



## AT-84

IBM® Plug Compatible  
Keyboards



# Keyboard Specifications

These specifications are subject to change without notice

# AT-84

## (AT OUTPUT)

### 1.0 SCOPE

This document is a product specification for defining HI-TEK's AT-84 IBM® plug compatible keyboards. This document defines part number 112083-001 (AT-84 with IBM AT code output).

HI-TEK also offers an AT-84 keyboard with IBM PC output codes. Please see Appendix for electronic specifications of this keyboard which differ from the AT-84 with AT output codes.

The AT-84 is designed to meet the low profile DIN standards.

### 2.0 MECHANICAL

#### 2.1 Outline dimensions

##### 2.1.1 AT-84 keyboard. Figure 1.

#### 2.2 Array configuration

##### 2.2.1 Keyboard keycap and character layout. Figure 2.

#### 2.3 Materials

##### 2.3.1 Enclosure — top piece

Injection molded thermoplastic. UL flammability rating 94 HB.

##### 2.3.2 Enclosure — bottom piece

Injection molded thermoplastic. UL flammability rating 94 HB.

##### 2.3.3 Keycaps

Polyester thermoplastic. UL flammability rating 94 HB.

##### 2.3.4 Printed circuit board

.062 thick CEM-1 with 1 oz. copper on both sides. UL flammability rating 94 VO.

##### 2.3.5 Switch housing

Molded thermoplastic. UL flammability rating 94 VO.

##### 2.3.6 Switch plunger

Molded acetal thermoplastic. UL flammability rating 94 HB.

##### 2.3.7 Spring

302 or 304 stainless steel.

##### 2.3.8 Contacts

Spring temper copper alloy with gold alloy inlay.

##### 2.3.9 Stiffener panel

Cold rolled steel.

#### 2.4 Finishes

##### 2.4.1 Enclosure (top and bottom)

Injection molded enclosure. Textured per Mold Tech #MT 1170 — color similar to Sherwin Williams Polane Driftwood F63A40.

##### 2.4.2 Spring

Non-metallic coating.

##### 2.4.3 Stiffener panel

Painted with semi-gloss black enamel, epoxy or urethane based paint.

##### 2.4.4 Keycap colors

Functional keys — Gray

HI-TEK color code: 890 (similar to Borg Warner color T33309).

Data keys — White

HI-TEK color code: 880 (similar to Borg Warner color T22061).

Nomenclature (legend) color — Black

HI-TEK color code: 010 (similar to Borg Warner color T4500).

##### 2.4.5 Keycap top texture

Mold Tech #MT1055-3.

- 2.5 Individual switch specifications
  - 2.5.1 Keyswitch movement (total travel)  
.140 ± .020 inch (3.56 ± .5mm).
  - 2.5.2 Operating movement (travel to make)  
.070 ± .020 inch (1.78 ± .5mm).
  - 2.5.3 Operating force
    - Linear feel:
      - 2.5.3.1 Momentary action 2.0 ± .5 oz. (57.1 ± 14.2 grams).
      - 2.5.3.2 Space bar 3.0 ± .5 oz. (85.6 ± 14.2 grams).
    - Tactile feel:
      - 2.5.3.3 Momentary action 2.3 ± .5 oz. (65.2 ± 14.2 grams).
      - 2.5.3.4 Space bar 3.0 ± .5 oz. (85.6 ± 14.2 grams).
  - 2.5.4 Feel  
Basic switch has either linear or tactile feel.
  - 2.5.5 Wobble  
Lateral movement will not exceed .020 inch (.5mm) in either axis.
  - 2.5.6 Life  
100 million cycles.
- 2.6 Legends  
Helvetica — .180 inch high.  
Helvetica Rounded — .100 inch high.  
Sublimation printed. Black color.
- 2.7 Keycap positioning  
All 1x1 Keycaps are on .75 inch centers in both horizontal and vertical directions. See Figure 3.
- 2.8 Keycap dimensions  
The dimensions of a keycap depend upon its location on the keyboard. See chart below Figure 3.

### 3.0 FUNCTIONAL

- 3.1 Auto repeat  
All keys on the keyboard are typematic (i.e. they will output down scan codes at some rate when held down for a certain period of time). The delay time and rate can be controlled by the system (see 3.10 System Command Set). The default typematic rate is 10 characters per second and the delay is .5 second.
- 3.2 Locking functions  
The following keys have LED indicators to indicate the mode of the keyboard. These LED indicators are controlled by the system. (See 3.10 System Command Set).
  - A. Num Lock
  - B. Caps Lock
  - C. Scroll Lock
- 3.3 N-Key rollover  
The keyboard features N-key rollover. If keys are sequentially depressed the keys will be processed in the order of depression regardless of the number of keys held down. The keyswitches are electrically connected in a x-y matrix as shown in Figure 4.
- 3.4 Software debounce  
Multiple entries due to contact bounce is avoided. This task is accomplished by the internal 8049 or 8749 microprocessor under firmware control.
- 3.5 Buffering  
The keyboard can buffer 16 keys when the system is not able to receive scan codes from the keyboard. The keystrokes are stored in a first-in-first-out (FIFO) buffer. The 17th position of the buffer is used to indicate an overrun. The overrun code is Hex00 which indicates that data may have been lost.
- 3.6 Input-output data logic level  
Data input and output is standard TTL logic level. Output will drive 3 standard TTL loads. Input loading is 1000 ohms (see Figure 5).



### 3.7 Power on reset

When power is first applied to the keyboard the keyboard does a power on reset by pulling the reset line on the microprocessor low for approximately 5 seconds. Then the microprocessor does a Basic Assurance Test (BAT). This test consists of the following:

- 1) ROM sum
- 2) RAM test

After the BAT is completed and the system is ready to receive data (both clock line and data lines are high), the keyboard outputs an AA if the BAT test has been passed. Any code other than an AA or no code indicates a keyboard failure.

After the BAT test is completed the keyboard resets the LED indicators, clears the buffer, sets default states and is ready to receive or send data to the system.

### 3.8 Output code

Each time a key is depressed or released, the keyboard transmits a scan code to the computer.

The keys on the keyboard are assigned arbitrary key position numbers as shown in Figure 6. These numbers are for reference only and DO NOT appear on the keycaps of the keyboard.

When a key is depressed, the keyboard outputs a scan code corresponding to the key position number. Scan codes for the AT-84 with AT output codes are shown in Figure 7.

### 3.9 Timing diagram

The keyboard data and clock timing diagram is illustrated in Figure 8.

### 3.10 Commands from system

Command set.

