4010 AND 4010–1
MAINTENANCE MANUAL

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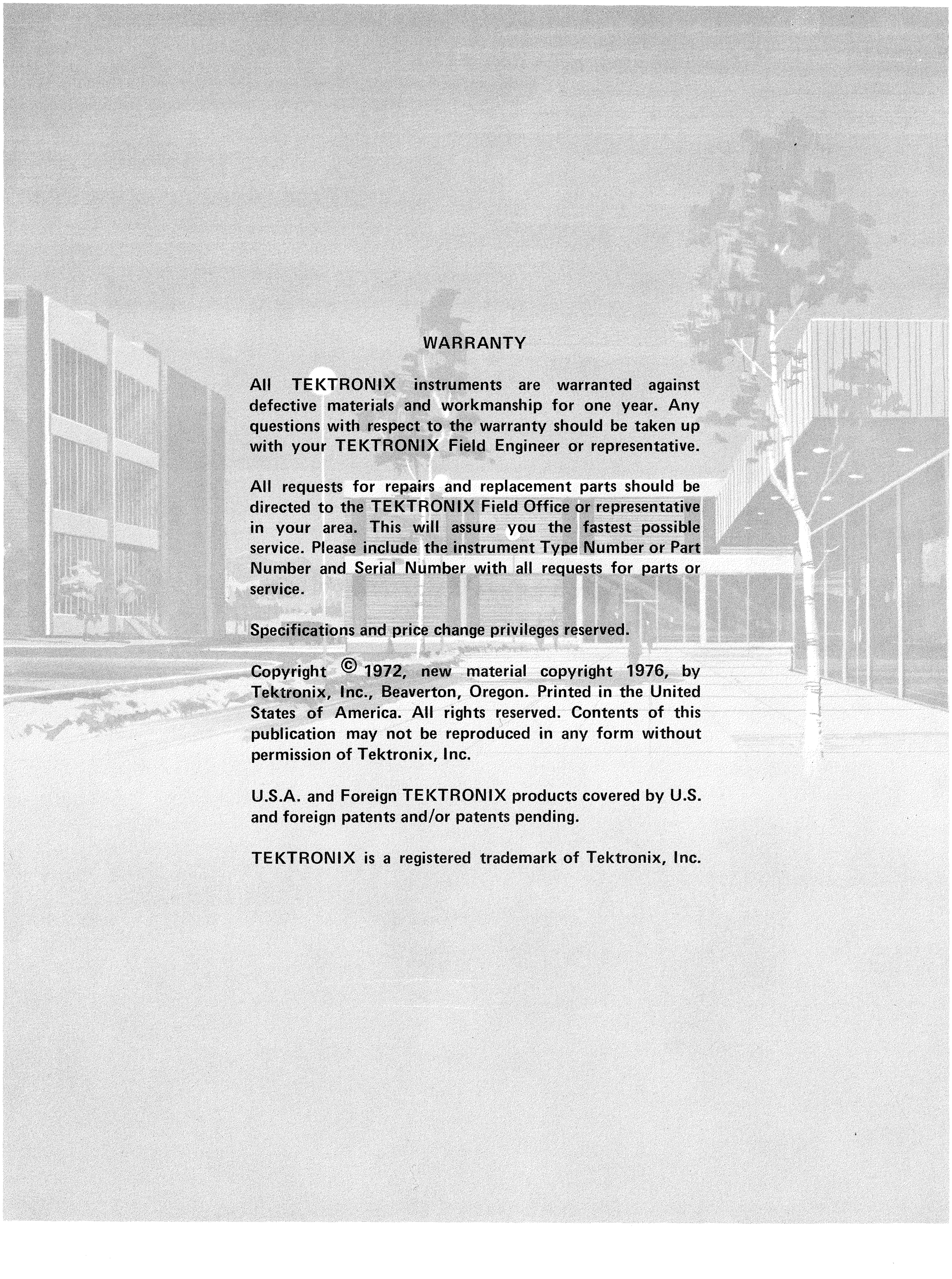

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Fig. 1-1. 4010 Computer Display Terminal.

INSTALLATION AND OPERATION

This manual is a part of the following set of documents which describe the 4010/4010-1 Computer Display Terminal:

OPERATOR'S HANDBOOK "Talking To The Computer"; TEKTRONIX Part No. 062-1445-00.

Contents—A general explanation of what the Terminal is and how it works.

4010 AND 4010-1 USERS MANUAL; TEKTRONIX Part No. 070-1225-00.

Contents—An explanation of how to operate and program the Terminal.

4010 AND 4010-1 MAINTENANCE MANUAL; TEKTRONIX Part No. 070-1183-01.

Contents—A comprehensive explanation of the Terminal. It includes operation, characteristics, servicing, adjustment, circuit diagrams, circuit descriptions, and parts lists.

Optional items used with the 4010/4010-1 Terminal are explained in separate manuals.

Introduction

The 4010 Computer Display Terminal interfaces between man and computer by permitting inputs through an integral keyboard and providing a display (alphanumeric or graphic) of computer output data. In addition, the Terminal can relay data bi-directionally between peripheral devices and a computer. An Interface Unit must be installed in the Terminal and connected to the computer — either directly or through a modem (modulator-demodulator)—to permit information interchange. The 4010-1 has all the features of the 4010, plus the ability to have copies made of its display, via a Hard Copy Unit.

INSTALLATION

General

The two main sections of the 4010 are the pedestal and the display unit. The pedestal section provides support for the display section, and contains the power supply, control circuits, and optional circuits. The display section contains the keyboard, the display storage CRT, and related circuits.

Desk-Top Operation

The display section can be detached from the pedestal and placed on a desk as far as four feet away from the pedestal. However, the pedestal section should remain in its upright position, and should have an air space at the bottom as shown, for proper cooling.

To remove the display section from the pedestal section, proceed as follows, referring to Fig. 1-2 as necessary.

1. Remove the four phillips-head screws that hold the display section to the pedestal.

2. Carefully push the display section back until the safety catch on the pedestal is free from the retainer slot.

3. Lift the display section up and away from the pedestal, guiding the extender cable as the display section is placed at the desired location.

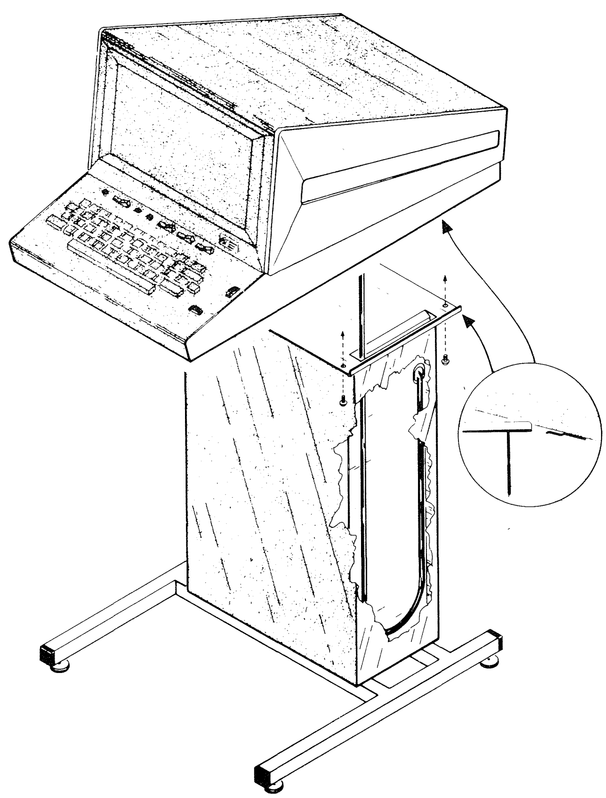


Fig. 1-2. Display Mounting.

4. To re-install the display section, reverse the procedure. For correct storage of the extender cable, feed it down into the storage bin as far as possible; then double it back and forth in the storage bin as the display section is placed on the pedestal.

Strappable Options

Strap options on circuit cards in the pedestal should be placed in the desired position upon installation. Refer to Table 2-13 for details.

Interfacing

Connect the Interface Unit to the computer or modem, as appropriate. The Interface Unit is installed in the pedestal section of the Terminal and the interconnecting cable(s) and plug(s) egress through the back of the pedestal unit. The configuration varies with the type of Interface Unit. The standard 4010 or 4010-1 contains a Data Communication Interface No. 021-0065-00. The Optional Data Communication Interface No. 021-0074-00 or the TTY Port Interface may be supplied as options in place of the Standard Data Communication Interface. Refer to the appropriate Interface documentation for specific installation instructions.

Optional Accessories

Refer to the documentation on the specific accessory for installation instructions.

Operating Power

The Terminal is intended to be operated from a single-phase power source which has one of its current-carrying conductors (the neutral conductor) at ground (earth) potential. Operation from other power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a multi-phase system, or across the legs of a 117–234 V single-phase three-wire system) is not recommended, as only the line conductor has over-current (fuse) protection within the instrument.

The Terminal is provided with a three-wire power cord with a three-terminal polarized plug for connection to the power source. The grounding terminal of the plug is directly connected to the instrument frame as recommended by national and international safety codes.

NOTE

The power cord on Tektronix instruments may conform to either of the following two electrical codes:

Conductor	*USA (NEC) & Canada*	*IEC*
Line	*Black*	*Brown*
Neutral	*White*	*Light Blue**
Safety-Earth	*Green w/yellow stripe*	*Green w/yellow stripe*

* Tinned copper conductor.

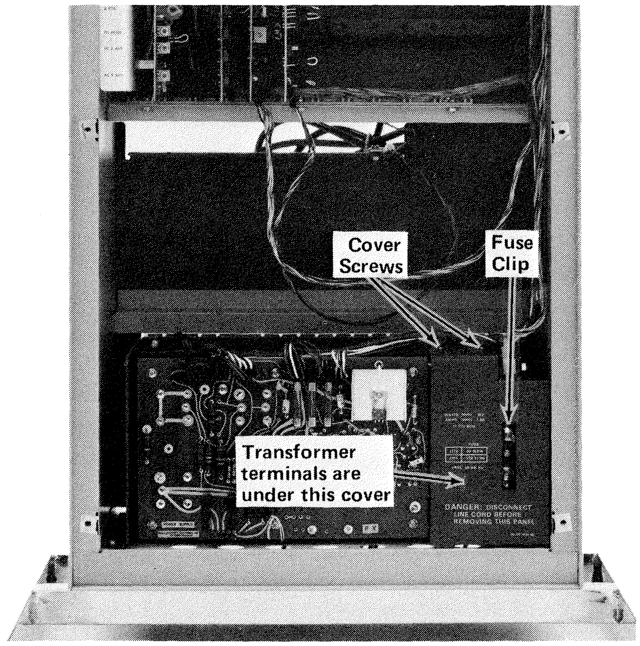


Fig. 1-3. Transformer terminals and fuse clip locations. (The fuse is contained on the pedestal front cover.)

The Terminal can be operated from either 110 or 220-volt nominal line voltage source. A clip-in fuse and a jumper arrangement on the transformer permits the Terminal to be modified to suit the supply. The fuse is mounted on the inside of the pedestal front cover, providing a cover interlock. The transformer and fuse clip are located in the bottom-right of the pedestal, as shown in Fig. 1-3. Fuse size is indicated on the transformer shield, and the wiring instructions are contained on the inside of the front cover. Wiring instructions are repeated in Fig. 1-4 for convenience. Fuse size is 2 A slo-blo for 110-volt operation and 1.25 A slo-blo for 220-volt operation. When changing fuses, the fuse should be pushed (rather than pulled) through the fuse holder.

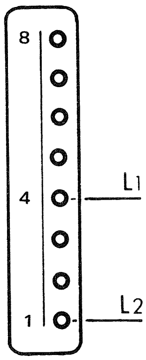
WARNING

Dangerous potentials exist at several places in the pedestal. Disconnect the Terminal from the power source before changing transformer connections.

INDICATORS AND CONTROLS

General

With the exception of the Power switch and the Hard Copy Intensity adjustment knob, the indicators and controls are located on the keyboard section of the display unit, as shown in Fig. 1-5. The Power switch is located on the upper right corner of the pedestal, immediately below the display unit. The Hard Copy Intensity adjustment knob is on the right side of the display unit.

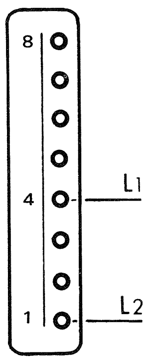


LINE CORD ALWAYS ATTACHED TO 1 & 4

JUMPER ARRANGEMENT

VOLTAGE $\pm 10\%$	100	110	120	200	220	240
TERMINAL NO.	1-8 4-5	1-2 4-3	1-7 4-6	5-8	2-3	6-7
	TWO JUMPERS REQUIRED			ONE JUMPER REQUIRED		

(A) Below serial number B020256.



LINE CORD ALWAYS ATTACHED TO 1 & 4

JUMPER ARRANGEMENT

VOLTAGE $\pm 10\%$	100	115	120	200	220	230	240
TERMINAL NO.	1-8 4-5	1-2 3-4	1-7 4-6	5-8	5-7	2-3	6-7
	TWO JUMPERS REQUIRED			ONE JUMPER REQUIRED			

(B) Serial number B020256 and above.

Fig. 1-4. Transformer terminals and jumper arrangement.

Indicators

Power lamp	Illuminated by the +5 V supply when the Power switch is turned on.
Indicator 1 Indicator 2	Multiple use lamps whose functions are determined by the accessories and optional equipment used with the Terminal.

Switches

Power	Applies power to the Terminal. Located at the top-right corner on the front of the pedestal.
LOCAL/LINE	A two-position rocker switch. LOCAL position isolates the Terminal from the computer and permits keyboard inputs to be displayed or otherwise executed by the Terminal. LINE position permits communication with the computer, and keyboard inputs are not displayed or otherwise executed by the Terminal unless echoing is being done by the Interface Unit, modem, or computer.
Switch 1 Switch 2	Two-position rocker switches whose functions are determined by the accessories and optional equipment used with the Terminal.
Switch 3	A momentary-type switch which is labeled MAKE COPY on the 4010-1. If a Hard Copy Unit is attached to the 4010-1, the switch initiates making of a hard copy of the Terminal display.

Adjustments

Hard Copy Intensity	An adjustment knob located on the right side of the Display Unit on 4010-1 Terminals. For hard copy operation, turn the control up to the point where the Hard Copy Unit scanning signal stores on the 4010-1 screen; then back off the adjustment to a point just below the storing level.

Thumbwheels

These are located on the right side of the keyboard section. They position the crosshair cursor which is displayed in Gin (Graphic Input) Mode.

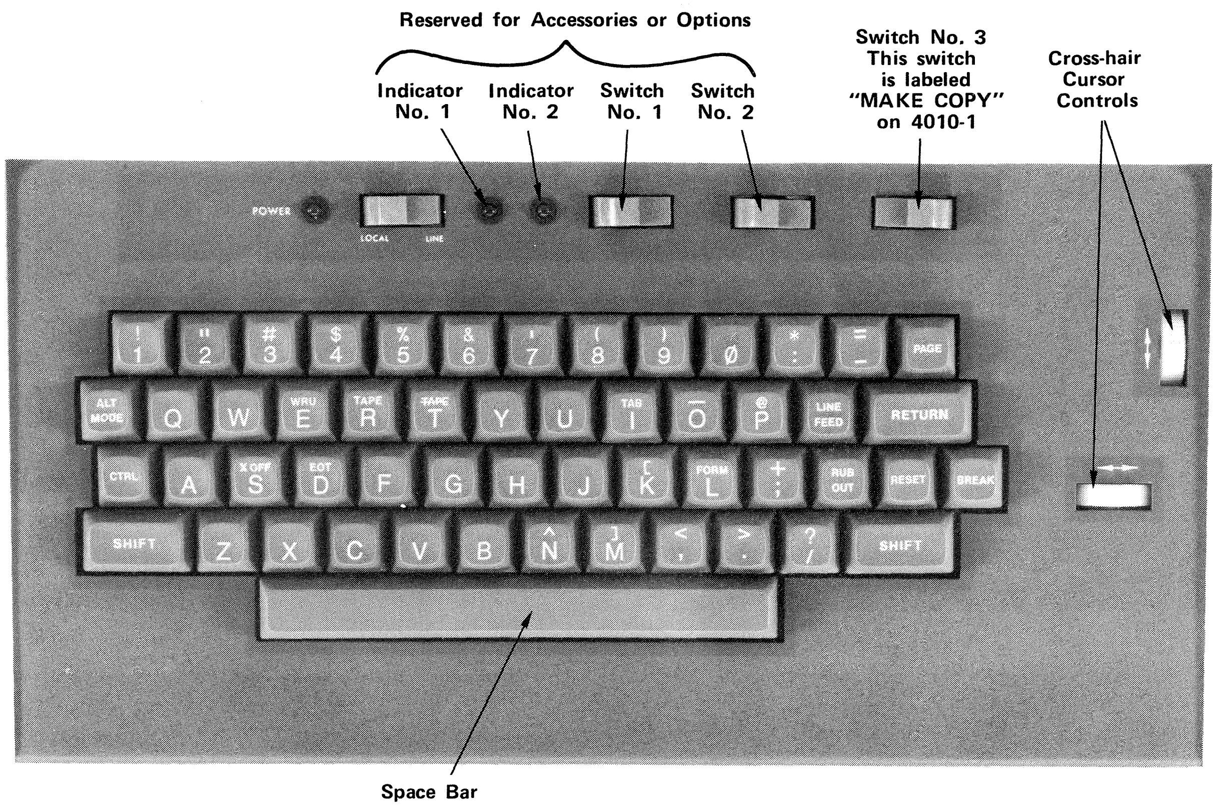


Fig. 1-5. 4010 Keyboard section.

NOTE

Keyboards with SN B055575 and up will not have the TTY codes (WRU, TAPE, ~~TAPE~~, TAB, X OFF, EOT, and FORM) on the keycaps. The 'FORM' label over the 'L' is replaced by /. Both keyboards function in the same manner.

Keys

The keyboard (shown in Fig. 1-5) is a TTY-type and is similar to a typewriter keyboard. It is designed for single key entry, dual key entry, and triple key entry. These are explained in the following paragraphs.

Single Key Entry — Causes transmission of ASCII-coded characters as indicated on the individual keys, with exceptions as listed here. Where two characters are shown on the key, the lower one applies. All letters are sent as upper case.

PAGE — Does not cause transmission, but erases and resets the Terminal to Alpha Mode, at home position.

ALT MODE — Sends the ASCII code for closing brace.

LINE FEED — Sends the ASCII-coded control character LF.

RETURN — Sends the ASCII-coded control character CR.

CTRL — Has no effect when used alone. Used for dual key and triple key entry.

RUB OUT — Sends the ASCII code for DEL.

RESET — Does not cause transmission, but resets the Terminal to Alpha Mode, home position.

BREAK — Sends an interrupt signal to the interface unit. The signal sent to the computer is interface dependent.

SHIFT — Resets the display from hold to view status in Alpha Mode. Has no other effect when used alone. Used for dual key and triple key entry.

Space Bar — Transmits ASCII-coded SP signal.

Dual Key Entry Using SHIFT Key

The Shift key can be used with any one of a number of other keys. The ASCII-coded characters sent are then as indicated on the upper section of the keys as shown in Fig. 1-5. E, R, T, I, S, D, and L are exceptions to this. The SHIFT L key combination sends the ASCII code for a reverse slant line. SHIFT plus any of the following keys sends the same character as the key alone: E, R, T, I, S, and D; the name on the upper portion of these keys refers to the TTY name for the code which is sent when the key is used with the CTRL key.

Dual Key Entry Using CTRL Key

The CTRL key can be used with any one of the alphabet keys to change their transmitted code to that required for ASCII control characters. The keys are shown in Fig. 1-5, and listed in Table 1-1 along with the ASCII-coded character that is sent when the key is pushed while the CTRL key is held down.

Triple Key Entry

Certain ASCII control character codes require that the CTRL and SHIFT keys both be held down before they can be transmitted in response to pressing a third key. The key combination and resultant characters are as listed in Table 1-2.

OPERATING MODES

General

Normal operation of the Terminal is achieved with the keyboard LOCAL/LINE switch at LINE position. The following operations are then possible:

Transmitting — ASCII-coded data is transmitted to the computer as entered at the keyboard.

Receiving — Alpha Mode causes alphanumeric characters to be written as received; control characters are executed as received; Terminal goes into a reduced intensity status (Hold) after approximately 90 seconds of inactivity; Terminal returns to View status upon keyboard entry or upon receipt of data from the computer. Graph Mode causes received data to be interpreted as specific addresses for the X and Y registers within the Terminal, resulting in moving the display unit beam to specific positions; the basic address positions are shown in Fig. 1-6. Control characters are executed as received.

TABLE 1-1

Dual Key Combinations vs ASCII Control Characters

Key Combination	ASCII Character	Comment
CTRL A	SOH	
CTRL B	STX	
CTRL C	ETX	
CTRL D	EOT	
CTRL E (WRU)	ENQ	WRU = Who are you?
CTRL F	ACK	
CTRL G	BEL	
CTRL H	BS	
CTRL I (TAB)	HT	TAB = Horizontal Tab
CTRL J	LF	
CTRL K	VT	
CTRL L (FORM)	FF	FORM = Form Feed
CTRL M	CR	
CTRL N	SO	
CTRL O	SI	
CTRL P	DLE	
CTRL Q	DC1	
CTRL R (TAPE)	DC2	Commonly used to start a tape punch unit.
CTRL S (X OFF)	DC 3	X OFF = Transmission Off. Commonly used to stop a tape reader unit.
CTRL T (~~TAPE~~)	DC 4	Commonly used to stop a tape punch unit.
CTRL U	NAK	
CTRL V	SYN	
CTRL W	ETB	
CTRL X	CAN	
CTRL Y	EM	
CTRL Z	SUB	

TABLE 1-2

Triple Key Combinations vs ASCII Control Characters

Key Combination	Character
CTRL SHIFT K	ESC
CTRL SHIFT L	FS
CTRL SHIFT M	GS
CTRL SHIFT N	RS
CTRL SHIFT O	US
CTRL SHIFT P	NUL

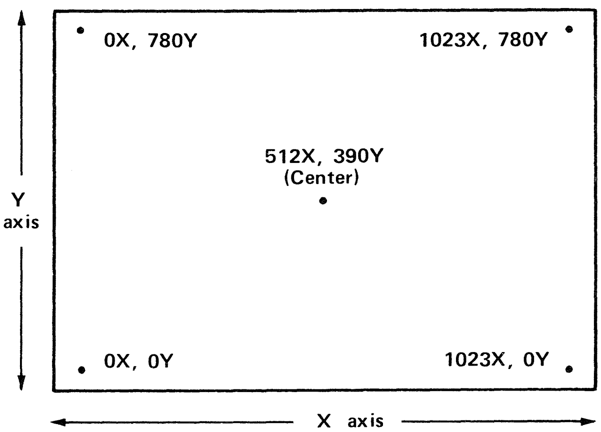


Fig. 1-6. Basic address positions on the display screen.

Interactive — Graphic Input (Gin) Mode causes the Terminal to automatically send its status and/or the address of the display beam to the computer in response to commands from the computer. A crosshair cursor may be displayed in Gin Mode as a preparatory status.

Local operation occurs when the keyboard LOCAL/ LINE switch is placed in the LOCAL position. The Terminal is then isolated from the computer and keyboard entries are displayed or otherwise executed by the Terminal.

4010-1 Terminals have a Hard Copy Mode which permits a hard copy reproduction of the display to be made if a Hard Copy Unit is connected to the Terminal. The mode can be initiated by computer command, by a MAKE COPY key on the Terminal keyboard, or by a switch on the Hard Copy Unit.

Transmitting

If the keyboard switch is at LINE position, data entered at the keyboard is transmitted in ASCII-coded form to the computer. The keyboard generates an eighth bit which is always either high or low, depending upon a strap option in the keyboard. This may be sent as set at the keyboard, or may be determined by the interface unit. Except for closing brace (ALT MODE) or DEL (RUBOUT), the keyboard is not capable of sending data from the last two columns on the right in the ASCII code chart shown in Fig. 1-7.

Receiving

General. The Terminal receiving circuits are essentially divorced from the keyboard and transmitting circuits while the keyboard switch is at LINE position. Data is then received as a result of transmission from the computer, including data being echoed by the computer or modem. However, data entered at the keyboard is applied to the receiving circuits if an ECHO signal is being asserted by the interface unit. ECHO is controlled by a switch or a strap option, depending upon the type of interface. The ECHO signal creates a situation referred to as echoplexing.

The Terminal response to signals thus received is essentially the same in either case, and depends upon the operating mode.

