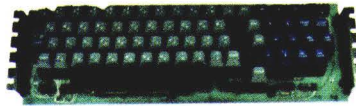




**key tronic...**

**keyboards...**





provide you...



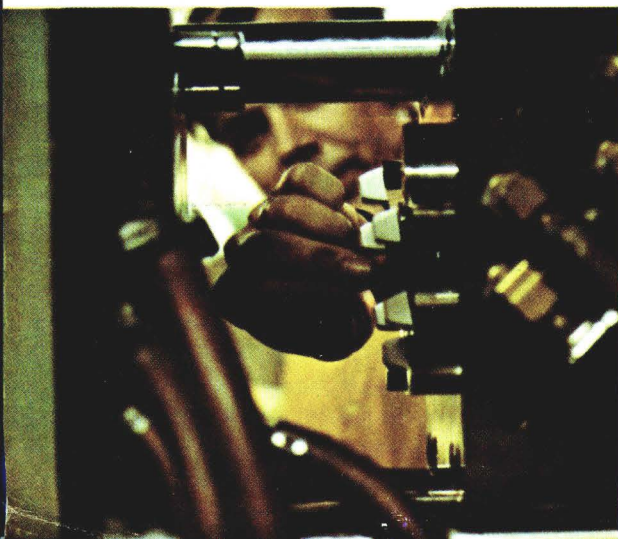
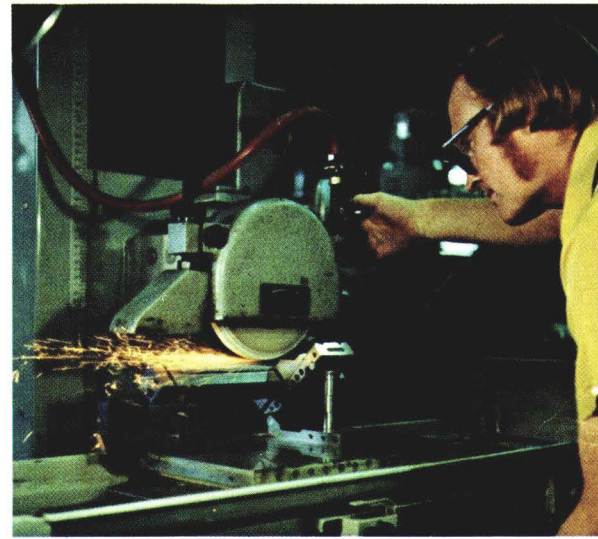
### DESIGN

Custom design  
Adaptable circuitry  
Human factor proficiency  
Selective rollover



### CUSTOM TOOLING

Multi-Pak switches  
Opti-Slide plungers  
Snap-on keytop (patented)  
Over 90 keytop dimensions



### 2-SHOT MOLDING

Made-to-order legends  
12 languages in library  
Multi-color inventory  
Lighted keys







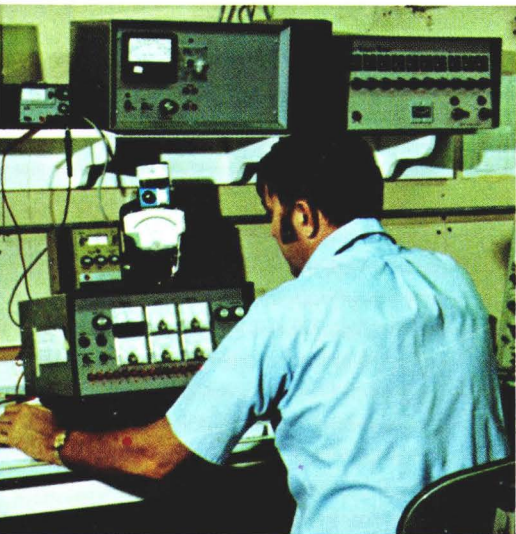
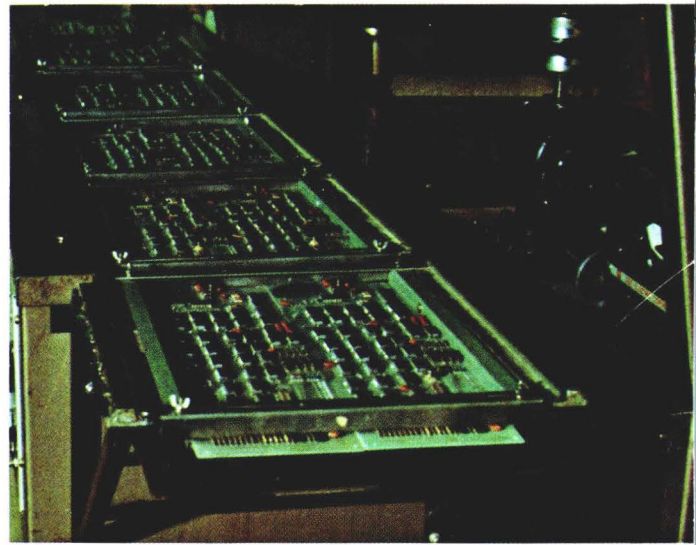
## CIRCUIT BOARD CONTROL

Photo lab  
Through-hole plate  
Pb, Au, Zn, Sn, Cu plating  
Masking, Screening



## CAPABILITY

One week Prototype fabrication  
Customer inventory support  
High volume/fast turn-around  
Shipping to all continents

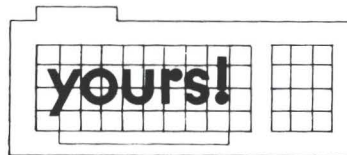


## RELIABILITY

Pretested devices  
Pre-cycling, electronic burn-in  
Operation documentation provided  
Environmental immunity







tronic  
oration

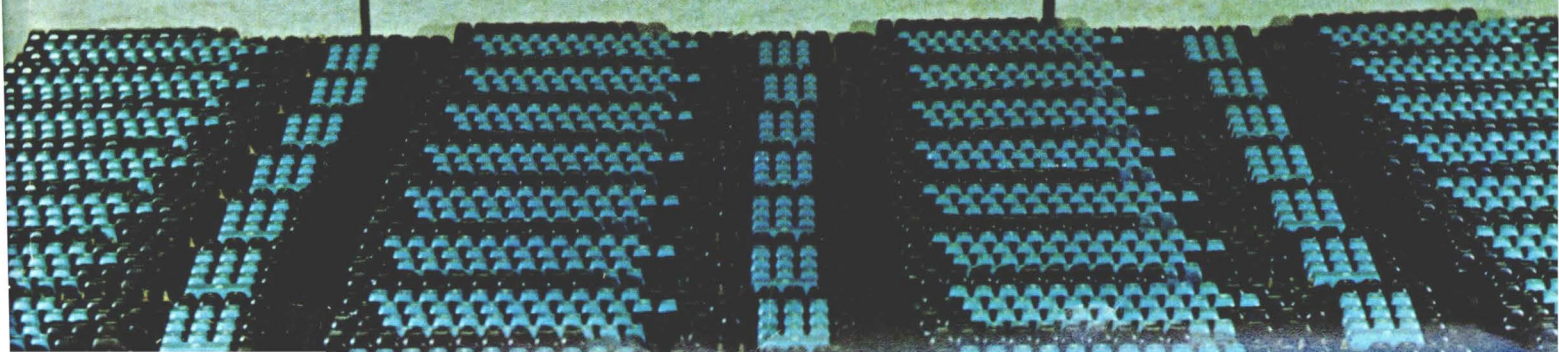
ANE INDUSTRIAL PARK  
ASHINGTON 99216

 key tronic  
corporation

BUILDING 14 SPOKANE INDUSTRIAL PARK  
SPOKANE, WASHINGTON 99216

 key tro  
corporation

BUILDING 14 SPOKANE INDUSTRIAL PA  
SPOKANE, WASHINGTON 99216







# ASR-37 WITH OPTIONS

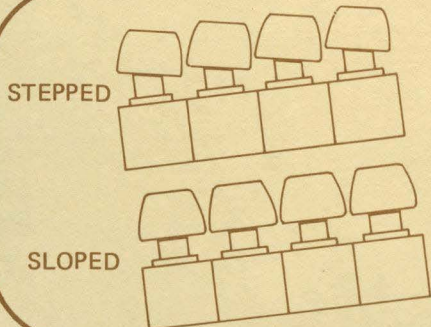
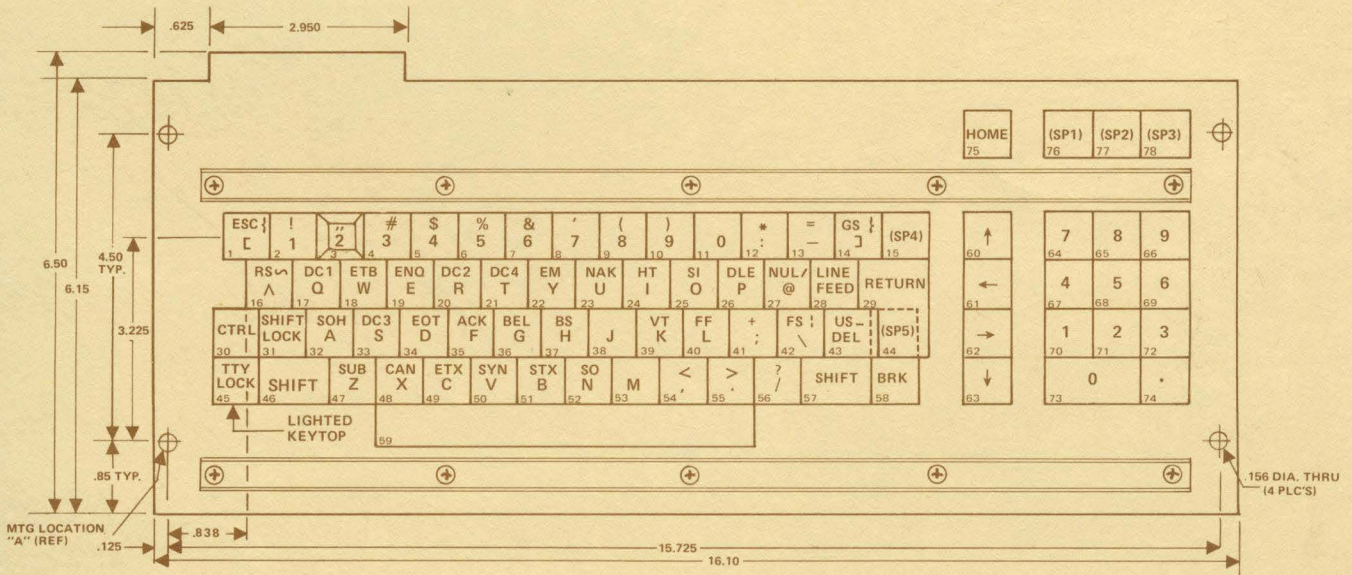
65-1066-01 (76 KEYS SHOWN) <sup>1-9</sup> \$171.20 <sup>10-24</sup> \$155.64

key tronic keyboards 65-1066 (57 KEYS) <sup>1-9</sup> \$148.55 <sup>10-24</sup> \$135.05 65-1066

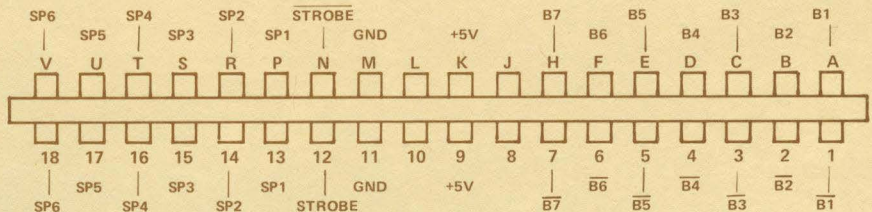
## FEATURES



- Five Mode ASC II Codes
- Positive and Negative Logic and Strobe Available
- Two-key Rollover
- Adjustable Automatic Repeat
- TTL Scan Encoding
- Forced Upper Case Alpha Mode
- 2 Shot Molded Keytops
- Low Power Consumption

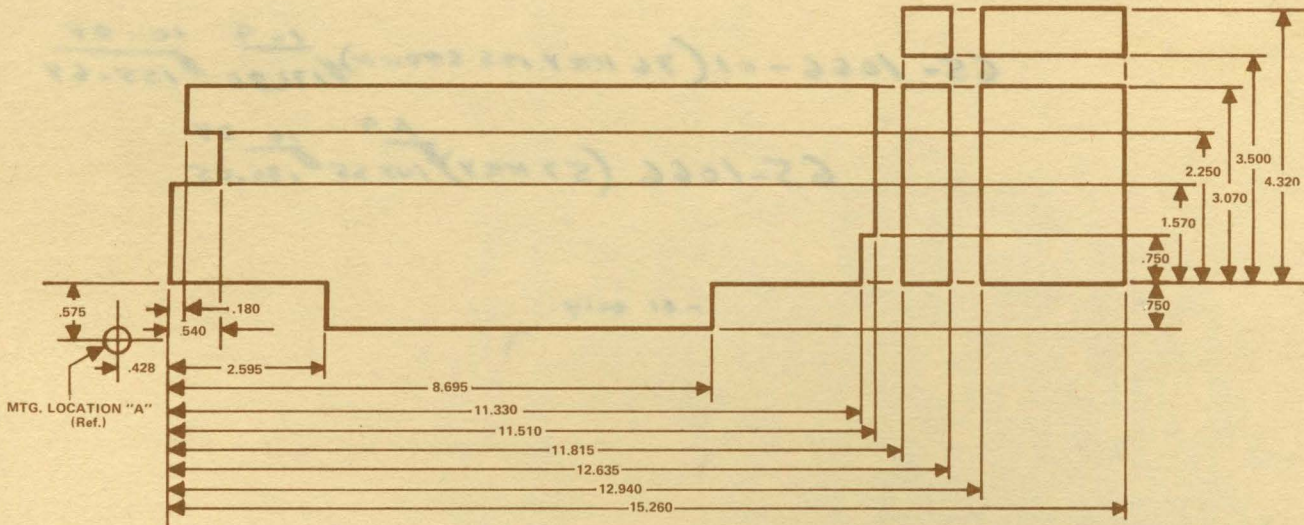


### CARD EDGE





# PANEL CUT OUT



## CODE CHART

Key	Un-Shift	TTY Un-Shift	TTY Shift	Control	Key	Un-Shift	TTY Un-Shift	TTY Shift	Control	Key	Un-Shift	TTY Un-Shift	TTY Shift	Control			
1	[	{	[	[	ESC	27	@	'	@	@	NUL	53	m	M	M	M	CR
2	1	!	1	!		28	LF	LF	LF	LF	LF	54	,	<	,	<	
3	2	"	2	"		29	CR	CR	CR	CR	CR	55	.	>	.	>	
4	3	#	3	#		30	CONTROL INT. FUNCTION				56	/	?	/	?		
5	4	\$	4	\$		31	SHIFT LOCK INT. FUNCTION				57	SHIFT INTERNAL FUNCTION					
6	5	%	5	%		32	a	A	A	A	SOH	58	SPARE KEY #6				
7	6	&	6	&		33	s	S	S	S	DC3	59	SP	SP	SP	SP	
8	7	'	7	'		34	d	D	D	D	EOT	60	SO	SO	SO	SO	SO
9	8	(	8	(		35	f	F	F	F	ACK	61	BS	BS	BS	BS	BS
10	9	)	9	)		36	g	G	G	G	BEL	62	HT	HT	HT	HT	HT
11	0	0	0	0		37	h	H	H	H	BS	63	LF	LF	LF	LF	LF
12	:	*	:	*		38	j	J	J	J	LF	64	7	7	7	7	
13	-	=	-	=		39	k	K	K	K	VT	65	8	8	8	8	
14	]	}	]	}	GS	40	l	L	L	L	FF	66	9	9	9	9	
15	SPARE KEY #4					41	;	+	;	+		67	4	4	4	4	
16	^	~	^	^	RS	42	\		\		FS	68	5	5	5	5	
17	q	Q	Q	Q	DC1	43	DEL	-	DEL	-	US	69	6	6	6	6	
18	w	W	W	W	ETB	44	SPARE KEY #5 (Option N.A. on Std.)				70	1	1	1	1		
19	e	E	E	E	ENQ	45	TTY LOCK - INTERNAL FUNC.				71	2	2	2	2		
20	r	R	R	R	DC2	46	SHIFT - INTERNAL FUNCTION				72	3	3	3	3		
21	t	T	T	T	DC4	47	z	Z	Z	Z	SUB	73	0	0	0	0	
22	y	Y	Y	Y	EM	48	x	X	X	X	CAN	74	.	.	.	.	
23	u	U	U	U	NAK	49	c	C	C	C	ETX	75	VT	VT	VT	VT	VT
24	i	I	I	I	HT	50	v	V	V	V	SYN	76	SPARE KEY #1				
25	o	O	O	O	SI	51	b	B	B	B	STX	77	SPARE KEY #2				
26	p	P	P	P	DLE	52	n	N	N	N	SO	78	SPARE KEY #3				

- POWER REQUIREMENTS + 5 VDC @ <500 ma
- LOGIC LEVELS

## ELECTRICAL DATA

DATA: Pos. Logic Neg. Logic  
 LOGIC 1 = 2.4 - 5 VDC <.4 VDC  
 LOGIC 0 = <.4 VDC 2.4 - 5 VDC

STROBE: Two Provided (Both Polarities) @ 10 ± 3 micro seconds.

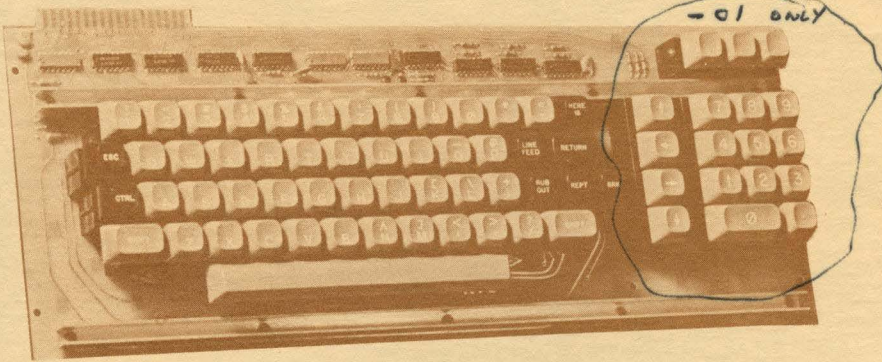


# ASR-33 WITH OPTIONS

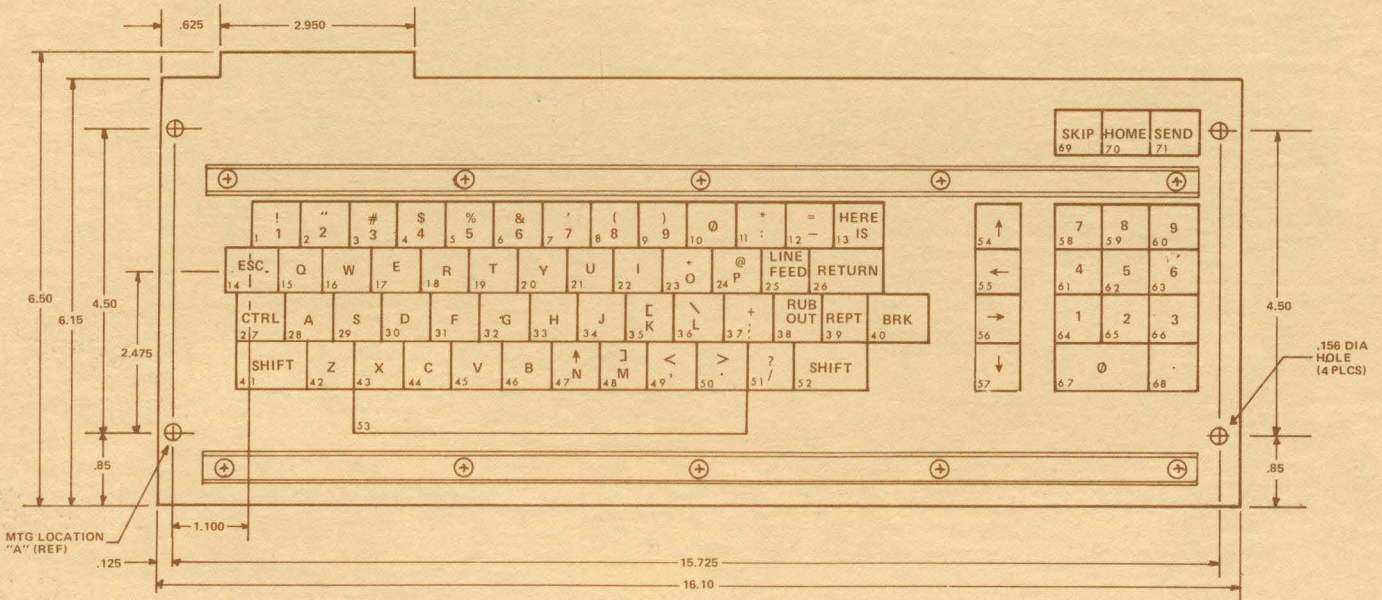
65-0627-01 (71 KEY AS SHOWN) <sup>1-9</sup> / 145.20 <sup>10-24</sup> / 132.00

key tronic keyboards 65-0627-04 (53 KEY) <sup>1-9</sup> / 121.60 <sup>10-24</sup> / 110.55 65-0627

