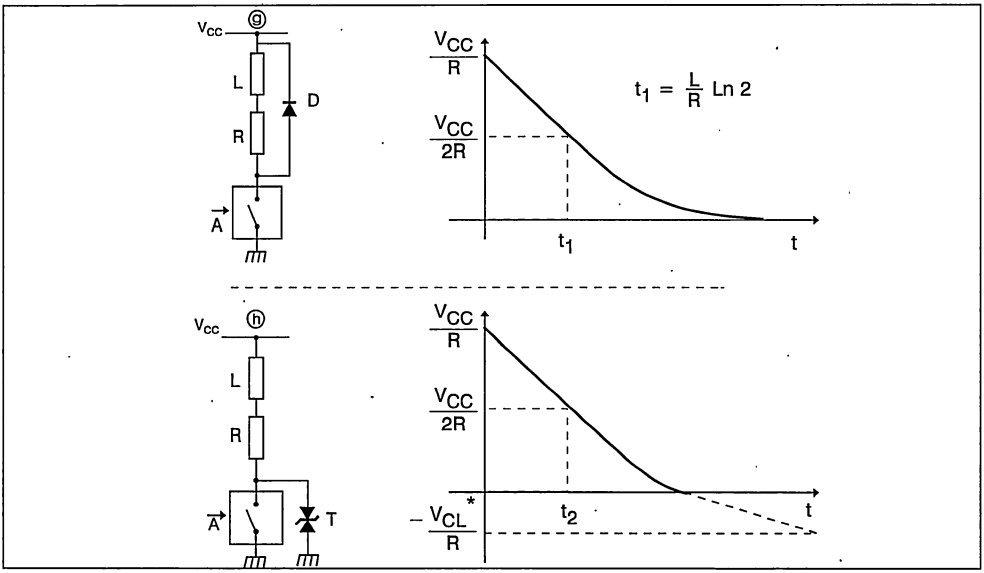
Figure 3 : Relay Drive Protection by :
d) Unidirectional Transil
e) Bidirectional Transil
f) Bidirectional Transil



V_{CL} is the voltage (measured) at the terminals of the Transil when the load current goes through it.

If we take $V_{CL} \approx V_{CC}$, we limit the overvoltage to a reasonable value and thus period t2 represents only 0.4 x t1. A correct choice of V_{CL} will reduce t2 to very low values and reach the mechanical limit given by the relay.

Figure 4 : Current in the inductance at switch off :
g) Recovery diode circuit : current slowly decreases to 0.
h) Transil circuit : current decreases rapidly. (asymptote = $\frac{-V_{CL}^*}{R}$)



3. CONCLUSION

The Transil is a must in relay drive circuits. It guarantees a reliable and efficient protection while reducing the delay between the coil drive turn-off and the contact release.

4. EXAMPLE OF APPLICATION : Calculation and choice of a Transil

We wish to protect the transistor in figure 5 by a Transil whose clamping voltage must not under any circumstances exceed $V_{CL} = 85$ V

The clamping voltage is given by :

$$V_{CL} = V_{BR} + R_d I_C$$

In the case of repetitive overload, the current is small enough such that the $R_d I_c$ term can be neglected. Thus V_{CL} approximates to :

$$V_{CL} \approx V_{BR}$$

The calculation is therefore simplified, and the Transil can be selected according to its thermal resistance.

1) MEAN POWER DETERMINATION : P_{AV}

A rough value can be obtained by assuming that all the energy contained in the inductance is absorbed by the Transil.
This is true when $V_{BR} >> V_{CC}$.

$$P_{AV} = \frac{1}{2}\ LI^2 f = \frac{1}{2} 0.35 \left(\frac{12+2.4}{45} \right)^2 50 = 0.9\ W$$

2) STAND OFF VOLTAGE SELECTION

The supply voltage varies between 9.6 V and 14.4 V.

The stand off voltage of the diode V_{RM} will be therefore be greater than or equal to 14.4 V.

3) V_{CL} DETERMINATION

From the data sheets we can see that for a low current, $V_{CL} = V_{BR}$

4) T_j CALCULATION

$T_j = T_{amb} + P_{AV} \times R_{th} = 50 + 90 = 140°C < T_j$ max (150°C)

This value is consistent with the characteristics of the BZW04- 61B Transil (F 126 case) but the safety margin is somewhat low, so a device from the 1500 W series is preferable as a first choice.

$$\begin{cases} 1.5\ \text{KE 75CP (CB-429 case)}\ V_{BR}\max = 82.5V, \\ R_{th} = 75°C/W,\ V_{RM} = 64.1V > 14.4V \end{cases}$$

$T_j = 50 + 68 = 118$C T_j max = 175°C

5) TEMPERATURE CORRECTION

Voltage at 118°C is :

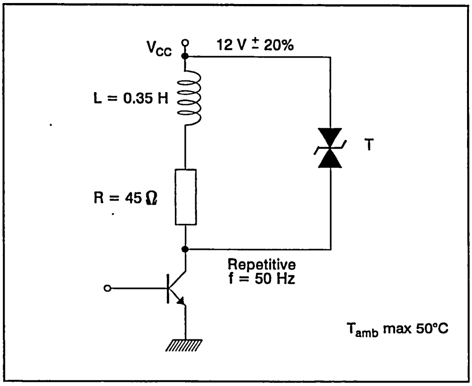
V_{CL} (118°C) = V_{CL} (25°C) [1 + aT (118 - 25)] = [1 + 10.5 x 10-4 (93)] 82.5 = 90.5 V

This value is too high.

6) DEFINITIVE CHOICE

1.5 KE 68CP :
V_{BR} max = 74.8 V, V_{RM} = 58.1 V > 14.4 V
VCL (118°C) = 1.098 x 74.8 = 82.5 V
⇒ 1.5 KE 68CP is suitable.

Figure 5 : Schematic of the Example



SGS-THOMSON
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APPLICATION NOTE

TRANSISTOR PROTECTION BY TRANSIL

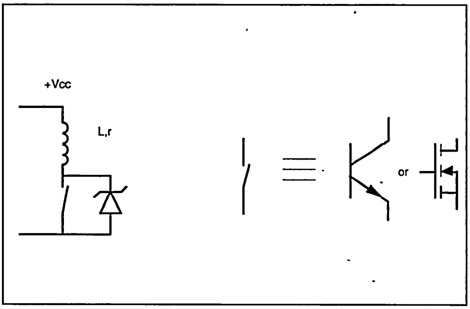
B. Rivet

1 - INTRODUCTION

In a large number of applications, we find the circuit in FIG.1 where a TRANSIL is used to protect a switch which controls an inductive load. The switch can be a bipolar or a MOS transistor.

The purpose of this paper is to calculate the dissipated power in the TRANSIL and the pulse current duration.

Figure 1 : Basic Diagram

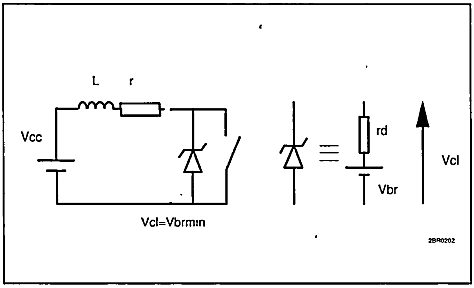


2 - CIRCUIT MODELLING

When the switch turns off we use the equivalent circuit represented in FIG.2

The worst case is to consider $V_{CL} = V_{BR}$ min. This hypothesis will be used in all formulae.

Figure 2 : Equivalent Circuit



V_{CL}	clamping voltage
V_{BR}	breakdown voltage
rd	equivalent resistance

3 - CURRENT IN THE TRANSIL

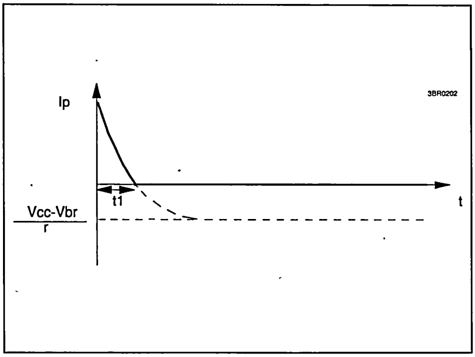
We can express the current i through the TRANSIL by the following formula :

$$i = \left(I_P + \frac{V_{BR}\,\text{min} - V_{CC}}{r} \right) \exp\left(- r \times t/L \right)$$

$$+ \left(I_P + \frac{V_{BR}\,\text{min} - V_{CC}}{r} \right)$$

Ip is the current through the coil when the transistor switches off. FIG.3 shows the current variation versus time.

Figure 3 : Current Waveform



t1 can be calculated by

$$\boxed{t\,1 = - L/r \times \ln \left(I_P + \frac{V_{BR}\,\text{min} - V_{CC}}{V_{BR}\,\text{min} - V_{CC} + r\, I_P} \right)}$$

4 - TRANSIL POWER DISSIPATION

We can consider two cases, single pulse operation and repetitive pulse operation.

a) Single pulse operation

In this case, in order to define a TRANSIL we need the peak power Pp and the pulse current standard duration tp.

Pp is given by

$$P_P = V_{BR}\min \times I_P$$

If we approximate the pulse current with a triangle the standard exponential pulse duration tp is calculated by the formula :

$$t_P = -(1.4L/2\,r) \times \ln\left(\frac{V_{BR}\min - V_{cc}}{V_{BR}\min - V_{cc} + r\,I_P}\right)$$

The energy in the TRANSIL can be expressed by :

$$\boxed{W = \left(\frac{V_{BR}\min \times L}{r}\right) \times \left[I_P + \left(\frac{V_{BR}\min - V_{CC}}{r}\right) \ln\left(\frac{V_{BR}\min - V_{CC}}{V_{BR}\min - V_{CC} + r\,I_P}\right)\right]}$$

When r tends to zero we find :

$$W = 1/2\; L I_P{}^2 \left(\frac{V_{BR}\min}{V_{BR}\min - V_{cc}}\right)$$

b) Repetitive pulse operation

In repetitive pulse operation the power dissipation can be calculated by the following formula.

$$\boxed{P = F \times \left(\frac{V_{BR}\min \times L}{r}\right) \times \left[I_P + \left(\frac{V_{BR}\min - V_{CC}}{r}\right) \ln\left(\frac{V_{BR}\min - V_{CC}}{V_{BR}\min - V_{CC} + r\,I_P}\right)\right]}$$

When r tends to zero we find :

$$P = 1/2\; L F I_P{}^2 \left(\frac{V_{BR}\min}{V_{BR}\min - V_{cc}}\right)$$

Where F is the switching frequency.

5 - EXAMPLE OF APPLICATION

A typical application would be a switched coil supplied by a battery. The different parameters of the application are :

V_{CC} = 14V L = 10mH r = 3 Ohms I_P = 4 A

TRANSIL : 1.5KE360 VBRmin = 34.2V (cf data sheet)

a) Single pulse

We find

$$P_P = 34.2 \text{ x } 4 = 136.8 \text{ W}$$

$$t_P = \frac{-1.4 \times 10 \times 10^{-3}}{2 \times 3}\, ln\left(\frac{34.2 \times 14}{34.2 - 14 + 3 \times 4}\right)$$

$$t_p = 1.08 \text{ ms}$$

The data sheet gives P_P ≈ 1500W for tp = 1.08ms, so the 1.5KE36P can be used in this application.

b) Repetitive pulse operation

The switching frequency is equal to 10Hz so

$$P = 10 \times \frac{34.2 \times 10 \times 10^{-3}}{3} \times \left[4 + \left(\frac{34.2 - 14}{3}\right) \ln\left(\frac{34.2 - 14}{34.2 - 14 + 3 \times 4}\right)\right]$$

$$P = 980\; mW$$

Rth = 75°C/W and Tj max. = 175°C

So Tj = P x Rth + Tamb.max.

With Tamb.max. = 50°C we find :

Tj = 0.98 x 75 + 50 = 123.5°C < Tj max

So we can also use this TRANSIL in repetitive pulse operation.

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

PROTECT YOUR TRIACS

By P. Rault

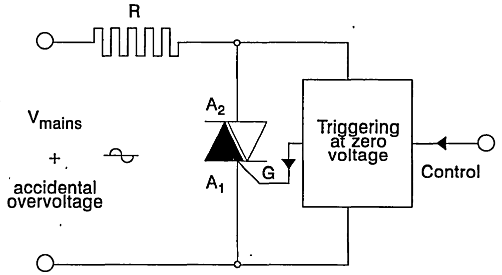
In most of their applications, triacs are directly exposed to overvoltages transmitted by the mains. When used to drive resistive loads (temperature regulation), it is essential to provide them with efficient protection.

WHY PROTECTION ?

In a typical circuit (figure 1), an overvoltage superimposed on the network voltage can turn on the triac by exceeding its avalanche voltage.

Under these conditions, because of its internal structure, only a part of the triac is effectively turned on and it can thus withstand only very low di/dt. This explains the considerable danger of damage to the component when used to drive purely resistive loads. In reality, the di/dt when turning on can, in this case, reach very high values (> 100 A/µs) since only the inductance of the connections limits the rate at which the current can increase.

Figure 1 : Typical Circuit.
The triac is directly connected to the distribution network : risk of damage



WHAT WE PROPOSE

The principle of the protection which we have studied consists of turning on the triac by the gate as soon as the voltage across it exceeds a certain value (figure 2), thus ensuring a high level of safety. To do this we use a bidirectional TRANSIL diode whose current/voltage characteristic is shown in figure 3.
When the voltage applied to the triac reaches the VBR voltage of the TRANSIL, the latter conducts, producing a current in the triac gate and turning it on (figure 4). The triac continues to conduct till the half cycle current passes through zero (figure 5).

Figure 2 : Protection of the Triac by a Bidirectional TRANSIL Diode.

The Triac is turned on by gate current (i) as soon as voltage A2 exceeds the voltage V_{BR} of the TRANSIL.