Alpha Mode. The Alpha Mode is the initial condition of the receiving circuits. In addition, it occurs in response to receiving a US, CR, or ESC FF. It is also initiated by entering PAGE or RESET at the keyboard. A pulsating cursor indicates the writing position of the next character. Alphanumeric characters are written on the display screen; control characters are executed by the Terminal. Lower case characters are written as upper case; Grave Accent (opening single quotation mark) is written as Commercial At; and Opening Brace is written as an Opening Bracket. Space causes spacing only. The 4010 does not respond to Vertical Line, Closing Brace, or Overline (Tilde). Rubout (DEL) is accepted and sent as a character, but does not cause a space or print. Control characters and control character sequences cause effects as listed in Table 2-1. Optional accessories may respond to other commands or sequences as determined by the optional accessory. Refer to Table 2-2 for a listing of Alpha Mode specifications.

Graph Mode. Control character GS puts the Terminal in Graph Mode. Then the Terminal draws vectors (either written or unwritten) in response to graphic address inputs as explained in Tables 2-4 and 2-5. The Terminal can still respond to control characters and control character sequences as explained in Table 2-1. Graph Mode ends and Alpha Mode occurs upon receipt of control characters US, CR, or control character sequence ESC FF. Graph Mode also ends upon receipt of ESC SUB, which sets Gin Mode and displays the crosshair cursor. Graph Mode can also be ended by pressing PAGE or RESET at the keyboard. Refer to Table 2-3 for Graph Mode specifications.

Interactive

Gin Mode. Gin Mode occurs in response to receipt of ESC ENQ at any time the Terminal is "on line". It also occurs in response to an ESC SUB which turns on the crosshair cursor. ESC SUB should not be entered at the keyboard while "on line" because immediate and erroneous transmission may occur. Receipt of ESC ENQ while in Alpha Mode results in immediate transmission of the Terminal status and the address of the point at the lower left corner of the Alpha cursor. CR or CR and EOT will automatically be transmitted immediately after the address, if selected by a strap option on TC-2. (EOT can not be sent

ASCII CODE FUNCTIONS

B4	B3	B2	B1	B7 B6 B5: Ø Ø Ø	Ø Ø 1	Ø 1 Ø	Ø 1 1	1 Ø Ø	1 Ø 1	1 1 Ø	1 1 1
BITS				CONTROL		HIGH X & Y GRAPHIC INPUT		LOW X		LOW Y	
Ø	Ø	Ø	Ø	NUL Ø	DLE 16	SP 32	Ø 48	@ 64	P 8Ø	` 96	p 112
Ø	Ø	Ø	1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	a 97	q 113
Ø	Ø	1	Ø	STX 2	DC2 18	" 34	2 50	B 66	R 82	b 98	r 114
Ø	Ø	1	1	ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
Ø	1	Ø	Ø	EOT 4	DC4 2Ø	$ 36	4 52	D 68	T 84	d 1ØØ	t 116
Ø	1	Ø	1	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 1Ø1	u 117
Ø	1	1	Ø	ACK 6	SYN 22	& 38	6 54	F 7Ø	V 86	f 1Ø2	v 118
Ø	1	1	1	BEL BELL 7	ETB 23	' 39	7 55	G 71	W 87	g 1Ø3	w 119
1	Ø	Ø	Ø	BS BACK SPACE 8	CAN 24	(40	8 56	H 72	X 88	h 1Ø4	x 12Ø
1	Ø	Ø	1	HT 9	EM 25	) 41	9 57	I 73	Y 89	i 1Ø5	y 121
1	Ø	1	Ø	LF 1Ø	SUB 26	* 42	: 58	J 74	Z 9Ø	j 1Ø6	z 122
1	Ø	1	1	VT 11	ESC 27	+ 43	; 59	K 75	[91	k 1Ø7	{ 123
1	1	Ø	Ø	FF 12	FS 28	, 44	< 60	L 76	\ 92	l 1Ø8	¦ 124
1	1	Ø	1	CR RETURN 13	GS 29	– 45	= 61	M 77	] 93	m 1Ø9	} 125
1	1	1	Ø	SO 14	RS 3Ø	. 46	> 62	N 78	∧ 94	n 11Ø	~ 126
1	1	1	1	SI 15	US 31	/ 47	? 63	O 79	_ 95	o 111	RUBOUT (DEL) 127

Fig. 1-7. ASCII Code Chart.

without CR.) Echoplexing is suppressed during Gin Mode. Gin Mode ends upon completion of transmission. If CR is transmitted during Gin Mode AND is echoed by the computer, the Terminal will return to full Alpha Mode upon completion of the transmission. If CR is not echoed, the Terminal must be reset by one of the following before character writing can occur: BEL, BS, CR, ESC ETB, ESC FF, HT, LF, US, or VT. Note that if CR is echoed, or if any command affecting the display position is sent to the Terminal, it will cause the cursor to move away from the position which was referenced in Gin Mode; use BEL or US if the display position is to be left undisturbed.

Receipt of ESC ENQ while in Graph Mode also causes Gin Mode, sending the Terminal status and address of the Graph Mode beam position to the computer. The computer or modem may not echo Gin Mode data back to the Terminal if Graph Mode and beam position are to be retained after an ESC ENQ. (CR echoed will reset the Terminal to Alpha Mode, and will move the cursor to the left margin; echoing the status and address bytes will change the beam address to a point different from that sent to the computer.) Gin Mode ends automatically upon completion of transmission, and the Terminal returns to full Graph Mode if CR is not echoed.

Receipt of ESC SUB sets Gin Mode and turns on the crosshair cursor as a preparatory step in transmitting an address to the computer. The thumbwheels (located on the keyboard) can be used to position the crosshair cursor anywhere in the display area. The address at the crosshair intersection is sent to the computer in response to an ESC ENQ from the computer, or in response to entry of any keyboard character. The Terminal returns to full Alpha Mode upon completion of transmission if CR is sent and echoed. If CR is not echoed, one of the following must be sent before the Terminal can again write: BEL, BS, CR, ESC ETB, ESC FF, HT, LF, US, or VT. Refer to Table 2-6 for Gin Mode specifications.

Local

Operation with the LOCAL/LINE switch at LOCAL is much the same as just described for LINE operation. However, the following exceptions exist: (1) The Terminal is isolated from the computer; (2) data entered at the keyboard while in Alpha Mode results in writing or executing data at the Terminal; (3) data entered at the keyboard while in Graph Mode results in drawing vectors or executing control characters at the Terminal; (4) the crosshair cursor appears in response to CTRL SHIFT K and CTRL Z, and can be positioned by the thumbwheels — but it can only be removed by entering RESET or PAGE.

FIRST-TIME OPERATION

This operation procedure is intended to acquaint a user with the operating features of the Terminal. It can also be used as a Terminal check-out procedure. Although the Terminal is not connected to a modem or computer, all modes are exercised. Computer echoing is simulated by a local echo feature. Responses are explained for all options.

Preliminary

The Terminal should not be connected to a power source, modem, or computer at this time.

Line Voltage. If the Terminal is being initially installed, check that the line voltage agrees with the voltage written on the tag which is attached to the Terminal. If it does not, remove the front cover of the pedestal after removing the screws, and change the transformer wiring and fuse size so that they agree with the power source. Wiring instructions appear inside the pedestal cover; fuse sizes are written on the transformer cover plate. The tag information should be changed when the wiring is changed. Replace the front cover.

Power. Plug the power cord into the power source and turn the Terminal Power switch ON. The switch is located on the front at the top of the pedestal, just below the display unit.

Power Lamp. Check that the Power lamp on the left of the keyboard illuminates, and the display screen becomes bright.

Data Transmission. With the keyboard switch at LINE, keyboard data is sent to the computer. It goes to the Terminal receiving circuits only if it is presented to them by one of the following methods: (1) Echoed by the computer or modem; (2) Echoed by the Terminal's interface unit.

With the keyboard switch at LOCAL, the Terminal is isolated from the computer; data entered at the keyboard is applied to the Terminal receiving circuits in a manner similar to that which occurs when the keyboard switch is at LINE and the interface unit is echoing data. LOCAL provides a dual advantage. It permits an evaluation of the data being transmitted by the keyboard, and at the same time tests the Terminal receiving circuits. For these reasons, LOCAL operation is used for most of this procedure. Discrepancies between LOCAL and LINE operation are mentioned wherever they occur. *IT SHOULD BE KEPT IN MIND THAT THE KEYBOARD'S PRIMARY FUNCTION IS TO ACT AS A SOURCE FOR THE COMPUTER; THE RECEIVING CIRCUIT'S PRIMARY FUNCTION IS TO*

RESPOND TO DATA FROM THE COMPUTER; THE KEYBOARD IS SIMPLY BEING USED AS A SOURCE OF DATA FOR THE RECEIVING CIRCUITS WHILE IN LOCAL OPERATION.

Initialization

Press the PAGE key to erase the display screen. The screen must be initialized by erasing it each time the Terminal is turned on. PAGE also selects Alpha Mode and places the beam at the upper-left corner of the display (Alpha Mode "home" position).

Alpha Mode

Character Transmission and Character Effect. Press each key in the keyboard cluster and note the effect. Most of them will cause character writing, permitting a check of the code being transmitted by the keyboard and a check of the dot pattern being presented by the character generator in the receiving circuits. Keys which are an exception to this are as follows:

PAGE—Causes no transmission. A direct connection to the receiving circuits causes Alpha Mode to be selected. It also causes erasing and places the Alpha cursor to the top-left corner of the display (Alpha Mode "home" position).

ALT MODE—Causes neither writing nor spacing, although the keyboard transmits the ASCII character for closing brace.

LINE FEED—Transmits the control character LF. At the receiving circuits, LF causes the Alpha cursor to move down to the next line. The cursor may also move to the left margin if the "LF Causes Carriage Return" strap option on TC-1 is at IN position.

RETURN—Transmits the control character CR. At the receiving circuits, it causes the Alpha cursor to move to the left margin. There are two "left" margin positions. One is vertically aligned with the "home" position and is referred to as "Margin Ø". The second is near the horizontal center of the screen, and is referred to as "Margin 1". Margin 1 is automatically selected each time the Terminal line-feeds past the 35th (last) line while Margin Ø exists. Margin Ø is selected when the Terminal line-feeds past the 35th line while Margin 1 exists, and is also selected when ESC FF is received or when PAGE or RESET is entered at the keyboard.

CTRL—Has no effect as a single key entry. It causes the keyboard to transmit control characters when used with other keyboard keys. For example, entering a G while the CTRL key is held down rings the bell, since it transmits the control character BEL; and the receiving circuits accept that as the command to ring the bell. As a second example, holding down CTRL and SHIFT and pressing K transmits the control character ESC. No reaction is evident at the Terminal, since the receiving circuits recognize it as an arming command, and wait for a second command before they act. Now enter CTRL L and note that the control character FF is transmitted, accepted by the receiving circuits, causes the display to erase and the Alpha cursor to go home. FF alone cannot do it. It must be preceded immediately by ESC. A complete listing of control character effects appears in Table 2-1.

RUBOUT—This key sends the ASCII code for DEL. The receiving circuits accept it, but it causes no spacing, writing.

RESET—Causes no transmission. A direct connection to the receiving circuits causes Alpha Mode to be selected and causes the Alpha cursor to move to the home position.

BREAK—Sends a break signal to the interface unit, which may then transmit a break signal to the computer. Has no effect upon the receiving circuits.

SHIFT—Its only effect as a single key entry is to restore View condition without otherwise affecting transmission or the receiving circuits. When used with other keys, it causes the shifted (upper) character to be transmitted as indicated on each key. Exceptions to this occur on the E, R, T, I, S, D, and L keys, where the upper inscription indicates the TTY character which is sent when those keys are pressed while CTRL is held down. Except for L, those keys send the same character while the SHIFT key is held down as they do when pressed alone. The L key sends a reverse slant line if pressed while the SHIFT key is held down.

Automatic Line Feed and Carriage Return. By now, it probably has been noticed that the Terminal receiving circuits automatically perform a carriage return and line feed each time the last (74th) character in a line is written. If it hasn't been noticed, enter a full line of characters and observe the effect. Note that the Alpha Cursor returns to the effective margin position—Margin 0 or Margin 1.

Margins. Enter a PAGE command and note the cursor position at the left edge (Margin Ø) of the display. Enter LINE FEED commands until the cursor disappears past the bottom of the display screen, and note that it re-appears at the top-center of the display, in Margin 1 position. Enter enough LINE FEED commands to again send the cursor past the bottom of the display; it will re-appear at the top in Margin Ø position. *THE EFFECTIVE MARGIN CONDITION CHANGES EACH TIME THE DISPLAY LINE-FEEDS PAST THE LAST (35TH) LINE.*

Again arrive at the Margin 1 position and enter several SP characters at the Space bar. Then enter CTRL M to send a CR to the receiving circuits. Note that the cursor returns to the effective margin position, in this case Margin 1. Now enter enough characters to space past the end of the line. Note that the cursor returns to Margin 1. *CR, RETURN, OR AUTOMATIC CARRIAGE RETURN SET THE CURSOR BACK TO THE EFFECTIVE MARGIN POSITION.*

Press RESET to set Margin Ø. Now enter characters until they cause spacing past the end of the line and subsequent line feed and carriage return. Note that character writing ignores Margin 1 position or Margin 1 information while Margin Ø exists. If two-column formatting is to occur, Margin Ø information must be kept to 36 characters or less.

View/Hold. Wait about 90 seconds and note that the Terminal automatically enters a reduced intensity condition referred to as Hold. This condition prolongs tube life, and occurs in Alpha Mode only. Therefore, the Terminal should always be placed in Alpha Mode when energized, but not in use.

Graph Mode

Note the position of the Alpha Cursor. Then send GS (CTRL SHIFT M) to the receiving circuits and note that the Alpha cursor disappears. Send the address 383Y, 512X to place the beam near the center of the screen. The required bytes can be determined from Fig. 1-8 through 1-11. They equate to + DEL Ø @ in ASCII code. Enter + RUBOUT Ø @ at the keyboard. (RUBOUT transmits DEL.)

Unwritten Vector. No obvious results occur in response to the just-entered commands, because it is the first address to be received after a GS, and the beam is blanked while the movement occurs.

Written Vector. Enter @ again. It will execute a second vector, which will be written. This vector appears as a dot near the center of the screen, since no change in position was commanded. (The @ contains the code for a Low X byte, which causes vector execution.) Now send the address for 32Y, 32X. This equates to SP DEL SP _ and is entered at the keyboard as SP RUBOUT SP _ to draw the vector. Note that nothing happens until the Low X (last) command is entered, but then a vector is drawn from the center to the lower left corner.

Resetting With US. Now go back to Alpha Mode, without otherwise disturbing the receiving circuits, by sending a US to the Terminal. Do it by entering a CTRL SHIFT O at the keyboard. Note that the Alpha cursor appears with its lower left corner at the end of the vector, since US causes no change in the Terminal position-register contents. Now send ten SP commands to the Terminal by pressing the keyboard Space bar. Note that the cursor moves away from the end of the vector.

Graph Memory. Put the Terminal back in Graph Mode by sending it a GS (CTRL SHIFT M). Then send the same Low X command as was last used, by again entering _ at the keyboard. The beam will move unseen back to the end of the vector because of the Graph Mode memory circuits. This can be confirmed by entering a second _ at the keyboard, to again send the Low X command to the receiving circuits. Note that the same Low X command as contained in the last address must be used, or the beam position will differ by the amount of difference between the two Low X bytes.

Resetting With CR. Now switch from Graph Mode to Alpha Mode by sending a CR to the receiving circuits. This can be done by pressing the RETURN key or entering a CTRL M at the keyboard. This places the Alpha cursor at the left margin, in line with the last graphic position of the beam.

Resetting With ESC FF. Send a GS to the receiving circuits by entering a CTRL SHIFT M at the keyboard. Enter two _ commands to confirm that the Terminal is back in Graph Mode, and is at the end of the drawn vector. Then send an ESC FF sequence to the receiving circuits. Do this by entering CTRL SHIFT K and then CTRL L. Note that this erases the display, selects Alpha Mode, and homes the Alpha cursor. This can also be done locally by pressing the PAGE key, regardless of the position of the LOCAL/LINE switch.

Resetting With RESET. Send another GS (CTRL SHIFT M) to the receiving circuits, enter _ to return to the last graphic address, and then draw a vector to 32Y, 1023X. This translates to SP DEL ? _ which can be sent by entering SP RUBOUT ? _ at the keyboard. Now press the RESET key at the keyboard. Note that the Alpha Mode is restored, and the Alpha cursor appears at the top left corner of the screen. No erasing occurs. This particular operation can only be accomplished from the keyboard. No program command equivalent to RESET can be sent.

Shortened Addresses. The sequence in Table 1-3 illustrates the ability of the receiving circuits to respond to various graphic commands of less than four bytes. The missing bytes remain as sent in the last address which contained them. Table 2-5 specifies the minimum bytes that can be sent in any one situation.

TABLE 1-3

Shortened Address Illustration

Address & Comment	Send	
	ASCII	Keyboard
543Y, 543X. (Initial address; send 4 bytes.)	Ø DEL Ø _	Ø RUBOUT Ø _
543Y, 512X. (Lo X changes; send only Lo X.)	@	@
541Y, 512X. (Lo Y changes; send Lo Y, Lo X.)	} @	ALTMODE @
29Y, 512X. (Hi Y changes; send Hi Y, Lo X.)	SP @	SP @
29Y, 0X. (Hi X changes; send Lo Y, Hi X, Lo X.)	} SP @	ALTMODE SP @
543Y, 0X. (Hi Y and Lo Y change; send Hi Y, Lo Y, Lo X.)	Ø DEL @	Ø RUBOUT @
31Y, 543X. (Hi Y, Hi X, and Lo X change; send four bytes.)	SP DEL Ø _	SP RUBOUT Ø _

View/Hold. The Hold feature is over-ridden while the Terminal is in Graph Mode. The Terminal should always be returned to Alpha Mode when energized, but not in use.

Gin Mode

Crosshair Cursor. Enter CTRL SHIFT K and CTRL Z and note that a crosshair cursor appears. (If the horizontal thumbwheel is in either limit, the vertical line may be the only line to appear; with the vertical thumbwheel at the lower limit, the horizontal line may be the only line to appear. Move both thumbwheels out of their limits to present both lines.) Check that the cursor can be moved via the thumbwheels. Press any key except PAGE or RESET and note that they have no effect. Press PAGE or RESET and note that the crosshair cursor disappears and the Alpha cursor returns. *THE RECEIVING CIRCUITS ARE INSENSITIVE TO SIGNALS FROM THE KEYBOARD WHILE IN LOCAL WITH THE CROSSHAIR CURSOR DISPLAYED. IT SHOULD ALSO BE NOTED THAT THE CROSSHAIR CURSOR CANNOT BE CALLED INTO VIEW BY THE KEYBOARD WHILE ON LINE; IN NORMAL OPERATION, AN ESC SUB FROM THE COMPUTER COMMANDS IT TO APPEAR.*

Gin Mode Transmissions. These cannot be demonstrated with the keyboard switch at LOCAL position. Refer to the Operating Modes information at the beginning of this section and/or refer to Table 2-6 for details concerning "on-line" Gin Mode operation.

View/Hold. The Hold feature is disabled while the crosshair cursor is displayed. Therefore, the Terminal should always be reset to Alpha Mode when energized, but not in use, to prolong tube life.

First Time Operation procedure has been completed for a 4010 Terminal. Continue with the next step only if a 4010-1 Terminal is being used.

Hard Copy Mode

This mode applies to 4010-1 Terminals only. A Hard Copy Unit must be connected to the Terminal and must be energized before the Hard Copy Mode can be exercised.

Switch the Terminal's LOCAL/LINE control to LOCAL. Enter a number of alphanumeric characters at the keyboard to create a display.

Transmit an ESC ETB signal to the receiving circuits by entering CTRL SHIFT K and CTRL W at the keyboard. (Pressing the MAKE COPY button on the keyboard, or pressing the Copy button on the Hard Copy Unit will achieve the same effects.) A scanning bar should appear and scan the display. A few seconds after scanning is completed, the Hard Copy Unit should eject a hard copy of the display. If the paper is blank, or if information dropout occurred, the Hard Copy Intensity control on the right side of the Terminal may be set too low. On the other hand, if the scanning bar caused storing on the display, the Hard Copy Intensity control may be set too high. Readjust the control while copy making is occurring, selecting a point just below that where the scanning bar stores. Then press PAGE, enter more characters on the display, and make another copy. If the adjustment was made properly, a clear copy of the display should result.

Low Order X ASCII	Low Order X DEC.	X or Y Coordinate								Low Order Y ASCII	Low Order Y DEC.
@	64	0	32	64	96	128	160	192	224	`	96
A	65	1	33	65	97	129	161	193	225	a	97
B	66	2	34	66	98	130	162	194	226	b	98
C	67	3	35	67	99	131	163	195	227	c	99
D	68	4	36	68	100	132	164	196	228	d	100
E	69	5	37	69	101	133	165	197	229	e	101
F	70	6	38	70	102	134	166	198	230	f	102
G	71	7	39	71	103	135	167	199	231	g	103
H	72	8	40	72	104	136	168	200	232	h	104
I	73	9	41	73	105	137	169	201	233	i	105
J	74	10	42	74	106	138	170	202	234	j	106
K	75	11	43	75	107	139	171	203	235	k	107
L	76	12	44	76	108	140	172	204	236	l	108
M	77	13	45	77	109	141	173	205	237	m	109
N	78	14	46	78	110	142	174	206	238	n	110
O	79	15	47	79	111	143	175	207	239	o	111
P	80	16	48	80	112	144	176	208	240	p	112
Q	81	17	49	81	113	145	177	209	241	q	113
R	82	18	50	82	114	146	178	210	242	r	114
S	83	19	51	83	115	147	179	211	243	s	115
T	84	20	52	84	116	148	180	212	244	t	116
U	85	21	53	85	117	149	181	213	245	u	117
V	86	22	54	86	118	150	182	214	246	v	118
W	87	23	55	87	119	151	183	215	247	w	119
X	88	24	56	88	120	152	184	216	248	x	120
Y	89	25	57	89	121	153	185	217	249	y	121
Z	90	26	58	90	122	154	186	218	250	z	122
[	91	27	59	91	123	155	187	219	251	{	123
\	92	28	60	92	124	156	188	220	252	¦	124
]	93	29	61	93	125	157	189	221	253	}	125
^	94	30	62	94	126	158	190	222	254	~	126
_	95	31	63	95	127	159	191	223	255	RUBOUT (DEL)	127
High Order X & Y	DEC.	32	33	34	35	36	37	38	39		
High Order X & Y	ASCII	SP	!	"	#	$	%	&	'		

Fig. 1-8. Coordinate conversion chart, part 1 of 4. INSTRUCTIONS: Find coordinate value in body of chart; follow that column to bottom of chart to find decimal value or ASCII character which represents the High Y or High X byte; go to the right in the row containing the coordinate value to find the Low Y byte, or go the left to find the Low X byte. EXAMPLE: 200Y, 48X equals & h ! P in ASCII code and also equals 38 104 33 80 in decimal code.

Low Order X										Low Order Y	
ASCII	DEC.	X or Y Coordinate								ASCII	DEC.
@	64	256	288	320	352	384	416	448	480	`	96
A	65	257	289	321	353	385	417	449	481	a	97
B	66	258	290	322	354	386	418	450	482	b	98
C	67	259	291	323	355	387	419	451	483	c	99
D	68	260	292	324	356	388	420	452	484	d	100
E	69	261	293	325	357	389	421	453	485	e	101
F	70	262	294	326	358	390	422	454	486	f	102
G	71	263	295	327	359	391	423	455	487	g	103
H	72	264	296	328	360	392	424	456	488	h	104
I	73	265	297	329	361	393	425	457	489	i	105
J	74	266	298	330	362	394	426	458	490	j	106
K	75	267	299	331	363	395	427	459	491	k	107
L	76	268	300	332	364	396	428	460	492	l	108
M	77	269	301	333	365	397	429	461	493	m	109
N	78	270	302	334	366	398	430	462	494	n	110
O	79	271	303	335	367	399	431	463	495	o	111
P	80	272	304	336	368	400	432	464	496	p	112
Q	81	272	305	337	369	401	433	465	497	q	113
R	82	274	306	338	370	402	434	466	498	r	114
S	83	275	307	339	371	403	435	467	499	s	115
T	84	276	308	340	372	404	436	468	500	t	116
U	85	277	309	341	373	405	437	469	501	u	117
V	86	278	310	342	374	406	438	470	502	v	118
W	87	279	311	343	375	407	439	471	503	w	119
X	88	280	312	344	376	408	440	472	504	x	120
Y	89	281	313	345	377	409	441	473	505	y	121
Z	90	282	314	346	378	410	442	474	506	z	122
[	91	283	315	347	379	411	443	475	507	{	123
\	92	284	316	348	380	412	444	476	508	¦	124
]	93	285	317	349	381	413	445	477	509	}	125
^	94	286	318	350	382	414	446	478	510	~	126
_	95	287	319	351	383	415	447	479	511	RUBOUT (DEL)	127
		40	41	42	43	44	45	46	47		
		(	)	*	+	,	-	.	/		
		High Order X & Y									

Fig. 1-9. Coordinate conversion chart, part 2 of 4. (Refer to part 1 for interpretation instructions.)