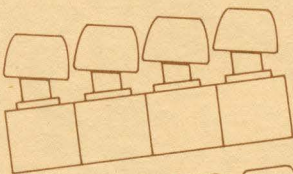
## FEATURES



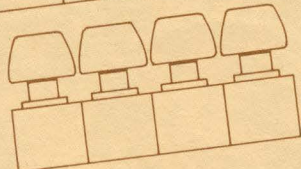
- Quad-level ASCII codes
- Positive or negative logic
- Pulsed strobe
- Two-key rollover
- Internal repeat
- Low power consumption
- Two-shot molded Keytops
- TTL scan encoding
- Optional enclosure available



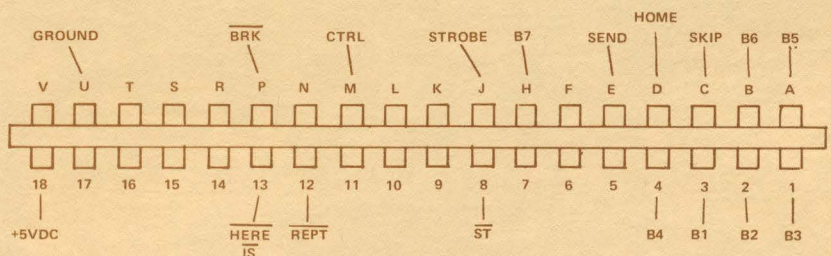
STEPPED



SLOPED

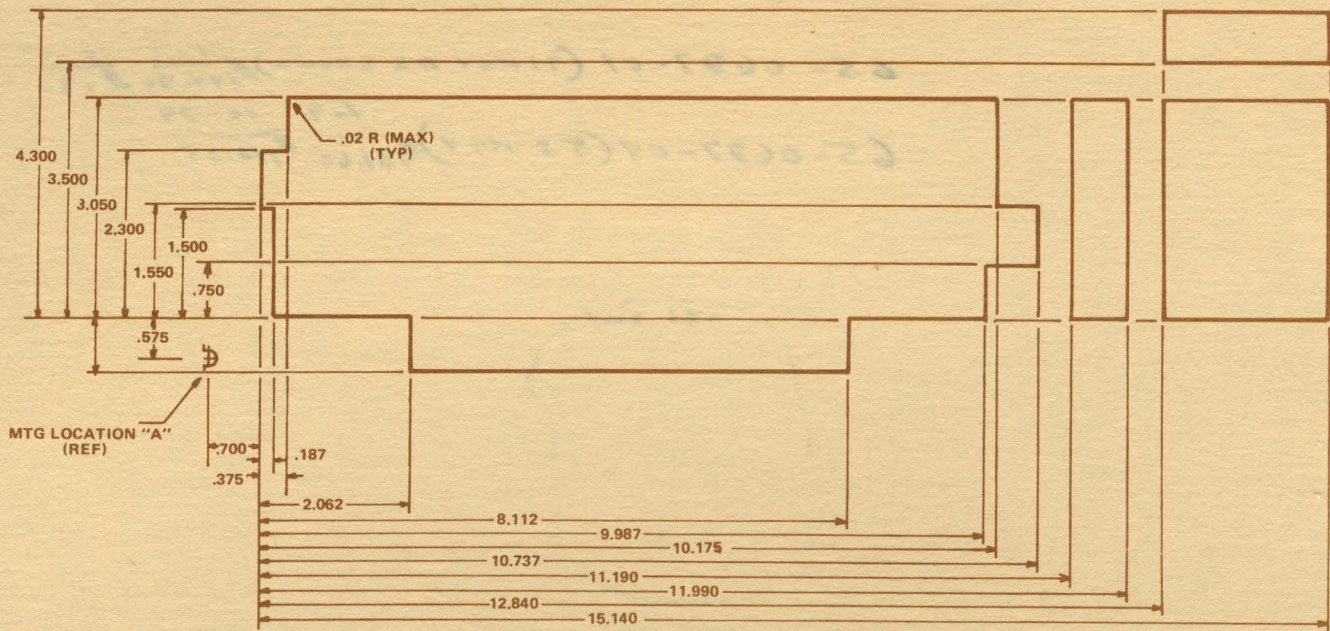


## CARD EDGE





# PANEL CUTOUT



## CODE CHART

Key	Unshift	Shifted	Control	Control & Shift
1.	1	!	1	!
2.	2	"	2	"
3.	3	#	3	#
4.	4	\$	4	\$
5.	5	%	5	%
6.	6	&	6	&
7.	7	'	7	'
8.	8	(	8	(
9.	9	)	9	)
10.	∅	∅	∅	∅
11.	:	*	:	*
12.	-	=	-	=
13.	FUNCTION-NEG. TRUE			
14.	ESC	ESC	ESC	ESC
15.	Q	Q	DC1	DC1
16.	W	W	ETB	ETB
17.	E	E	ENQ	ENQ
18.	R	R	DC2	DC2
19.	T	T	DC4	DC4
20.	Y	Y	EM	EM
21.	U	U	NAK	NAK
22.	I	I	HT	HT
23.	O	-	SI	US
24.	P	@	DLE	NUL

Key	Unshift	Shifted	Control	Control & Shift
25.	LF	LF	LF	LF
26.	CR	CR	CR	CR
27.	CTRL	CTRL	CTRL	CTRL
28.	A	A	SOH	SOH
29.	S	S	DC3	DC3
30.	D	D	EOT	EOT
31.	F	F	ACK	ACK
32.	G	G	BEL	BEL
33.	H	H	BS	BS
34.	J	J	LF	LF
35.	K	⌈	VT	ESC
36.	L	/	FF	FS
37.	;	+	;	+
38.	DEL	DEL	?	?
39.	FUNCTION (REPEAT)			
40.	FUNCTION - NEG TRUE			
41.	SHIFT	SHIFT	SHIFT	SHIFT
42.	Z	Z	SUB	SUB
43.	X	X	CAN	CAN
44.	C	C	ETX	ETX
45.	V	V	SYN	SYN
46.	B	B	STX	STX

Key	Unshift	Shifted	Control	Control & Shift
47.	N	^	SO	RS
48.	M	J	CR	GS
49.	,	<	,	<
50.	.	>	.	>
51.	/	?	/	?
52.	FUNCTION (SHIFT)			
53.	SP	SP	SP	SP
54.	SO	SO	SO	SO
55.	BS	BS	BS	BS
56.	HT	HT	HT	HT
57.	LF	LF	LF	LF
58.	7	7	7	7
59.	8	8	8	8
60.	9	9	9	9
61.	4	4	4	4
62.	5	5	5	5
63.	6	6	6	6
64.	1	1	1	1
65.	2	2	2	2
66.	3	3	3	3
67.	∅	∅	∅	∅
68.	.	.	.	.
69.	FUNCTION-NEG. TRUE			
70.	FUNCTION-NEG. TRUE			
71.	FUNCTION-NEG. TRUE			

## ELECTRICAL DATA

- POWER REQUIREMENTS +5VDC @275 ma typ 330 max

- LOGIC LEVELS

DATA: Positive Logic

Logic 1 = 2.4-5 VDC

Logic 0 = .4 VDC

STROBE: Two provided (both polarity) @10 ± 2 micro seconds

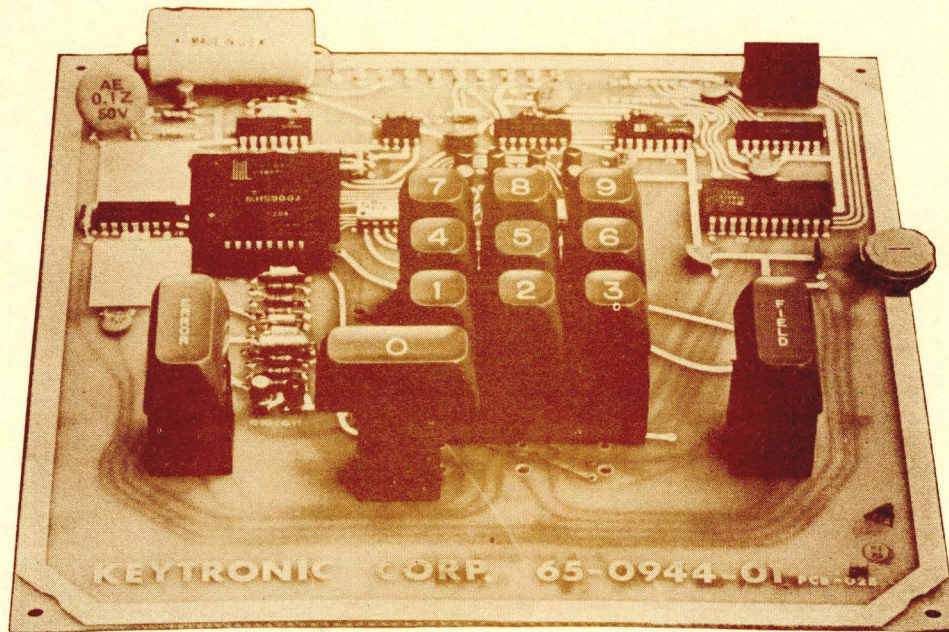




# • TONE ENCODED KEYBOARDS

keytronic keyboards

CUSTOM

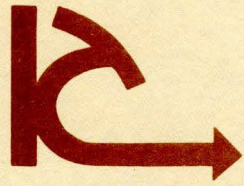


## FEATURES

- Two out of Eight Tone Encoded (or Programmable)
- 2 Watt Audio Amplifier
- Error Free Two Key Rollover
- Hermetically Sealed Environmentally Immune Switch
- Hybrid Tone Encoder
- 2 Shot Molded Key Tops with Legends per your specifications

FREQUENCIES	KEYS													
	0	1	2	3	4	5	6	7	8	9	Error	Field	•	
H4 1633														X
H3 1477				X			X			X		X		
H2 1338	X		X			X			X					
H1 1209		X			X			X			X	X		
L1 941	X										X			
L2 852								X	X	X				
L3 770					X	X	X							
L4 697		X	X	X										X

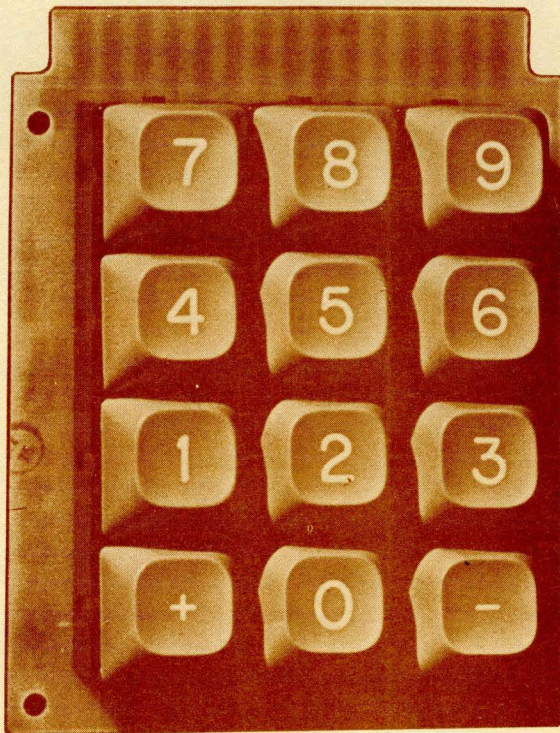




# 12 KEY ADDER PAD.

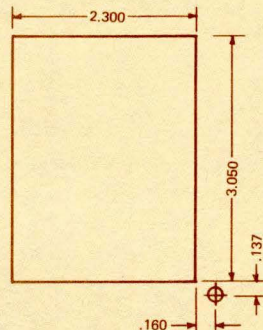
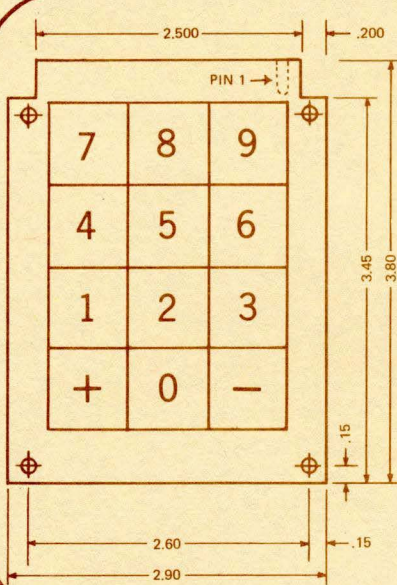
key tronic keyboards

65-0542



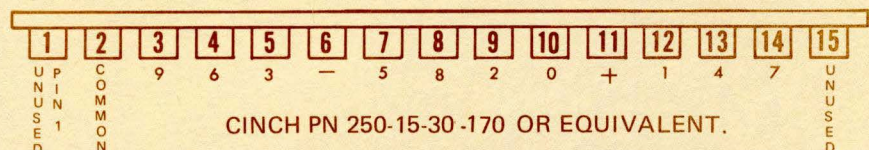
## FEATURES

- Hermetically Sealed Environmentally Immune Switch
- Life Expectancy  $100 \times 10^6$  Operations Per Switch
- Low Bounce Less than 100 Microseconds, Interfaces Easily with TTL or Mos Electronics.
- 2 Shot Molded Key Tops With Legends Per Your Specifications



**RECOMMENDED  
PANEL CUTOUT**

**CARD EDGE TERMINATION  
RECOMMENDED CONNECTOR:**



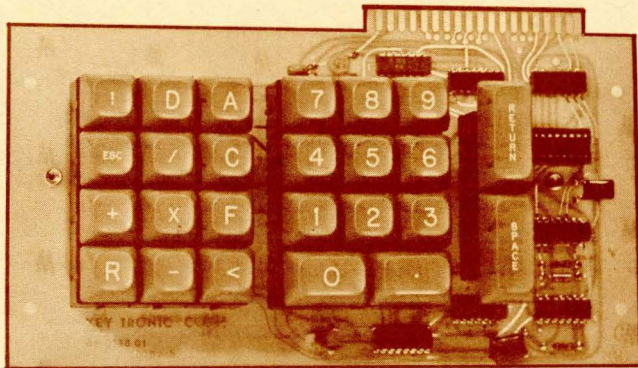




# PROGRAMMABLE P.O.S.-ADDER

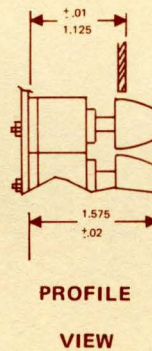
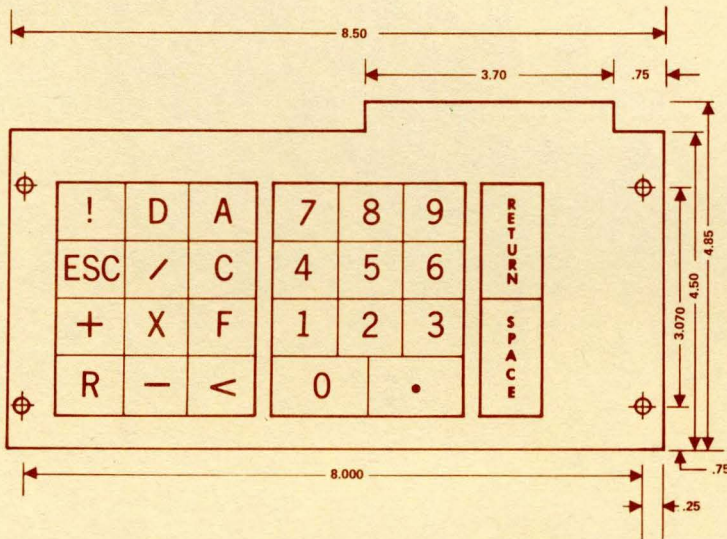
key tronic keyboards

65-0738



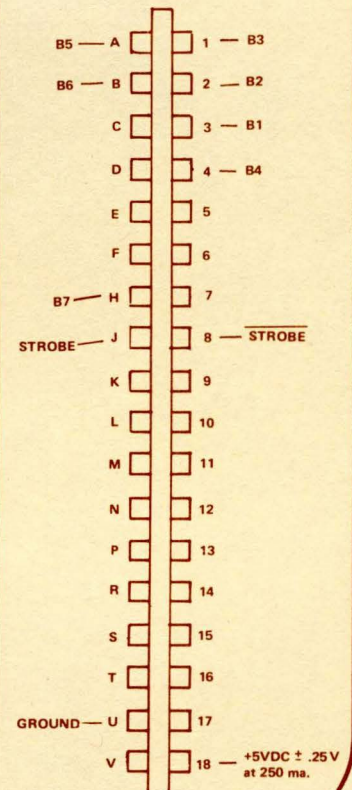
## FEATURES

- 25 Keys, All Programmable
- Positive Logic Data
- Positive and Negative Pulsed Strobe
- 8 Data Bits Per Key
- Error Free 2 Key Rollover
- 2 Shot Molded Keys

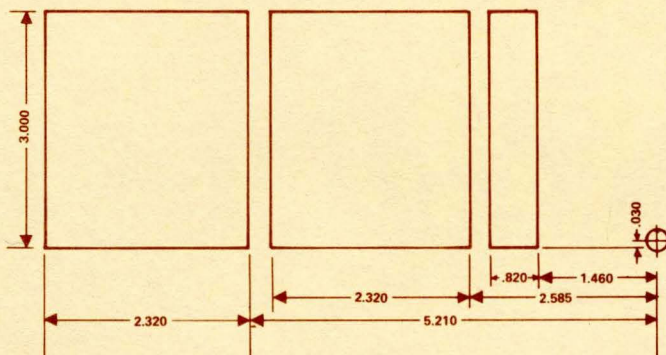


### CARD EDGE TERMINATION

RECOMMENDED CONNECTORS:  
CINCH PN 251-18-30-160  
OR EQUIVALENT



### RECOMMENDED PANEL CUTOUT



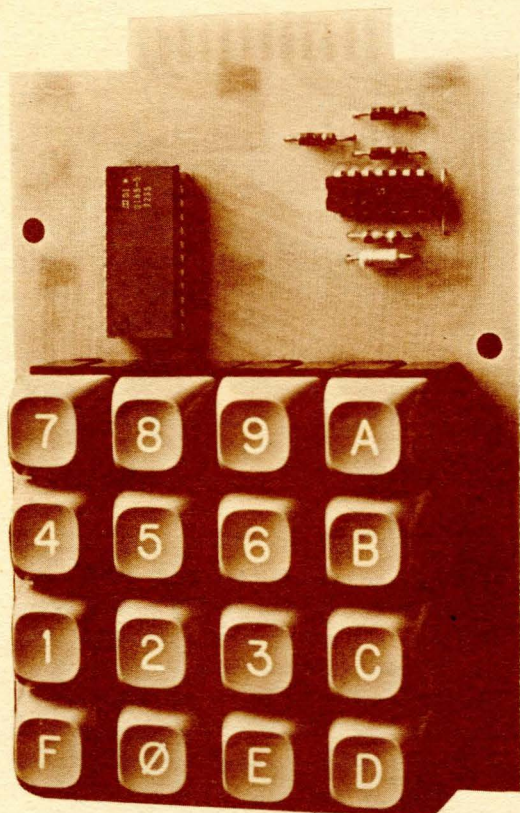




# 16 KEY BCD CODED

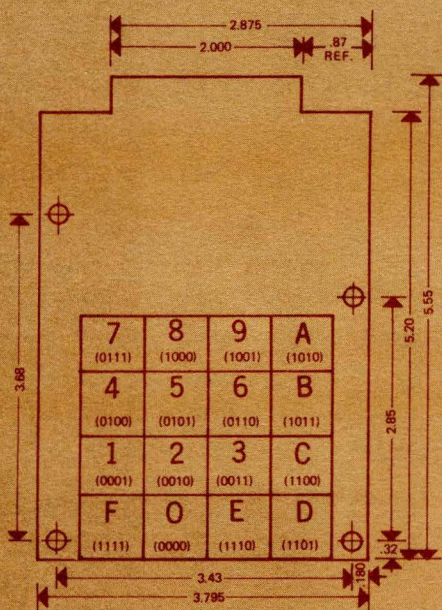
key tronic keyboards

65-0504

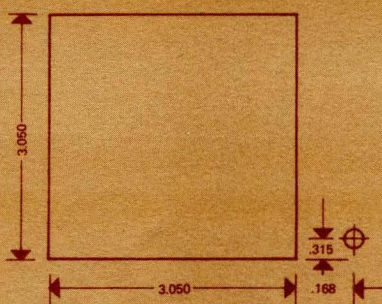


## FEATURES

- Mono Mode Coded Outputs
- Positive Logic Data  
Positive Logic Level Strobe
- Error Free Two Key Rollover
- Power Consumption +5VDC  $\pm$  5%  
At Less Than 100 Milliamps
- 2 Shot Molded Key Tops  
With Legends Per Your Specifications



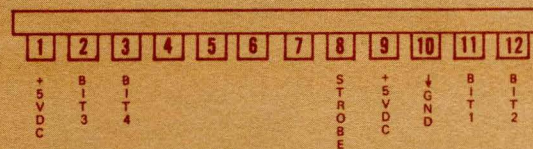
### RECOMMENDED PANEL CUTOUT



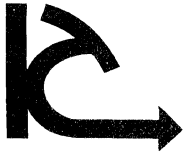
### CARD EDGE TERMINATION

RECOMMENDED CONNECTOR:

CINCH PN 250-12-30-170  
OR EQUIVALENT.