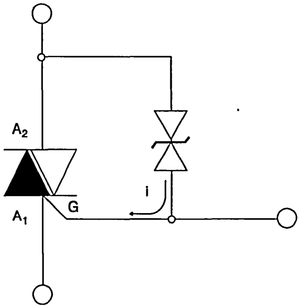


Figure 3 : Voltage-current Characteristic of a TRANSIL Diode.
V_{BR} Specified at 1mA (tolerance 5 or 10%)
V_{CL} limitation voltage is given for a high Ipp current level (from several amperes to several tens of amperes, depending on the type).

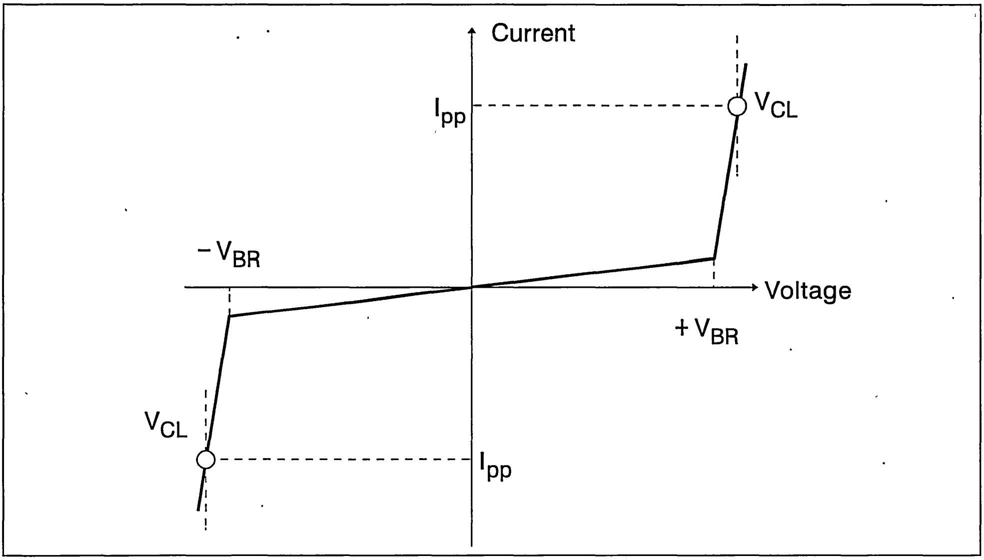


Figure 4 : Characteristic of the TRIAC + TRANSIL Assembly. Case of a 600V/12A triac protected by a 440V TRANSIL diode (the dotted line gives the characteristic of the triac alone)

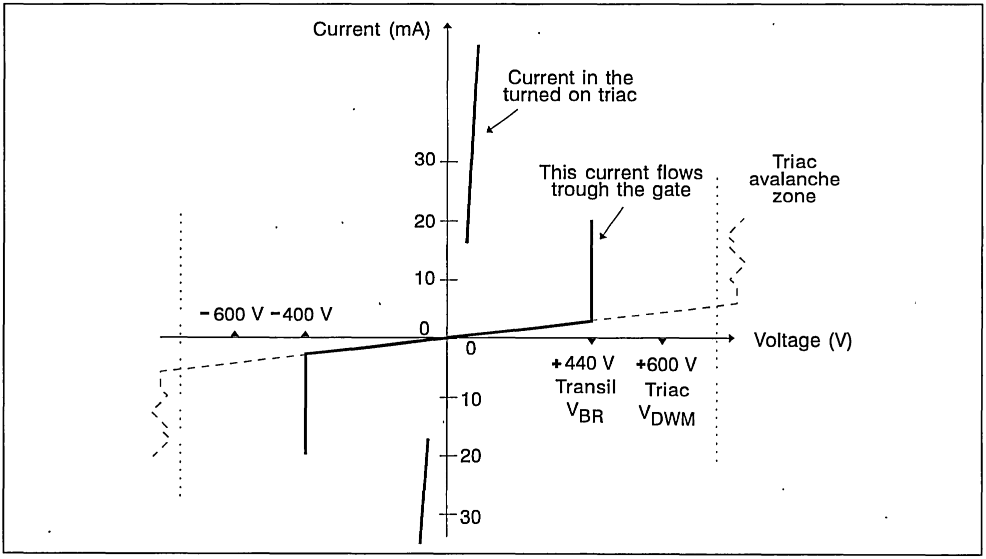
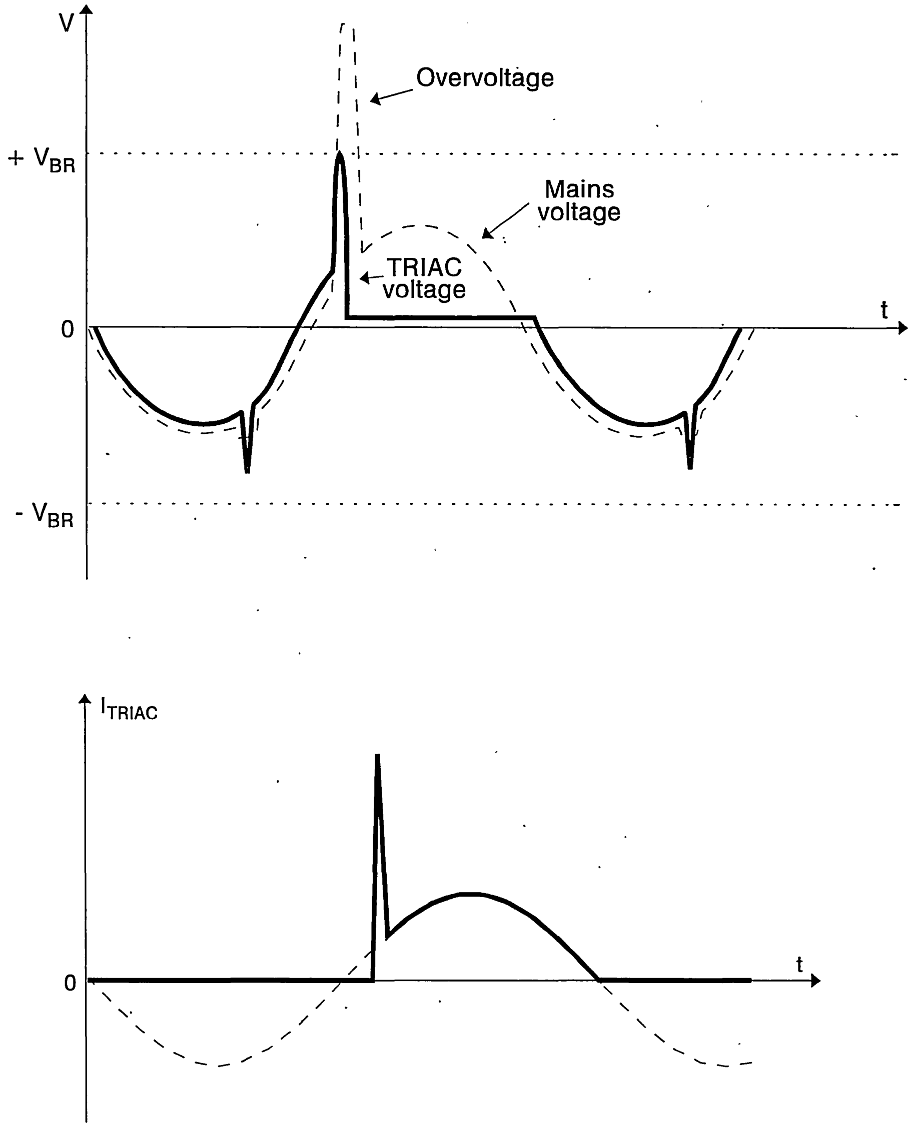


Figure 5 : Behaviour of a Triac Protected by a TRANSIL Diode (the triac is turned on by the gate at the beginning of the overvoltage and continues conducting through the rest of the half-wave)



THE ADVANTAGES OF THIS SOLUTION

- The triac will always operate within the voltage limits given by the manufacturer (VDWM) and thus far from the avalanche zone.
- Not much power is dissipated in the triac during the disturbance before the turn-on, the dissipated power is localized in the protection component (the TRANSIL is made for that !).

The triac is turned on by a gate current which will ensure optimal di/dt conditons.

THE RESULTS

We have carried out tests with repetitive overloads (1Hz) under various conditions :
Exponential shock waves of about 1ms, calibrated in voltage (up to 2000V) and controlled in di/dt (500 A/µs max).
The tests were carried out with steep-edged voltage pulses (dV/dt > 1000 V/µs) and also with gradual slopes (< 50 V/µs).
All these tests were successful : zero failure.

SELECTION OF THE TRANSIL DIODE REQUIRED FOR PROTECTING A TRIAC

VOLTAGE : V_R

Obviously the triac associated with the TRANSIL diode should not be turned on by the maximum mains voltage. An additional safety margin should be given to prevent untimely turning on by the small voltage spikes, often repetitive, which are always present on a "normally" disturbed mains line.

$$V_R > V_{mains} \times \sqrt{2} + \text{safety margin.}$$

In the absence of accurate specifications, add 20% for the safety margin.

Example : 220V network :

$$V_R > 220\sqrt{2} + 20\% = 375V$$

POWER

The TRANSIL only conducts when turning on the triac (t ≡ 1µs).

The current during this time can reach very high levels (several tens of amperes) in the case of disturbances with steep edges (> 1000V/S), however the dissipated power remains well within the capability of TRANSILS.
The BZW 04(400W/1ms) is suitable for all cases.

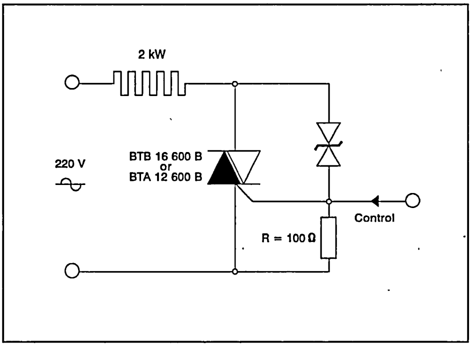
PRACTICAL EXAMPLE

Drive circuit for a 2kW heating element on 220V mains (figure 6).

The BZW 04.376B type TRANSIL perfectly protects the BTB 16.600B triac (V_{DWM} = ± 600V).

The 100 Ω resistor, R, between the gate and A1 is not absolutely indispensable, but it preserves the dV/dt characteristic of the triac which would be reduced (by about 20%) by the junction capacitance of the TRANSIL between anode and gate.

Figure 6 : Practical Example of the Protection of a 12 or 16A Triac against Overvoltages



CONCLUSION

With the protection circuit proposed, the triac always operates under perfectly defined conditions in case of overvoltages :

- The voltage remains limited to the maximum specified for the triac
- Turn-on is ensured by a gate current.

This circuit, which we have tested in a number of different setups (different lads, high amplitude overvoltages, disturbances of long duration, etc...), enables a considerable increase in the reliability of circuits using triacs and is indispensable for driving resistive loads on highly disturbed networks.

AUTOMOTIVE APPLICATION NOTES

APPLICATION NOTE

PROTECTION STANDARDS APPLICABLE TO AUTOMOBILES

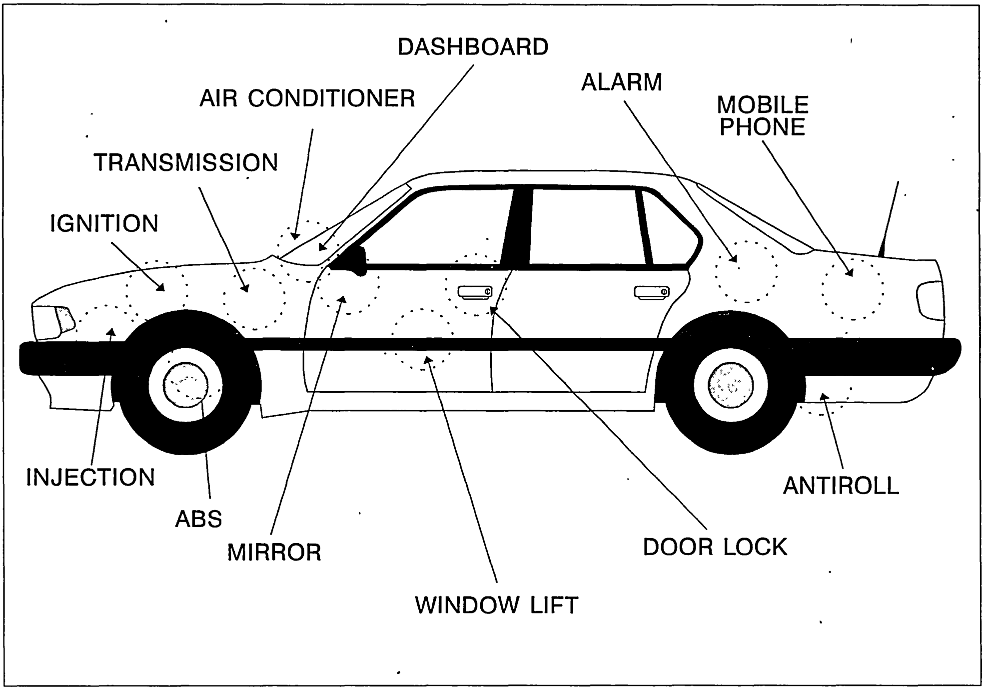
A. Bremond

1 - INTRODUCTION :

A growing number of sensitive electronic units can be found in motor vehicles. Unfortunately the presence of electrical disturbances threatens their reliability.

The objective of this paper is to list all these disruptive factors and to suggest appropriate protection devices.