Low Order X ASCII	Low Order X DEC	X or Y Coordinate								Low Order Y ASCII	Low Order Y DEC.
@	64	512	544	576	608	640	672	704	736	`	96
A	65	513	545	577	609	641	673	705	737	a	97
B	66	514	546	578	610	642	674	706	738	b	98
C	67	515	547	579	611	643	675	707	739	c	99
D	68	516	548	580	612	644	676	708	740	d	100
E	69	517	549	581	613	645	677	709	741	e	101
F	70	518	550	582	614	646	678	710	742	f	102
G	71	519	551	583	615	647	679	711	743	g	103
H	72	520	552	584	616	648	680	712	744	h	104
I	73	521	553	585	617	649	681	713	745	i	105
J	74	522	554	586	618	650	682	714	746	j	106
K	75	523	555	587	619	651	683	715	747	k	107
L	76	524	556	588	620	652	684	716	748	l	108
M	77	525	557	589	621	653	685	717	749	m	109
N	78	526	558	590	622	654	686	718	750	n	110
O	79	527	559	591	623	655	687	719	751	o	111
P	80	528	560	592	624	656	688	720	752	p	112
Q	81	529	561	593	625	657	689	721	753	q	113
R	82	530	562	594	626	658	690	722	754	r	114
S	83	531	563	595	627	659	691	723	755	s	115
T	84	532	564	596	628	660	692	724	756	t	116
U	85	533	565	597	629	661	693	725	757	u	117
V	86	534	566	598	630	662	694	726	758	v	118
W	87	535	567	599	631	663	695	727	759	w	119
X	88	536	568	600	632	664	696	728	760	x	120
Y	89	537	569	601	633	665	697	729	761	y	121
Z	90	538	570	602	634	666	698	730	762	z	122
[	91	539	571	603	635	667	699	731	763	{	123
\	92	540	572	604	636	668	700	732	764	¦	124
]	93	541	573	605	637	669	701	733	765	}	125
∧	94	542	574	606	638	670	702	734	766	~	126
_	95	543	575	607	639	671	703	735	767	RUBOUT (DEL)	127
		48	49	50	51	52	53	54	55		
		0	1	2	3	4	5	6	7		
		High Order X & Y									

Fig. 1-10. Coordinate conversion chart, part 3 of 4. (Refer to part 1 for interpretation instructions.)

Low Order X ASCII	Low Order X DEC.	X or Y Coordinate								Low Order Y ASCII	Low Order Y DEC.
@	64	768	800	832	864	896	928	960	992	`	96
A	65	769	801	833	865	897	929	961	993	a	97
B	66	770	802	834	866	898	930	962	994	b	98
C	67	771	803	835	867	899	931	963	995	c	99
D	68	772	804	836	868	900	932	964	996	d	100
E	69	773	805	837	869	901	933	965	997	e	101
F	70	774	806	838	870	902	934	966	998	f	102
G	71	775	807	839	871	903	935	967	999	g	103
H	72	776	808	840	872	904	936	968	1000	h	104
I	73	777	809	841	873	905	937	969	1001	i	105
J	74	778	810	842	874	906	938	970	1002	j	106
K	75	779	811	843	875	907	939	971	1003	k	107
L	76	780	812	844	876	908	940	972	1004	l	108
M	77	781	813	845	877	909	941	973	1005	m	109
N	78	782	814	846	878	910	942	974	1006	n	110
O	79	783	815	847	879	911	943	975	1007	o	111
P	80	784	816	848	880	912	944	976	1008	p	112
Q	81	785	817	849	881	913	945	977	1009	q	113
R	82	786	818	850	882	914	946	978	1010	r	114
S	83	787	819	851	883	915	947	979	1011	s	115
T	84	788	820	852	884	916	948	980	1012	t	116
U	85	789	821	853	885	917	949	981	1013	u	117
V	86	790	822	854	886	918	950	982	1014	v	118
W	87	791	823	855	887	919	951	983	1015	w	119
X	88	792	824	856	888	920	952	984	1016	x	120
Y	89	793	825	857	889	921	953	985	1017	y	121
Z	90	794	826	858	890	922	954	986	1018	z	122
[	91	795	827	859	891	923	955	987	1019	{	123
\	92	796	828	860	892	924	956	988	1020	|	124
]	93	797	829	861	893	925	957	989	1021	}	125
^	94	798	830	862	894	926	958	990	1022	~	126
_	95	799	831	863	895	927	959	991	1023	RUBOUT (DEL)	127
		56	57	58	59	60	61	62	63		
		8	9	:	;	<	=	>	?		
		High Order X & Y									

Fig. 1-11. Coordinate conversion chart, part 4 of 4. (Refer to part 1 for interpretation instructions.)

CHARACTERISTICS

Introduction

The characteristics are contained in two parts. The first part consists of an alphabetic listing. The alphabetic listing makes reference to the second part, which contains tabulated information.

The following conditions must be met before all characteristics can be considered valid:

The Terminal must have been adjusted at an ambient temperature between +20°C and +30°C.

It must be operating in an environment as specified under Environmental Specification.

Operation must be preceded by a warmup period of at least 20 minutes.

Specified power requirements must be met.

The specifications pertain principally to On Line operation as selected at the keyboard rocker switch, and should not be presumed applicable to Local operation. Refer to the Local operation specification for qualifying information.

The following tables are included immediately after the alphabetic listing of characteristics:

Table 2-1 Control Character Effect on Terminal
Table 2-2 Alpha Mode Specification
Table 2-3 Graph Mode Specification
Table 2-4 Graph Mode Vector Drawing
Table 2-5 Bytes Required for Graphic Addressing
Table 2-6 Gin Mode Specifications
Table 2-7 Local Operation Specification
Table 2-8 Hard Copy Mode Specification (4010-1 Only)
Table 2-9 Display Unit Specifications
Table 2-10 Power Supply Specifications
Table 2-11 Physical Characteristics
Table 2-12 Environmental Specifications
Table 2-13 Strappable Options of Basic 4010/4010-1
Table 2-14 Accessories for the 4010/4010-1

The characteristics included in the alphabetic listing are as follows:

Accessories
Address
Alpha Mode
Arming
Carriage Return
Character Effect on Terminal
Character Matrix
Character Size
Character Transmission in Alpha Mode
Character Transmission in Gin Mode
Character Type
Character Writing
Character Writing Suppression
Characters, Lower Case
Clock
Control Character
Control Character Sequence
Cursor, Alpha
Cursor, Crosshair
Data Transfer Rate
Display Measurement Unit
Display Size
Display Unit Specifications
Echoplex
Echoplex Suppression
Environmental Specifications
Gin Mode
Graph Mode
Graphic Address
Graph Mode Memory
Graph Mode Vector Drawing
Hard Copy Mode
Hold Status
Home Position
Interface Specification
Line, Alpha Mode
Line Feed
Line Length, Graphic
Local Operation
Margin, Horizontal
Minibus
Modes
Options, Equipment
Options, Strappable
Pagefull
Physical Characteristics
Point (Tekpoint)
Power Supply Specifications
Receive Rate
Resetting Gin to Alpha Mode
Resetting Graph to Alpha Mode
Resetting Home Position
Resetting Margin 1 to Margin 0
Space
Status Bits
Strappable Options
Tekpoint
Thumbwheels
Time, Character Writing
Time, Vector Drawing
Transmission, Alpha Mode
Transmission, Gin Mode
Transmission Rate
Vector Drawing Time
Vector Dynamic Geometry Error
Vector Length Error
View Mode

Alphabetic Listing

Accessories. See Table 2-14.

Address. A display position with reference to a grid of 1024 x 1024 points with 0, 0 being at the bottom left. Point density is nominally 54.5 points per cm (139 points per inch) horizontal or vertical with Terminal adjusted as outlined in the adjustment procedure.

Alpha Mode. A Terminal writing mode in which characters are written on the display screen. See Character Effect on Terminal and Table 2-2 for details.

Arming. Certain functions at the Terminal require a control sequence whose first character "arms" the Terminal, permitting the next character to perform a function other that what it would do if the Terminal were not armed. ESC is normally used as the arming command. The execution commands are listed under "Character Effect on Terminal". In addition, accessory devices may use other execution commands as explained in the accessory device instruction manual.

Carriage Return. Return of writing beam to the left or center margin (depending on effective margin position). Occurs on receipt of CR or ESC FF. Also occurs on receipt of LF if strapped on TC-1. Occurs automatically when beam spaces past 1023 address in Alpha Mode. Also caused by initializing or pressing PAGE or RESET key.

Character Effect on Terminal. Terminal recognizes all characters contained in ASCII code. During Alpha Mode all alphanumeric and graphic characters result in character writing and subsequent spacing except as follows: Low Case letters are written as upper case; Grave Accent (opening single quotation mark) is written as Commercial At; and Opening Brace is written as an Opening Bracket. Space causes spacing only. The 4010 does not respond to Vertical Line, Closing Brace, or Overline (Tilde). Rubout (DEL) is accepted and sent as a character, but does not cause a space or print. Control character and control character sequences are decoded and perform specific functions as shown in Table 2-1. Additional use of control characters or control character sequences may be made by accessory devices connected through circuit cards to Terminal minibus. Control characters or control character sequences are recognized during Graph Mode; all other data received in Graph Mode is accepted as a vector address as explained in Graph Mode.

Character Matrix. A five-by-seven dot pattern which creates characters by lighting specific combinations of the dots. Dot position is determined by modifying the X and/or Y position of the deflection beam through the pattern shown in Fig. 2-1. The matrix stops long enough in each position to turn the beam on to store a dot during character writing, or to display a non-storing dot during Alpha Mode cursor writing. The bottom-left dot in the matrix is determined by the X and Y register contents (address). However, the X and Y deviation from this point is independent of the register address. Matrix size is approximately 2.7 mm high x 1.8 mm wide (0.1 x 0.07 inch).

Character Size. Limits determined by character matrix, which is approximately 2.7 mm high x 1.8 mm wide.

Character Transmission in Alpha Mode. All ASCII characters except lower case, grave accent, opening brace, vertical line, and aproximate can be transmitted from the keyboard in response to a key, in response to a SHIFT and key combination, or in response to a CTRL SHIFT and key combination. ALT MODE key transmits the code for closing brace; RUBOUT sends the code for DEL. Bit 8 is sent as strapped at the keyboard (normally high), or as determined by the data communication interface in use. The minibus can accept any eight-bit combination from accessory units and transmit them to the computer.

Character Transmission in Gin Mode. A sequence of characters is transmitted to the computer in response to a control character sequence from the computer. See Gin Mode for details.

Character Type. If the Terminal is equipped with an alternate character set, it can be selected in accordance with the option setting as explained in Table 2-13.

Character Writing. The Terminal has writing capability for 63 ASCII characters as shown in Fig. 2-1. Character writing time is approximately 0.8 ms.

Character Writing Suppression. The character generator is suppressed in Gin and Graph modes. The Alpha cursor as well as alphanumeric characters are prevented from being written. The character generator becomes fully enabled when the Terminal is switched from Graph to Alpha Mode. It also becomes fully enabled when Gin Mode is ended by an ESC FF or CR command from the computer or by a PAGE or RESET command from the keyboard. However, when Gin Mode is ended by transmitting the address of the Alpha cursor or the crosshair intersect address, the character generator will not become fully enabled unless the CR is sent as a part of the address transmission, *AND IS ECHOED BACK* by the computer. If CR is not echoed back, the Terminal will be unable to write in Alpha Mode (even though the Alpha cursor appears) until one of the following is received by the Terminal: BEL, BS, CR, ESC ETB, ESC FF, HT, LF, US, VT from the computer, or PAGE, RESET, LOCAL, or MAKE COPY from the keyboard.

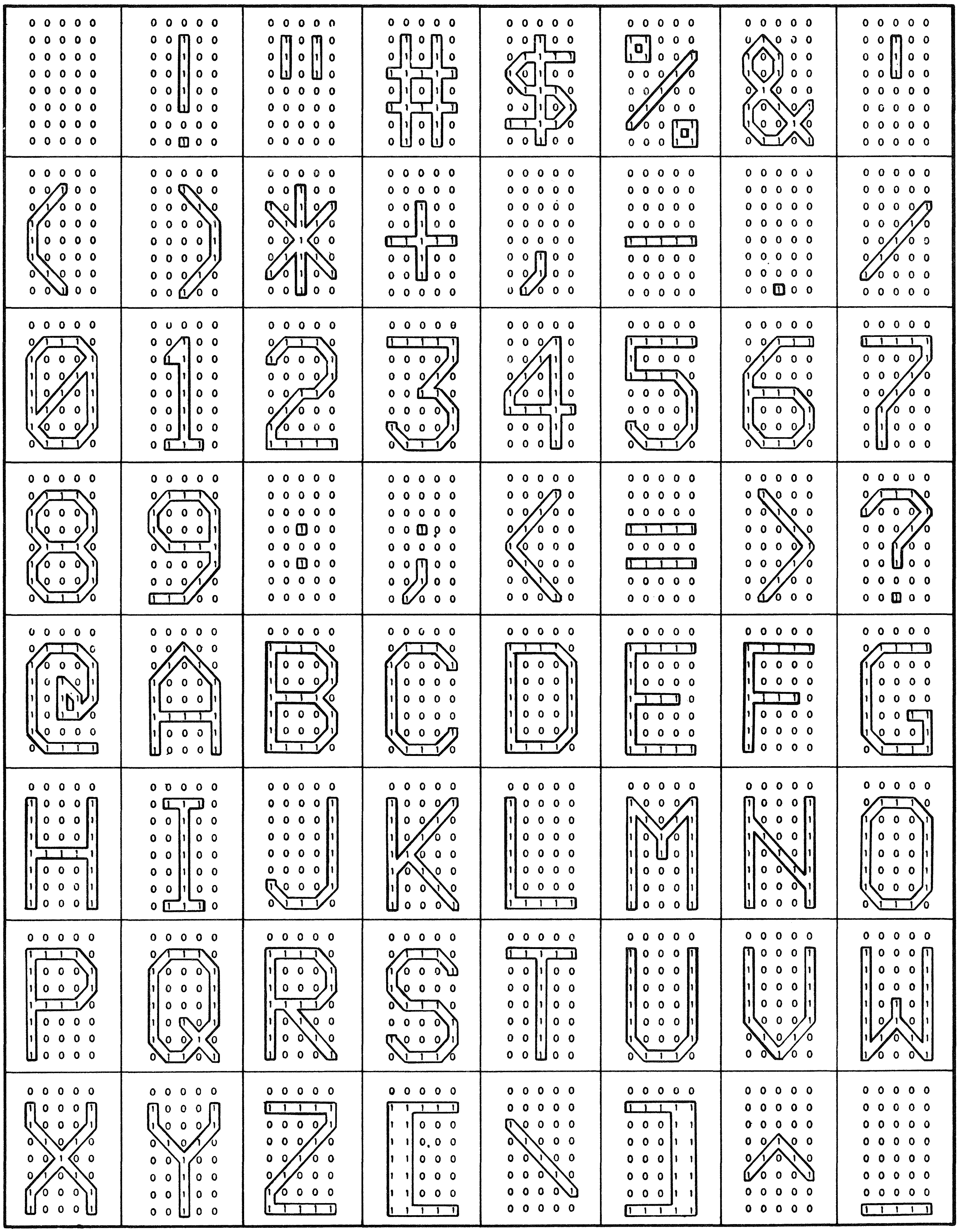


Fig. 2-1. Written Character Set.

Characters, Lower Case. Lower case ASCII characters are accepted and recognized as upper case characters during Alpha Mode. Lower case characters cannot be transmitted unless placed on the minibus by an accessory device, since the keyboard does not have lower case capability.

Clock. The Terminal operates on an internal 4.9 MHz clock. This and a 614 kHz derivation are available on the minibus.

Control Character. See Character Effect on Terminal.

Control Character Sequence. See Character Effect on Terminal.

Cursor, Alpha. Flickering, non-storing five-by-seven dot matrix which indicates position of writing beam. Occurs in Alpha Mode, during View condition. Position of lower-left corner of matrix is sent to computer in response to receipt of an ESC ENQ command sequence.

Cursor, Crosshair. Gin Mode non-storing cursor occurring in response to an ESC SUB command sequence. Cursor is caused by alternate cycling of the X and Y registers through each point, pausing at each point long enough to write the point with an intensity insufficient for storing it. The intersect point can be moved to any point within 0-1023 X and 0-780 Y by using the keyboard X and Y thumbwheels. The address of the intersect point is sent to the computer in response to an ESC ENQ from the computer or in response to entering a keyboard character. See Gin Mode for explanation of transmission.

Data Transfer Rate. Interface dependent; limited to approximately 12,000 words per minute (average of six characters per word).

Display Measurement Unit. Point. Equivalant to one increment of X or Y position register. Approximately 54.5 points per cm (139 per inch). 0.183 mm between center of points. 1024 X points addressable and viewable; 1024 Y points addressable, 780 Y points viewable (Terminal adjusted as outlined in adjustment procedure).

Display Multiplexer Option Strap. A strap (on the Motherboard) which can be removed for controlling the display with a Display Multiplexer card. A cable then connects between J35 and the Display Multiplexer card. This feature is not included in standard Motherboards numbered 670-1734-00.

Display Size. 19.1 cm horizontal by 14.3 cm vertical with its center within 6.35 mm of CRT faceplate center (7.5 x 5.625 inches centered within 0.25 inch).

Display Unit Specifications. Refer to Table 2-9.

Echoplex. Consists of executing data at the Terminal as the data is being sent to the computer. Can be caused by placing an $\overline{\text{ECHO}}$ command on the minibus, usually from the interface unit.

Echoplex Suppression. Over-rides the $\overline{\text{ECHO}}$ signal from the interface unit, inhibiting echoplex operation. Occurs automatically when the Terminal is in Gin Mode, permitting the coded position data to be sent to the computer without affecting the Terminal, despite condition of the $\overline{\text{ECHO}}$ signal. See Table 2-6 for additional details.

Environmental Specifications. See Table 2-12.

Gin Mode. An interactive graphic mode which permits the Terminal to send one of the following to the computer: Terminal status and the position of the bottom-left corner of the Alpha cursor; or the Terminal status and the Graph Mode beam position; or the position of the Gin Mode crosshair intersect point. The crosshair intersect point is controlled by the thumbwheels at the right on the keyboard. Note that moving the horizontal thumbwheel to either limit may remove the vertical line from the display and disable the vertical thumbwheel. Similarly, moving the vertical thumbwheel to the lower limit may remove the horizontal line from the display and disable the horizontal thumbwheel. The Terminal status and Alpha cursor position is sent if ESC ENQ is received while the Alpha cursor is being displayed. Terminal status and Graph Mode beam position is sent if ESC ENQ is received while in Graph Mode. Receipt of ESC SUB causes the crosshair cursor to be displayed. Its intersect point is then sent in response to an ESC ENQ from the computer or in response to the operator entering a keyboard character. A delay of at least 20 ms must occur between ESC SUB and ESC ENQ. See Table 2-6 for Gin Mode details.

Graph Mode. A graphic display mode which occurs upon receipt of GS. It permits the Terminal to accept data as addresses. Movement to the address can either be dark or can result in drawing a vector. See Tables 2-3, 2-4, and 2-5.

Graphic Address. A combination of X and Y register values which indicates a position on the display (X 0-1023, Y 0-780) or off the display (Y 780-1023). Address of bottom-left corner of display is 0X, 0Y; address of top-right corner of display is 1023X, 780Y. See Tables 2-4 and 2-5 for information about sending an address to the Terminal.

Graph Mode Memory. The ability of the Terminal to remember the first three bytes of the last graphic address when switched out of Graph Mode. The Terminal requires receipt of only the low X byte to return to its last Graph Mode address when switched back to Graph Mode.

Graph Mode Vector Drawing. See Table 2-4.

Hard Copy Mode. Permits copying of the Terminal Display by a Hard Copy Unit. Applicable to 4010-1, but not 4010. Mode is caused by $\overline{\text{READ}}$ from a Hard Copy Unit. $\overline{\text{TBUSY}}$ holds the Terminal busy during Hard Copy Mode. See Table 2-8.

Hold Status. A reduced intensity condition for the display unit. It occurs if the Terminal is inactive for approximately 90 seconds. The Terminal returns to View Status as soon as data is received or a keyboard character is entered.

Home Position. Top left corner of display unit in Alpha Mode, commanded by 0X, 767Y. Beam moves to that position upon initialization, and upon receiving ESC FF. It is also arrived at by entering PAGE or RESET at the keyboard.

Interface Specification. See documentation pertaining to specific interface unit.

Line, Alpha Mode. Consists of ⩾72 character spaces; lines are 22 points apart (approximately 4 mm or 0.16 inch) between identical reference points. 35 lines comprise the total display.

Line Feed. Moves writing beam down 22 points. This equals one line in Alpha Mode. Occurs upon receipt of LF or ESC FF. Occurs automatically when spacing past the end of a line.

Line Length, Graphic. Maximum line lengths within the quality display area are 18.75 cm (7.4 inch) horizontal, 14.3 cm (5.625 inch) vertical, 23.6 cm (9.29 inches) diagonal. (Values given are within the display quality area with the Terminal adjusted as outlined in the adjustment procedure.)

Local Operation. Off-line operation used principally for operator training, formatting of data, and equipment maintenance. It is selected by the LOCAL/LINE switch at the keyboard, and isolates the Terminal from the computer. See Table 2-7 for details.

Margin, Horizontal. Margin Ø is located at 0X; Margin 1 is located at 512X. Margins alternate automatically when line-feeding past the 35th line. Carriage return resets the beam to selected margin. ESC FF resets the Terminal to Margin Ø. Terminal also resets to Margin Ø in response to PAGE or RESET keys.

Minibus. Signals available at each of the board-edge connectors on the motherboard (except for Deflection Amp and Storage board connector). See Dictionary of Line Titles and Wire List in the Diagrams section for details.

Modes. Alpha (Alphanumeric), Graph (Graphic Display), Gin (Graphic Input), Hard Copy. See specific mode descriptions for details.

Options, Equipment. Options available for the 4010/4010-1 at the time of this printing include the Optional Data Communication Interface and a variety of TTY Port Interfaces. Also see Accessories.

Options, Strappable. See Table 2-13 for strappable options for the basic 4010/4010-1; see interface unit documentation for strap option information pertaining to interface units.

Pagefull. A condition occurring in Alpha Mode when line-feeding past the 35th line. It causes Margin 1 to occur (center of screen) if Margin Ø had been set, and vice-versa. Margin 1 can cause a terminal busy signal, if selected by option on TC-2.

Physical Characteristics. See Table 2-11.

Point (Tekpoint). The basic unit of measurement for Graph and Gin Modes. 1024X (0-1023) and 1024Y (0-1023) points addressable; 1024X and 780Y viewable. Point spacing is approximately 0.18 mm. (Approximately 54.5 points per cm.) (Terminal adjusted as outlined in the adjustment procedure.)

Power Supply Specifications. See Table 2-10.

Receive Rate. Capable of ⩾12,000 words per minute (average of six characters per word). Interface dependent.

Resetting Gin to Alpha Mode. Gin Mode is cancelled and Alpha Mode reset upon receipt of CR or ESC FF from the computer. Resets to Alpha (without transmitting to computer) in response to entering PAGE or RESET at the keyboard. Terminal also resets to Alpha Mode after completing Gin transmitting function. Refer to Table 2-6 for details.

Resetting Graph to Alpha Mode. Graph Mode is cancelled and Alpha Mode reset in response to US, CR or ESC FF from the computer. It can also be reset by entering PAGE or RESET at the keyboard.

Resetting Home Position. The Terminal display resets to home position (top-left of display) in response to ESC FF from the computer. It also resets to home position in response to an LF past line 35 if Margin 1 exists and the TC-1 option is set so that line feed causes carriage return. Home position also occurs when PAGE or RESET is entered at the keyboard.

Resetting Margin 1 to Margin Ø. Margin 1 (horizontal center of display) resets to Margin Ø (left edge of display) in response to ESC FF from the computer, or in response to an LF (line feed) past the 35th line. Margin Ø also occurs in response to PAGE or RESET entered at the keyboard.

Space. An Alpha Mode measurement made from a reference point in a character to the same reference point in a horizontally adjacent character. A space is equal to 14 Tekpoints, which equates to approximately 2.6 mm (0.1 inch). There are at least 72 spaces per line.