The keyboard is capable of receiving commands from the system. The following is a brief description of the Keyboard responses to the given commands.

Command	Code	Keyboard response
Reset	0FFH	When the keyboard receives this command it will respond with an ACK code (0FAH) and then will perform a BAT as described in paragraph 3.7.
Resend	0FEH	When this command is received the keyboard will resend the previous code.
Set/Reset Mode Indicators	0EDH	This is a two byte code. The first byte is a 0EDH code. The keyboard responds to this command byte with an ACK (0FAH) and discontinues scanning and waits for the second byte.  The second byte determines the state of the LED indicators. Bit 0* = Scroll Lock Bit 1* = Numeric Lock Bit 2* = Caps Lock  The keyboard sets the LED's to their new state then sends an ACK (0FAH) back to the system and begins to scan the keyboard. *“1” equals “on.”
Echo	0EEH	When this command is received the keyboard responds with a 0EEH code.
Set Default	0F6H	The keyboard sends ACK (0FAH) back to the system, resets buffers, sets all default states and continues to scan the keyboard.
Default Disable	(0F5H)	Same as default but disables keyboard scan.
Enable	(0F4H)	Keyboard responds to the system with ACK (0FAH), clears buffer and starts scanning.
Set Typematic Rate	0F3H	The typematic rate and delay is controlled by the system. The typematic command is a two byte command. The typematic rate and delay is determined by the value of the byte following a 0F3H byte. The rate and delay is determined by the value of this byte as follows. Bits 5 and 6 of this byte determines the amount of delay. Bits 0-4 determine the rate. The delay can be programmed to be between 250 milliseconds and 1 second. The repeat rate can be programmed between .2 to 30 hertz.  When the keyboard receives a set typematic rate command 0F3H it sends an ACK (0FAH) back to the system, stops scanning and waits for the set rate/delay byte. When this byte is received the keyboard sets the new rate/delay, sends an ACK back to the system and continues to scan.



### 3.11 Commands from keyboard

The keyboard can issue the following commands to the system:

Command	Code	Function
Resend	0FEH	The keyboard will send this command to the system when it receives an invalid input.
ACK	0FAH	The keyboard responds with an ACK code to any command from the system other than Echo or Resend.
Overrun	000H	This hex code is placed in the 17th position of the buffer and indicates that data has possibly been lost.
BAT Completion	0AAH	This code is sent to the system when the BAT has been successfully completed.
Echo Response	0EEH	This command is sent to the system in response to Echo command.

### 3.12 Keyboard — system handshaking

When the keyboard has data to send to the system it checks both the data and clock lines. If the clock line is low (data inhibit) the keyboard buffers all data (see keyboard buffer section). If the data line is low the system wants to send data to the keyboard. The keyboard buffers data and begins generating a clock in order to accept system data. If both the clock line and data line are high, the keyboard begins sending data.

The keyboard interrogates the data line approximately every 3 milliseconds to see if the system has data to send to the keyboard. If the system has data to send to the keyboard, the keyboard generates a clock signal.

### 3.13 Data format

Data is transmitted to and from the keyboard in the following format:

- a) 11 bits
- b) 1st bit — start bit (always a “0”)
- c) Bits 2 thru 9 are data bits. Data bit 7 (least significant bit) is transmitted first. Data bit 0 (most significant bit) is transmitted last.
- d) Bit 10 — parity (odd)
- e) Bit 11 — stop bit (always a “1”)

## 4.0 ELECTRICAL

### 4.1 Contact system

SP ST normally open (Form A).

### 4.2 Input voltage

4.75 to 5.25 V.D.C.

### 4.3 Input current

300 milliamperes maximum.

### 4.4 Keyboard connection

The metal stiffener panel is grounded to the chassis ground which returns to host on a separate output.

See signal ground and pin output diagrams, Figures 9 and 10.

## 5.0 ENVIRONMENTAL

### 5.1 Temperature

5.1.1. Operating +32 °F to +131 °F (0 °C to +55 °C).

5.1.2 Storage: -40 °F to +149 °F <(-40 °C to +65 °C).

### 5.2 Relative humidity

0 to 95 percent.

### 5.3 Vibration

Mil-Std-810 B, Method 514, procedure x per paragraph 4.5.1.3, curve "AY" of Figure 514.1 VII. Omit resonance search and dwell. Test in three perpendicular planes. From 5-200-5 Hz for one hour in each plane.

### 5.4 Shock

A keyboard that is hard mounted in a rigid carrier which protects the keys and electrical leads shall withstand a 40 g, 1/2 sinusoidal, 10 ms duration shock in each direction along the three mutually perpendicular axis.

### 5.5 Electro-magnetic compatibility

The keyboard has been tested for and has passed the EMI requirements of a class B device. FCC rules: Part 1. Class B.

### 5.6 Electrostatic discharge

The keyboard has been tested for resistance to damage from electrostatic discharge by an independent testing agency. The keyboard withstood repeated ESD of up to 20 KV.

### 5.7 Keycap abrasion and wear resistance

Keycaps were exposed to an eraser loaded to 2 ozs. being wiped across the keycap legend. The printed keycaps were cycled in parallel with standard two shot keycaps. Deep grooves (.005") were worn on the two shot legends before there was any noticeable wear on the printed keycap legend.

### 5.8 Keycap legends — resistance to hand lotions

After extensive testing of printed keycaps exposed to hand lotion at 50 °C, it was determined that hand lotions had no adverse effects on the printed legends.

# APPENDIX

## (AT-84, PC OUTPUT)

AT-84 with PC output.

1.0 This supplement is a product specification for HI-TEK's AT-84 with IBM PC output codes. This IBM plug compatible keyboard, HI-TEK Part Number 112166-001, is designed to meet the low profile DIN standard. Any deviation from the AT-84 with AT output code specifications will be noted below.

### 3.0 FUNCTIONAL

#### 3.1 Auto repeat

When a key is pressed for .5 second or longer, the keyboard will continuously output the character at the rate of once every .09 second. The following keys do not auto repeat:

- A. Scroll Lock
- B. Caps Lock
- C. Num Lock
- D. Ctrl
- E. Shift

#### 3.2 Locking functions

The keyboard does not provide any locking features. This is function of the software in the computer. When the following keys are pressed, the corresponding LED in the keycap is alternately turned on and off each time the key is pressed and released.

- A. Num Lock
- B. Caps Lock
- C. Scroll Lock

If the CTRL key and one of the above keys are depressed simultaneously, the respective LED will not toggle. All of the LED's are turned off when the keyboard is reset by holding down CTRL, ALT and DEL keys in sequence.