Figure 1 : Electronic modules in a car



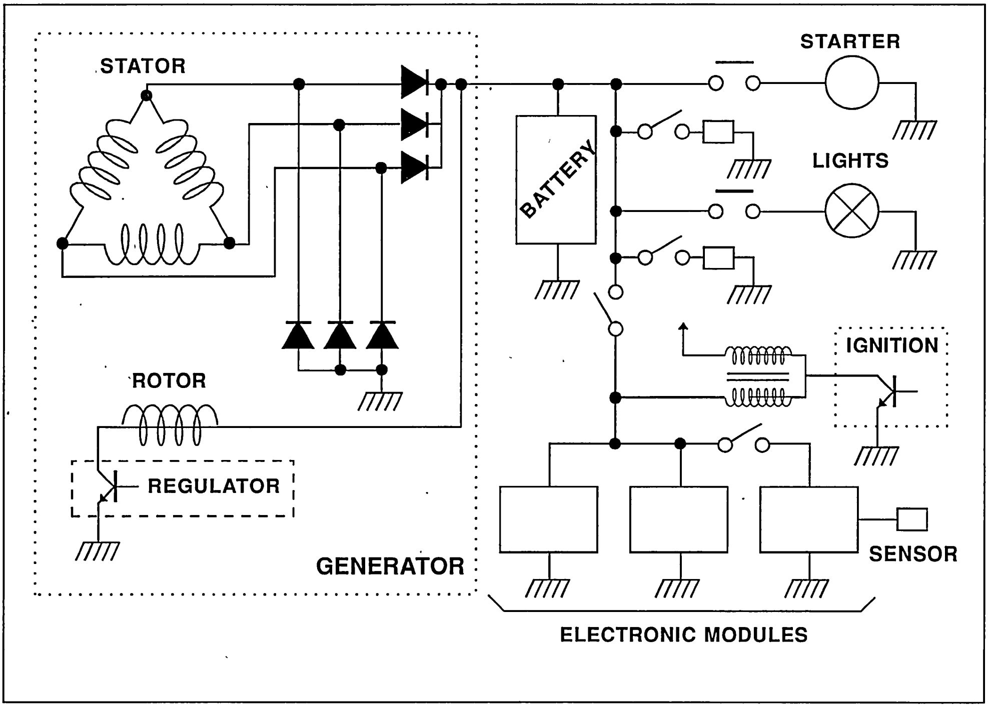
II - GENERAL INFORMATION :

II.1 Simplified diagram of an automotive electrical circuit

II.2 Coexistence of electromechanical engineering with electronics :

Fig. 2 shows that the electrical system of a motor vehicle contains some electromechanical engineering which generates disturbances (alternator, ignition system, starter, relays etc...) and some electronic equipment affected by these disturbances (instrument computer, injection unit etc...). The role of the protection devices will be to ensure the smooth coexistence of both.

Figure 2 : Automotive electrical diagram



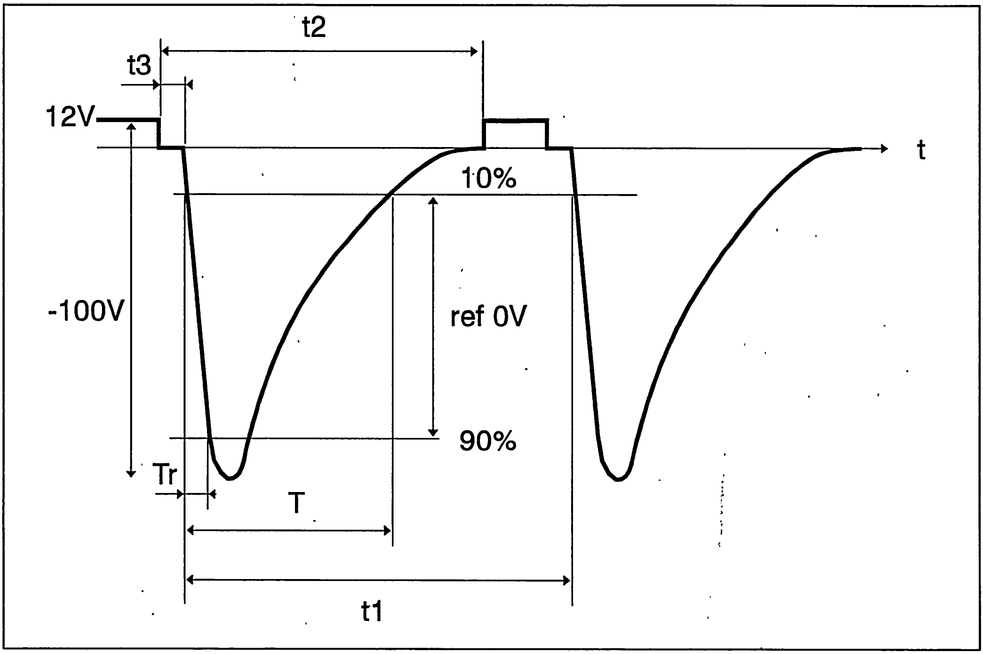
III - ORIGIN AND WAVEFORM PARAMETERS :

Electronic units receive the disturbances through the various cables which are connected to them. They are defined by the ISO/TC 22 standards and described in appropriate technical notes issued by the various motor vehicle manufacturers.

III.1 Disconnecting inductive loads :

Disconnecting an inductive element causes a high inverted overvoltage on its terminals.

Figure 3 : Shape of test pulse 1 (disconnection of Inductive Loads)



T = 2 milliseconds

Tr = 1 microsecond

Ri = 10 ohms *

t1 = 5 seconds

t2 = 0.2 second

t3 < 100 µs

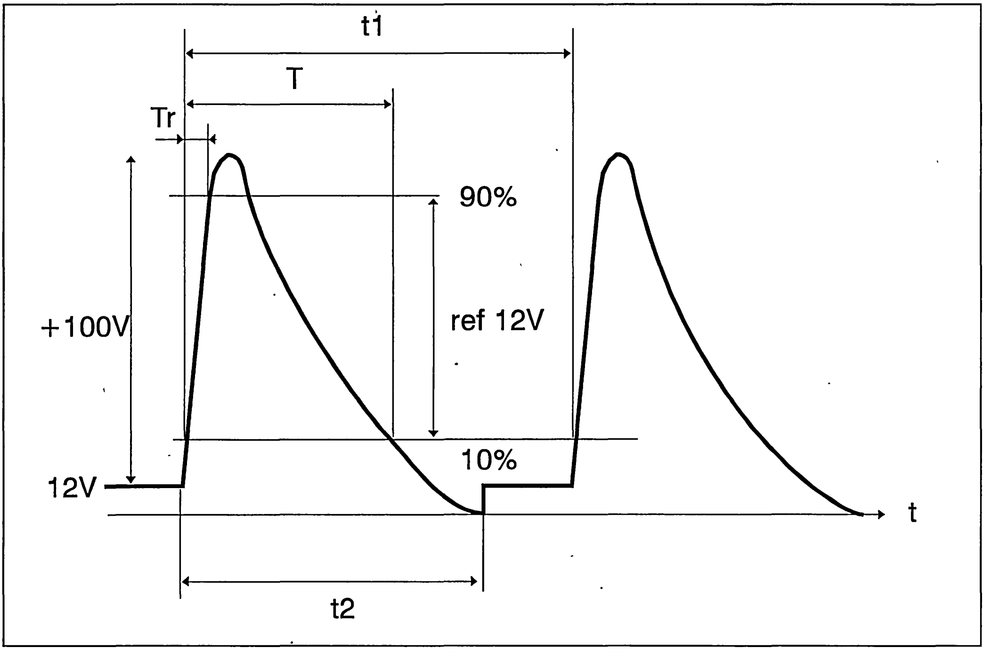
* Internal series resistor of the surge generator.

III.2 Sudden power cut off in the main circuit :

After the battery supply circuit is cut by the ignition key, the ignition circuit contines to release disturbances until the engine stops rotating.

Overvoltages are generated by switching the power supplied by electric motors acting as generators, e.g. the air conditioning fan. Their amplitude is increased by the absence of the filtering which would normally be carried out by the battery.

Figure 4 : Shape of test pulse 2 (Sudden Interruption of Series Current)



T = 2 milliseconds

Tr = 1 microsecond

Ri = 10 ohms

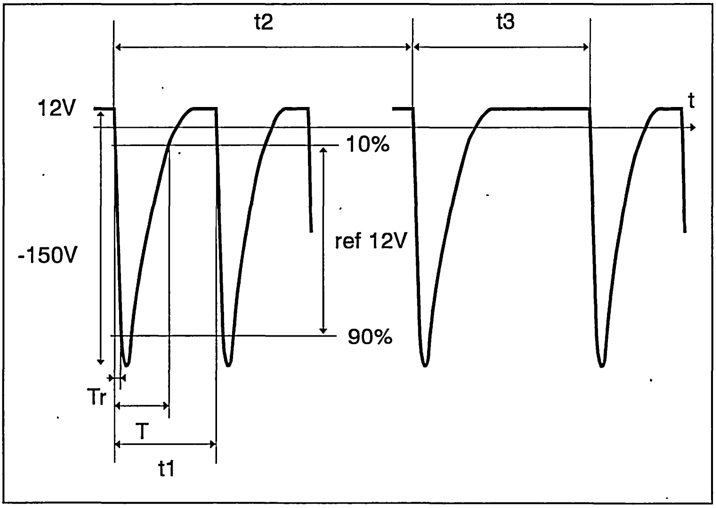
t1 = 0.5 to 5 seconds

t2 = 0.2 second

III.3. Switch bounce :

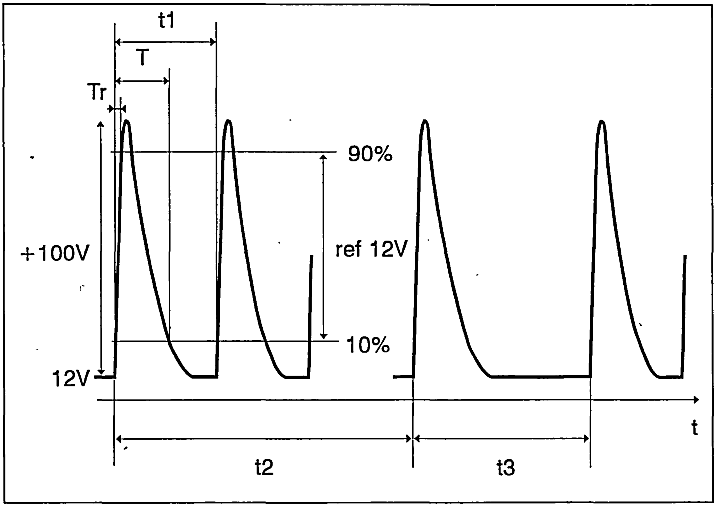
Power cut-off in the supply network capacitances and inductances, resulting from switch rebounds, generates sets of disturbances.

Figure 5A : Shape of test pulse 3A (switching spikes)



T = 0.1 microsecond
Tr = 5 nanoseconds
Ri = 50 ohms
t1 = 100 microseconds
t2 = 10 milliseconds
t3 = 90 milliseconds

Figure 5B : Shape of test pulse 3B (switching spikes)

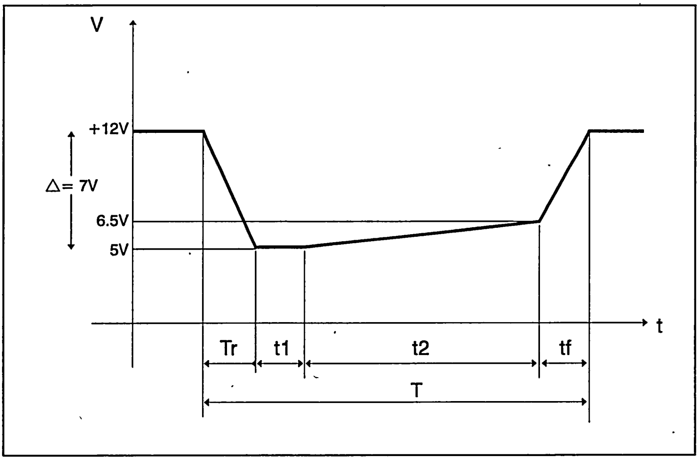


T = 0.1 microsecond
Tr = 5 nanoseconds
Ri = 50 ohms
t1 = 100 microseconds
t2 = 10 milliseconds
t3 = 90 milliseconds

III.4. Activating the starter :

When the starter circuit is activated, a voltage drop occurs in the supply source.

Figure 6 : Shape of test pulse 4 (starter motor engagement disturbance)



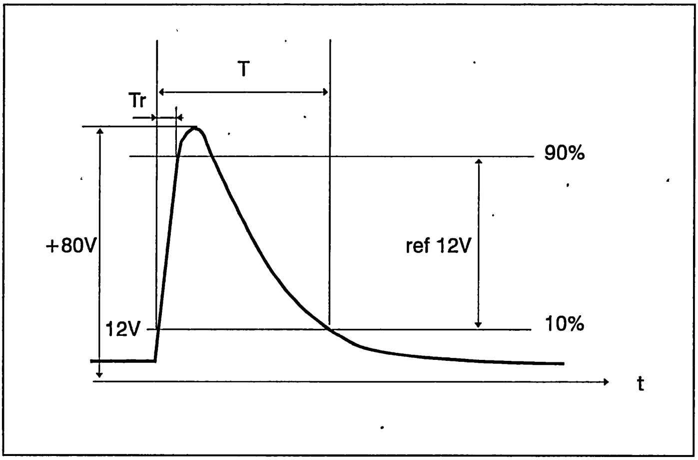
T = 130 milliseconds
Ri = 0.01 ohm
Tr = 10 milliseconds
t1 = 10 milliseconds
t2 = 100 milliseconds
Tf = 10 milliseconds

III.5. Load dump :

This happens when the battery is disconnected whilst being charged by the alternator.

During this load dump, the voltage on the alternator terminals increases rapidly. The length of this disturbance depends on the time constant of the generator excitation circuit.