Status Bits. Bits transmitted in Gin Mode to denote the status of the Terminal. They are transmitted as part of a response to an ESC ENQ received while in Alpha or Graph Mode, and consist of the following:

Bit 8 = 1, Bit 7 = Ø, Bit 6 = 1.

Bit 5 = Hard Copy Unit status; 0 is intended to mean that the Hard Copy Unit is in working order, ready to accept a hard copy request. (With 4610 connected, it means that the 4610 Hard Copy Unit is connected and energized.)

Bit 4 = Vector Status indicator. A 1 indicates that the Terminal is set up to draw vectors.

Bit 3 = Graphic Mode indicator. A Ø indicates that a graphic mode exists. 1 indicates Alpha Mode.

Bit 2 = Margin Indicator. 1 indicates that Margin 1 exists. Ø indicates Margin Ø.

Bit 1 = Auxiliary device indicator. Ø indicates that some optional auxiliary unit is activated.

Strappable Options. Optional operating features which can be selected by connectors within the Terminal. See Table 2-13.

Tekpoint. A unit of measurement associated with TEKTRONIX Terminals. It consists of the distance between two adjacent points in the 1024 x 1024 grid provided by the X and Y registers. See Point.

Thumbwheels. Potentiometers located on the keyboard; used to position the crosshair cursor.

Time, Character Writing. Approximately 0.8 ms.

Time, Vector Drawing. Time required to draw a complete vector is approximately 2.6 ms.

Transmission, Alpha Mode. Data is transmitted as entered at the keyboard, or as placed on the minibus by other devices.

Transmission, Gin Mode. Data is transmitted as a series of bytes in response to an ESC ENQ from the computer, or in response to a keyboard character entered while the crosshair cursor is displayed. Refer to Table 2-6 for details.

Transmission Rate. Interface dependent. See documentation pertaining to the specific interface unit. Also see Data Transfer Rate.

Vector Drawing Time. 2.6 ms or less.

Vector Dynamic Geometry Error. Deviation from mean straight line does not exceed 1.5% worst case (45° line).

Vector Length Error. Does not exceed 1% of actual vector length.

View Mode. Normal intensity display. Occurs at all times except during copy making (Hard Copy Mode) and Hold Status.

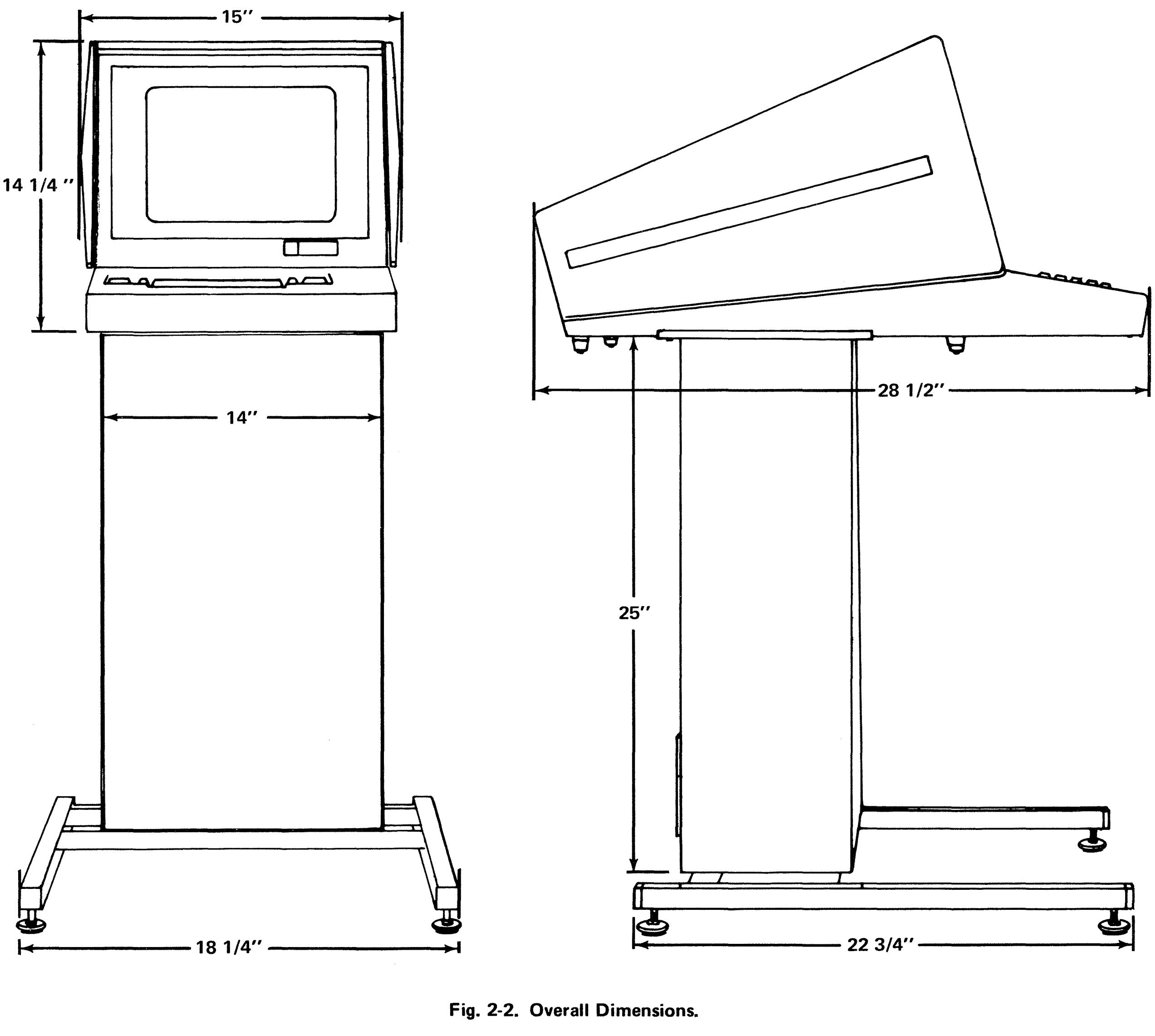


Fig. 2-2. Overall Dimensions.

TABLE 2-1

Control Character Effect on Terminal

ASCII	TTY	Effect
BEL	CONTROL G	A burst of 1200 hertz tone on the speaker. Makes Terminal go busy for approximately 200 ms. Sending a character or vector to the Terminal during the tone burst will terminate that burst.
BS	CONTROL H	Backspaces one space. Backspacing to the left of the margin will cause wraparound.
CR	RETURN or CONTROL M	Causes carriage return by clearing X register. Clears Gin and Graph. (If the crosshair is reset with CR, the resulting status of Y and Margin perform the Page Full function. With interfaces directly connected to the CPU, it is better to clear the cursor by sending ESC ENQ or ESC FF.)
ESC	CONTROL SHIFT K	First character of a special two-character sequence. (See ESC ENQ, ESC FF, ESC ETB, ESC SUB.) ESC raises LCE (B on the Minibus) which remains high until after the trailing edge of the next byte or activation of $\overline{\text{HOME}}$. Does not cause a response on $\overline{\text{TBUSY}}$.
ESC ENQ	CONTROL SHIFT K CONTROL E	Causes Terminal status and/or cursor position to be sent to CPU. Useful for remote diagnostics, in addition to graphic uses. Local copy is not generated. See explanation under Gin Mode. Activates echoplex suppression. If the $\overline{\text{CSTROBE}}$(s) generated does not cause a $\overline{\text{CBUSY}}$ response, TC will remain in Gin Mode. This would occur if ESC ENQ were struck while in LOCAL. Does not cause a response on $\overline{\text{TBUSY}}$.
ESC ETB	CONTROL SHIFT K CONTROL W	$\overline{\text{MAKE COPY}}$ is asserted.
ESC FF	CONTROL SHIFT K CONTROL L	Same as PAGE signal from keyboard. Erases screen. Resets X to 0. Resets Y to 1023. Y then counts down to 767 at 614 kHz. Resets Gin, Echoplex Suppression, Margin, and Graph.
ESC SUB	CONTROL SHIFT K CONTROL Z	Clears Graph. Starts crosshair cursor (which sets Gin). Activates Echoplex Suppression (see below). Does not cause a response on $\overline{\text{TBUSY}}$.
GS	CONTROL SHIFT M	Sets Terminal to Graph Mode; sets for dark vector. Does not cause a response on $\overline{\text{TBUSY}}$.
HT	CONTROL I	Spaces one space to right.
LF	CONTROL J	Y moves down one line (counts down by 22). If Y underflows, margin is complemented and Y counts down to 767. Strap on TC-1 can be set so that it also causes carriage return.
SI	CONTROL O	If strap on TC-1 is set for SI-SO, selects the normal Character Set (ROM A). Does not cause a response on $\overline{\text{TBUSY}}$.
SO	CONTROL N	If strap on TC-1 is set for SI-SO, selects the alternate character set (ROM B), if installed. Does not cause a response on $\overline{\text{TBUSY}}$.
US	CONTROL SHIFT O	Clears Terminal from Graphic Display Mode.
VT	CONTROL K	Y counts up by 22. If Y exceeds 767, Y will then count back down to 767.

TABLE 2-2

Alpha Mode Specification

Character Writing Area	19.1 cm x 14.3 cm (7.5 x 5.625 inches).
Character Writing Position	Indicated by pulsating cursor (5 x 7 dot matrix), 1.8 mm wide x 2.7 mm high (.07 x 0.1 inch).
Character Recognition	Complete ASCII code is recognized.
Character Writing	Lower case is written as upper case, providing 63 different printing characters.
Character Size	Written within limits of 5 x 7 dot matrix, restricting size of largest characters to 1.8 mm wide by 2.7 mm high.
Character Writing Time	Approximately 0.8 ms, providing at least 1200 characters per second.
Characters Per Line	At least 72.
Space	14 Tekpoints (equal to approximately 2.6 mm) between corresponding points in adjacent characters.
Number of Lines	35 lines.
Line Feed Spacing	22 Tekpoints (approximately 4 mm) between corresponding points on adjacent lines.
Carriage Return/Line Feed	Automatically occurs after character is written at end of line (74th character). Strap option can be set to cause carriage return to occur in response to programmed line feed.
Margin	Margin Ø (left edge) and Margin 1 (horizontal center) alternately occur when executing a line feed while at 35th line.
Rubout	Does not print or space.
Home	Top-left corner of display (0X, 767Y).
Pagefull	Occurs when line-feeding past 35th line with Margin Ø set.
Mode set by	Initialization; PAGE or RESET at keyboard; receipt of ESC FF or CR.
Writing Rate	⩾12,000 words per minute (average of 6 characters per word).
Cursor	Non-storing, pulsating 5 x 7 dot matrix.
Hold	Reduced intensity status which occurs in Alpha Mode only; occurs after approximately 90 seconds of inactivity.
View	Normal viewing status.

TABLE 2-3

Graph Mode Specification

Mode Function	Display graphic information.
Mode Commanded By	ASCII GS.
Mode Ended By	ASCII US, CR, ESC FF, ESC SUB, or keyboard entry of PAGE or RESET.
Basic Unit of Measurement	Point (Tekpoint).
Address Capability	1024X by 1024Y points.
Display Capability	1024X by 780Y points.
Display Address Orientation	0, 0 at bottom-left of display; 1023X, 780Y at top-right.
Display Area	19.1 cm by 14.3 cm (7.5 x 6.525 inches).
Vector Length Error	Does not exceed 1% of actual vector length.
Vector Writing Time	2.6 ms.
Vector Dynamic Geometry Error	Deviation from mean straight line does not exceed 1.5% worst case (45° line).
Display Scale Factor	Approximately 0.18 mm (.07 inch) point center to point center (approximately 54.5 points per cm or 139 points per inch).
Dark Vectors	First vector to follow a GS is unwritten. GS can be repeated at any time. Second vector following GS, and all subsequent vectors, are written.
Viewing Time	Indefinite—Hold Status is inhibited. (Terminal should not be kept in Graph Mode when not in use.)
Vector Drawing Commands	See Tables 2-4 and 2-5.
Wraparound	Enabled.
Margin	Disabled.
Graph Mode Memory	First three bytes of last Graph Mode address are remembered when the Terminal is switched out of Graph Mode. Terminal requires only the Low X byte to return to its last graphic address when switched back to Graph Mode.

TABLE 2-4

Graph Mode Vector Drawing

(1) GS Places the Terminal in Graph (Vector) Mode.

(2) The Terminal can be addressed to any position within 0-1023X and 0-1023Y as follows:

(A) Convert Y coordinate to ten binary digits; convert X coordinate to ten binary digits.

(B) Form a Hi Y byte by affixing 01 (as bits 7 and 6) to the 5 MSB of the ten digits of the Y coordinate.

(C) Form a Lo Y byte by affixing 11 (as bits 7 and 6) to the 5 LSB of the ten digits of the Y coordinate.

(D) Form a Hi X byte by affixing 01 (as bits 7 and 6) to the 5 MSB of the ten digits of the X coordinate.

(E) Form a Lo X byte by affixing 10 (as bits 7 and 6) to the 5 LSB of the ten digits of the X coordinate.

(F) Send the four bytes as formed in (B) through (E).

(3) The Lo X byte causes the beam to move to the new position. The first movement after a GS is unwritten (dark vector). Subsequent movement in response to a Lo X byte is written to form a vector. GS can be sent at any time to cause the next vector to be dark. (780Y-1023Y is outside the viewing area of the horizontally oriented display.)

(4) Address transmission can consist of all four bytes or can be shortened to 3, 2, or 1 byte(s). Omitted bytes are assumed to be correct as held in the Terminal. Table 2-5 specifies the minimum byte transmission which is required under all addressing situations.

(5) Hi Y, Lo Y, and Hi X bytes of the last address received are "remembered" by the Terminal if switched to Alpha or Gin Mode. The Terminal requires receipt of only the Low X command to return to its last address after being switched back to Graph Mode.

(6) Hold status is inhibited during Graph Mode.

TABLE 2-4 (cont)

(7) Graph Mode is ended by US, CR or ESC FF, which reset the Terminal to Alpha Mode. Graph Mode can also be ended by ESC SUB, which switches the Terminal to Gin Mode. PAGE and RESET from the keyboard also end Graph Mode, resetting Alpha Mode.

(8) TBUSY does not occur in response to Hi Y, Lo Y, Hi X.

TABLE 2-5

Bytes Required for Graphic Addressing

Bytes Which Change				Byte Transmission Required			
Hi Y	Lo Y	Hi X	Lo X	Hi Y	Lo Y	Hi X	Lo X
			#				#
		#			#	#	#
	#				#		#
#				#			#
		#	#		#	#	#
	#		#		#		#
#			#	#			#
	#	#			#	#	#
#		#		#	#	#	#
#	#			#	#		#
	#	#	#		#	#	#
#		#	#	#	#	#	#
#	#		#	#	#		#
#	#	#		#	#	#	#
#	#	#	#	#	#	#	#
Sending initial address				#	#	#	#
Returning to remembered address							#

TABLE 2-6

Gin Mode Specifications

Functions

Transmit Terminal Status and Alpha Cursor Position

With Alpha cursor displayed, the Terminal status, address of bottom-left corner of Alpha cursor, CR[1] and EOT[1] are transmitted to the computer in response to ESC ENQ from the computer. The Terminal automatically resets to full Alpha Mode upon completion of sending the following bytes if CR is echoed by the computer. Otherwise, the Terminal must be reset as explained under Echoplex Suppression. Note that if CR is echoed, it resets the cursor to the left margin.

Byte	Item	Bit 7	Bit 6	Bits 5—1
1	Terminal Status	0	1	Status Bits
2	High bits of X address	0	1	5 MSB X
3	Low bits of X address	0	1	5 LSB X
4	High bits of Y address	0	1	5 MSB Y
5	Low bits of Y address	0	1	5 LSB Y
6	CR[1]	0	0	01101
7	EOT[1]	0	0	00100

Transmit Terminal Status and Graph Mode Beam Position

If ESC ENQ is received while in Graph Mode, bytes 1 through 7 will be sent as explained above. Echoing of the bytes by the computer is not recommended because echoing of bytes 1 through 5 will affect the content of the Y memory latch, and echoing of CR will reset the Terminal to Alpha Mode.

Display Crosshair Cursor

ESC SUB from the computer turns the crosshair cursor on. (ESC SUB should not be entered at the keyboard.) This is a preparatory state for transmitting the address of the crosshair intersect point. The Terminal can be reset to Alpha Mode by ESC FF without causing it to transmit the crosshair intersect address. The Terminal can also be reset to Alpha Mode by a PAGE or RESET command entered at the keyboard, without transmitting the crosshair intersect address.

Transmit Crosshair Intersect Address

In Response to ESC ENQ

With crosshair cursor displayed, ESC ENQ from the computer causes transmission of bytes 2 through 7 as previously listed. The Terminal automatically returns to Alpha Mode upon completion of transmission if CR is echoed by the computer. Otherwise, the Terminal must be reset as explained under Echoplex Suppression. A 20 ms delay must exist between ESC SUB and ESC ENQ.

In Response to Keyboard Character Entry

With crosshair cursor displayed, a keyboard character entry causes the Terminal to transmit the keyboard character, and then to transmit bytes 2 through 7 as previously listed. The Terminal automatically returns to Alpha Mode upon completion of transmission if CR is echoed by the computer. Otherwise, the Terminal must be reset as explained under Echoplex Suppression.

[1] **CR and EOT are optional, being dependent on straps on TC-2. EOT, or CR and EOT may be omitted. EOT cannot be sent without sending CR.**

TABLE 2-6 (cont)

Address	
Basic Unit of Measurement	Point (Tekpoint).
Alpha Cursor	
Limits	0 to 1023X, 0 to 767Y, inclusive.
Transmission Accuracy	Actual address of lower left corner is transmitted. However, if Margin 1 exists (as indicated by Bit 2 of the status byte) and the X transmission is less than 512, the address is with respect to Margin 1 (center screen). The address must then be increased by 512 to determine its value with respect to Margin 0 (left edge of screen). Effectively, if the Margin bit is true, the most significant X bit (512 bit) must be considered to be true, regardless of how it was transmitted by the Terminal.
Crosshair Cursor	
Limits	4X to 1023X, 0Y to 780Y inclusive, except in Terminals containing TC-2 circuit cards numbered 670-1729-00, where it is 15X to 1023X, 0Y to 767Y, inclusive.
Controlled by	Horizontal and vertical thumbwheels at right on keyboard panel.
Transmission Accuracy	Within ±1 point of actual position of crosshair cursor intersect point.
Status Bits	Bit 8 = 1, Bit 7 = Ø, Bit 6 = 1.
	Bit 5 = Hard Copy Unit status; Ø is intended to mean that it is in working order, ready to accept a hard copy request. (With 4610, it indicates the Hard Copy Unit is connected and energized.)
	Bit 4 = Vector Mode indicator. 1 indicates that the Terminal is set to draw vectors.
	Bit 3 = Graph Mode indicator. Ø indicates that a graphic mode exists; 1 indicates Alpha Mode.
	Bit 2 = Margin indicator. 1 indicates that Margin 1 exists; Ø indicates Margin Ø.
	Bit 1 = Auxiliary device indicator. Ø indicates that some optional auxiliary device is activated.
Echoplex Suppression	Over-rides local echoing and disables character generator during Gin Mode. The receiving circuits automatically become enabled upon completion of transmission if CR is echoed by the computer. If CR is not echoed, the Terminal must be reset by BEL, BS, CR, ESC ETB, ESC FF, HT, LF, US, or VT from the computer, or by entering PAGE, RESET, LOCAL, or MAKE COPY at the keyboard. Resetting is not required in Graph Mode.
Byte Format	8 bits. In Terminals equipped with a Data Communication Interface 021-0065-00, bit 8 is determined by a strap on the keyboard which is factory-wired to 1 but may be changed to zero. In other interface units, bit 8 may be controlled by the keyboard strap or by the interface unit.

TABLE 2-7

Local Operation Specification

General	The Terminal is isolated from the computer.
Alpha Mode	Terminal accepts keyboard data as though it were coming from a computer, writing alphanumeric characters and executing control characters.
Gin Mode	Crosshair cursor can be obtained by entering a sequence consisting of CTRL SHIFT K and CTRL Z. The cursor is under full control of the thumbwheels. It will not disappear in response to character entry as it does when on-line. The Terminal can be reset to Alpha Mode by entering PAGE or RESET at the keyboard.
Graph Mode	Can be obtained by entering CTRL SHIFT M at the keyboard. Terminal will then write vectors in response to keyboard entries of graphic addresses as explained in Tables 2-3, 2-4, and 2-5. Obviously, the addresses must be converted to alphanumerics before knowing which keys send which address bytes. Low order Y bytes are limited to RUBOUT (DEL) and ALT (closing brace) since the keyboard does not have lower case capability. Dark vectors will follow any CTRL SHIFT M entries. The Terminal retains the ability to execute control characters.

TABLE 2-8

Hard Copy Mode Specification (4010-1 Only)

Function	Display is scanned by signals from the Hard Copy Unit, providing readout information to the Hard Copy Unit.
Initiated By	$\overline{\text{READ}}$ signal from Hard Copy Unit. ($\overline{\text{READ}}$ occurs in response to a Make Copy command from the keyboard, a Copy command from the Hard Copy Unit, or an ESC ETB sequence from the computer.)
Gin Cursor	Inhibited.
Alpha Cursor	Inhibited.
Hold Mode	Inhibited.
Display Unit	Under control of Hard Copy Unit.
Terminal Busy	Asserted.
Gin Mode Graphic Input	If commanded during Hard Copy Mode, the Gin transmission is delayed until copying is completed.

TABLE 2-9

Display Unit Specifications

Characteristics	Performance Requirements	Supplemental Information
Display Quality Area	7.5 inches horizontal by 5.625 inches, whose center is within 0.25 inch of the CRT faceplate center.	
Deflection Factors		
Center of Screen		Zero volts.
Edge of Screen		+5.0 volts left or down, −5.0 volts right or up.
Usable Storage Time		Up to one hour without permanent damage to the storage target. If a residual image is retained after a long viewing period, the target may be returned to normal condition by repeated erasures.
Line Straightness	Within 0.5% deviation from mean straight line (inside the specified display area).	
Geometry		
Orthogonality		$\leqslant 1°$.
Parallelism	Within ±2%.	Condition for Test: Draw a rectangle on edge of specified area. Vertical line lengths should be within 2%, and horizontal line lengths should be within 2%.

TABLE 2-10

Power Supply Specifications

Characteristics	Performance Requirements		Supplemental Information
Line Voltage Ranges	110 V AC	220 V AC	
Low	100 V ±10%	200 V ±10%	
Medium	115 V ±10%	220 V ±10% 230 V ±10%	
High	120 V ±10%	240 V ±10%	
Power Consumption			192 watts maximum.
Line Frequency Range	48 to 440 Hz		
Fuses	2 A slo-blo for 110 V operation. 1.25 A slo-blo for 220 V operation.		

TABLE 2-11

Physical Characteristics

Finish	Metal and plastic painted cabinet.
Weight	Approximately 78 lbs. (shipping weight 87 lbs.).
Dimensions, Overall	See Fig. 2-2.
Height	About 41.5 inches.
Width	About 18.25 inches.
Length	About 28.5 inches.

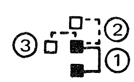
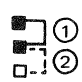
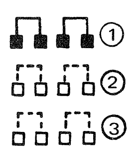
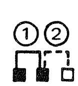
TABLE 2-12

Environmental Specifications

Temperature	
Non-operating	–40°C to +65°C.
Operating	+10°C to +40°C.
Altitude	
Non-operating	To 50,000 feet.
Operating	To 15,000 feet.
Vibration (Non-operating)	Complete 4010: Not specified. Display Only: 10-50-10 c/s @ .015" total displacement. Pedestal Only: 10-55-10 c/s @ .015" total displacement.
Shock (Non-operating)	To 20 Gs, 1/2 sine, 11 ms duration.
Transportation	Meets National Safe Transit Committee type of test when packaged as shipped by factory.

TABLE 2-13

Strappable Options of Basic 4010/4010-1

Feature	Location (see Fig. 2-3)	Choice	Effect
Character type (if alternate character memory is installed.	TC-1, 2nd row		1. Normal characters. 2. Alternate or normal character selection controlled by switch 2 on keyboard panel. 3. Alternate or normal character selection controlled by SO and SI control characters.
Line Feed Causes Carriage Return	TC-1, top row		1. Out. 2. In (LF causes carriage return).
Graphic Input Terminators	TC-2, top row		1. CR and EOT are automatically sent after address transmission in Gin Mode. 2. CR automatically follows address transmission in Gin Mode. 3. No CR or EOT sent after Gin address transmission.
PF BREAK	TC-2, 4th row		1. Out. 2. In (Page full makes 4010 busy).
Display Multiplexer Bypass Straps	Top-left on Motherboard	1. J35 connected to J36. 2. J35 connected to the Display Multiplexer card.	1. Normal. Display Multiplexer option card cannot control Terminal Screen. 2. Optional position. Terminal screen under control of installed Display Multiplexer card.