#### 3.5 Buffering

The keyboard will buffer up to 16 characters if the computer is not ready to receive more information. If the computer holds the data line low, then the keyboard will store the keystrokes in its own internal buffer until the data line is brought high again. The stored key codes are then output in the correct order of entry.

#### 3.7 Power on reset

The keyboard has a self test feature. This self test feature performs the following tests:

- 1. Tests the microprocessor RAM for bad memory cells.
- 2. ROM sum check
- 3. Scans the switch matrix searching for shorted switches.

The keyboard response to the self test is as follows:

- 1. A hex code of AA is transmitted to the computer if the keyboard passes the self test feature.
- 2. If a shorted switch is detected, the scan code of the shorted switch is transmitted back to the computer.

The keyboard self test feature will be initiated when the keyboard has received the "FF" code from the computer.

#### 3.8 Output codes

Figure 11 shows the AT-84 switch layout with PC output codes. The numbers on the layout are for reference only and do not appear on the keycaps of the keyboard.

Scan codes for the AT-84 with PC output codes are shown in Figure 12.

#### 3.9 Timing diagram

The keyboard data and clock timing are illustrated in Figure 13.

#### 3.13 Data format

Data is transmitted to and from the keyboard in the following format:

- a) 10 bits
- b) 1st bit — start bit (always a "0")
- c) Bits 2 thru 9 are data bits. Data bit 7 (least significant bit) is transmitted first. Data bit 0 (most significant bit) is transmitted last.
- d) Bit 10 — stop bit (always a "1")

#### 3.14 Reset

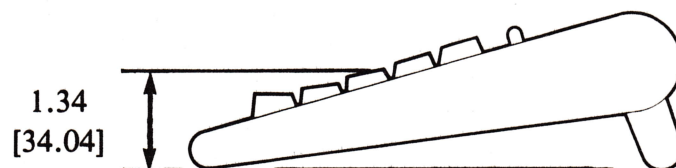
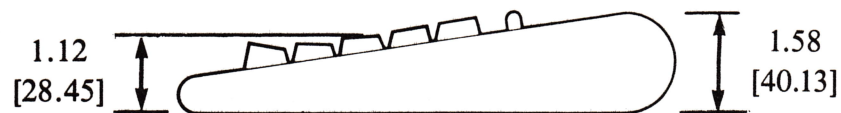
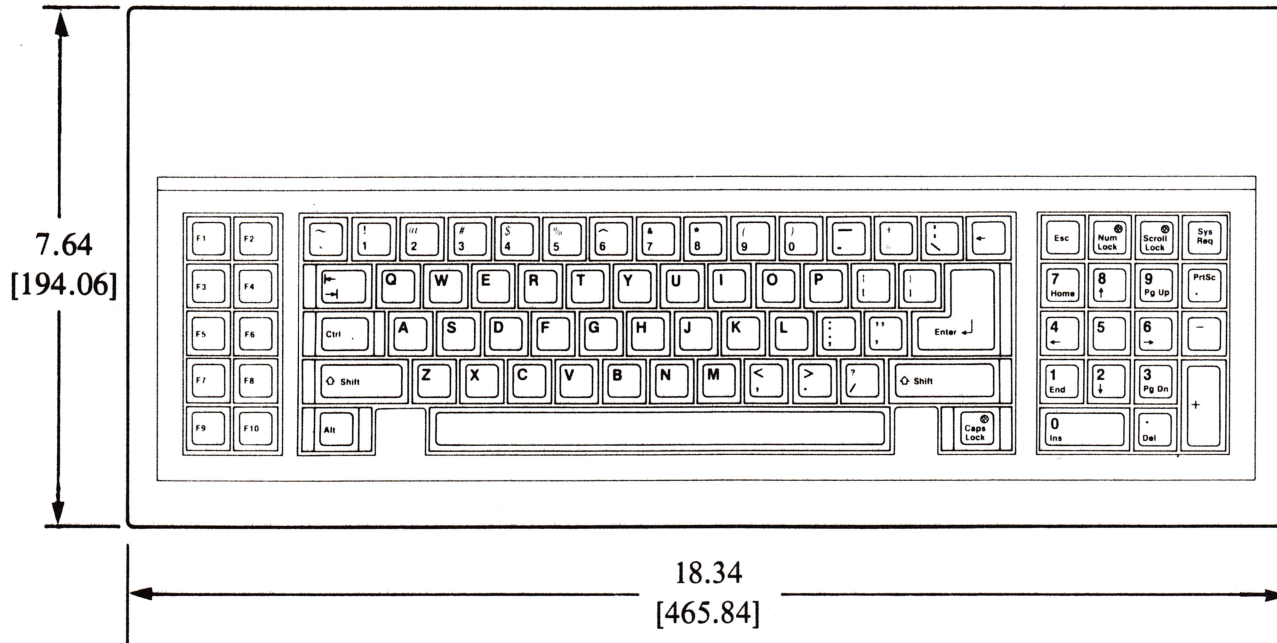
A single level of - .05 to + .6 V.D.C. on the reset line for 50 milliseconds or more will reset the keyboard.