Figure 7 : Shape of test pulse 5 (load dump)

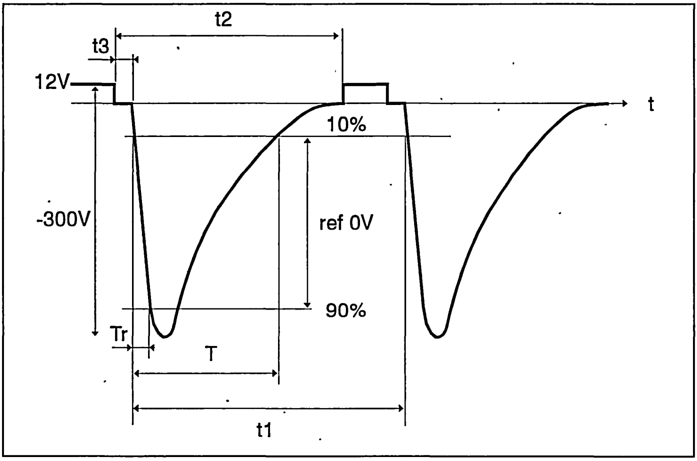


Tr < 10 milliseconds
Ri = 2 ohms
T = 300 ms

III.6. Power cut off in the ignition coil :

This disturbance occurs when the ignition contact is cut off.

Figure 8 : Shape of test pulse 6 (ignition coil current interruption)

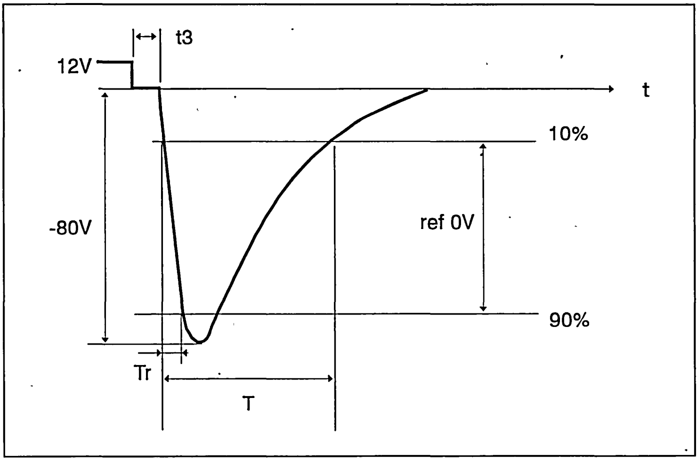


T = 300 microseconds
Tr = 60 microseconds
Ri = 30 ohms
t1 = 15 seconds
t2 = 1 second
t3 < 100 microseconds

III.7. Alternator magnetic field decay :

This negative overvoltage appears when the magnetic field of the alternator disappears (when the engine stops turning).

Figure 9 : Shape of test pulse 7 (alternator field transient at engine stop)



T = 100 milliseconds
Tr = 5 to 10 milliseconds
Ri = 10 ohms
t3 < 100 microseconds

III.8. Regulator failure :

This type of problem can cause the output generated to be permanently too high, perhaps greater than 18 V.

III.9. Starting aid :

In certain cases, when new motor vehicles have been stored over a long period (eg. sea deliveries, when starting takes place at low temperatures, etc...,) using another source of energy other than that of the vehicle becomes necessary.

The most common procedure is the use of two standard 12 Volt batteries paralleled with that of the vehicle. The overvoltage estimate is 24 Volts (or -24V in the case of an inverted connection).

III.10. Miscellaneous :

Motor vehicles can be subject to other sources of disturbances, such as :

- the connection to a diagnostic unit.
- electric soldering.
- paint electrostatic tension.
- HF rays generated by tranmission equipment.

IV - ANALYSIS OF THE VARIOUS DISTURBANCES :

ORIGIN	DURATION	VOLTAGE	ENERGY	FREQUENCY
Disconnection of inductive loads	2 ms	- 100 V	2.3 j	Frequent
Power cut-off in the main circuit	2 ms	+ 100 V	2.3 j	Frequent
Switch bounce	0.1s x 10	+ 100 V - 150 V	50j x 10	Frequent
Starter engagement	130 ms	-	-	At every start
Load dump	300 ms	+ 80 V	50 j	rare
Ignition	300 s	- 300 V	0.003j	Frequent
Alternator magnetic field decay	100 ms	- 80 V	0.2 j	At every stop
Imperfections at regulator level	Continuous	+ 18 V	-	rare
Starting aid	Several minutes	24 V	-	rare

V - CONCLUSION

Table IV shows that we are confronted with 5 types of disturbances :

a/ Positive impulsive overvoltages

b/ Negative impulsive overvoltages

c/ Positive continuous overvoltages

d/ Negative continuous overvoltages

e/ Impulsive voltage drop

The goal of protection circuits is to prevent destruction due to these disturbances.

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MICROELECTRONICS

APPLICATION NOTE

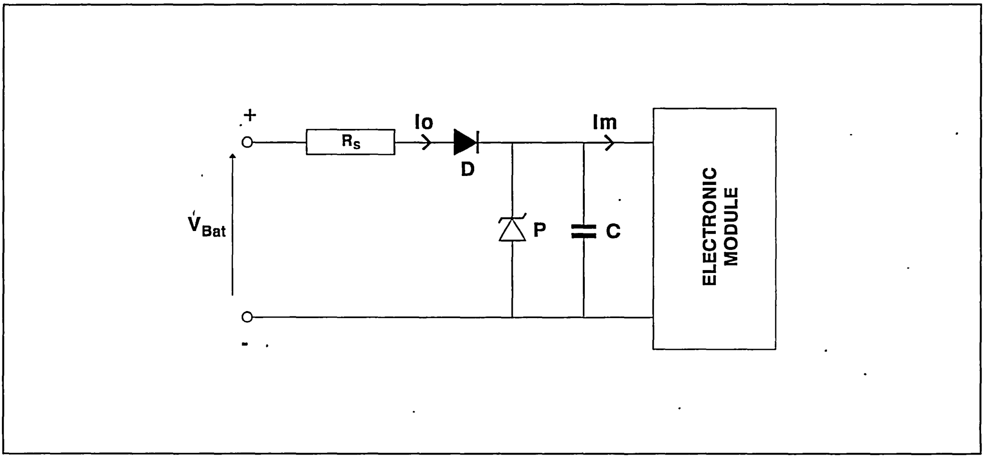
CHOICE OF PROTECTION IN AUTOMOTIVE APPLICATIONS(CLASSICAL TOPOLOGY)

A. Bremond

1. INTRODUCTION

This paper describes a protection schematic based on discrete components, together with a general method of choosing the components to suppress the surge effects on automotive modules.

Figure 1 : General Protection Topology



2. GENERAL PROTECTION SCHEMATIC :

2.a Positive impulsive overvoltages :

This type of overvoltage is clamped by the protection component P at maximum voltage V_{CL}. Resistance R_S limits the dissipated energy in the protection component without compromising the clamping function.

2.b Negative impulsive overvoltages :

There are two ways to limit these :

- Without diode D : the protection component operates as a rectifier diode and clamps the voltage at the unit terminals to approximately 1 V.

- With diode D : the diode is reverse-biased and therefore protects the unit.

One important thing to take into account is the peak reverse voltage limit of D. V_{RRM} = 400V seems a good compromise (see curve N° 6 of the ISO/TC22 standard).

2.c Positive continuous overvoltages :

During this phase, the protection component must be in the stand- by phase (very low current passing through the component).

2.d Negative continuous overvoltages :

This protection is achieved by diode D which is reverse -biased.

2.e Impulsive voltage drop :

During this phase, the unit is fed by capacitor C while diode D prevents C from discharging into the battery circuit.

3. THE CHOICE OF COMPONENTS :

3.a Diode (D)

The following parameters will constitute the selection criteria :

- The average current used by the electronic module.

- The maximum repetitive peak reverse voltage V_{RRM}

- The maximum ambient temperature T_{amb}.

The following inequality must apply in all cases :

$$T_{amb} + R_{th}\, P < T_j \max$$

where

$$P = V_{TO}\, I_F\, (AV) + rd\, I^2_F(R_{MS})$$

R_{th} = thermal resistance (Junction - ambient) for the device and mounting in use.

3.b Resistance (Rs)

Its presence allows a "size" (and thus cost) reduction of the protection component.

Its value is a function of the following elements :

V_{bat} min : lowest battery voltage which is specified in the technical note issued by the manufacturer.

V_{CC} min : minimum voltage needed for the electronic unit in operation.

I_{CC} max : maximum supply current of the electronic module.

The maximum value of Rs will be :

$$R_S \max = (V_{bat} \min - V_{CC} \min)/I_{CC} \max$$

3.c Capacitor (C)

Its role is to make sure that the voltage at the terminals of the electronic unit is greater than or equal to Vcc min while the starter circuit is active.

Its value depends on :

V_{bat} : voltage across the battery before the disturbance

V_{CC} min : see par. 5.b

T : length of the disturbance (130 ms: see application note 4.1, paragraph III.4)

The minimum value of C will be :

$$C\min = (130 * 10^{-3}/R_{eq})/\ln (V_{CC} \min/V_{bat})$$

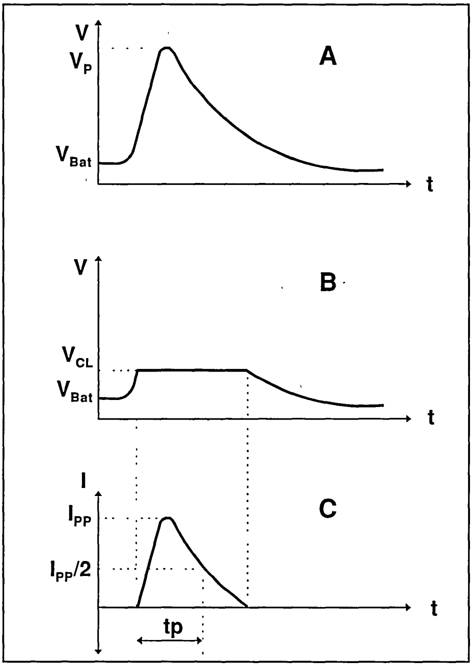
with R_{eq} = equivalent resistance of the electronic unit

$$R_{eq} = V_{CC} \min/I_{CC} \max$$

3.d Protection component (P)

- How it works :

Figure 2 : Transil Behaviour



A : Disturbance

B : Voltage across the protection device

C : Current through the protection device

The role of the protection device is to suppress the destructive effects of the surge (Fig.2a), the most agressive being the load dump impulse.

To achieve this, the TRANSIL clamps the spike at a maximum value V_{CL} (Fig.2b). A surge current flows through the suppressor during this phase (Fig.2c).

4. THE CHOICE OF THE PROTECTION DEVICE

4.a Parameters to take into account

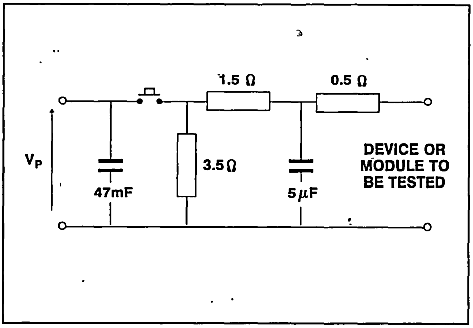
To choose the TRANSIL we have to know the surge parameters and the application requirements.

- Surge parameters

The surge is defined by the peak value Ip and the duration tp of the current wave flowing through the protection device during the clamping.

As shown in the ISO/TC22 standard the most energetic impulsive disturbance is the load dump surge. Most car manufacturers recommend the SCHAFFNER NSG 506 generator to synthesise this wave. See fig.3.

Figure 3 : Equivalent circuit of Schaffner generator



This circuit allows us to determine the parameters of the current wave seen by the TRANSIL.

The peak current I_P is equal to :

$$I_P = (V_P - V_{CL}) / (R_G + R_S)$$

Where

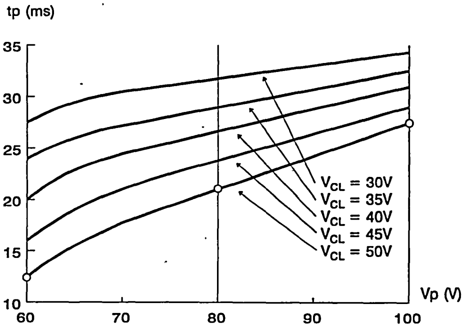
V_P = Peak voltage of the surge (+ 80V)
V_{CL} = Clamping voltage of the transil

R_G = Series resistance of the generator (2 Ohms)

R_S = Series resistance of the module to be protected (see chapter 3.b)

For example with V_P = 80V, V_{CL} = 40 V and R_S = 0 Ohm, we have I_P = 20A

Figure 4 : Current pulse duration versus V_P and V_{CL}



The curves of figure 4 give the duration tp of the current wave in the TRANSIL during clamping. This parameter depends on the peak voltage V_P of the surge and on the clamping voltage V_{CL} of the protection device. For example with V_P = 80V and V_{CL} = 40V, tp = 27.5 ms.

- Application requirements

Three values are necessary :

- The maximum operating voltage, which is the greatest battery potential. Often the car's electrical equipment has to withstand two battery voltages (due to starting aids: see ISO/TC22 standard). These parameters define the minimum stand off voltage V_{RM} of the TRANSIL.

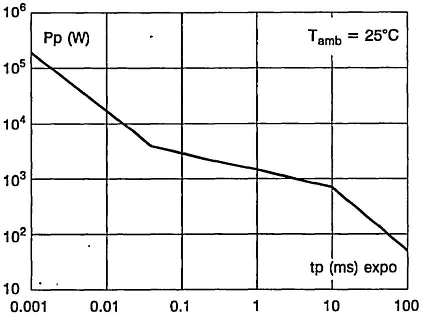
- The minimum destructive voltage, which is the voltage value over which the device will be destroyed. This limit determines the maximum clamping voltage V_{CL} of the protection device.