## INTRODUCTION

## A. WHY KEY TRONIC?

Key Tronic has demonstrated extraordinary growth and success because we care about our customers and we are unique in many ways. The reliability, timely deliveries and competitive pricing that are needed to make our customers successful are guaranteed by Key Tronic's knowledge of the keyboard industry, our product and customer requirements, as well as, complete manufacturing control beginning with the engineering and tooling through to final inspection.

KNOWLEDGE

Key Tronic's only final product is keyboards, so we have to understand customer problems and have solutions. To support our customers' needs, we perform all tasks of:

- |                             |  |
|-----------------------------|--|
| (a) Engineering:            | All design, printed circuit artwork and keytop legend layout is handled by Key Tronic personnel.                           |
| (b) Printed Circuit Boards: | Key Tronic fabricates all printed circuit boards used in our keyboards, including: Au-, Sn-, Ni- and Cu-plating processes. |
| (c) Tool and Die:           | Make all molds and cavities for keys and switch assemblies in our tooling division.  |
| (d) Molding:                | Mold every plastic assembly involved with keytops and switch assembly.   |
| (e) Manufacturing:          | All subassemblies, as well as, complete electronic insertion and wave soldering.   |
| (f) Quality Control:        | Each keyboard is checked over eight times at various stages of manufacturing, including electronic burn-in.                |



## INTRODUCTION

### A. Why Key Tronic?

#### CONTROL

Custom requirements are designed and built with complete awareness of every technology involved with the final product.

#### A LEADER

Key Tronic is dedicated to improving through new manufacturing efficiencies, new innovations, as well as, improvements of existing technology.

- . Key Tronic's unique process can deliver a two-shot, custom molded legend without incurring a time-consuming and costly keytop legend tooling for prototype quantity.
- . Key Tronic's keyboard switch is guaranteed for five (5) years.
- . Key Tronic can ship a custom keytop shape, color and custom legends without relying on any outside vendor.
- . Key Tronic helps service your centers abroad through our facilities in Scandinavia and the United Kingdom.
- . Our legend library covers over nine languages. Key Tronic keyboards are in over 40 different countries.
- . Realizing the need for an environmentally immune switch, all keyboard switches from Key Tronic are hermetically sealed.

#### PRIDE

We are a people company. Key Tronic's innovative bonus-sharing plan directly relates the wages of every single employee to timely deliveries of a quality product--in essence, complete customer satisfaction.

Evaluate Key Tronic! Visit our plant, talk to any of our people. We are eager to give you a customer listing--any of whom, you may call to confirm the reputation of which Key Tronic is so proud.



B. GROWTH AND HISTORY

Key Tronic Corporation, located in Spokane Industrial Park, is approximately ten miles east of the center of Spokane, Washington. Immediate access to road, rail and air transportation is available to major industrial cities.

BUILDINGS

Plant No. 1, Central Facility. Our central plant presently consists of 34,000 sq. ft. This area includes tool and die, molding, assembly, quality assurance, engineering and administration departments.

Plant No. 2, Printed Circuit Boards. A self-contained facility, this 8,000 sq. ft. plant is less than 1,000 feet away from the Central Plant.

OPERATIONS

Lewis G. Zirkle, BSIE, Ohio State, and Chief Executive Officer, oversees manufacturing. Lew has built and guided major companies dealing with products ranging from power transformers to switches and now, keyboards. Lew's refined skills in plastic molding, tool design development and mass production, provide for a strong manufacturing organization. He has been active in the development of Key Tronic's two-shot molding process, manufacture of all plastic parts and the creation of our printed circuit board capability.

MARKETING

As Vice President of Marketing, A. T. (Fred) Zirkle, a Duke University BA, has the knowledge and experience required to handle customer problems and inquiries rapidly and efficiently. Prior to assuming his present duties, Fred had broad responsibilities in the areas of procurement, manufacturing and administration. Supported by a competent staff of Regional Representatives and Internal Marketing Coordinators, Fred is able to give his personal attention to the requirements of Key Tronic customers.



## INTRODUCTION

### B. Growth and History

#### ENGINEERING

Louis E. Sims, BSEL, California State Polytechnic University and MSEE, University of Washington, brings 13 years of experience in solid state circuit design to Key Tronic. Lou developed our selective N-key rollover approach utilizing MOS keyboard encoders. Lou has been a major force in the development of the 90-key MOS keyboard encoders being presently built by seven (7) different MOS houses.

The Engineering Department is a quick reacting team of highly qualified people whose greatest concern is the satisfaction of the customer. Over 1,000 unique keyboard designs have been produced by this group.

#### QUALITY ASSURANCE

Responsible for quality controls, Walter Z. Davis, MBA - Harvard School of Business, MS in Applied Mathematics, Harvard University and BSEE, California Institute of Technology. Walt's experience in electronic manufacturing, as well as quality control, makes him effective in instituting manufacturing controls as well as the final stages of testing which provide keyboards of the highest obtainable quality.

#### PRODUCTION SCHEDULING

Brian Ladyman, a graduate of the Liverpool Technical College, England, heads this department. Brian is a journeyman tool and diemaker and also has extensive manufacturing supervisory experience. Ensuring the smooth, rapid flow of orders through our plant is Scheduling's major function. Through maintaining the proper inventory of components and programming manufacturing processes, Brian and his staff have established an enviable record of meeting customer shipping dates.



## INTRODUCTION

### B. Growth and History

#### PRINTED CIRCUIT BOARD OPERATION

Heading this function is Bruce Foreman, BA in Chemistry from Eastern Washington State College. This leadership, backed by a seasoned staff, provides the extensive technology so vital to Key Tronic's quality standards. The photoprocessing, precision drilling, etching and through-hole tin-, nickel-, and gold-electroplating expertise available in this 8,000 sq. ft. facility, provides Key Tronic with one of the largest and best equipped printed circuit board operations in the Pacific Northwest.

#### TOOL AND DIE

The Manager, Norman F. Seymour, has recruited tool and die men from as far away as New Zealand. Norm's research and development in molding has yielded most fruitful results. This area produces, tests and executes all hobs, cavities and molds used throughout the plant. Efficiency is characterized by multicavities, semiautomated two-shot molding and engraved hobs for standard legends.

#### RESEARCH AND DEVELOPMENT

If there is a better way to build any part of a keyboard, Key Tronic Corporation intends to be the first to know how! For this reason, high investment in research dollars continues to support product innovations. Recently joining our organization as Manager of R & D, is Michael Davis. Mike has a BS in Mechanical Engineering from California State Polytechnical College and years of experience in electrical contacts and plastics technology.

Also working in this department is Don Anderson, BS, Industrial Technology, Eastern Washington State College, Don's innovative approach to the sculptured keyboard, simple shift lock key and other improvements have enhanced the maintenance-free reliability of Key Tronic's present products as well.



## INTRODUCTION

### B. Growth and History

#### ASSEMBLY

The Electrical and Mechanical Assembly Division performs the major portion of the keyboard assembly beginning with the initial loading of electronic components onto the printed circuit boards and following through to the installation of the switch assemblies. The assembly processes are governed by written Key Tronic Corporation Workmanship Specifications with verification performed by the Quality Control Department to ensure a consistently high-quality keyboard.

The Electrical and Mechanical Assembly Division is managed by Arlin Beehler. Arlin graduated from De Vry Technical Institute, attended the University of Indiana and has over 15 years' experience in aerospace and commercial production operations.

#### MOLDING DEPARTMENT

William (Bill) Curry, BA in Business Management from Whitworth College, supervises this department. As an integral function in the Key Tronic organization, the mold shop provides all plastic parts for our custom keyboards. This includes: switches, standard and custom keytops, including our sculptured program which is in full production.

#### ENGRAVING

John Albers, Engineering Specialist, brings many years of experience in design and fabrication of small parts and components. The Engraving Department is able to accommodate customers' special legend keytops for custom requirements. Legends are engraved and two-shot molded for fast turnaround without costly tooling for short runs.



## INTRODUCTION

C. Electronics

D. Reed

### C. ELECTRONICS

Key Tronic has always been a leader in the electronic keyboard area. Because we cater to the custom keyboard needs of the world, many times we are asked to go beyond what is normal keyboard encoding. Keyboards have been designed and built with parity select options, both serial and parallel output, telephone and Teletype modem interfaces, long-line driving capability, option to change encoding by PROM plug-in, variable strobe adjust, etc., to name a few.

Key Tronic has pioneered many circuit innovations. We offer seven (7) different rollover approaches. This permits the customer to select and pay for only the rollover he needs. Scanning matrix circuits are being written in the literature today as new designs. Key Tronic has been using these circuits since the company started.

Many of today's MOS encoders are patterned wholly, or in part, after specifications written by Lou Sims, Manager of Engineering. Of the encoders on the market today, this single influence in functional characteristic and design of the keyboard encoder is dominating even though Key Tronic does not manufacture its encoder.

### D. REED

Key Tronic Corporation selected the reed as its switch contact after much study and for several basic reasons:

(a) Life Expectancy: 100,000,000 cycles may seem to be beyond the needs of the average switch but stop and think about the following:

Space bar operates 50 cycles/minute for 50 words per minute rate. This is 6,000,000 cycles per year with full eight-hour per day usage.

Keyboards should be designed to last a minimum of ten years.



## INTRODUCTION

D. Reed

- (b) Shock: Keyboards are pounded, beat upon and are good outlets to relieve frustrations. The reed can take a 50G shock wave.
- (c) Vibration: Keyboards are sometimes located in areas of shake, rattle and roll. The reed can take 10Gs continuously from 10 to 2,000 cycles.
- (d) Environment: Keyboards are being located in all atmospheres. They are subject to chemical fumes, liquids and all types of pollution. The reed is sealed in a glass capsule and is totally immune to the atmosphere.
- Therefore, the pumping action in all plunger-operated switches which continuously breathes--inhaling and exhaling dirty air--cannot affect our hermetic seal.
- (e) Clean Contact Closure: Many keyboards require a contact closure from the keyboard for the system as opposed to change of state. Therefore, no "overhead" electronics are needed to detect a level change. A Key Tronic keyboard requires no extra power supply cost and continuous drain to monitor switch level change.

In the last three years, we have sent out over 5 million reeds. This history has proven the wisdom of the reed selection. In-house tests have cycled groups of reeds to 2.6 billion cycles--each without failure. Field data on two long-term studies showed only 13 reeds replaced in 250,000 switches delivered over 18 months and 20 reeds replaced in 85,000 switches in keyboards used nearly continuously for 12 months.

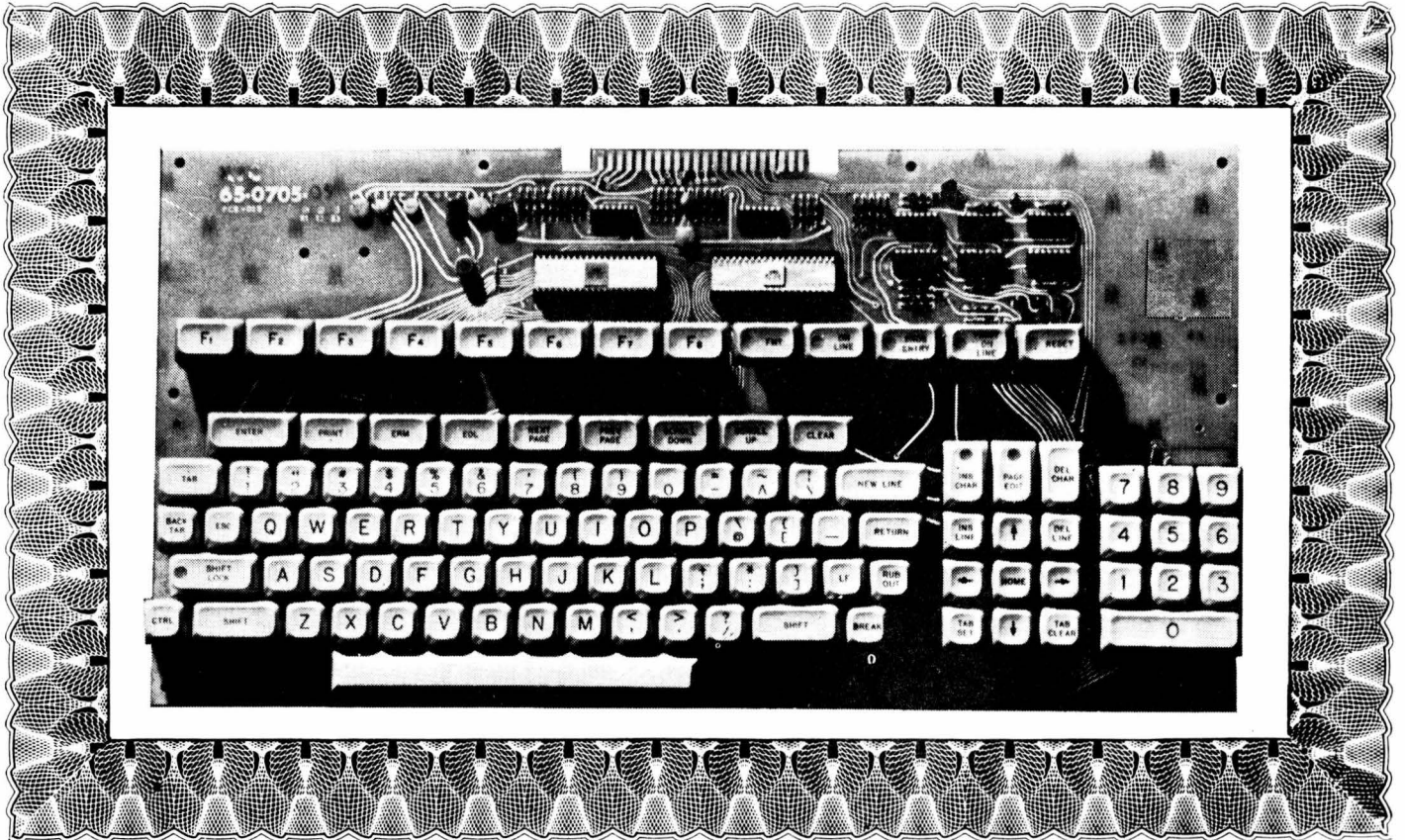




- . Easy insert, environmentally immune, reed capsule switch mechanism accessible from underside of keyboard without removing switch modules.
- . Modular key stations, interlocking units up to six in a module, rigid self-supporting without metal frames.
- . Key plungers made of low-friction Delrin. Unique large area square-necked plunger design ensures satisfactory performance to 100,000,000 operations.
- . Snap-on keytops with locking feature. Keytops are two-shot molded of high wear-resistant plastic in large selection of colors.
- . Sloped and stepped keyboards, at any time, by reorientation of plunger. Sculptured keytops also available. Same panel cutout will fit all of the above three.
- . Large diameter springs accurately control key depression force to  $\pm 10$  percent.
- . Reed capsules from leading manufacturers to strict levels of quality control:
  - contact resistance, 2 ohms at life
  - bounce less than one millisecond
  - 100% tested in keyboard
  - 100,000,000 cycles life
- . Printed circuit board, two-sided, with through-plated holes, are designed and manufactured in-house.
- . Electronic keyboards are given a 24-hour power-on/burn-in before release to final test.



# A Guaranteed Switch



**5 TROUBLE FREE  
YEARS OR WE'LL  
REPLACE IT...<sup>N/C!</sup>**



**key tronic corporation**

BUILDING 14, SPOKANE INDUSTRIAL PARK

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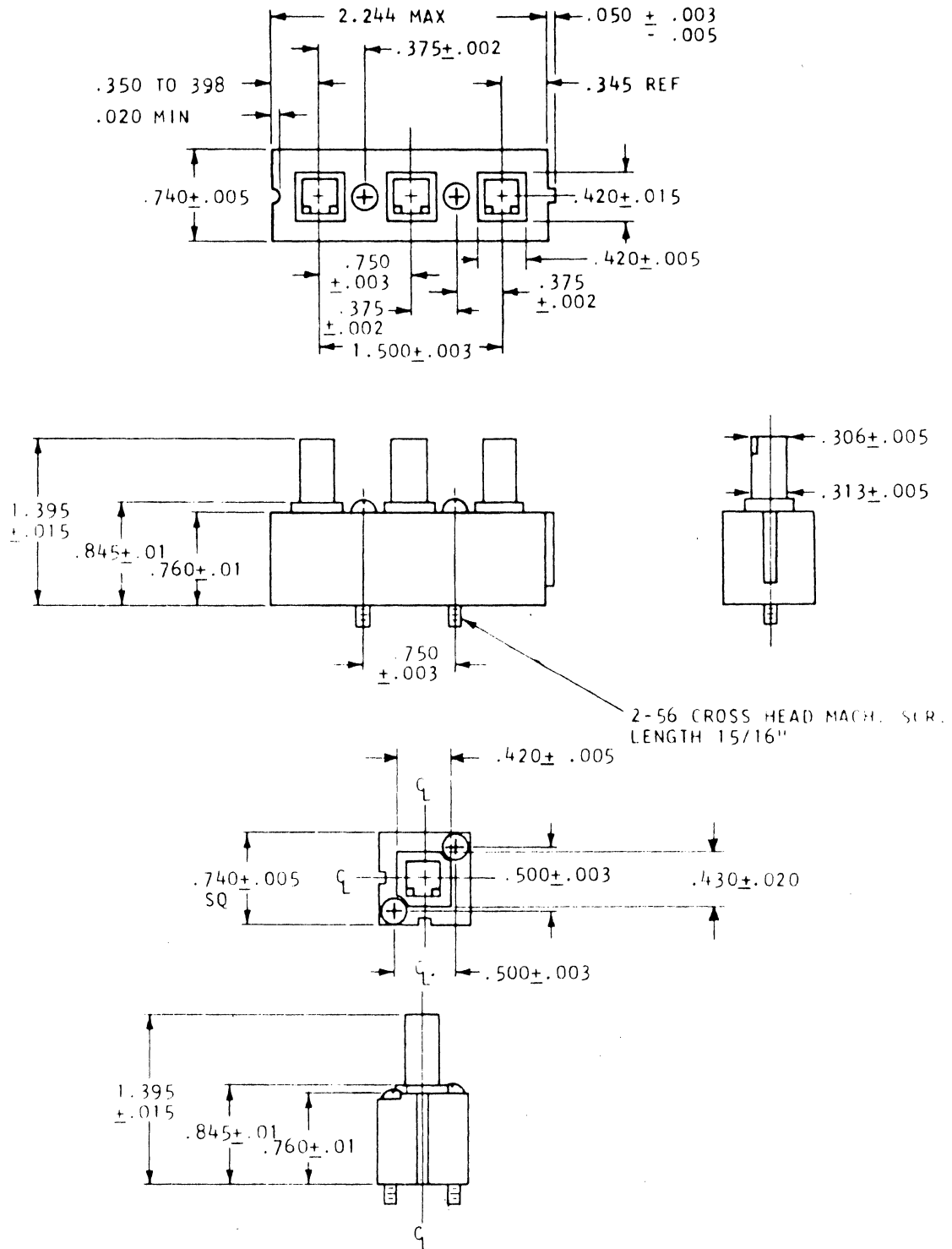
**VISIT**