# FIGURE 1

## OUTLINE DIMENSIONS

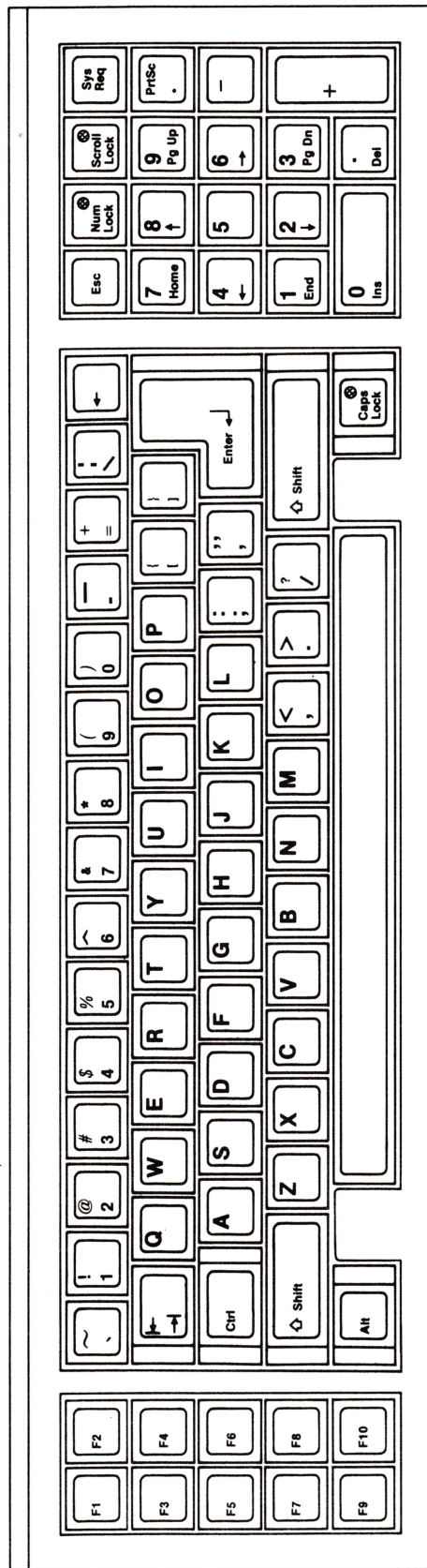
### AT-84



DIMENSIONS ARE IN INCHES  
 DIMENSION IN [ ] ARE IN MILLIMETERS

# FIGURE 2

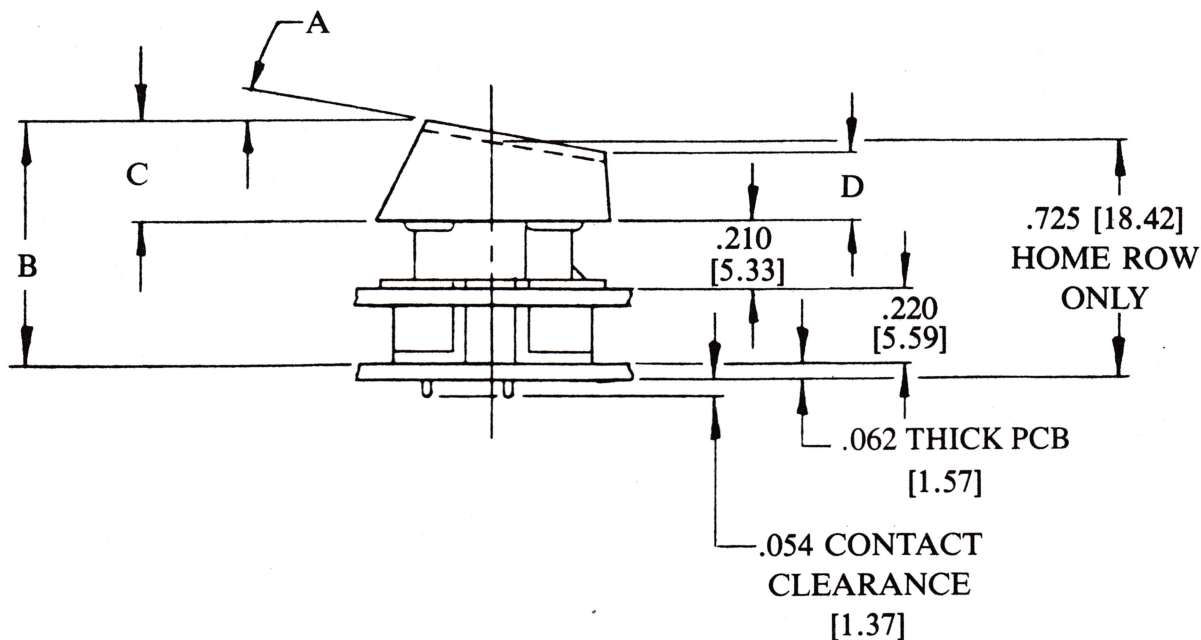
ARRAY CONFIGURATION  
AT-84



# FIGURE 3

## HI-TEK 725 SERIES KEYSWITCH DIMENSIONS

AT-84

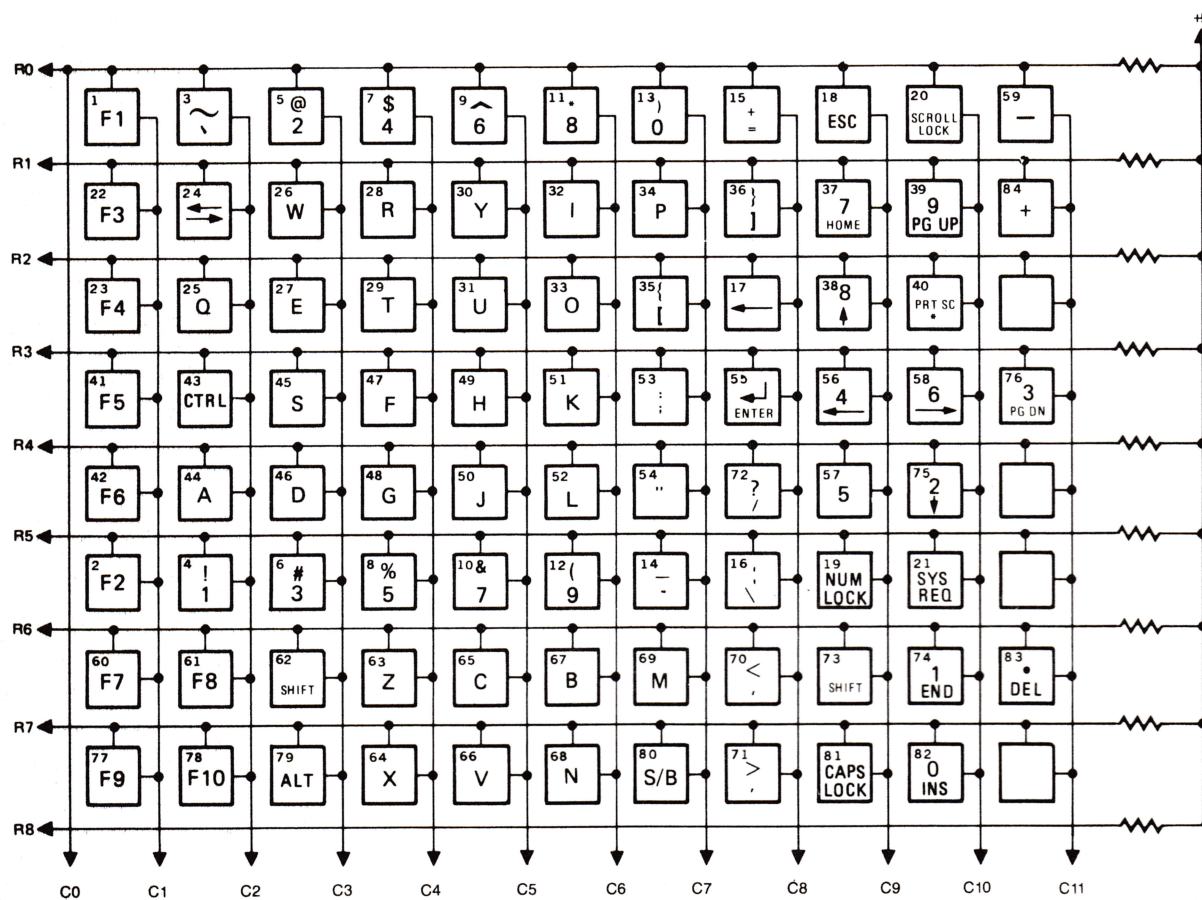


725 SERIES KEYCAPS DIMENSION TABLE					METRIC [MM]		
DIM ROW	A	B	C	D	B	C	D
S/B	18°	.825	.400	.230	20.96	10.16	5.84