- The maximum ambient temperature T_{amb} that would decrease the power dissipation capability of the TRANSIL.

4.b Choice of the protection device

The choice of component is made with the help of the parameters t_P, P_P in the curve $P_P = f(t_P)$ from the "PROTECTION DEVICES" data book.

Figure 5 : Peak pulse power versus exponential pulse duration (1.5KE, 10V < V_{BR} < 250 V)

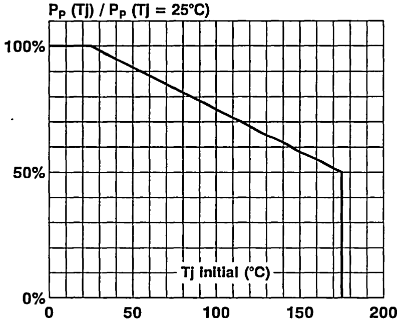


If the operating point defined by t_P and $P_P = V_{CL} * I_P$ is on or below the curve, the TRANSIL can operate in the application at 25°C of ambient temperature.

4.c The ambient temperature effect :

Component characteristics are given at an ambient temperature of 25°C (die temperature before clamping action). The following chart shows the effect of junction temperature on the power suppression capability.

Figure 6 : Allowable power dissipation versus junction temperature



This curve gives the derating to be applied to the peak power capability of the protection device according to junction temperature.

The second temperature effect is the shift of V_{BR}.

$$V_{BR} \text{ (at T)} = V_{BR} \text{ (at 25°C)} * (1 + \alpha_T \text{ (T-25)})$$

Where α_T is the temperature coefficient of V_{BR}.

4.d Calculation of clamping voltage V_{CL}

The clamping voltage V_{CL} can be estimated as follows :

$$V_{CL} = V_{BR} \max + (Rd\ IP)$$

Where Rd is the dynamic resistance of the TRANSIL

Table 1 - Typical Rd for wave of t_P = 30 ms at 25°C

	BZW04 P23	P6KE 30P	1.5KE 30P	BZW50 -22	LDP24AS
Rd typ (Ω)	1.2	0.75	0.35	0.15	0.12

5 - EXAMPLE :

A / Disturbances

The load dump is the most agressive

B / Battery voltage

The electronic unit will have to function with a battery voltage of 11 V.

C / Ambient temperature

Tamb = 85°C

D/ Electrical characteristics of the module

Table 2 - Module characteristics

PARAMETERS	V_{CC}	I_{CC}
DESCRIPTION	Supply voltage	Supply current
MIN	8	-
TYP	12	400
MAX	32	600
UNIT	Volts	mA

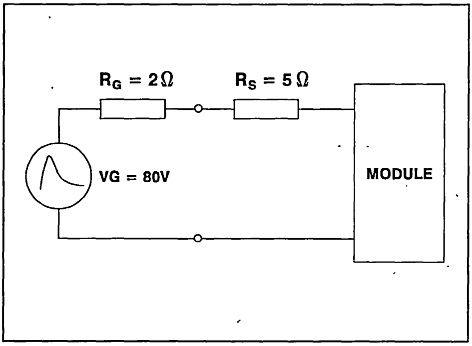
E / Analysis

E/1 Calculation of R_S max

$$R_S \text{ max} = (V_{bat} - V_{CC} \text{ min})/I_{CC} \text{ max}$$
$$R_S \text{ max} = (11\text{-}8)/0.6 = 5 \text{ Ohms}$$

E/2 Diagram

Figure 7 : Application Diagram



E/3 Peak current

$$I_{PP} = (V_G\text{-}V_{CL})/(R_G+R_S) = (80\text{-}32)/7\text{=}6.9\text{A}$$

E/4 Peak power

$$P_P = V_{CL} * I_{PP} = 32 * 6.9 = 221 \text{ W}$$

E/5 Conduction time

$$t_P = 30 \text{ ms}$$

E/6 Choice of the TRANSIL

Table 3 - Transil characteristics

TYPE	**POWER CAPABILITY** (tp = 30 ms)	
	at 25°C	at 85°C
BZW04	60 W	45 W
P6KE	80 W	64 W
1.5KE	200 W	160 W
BZW50	700 W	525 W
LDP24A	1980 W	1800 W

E/7 Conclusion

Diode BZW50-22 is an efficient protection device within the 85°C temperature range, and the V_{CL} max is given as follows :

$$V_{BR}\,(85°\text{C}) = V_{BR}\,(25°\text{C}) \text{ x } (1 + \alpha_T(85\text{-}25))$$
$$= 29.8 * (1 + 9.6 * 10\text{-}4 * 60)$$
$$= 31.5\text{V}$$
$$V_{CL}\,(85\ °\text{C}) = V_{BR}\,(85\ °\text{C}) + \text{Rd } I_P$$
$$= 31.5 + (0.15 * 6.9)$$
$$= 32.5 \text{ V}$$

AUTOMOTIVE PROTECTION WITH THE RBOxx SERIES

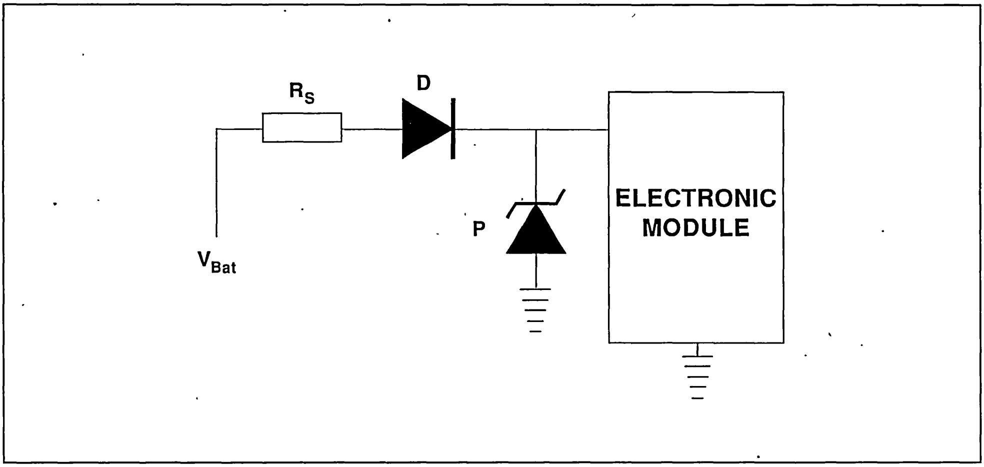
C. Cytera

1. INTRODUCTION

The harsh electrical environment in automobiles poses problems for the electronic modules present. Even in normal operation, large positive and negative overvoltages due to switch bounce, ignition coil switching and other phenomena are a potential cause of destruction. An additional hazard is the possibility of supply reversal, perhaps caused by faulty wiring. Another danger is the "load dump" effect, caused by battery disconnection while the engine is running. This causes the energy stored in the alternator coils to manifest itself as an 80 V transient lasting around 300 ms : lethal to semiconductor circuits. See application note 4.1 : "Protection standards in automotive applications" for more details.

Protection is therefore required, which can be centralized or distributed. Centralized protection attempts to suppress disturbances at their source, for example crowbar devices at the alternator to counter the load dump effect. Distributed protection aims to dissipate disturbances at their destination. Components performing this function are present in the electronic modules themselves and are thus relatively numerous. The RBOxx (Reversed Battery and Overvoltage) series of protection devices from SGS-THOMSON has been designed to reduce this distributed protection component count.

Figure 1 : Classical protection circuit

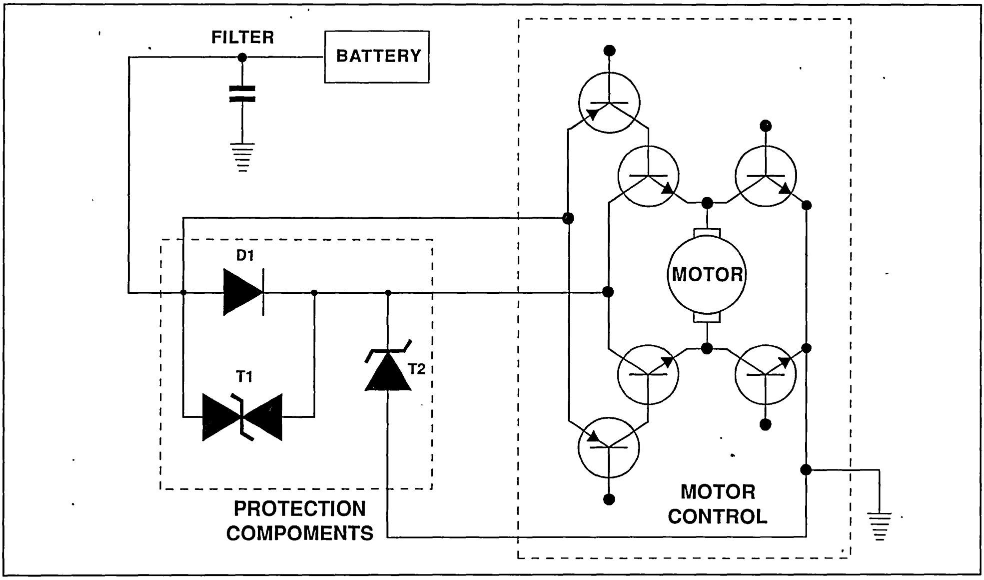


2. CLASSICAL DISTRIBUTED PROTECTION

The circuit shown in fig.1 protects the module against battery reverse as well as impulsive and continuous overvoltages, both positive and negative. In addition, overvoltages generated by the module are prevented from reaching the car supply network. Rs, in cases where it can be used, limits the power dissipated in the protection device P. Note that diode D is used in reverse-bias to block negative overvoltages, so its peak reverse voltage limit (VRRM) must be taken into account.

Motor driver protection is complicated by the presence of transistor circuits which control the direction and magnitude of current flow through the motor. A bidirectional clamping device needs to be added in order to ensure protection of both halves of this circuit. See fig.2.

Figure 2 : Motor driver protection with discrete components



The NPN transistors supplied via D1 are protected in the classical fashion already described. The PNP devices are connected directly to the car supply network and are protected as follows :

- Positive surges : overvoltage is clamped by T2 with D1 forward- biased.

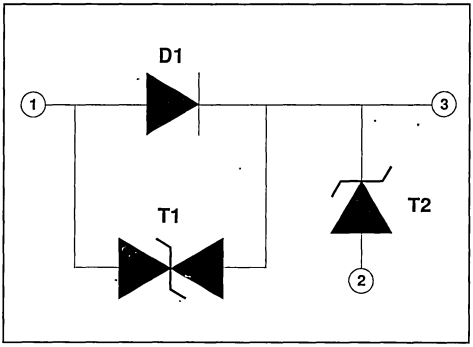
- Negative surges : These are clamped by T1 with T2 forward - biased.

Three components are thus required per motor driver, representing significant component and area cost.

3. DISTRIBUTED PROTECTION WITH THE RBOxx FAMILY

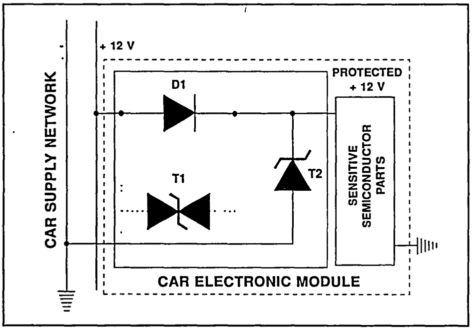
The RBOxx devices integrate all the protection functions required by car electronic modules : see fig.3.

Figure 3 : Schematic diagram of an RBO device



Diode D1 protects against a reversed battery, while the "Transil" clamping device T2 suppresses positive surges. Negative surges are blocked up to the breakdown voltage of the bidirectional clamp T1. Larger negative surges are suppressed by T1 in avalanche breakdown in series with T2 forward-biased. Fig.4 shows the basic application of the RBOxx.

Figure 4 : RBO basic application



Note that as the voltage across D1 is clamped by T1, the VRRM of the diode is no longer a concern. The clamping voltage is the same as that of T2, given by the yy digits in the part number of the form RBOxx-yy. The xx digits indicate the average forward current between pins 1 and 3.

Two devices are available at the time of writing : the RBO08-40 and the RBO40-40. The latter device is specifically designed to protect against "load dump" surges due to the greater power capability of T2, while the RBO08-40 is adequate for suppressing the other overvoltages present.

The presence of T1 makes possible an elegant solution to the motor driver protection. The RBOxx replaces the three protection components shown in fig.2 and protects the motor driver circuit in the same way.

4. CONCLUSION

A car power supply network is often contaminated with voltage surges potentially damaging to the semiconductor circuits present. The SGS-THOMSON family of RBOxx protection devices enables full protection from these surges with the minimum component count.

COMPUTER APPLICATION NOTES

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

CHOOSING AN ITAxx REQUIRES A SYSTEM APPROACH

CH - Politano

INTRODUCTION.

Destined for the protection of data transmission lines, each one of these components corresponds to a particular application. Therefore, one no longer chooses an ITAxx - type protection as he did a Transil diode. In order to accurately select the correct component, one must take into account the entire system and analyse the following points:

* against what type of disturbances do we want protection?