**expo'74.**

World's Fair  
Spokane, USA  
May-Oct., 1974

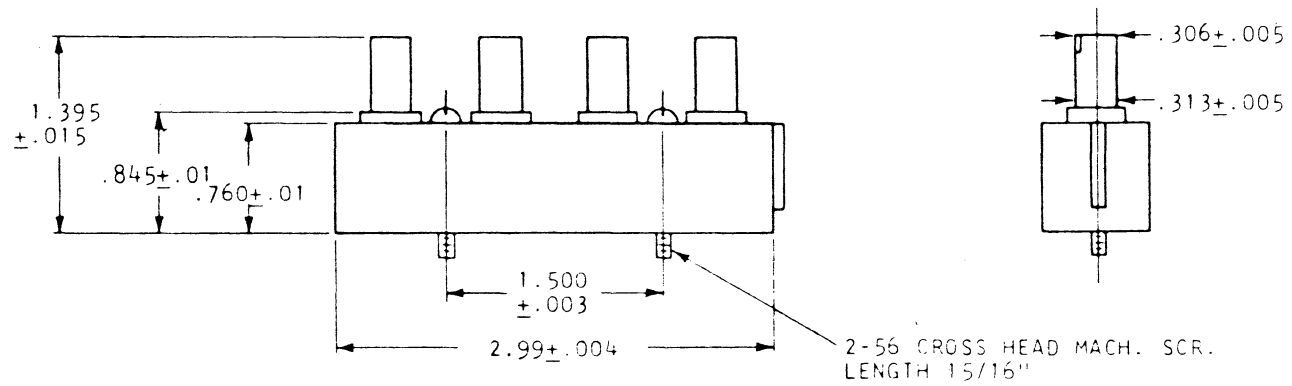
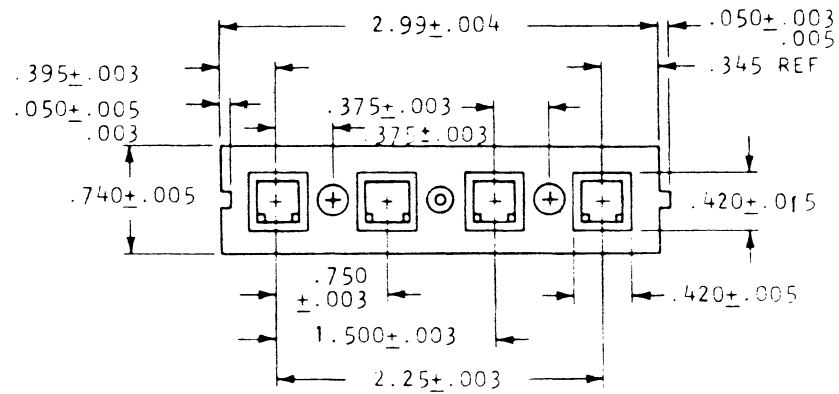




NOTE: PLUNGER POSITION SHALL BE AS SHOWN IN RELATION TO TONGUE AND GROOVE.

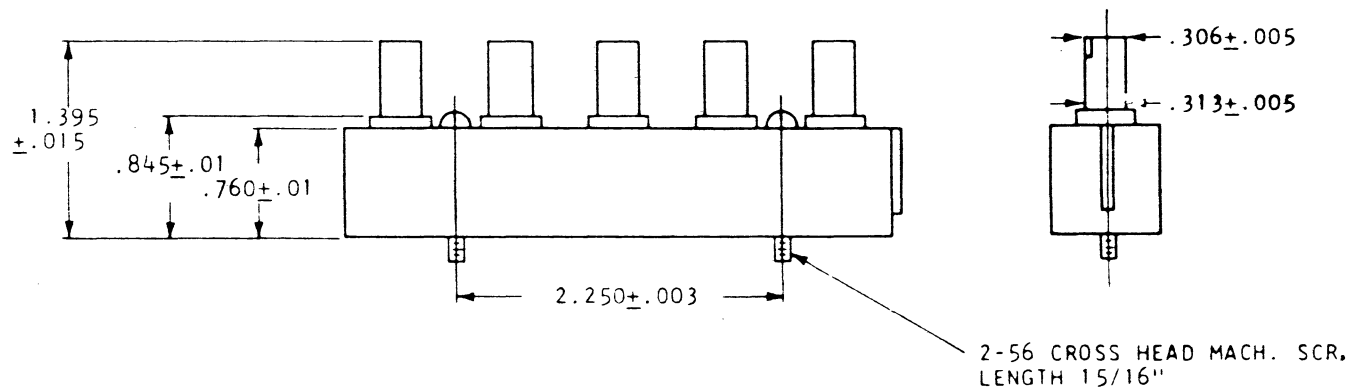
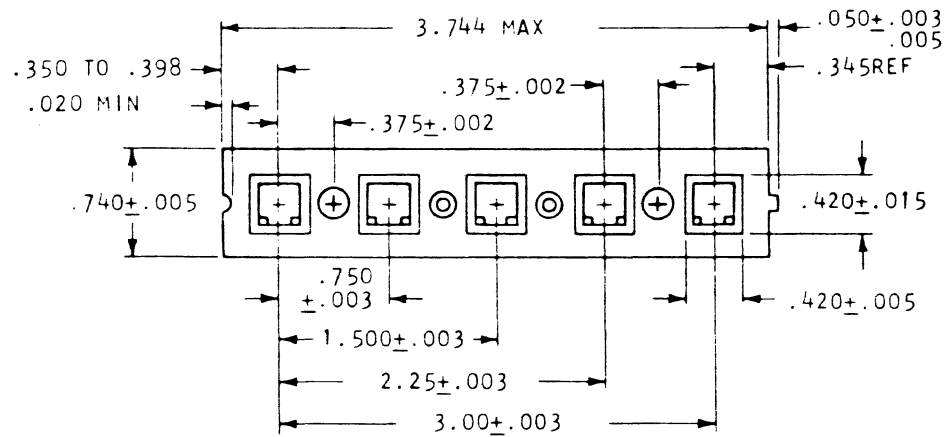
FIGURE 1 TYPE I AND II SWITCHES





NOTE: PLUNGER POSITION SHALL BE AS SHOWN IN RELATION TO SWITCH TONGUE AND GROOVE.

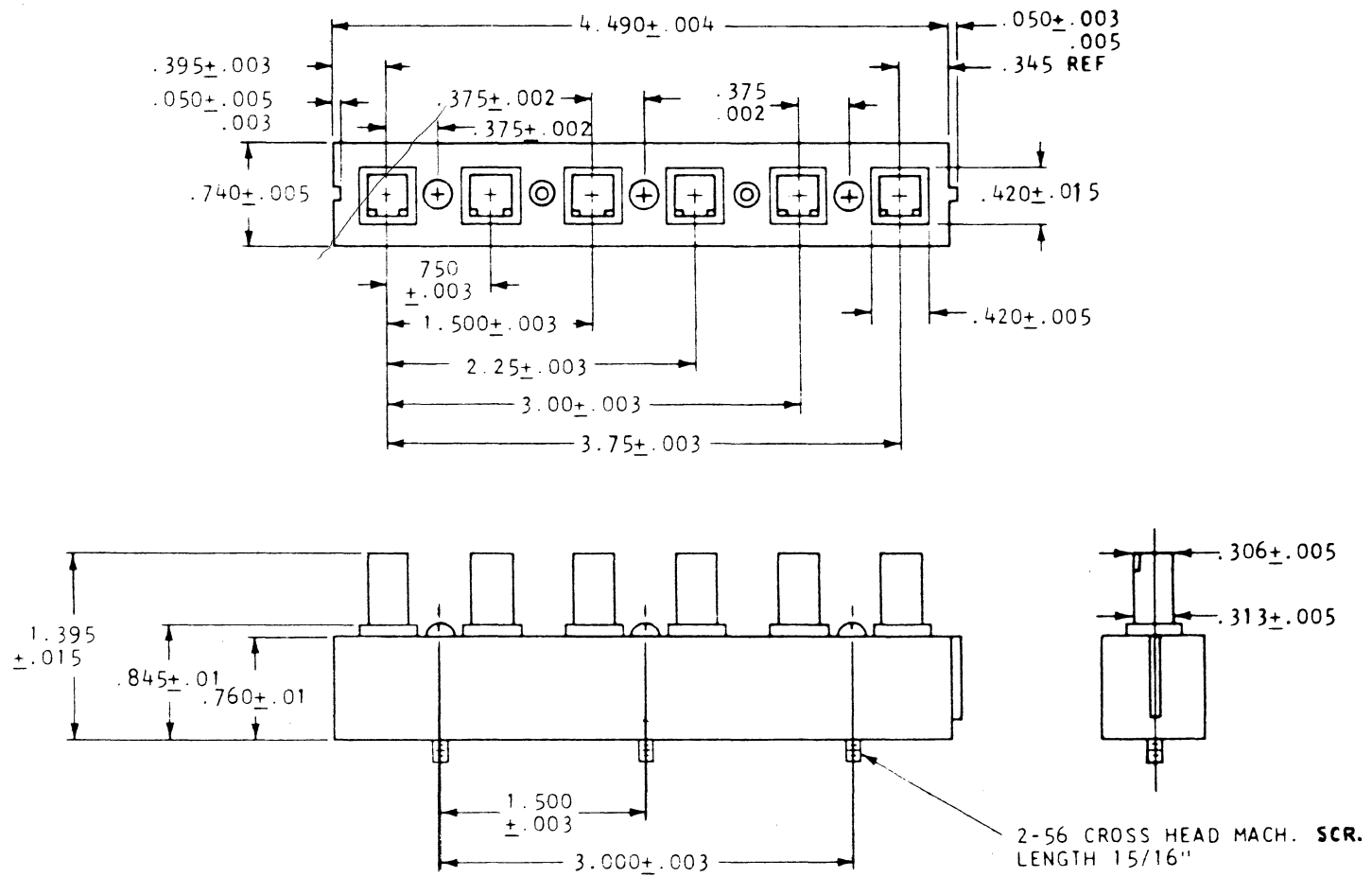
FIGURE 2 TYPE III SWITCHES



NOTE: PLUNGER POSITION SHALL BE AS SHOWN IN RELATION TO SWITCH TONGUE AND GROOVE.

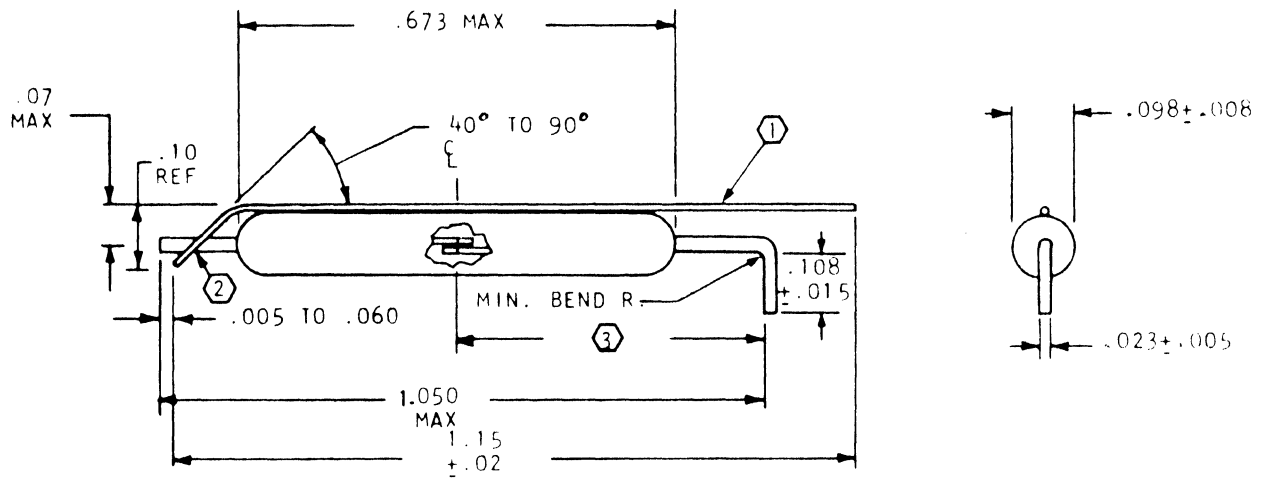
FIGURE 3 TYPE IV SWITCHES





NOTE: PLUNGER POSITION SHALL BE AS SHOWN IN RELATION TO SWITCH TONGUE AND GROOVE

FIGURE 4 TYPE V SWITCHES

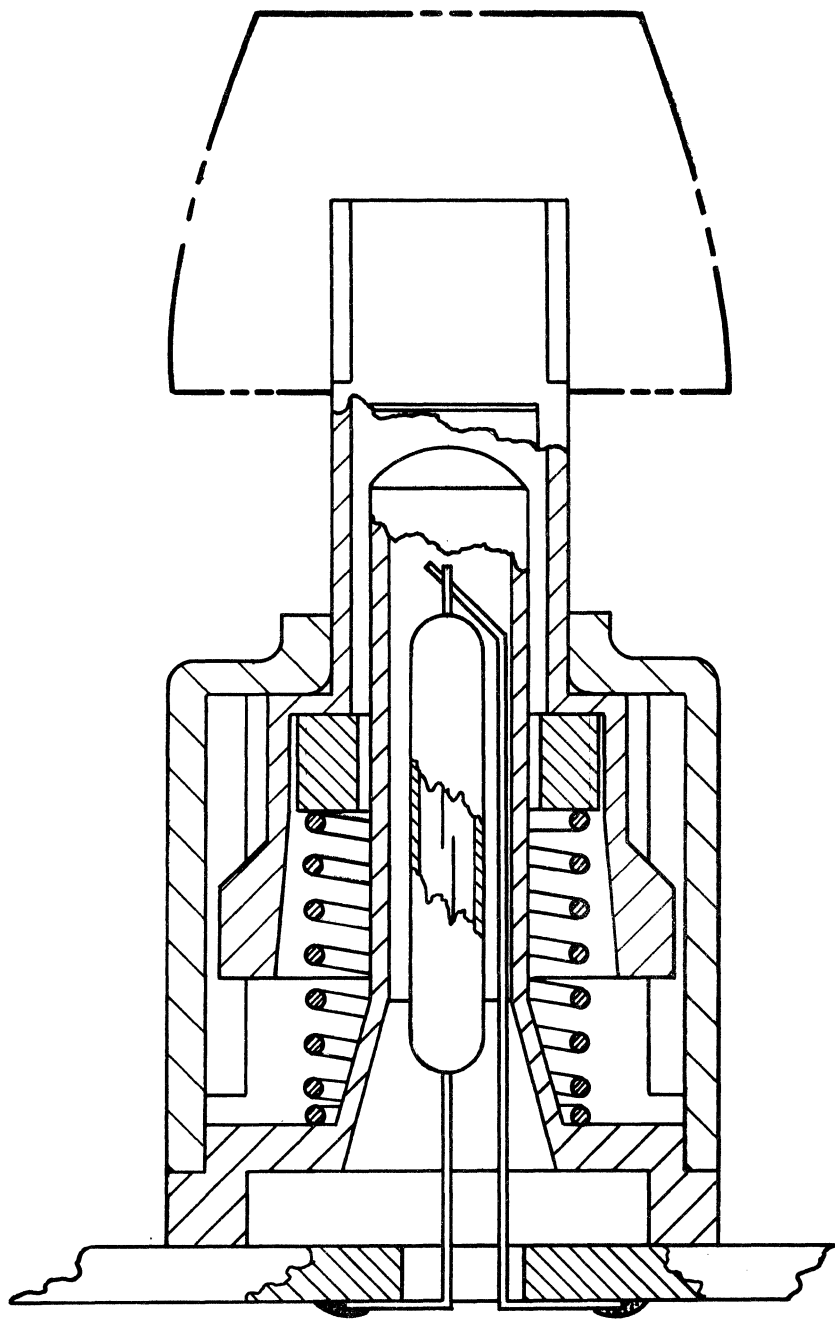


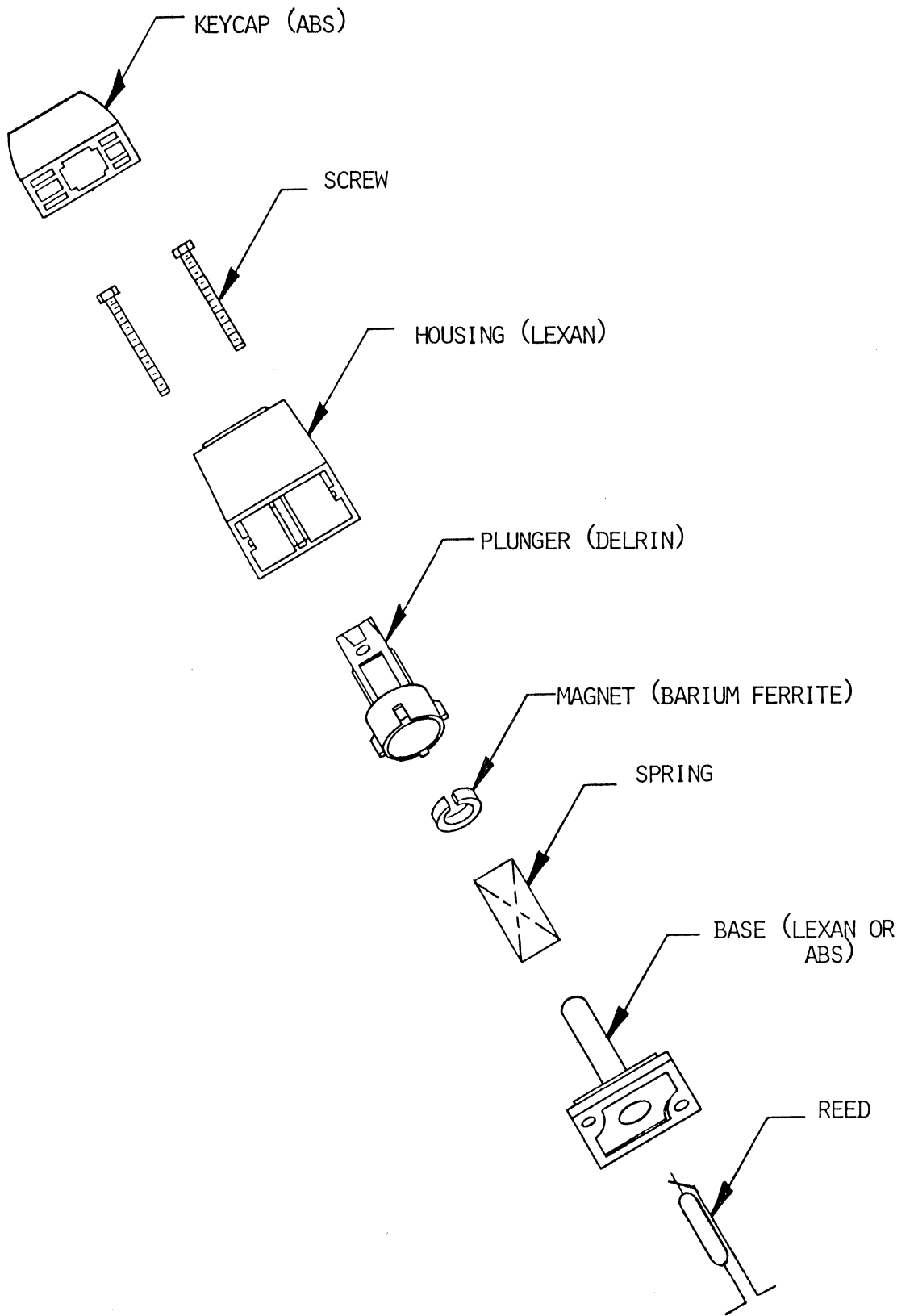
NOTES:

1. .016 Dia (26 GA) Nickel Wire, Soft Condition.
2. Resistance Weld in Accordance with MIL-W-8939.
3.  $.495 \pm .005$  for 25-35 Amp-Turn Switch.