1	18°	.825	.400	.230	20.96	10.16	5.84
HOME ROW 2	10°	.725	.300	.200	18.42	7.62	5.08
3	5°	.725	.300	.250	18.42	7.62	6.35
4	0°	.785	.360	.360	19.94	9.14	9.14
5	0°	.785	.360	.360	19.94	9.14	9.14

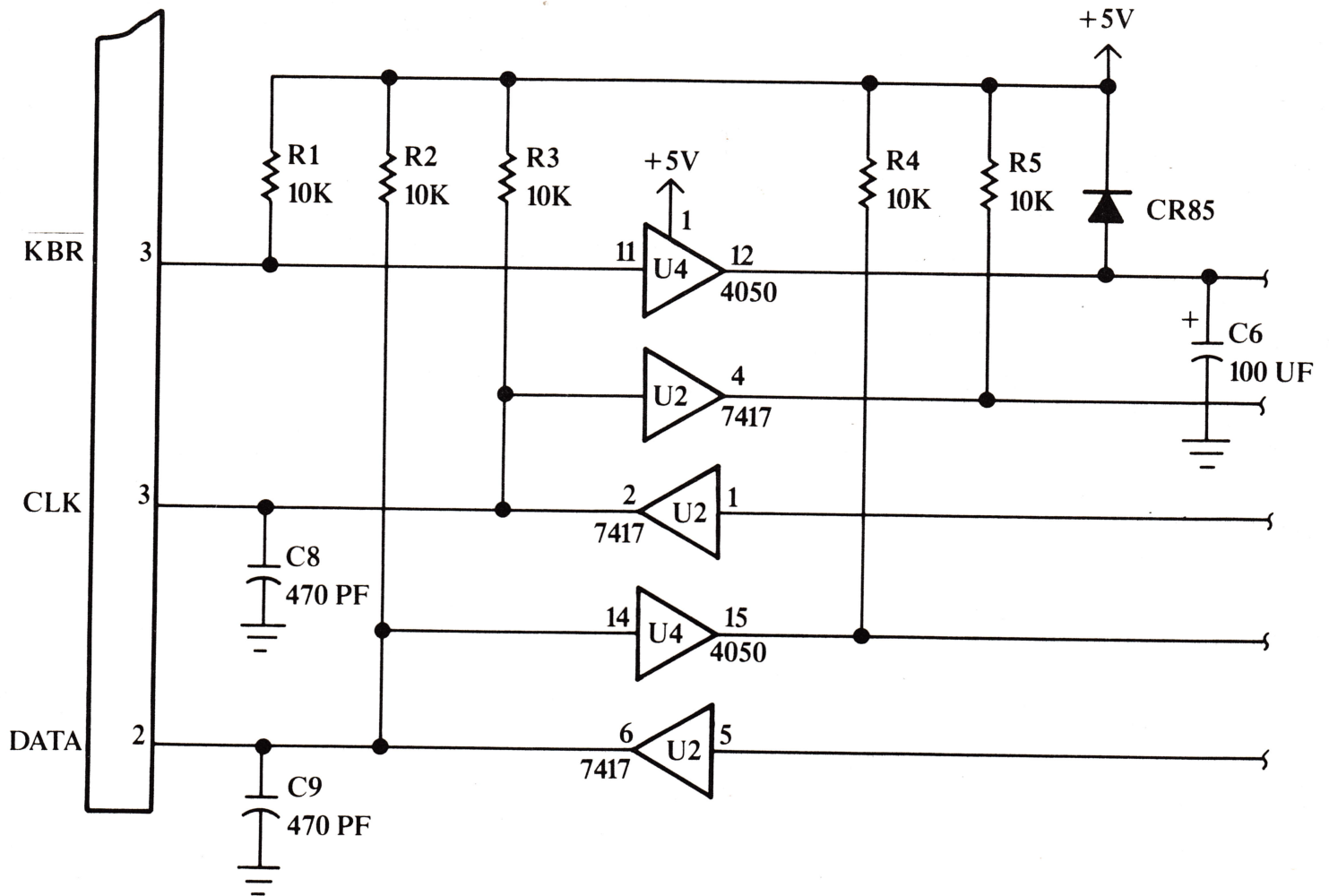
DIMENSIONS ARE IN INCHES  
 DIMENSION IN [ ] ARE IN MILLIMETERS



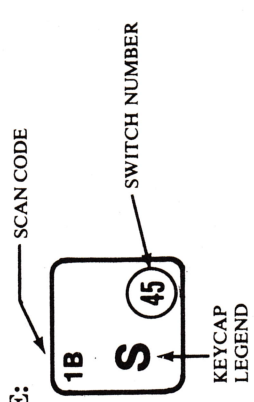
**X-Y MATRIX**  
**AT-84**



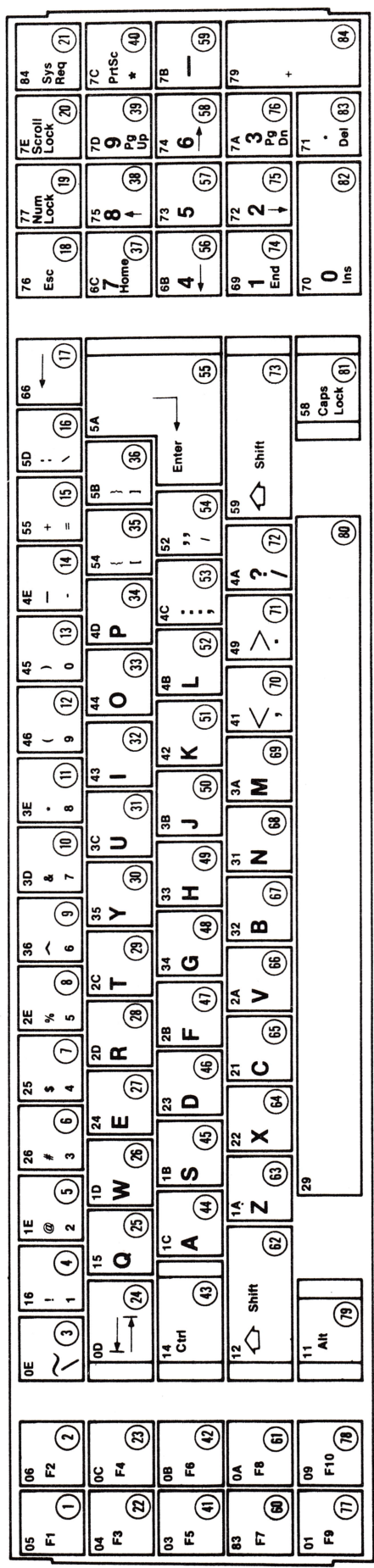
**FIGURE 5**  
INTERFACE SCHEMATIC  
AT-84