 Ⓐ1

TABLE 2-14

Accessories for the 4010/4010-1

Item	Part No.
STANDARD ACCESSORIES	
Data Communication Interface	021-0065-00
Instruction Book	062-1445-00
4010/4010-1 User's Manual	070-1225-00
OPTIONAL ACCESSORIES	
4010/4010-1 Maintenance Manual	070-1183-01
Logic Extender Card	067-0653-00
Audio Recorder Card	018-0066-01
Motherboard Extender	018-0069-00
Display Multiplexer	018-0067-00
Copy Holder	016-0291-00
72-Pin Extender Card	067-0664-00
4010 Auxiliary Card	018-0065-00
Optional Data Communication Interface	021-0074-00
TTY Port Interface (Part number varies with type of installation)	021-XXX-XX

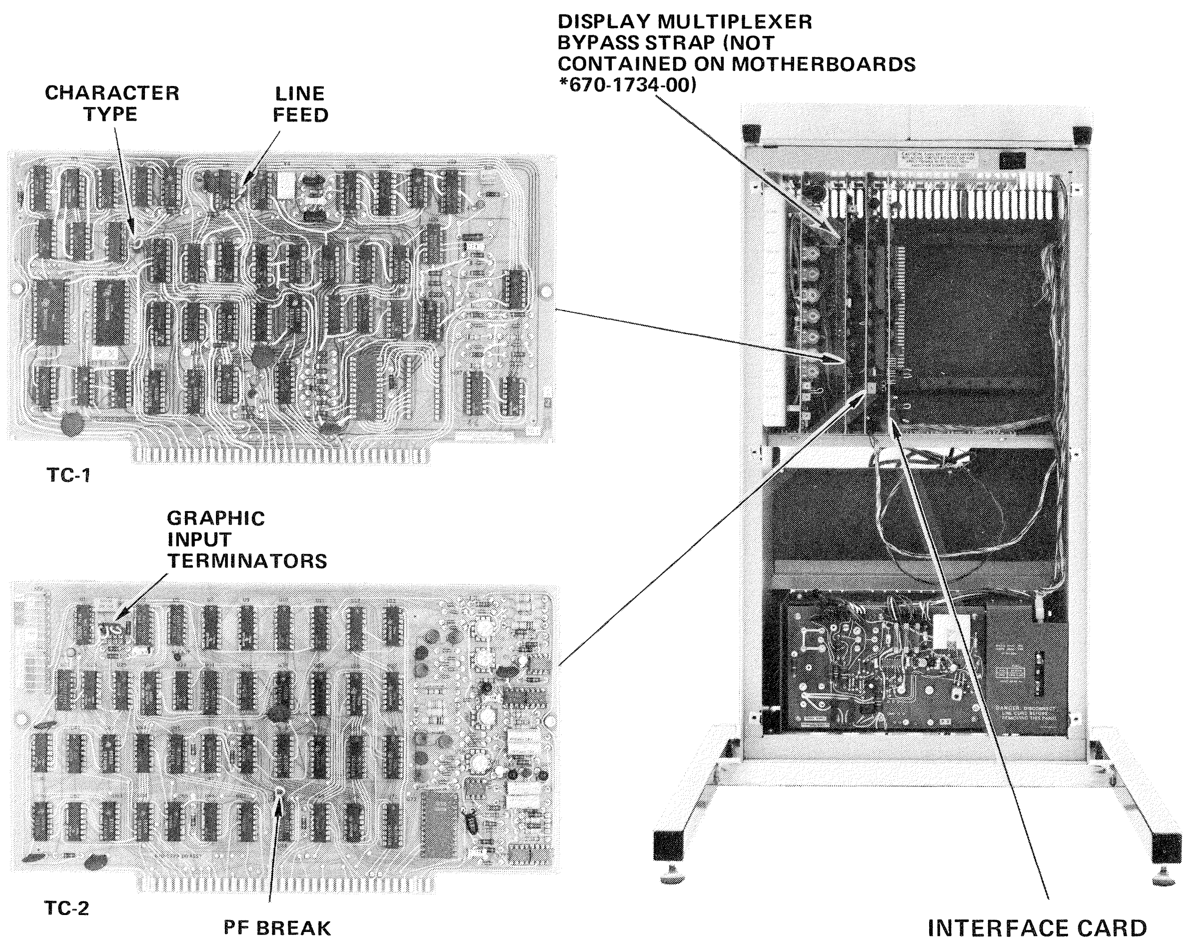


Fig. 2-3. Location of Strappable options. Additional Strappable Option information is given in Table 2-13. Locations of TC-1, TC-2, and the Interface are interchangeable.

SERVICING

INTRODUCTION

Beyond the need for occasional cleaning of the face of the display and other outer surfaces of the Terminal, there is virtually no need for routine servicing of the Terminal. It has no lubrication points, no air filters, and (with the exception of the CRT) no vacuum tubes. The solid-state components provide stable operation, with little need for routine adjustment.

However, if a routine schedule and procedure is desired, a one-year interval and the following sequence is recommended. The disassembly and assembly instructions contained in this section should be referred to as necessary.

Servicing Procedure

(1) Disconnect the line cord from the power source.

(2) Unbolt the display unit from the pedestal and set them adjacent to each other on a work surface.

(3) Remove the top from the display unit and the front from the pedestal.

(4) Using a vacuum cleaner, remove dust accumulation from within both units. Use a soft-bristled brush to loosen dust which won't otherwise vacuum out. A soft cloth and a mild soap and water solution can be used to remove any really stubborn dirt.

(5) Inspect the interior of both units for broken leads, loose connections, heat damaged components, etc. Correct as necessary. Investigate the cause of any heat-damaged components.

(6) Remove the graticule mask and the filter from the front of the display screen. Then wash the face of the CRT and the back surface of the filter, using a soft cloth and a mild soap and water solution. Then replace the filter and graticule mask. *THIS STEP SHOULD NOT NORMALLY BE NECESSARY, SINCE A NEOPRENE MOUNTING RING SEALS THE SPACE BETWEEN THE FACE OF THE CRT AND THE FILTER. IT IS RECOMMENDED ONLY IF DIRT IS VISIBLE BETWEEN THE TWO SURFACES, OR IF THE DISPLAY APPEARS EXCESSIVELY DIM AND DIRT ACCUMULATION IS SUSPECTED.*

(7) Perform the check-out procedure found in this manual. Perform the adjustment procedure if the check-out procedure indicates that it is necessary.

(8) Put the covers back on the display unit and on the pedestal. Install the display unit on the pedestal, if desired.

(9) Clean the outside of the units, using a soft cloth and a mild soap and water solution. Use particular care in cleaning the external surface of the display filter.

Mounting the Display Unit on the Pedestal

Fig. 3-1 provides details for mounting the display unit on the pedestal. The units can be separated by reversing the procedure.

TROUBLESHOOTING INFORMATION

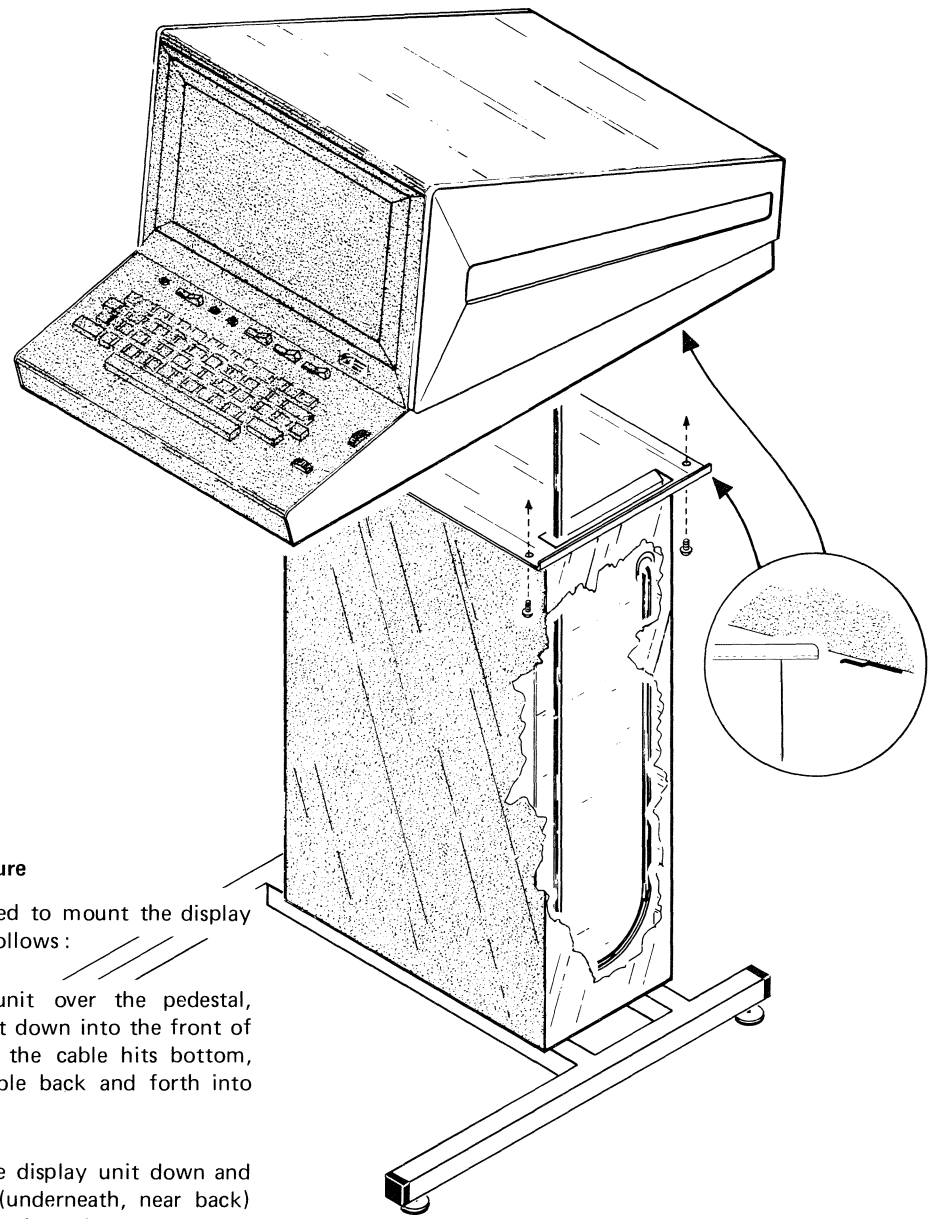
Troubleshooting of the Terminal can be done best if the various features of this manual are used to their fullest advantage. These features and recommended usage are listed here.

Controls and Operation. This information insures operator understanding of the Terminal features and operation.

Specification. A complete explanation of the Terminal capabilities is contained in the Specification, along with explanations of how to put the capabilities into use.

Performance Check. This provides a rapid means of checking for proper operation in a logical sequence under normal equipment configuration. It can also be used with the options and the interface unit removed, to indicate operating status of the basic Terminal.

Adjustment. The procedure follows a logical sequence of adjusting the basic Terminal (including verifying non-adjustable features).



Mounting Procedure

Two people are required to mount the display unit on the pedestal, as follows:

1. Lift the display unit over the pedestal, inserting the cable straight down into the front of the cable trough. When the cable hits bottom, double the remaining cable back and forth into the trough.

2. Tilt the back of the display unit down and place its hold-down lip (underneath, near back) under the pedestal top (see insert).

3. Lower the front of the unit in place. Then align the mounting holes by sliding the display forward.

4. Start the four screws through the pedestal top into the display unit. Then tighten the four screws.

Fig. 3-1. Mounting the display unit on the pedestal.

Block Diagrams and Circuit Diagrams. These diagrams and their associated descriptions provide an understanding of Terminal operation on a circuit as well as component level. The information contained therein is essential to efficient location of trouble.

Component Layout Illustrations. These appear in the Diagrams section and can be used as aids for locating components.

Interconnecting Wire Lists. A listing of cables, jacks and plugs, as well as an explanation of their use, is provided at the beginning of Section 6. Wire colors are also provided, using the standard code for resistors.

Semiconductor Information. An illustration of semiconductors appears near the beginning of the Diagrams section, and can be used for pin identification. An integrated circuit test clip is recommended for use in troubleshooting the in-line integrated circuits, since it makes their leads easily accessible.

Troubleshooting Procedure

To troubleshoot the basic Terminal, remove all accessory cards and the interface card. Then check operation by doing the Performance Check. Stop where the Terminal fails to respond properly, and troubleshoot the referenced area, using block diagrams, schematics, and associated descriptions. Replacement of suspected circuit cards is recommended as a fast means of confirming suspicions. If the Performance Check works satisfactorily in the basic Terminal, install option cards and the interface card one at a time and repeat the Performance Check until it fails. Then troubleshoot the last-inserted option card and the circuits with which it interacts.

Obviously, not all troubles can be high-lighted by the Performance Check or Calibration Procedure. However, they should prove beneficial in most cases, and should go a long way in guiding a technician to the trouble area.

Recommended Troubleshooting Equipment

A Logic Extender Card, TEKTRONIX Part No. 067-0653-00, is an efficient tool for circuit analysis. This card can be used as an independent plug-in card to make all minibus signals available to the Technician, providing level indicators for most of the lines. In addition, it provides a feature for injecting high or low level logic signals into the signal lines. The card can also be used as a extender for other circuit cards, and then permits interruption of any or all signals to the card which is attached to it.

Another extender card is available under TEKTRONIX Part No. 067-0664-00. This card can be installed into the minibus to make bus lines available at test points, and can also be used as an extender for cards installed in the minibus.

A –15 V to +400 V DC voltmeter and a 10 MHz frequency response oscilloscope are recommended test equipment for troubleshooting low-voltage and logic circuits. A –4000 V DC meter is required for troubleshooting the high voltage circuits.

WARNING

Dangerous voltages exist within the pedestal and display units. Normal electrical safety precautions should be observed at all times when working around exposed circuits within these units.

When troubleshooting the power supply circuits, a resistive dummy-load should be connected in place of the Terminal circuits. This avoids accidental damage to other circuits in the Terminal. Recommended loads are as follows:

Power Supply	Connector	Load
+15 V	J70	30 Ω, 15 W
–15 V	J73	30 Ω, 15 W
+5 V	J72	1 Ω, 50 W

DISASSEMBLY AND ASSEMBLY

Access to the Display Unit Circuitry

For access to the circuits within the display unit, remove the three screws at the top of the rear surface. Then lift the top panel up and forward.

The high voltage shield must be removed to obtain access to the majority of the circuits on the High Voltage and Z Axis circuit board. To remove it, first remove the left side panel (as viewed from the front). Then remove the three screws from the shield. Lift the shield out the side of the unit.

Keyboard Information

Perform the following procedure to get at the keyboard circuits:

(1) Remove four screws from underneath the front of the keyboard.

(2) Remove the four screws which hold the graticule mask in place and remove the mask.

(3) Remove two screws from the top-rear of the keyboard panel.

(4) Lift the keyboard out as far as the cables will allow. Then turn the keyboard over.

(5) The top surface of the circuit board can be accessed by removing the six screws which hold the keyboard assembly to the keyboard panel.

Key caps can be removed by pulling them directly away from the keyboard.

Keys can be removed by unsoldering the two contacts which hold them to the circuit board, and lifting them out of their access slots.

Pedestal Information

Access. Remove the six screws from the front cover and pull the cover off the front. Note that the line fuse is located in a holder at the bottom of the cover.

Circuit Card Removal. All cards connected to the mini-bus portion of the motherboard are held in by friction. This does not include the first card on the viewer's left (Deflection Amp and Storage Card). That card is fastened to the adjacent heat sink (which is silk-screened with the names of the card adjustments). To remove the card and the attached heat sink, remove the three screws which hold the heat sink in place. The screws are accessible at the back on the outside of the pedestal, second row in from the edge.

Power Supply Removal. Remove the cables which connect to the power supply circuit board. Remove the power plug which is connected to the transformer assembly.

At the bottom-front within the pedestal, remove the two screws which fasten the power supply side panels to the bottom of the pedestal.

On the outside at the back of the pedestal, remove the two screws on each side of the power supply heat sink.

Withdraw the power supply out the back.

When re-assembling the power supply, refer to Table 3-1 for cable-connecting information.

TABLE 3-1

Power Supply Plug Reference

+15V P70—3 pin connector	—	3 brown on red wires
P71—5 pin connector	—	Pin 1—orange on red wire Pin 2—green on white wire Pin 3—green on white wire Pin 4—black on white wire Pin 5—black on white wire
+5V P72—6 pin connector	—	4 black on red wires
-15V P73—3 pin connector	—	3 black on violet wires
P74—1 pin connector	—	Violet on white wire
P75—10 pin connector	—	8 black wires (1 wire is white on black on some instruments)
P76—3 pin connector	—	Pin 1—red wire Pin 2—orange & green on red wire
P77—3 pin connector	—	Pin 1—brown on red wire Pin 2—green on white wire Pin 3—orange on red wire
P78—3 pin connector	—	2 brown on violet wires
P79—3 pin connector	—	Pin 1—brown on violet wire Pin 2—black on violet wire Pin 3—red on white wire

Silicon Grease. Silicon grease is applied to both sides of the mica insulators used with the following components: Q510, Q515, Q520, CR502, CR503. In addition, silicon grease is applied between the heat sink and the mounting plate on Q75.

Power Transformer Information

The power transformer (located in the pedestal) can be wired for use with 115 V or 230 V nominal line voltage, and can be set for any of three ranges within the nominal setting.

Instructions for connecting the transformer are contained on the inside of the pedestal front panel and are not repeated here. Note that the line fuse must also be changed when shifting between 115 and 230 volt operation. Instructions for fuse changing are contained on the panel which covers the transformer assembly.

Display Filter Removal, Cleaning, Installation

Removal. Remove the CRT mask after removing the four screws from its corners.

Place a small piece of tape on the surface of the filter, outside of the display area. This will be used as a reference during replacement. If a new filter is to be installed, it will be used for comparison.

Remove the angle brackets from the top and the bottom of the filter, after removing the two screws from the ends of each.

Lift the filter out of the neoprene mounting ring. It may be necessary to use a thin-bladed device to aid in removal. Use caution to avoid scratching or breaking the filter.

Cleaning. Clean the face of the CRT and the under-side of the filter, using a soft cloth and a mild soap and water solution. Note that the under-side can be distinguished from the outer surface by the masking tape if the original is being re-installed. If the old filter is being replaced with a new one, the under-side can be determined by comparing it with the old filter. Note that less glare from reflected light is apparent on the outer surface than on the under surface of the filter.

Installation. Put the filter in place in the recess in the neoprene mounting ring. The outer surface should be flush with the edge of the frame when properly installed. It may be necessary to use a non-abrasive device (such as a toothpick) to work the filter into place.

Install the angle brackets and fastening screws.

Clean the outer surface of the filter, using a soft cloth and a mild soap and water solution.

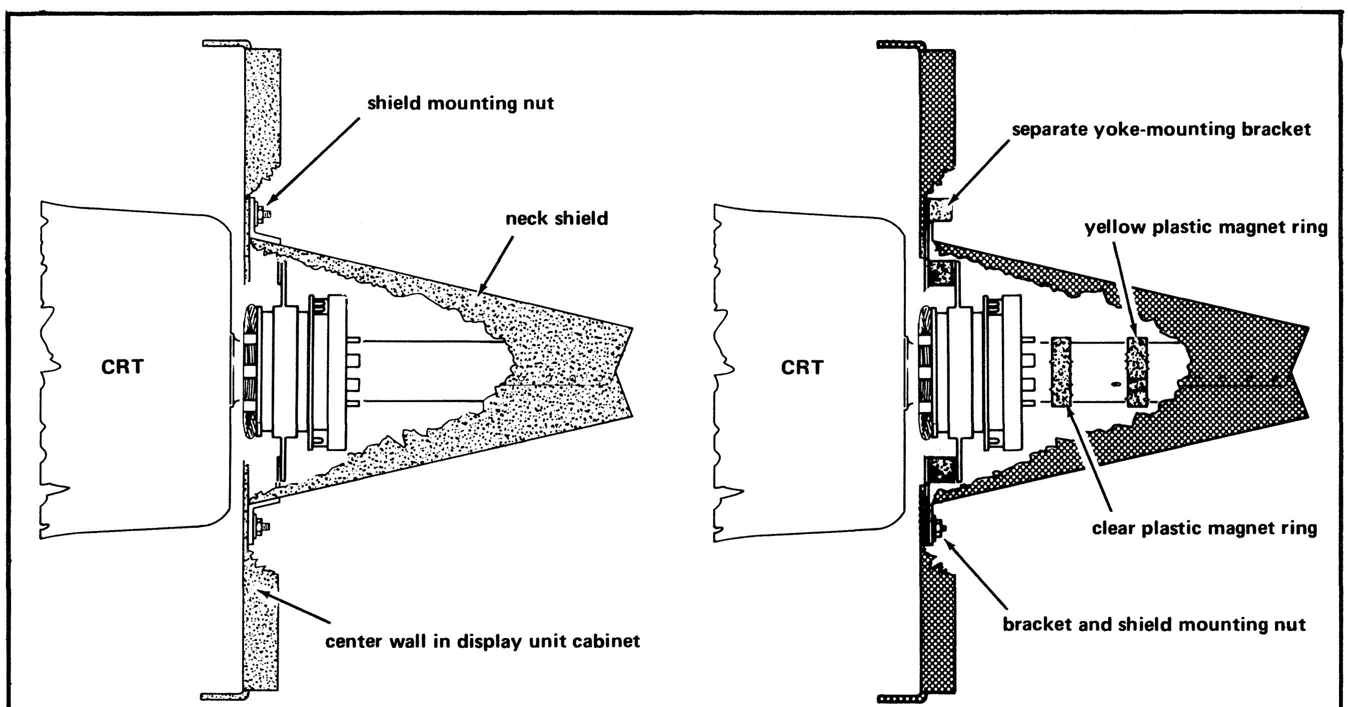
Install the face mask and fasten it in place with the four screws.

CRT and Deflection Yoke Removal and Installation

WARNING

The CRT may implode if it is scratched or struck severely. Do not handle the CRT by its neck. Wear protective clothing and a face shield when handling the CRT.

Introduction. There are two types of yoke-mounting hardware in use in the Terminal. The original type (integral yoke-mounting bracket) is shown in Fig. 3-2(A). Fig. 3-2(B)



(A) Integral yoke-mounting bracket installation.

(B) Separate yoke-mounting bracket installation. Magnet rings may or may not be present; they should only be used when supplied with the CRT being installed.

Fig. 3-2. The two types of yoke-mountings.

depicts the latest version (separate yoke-mounting bracket). CRT and yoke replacement procedures are considerably different for the two types. To determine the type being used, remove the top cover from the display unit cabinet and check for the presence or absence of the separate yoke-mounting bracket.

CRT Removal. Refer to the illustration in the Mechanical Parts List as necessary during this procedure. Remove the top from the display unit cabinet. Disconnect the plug from the rear of the neck shield by pulling gently and evenly on the leads. Disconnect the plug which connects to the leads coming from the deflection yoke near the middle of the CRT. The leads may come out of the top or bottom at the front of the neck shield.

Remove both side panels from the display unit after removing two screws from each.

If the unit contains an integral yoke-mounting bracket, loosen the two nuts which fasten the neck shield to the center wall in the display unit, permitting the shield to move freely.

If a separate yoke-mounting bracket is installed, remove the rear panel from the display unit. Then remove the two nuts which hold the neck shield to the center wall. Remove the neck shield and replace (but don't tighten) the nuts, holding the yoke bracket in place. The CRT may or may not have one or two magnet rings installed on its neck. See Fig. 3-3. If rings are installed, note that the ring positions are marked as in Fig. 3-3(A) and then slide the ring(s) off the neck of the tube.

Remove the four screws which hold the CRT mask in place at the front of the display unit.

Place a small piece of masking tape on the front surface of the filter, outside of the CRT display area. It will be used for installation reference.

Remove the four nuts from the corners of the frame which holds the CRT in place. Then remove the frame and filter assembly from the front of the CRT. There are two types of frame assemblies in existance. The latest version has grounding clips fastened to each corner of the frame which holds the CRT in place. The clips are separate items in the early version, and may remain on the studs when the frame is removed; in this event, remove the clips before proceeding.