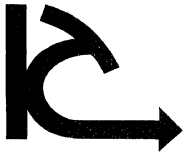
FIGURE 5 REED SWITCH CAPSULE











## DESIGN

- A. General
- B. Switch

### A. GENERAL

The design of a simple wired only or fully encoded electronic keyboard, with its multitude of complex functions, is most important to the O.E.M. and his user. Key Tronic maintains rigid design standards assuring specifications are met. Field documentation control (discussed in another section), complete drafting and printed circuit board film tape-up capability and engineering laboratory for prototype development, are only part of the Key Tronic engineering program. In addition, a development laboratory is staffed to look at new concepts and see that the most promising ones are fully tested before introducing them to the marketplace.

### B. SWITCH

#### 1. REED

The reed was selected because it offers:

- . environmental immunity
- . long life
- . high reliability
- . good shock characteristics
- . good vibration characteristics
- . clean contact closure
- . zero power consumption

#### (a) Life Expectancy - 100,000,000 Cycles

The individual sample groups have been cycled to 2.6 billion cycles. In ten years of typing, at only 50 wpm for 2,000 hours per year, the space bar will be used 60,000,000 times. Therefore, 100,000,000 cycle-life expectancy makes sense--especially, when it costs nothing extra.

(b) Reliability and Performance Data

The Mean Cycles Between Failure (MCBF) are 1.4 billion cycles from test data.

Field experience shows failure rates to be 0.024% to 0.006% per million cycles using 1,000 keyboards for one year and 2,500 keyboards for 18 months.

Test data shows groups of reeds cycled to 2.6 billion cycles without failure.

(c) Qualification Testing

Reed suppliers must meet rigid qualification tests for visual and functional performance. Exhaustive qualification testing is done to determine life expectancy and failure modes before a supplier is qualified.

Each batch and lot of reeds received for production is sampled for visual inspection, life testing and verification of lot specifications. The samples are processed by test procedures and cycled to over 100,000,000 cycles before releasing any lot to production. Each keyboard has a follower tag that shows the lot number of the reeds installed on the keyboard.

The switch used is a sealed reed switch capsule. This is actuated by a magnet on the plunger. The characteristics are listed below:

Contact Arrangement	SPST N/O Center Gap
Mounting Position	Vertical
Resonance	3000 Hz Typical
Contact Material	Soft Gold or Rhodium



## DESIGN

### B. Switch

#### Maximum Contact Ratings

Voltage	28 VDC
DC Resistive Load	3 watts
AC Resistive Load	3 VA
Current	.125 A switching

#### Life Expectancy

At Maximum Rating	$5 \times 10^6$ Operations
At 1/2 Maximum Rating	$10 \times 10^6$ Operations
At Low Load	$100 \times 10^6$ Operations

End of Life Resistance                      2 ohms

Initial Contact Resistance                      500 milliohms maximum

Bounce Time                                      1000 USEC maximum

#### Environmental:

This switch will easily meet your environmental requirements. Switching contacts are hermetically sealed. Humidity, moisture and temperature, therefore, have no affect on the reed switch.

## 2. MULTIPAK SWITCH STATIONS

Key Tronic switches come in single, 3, 4, 5 and 6 switch paks. The multistation switch pak concept offers rigidity without special bracketry permitting easier access to the keyboard for inspection, further manufacture and servicing.

The reed switch is soldered directly to the printed circuit board, thus enhancing reliability by eliminating intermediate interconnections between the switching element and the printed circuit board. The reed is replaceable from the bottom of the keyboard without removing any of the switch's mechanical assemblies. The key switch assembly will consist of a Delrin

plunger in a Lexan housing. These materials are used to obtain the lowest possible coefficient of friction between moving parts. The housings come in single units or in multiple assemblies of 3, 4, 5 and 6, as required.

<u>Available Operating Forces</u>		<u>Color Codes</u>
56.6 ± 5.7 grams	2 oz. ± .2 oz.	red
70.7 ± 7.1 grams	2.5 oz. ± .25 oz.	blue
85.0 ± 8.5 grams	3 oz. ± .3 oz.	natural
141.3 ± 14.3 grams	5 oz. ± .5 oz.	black
170.0 ± 17.0 grams	6 oz. ± .6 oz.	green
254.7 ± 25.5 grams	9 oz. ± .9 oz.	orange

(Other Operating Forces upon request.)

Travel:

Total Travel is: 4.34 ± 0.254 mm	.171 ± .010 inch
Pretravel is: 2.54 ± 0.89 mm	0.100 ± .035 inch

### 3. SWITCH OPTIONS/ADDITIONAL FUNCTIONS

In addition to the standard switch, the following options are available:

#### (a) Lighted Indicator

A lighted switch can be provided as an indicator only. The reed switch will be omitted, saving cost. A lock to hold the plunger always in the "UP" position can be provided. Standard T 1-3/4 lamps are top replaceable simply by removing the keytop and removing the lamp.

#### (b) Lighted Switch

A center lighted switch is available. Also, lights can be installed as bullets under larger keytops (see section on Keytops). Lamps are top replaceable without need for a special tool.



## DESIGN

- B. Switch
- C. Electronics

### (c) Mechanical Alternate Action

Mechanical alternate action switches are available. Depress the switch once, it stays down in the "ON" position. Depress it a second time and it returns to the "UP" and "OFF" position.

### (d) Mechanical Alternate Action - Lighted

A center lighted switch with mechanical alternate action is available.

### (e) Switch Locks

A switch lock can be provided to keep the switch useful for blank stations, stations not needed on a system, lighted indicators, etc.

### (f) Mechanical Shift Lock

The Shift Lock can be released by depressing the Shift key.

## C. ELECTRONICS

Many keyboard functions may be performed electronically more easily than if they had been implemented mechanically and at a much higher reliability. Changes may be made to electronic circuits much faster than to mechanical hardware if requirements change during the development of a particular keyboard layout and design. An additional factor involved is to make the keyboard as flexible as possible so the keyboard characteristics may be tailored by the use of read/only memories or programmed read/only memories. Thus, the design job is made easy.

### 1. KEY ROLLOVER OPTIONS

In the standard alphanumeric section of the keyboard, seven types of rollover have been devised and used at Key Tronic Corporation.

These are:

1. Second-key Inhibit
2. Two-key Rollover
3. Two-key Rollover, N-key Lockout
4. N-key Rollover
5. N-key Rollover - Selective
6. N-key Rollover - Staggered Scan
7. N-key Rollover - Multiple Lockout

(a) Second-key Inhibit

With Second-key Inhibit, the keyboard is required to be clear between key strokes. That is, a person cannot "rollover" and get the second key to work. The operator must release all keys on the complete keyboard between key strokes. This type of rollover is commonly found on calculators but is also useful in large keyboards which have applications in such places as machine shops, control panels and point-of-sale.

(b) Two-key Rollover

Two-key Rollover is commonly found on keyboards in a number of forms. When depressing one key, the code is put out immediately. If this key is held down and a second key is subsequently depressed, nothing happens upon depression of the second key. As the first key is released, the second key code is put on the keyboard output data lines. Some two-key rollover systems have a deficiency in that if one key is pushed and held down and the second key is hit and released, the code for the first key will come out twice. In fact, it will come out once every time the second key is hit and released. Key Tronic standard two-key rollover circuit does not suffer from this deficiency.

(c) Two-key Rollover, N-key Lockout

The Two-key Rollover, N-key Lockout circuit has the feature that if more than two keys are depressed on the keyboard, the keyboard locks out until only one key remains depressed and then its code is put out. With this feature, if two keys are hit simultaneously, they are also locked out.



(d) N-key Rollover (True-key Rollover)

With N-key Rollover, the code for each key is put out as soon as the key is depressed, without regard to the release of any other key. In other words, half the keyboard switches may be depressed and as another key is hit, its code will come out. Nothing happens as all the keys are then released. This is what Key Tronic calls, True-key Rollover. Any keys may be held down anywhere on the keyboard without regard to position or physical possibilities of an actual typist doing this, for the keyboard must rollover.

(e) N-key Rollover - Selective (Selective N-key Rollover)

Key Tronic's Selective N-key Rollover works the same as N-key Rollover except that the layout is studied and keys assigned in the circuit matrix with consideration being given to the touch typist's fingers which will activate them. The Selective N-key Rollover keyboard then appears as True N-key Rollover to a touch typist. This is really the only time N-key rollover is required. The advantage of Selective N-key Rollover over N-key Rollover is only in the cost that it takes to achieve the circuitry.

(f) N-key Rollover - Staggered Scan

The N-key Rollover - Staggered Scan circuit is used to help the N-key Rollover keyboard interface with a slower terminal than the speed of the operator. The first key depressed locks the keyboard up momentarily on that key's particular code and stops the rest of the keyboard circuitry from producing codes until the terminal equipment has time to recognize the first code. After the first code is recognized, then the keyboard circuitry puts out the code for the second key down. This Staggered Scan approach helps to eliminate first-in/first-out character buffers when operating a fast N-key Rollover keyboard into slower equipment.

Again, the factor involved here is the lower cost of a staggered scan approach than that which requires first-in/first-out character buffers. The Staggered Scan approach will fail if the terminal equipment becomes so slow that the operator can depress two more keys before the first key has been processed. The keyboard would not know which of the second two keys comes first.

(g) N-key Rollover - Multiple Lockout

The N-key Rollover - Multiple Lockout system produces either Selective or True N-key Rollover with the second advantage that if keys are simultaneously struck, they will be inhibited. A time frame is defined for what is meant by simultaneous key depressions.

2. CODE INHIBIT

In terminal or data entry equipment, sometimes it is desirable to interlock keys with the SHIFT or CONTROL keys so that unwanted codes are not produced. An example of this would be to interlock the SCREEN ERASE key with the CONTROL key so that the CONTROL key has to be depressed before the SCREEN ERASE key will work. Alternately, it is sometimes desired to inhibit certain keys in the shifted mode in which they do not have meaningful codes. An application of this sort might occur on a key punch where the key punch is in the numeric (shifted) mode and certain keys do not have upper case symbols associated with them. In both of these cases, it is possible to program keys to lockout in any mode. Since these keys are selected, this operation is called, Selective Key Lockout. With it, a number of other options may be provided. An error signal may be turned on when an operation is attempted that results in the key stroke being inhibited. Alternately, the keyboard may be locked out so that nothing happens until a RESET key is hit.



### 3. REPEAT OPTIONS

A number of types of repeat are available using a separate REPEAT key. There are four ways in which it may be made to work. Simply depressing the REPEAT key by itself may cause the last character hit to be depressed in conjunction with the DATA key. Letting up either one of these keys would stop the repeat action. A third mode of operation would be to require the REPEAT key to be depressed first and the DATA key to be struck which causes that particular key to be repeated. To stop the repeat, the REPEAT key must be released. With this mode of operation, once the DATA key is hit, it does not have to be held and may be released. Still another approach is the depressing of two or more keys with the REPEAT key depressed and the output will alternate between the keys held down.

Another type of repeat which does not involve the use of a REPEAT key, is called Auto-repeat. After a DATA key is struck and its code initially put out, there is a delay and then the key begins to automatically repeat if it is still held down. Many times, the delay and the repeat rate are made adjustable to suit the operator. As an extension of this, Selective Auto-repeat is possible in that the keys that are supposed to repeat are specified. Only these keys repeat. In fact, it is possible to specify a key to repeat only in certain modes of operation, such as, an upper case "X" may be made to automatically repeat and a lower case "x" does not. Or, possibly, a lower case "comma" may be made to repeat and an upper case "comma" which might be a "less than" (<) sign, would not repeat.

A recent development at Key Tronic is the Selective rate for certain keys. With this type of operation, some keys are selected to repeat at a faster rate than others. Keys like CHARACTER DELETE are made to operate fast while keys, such as, SCROLL UP and SCROLL DOWN are made to operate slowly.

#### 4. SPECIAL KEY OPTIONS

Many auxiliary functions are available on a keyboard which may be electronically performed. An electronic alternate action switch where a flip-flop is set and reset on alternate depressions of the key switch with an LED indicating the flip-flop state is more reliable than the mechanical equivalent.

In a similar manner, an electronic Shift Lock may be performed where either SHIFT key releases the SHIFT LOCK. Coded SHIFT keys are used in some applications where the SHIFT key causes a coded output on depression and a different code output when it is released.

With special electronics, it is possible to have keys which are capable of operation at the same time where the operation being performed is a combined operation of the two keys being depressed. For example: CURSOR CONTROL keys which may be hit at the same time, may cause a cursor to go at a  $45^{\circ}$  diagonal on the base of a CRT. If the UP CURSOR and the RIGHT CURSOR were hit simultaneously with this type of operation, the cursor would go up and right simultaneously. This type of operation is used in conjunction with an automatic repeat for rapid cursor positioning. Similarly, SCROLL UP and SCROLL DOWN may be created by using a SCROLL key and CURSOR UP and CURSOR DOWN key.

Another possibility is to electronically duplicate a bailed switch. That is, a combination of switches where the last one hit is the only active switch. The mechanical equivalent is found on channel selectors, such as, in a car radio.

#### 5. SPECIAL KEY FIELD SHIFTING

A commonly used feature on keyboards is what we call the Forced Alpha Upper Case. When using this feature, the operator depresses a key to enter into the Forced Alpha Upper Case mode. In this mode, the alphabet

is shifted to upper case and stays in upper case when the SHIFT key is depressed but the rest of the keyboard keys still put out their lower case code until the SHIFT key is depressed, at which time, they put out the upper case. This feature is commonly used when someone wants to type in upper case but still wants to use the number on the main section of the keyboard. He then does not have to unshift, hit a number and re-lock the keyboard into SHIFT LOCK to go back typing alphabet.

Numerous possibilities exist in the layout of a keyboard and the inclusion of Special Key Field. A common key field is a numeric inset commonly found on a key punch machine, such as, the IBM 026 or 029. It is possible with keyboard electronics to shift into such a numeric mode and still put out the correct ASCII character for the 0 through 9 of the numeric inset. Ten-key Adder pads are possible which may be converted to a key punch format with the addition of a Ten-key Shift Key. That is, where the 1, 2, 3 keys take the position of the 7, 8, 9, etc. In systems which need many control functions, it is possible with the addition of a CONTROL key to have the alphanumeric keys provide control codes.

## 6. MOS ENCODING

Logical bit pairing is no longer a requirement on the engineer specifying the keyboard due to four-mode MOS encoding. Control codes may be assigned to keys with the ease of operations as a primary objective. The keyboard, thus laid out, eliminates many extra keys and is a more compact unit. For example, a person doing the keyboard layout might assign control functions to the numeric keys across the top of the keyboard so that when the keyboard is installed in its case, the control functions could be identified on the panel instead of being molded into the keytop.



## 7. EXTERNAL CONTROL SHIFT

External control of keyboard electronics is often done in data entry systems. Control of the mode of a keyboard is done to increase the operator's speed. The shift from alpha characters to numeric is done by switching an external control line input. Thus, when an operator is typing alphas, such as a person's name, and enters a numeric field where she should be typing his credit card number, the keyboard will shift under computer control to numerics so that the operator does not have to be concerned with the alpha and numeric shift keys. Keyboards are often enabled or disabled under computer control to stop an operator from inputting more data after he has made an error or merely to be able to utilize the keyboard on a Tri-state Buss System.

## 8. MULTIPLE FUNCTION KEYS

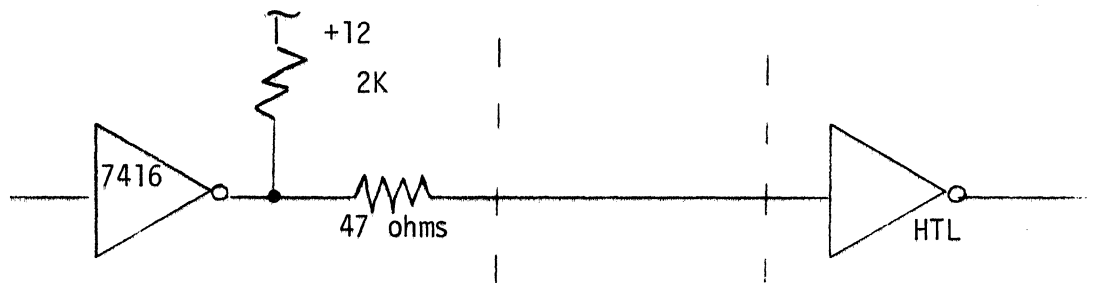
Multiple functions per key stroke are also possible. This is often done when a key, such as, CARRIAGE RETURN and a key, such as, LINE FEED must be hit at the end of every line on a Teletype machine instead of having a separate LINE FEED/CARRIAGE RETURN key. The LINE FEED function is transmitted from the keyboard immediately after the CARRIAGE RETURN code, automatically.

Sometimes the keyboard electronics is designed so that an external input, which is controlled by the user, can select whether or not he wants to use the automatic line feed feature. In a longer type of multiple functions, Key Tronic provided keyboards where hitting one key will cause up to 64 programmable characters to be transmitted. This operation is also used on a Teletype for the "answer back." It is conceivable that this type of electronics can be used on a machine and programmed to type a company's name, address and telephone number upon a single key stroke. If this type of electronics were extended to a typewriter, a single key

could be assigned commonly used words in the industry for which the typewriter is being used. For example: a company making semiconductors could program a single key to cause the words, "INTEGRATED CIRCUITS" to be printed out.

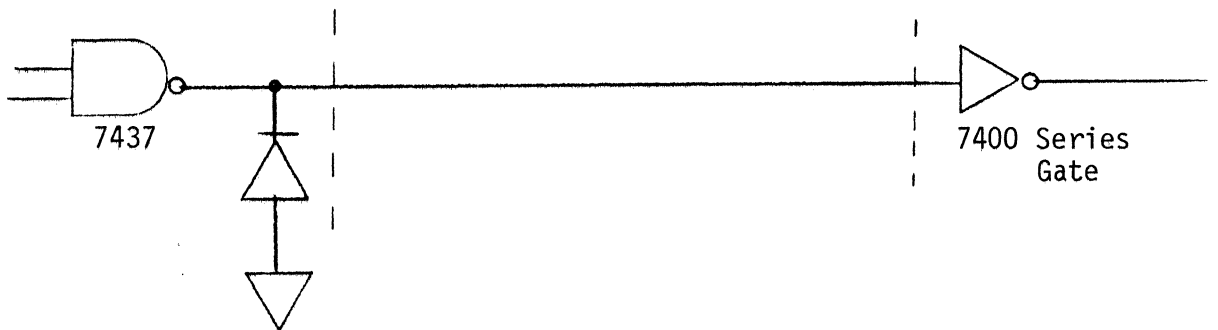
### 9. DRIVING LONG CABLES FROM KEYBOARD

A 12 volt driver/receiver system is shown below:



The receiver is a Fairchild High-threshold logic gate.

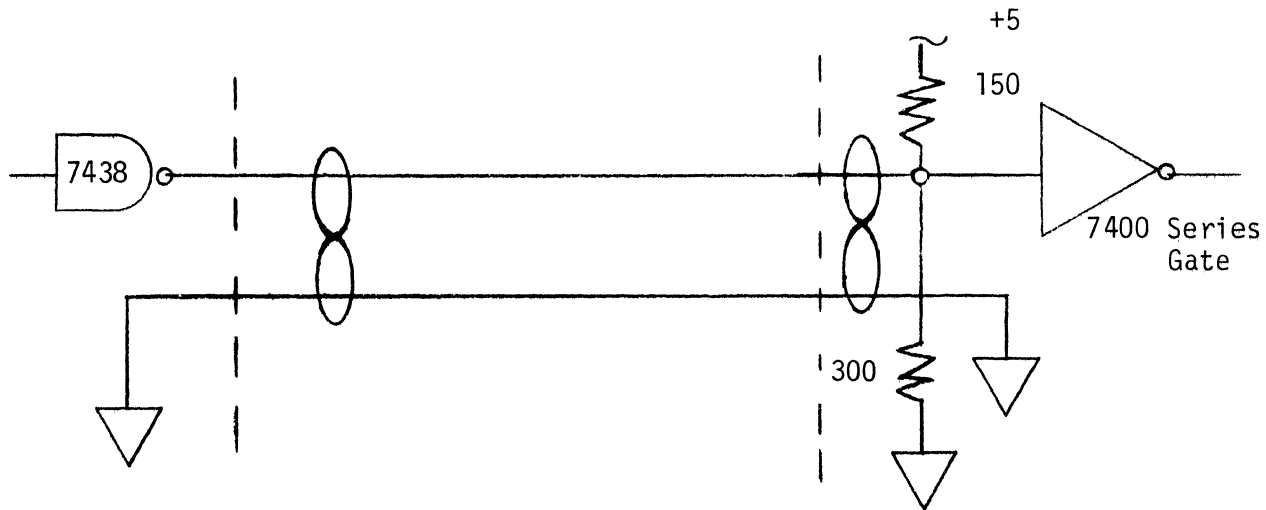
A system used for up to 20 feet, is shown below:



This circuit was put on all data lines and the strobe. The diode was to clamp negative undershoot since the 7437 gate output does not perform this function.