EXAMPLE:



**FIGURE 6**  
SWITCH LAYOUT  
AT-84  
(AT-OUTPUT)





# FIGURE 7

## AT-84 CODE CHART

(IBM AT-OUTPUT CODES\*)

Switch	Desig.	Down	Up*		Switch	Desig.	Down	Up*		Switch	Desig.	Down	Up*
1	F1	05			29	T	2C			57	5	73	
2	F2	06			30	Y	35			58	6 →	74	
3	- \ !	0E			31	U	3C			59	—	7B	
4	1	16			32	I	43			60	F7	83	
5	@ 2	1E			33	O	44			61	F8	0A	
6	# 3	26			34	P	4D			62	Shift	12	
7	\$ 4	25			35	{ [	54			63	Z	1A	
8	% 5	2E			36	} ]	5B			64	X	22	
9	^ 6	36			37	7 Home	6C			65	C	21	
10	& 7	3D			38	8 ↑	75			66	V	2A	
11	* 8	3E			39	9 Pg Up	7D			67	B	32	
12	( 9	46			40	Prt SC	7C			68	N	31	
13	) 0	45			41	F5	03			69	M	3A	
14	— -	4E			42	F6	0B			70	< , >	41	
15	+ =	55			43	Ctrl	14			71	.	49	
16	: \ ←	5D			44	A	1C			72	? /	4A	
17	←	66			45	S	1B			73	Shift	59	
18	ESC	76			46	D	23			74	1 End	69	
19	Num Lock	77			47	F	2B			75	2 ↓	72	
20	Scroll Lock	7E			48	G	34			76	3 Pg Dn	7A	
21	Sys Req	84			49	H	33			77	F9	01	
22	F3	04			50	J	3B			78	F10	09	
23	F4	0C			51	K	42			79	Alt	11	
24	← →	0D			52	L	4B			80	S/B	29	
25	Q	15			53	: ; *	4C			81	Caps Lock	58	
26	W	1D			54	/ /	52			82	0 Ins	70	
27	E	24			55	ENTER	5A			83	. Del	71	
28	R	2D			56	4 ←	6B			84	+	79	

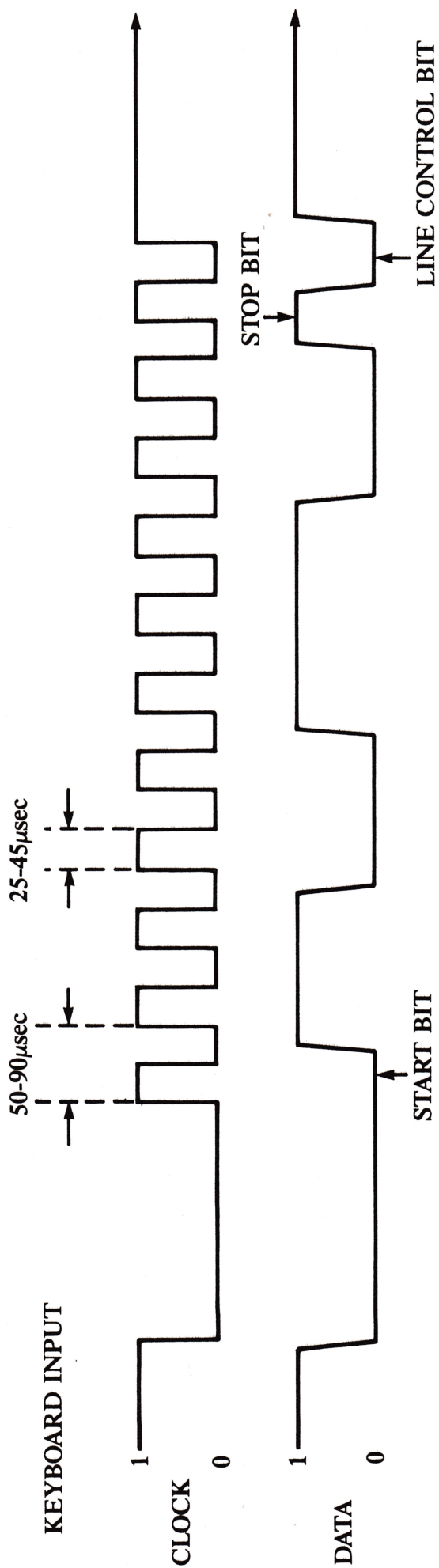
\*Note: The up code (i.e. break code) is a two byte code. The first byte is the break code prefix hex F0, followed by the second byte which is the make scan code (i.e. down code) for that key.

# FIGURE 8

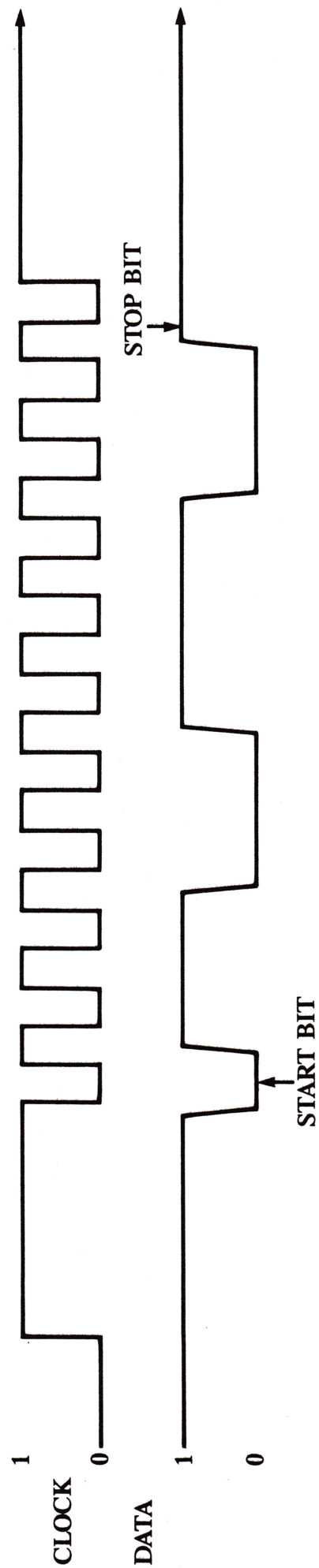
## TIMING DIAGRAM

AT-84

(AT-OUTPUT)