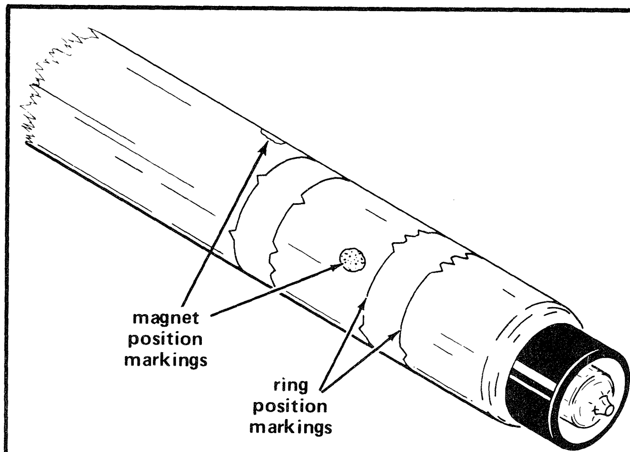
Slide the CRT out the front of the unit, avoiding side pressure which may break the neck of the CRT. A second person should feed the deflection cable and plug through the hole in the center wall to avoid its getting caught. *DO NOT HOLD THE CRT BY ITS NECK.*

Set the CRT face-down on a flat surface. The neoprene mounting ring will keep the faceplate from contacting the surface.

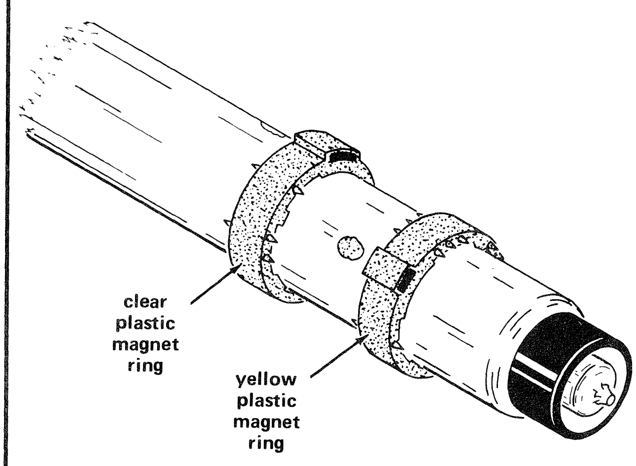
Yoke Replacement. With the CRT removed, remove the nuts and washers which hold the neck shield or yoke-mounting bracket in place. Remove the shield or yoke-mounting bracket.

Unscrew the two bolts which fasten the yoke-mounting strap to the mounting bracket or shield.

Install the new yoke. Note that the metal tang fastened to the yoke is toward the top.



(A) Section of neck showing magnet ring position markings.



(B) Magnet rings installed. Note that magnets are aligned with dots on neck. Points on ring match points on position markings. Dots permit rapid locating of magnet position, but might not be present on all CRTs.

Fig. 3-3. CRT Magnet ring location details. The magnet rings should be used only when supplied with the CRT.

Install the yoke-mounting bracket or shield, as appropriate, in place on the center wall. Leave the nuts loose enough to permit the yoke to align with the neck of the CRT during replacement.

CRT Installation. At each side, loosen (don't remove) two screws which hold the center wall in place, permitting the wall to be moved easily. Then position the wall so that the neoprene bumpers on the front of the CRT shield are just started past the tangs on the cabinet. Re-tighten the two screws at each side of the center wall.

Insert the CRT and attached neoprene mounting ring into the display unit cabinet, carefully aligning the neck with the yoke. Avoid side pressure on the neck. With the CRT partially inserted, a second person should feed the deflection plug and cable through the top or bottom, depending upon whether the CRT is inserted with the deflection cable on the top or on the bottom.

This paragraph pertains only to the early version of the frame assemblies in which the corner clips are separate from the frame. Remove the corner clips from the frame. Place a corner clip on each screw attached to the cabinet near each corner of the face of the CRT. The plane containing the hole should be outermost, with the lip aligning with the step in the neoprene mounting ring. See Fig. 3-4. (The clips may be difficult to align at this time, but will be adjusted as necessary in a later step.)

CAUTION

During the following procedure, the neck shield mounting nuts must be loose enough for the assembly to move around easily, avoiding pressure on the neck.

Remove the filter and the two angle brackets from the frame. The angle brackets are held in place by screws at each end.

Put the frame in place, fitting it over the neoprene mounting ring. Install it carefully to avoid distorting the neoprene mounting ring. If necessary, slide the CRT forward slightly to make it easier to install the frame.

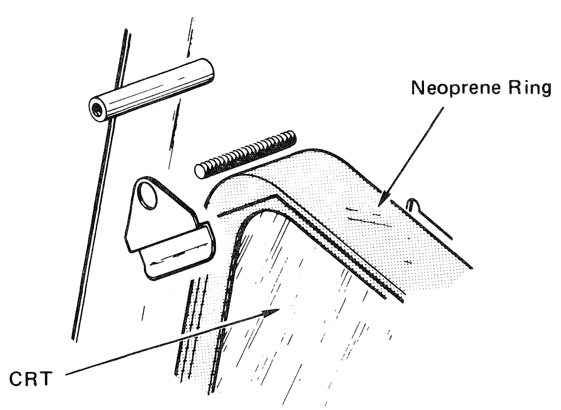


Fig. 3-4. Positioning of Corner Clips.

While holding the frame in place, install the four spacer sleeves over the corner screws, aligning the sleeves with the frame, clips, and screws as required. It may be necessary to lift up on the bottom of the frame. If the early version of the frame is installed, it may be necessary to adjust the clips while installing the spacers.

Start the nuts onto the top screws. then place the nuts on the bottom screws, pressing in and up on the bottom of the frame as necessary.

If the early version of the frame is installed, check that the clips at the bottom corners are properly in place, extending over the step in the neoprene ring; then push each clip as far toward the corner as possible and tighten the bottom nuts. Repeat at the top corners. If the latest version frame is installed (corner clips fastened to the frame), simply tighten the four nuts, drawing them up evenly.

Check the alignment of the CRT with the display unit cabinet. The edge of the display area should be parallel with the top edge of the display unit frame. If it isn't, loosen the corner nuts slightly, adjust the CRT, and retighten.

Using a soft cloth and a mild soap and water solution, clean the face of the CRT and the rear surface of the filter. (The rear surface is the side opposite to that having the tape attached. It can also be identified as the side exhibiting the most glare from reflected light.)

CAUTION

Avoid touching the face of the CRT or the back of the filter during the rest of the procedure. Otherwise, the filter will have to be removed for cleaning.

Set the filter in place in the recess in the neoprene mounting ring, with the side containing the masking tape on the outer surface. (The outer surface is the side exhibiting the least glare from reflected light.) The filter should fit flatly on all edges. Otherwise, it may break when tightened in place. When properly installed, the front surface of the filter should be approximately flush with the front surface of the frame. If it is not, it may be improperly seated in the neoprene ring. A toothpick, or other non-abrasive object may be used to move the lip on the neoprene ring sufficiently to allow the filter to move past the lip. If the early version of the frame is installed, a possible cause of improper seating could be that a corner clip may be mounted insufficiently far into the corner of the frame. In that case, loosen the appropriate corner screw, push the clip into the corner and retighten.

Put the angle bracket in place over the top and bottom edges of the filter, fastening them each in place with two screws. Note that filter breakage may occur if the front surface of the filter is not approximately flush with the front edge of the frame.

Remove the masking tape which was put on for identification. Then clean the surface of the filter, using a soft cloth and a mild soap and water solution.

Put the face mask in place, and install the four screws.

Inside the unit, slide the deflection yoke-mounting bracket or neck shield (as appropriate) up against the center wall and tighten the nuts which hold it in place.

Loosen the side screws which hold the center wall in place and slide the center wall forward, keeping the pressure in line with the neck of the CRT. Do not permit the center wall to move toward the back or the shield may slip off the tangs. *AVOID SIDE PRESSURE AGAINST THE CRT NECK.*

Tighten the side screws while holding the assembly in place.

This paragraph pertains only if the unit contains a separate yoke-mounting bracket. If magnet rings were supplied with the CRT, install them; align them as illustrated in Fig. 3-3. Remove the deflection yoke-mounting bracket nuts. Slide the neck shield into place. Replace the nuts and tighten them moderately.

Reconnect the deflection cable plug and the base plug. Note that they are both keyed for proper alignment.

Clean the front of the filter and replace the graticule mask, fastening it in place with the four screws.

Turn the Terminal on. After approximately one minute, press PAGE, put the rocker switch to LOCAL, and enter CTRL SHIFT K and CTRL Z to obtain a crosshair display. Place the vertical thumbwheel at its upper limit, placing the horizontal line near the top of the display. Loosen the neck shield mounting screws sufficiently to permit moving the yoke-mounting bracket or shield. Then rotate the bracket or shield until the horizontal line is parallel with the top surface of the cabinet. Tighten the mounting screws. Fasten the rear cover, side panels, and top cover in place.

PERFORMANCE CHECK/ADJUSTMENT

PERFORMANCE CHECK

General. This procedure can be used under normal operating conditions with all circuit cards installed. Since it uses LOCAL operation, no computer connection is required. Checks are referenced to a circuit and/or to a step in the Adjustment Procedure to permit rapid evaluation of incorrect results. In event of an improper response, recheck the step with all optional and interface cards removed from the pedestal to determine if the Terminal itself is at fault. Steps requiring position measurement should be made without parallax. That is, the line of sight should be perpendicular to the viewing area; this can be achieved by closing one eye and checking that the reflection of the viewing eye is in line with the point being observed.

Activity	Results	Circuit/Adjustment
Turn the Terminal on	Indicator on left of keyboard glows	Power Supply; Steps 1 and 2
Wait 30 seconds	Face of display becomes bright	Storage circuits; Step 6
Press PAGE	Erase cycle occurs	Storage circuits
Wait 5 seconds	Alpha cursor appears in top-left of display, approximately 1.4 cm ±6 mm from left edge and 1.2 cm ±6 mm from top edge of display area	High Voltage and Z Axis circuits; Deflection circuits; Terminal Control (TC) Circuits
Wait about 2 minutes	Cursor disappears	View/Hold circuits
Press SHIFT	Cursor re-appears	View/Hold circuits
Select LOCAL; Enter ten 8s	8s are written in line and remain stored on display	Keyboard; Deflection circuits; Character Generator; Storage circuits; Step 6
Wait 5 minutes and press SHIFT	Check for fade-positive and drop-out effects	Storage circuits; Step 6
Enter LINE FEED	With LF CAUSES CR option OUT, cursor moves vertically to next line; with LF CAUSES CR option IN, cursor moves to next line and to margin at left of display	TC
Enter 8s to complete a line (74 characters)	Cursor resets to next line and to margin at left of display	TC
Press PAGE	Erase cycle occurs; cursor goes home	
Enter 34 LINE FEEDs	Cursor goes to bottom-left corner of display	
Enter 35th LINE FEED	Cursor moves to margin 1 position at top-center of display	TC
Enter thirty-seven 8s	8s written and stored; cursor moves to next line and back to margin 1	TC
Enter 5 Space commands	Cursor moves 5 spaces to right	TC
Enter RETURN	Cursor moves to margin at center of display	TC

PERFORMANCE CHECK (cont)

Activity	Results	Circuit/Adjustment
Enter PAGE	Display erases; Alpha cursor goes home	
Enter each written character indicated on keyboard	Check for proper writing and focus of selected character	Keyboard; TC; Steps 8, 9
Enter PAGE	Display erases; cursor goes home	
Enter CTRL SHIFT K CTRL Z	Crosshair cursor appears but does not store	TC; step 10
Move vertical thumbwheel to upper limit	Horizontal line moves up near top of display; approximately 1.4 cm ±6 mm spacing exists between ends of line and edges of display area	TC; Deflection Amplifier; Step 5
Move horizontal thumbwheel to mid-position	Vertical line is positioned near center of display; bottom of line should be approximately 1.2 cm ±6 mm from bottom edge of display area; horizontal line should be approximately 1.2 cm ±6 mm from top edge of display area	TC; Deflection Amplifier; Step 5
Check horizontal line straightness	All points should be within 2% of length of mean straight line	Deflection Amplifier; Step 5
Move vertical line to a position near the left edge of the display area, using the horizontal thumbwheel, and check vertical line straightness	All points should be within 2% of length of mean straight line	Deflection Amplifier; Step 5
Enter PAGE	Crosshair disappears, Alpha cursor appears at top-left corner	TC
Enter CTRL SHIFT K CTRL Z	Crosshair returns	
Enter any key except PAGE or RESET	No effect	
Position the crosshair intersection to approximate mid-screen and enter RESET	Crosshair disappears and Alpha cursor appears at top-left corner	TC
Enter CTRL SHIFT M	Cursor disappears	TC
Enter Space RUBOUT Space _	No apparent effect	TC
Enter _	Dot appears in lower-left corner	TC
Enter 7 RUBOUT 7 _	45° diagonal line appears, starting from bottom-left corner	TC
Check line focus	Should be sharply focused	Step 11

PERFORMANCE CHECK (cont)

Activity	Results	Circuit/Adjustment
Check line straightness	All points on the line should be within 2% of length of mean straight line	Step 13
Press PAGE	Alpha cursor appears at top-left	TC
Enter CTRL G (BEL)	Rings bell	TC
Enter CTRL I (HT)	Cursor moves one space to right	TC
Enter CTRL H (BS)	Cursor moves one space to left	TC
Enter CTRL J (LF)	Cursor moves down one line	TC
Enter CTRL K (VT)	Cursor moves up one line	TC
Enter CTRL SHIFT M (GS)	Selects Graph Mode; cursor disappears	TC
Enter Space RUBOUT Space _ + RUBOUT Ø @	Vector appears	TC
Enter CTRL SHIFT K CTRL W (ESC ETB)	Copy of display is made if Hard Copy Unit is attached and energized	TC; Hard Copy TARSIG Amp; Hard Copy Selector; High Voltage and Z Axis circuit; Storage circuit; steps 16 through 21
Enter CTRL SHIFT K CTRL L (ESC FF)	Display erases; Alpha cursor homes	TC
Enter CTRL SHIFT M (GS)	Cursor disappears	TC
Enter @ @	Dot appears near display center	TC
Enter CTRL SHIFT O (US)	Alpha cursor appears with bottom-left corner at dot	TC
Enter CTRL SHIFT M (GS)	Cursor disappears	TC
Enter @ _	A line is written near display center	TC
Enter CTRL M (CR)	Alpha cursor appears at left margin opposite the line	TC
Enter CTRL SHIFT K CTRL Z (ESC SUB)	Alpha cursor disappears; crosshair cursor appears (should not be entered at keyboard with switch at LINE)	TC
Put LOCAL/LINE switch at LINE; Enter any character at keyboard	Crosshair cursor disappears; Alpha cursor appears	TC
Put LOCAL/LINE switch at LOCAL	Performance Check completed	

Introduction

Adjustment of the Terminal normally is required only when it ceases to properly perform its intended functions, or after circuit repairs have been made. However, if adjustment is to be performed on a routine schedule, an interval of one year between adjustments is recommended. Adjustment should be preceded by a thorough cleaning and inspection as outlined in the Servicing section. Adjustment should be performed in a +20°C to +30°C environment and should be preceded by a thirty minute warmup period.

Equipment Required

The following equipment is required in this procedure: Variable voltage source which has an output capability of at least 2 A at 100, 110 or 120 VAC, or at least 1.25 A at 200, 220 or 240 VAC. The instrument output should be variable to at least plus and minus 10% from the stated value.

Oscilloscope. Dual trace with vertical deflection factors of 5 mV and 2 V per division, and sweep rates of 0.1 μs, 0.5 μs, 1 ms and 10 ms per division; frequency response should include DC to at least 10 MHz.

Voltmeter. Range at least −25 V DC to +400 V DC; accuracy within at least .05% at +15 V, 0.1% at −15 V, 0.2% at +5 V and at least 1% at all other voltages. High voltage range to −4000 V DC, accurate to within at least 0.5% at −3850 V DC.

Circuit Card Extender. TEKTRONIX Part No. 067-0664-00.

TEKTRONIX 4610 Hard Copy Unit. Required only for 4010-1 Terminal calibration.

Index of Adjustments

The following can serve as an index, or as an adjustment record. It can also be used as a short form adjustment procedure for technicians experienced in adjusting the Terminal. If used as a record of adjustment, copies should first be made to avoid repetitive writing on the copy in the manual.

Preliminary—Set the equipment up for adjusting. Page 4-6

1. Low Voltage Power Supply Check/Adjustment (R27—Reg Voltage, on Power Supply Board in pedestal) Page 4-9

See Table 4-1 and 4-2 for details.

2. +5 V Over-Voltage Check/Adjustment (R50—Crowbar, on Power Supply Board in pedestal) Page 4-11

Adjust R50 for 4.8 V at Q99 base. Short R26-R27 junction to R43-C43 junction to open F41. Replace F41 with 6 A fast-blow fuse.

3. High Voltage Check/Adjustment (R82—HV, on High Voltage and Z Axis Board in display unit) Page 4-11

Adjust R82 for −3850 V at TP64.

4. Intensity Check/Adjust (R130—Intensity, on High Voltage and Z Axis Board in display unit) Page 4-12

With Cursor Brightness on TC-1 fully CW adjust R130 fully CW, then CCW until no dot appears after an erase cycle.

5. Display Positioning Check/Adjustment (X GAIN, Y GAIN, X POS, Y POS, X GEOM, Y GEOM on Deflection Amp and Storage Board in pedestal) Page 4-12

Adjust X POS to center horizontal Gin line; with vertical thumbwheel at upper limit, adjust Y POS so horizontal line is the same distance from the top of the display area as the bottom of the vertical line is from the bottom of the display area; rotate neck shield or yoke-mounting bracket (depending upon assembly type) for parallelism between horizontal line and top of display area; with vertical line near left edge of display area, adjust X GEOM for straight vertical line; with horizontal line near top of display, adjust Y GEOM for straight horizontal line; adjust X GAIN for 18.75 cm (7.4 inches) horizontal line; adjust Y GAIN for 14.04 cm (5.53 inches) between bottom of vertical Gin line and bottom of top line of Alpha Mode characters.

6. Storage Check/Adjustment (NORM COLL, OP LEVEL in Deflection Amp and Storage Board in pedestal) Page 4-14

Adjust NORM COLL for presence (at Deflection Amp and Storage Board pin 30) of CE value written on shield; adjust OP LEVEL for presence (at Deflection Amp and Storage Board pin 33) of STORAGE LEVEL value written on shield for same CRT, or to value midway between fade-positive and dropout for replacement CRT. Re-adjust OP LEVEL as necessary to avoid fade-positive after erase cycle, or drop out from fully written page.

7. Cursor Brightness Check/Adjustment (R28, Cursor Brightness on TC-1 in pedestal) — Page 4-15

Adjust R28 for desired non-storing Alpha cursor intensity.

8. Corner Focus Check/Adjustment (FOCUS ADJUST on High Voltage and Z Axis Board in display unit) — Page 4-15

Adjust FOCUS ADJUST for sameness of diagonal legs of K written in corner of display. Compromise for sameness in four corners.

9. Alpha Focus Check/Adjustment (R20—Alpha Focus, on High Voltage and Z Axis Board in display unit) — Page 4-16

Adjust Alpha Focus for center-screen focus of K.

10. Crosshair Cursor Intensity Check/Adjustment [R29 (R85 on boards numbered 670-1729-04 and lower)—Cursor Brightness on TC-2] — Page 4-16

Adjust R29 (R85 on boards numbered 670-1729-04 and lower) in Gin Mode so that the cursor is visible, but does not store.

11. Vector Focus (R10—Vector Focus, on High Voltage and Z Axis Board in display unit) — Page 4-16

In pseudo vector mode, adjust Vector Focus for sharpest curved lines positioned near center of display.

12. Vector Drawing Time Check — Page 4-16

2.6 ms negative-going pulse at pin 2 on Deflection Amp and Storage Board following entering of A at keyboard.

13. Vector Dynamic Geometry Error Check — Page 4-16

Enter PAGE CTRL SHIFT M Space RUBOUT Space _ 7 RUBOUT 7 _ and then check for ⩽1.5% deviation from mean straight line.

14. Vector Parallelism — Page 4-17

Enter PAGE CTRL SHIFT M Space RUBOUT Space @ 7 RUBOUT Space @ 7 RUBOUT ? _ Space RUBOUT ? _ Space RUBOUT Space @ and check that the difference between horizontal lines is ⩽2% of vertical line length and that the difference between vertical lines is ⩽2% of horizontal line length.

15. Control Character Response Check — Page 4-17

Check control character response as outlined in step 15 of the detailed procedure.

16. (4010-1 Only) Hard Copy Interrogate Pulse Width Check/Adjustment (HC INTERR on Deflection Amp and Storage Board in pedestal) — Page 4-18

Adjust HC INTERR for 300 ns pulses on pin 4 of Deflection Amp and Storage Board.

17. (4010-1 Only) Hard Copy Amplitude Check/Adjustment (HC Y AMP, HC X AMP on Deflection Amp and Storage Board in pedestal) — Page 4-18

Adjust HC Y AMP for scan 1/4 inch below and 1/8 inch above page full of written characters; adjust HC X AMP for scan 1/8 inch beyond left and right edges of page full of written characters.

18. (4010-1 Only) Hard Copy Intensity Adjustment (Hard Copy Intensity on side of display unit) — Page 4-19

Position Hard Copy Intensity just below level at which the Hard Copy scan bar stores.

19. (4010-1 Only) Hard Copy Damping Check/Adjustment (R21—Hard Copy Damping on Hard Copy TARSIG Amplifier Board in display unit) — Page 4-19

Observe at TP32 on Hard Copy TARSIG Amplifier Board during Hard Copy scan. Adjust Hard Copy Damping for maximum negative-going pulses with minimum ringing.

20. (4010-1 Only) Hard Copy Threshold Check/Adjustment (R35—Hard Copy Threshold on Hard Copy TARSIG Amplifier Board in display unit) Page 4-20

Adjust Hard Copy Threshold for pulse overlap of 1/3 pulse height of pulses observed at TP32 and TP30 on the Hard Copy TARSIG Amplifier Board during Hard Copy scanning.

21. (4010-1 Only) Hard Copy Writing Check Page 4-21

Check for five satisfactory copies of same full screen display.

22. Restoring Original Conditions Page 4-21

Turn Terminal off; remove line plug; reset transformer wiring and fuse; reset option straps; remove jumper(s) (2 jumpers from 021-0065-00 Interface, or 1 jumper from 021-0074-00 Interface, or two jumpers from TTY Port Interface). Reconnect output cable or reset the control switch (cable on 021-0065-00 or TTY Port Interfaces; switch on 021-0074-00); remove extender card and insert Deflection Amp and Storage Card.

Preliminary Procedure

Turn off the Terminal power switch (at top of pedestal) and remove the line cord from the power source.

WARNING

Dangerous voltages exist within the Terminal display unit and pedestal. Normal electrical precautions should be observed whenever working within those units while the covers are removed.

Although the Terminal can be adjusted without separating the display unit and pedestal, it is much more convenient if they are separated and placed alongside each other on a work bench. To separate them, remove the four screws which hold the display unit to the pedestal. The screws are located underneath the display unit mounting plate which is on top of the pedestal. (Refer to the mounting procedure illustration in Fig. 3-1, if necessary.) Support the front of the display unit while the last screw is being removed. Then move the display unit back about 1/2 inch and lift up on it. Withdraw enough cable from the top of the pedestal to permit the display unit to be set down on a bench adjacent to the pedestal as shown in Fig. 4-1.