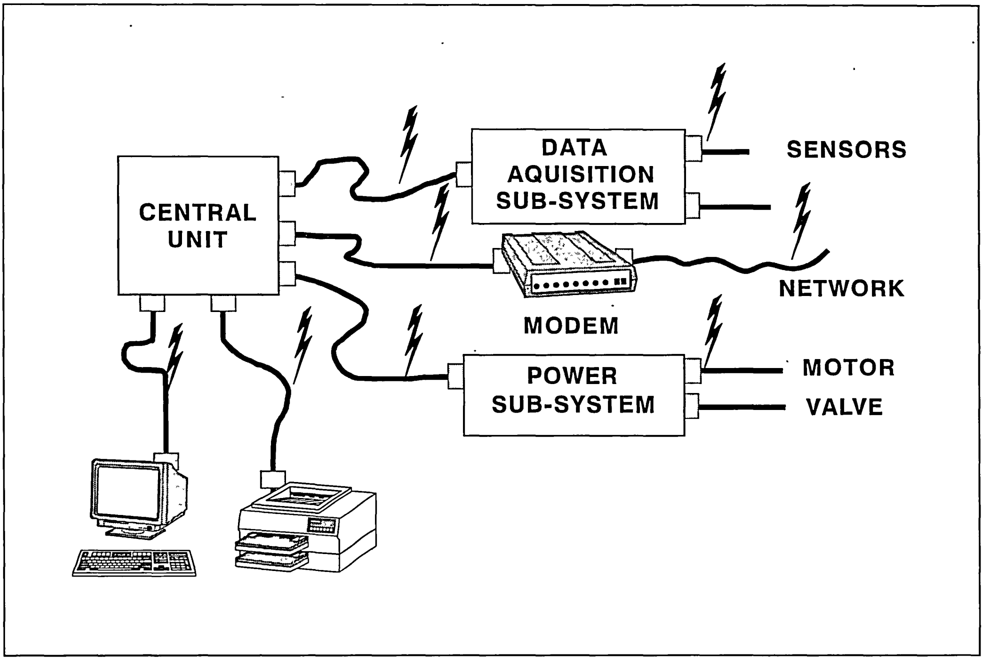
* what Transil array configuration do we need (number of I/O, voltage of the line signal)?

* what type of interface circuit are we protecting, and what are the destruction limits?

Once this step is done, the only thing left to do is to define the adapted Transil array. To help the user, a detailed description of the characteristics and the functioning mode of the ITAxx arrays is required.

1) The protection level of the ITAxx :

The protection of electronic and computer systems against ESD and EOS disturbances is regulated by numerous standards, such as IEC801-xxx, Mil Standard, etc. Within one standard, the protection levels change in function of the application.



SGS-THOMSON's objective in developing this range of Transil arrays (ITAxxx) was to propose solutions that correspond exactly to these demands (see Annex 1: Applicable Protection Standards ...). These components are designed in order to protect against over-voltages resulting from ESD or EOS that disturb data transmission lines and for which the characteristics are stated below:

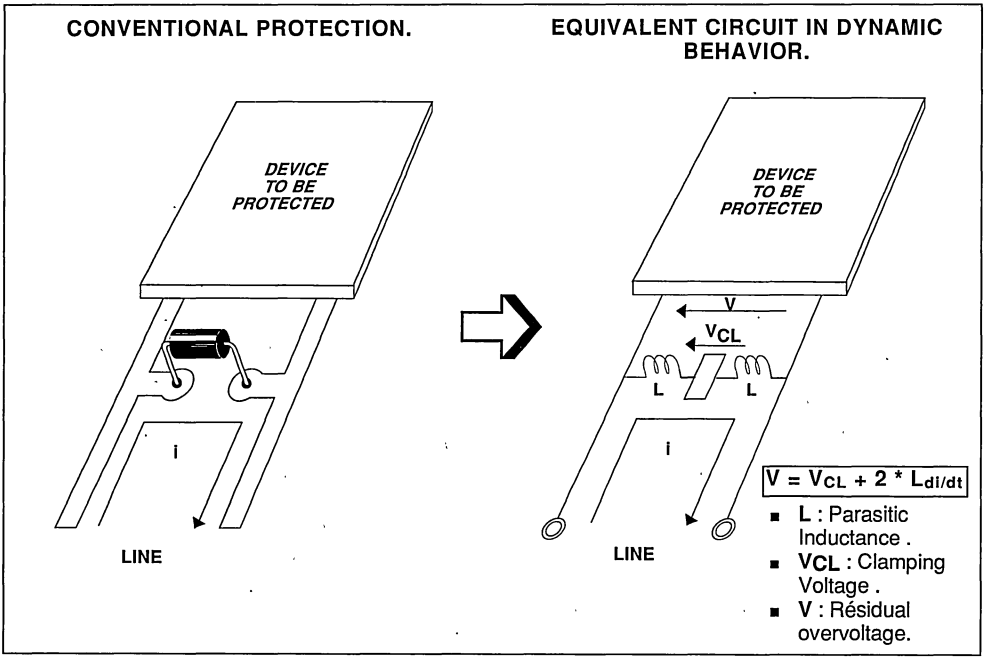
- ESD discharges have very little energy. However, they are very rapid (5/30 ns waves) and present very high voltage peaks, around 15 KV. The component must assure an efficient protection in dynamic behavior. Low clamping voltage levels (V_{CL} < 30 V) must be maintained in the presence of very fast transients with rise times such as 10A/ns. In this case, the performance of the protection device is not linked to the silicon but to the structure of the connections and the track lay-out of the PC board.

- The EOS are longer over-voltages (1.2/50 µs waves) with voltage peaks of 500 volts to 1 KV. Because these disturbances are powerful, the protection device must be able to dissipate the power in the silicon in order to guarantee low clamping voltage levels.

2) ITAxx, a reliable protection against ESD :

It has been shown that in the presence of ESD-type disturbances, standard protection devices (axial and even SMD diodes) only guarantee a protection level of about a few hundred volts. We still find at the lead level of the sensitive component to be protected the clamping voltage (Vcl) to be 10 to 30 volts, and especially an over-voltage created by the parasitic inductances (Ldi/dt) which can reach several hundreds of volts. Figure 3 illustrates this behavior.

Figure 3 : Protection Against ESD



Aware of this problem, the manufacturers of interface circuits have proposed components with auto-protected I/O's up to 1 to 2 kV. But in the case of long lines which are heavily exposed to disturbances, this precaution is not enough and, therefore, requires the use of specific ESD protection devices.

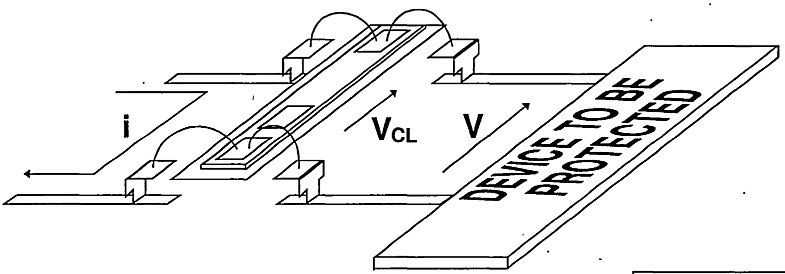
The ITAxxB3 and ITAxxU3, which offer 8-transil functions in an SO 20 package, have been especially designed for this application. The internal wiring is based on a 4-point structure which allows the isolation of the input from the output, guaranteeing a reliable protection with clamping voltages less than 30 volts. This assures a real protection of the line interfaces.

In order to achieve such performance from these components, some recommendations about PCboard mounting must be given.

Figure 4 shows what type of lay-out must be used in order to take advantage of the 4-point structure of the ITAxxB3 and ITAxxU3. With this configuration, each data line passes through the protection device. In this case, it acts as an interface between the cable and the circuit to be protected and guarantees an isolation between its inputs and outputs.

The ESD wave is deviated across the input of the protection device. Therefore, the circuit to be protected is no longer exposed to the Ldi/dt generated by the parasitic inductances of the wiring.

Figure 4 : 4 - Points Structure (ITAxxB)



V = V_{CL}

- **VCL** : Clamping Voltage.
- **V** : Residual Overvoltage.

3) The ITAxx, an efficient protection against EOS :

Due to their monolithic structure which allows to optimize the active surface of the silicon, these products have a dissipation capability equal to that of discrete components. These devices can be considered as real protection against industrial disturbances (EOS) of the 1.2/50 µsec type by guaranteeing clamping voltages at high currents well under the maximum ratings of line interface circuits.

For example, these characteristics (V_{CL}, I_{pp}) are given for several part types in the table below:

Device	VBR	Ipp max 8/20 µsec	VCL @ Ipp 8/20 µsec	VCL @ Ipp 8/20 µsec
ITA6V1U3	6V1	40 A	10V at 10 A	12V at 25 A
ITA6V1M3	6V1	40 A	12V at 10 A	14V at 25 A
ITA18B1	18	40 A	25V at 10 A	28V at 25 A
ITA25B3	25	40 A	31V at 10 A	36V at 25 A

Note that the maximum dissipation capability is equal to I_{PP} = 40 A @ 8/20 µsec for all configurations no matter what the voltage is. The objective is to meet the protection standards concerning industrial disturbances applied to data transmission lines, which require to withstand the same level of energy no matter the application. This is reflected in the standard IEC801-5.

4) The choice and use of the ITAxx :

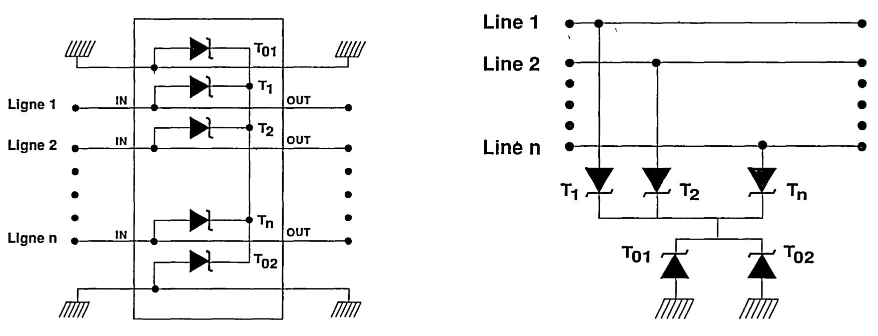
All of the ITAxxx monolithic arrays have been developed with the same basic concept of the integration of uni-directional functions, for uni-directional as well as bi-directional products (see Annex 2: Product Range - Configurations).

The uni-directional products (ITAxxU series) are achieved with a network of common-anode Transil which is similar to the discrete solution lay-out.

The bi-directional devices (ITAxxB series) are created with a network of common-cathode Transil which require special attention for their usage.

Figure 5 below explains the functional schematic diagram obtained with a bi-directional Transil array (ITAxxB series).

Figure 5 : The use of a Bi-Directional Transil Array (ITAxxB series)



Wiring Principle.

Equivalent Function.

a) Basic Principle :

Connect two Transil to ground (T01 and T02). This precaution doubles the current capability in relation to ground, thus allowing to support the maximum ratings (I_{PP} = 40 A, 8/20 µsec) on two wires at the same time. This guarantees a large safety margin, because when a disturbance occurs, it spreads out over all the wires.

b) Choice of the break-down voltage (V_{BR}) of the ITAxxB :

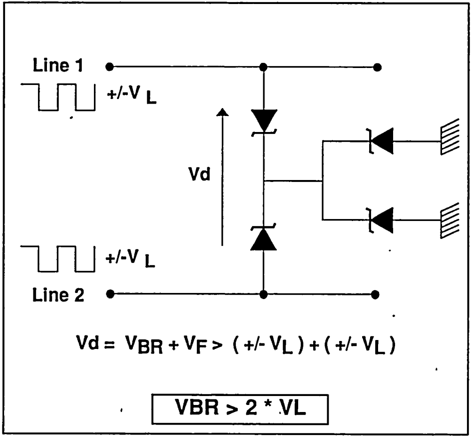
In the case of symmetrical signals (+/- V_{LINE}), a bi-directional Transil array with a break-down voltage (V_{BR}) greater than the maximum differential voltage between the 2 wires must be used.

Figure 6 helps to understand the break-down voltage (V_{BR}) calculation:

$$V_{BR} > 2 * V_L.$$

Each line is protected in the common mode at a voltage equal to the V_{BR}, and the line signals are not clamped in the differential mode.

Figure 6 : Calculation of the Breakdown Voltage (V_{BR}).



c) Examples of the use of bi-directional transil arrays.

Maximum Line Signals	ITAxxB Solutions
+/- 5 V	ITA10Bx
+/- 9 V	ITA18Bx
+/-12 V	ITA25Bx

5) An ITAxx assures protection, even after its destruction :

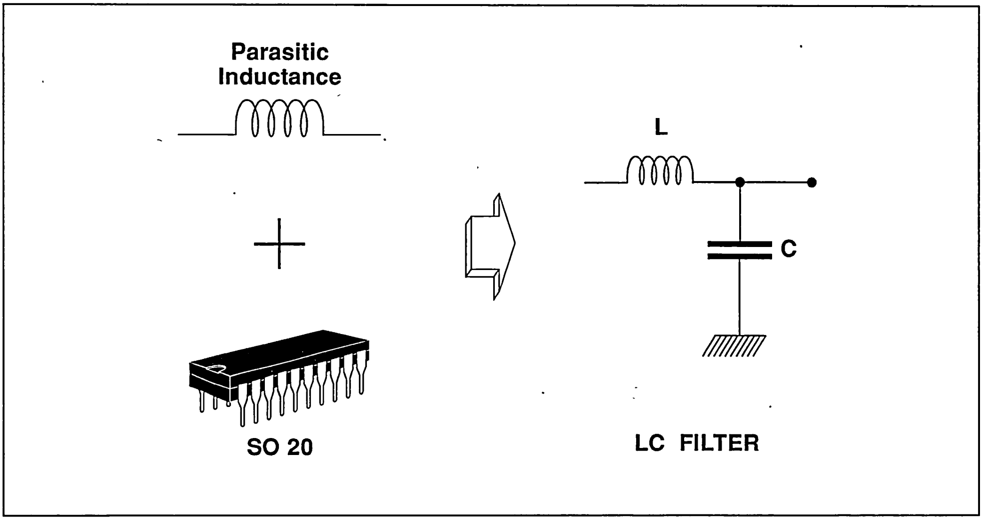
When a disturbance occurs whose energy is greater than the dissipation capability of the component, the destruction mode is a short-circuit.