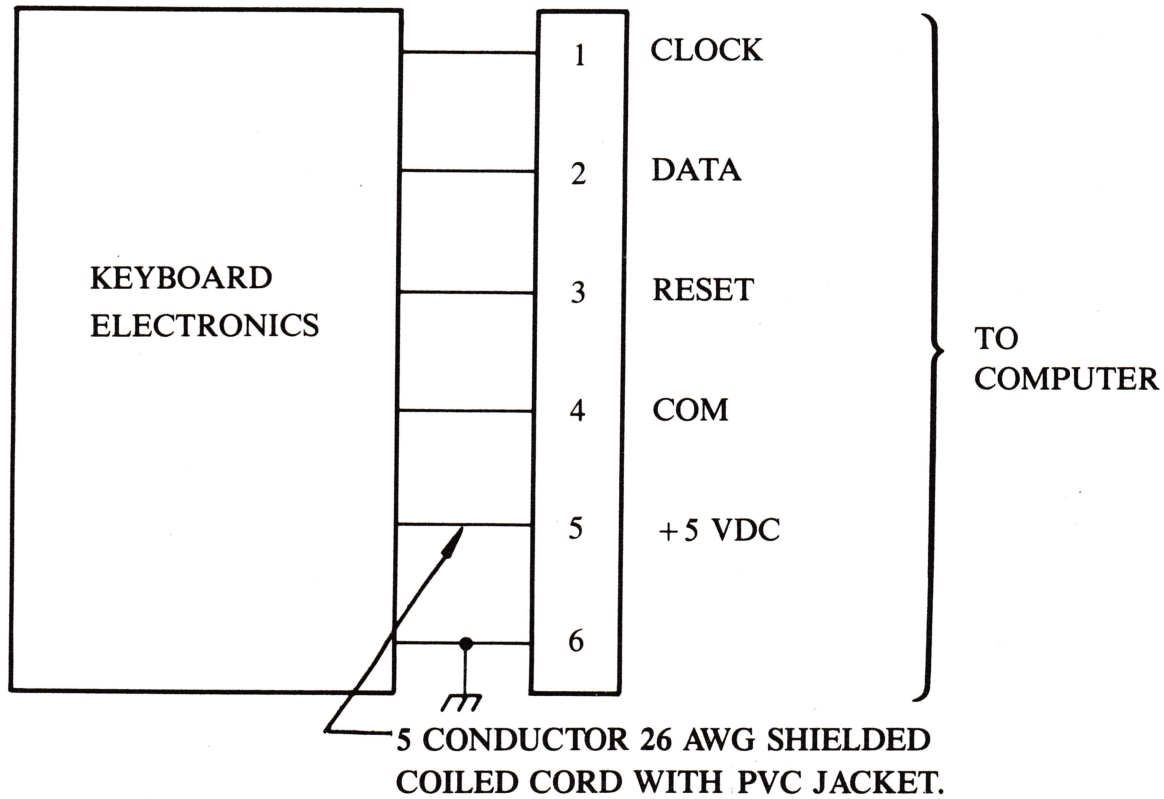


## KEYBOARD OUTPUT



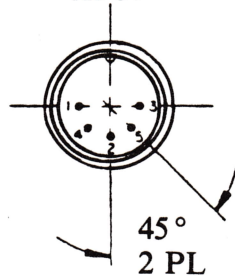
# FIGURE 9

SIGNAL OUTPUT  
AT-84



# FIGURE 10

PIN OUTPUT  
AT-84



KEYBOARD CONNECTOR TO MATE WITH DIN STYLE 5 PIN  
AT 180° FEMALE CONNECTOR.  
(REF. SWITCHCRAFT P/N 57NC5F OR EQUIVALENT)

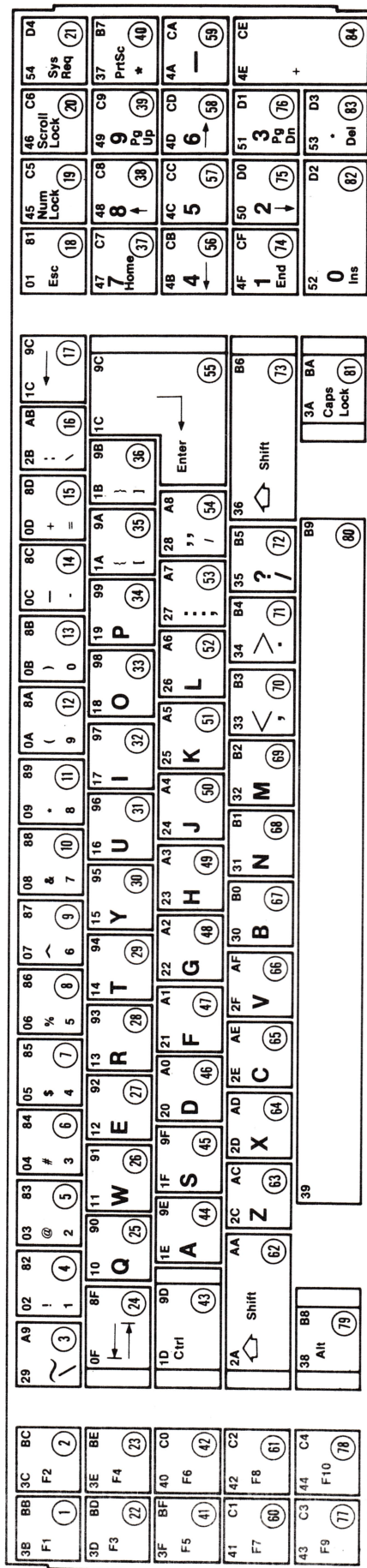
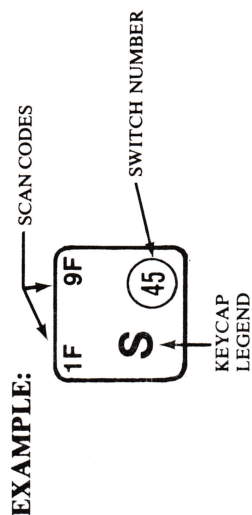