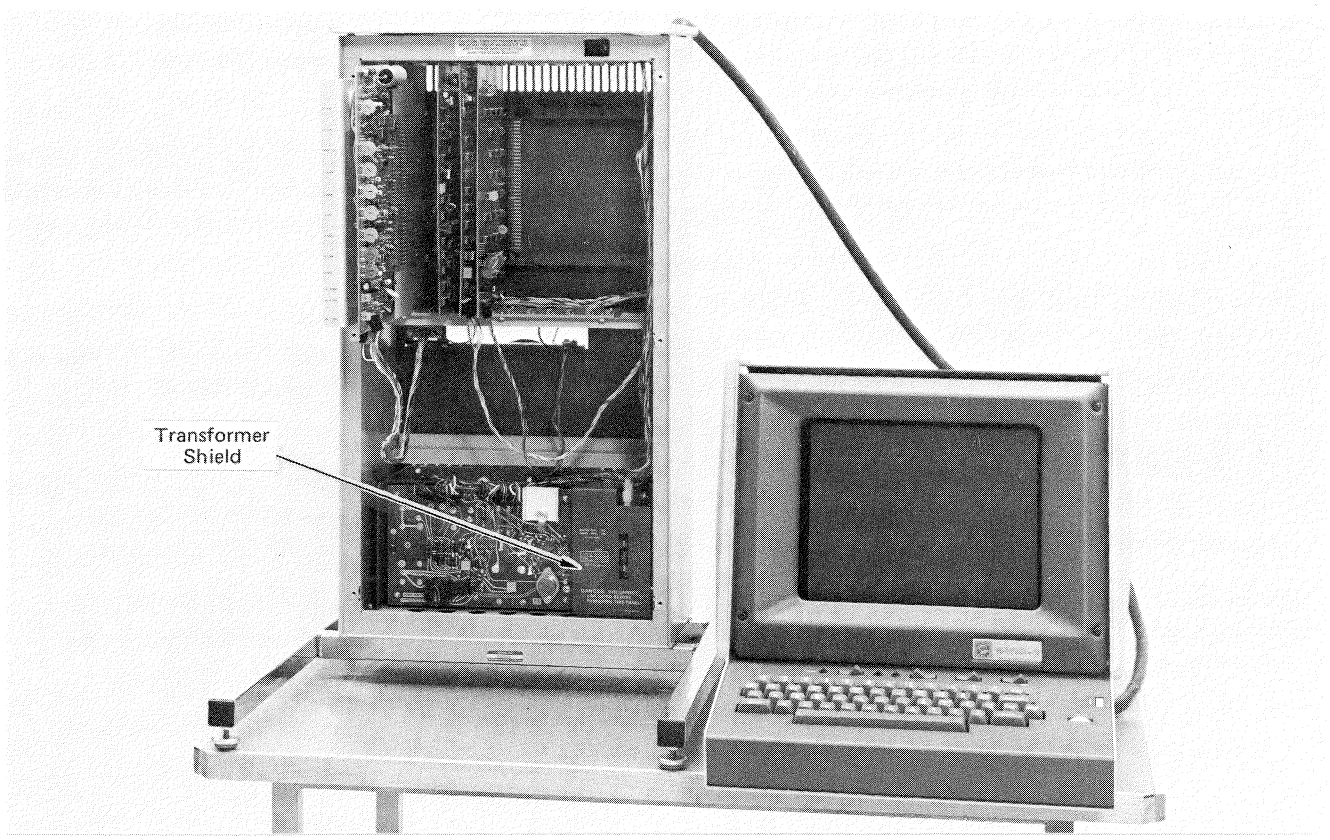


Fig. 4-1. Setup for Adjusting.

Remove the three screws from the back of the top cover on the display unit. Remove the cover by lifting the back of it up and forward.

Remove the six screws from the pedestal's front cover and remove the cover. The line fuse is mounted in a holder in the front cover and is removed with it.

Remove the three screws which hold the heat sink and the attached Deflection Amp and Storage card (left card) in place. These screws are accessible from the back of the unit, about one inch from the side. Then remove the heat sink and circuit card assembly by pulling alternately at the top and bottom of the heat sink.

Install a circuit card extender, TEKTRONIX Part No. 067-0664-00 in the vacated slot. Then install the Deflection Amp and Storage assembly in the extender card.

CAUTION

The Deflection Amp and Storage card is keyed to fit only in the left jack on the mother board. Since the extender card defeats this keying, make certain that the extender is never placed in any other jack while the Deflection Amp and Storage card is attached to it.

This procedure does not include accessory cards which may be used with the Terminal (such as Display Multiplexer or Audio Recorder Interface). Therefore, remove all cards other than the Deflection Amp and Storage card, TC-1, TC-2, and the Communication Interface Card from the top section of the pedestal. Set them aside until the procedure is completed. If a Display Multiplexer card was installed and a cable connected from it to J35 on the Motherboard, disconnect the cable from J35 and install a Display Multiplexer Bypass Strap between J35 and J36. (J35 and J36 don't exist in standard Motherboards No. 670-1734-00)

Pull TC-1 and TC-2 out and check the strap options shown in Fig. 4-2. If different, record their original positions and change them to agree with Fig. 4-2.

Determine the type of Interface card installed. If it is a Data Communication Interface 021-0065-00, check it against Fig. 4-3 and change the straps as necessary, recording the original setting. Then disconnect the cable from J360 and strap J360 pin 1 to J360 pin 7 on the card. Jumper U67 pin 10 to U67 pin 11. (This connects $\overline{\text{TSTROBE}}$ to $\overline{\text{CSTROBE}}$.) This can be done quite easily if an Integrated Circuit Test Clip is first connected to U67. Install the card in the minibus.

If the Interface is an Optional Data Communication Interface 021-0074-00, set the selector switch (rear panel) to the LOOP BACK position. Set the TRANSMIT BAUD RATE switch and the RECEIVE BAUD RATE switch both to 9600. Record the previous positions for later reference. On the Interface card, connect U68 pin 6 to U47 pin 9 (this connects $\overline{\text{TSTROBE}}$ to $\overline{\text{CSTROBE}}$). Install the card in the minibus.

If a TTY Port Interface is installed, disconnect the Relay Card cables from the J161 and J162 connectors on the Control Card. Set the card straps as shown in Fig. 4-4. Record the original positions of any straps that have to be changed. Connect J162 pin 2 to J162 pin 3; connect J161 pin 6 to J162 pin 7. Connect U81 pin 3 to U81 pin 6 (this connects $\overline{\text{CSTROBE}}$ to $\overline{\text{TSTROBE}}$). This can be done most easily if an Integrated Circuit Test Clip is first attached to U81. Install the card in the minibus.

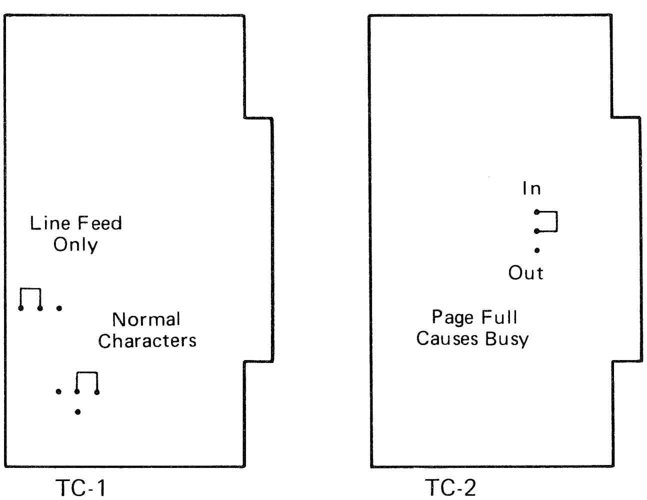


Fig. 4-2. TC-1 and TC-2 strappable option selections for adjusting the terminal.

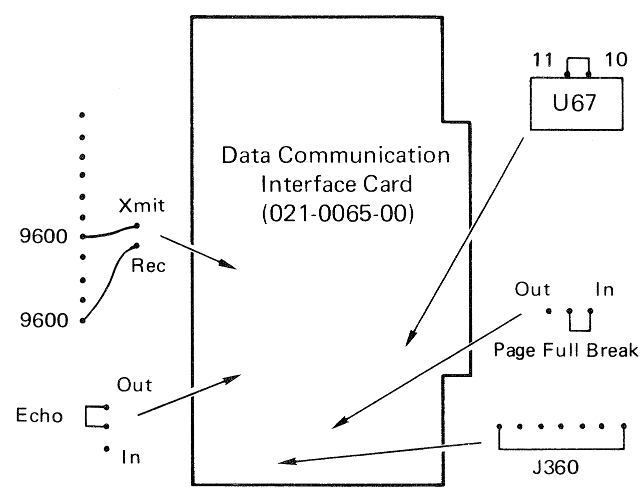
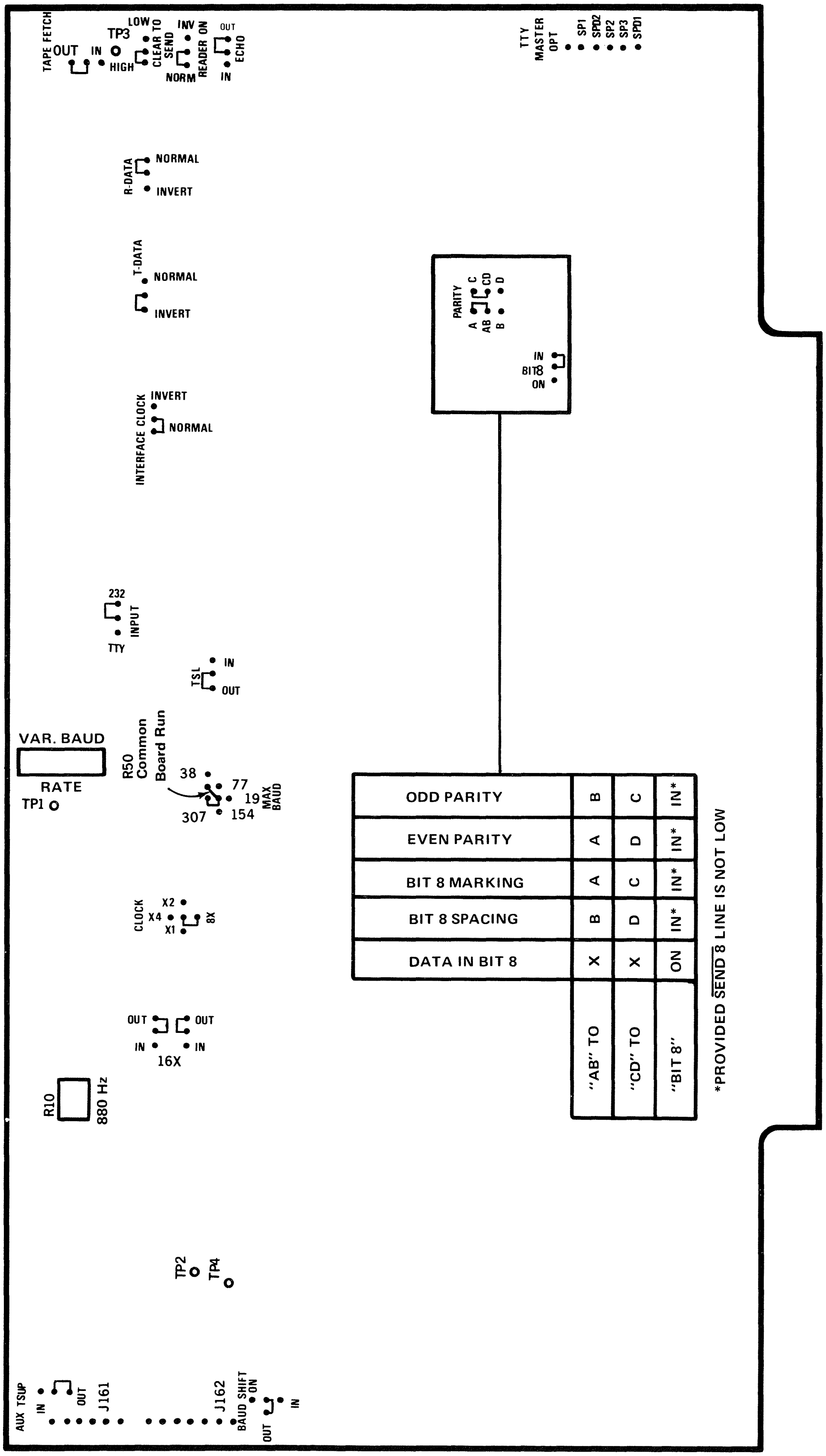


Fig. 4-3. Data Communication Interface (021-0065-00) strappable option and jumper positions for adjusting the Terminal.



	DATA IN BIT 8	BIT 8 SPACING	BIT 8 MARKING	EVEN PARITY	ODD PARITY
"AB" TO	X	B	A	A	B
"CD" TO	X	D	C	D	C
"BIT 8"	ON	IN*	IN*	IN*	IN*

*PROVIDED $\overline{\text{SEND 8}}$ LINE IS NOT LOW

Fig. 4-4. TTY Port Interface strap option positions for calibrating the Terminal.

CAUTION

Do not put the Terminal in Graph Mode with the LOCAL/LINE switch at LINE and the $\overline{\text{TSTROBE}}$ to $\overline{\text{CSTROBE}}$ jumper connected. Doing so may damage the display screen.

At the lower right corner of the pedestal, remove the shield which covers the transformer terminals. (It is held in place by two screws on top.) Determine what voltage the transformer is wired for by comparing the connections against the diagram on the inside surface of the pedestal cover. If a variable AC power supply is available, it will be set to that value. If the indicated supply is not available, record the transformer wiring condition so that it can be restored upon completion of the adjustment procedure. Then rewire the transformer connections to agree with the available voltage supply. See diagram inside the front cover for instructions.

Install an approriate slow blow fuse (2 A for 115 V or 1.25 A for 230 V) and replace the shield to minimize shock danger. If the fuse mounted in the front cover is to be used during the adjustment, it can be pushed (not pulled) from its holder, or the holder assembly can be removed from the front cover, as desired.

WARNING

Dangerous voltages exist in the fuse and transformer circuits. Keep the line cord disconnected while working in those areas.

Check the remaining fast blow fuses for proper sizes. Their values should be: F21—2 A, F41—6 A, F61—2 A.

Detailed Procedure

1. Low Voltage Power Supply Check/Adjustment (R27—Reg Voltage)

NOTE

Early power supply boards had filaments connected from J78—pin 1 (—20 V) to J71—pin 1 (+20 V). Some later boards had the filaments connected from J78—pin 1 (—20 V) through a selectable resistor to J71—pin 1 (+20 V). The selectable resistor was used to drop the filament supply to the proper level. The procedure that follows pertains to boards marked PA.

a. After the preliminary procedure has been completed, connect the line cord to a variable power source (autotransformer) which is set to the voltage for which the transformer is wired.

b. Turn the Terminal power switch ON, and place the LOCAL/LINE switch at LOCAL.

c. Using a voltmeter which has .05% or better accuracy at 15 V, adjust R27 to obtain +15.000 V at the +15 V test point indicated in Fig. 4-5. (Connect the voltmeter reference lead to the ground point shown in Fig. 4-5.)

d. Measure the various power supply voltages as listed in Table 4-1. Test points are shown in Fig. 4-5. Record all voltages in Table 4-2. (Make duplicate copies of Table 4-2 for future use.)

TABLE 4-1

Power Supply Voltage Limits

Supply	Limits Voltage	Ripple (P-P)	Comments
+15 V	+14.025 to +15.075	10 mV	Adjust R27 for +15.000 V; readjust if necessary to compromise so that +15, +5, and —15 V supplies are all within limits with line voltage at mid-position as well as at high and low limit
+5 V	+4.9 to +5.1	10 mV	
—15 V	—14.850 to —15.150	10 mV	
—20 V Unreg	—17.6 to —22.4	2.8 V	Not adjustable
+20 V Unreg	+17.6 to +22.4	2.8 V	
+20 V Fil	35.5 to 41 V more positive than —20 V supply value	2.8 V	
+175 V Unreg	+155 to +195	6 V	
+328 V Unreg	+289 to +367	8 V	

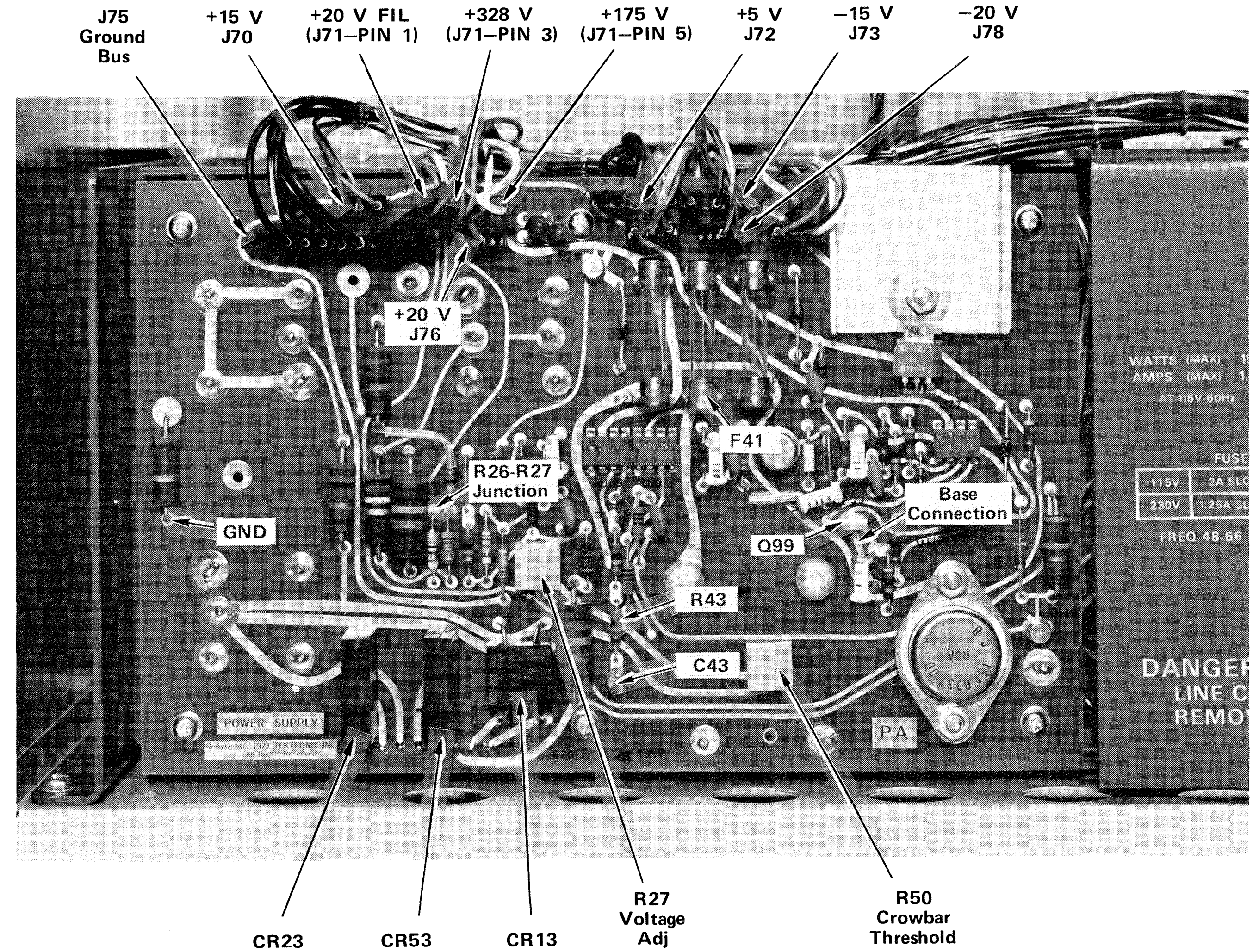


Fig. 4-5. Power Supply Adjustments and Test Points.

TABLE 4-2

Observed Voltages

Supply	(A) Center Line Voltage	(B) Low Line Voltage	(C) High Line Voltage	(D) Greater Deviation From (A)	% Observed Regulation $\frac{(D)}{(A)}$ X100	Regulation Limit
+15 V						0.2%
+5 V						1.0%
−15 V						0.2%
−20 V Unreg						
+20 V Unreg						
+20 V Fil					NOT APPLICABLE	
+175 V Unreg						
+328 V Unreg						

Ⓐ

e. Using the test oscilloscope, check that ripple voltages do not exceed those values given in Table 4-1. If ripple appears excessive or marginal, move the voltage reference lead to the ground bus at J75 and recheck.

f. Change the variable power source to 10% below the center value for which the transformer is wired.

g. Measure and record the supply voltages, again using Tables 4-1 and 4-2. Then check the ripple of each supply.

h. Change the variable power source to 10% above the center value for which the transformer is wired.

i. Again measure and record the supply voltages and check ripple.

j. Analyze the results. All voltages should be within the specified values. The differences between voltages at center line and either high or low line should not show a regulation factor larger than that specified in Table 4-2.

k. Set the line voltage to the center voltage for which the transformer is wired.

2. +5 V Over-Voltage Check/Adjustment (R50—Crowbar, on Power Supply Board in pedestal)

a. Check the voltage at the base of Q99 for 4.8 V. Adjust R50 as necessary to obtain that value. See Fig. 4-5 for component locations.

b. Check over-voltage protection. A spare 6 A fast-blow fuse is needed for this check. If none is available, this step will have to be omitted.

(1) Using a shorting strap, momentarily connect the R26-R27 junction to the R43-C43 junction, expecting a flash from F41. See Fig. 4-5 for locations. The voltage at the +5 V test point indicated in Fig. 4-5 should drop to 0 V.

(2) Turn the Terminal power switch OFF and disconnect the line cord.

(3) Replace F41 with a new 6 A slow-blow fuse. (If F41 does not open, troubleshoot the power supply. All plugs should be removed from the board and dummy loads substituted during troubleshooting; logic circuitry may otherwise be damaged. Instructions are given in the Servicing Section. Check plug locations before removing, to insure their proper replacement.)

3. High Voltage Check/Adjustment (R82—HV, on High Voltage and Z Axis Board in display unit)

a. With the Terminal off, set the voltmeter to read −3850 V DC and connect it to TP64 on the High Voltage and Z Axis board in the back of the display Unit. See Fig. 4-6.

b. Reconnect the line cord and turn the Terminal power switch ON.

c. After about one minute, check for −3850 V at TP64. Adjust R82 (Fig. 4-6) as necessary to obtain that value.

d. Set the variable power source first to 10% below the transformer center voltage and then to 10% above it and check that the high volage remains between −3735 and −3965 volts at both positions.

e. Set the variable power source to the transformer center voltage.

f. Turn the Terminal power switch OFF.

g. Disconnect the voltmeter from TP64.

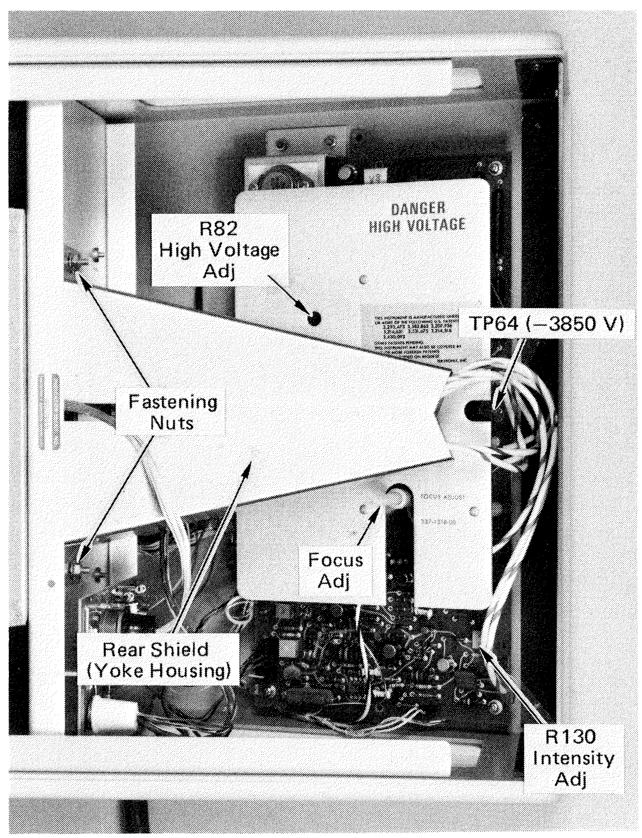


Fig. 4-6. High Voltage Adjustments and Test Points.

4. Intensity Check/Adjustment (R130—Intensity, on High Voltage and Z Axis Board in display unit)

a. In this and subsequent steps employing Alpha Mode, the Terminal may go into Hold Mode, diminishing display brightness. Entering any character will restore the View Status; however, pressing the SHIFT key will restore View Status without otherwise affecting the display.

b. Turn the Terminal ON and after approximately one minute, momentarily press the PAGE key to initiate an erase and reset cycle.

c. Note the edges of the display area after the erase cycle has been completed. If the edges become obviously brighter than the rest of the display area (fade-positive, Fig. 4-9), turn the OP LEVEL (top-left in pedestal) fully counterclockwise. OP LEVEL will be adjusted properly in a later step.

d. At TC-1 in the top of the pedestal unit, turn R28 (Cursor Brightness) fully clockwise. (See Fig. 4-7 for location.)