This behavior, linked to the physical laws of silicon but also to an adequate wiring, assures constant protection, even after destruction. Additionally the line failure detection is immediate.

6) Use of transil arrays as an EMI filter :

By using these transil arrays, the EMI filter function is offered "for free". The combination of the junction capacitance (from 500 to 1000 pf) with the parasitic inductances of the PC board tracks (L = 10 nH/cm) creates an EMI filter whose attenuation can satisfy applications with low exposure levels such as centronics connection in printers.(See Fig. 7)

Figure 7 : The use of Transil Arrays as Emi Filter



Here is an example of a calculation of attentuation using the following hypothesis:

* L = 80 nH (equal to an 8-cm track)
* C = 1100 pF (ITA6U1M3 type)

This gives a cut-off frequency of Fo = 17 MHz and an attenuation equal to 28 dB at 80 MHz.

7) The ITAxx assures a multi-channel protection without disturbing the signal transmissions.

The strong concentration of protection functions included in the ITAxx required the adoption of a new monolithic technology. This concept, characterized by a high density of lines, generates parasitic capacitances between adjacent channels. The trial testing done by our application laboratory showed that these "crosstalk" disturbances were not sufficient enough to disrupt the most widely used numeric data transmission lines.
An example of this would be the RS232 connection (V_L = +/- 12V) where experimentation has allowed the evaluation of the parasitic signals induced on the adjacent lines. This has showed them to be at +/- 2.5V max (Fig. 8) for a duration of 0.4 us (Fig. 9).

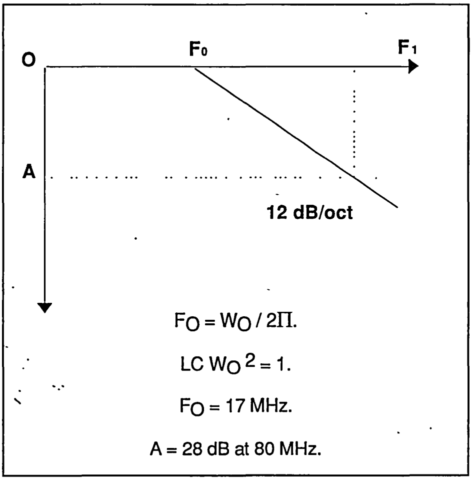


Figure 8 : Inter-Line Interference (amplitude)

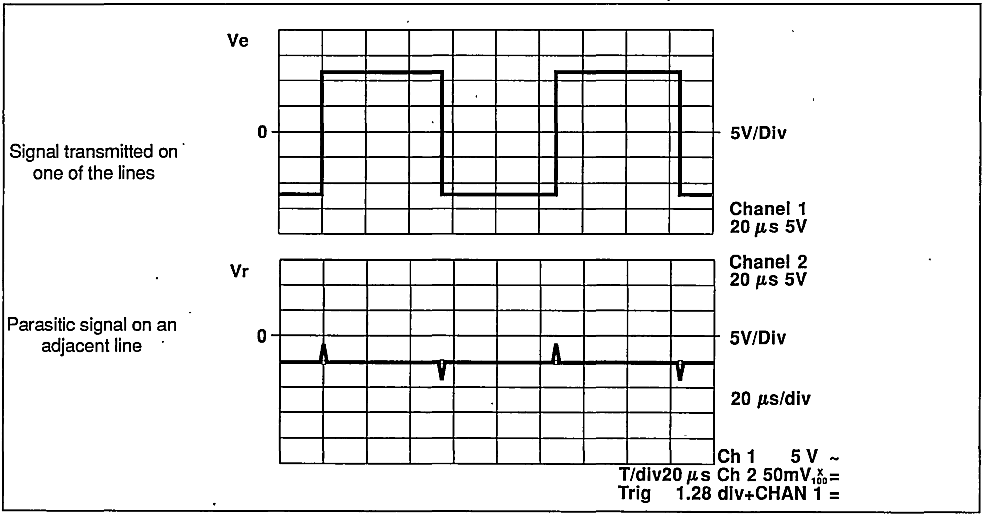
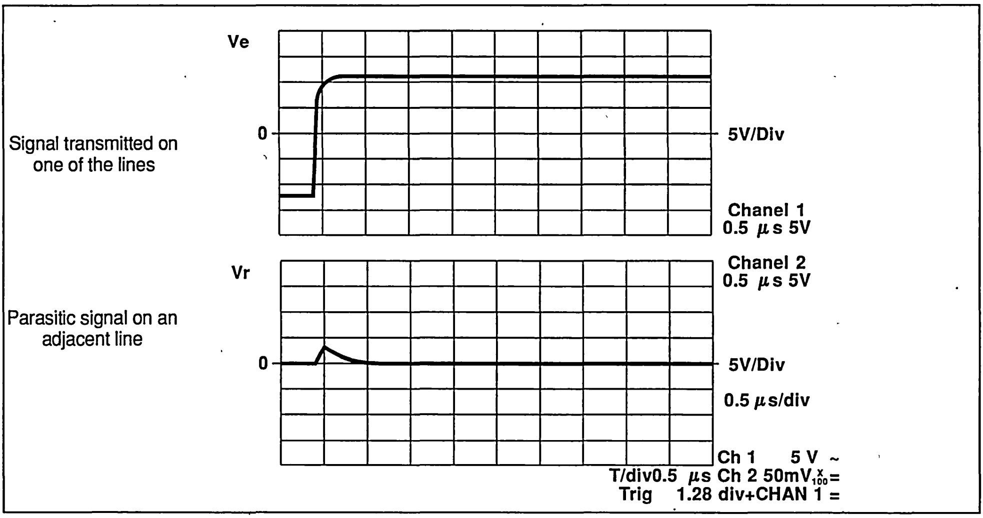


Figure 9 : Inter-Line Interface (duration)



The +/- 2.5V superimposed on the +/- 12V of the real signal are not detected by line receivers whose threshold is generally ajusted to +/- 1V. Additionally, the sampling system of the UART series interface circuits "hides" the disturbances of 0.4 us among the 51 us of one bit at 19600 bauds (see Fig. 9).

8) Use of the ITAxxx

In conclusion, the table below gives a matrix of the uses of the ITAxxx according to the type of line to be protected. The main products are listed here, but others are equally available for more specific applications. (See Annex II, Transil Arrays-Configurations).

Transil Array Utilization

DATA LINE	2/4 LINES SO8	5/8 LINES SO20	18 LINES SO20
CENTRONICS 0/5V	ITA6V1U1	ITA6V1U3	ITA6V1M3 LCTA6V1M3 (Low Capacitance)
RS485/422 0/- 6V	ITA6V1U1	ITA6V1U3	
RS423 +/- 6V	ITA10B1	ITA10B3	
RS232 +/- 12V	ITA18B1 ITA25B1	ITA18B3 ITA25B3	

ANNEX 1

Protection Standards Applicable to Computer and Electronic Systems

TYPE OF DISTURBANCE	PROTECTION STANDARD.			APPLICATION
	REFERENCE	LEVEL	WAVE	
E.S.D.	IEC 801-2	1 To 4	2 kV To 15 kV 5/30 nsec	I/O of data lines
	IEC 801-4	1 To 4	0.5 kV To 4 kV 5/30 nsec WAVE TRAIN	I/O of data lines
	Human body test MIL STAND. 883c-3015.7		4 kV 5/30 nsec	I/O of data lines
	E.S.D. MIL STAND. 883c-3015.2		25 kV 5/30 nsec	I/O of data lines
E.O.S.	IEC801-5	1 To 3	0.5 kV To 2 kV 1.2/50 µsec	I/O of data lines
E.M.I.	IEC801-3	1 To 3	27 MHz To 500MHz	I/O of data lines

ANNEX 2

Transil Arrays Product Range-Configurations

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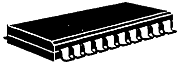
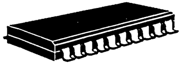
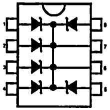
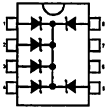
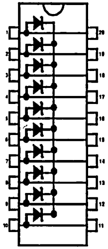
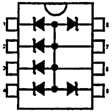
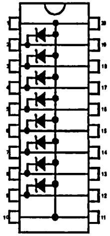
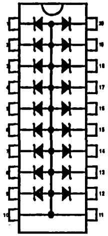
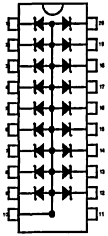
<tr><td colspan="2"> SO 8</td><td> SO 20</td><td colspan="2"> SO 8</td><td colspan="3"> SO 20</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>EN DEVOLOPPEMENT</td><td></td></tr>
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<tr><td rowspan="2">ITA6V5B1
ITA10B1
ITA18B1
ITA25B1</td><td rowspan="2">ITA6V5C1
ITA10C1
ITA18C1
ITA25C1</td><td rowspan="2">ITA6V5B3
ITA10B3
ITA18B3
ITA25B3</td><td rowspan="2">ITA6V1U1</td><td rowspan="2">ITA6V1U3</td><td rowspan="2">ITA6V1M3</td><td colspan="2">Low Capacitance</td></tr>
<tr><td>LCTA6V1U3</td><td>LCTA6V1M3</td></tr>
</table>

SGS-THOMSON
MICROELECTRONICS

APPLICATION NOTE

CROSSTALK BEHAVIOUR OF ITA25 IN RS232 TRANSMISSION

A Bremond

I - INTRODUCTION

Crosstalk is a digital interference phenomenon between data lines. The signal transmission by one data line produces parasitic voltages on nearby channels. These disturbances are due mainly to capacitive coupling or electro magnetic interference. This phenomenon occurs particulary when a great number of lines are located in a small area, notably in the case of multiline protection circuits having a high density.

The decrease of available area and the increase in the number of lines managed by a board forces the use of a single chip configuration to realize the protection function.

The goal of this paper is to quantify the parasitic effect of SGS-THOMSON monolithic protection products.

II - TEST DIAGRAM

To analyse the crosstalk behavior we will take as an example the most commonly- used interface : RS232.

Figure 1 : Test circuits

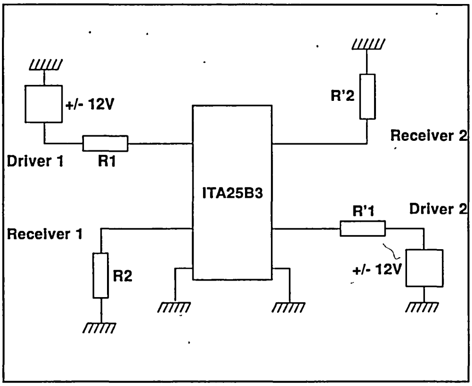


Figure 1 shows the test circuits used to do the crosstalk measurements.

The equivalent circuits of the drivers and receivers have been determined from the RS232C standard. So the following tests are done with :

R1 + R'1 = 500 Ohms and R2 + R'2 = 3 k Ohms

III - THEORICAL ANALYSIS

Figure 2 : Equivalent diagram

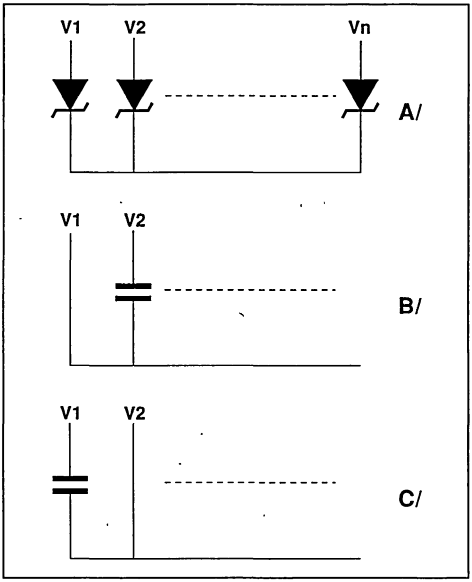


Figure 2 A/ shows the internal circuit diagram of the 8 way protection device ITA25. We see that the cathodes of all channels are common. If we consider the two adjacent lines V1 and V2, we note that when V1 is more positive than V2, both channels are connected through the off state capacitance of one of the diodes (see fig.2 B/).

We have the same phenomenon when V2 is more positive than V1 (see fig.2 C/).

So the equivalent circuit of both driver and receiver lines is given by fig.3. This diagram shows the worse case, because the input resistance of the receiver 2 has not been taken into account and zero line capacitance has been assumed.

The simulation results using this equivalent circuit are given in figure 4.

The capacitance C is equal to 200 pF for a bias voltage of 12 V.