It should be noted that a .3 VDC voltage drop in the ground on a six-foot cable may make the outputs appear to be out of specification when at the zero logic level.

For driving twisted pair cables, the following configuration of gates has been utilized:

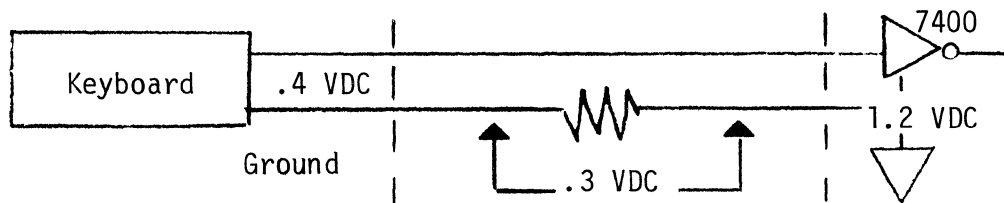


The 100 ohm terminating impedance approximately matches the impedance of a twisted pair line using #24 AWG PVC insulated wire twisted at 36 turns per foot.

Integrated circuits, such as, National's DM 8830 line driver or Motorola's MC 1488, are available for keyboard interfacing which minimizes the design time and provide proven solutions to the long line interface problem.

In driving data over long lines, an important point to consider is the grounding technique used. Common mode noise, caused by the current in the ground will cause problems with any of the single-ended transmission schemes. In fact, the DC drop could be great enough so that the receiving gate never sees a logic zero.





If 1,000 feet of AWG #20 copper wire were used for ground and 200 MA of DC current flow to power the keyboard, the voltage drop is calculated:

$$\begin{aligned}
 R_{\text{Wire}} &= \frac{10.371 \text{ ohms} - \text{C M A}}{\text{foot}} (1,000 \text{ feet}) \\
 &= \frac{10.371 \text{ ohms} - \text{C M A}}{1020 \text{ C M A}} \\
 &= 10.2 \text{ ohms} \\
 V_{\text{GD}} &= (10.2 \text{ ohms}) (200 \text{ MA}) = 2.04 \text{ VDC}
 \end{aligned}$$

## 10. KEYBOARD INTERFACES

Many different types of keyboard interface logic have been built at Key Tronic. These may be broken down into parallel and serial methods of data interchange. Driver circuits described in Paragraph 9, may be used in either method although more driver and receiver circuits are required for the parallel methods.

### Parallel Interfaces:

In a parallel interface, the data may be latched (stored in a register), presented as long as the key is down or pulsed. The strobe signal may be pulsed, maintained as long as the key is down or latched and reset with an external pulse. The most common interface is shown on the following page:

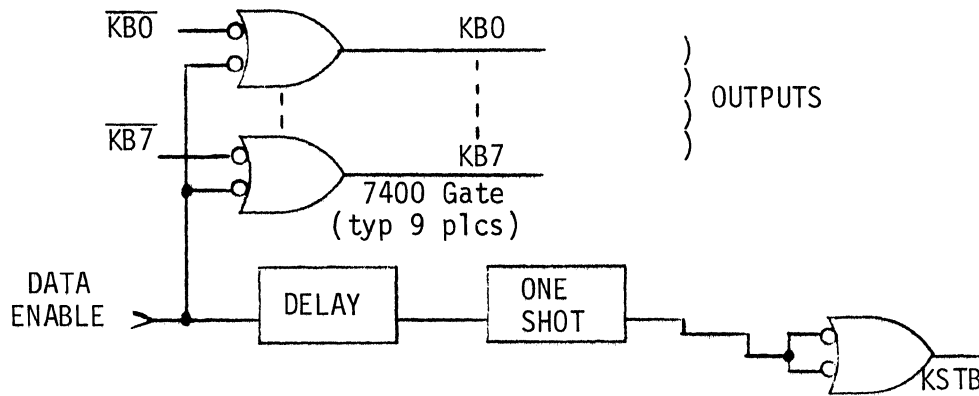


Figure 1. Parallel Interface

In the interface shown in Figure 1, the 7400 Series NAND gates, with active pull up can be replaced with 7403 or 7438 type gates. This gives an open collector output from the keyboard with the "keys idle" condition being that all the output transistors are shut off. This allows two key-boards to have their outputs physically wired together as long as only one is being operated at a time.

Another interface arrangement is shown in Figure 2.

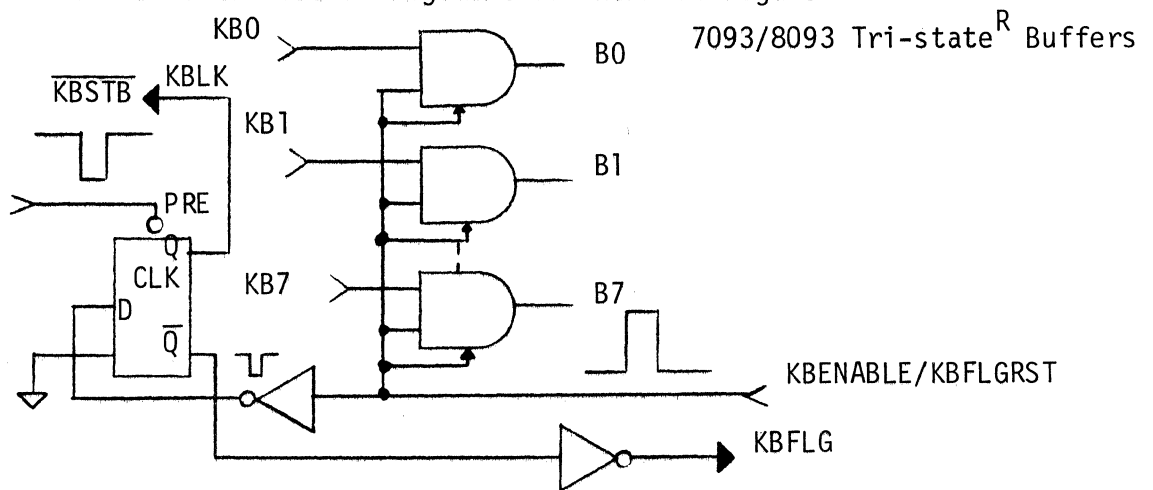


Figure 2. Parallel Tri-state<sup>R</sup> Interface

(Tri-state<sup>R</sup> is a registered trademark of National Semiconductor)

In this arrangement, the keyboard sets a flip-flop with internal signal  $\overline{\text{KB STB}}$ . This is used as an interrupt into the rest of the system. When the system is ready to accept keyboard data, it issues a pulse on the  $\text{KBENABLE/KBFLGRST}$  line. During this pulse, the Tri-state<sup>R</sup> gates are enabled and keyboard data are on the data buss. At the end of the pulse, the flip-flop is reset. Timing is shown in Figure 3.

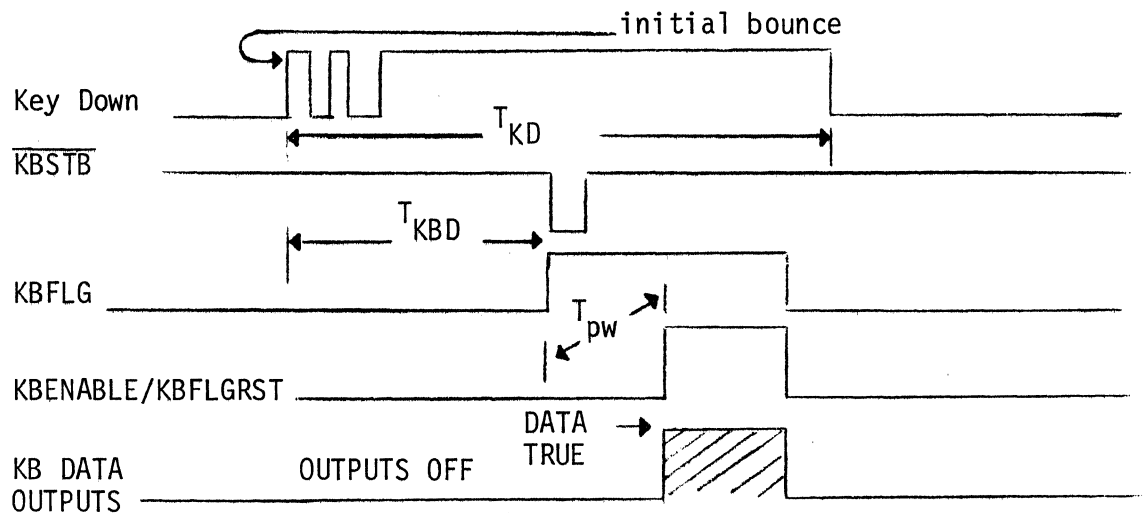


Figure 3. Parallel Interface Timing

If  $T_{pw}$  is longer than  $T_{KD}$ , then without latched data, the character could be lost, or, with a fast operator, replaced by a second character.

To eliminate the need for latches on a TTL two-key rollover keyboard, the signal  $\text{KBLK}$  (keyboard lock) can be used to lock the electronics onto the code with no subsequent key depressions being recognized, until the system has accepted the first code. This gives a sort of electronic two-key rollover with both the first key down or the system locking the scanning circuit. If  $T_{pw}$  is less than one MSEC, then this addition is not necessary as the minimum time a key is closed is 40- to 50-milliseconds. If  $T_{pw}$  goes out much past the 50 milliseconds, then the operator has to slow down and FIFO character buffers should be considered.



A third parallel interface latches the keyboard data and leaves it on the interface until it is replaced by the next character. The strobe is delayed and may be a pulse or a level for as long as the key is down. Figure 4 illustrates timing.

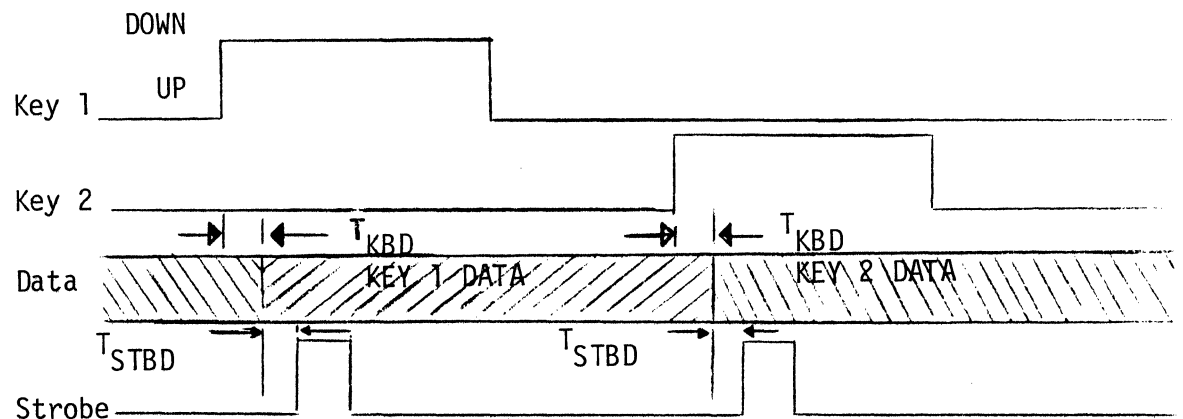


Figure 4. Parallel Interface Timing

Many variations are possible from each of these parallel interface schemes. Key Tronic Engineering staff has designed and built just about any possible interface configuration including a Tri-state interface with the keyboard having to decode its own address off the data buss before it could enable its output drivers. Addresses were selectable with an eight position slide switch.

#### Special Interfaces:

Serial interfaces usually save line drivers, line receivers and cabling. Serial interfaces used with keyboards can be synchronous or asynchronous (Teletype format). The synchronous interfaces are usually done on burst basis with the receiving system supplying a burst of eight clock pulses to clock the data in response to a strobe pulse. Timing for such a system is shown in Figure 5.

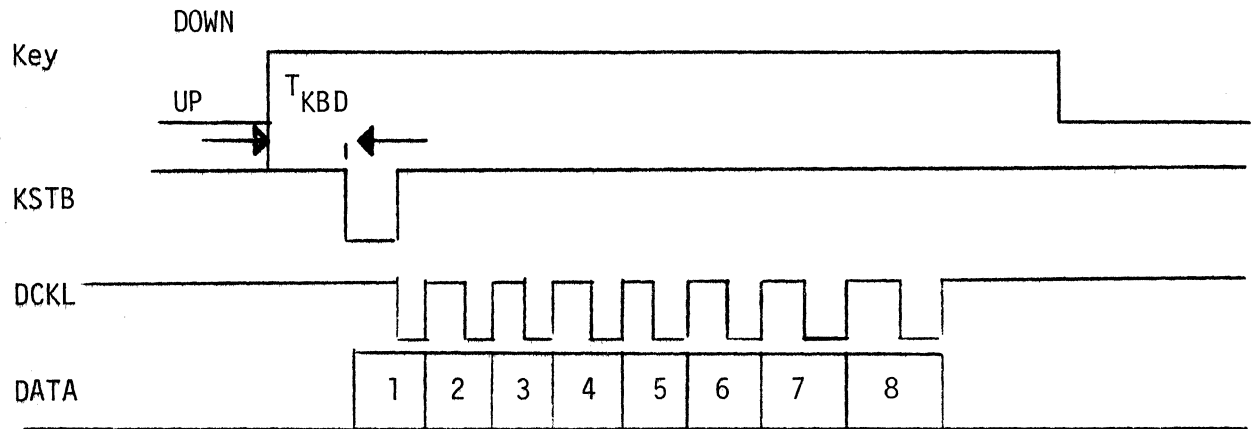


Figure 5. Serial Interface Timing

The keyboard circuitry is simple and is shown in Figure 6.

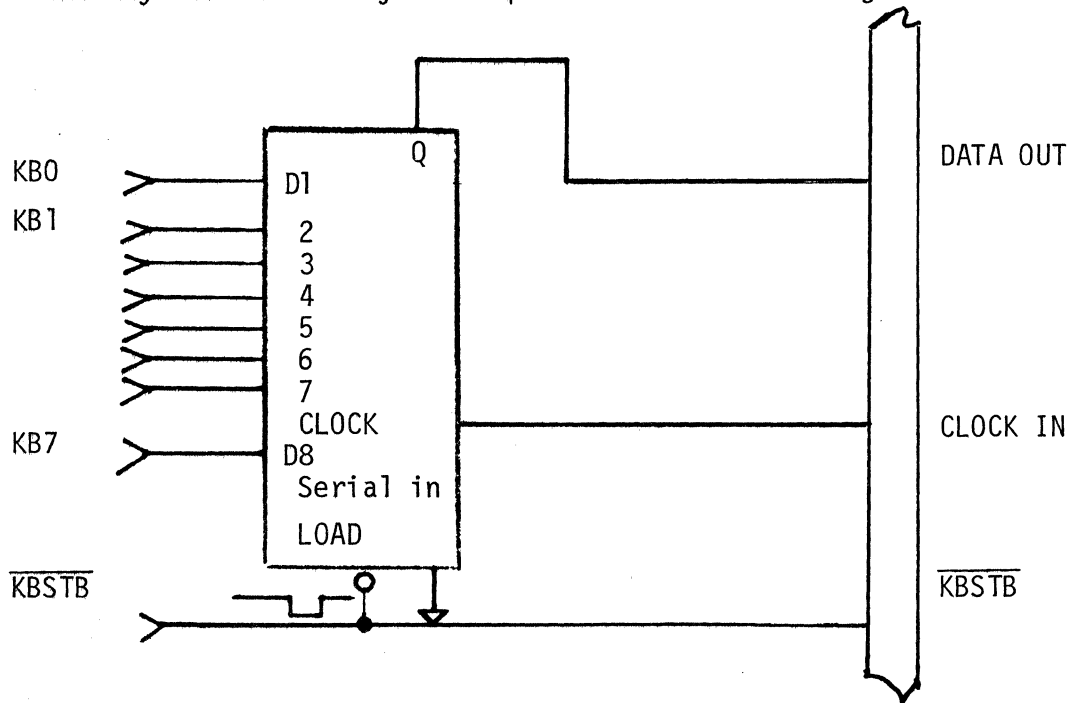


Figure 6. Serial Interface

Another type of serial interface is a POLL/RESPONSE type of operation. The keyboard is polled by a pulse on a CLOCK line. If the keyboard has data, it answers with a PULSE on the DATA line. If the receiver system gets an answer, it comes back with eight (8) clock pulses on the CLOCK line and the keyboard puts data on the DATA line. Timing of this scheme is shown in Figure 7.

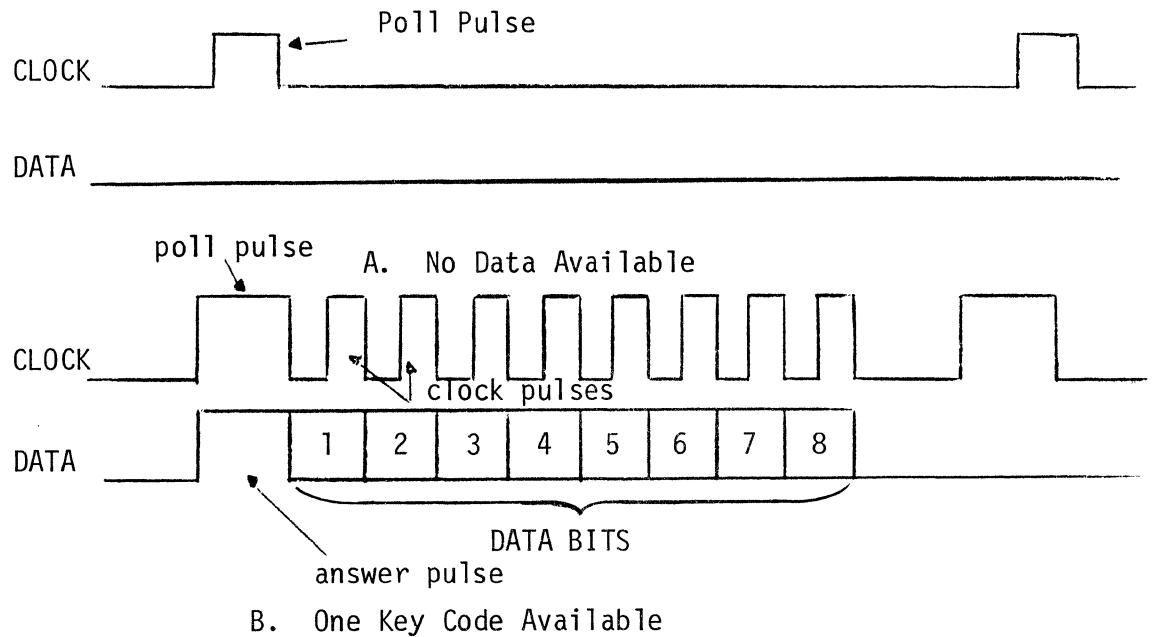


Figure 7. POLL/RESPONSE SERIAL INTERFACE TIMING

The most common type of serial interface is the asynchronous one used by Teletype machines. Only a single line is required. Timing is shown in Figure 8.

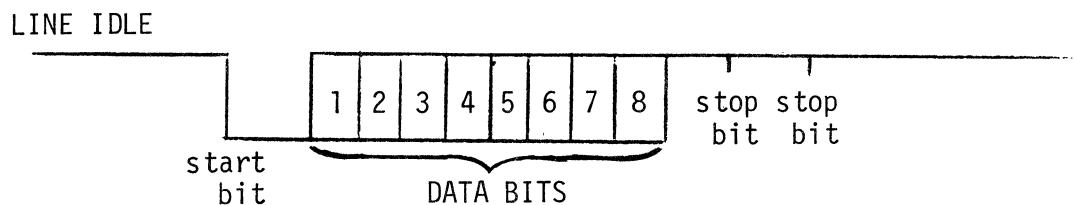


Figure 8. ASYNCHRONOUS SERIAL INTERFACE TIMING



The START bit is used to synchronize the receiver system clock which then runs free at a rate close enough to the sending system rate to allow eight (8) data bits to be CLOCKED into the receiving system. Timing for the receiver is shown in Figure 9.