# FIGURE 11

## SWITCH LAYOUT

### AT-84

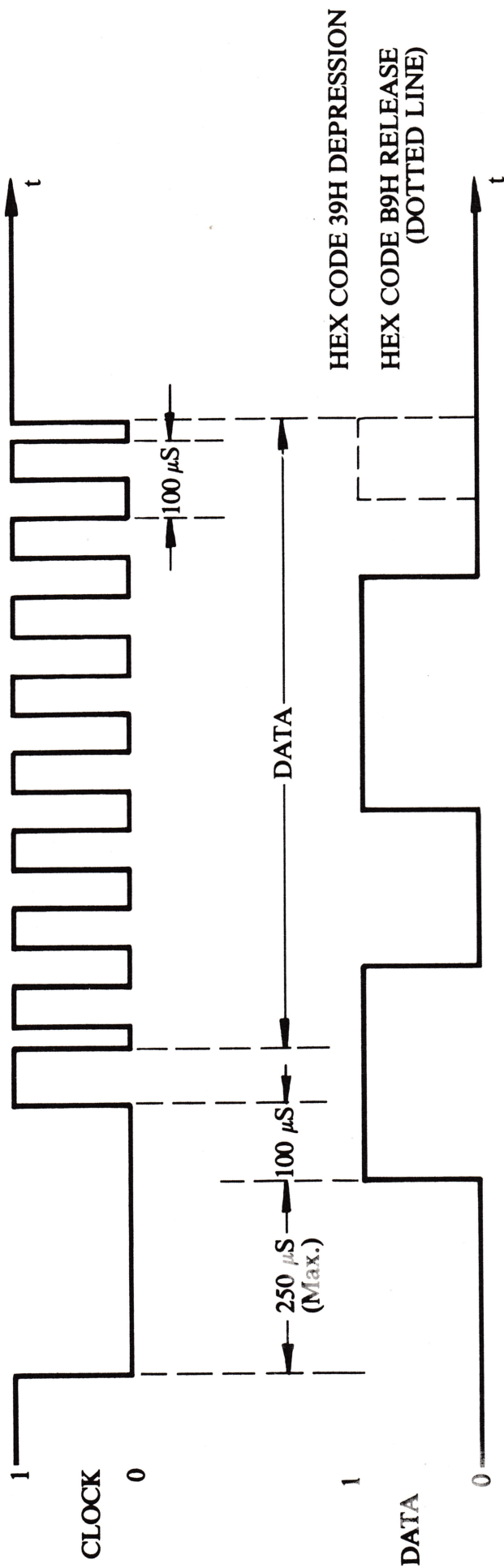
#### (PC-OUTPUT)



**FIGURE 12**  
**AT-84 CODE CHART**  
**(IBM PC-OUTPUT CODES)**

Switch	Desig.	Down	Up		Switch	Desig.	Down	Up		Switch	Desig.	Down	Up
1	F1	3B	BB		29	T	14	94		57	5	4C	CC
2	F2	3C	BC		30	Y	15	95		58	6 →	4D	CD
3	~ `	29	A9		31	U	16	96		59	—	4A	CA
4	! 1	02	82		32	I	17	97		60	F7	41	C1
5	@ 2	03	83		33	O	18	98		61	F8	42	C2
6	# 3	04	84		34	P	19	99		62	Shift	2A	AA
7	\$ 4	05	85		35	{ [	1A	9A		63	Z	2C	AC
8	% 5	06	86		36	} ]	1B	9B		64	X	2D	AD
9	^ 6	07	87		37	7 Home	47	C7		65	C	2E	AE
10	& 7	08	88		38	8 ↑	48	C8		66	V	2F	AF
11	* 8	09	89		39	9 Pg Up	49	C9		67	B	30	B0
12	( 9	0A	8A		40	Prt Sc	37	B7		68	N	31	B1
13	) 0	0B	8B		41	F5	3F	BF		69	M	32	B2
14	— -	0C	8C		42	F6	40	C0		70	< ,	33	B3
15	+ =	0D	8D		43	Ctrl	1D	9D		71	> .	34	B4
16	: \ 	2B	AB		44	A	1E	9E		72	? /	35	B5
17	←	1C	9C		45	S	1F	9F		73	Shift	36	B6
18	ESC	01	81		46	D	20	A0		74	1 End	4F	CF
19	Num Lock	45	C5		47	F	21	A1		75	2 ↓	50	D0
20	Scroll Lock	46	C6		48	G	22	A2		76	3 Pg Dn	51	D1
21	Sys Req	54	D4		49	H	23	A3		77	F9	43	C3
22	F3	3D	BD		50	J	24	A4		78	F10	44	C4
23	F4	3E	BE		51	K	25	A5		79	Alt	38	B8
24	← →	0F	8F		52	L	26	A6		80	S/B	39	B9
25	Q	10	90		53	: ;	27	A7		81	Caps Lock	3A	BA
26	W	11	91		54	" /	28	A8		82	0 Ins	52	D2
27	E	12	92		55	ENTER	1C	9C		83	. Del	53	D3
28	R	13	93		56	4 ←	4B	CB		84	+ _	4E	CE

**FIGURE 13**  
TIMING DIAGRAM  
AT-84  
(PC-OUTPUT)



IBM® PC COMPATIBLE WAVE FORMS  
EACH DIVISION EQUALS 100 μSEC

# NOTES





## **NMB HI-TEK SALES OFFICES**

### **KEYBOARD HEADQUARTERS**

NMB HI-TEK Corporation  
7274 Lampson Avenue  
Garden Grove, CA 92641  
Telephone: (714) 898-9511  
Telex: 67-8486  
FAX: (714) 891-0895

### **NMB HEADQUARTERS**

NMB Corporation  
9730 Independence Avenue  
Chatsworth, CA 91311  
Telephone: (818) 341-0820  
TWX: 910-494-1232  
FAX: (818) 709-0387

### **NORTHWESTERN REGION**

NMB Corporation  
3333 Bowers Avenue, Suite 185  
Santa Clara, CA 95051  
Telephone: (408) 727-3952  
TWX: 910-338-2171  
FAX: (408) 980-1860

### **MIDWESTERN REGION**

NMB Corporation  
415 West Golf Road, Suite 27  
Arlington Heights, IL 60005  
Telephone: (312) 364-1414  
TWX: 910-222-1610  
FAX: (312) 364-1282

### **EASTERN REGION**

NMB Corporation  
7 Westchester Plaza  
Elmsford, New York 10523  
Telephone: (914) 592-3370  
TWX: 710-567-1249  
FAX: (914) 592-3125

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