Figure 3 : Equivalent circuit of both driver and receiver adjacent lines

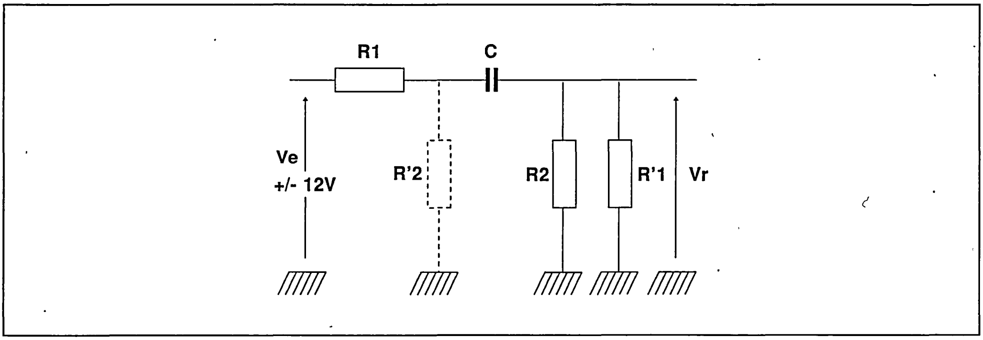
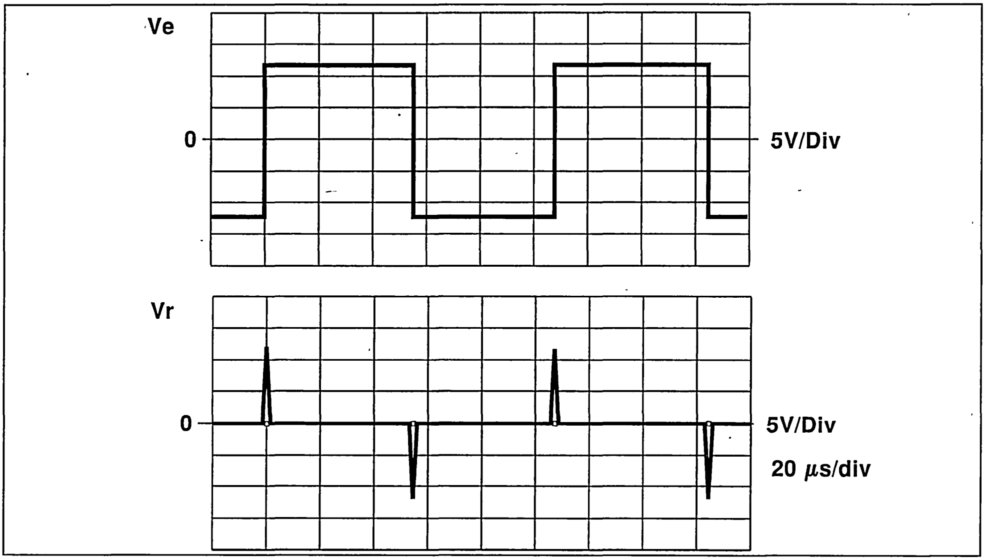


Figure 4 : Crosstalk simulation behavior



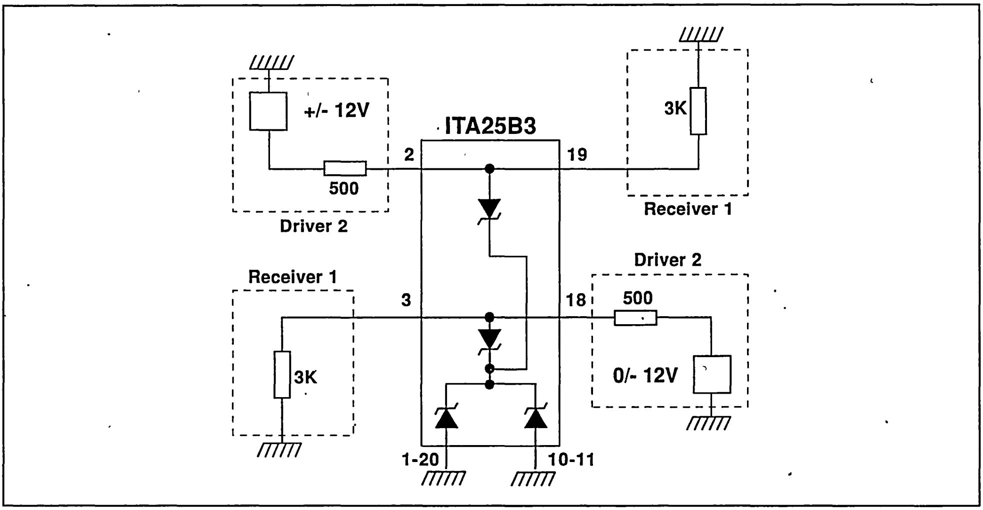
This simulation gives the following parameters :

- VR peak : +/- 11.7 V
- Time constant : 0.2 us

Despite their large amplitude, these peaks would not cause any problems. Their short duration means that they would be filtered out by the RS232 input sampling operation.

IV - MEASUREMENTS

Figure 5 : Measurement circuits



The measurements have been done in the figure 5 configuration. Three cases have been taken into account :

- DRIVER 2 output at -12 V (see fig.6)
- DRIVER 2 output at O V (see fig.7)
- DRIVER 2 output at +12 V (see fig.8)

Figure 6 : Ve/VR with DRIVER 2 voltage = -12 V

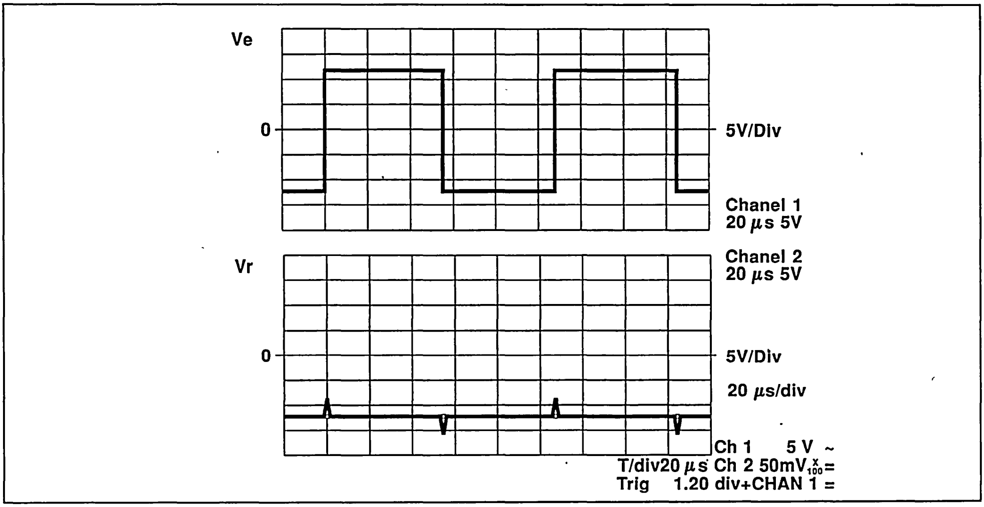


Figure 7 : Ve/VR with DRIVER 2 voltage = 0 V

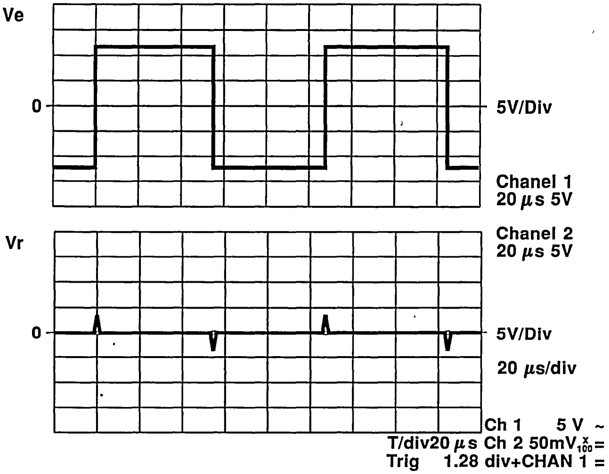
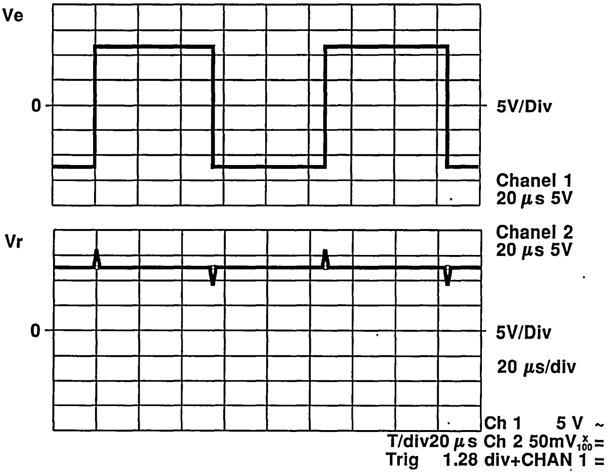


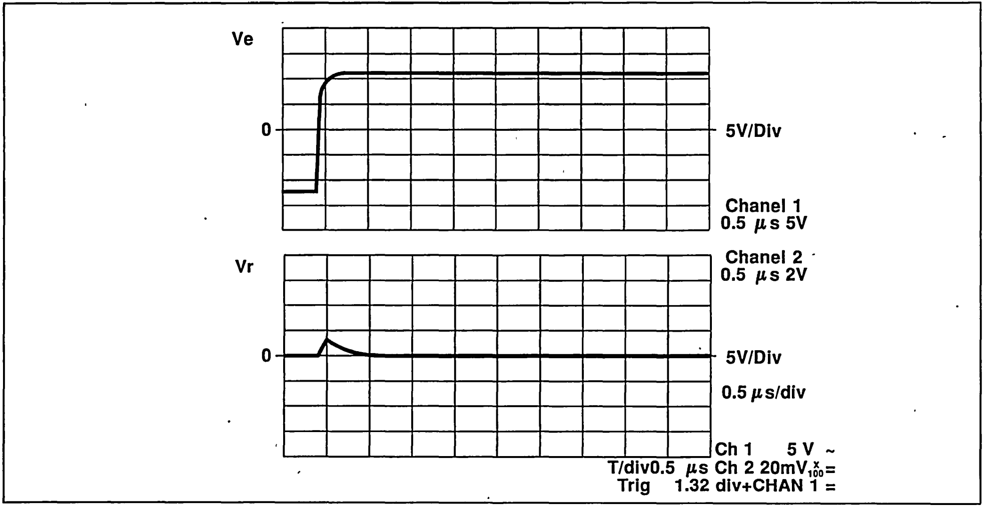
Figure 8 : Ve/VR with DRIVER 2 voltage = 12 V



The waveforms of figs. 6, 7 and 8 show parasitic overvoltages lower than in the simulation. This is largely due to the presence of line capacitance and a finite input impedance. The duration of the spikes is similar, so again they would be removed by the RS232 input sampling.

The expanded view of figure 7 given by figure 9 quantifies the duration of the phenomenon.

Figure 9 : Expanded view of Ve/VR with DRIVER 2 output = 0 V



V - DISTURBANCE EFFECTS - CONCLUSION

The measurements described in chapter IV show parasitic overvoltages of +/- 3 V for a duration of about 0.4 us. These will not result in any corruption of data because of input sampling by the RS232 interface.

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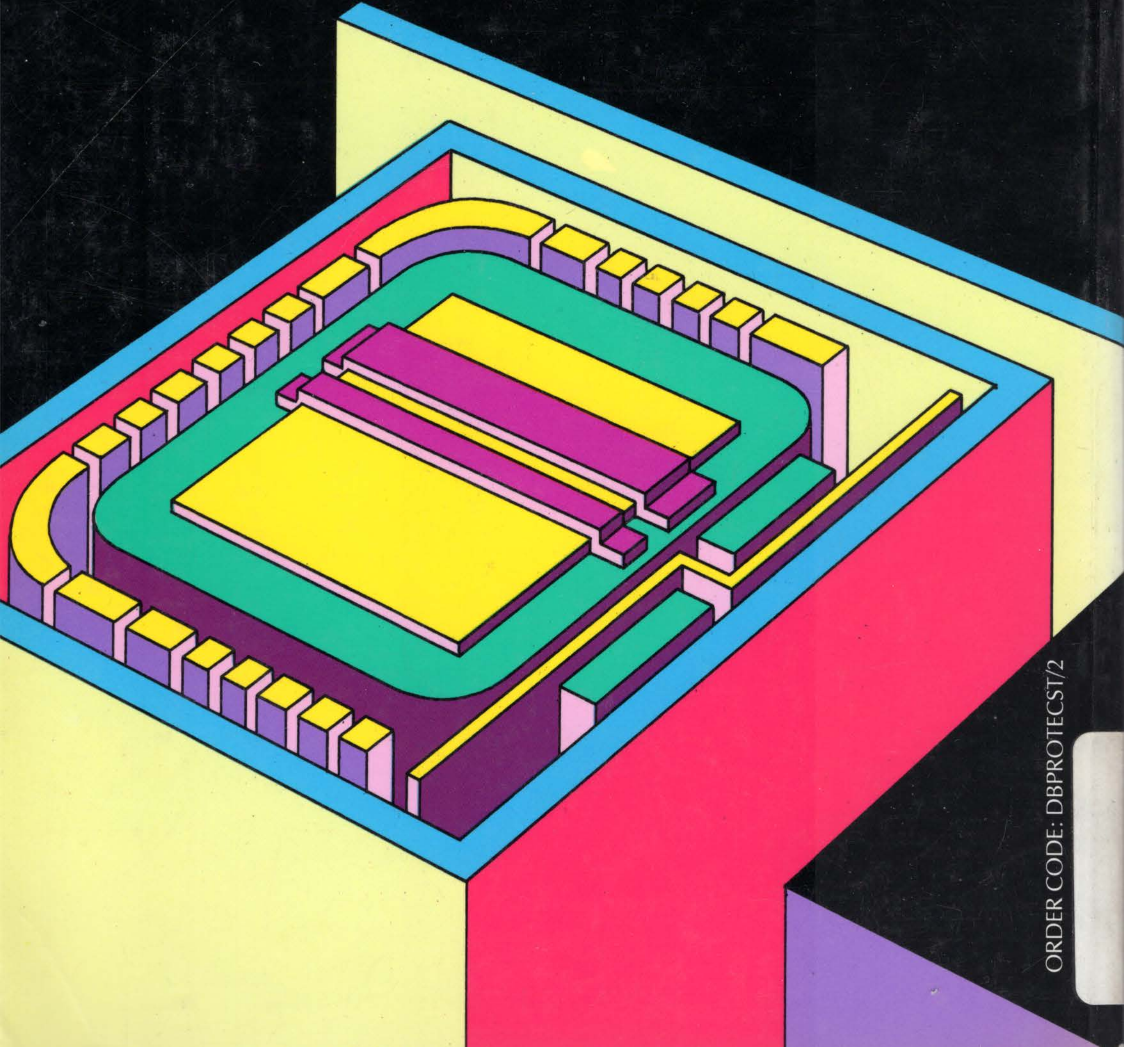

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