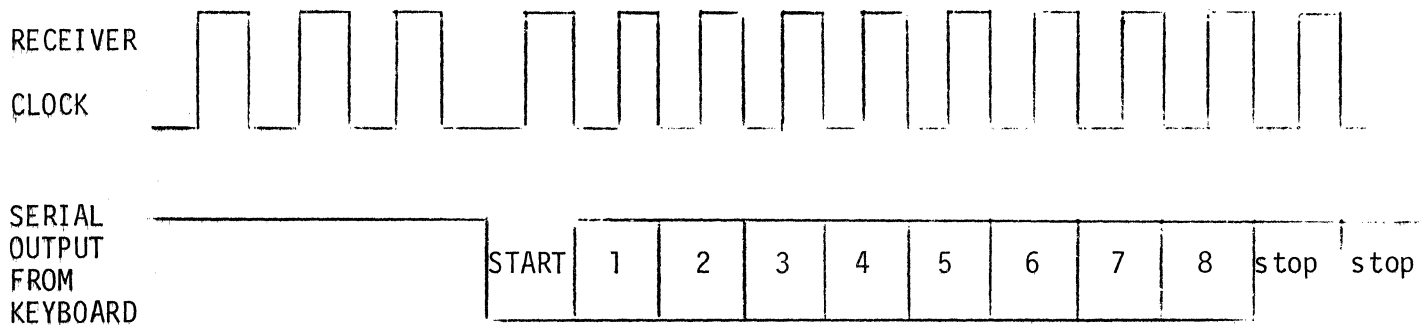


Figure 9. ASYNCHRONOUS SERIAL INTERFACE RECEIVER TIMING

If the receiver clocking is done on the positive edge of the clock, note that the two signals may be off almost one-half a clock period on the eighth bit and still receive it correctly.

#### 11. KEYBOARD CODES - ASCII

The most predominant code used for keyboards is USASCII. (United States of America Standard Code for Information Interchange.) This code is defined in USA Standard X3.4 1967 - Standard Code for Information Interchange and was adopted as a Federal Standard on November 1, 1968 (see FIPS PUB. 1 from National Bureau of Standards). Also partially adopted was X3.4 1968.

The common name for this code is ASCII, "Ask-ee." The code structure is followed by the European Computer Manufacturers Association and is known as the ECMA 7-bit code. This is defined in Standard ECMA-6. Some character substitutions are allowed for National use characters in the ECMA version.

ASCII is a 7-bit code with an eighth bit sometimes added for parity checking. This code is reproduced in Figure 1. A 6-bit subset of ASCII may be formed by dropping the seventh bit. This code is shown in Figure 2.

A listing of the names of the ASCII control and graphic characters is given in Figure 3.

The Japanese Industrial Standard Code is formed from ASCII by adding an eighth bit (not parity) which doubles the code set size. The Japanese Kata Kana characters are entered in columns 10, 11, 12 and 13. This code is shown in Figure 4.

<u>Control Characters</u>		<u>Symbol</u>	<u>Graphic Characters</u>
NUL	Null	SP	Space (normally nonprinting)
SOH	Start of Heading	!	Exclamation Point
STX	Start of Text	"	Quotation Marks (diaeresis)
ETX	End of Text	#	Number Sign
EOT	End of Transmission	\$	Dollar Sign
ENQ	Enquiry	%	Percent
ACK	Acknowledge	&	Ampersand
BEL	Bell (audible or attention signal)	'	Apostrophe (closing single quote mark; acute accent)
BS	Backspace	(	Opening Parenthesis
HT	Horizontal Tabulation	)	Closing Parenthesis
LF	Line Feed	*	Asterisk
VT	Vertical Tabulation	+	Plus
FF	Form Feed	,	Comma
CR	Carriage Return	-	Hyphen (Minus)
SO	Shift Out	.	Period (Decimal Point)
SI	Shift In	/	Slant
DLE	Data Link Escape	:	Colon
DC1	Device Control 1	;	Semicolon
DC2	Device Control 2	<	Less Than
DC3	Device Control 2	=	Equals
DC4	Device Control 4	>	Greater Than
		?	Question Mark
		@	Commercial "at"
		[	Opening Bracket
		\	Reverse Slant
		]	Closing Bracket
		^	Circumflex



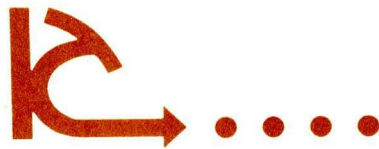
	<u>Control Characters</u>	<u>Symbol</u>	<u>Graphic Characters</u>
NAK	Negative Acknowledge	—	Underline
SYN	Synchronous Idle	`	Grave Accent (opening single quotation mark)
ETB	End of Transmission Block	{	Opening Brace
CAN	Cancel		Vertical Line
EM	End of Medium	}	Closing Brace
SUB	Substitute	~	Overline (tilde; general accent)
ESC	Escape		
FS	File Separator		
GS	Group Separator		
RS	Record Separator		
US	Unit Separator		
DEL	Delete (or sometimes, Rubout)		

Figure 3. Control and Graphic Characters

Cross-references are given in Figure 5.

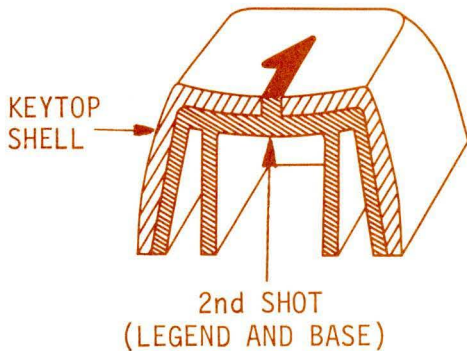
<u>STANDARD ORGANIZATION</u>	<u>DOCUMENT</u>
ISO	R646
ECMA	ECMA-6
ANSI	X3.4 - 1968
US FIPS PUB	1
JIS	C6220- 1969
USSR	GOST 13052-67

Figure 5. Code Standards



# KEYTOPS

KEYTOP CROSS SECTION  
OF CHARACTER "1"



Keytops are available with the following standard shell colors:

COLOR	DESCRIPTION	CYCOLAC NUMBER
AB	BLUE	5500
BB	BLACK	4500
CB	BEIGE	82359
CD	BROWN	81040
GG	DARK GRAY	3500
GL	LIGHT GRAY	3501
GC	CHARCOAL GRAY	3502
RR	RED	6500
WA	WHITE	2500
WW	APPLIANCE WHITE	2502

Custom colors carried in stock are:

AA	AQUA BLUE	5502
AC	PASTEL BLUE	5501
AE	IBM BLUE	50433
AG	HORIZON BLUE	52257
CA	BROWN	8502
CC	TAN	8500
CE	BROWN	80552
CF	DARK BROWN	83177
DA	LIGHT GREEN	9502
DG	DARK GREEN	9500
GA, GB	GRAY	30553, 31167
GH, GK		31023, 31022
RB	RED	60473
RA	PINK	6501
RC	RED ORANGE	70912S
RD	PUMPKIN ORANGE	70997S
WB	OFF-WHITE	20608
YA	YELLOW	7500
YB	SUNSHINE YELLOW	7502

## TWO-SHOT MOLDING:

Key Tronic's two-shot molded keytops are manufactured by two techniques--each designed to provide two-shot molded keytops at the lowest cost to the customer. Both techniques provide superior surface and character definition when compared to other molding or filling methods.

For smaller orders, the legend is engraved in the keytop shell and then the legend and base are molded; completing the keytop. For long-run economies, the legend can be tooled in the keytop shell mold. The legend and base are then molded as in the first method.

## LEGENDS:

Keytop legends are available in several different alpha, numeric and symbol sets, as well as foreign characters, in eight different languages; including the Japanese Kata Kana and most European characters.

## SIZE AND SHAPE:

Keytop sizes and shapes range from a single 3/4" square keytop to a space bar 8-7/16" in length (see reverse side).

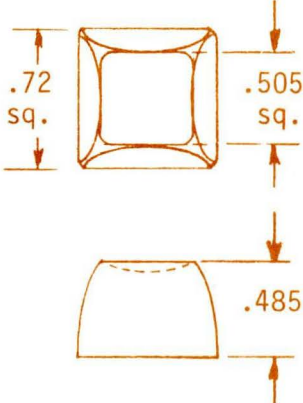
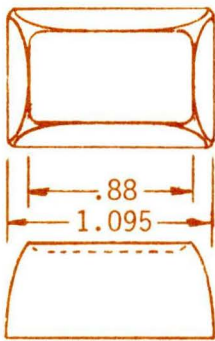
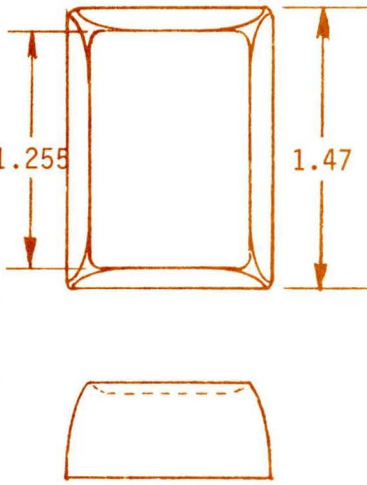
This variety of different sizes and shapes enables Key Tronic to supply most any custom configuration of keyboard that human factors construe.

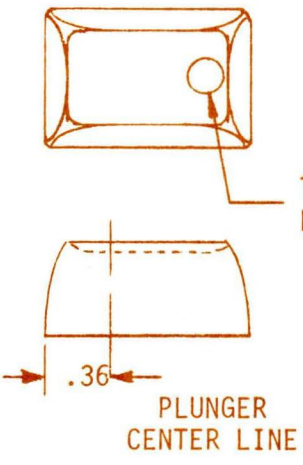
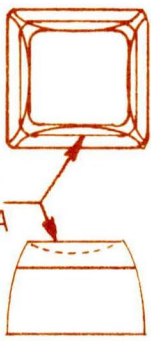
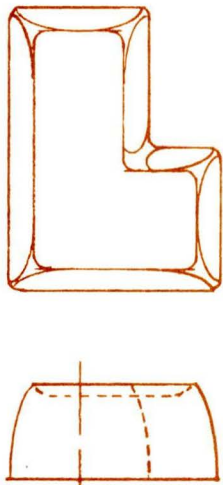
\* \* \* \*

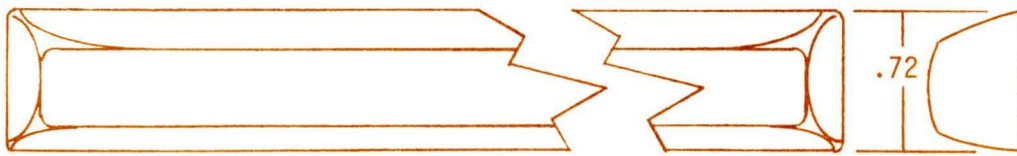
Key Tronic Staff and Representatives are available to help you select colors, legends and keytop sizes and shapes. Non-standard colors and sizes can be engineered to your specifications.

Key Tronic Corporation  
Bldg. 14, Spokane Industrial Park  
Spokane, Washington 99216  
Telephone: (509) 924-9151  
TWX: 510-773-1885

# KEYTOP SHAPES & SIZES

 <p>1 UNIT (3/4" sq.)</p> <p>Also Available As:</p> <ul style="list-style-type: none"> <li>Flattop</li> <li>Deep Dish</li> <li>Dimpled</li> </ul>	 <p>1 UNIT X 1-1/2 UNITS</p> <p>Also Available As:</p> <ul style="list-style-type: none"> <li>1 X 1-1/4</li> <li>1 X 1-3/4</li> <li>1 X 2</li> <li>1 X 2-1/4</li> <li>1 X 2-3/4</li> <li>1 X 3</li> </ul>	 <p>1-1/2 X 2 SIZE KEYTOP</p>
--	--	---

 <p>TRANSLUCENT LIGHTED AREA</p> <p>PLUNGER CENTER LINE</p> <p>1-1/2 Size Right Offset, Lighted Target Available: 2 Units Wide 1-1/2 Units Left Offset,</p>	 <p>3/4 SQ. TOP LIGHTED</p> <p>Also Available:</p> <ul style="list-style-type: none"> <li>2 Units Wide</li> </ul>	 <p>1-1/2 X 2 L-SHAPE KEYTOP</p> <p>Also Available:</p> <ul style="list-style-type: none"> <li>1-1/3 x 2 L-SHAPE KEYTOP</li> <li>1-1/4 x 2 L-SHAPE KEYTOP</li> </ul>
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SPACE BARS Available in lengths of:  
2-1/4, 3, 6, 6-3/4, 7-1/2, and 8-7/16".



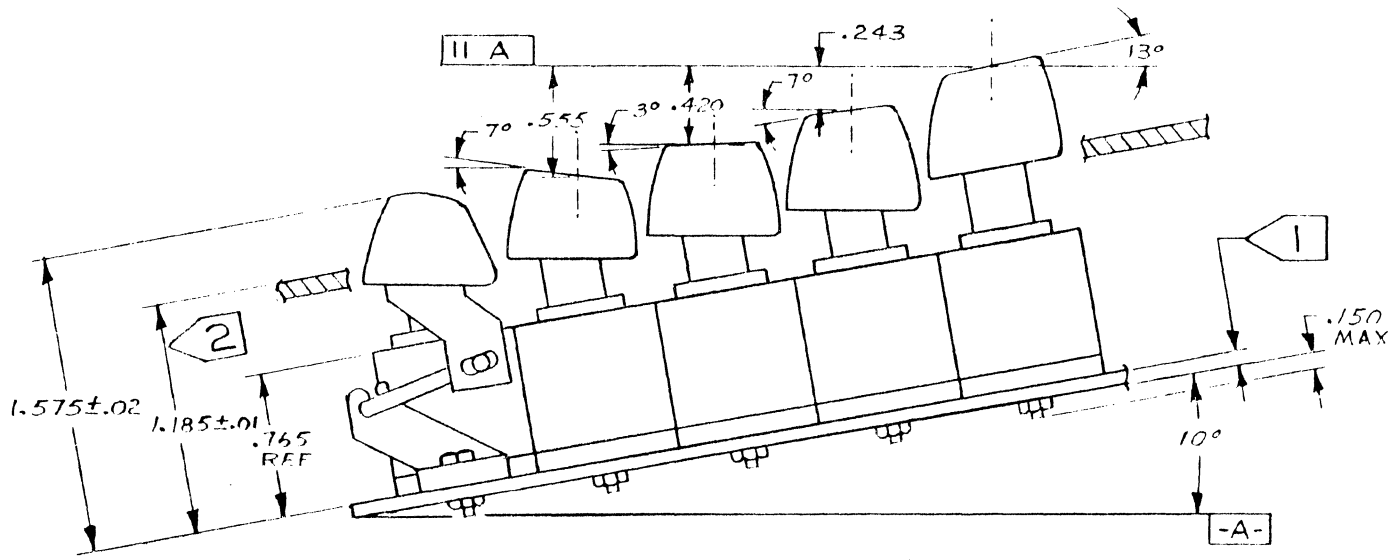
Keytops used on Key Tronic keyboards are molded in a variety of colors utilizing the material ABS (acrylonitrile, butadiene, styrene). All keytops, whether or not a short prototype run or a large production run, are two-shot molded to the highest appearance standard in the industry. Methods such as hot stamping are not used due to the inferior quality of the legend produced and the dirt gathering properties that are inherent in such a method.

Key Tronic keytops are fitted to the switch assembly by means of a patented snap-on/snap-off mechanism. This mounting method also allows one keytop to be used on both stepped and sloped keyboards using the same components.

A variety of shapes and sizes exist with regard to Key Tronic standard keytops ranging anywhere from a single size (3/4" square keytop) to a space bar 8-7/16" long. The keytops ranging between these two extremes are made up of a variety of "L" shapes, multiple key units, stepped keytops, etc. Also available, is a complete line of sculptured keytops.

Key Tronic Corporation offers one of the most extensive keytop legend libraries available, with complete sets of ASCII, 029 style and text editing keytops. Also hard tooled, are languages ranging from the Japanese Kata Kana to Hebrew to Scandinavian language sets. This legend library is by no means the extent of our ability; however, custom keytops with legends only limited by the physical size of the keytop and your imagination can be engraved and two-shot molded for your requirements.

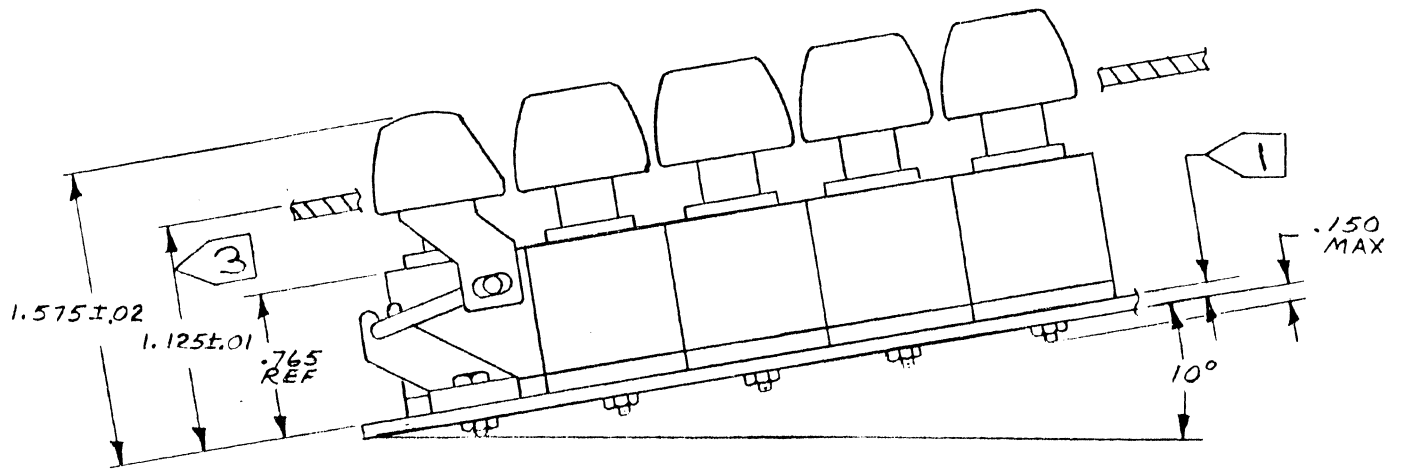




NOTE:


- 1. PCB THICKNESS FROM .062 TO .125
- 2. RECOMMENDED CLEARANCE BETWEEN EDGE OF .720 SQ. KEYTOP & EDGE OF PANEL IS .050

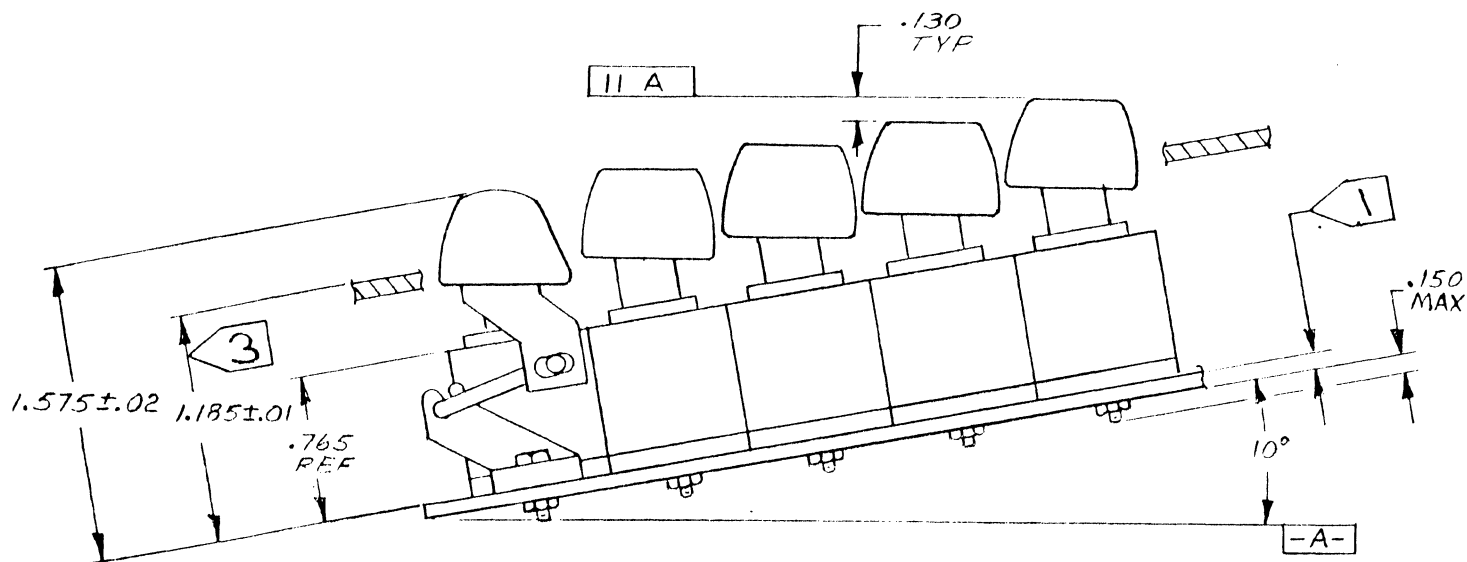
SCALE		TITLE PROFILE & RECOMMENDED PANEL HEIGHT FOR SCULPTURED KYBD	
A	ECO# 433	10-3 73	key tronic corporation
REV.	DESCRIPTION	APP.	DATE
		SPOKANE, WASH. U.S.A.	
		DR. <i>DB</i>	DATE 6/20/73
		APP. <i>DA</i>	DATE 6/25/73
		DWG. NO. 98-0019	
		SHEET 1 OF 1	A



NOTES:

- 1. PCB THICKNESS FROM .062 TO .125
- 2. RECOMMENDED CLEARANCE BETWEEN EDGE OF .720 SQ. KEYTOP & EDGE OF PANEL IS .050
- 3. RECOMMENDED PANEL HEIGHT 1.155 FOR SLOPED & STEPPED IN SAME MOUNTING FRAME

SCALE		TITLE PROFILE & RECOMMENDED PANEL HEIGHT FOR SLOPED KYBD	
B	ECO# 434	JA	10-3 73
A	CHG 1.185 TO 1.125	DA	6/24/73
REV.	DESCRIPTION	APP.	DATE
 <b>key tronic corporation</b> SPOKANE, WASH. U.S.A.		DR. (B)	DATE 6/20/73
		APP. JAL	DATE 6/25/73
		DWG. NO. 98-0020	
		SHEET 1 OF 1	<b>A</b>



NOTES:

- ① PCB THICKNESS FROM .062 TO .125
- 2. RECOMMENDED CLEARANCE BETWEEN EDGE OF .720 SQ. KEYTOP & EDGE OF PANEL IS .050
- ③ RECOMMENDED PANEL HEIGHT 1.155 FOR SLOPED & STEPPED IN SAME MOUNTING FRAME

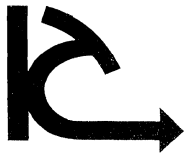
SCALE ~ TITLE PROFILE & RECOMMENDED PANEL HEIGHT FOR STEPPED KYBD

A	ECO # 434	10-3	73
REV.	DESCRIPTION	APP.	DATE



DR. (D)	DATE 6/21/3
APP. (A)	DATE 6/25/3
DWG. NO. 98-0021	

SHEET 1 OF 1 **A**



## QUALITY AND RELIABILITY

- A. Design
- B. Prototype
- C. Testing and Incoming Inspection

### A. DESIGN

Quality and reliability start with customer specifications and Key Tronic Engineering. Our engineers have designed over 1,000 keyboards in just four years. This means in-depth experience in keyboard knowledge of functions and human factors. This also means experience in using parts and knowing what works and what doesn't. Reliability begins at design.

### B. PROTOTYPE

The purpose of prototyping is to build one unit to specifications for Key Tronic and customer engineering check out before manufacturing in quantity. It is very important to check out mechanical fit, electronic interfacing, encoding, timing, signal levels, special electronic functions, legends, colors, etc. This is the opportunity for the customer to check his specifications with an operational keyboard in his system.

A prototype can be designed and built quicker, easier and more accurately with good specifications (refer to Key Tronic Corporation's "Design" section). We have built keyboards from information penciled on the back of an old envelope. However, formal specifications, using our Key Tronic Corporation "Design Package," will answer questions, save time and save cost to our customer.

### C. TESTING AND INCOMING INSPECTION

Each manufacturing person at Key Tronic is his own inspector. He visually reviews and tests each component. In addition, Quality Control stations have been established at various points in the process to inspect and test each and every keyboard as it passes.

Critical items, such as the reed, are tested in incoming inspection and again, in process. Each lot is sampled for visual and life testing to 100,000,000 cycles before commitment to production.



QUALITY AND RELIABILITY  
C. Testing and Incoming  
Inspection  
D. Reliability

Printed circuit boards are inspected to the Institute of Printed Circuit Boards (IPC) standards. There are in-process, as well as, final Quality Control stations. A chemistry laboratory maintains daily surveillance on all chemical tanks. Mechanical gauging and templates are regularly checked for wear and accuracy.

In the Assembly area, printed circuit board loading and soldering inspection are 100 percent.

Each switch is manufactured, inspected and tested as it is fabricated and again when installed on the keyboard by Manufacturing. Quality Control testing then checks each switch for pretravel of  $0.100 \pm 0.035$ " and also for contact resistance as soldered in place.

Electronic keyboards are tested twice to Factory Test Procedures, once before a 24-hour power-on burn-in and afterward. These procedures were written by Engineering from customer specifications at the time the prototype was designed. Copies of the Test Procedures go to the customer for review with the prototype.

A final inspection is made on each keyboard before it is packed to assure overall integrity.

D. RELIABILITY

Reliability testing and analysis has been performed on all components used in Key Tronic keyboards. Examples of three Mean Time Before Failure (MTBF) calculations are shown on the following pages.

Mean Cycles Before Failure (MCBF) for the reed have been calculated from field data to be  $1.4 \times 10^9$  cycles.

#### 1. ELECTRONIC KEYBOARDS MTBF

The following Mean Time Before Failure (MTBF) calculation is for a typical keyboard with 75 keys and fully encoded. Both a TTL and MOS solution are shown. Please note, we use standard MIL-SPECS or commercial data information in our figures. The data for the Key Tronic switch has been derated by a factor of 10 to be conservative.

<u>Description</u>	<u>%/1000 Hours</u>	<u>Source</u>
diodes	.002	MIL-HDBK-217A
¼ watt resistors	.002	MIL-HDBK-217A
ceramic capacitors	.0005	MIL-HDBK-217A
tantalum capacitors	.0023	MIL-HDBK-217A
film capacitors	.001	MIL-HDBK
TTL I/Cs	.100 (60% C.L.)	National Semiconductor
DTL I/Cs	.100 (60% C.L.)	National Semiconductor
MOS encoder	.400 (60% C.L.)	estimated
MOS clock	.300 (60% C.L.)	estimated
solder joints	.00057	MIL-HDBK-217A
reeds	.006%/10 <sup>6</sup> cycles	Key Tronic Qualifying Test Data
switch mechanism	0.001%/10 <sup>6</sup> cycles	Key Tronic Test Data

Switch Calculation

$$\begin{aligned}
 \text{switch mechanism} &= 0.01\% \text{ failure}/10^6 \text{ cycles} \\
 \text{reed} &= 0.06\% \text{ failure}/10^6 \text{ cycles} \\
 \text{switch} &= 0.07\% \text{ failure}/10^6 \text{ cycles} \\
 &\text{or } 1,428 \times 10^6 \text{ cycles} \\
 \text{keying rates} &= 8000 \text{ hours} \times \frac{60 \text{ minutes}}{\text{hour}} \times \frac{300 \text{ strokes}}{\text{minute}} \\
 &= 144 \times 10^6 \text{ cycles} \\
 \text{strokes per hour} &= \frac{300 \text{ strokes}}{\text{minute}} \times \frac{60 \text{ minutes}}{\text{hour}} \\
 &= 1.8 \times 10^4 \frac{\text{strokes}}{\text{hour}} \\
 \text{switch failure} &= 0.07\% \frac{\text{failure}}{10^6 \text{ strokes}} \times 1.8 \times 10^4 \frac{\text{strokes}}{\text{hours}} \\
 &= 1.3\% \frac{\text{failure}}{1000 \text{ hours}}
 \end{aligned}$$

(a) Electronic Calculation (TTL)

<u>Description</u>	<u>Estimated No.</u>	<u>No. X F/R</u> <u>(%/1000 Hrs.)</u>
diodes	10	0.02
resistors	30	0.060
ceramic capacitors	4	0.002
tantalum capacitors	2	0.0046
film capacitors	4	0.004
TTL and DTL I/Cs	21	2.10
soldering	550	<u>0.0330</u>
		2.5206

MTBF

switch failure: 1.3% failure/1000 hours  
 electronics: 2.52% failure/1000 hours  
 keyboard failure: 3.82% failure/1000 hours  
 MTBF=  $\frac{1000 \text{ hrs.}}{0.0382}$  = 25,000 hours

(b) Electronic Calculation (MOS)

<u>Description</u>	<u>Estimated No.</u>	<u>No. X F/R (%/1000 Hrs.)</u>
diodes	75	0.150
resistors	15	0.030
ceramic capacitors	6	0.003
tantalum capacitors	3	0.007
film capacitors	2	0.002
TTL	5	0.500
MOS encoder	1	0.400
MOS clock	1	0.300
solder joints	547	0.312
		<u>1.804</u>

MTBF

switch failure: 1.3% failure/1000 hours  
 electronics: 1.8% failure/1000 hours  
 keyboard failure: 3.1% failure/1000 hours  
 MTBF=  $\frac{1000 \text{ hours}}{0.031}$  = 32,000 hours

2. WIRED ONLY KEYBOARD (MTBF)

The following Mean Time Before Failure (MTBF) calculation is for a typical keyboard with 75 keys and no electronics. Please note, we use



standard MIL-SPECs or commercial data information in our figures. The data for the Key Tronic switch have been derated by a factor of 10 to be conservative.

<u>Description</u>	<u>%/1000 Hours</u>	<u>Source</u>
solder joints	.00057	MIL-HDBK-217A
reeds	.06%/10 <sup>6</sup> cycles	Key Tronic Qualifying Test Data. Actual results derated by factor of 10.
switch mechanism	.01%/10 <sup>6</sup> cycles	Key Tronic Test Data. Actual results derated by factor of 10.

#### Switch Calculation

switch mechanism= 0.01% failure/10<sup>6</sup> cycles  
 reed= 0.06% failure/10<sup>6</sup> cycles  
 switch= 0.07% failure/10<sup>6</sup> cycles  
 or 1,428 X 10<sup>6</sup> cycles - Mean Cycles Before Failure (MCBF)

keying rates= assume average usage of  $\frac{300 \text{ strokes}}{\text{minute}}$

strokes per hour=  $\frac{300 \text{ strokes}}{\text{minute}} \times \frac{60 \text{ minutes}}{\text{hour}}$

$$= 1.8 \times 10^4 \frac{\text{strokes}}{\text{hour}}$$

switch failure= 0.07%  $\frac{\text{failure}}{10^6 \text{ strokes}} \times 1.8 \times 10^4 \frac{\text{strokes}}{\text{hours}}$

$$= 1.3\% \frac{\text{failure}}{1000 \text{ hours}}$$

QUALITY AND RELIABILITY

- D. Reliability
- E. Repairability

Electrical Calculation

<u>Description</u>	<u>Estimated No.</u>	No. X F/R (%/1000 Hrs.)
solder joints (reed, etc.)	150	0.085

MTBF

switch failure: 1.3% failure/1000 hours  
electrical: 0.085% failure/1000 hours  
keyboard failure: 1.38% failure/1000 hours  
MTBF=  $\frac{1000 \text{ hrs.}}{0.0138} = 72,500 \text{ hours}$

This calculation should be considered typical. The actual requirements of your keyboard can be computed easily for you.

E. REPAIRABILITY

Even though Key Tronic designs and builds quality and reliability into its keyboards, extensive thought has been also given to their repair.

The reed can be replaced without removing the mechanical switch. Mean Time To Repair (MTTR) is two (2) minutes.

Switch mechanism replacement is about three (3) minutes.

Electronic repair is more complex. MTTR for the average electronic failure is less than thirty (30) minutes.

## KEY TRONIC FIVE-YEAR WARRANTY

- . KEY TRONIC provides a one (1) year warranty on materials and workmanship on all keyboards. (This part of our warranty is standard for the keyboard industry.)
- . IN ADDITION, . . . . KEY TRONIC will replace our standard switch at no charge in the event of failure during the following four (4) years. This gives you a full five- (5) year warranty on the switch mechanism. All you have to do is return the failed device and Key Tronic will send you a new one free! If you desire, Key Tronic will install the new switch and test the keyboard according to Factory Test Procedures at a modest charge.
- . Why is KEY TRONIC the only keyboard company to warrant its switches for five (5) years?

It's EASY . . . . Our failure rate is so low that we doubt that you will even remember we warrant it for five (5) years.

Because:

Environmental immune switch	- BUILT TO LAST.
Withstands heavy vibration and shock	- BUILT TO USE.
Rigid Quality Control standards	- BUILT WITH BEST PARTS.
Pride in our product	- BUILT BY PEOPLE WHO CARE.
Eagerness to serve	- BUILT BY PEOPLE WHO KNOW.

CONFIDENTIAL: Actually, this whole five-year warranty idea was Marketing's idea. We were doing it anyway, so why not blow our horn?!

- . What does this warranty cost?  
Compare KEY TRONIC'S prices to our best competition--we haven't raised our prices, so we must be confident of the quality and reliability built into our product.

What do you save?

If KEY TRONIC can warrant switches for five (5) years, you know you are going to save. We design for more than clean-room environment operations and "feather" typists. This is why you save because you know you are going to get a switch that lasts.

Look around! Chances are, you are going to encounter what we call the "18- to 25-month switch contact failure syndrome." This means, you start your service calls beginning 18 months from receipt of shipment and your service technicians become switch replacement experts.

Assume: Mean Time Before Failure (MTBF)= 18 months  
Assume: Five (5) years' usage

Forget: Mean Cycles Before Failure (MCBF) . . . .

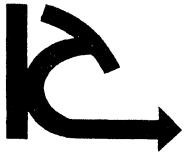
- Because:
1. Many switches fail less if you exercise them more.
  2. It's cycled in a clean room, anyway.

Therefore: That keyboard will cost you \$99.90\* (i.e., [3.33 field calls] at [\$30/call]) after 3.33 service calls AND the purchase price is less than the maintenance costs.

\*assuming only one (1) switch fails every 18 months.

If any or all of the above does not seem clear, call us . . . . .  
(509) 928-3850!





# MAINTENANCE REED-FIELD REPLACEMENT

## key tronic keyboards

One advantage in purchasing a Key Tronic keyboard is that it can be repaired in the field. The following description tells how these repairs can be made.

### Replacement of Reeds

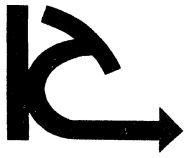
Faulty reed operation is normally easily identifiable and falls into one of the following cases which are listed in the order of most frequent occurrence:

1. High-contact resistance or completely open circuit. The reed still has a mechanical clicking sound when operated but does not close the circuit.
2. Intermittently high-contact resistance. The reed sometimes works and, if hit hard, may begin working correctly for a short period of time.
3. Contact bounce or noisy reed switches may cause multiple printouts.
4. Reed contacts stuck in a closed position. Depending on the electronic, it would give a character corresponding to the closed key and inhibit all others because of the two-key rollover electronics.

If it is possible to check the keyboard when electrically connected, a quick check of the switch in question is to short across the reed connections on the circuit board with a paper clip or a short wire to verify that the problem is at the reed capsule. The reed can also be checked with an ohmmeter when it is electrically disconnected from the system.

### REED REPLACEMENT PROCEDURE:

After verifying which reed is faulty, remove the keyboard from the unit and place it upside down on a protective pad. Remove solder around faulty reed leads using a "solder wick," and then carefully pull the reed out of the hole in the printed circuit board noting the location of the pad that the reed switch lead was soldered to.



# MAINTENANCE REED-FIELD REPLACEMENT

## key tronic keyboards

Carefully install the new reed through the hole in the printed circuit board with the reed switch lead located over above noted pad (see figure 1). Do not force reed; if resistance is encountered, rotate reed until it drops in. Resolder both connections.

Check operation of keyboard.

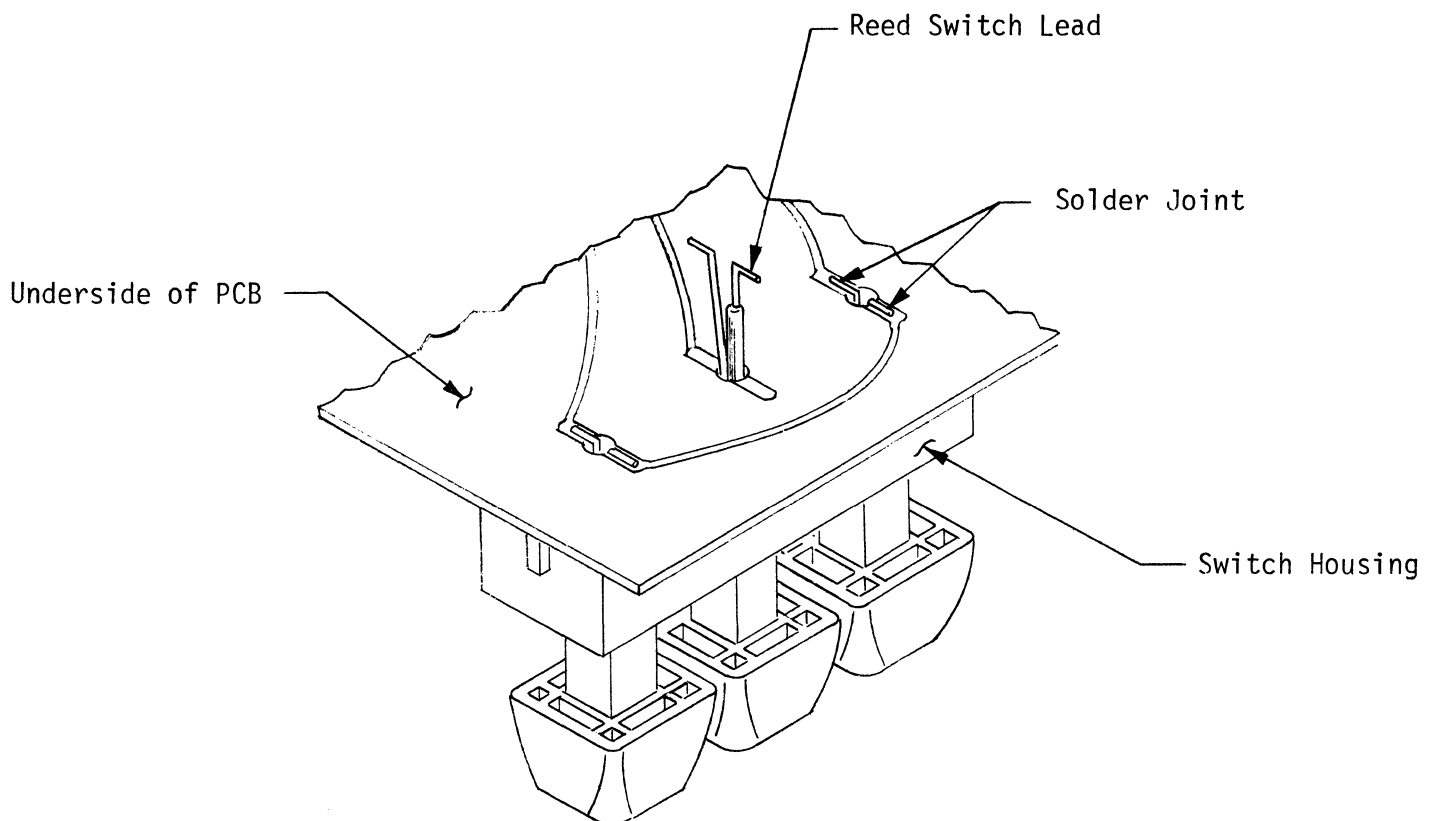


FIGURE 1