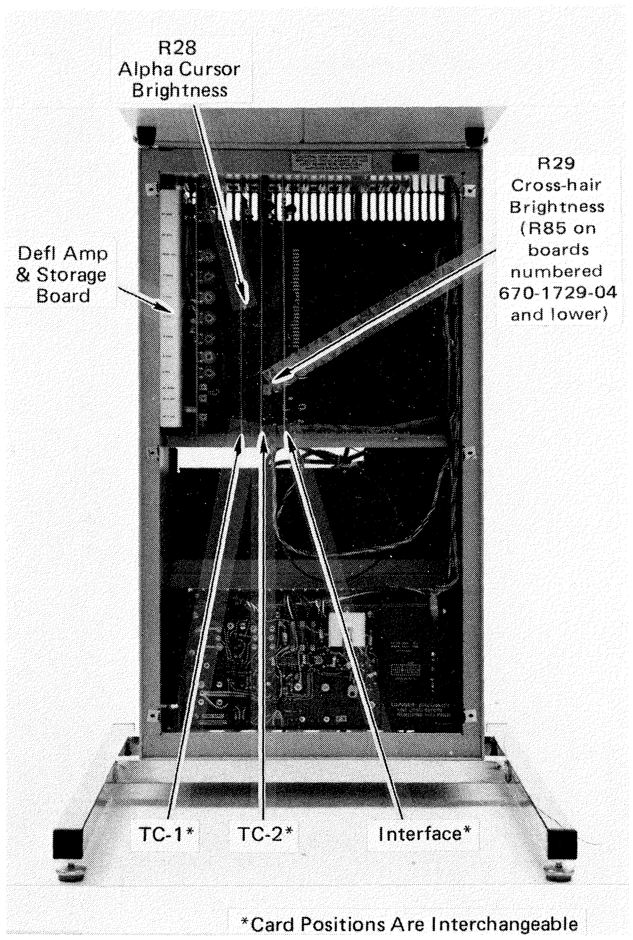


Fig. 4-7. Pedestal Circuit Card Information.

e. Enter 37 space commands and 17 LINE FEED commands.

f. On the High Voltage and Z Axis board in the back of the display unit, rotate R130 (Intensity) to increase intensity until the Alpha cursor (located near display center) gets brighter and its flickering seems to diminish. The R130 location is shown in Fig. 3-5. (If the Alpha cursor doesn't appear, R28 on TC-1 may be set to the wrong limit.)

g. Press PAGE. The cursor should move to the top-left corner of the display. If the cursor was viewable in step f, and now has moved entirely out of the viewing area, turn X POS fully clockwise and Y POS fully counterclockwise to bring the cursor back into view.

h. Press PAGE and note that a dot appears at the bottom-left of the cursor position prior to the cursor coming back into view.

i. Alternately decrease the setting of R130 in small increments and press PAGE, until the dot can no longer be seen. The flickering cursor should remain.

5. Display Positioning Check/Adjustment (X GAIN, Y GAIN, X POS, Y POS, X GEOM, Y GEOM on Deflection Amp and Storage Board in pedestal)

NOTE

This procedure provides for an approximately centered display of specific size. Both positioning and size may be modified as desired by changing the adjustment parameters accordingly. All position and size measurements should be made with a minimum of parallax. This can be achieved by closing one eye and keeping the reflection of the viewing eye in line with the point being observed.

a. Enter CTRL SHIFT K and CTRL Z and place the keyboard thumbwheels near midrange. A crosshair cursor should appear on the display. If it does not, adjust the crosshair Brightness, R29, on TC-2 (R85 on boards numbered 670-1729-04 and lower) as necessary to obtain it. The R29 (R85) location is shown in Fig. 4-7.

b. Move the thumbwheels slightly and note if the previous crosshair position has stored on the display. If so adjust R29 (R85) to decrease the crosshair intensity slightly and repeat the check. Readjust R29 (R85) until the crosshair no longer shows.

c. Put the vertical thumbwheel to its upper limit.

d. Enter PAGE and CTRL SHIFT K and CTRL Z to erase the display and regain the crosshair. (CTRL SHIFT K and CTRL Z must be entered to regain the crosshair cursor each time the display is erased, since PAGE also resets the Terminal to Alpha Mode.)

e. Check display positioning. It should meet the following requirements (see Fig. 4-8):

Horizontal line	Should remain in view
	Both ends occur before reaching edges of display area
	Approximately centered horizontally in display area
	Approximately 18.75 cm (7.4 inches) long
	Parallel with top edge of display area
	Deviation from mean straight line is within approximately 2.8 mm (0.11 inch)
Vertical Line	Bottom end occurs approximately 1.27 cm (0.5 inch) before reaching edge of display area.
	Horizontal intercept is approximately 14 cm (5.5 inches) above bottom of vertical line
	Approximately parallel with left edge of display area
	When positioned near left edge of display area (by using horizontal thumbwheel), deviation from mean straight line is within approximately 2.1 mm (.08 inch)

f. If lines are excessively long, set X GAIN and/or Y GAIN (top-left in pedestal) fully counterclockwise.

g. Adjust display positioning as follows; adjustments are located near the top-left in the pedestal unless otherwise stated:

(1) Adjust X POS for approximate left-right centering of horizontal line.

(2) Adjust Y POS to approximately center the vertical line segment described by its lower end and the point of intercept with the horizontal line (vertical thumbwheel at upper limit). See Fig. 4-8.

(3). If necessary, rotate the yoke housing or yoke-mounting bracket (depending on type of assembly to obtain approximate parallelism between the ends of the horizontal line and the top edge of the display area. Two nuts hold the yoke housing in place behind the center divider in the display unit (Fig. 4-6). Final adjustment and tightening of the yoke housing is done in a later step.

(4) Adjust X GEOM for approximate straightness of the vertical line; vertical line to be positioned as close to the left edge of the display area as possible by using the horizontal thumbwheel.

(5) Adjust Y GEOM for approximate straightness of horizontal line, with vertical thumbwheel at its upper limit.

(6) Adjust X GAIN for 18.75 cm (7.4 inches) horizontal line length.

(7) Readjust X POS for horizontal line centering as necessary.

(8) Press PAGE and then enter four Zs. The Zs should store. If storing doesn't occur, increase the OP LEVEL setting while entering Zs until they store. Then press PAGE and again enter four Zs.

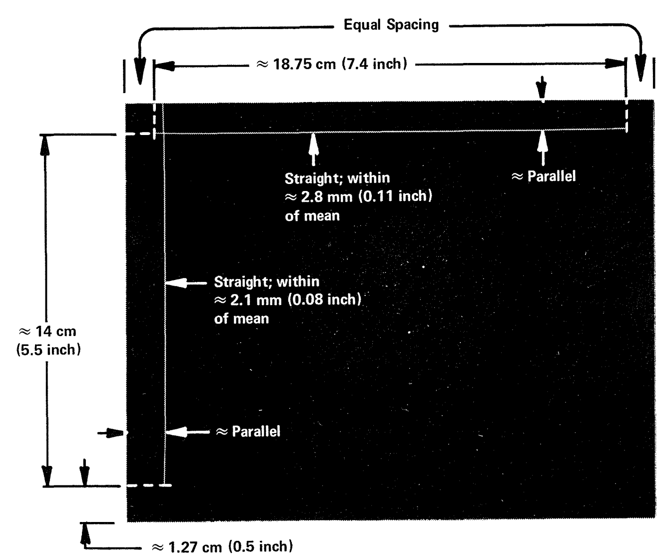


Fig. 4-8. Display Positioning, Using Cross-hair Cursor.

(9) Enter CTRL SHIFT K and CTRL Z. The Zs should remain and the crosshair cursor should appear.

(10) Using the horizontal thumbwheel, place the vertical line so that it passes through a Z.

(11) Check vertical gain. The distance from the bottom of the vertical line to the bottom of a Z should be approximately 14.04 cm (5.53 inches). If it is not, adjust Y GAIN to compensate for 1/2 of the error, observing the adjustment effect at the bottom of the vertical line. Then repeat steps (8), (9), and (11).

(12) Check vertical position. The bottom of the vertical line and the top of the Z should be equidistant from their respective horizontal edges of the display area. If not, adjust Y POS to center the display vertically. Observe the bottom of the vertical line during adjustment. Then repeat steps (8), (9) and (12).

(13) Recheck parallelism between horizontal line and the top edge of the display area. Readjust the yoke housing rotation as necessary. Then tighten the yoke securing nuts.

(14) Recheck horizontal and vertical line straightness with lines positioned near the top and left edges, respectively. Readjust X GEOM for vertical line and Y GEOM for horizontal line straightness as necessary.

(15) Position the cursor lines to various places on the display area and check for line straightness. If necessary, readjust X GEOM and Y GEOM for best overall compromise.

6. Storage Check/Adjustment (NORM COLL, OP LEVEL on Deflection Amp and Storage Board in pedestal)

a. Perform this step for adjusting a Terminal in which the CRT has not just been changed.

(1) Note the CE voltage value written on the tag attached to the top of the CRT shield. Check for that value at pin 30 on the extender card which was installed during the preliminary procedure.

(2) Adjust NORM COLL (R257, on edge of card which is attached to the extender) to obtain the specified value at pin 30.

(3) Note the STORAGE LEVEL value written on the tag attached to the top of the CRT shield. Check for that value at pin 33 on the extender card.

(4) Adjust OP LEVEL (R222, on edge of extended card) to obtain the specified value.

(5) Put the LOCAL/LINE switch at LINE. Then go to step c.

b. Perform this step for adjusting a Terminal in which the CRT has just been changed.

(1) Adjust NORM COLL (R257, on edge of card which is attached to the extender) to obtain +100 V DC at pin 30 on the extender card.

(2) Connect the voltmeter to pin 33 on the extender card, expecting approximately +200 V DC.

(3) Set OP LEVEL (R222, on edge of extended card) fully counterclockwise. Then adjust it clockwise in moderate increments, pressing PAGE between increments, until a point is reached where the edges of the display area start to become obviously brighter, or "fades positive". (See Fig. 4-9). Record the voltage which exists on pin 33.

(4) Put the LOCAL/LINE switch at LINE and press the 8 key. The display should fill with 8s.

(5) Turn the OP LEVEL counterclockwise until the displayed numbers appear to degrade due to dots disappearing (dropping out). See Fig. 4-9. Record the pin 33 voltage at which this occurs. (Press the SHIFT key as necessary to maintain View status.)

(6) Determine the mid-voltage between the two recorded voltages. Set the OP LEVEL to obtain this value at pin 33.

c. Press PAGE and then press 8. The display should become filled with 8s. Wait approximately five minutes and view the display, checking for drop-out or fade-positive conditions. If drop-out occurs, adjust the OP LEVEL positive in five-volt increments and repeat the check. If fade-positive occurs, adjust in five-volt negative increments and repeat the check. (If both conditions occur, the CRT is near the end of its useful life, and a slight fade-positive condition must be tolerated if drop-out is to be avoided.)

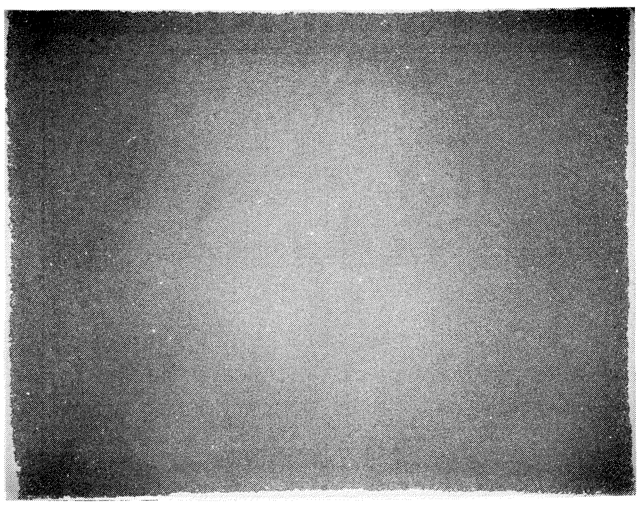
d. Upon completion of step c, measure the voltage at pin 33 on the extender card and write that value opposite STORAGE LEVEL on the tag on the CRT shield. Simply cross out the old value without obliterating it.

7. Cursor Brightness Check/Adjustment (R28—Cursor Brightness, on TC-1 in the pedestal)

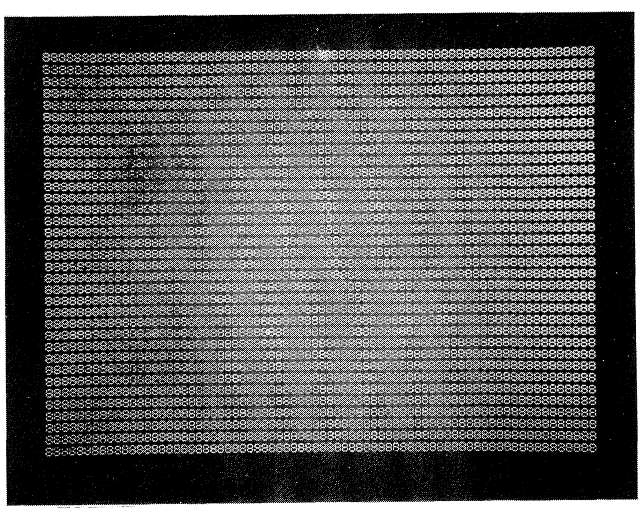
a. Put the LOCAL/LINE switch at LOCAL. Press PAGE to erase the display.

b. Note the intensity of the Alpha cursor. It should be bright enough for convenient viewing, but not so bright that it stores.

c. Adjust Cursor Brightness (R28 on edge of TC-1) to obtain the desired intensity. See Fig. 4-7 for adjustment location.



(A) Fade-Positive



(B) Drop-Out

Fig. 4-9. Display Conditions.

8. Corner Focus Check/Adjustment (FOCUS ADJUST on High Voltage and Z Axis Board in display unit)

a. Press PAGE. Enter a K and note the appearance of its two diagonal legs. They should appear similar. The dots which make up the lines should be round.

b. Adjust FOCUS ADJUST (alongside yoke housing in display unit—Fig. 4-10) in small increments, pressing K after each adjustment, until the dots achieve optimum roundness and the two diagonal legs appear similar. Press PAGE as necessary to keep writing in the corner of the display area.

c. Switch the LOCAL/LINE switch to LINE. Press K and the display should fill up with Ks. Compare the letters in the four corners. They should appear similar. If noticeable difference exists, slightly adjust FOCUS ADJUST, pressing PAGE and K and then recheck. Repeat until the best focus compromise is achieved for the four corners.

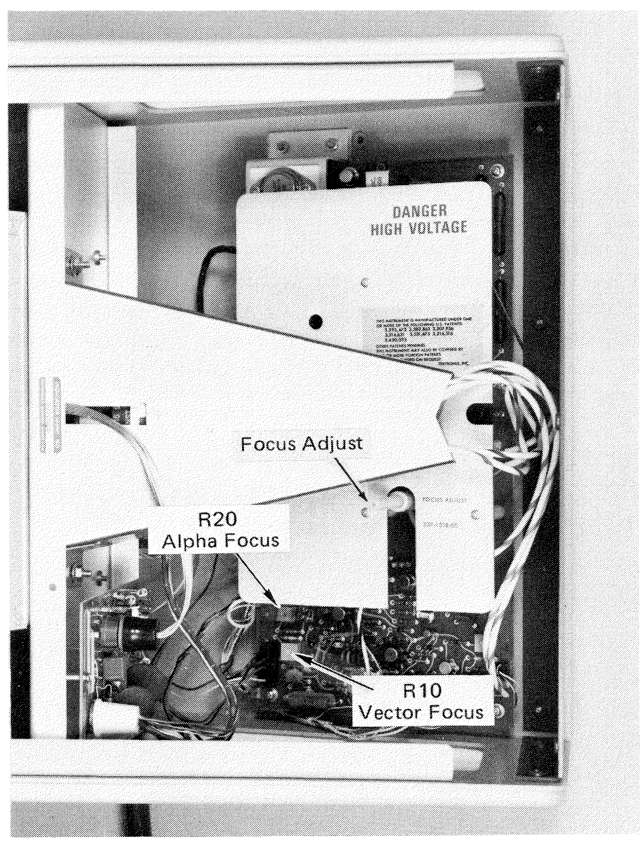


Fig. 4-10. Alpha Focus and Vector Focus Adjustment Locations.

9. Alpha Focus Check/Adjustment (R20—Alpha Focus, on High Voltage and Z Axis Board in display unit)

a. With a page full of Ks displayed as in step 8, check the center focus. It should be comparable to the corner focus.

b. To adjust, proceed as follows:

(1) Place LOCAL/LINE switch at LOCAL.

(2) Press PAGE.

(3) Using the Space Bar, LINE FEED, RETURN and K keys, enter several Ks in each of the four corners. Then position the cursor to the center of the display area.

(4) Alternately enter a K and adjust Alpha Focus (R20 in the display unit; Fig. 4-10) until center focus and corner focus are approximately the same.

c. Place the LOCAL/LINE switch at LINE. Then press PAGE.

d. Enter an 8 and the display should fill with 8s.

e. Check display. If uniform focus has been achieved and NORM COLL is properly set, the overall display should have approximately even brightness. If it appears to intensify or dim out as it approaches center, recheck the center focus against the corner focus. If this appears satisfactory, adjust NORM COLL (on extended card in pedestal) while observing the display. Adjust for most uniform intensity. This should occur slightly clockwise of point of brightest display.

10. Crosshair Cursor Intensity Check/Adjustment [R29 (R85 on TC-2 boards numbered 670-1729-04 and lower)—Cursor Brightness, on TC-2]

a. Put the LOCAL/LINE switch at LOCAL.

b. Press PAGE. Then enter CTRL SHIFT K and CTRL Z to obtain a crosshair cursor.

c. Move the thumbwheels and check to see if cursor stores.

d. If necessary, adjust R29 (R85) on TC-2 (see Fig. 4-7 for location of adjustment) so that the cursor can be seen but does not store.

11. Vector Focus Check/Adjustment (R10—Vector Focus, on High Voltage and Z Axis Board in display unit)

a. With the LOCAL/LINE switch at LOCAL and the crosshair cursor displayed, enter CTRL SHIFT M to put the Terminal in a pseudo vector mode. (See Fig. 4-11.) Note that the Terminal will not produce the display shown in Fig. 4-11 unless $\overline{\text{TSTROBE}}$ is connected to $\overline{\text{CSTROBE}}$ as explained in the Preliminary Procedure.

b. Place the rounded segments of the crosshair cursor at the center of the display area, using the thumbwheels.

c. Adjust Vector Focus (R10 in display unit; Fig. 4-10) for sharpest focus of the line segments near the center of the display area.

d. Turn the Terminal off. Remove the $\overline{\text{TSTROBE}}$ to CSTROBE jumper which was installed during the preliminary procedure. Then turn the Terminal on.

12. Vector Drawing Time Check

a. Connect the oscilloscope probe to pin 2 on the extender card. Set the oscilloscope sensitivity to 2 V/division and the sweep rate to 1 ms/division.

b. Press PAGE. Then enter CTRL SHIFT M.

c. Repeatedly press A at the keyboard, while checking the oscilloscope waveform.

d. CHECK—The negative-going waveform on the oscilloscope should be approximately 2.6 ms.

13. Vector Dynamic Geometry Error Check

a. Press PAGE. Then enter CTRL SHIFT M.

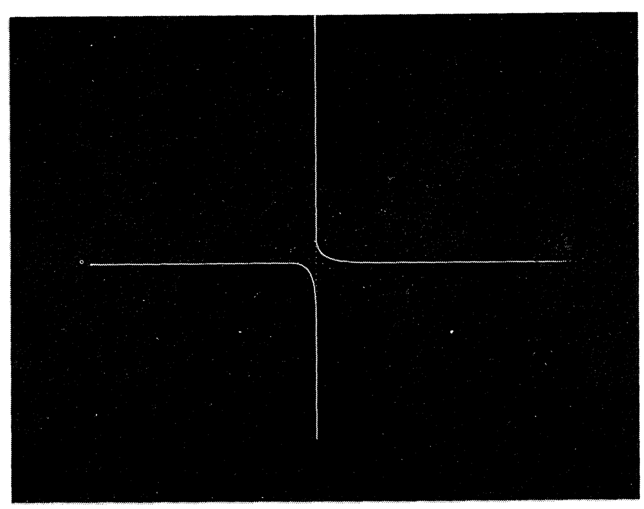


Fig. 4-11. Vector focus Display.

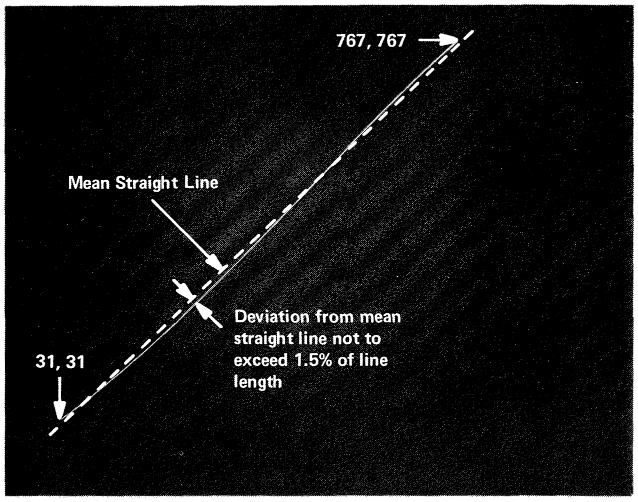


Fig. 4-12. Vector Dynamic Geometry Error.

b. Enter Space RUBOUT Space _ to set the beam to 31, 31.

c. Enter 7 RUBOUT 7 _ to draw a vector from 31, 31 to 767, 767.

d. CHECK—Deviation from a mean straight line should not exceed 1.5% of the line length. See Fig. 4-12. [If the gain were adjusted in accordance with this procedure, the line length should be approximately 19.1 cm (7.52 inches), and deviation from a mean straight line should not exceed approximately 3 mm (actually 2.865 mm) or 1/8 inch at any point.]

e. If the deviation from the mean straight line exceeds the specified amount, repeat step 5.

14. Vector Parallelism Check

a. Enter PAGE and CTRL SHIFT M.

b. Enter the following sequence to draw a rectangle:

Space RUBOUT Space @
7 RUBOUT Space @
7 RUBOUT ? _
Space RUBOUT ? _
Space RUBOUT Space @

c. Measure the length of all lines.

d. CHECK—Parallelism. The difference in the length of the horizontal lines should not exceed 2% of the vertical line length. The difference in the length of the vertical lines should not exceed 2% of the horizontal line length. With the Terminal adjusted as outlined in this procedure, the line length is approximately as follows: horizontal—18.75 cm (or 7.4 inches); vertical—13.48 cm (or 5.31 inches). Line length difference should not exceed: horizontal—approximately 2.7 mm (0.11 inch); vertical—approximately 3.8 mm (0.15 inch).

15. Control Character Response Check

a. With the LOCAL/LINE switch at LOCAL, enter the following at the keyboard and check the response:

CONTROL CHARACTER RESPONSE CHECK

Command	ASCII Equivalent	Response
CTRL G	BEL	Rings bell
CTRL I	HT	Moves cursor one space to right
CTRL H	BS	Moves cursor back one space
CTRL J	LF	Moves cursor down one line
CTRL K	VT	Moves cursor up one line
CTRL SHIFT M	GS	Selects Graph Mode
Space RUBOUT Space _ + RUBOUT Ø @	SP DEL SP _ + DEL Ø @	Draws a vector
CTRL SHIFT K and CTRL L	ESC FF	Erases display, homes cursor
CTRL SHIFT M	GS	Selects Graph Mode

CONTROL CHARACTER RESPONSE CHECK (cont)

Command	ASCII Equivalent	Response
@ @	@ @	Writes a point
CTRL SHIFT O	US	Switches back to Alpha without moving writing beam
CTRL SHIFT M	GS	Selects Graph Mode
@ _	@ _	Draws a vector
CTRL M	CR	Switches back to Alpha and moves writing beam to margin Ø
CTRL SHIFT K and CTRL Z	ESC SUB	Selects Gin Mode and displays crosshair cursor
Put LOCAL/LINE switch at LINE; then enter any character at keyboard and return LOCAL/LINE switch to LOCAL		Crosshair cursor disappears and Alpha cursor re-appears

b. If a 4010-1 is being adjusted, and a Hard Copy Unit is available, proceed with the next step. Otherwise, go to step 22.

16. (4010-1 Only) Hard Copy Interrogate Pulse Width Check/Adjustment (HC INTERR on Deflection Amp and Storage Board in pedestal)

a. Turn the Terminal off and replace the $\overline{\text{TSTROBE}}$ to $\overline{\text{CSTROBE}}$ jumper which was removed in step 11d. Then turn the Terminal on.

b. Connect the Hard Copy Unit to the Terminal, via J525 which is located on the back of the pedestal unit.

c. Remove the paper from the Hard Copy Unit or disengage the paper drive. Then energize the Hard Copy Unit.

d. Connect the test oscilloscope to pin 4 on the extender card. Set the oscilloscope for a 300 ns 5 V signal. (0.1 μs and 2 V/division recommended, including probe.)

e. Press MAKE COPY and observe the negative-going pulses. They should be approximately 300 ns duration at mid amplitude.

f. Adjust HC INTERR (on extended card) for 300 ns pulses. Press MAKE COPY as often as necessary to complete the adjustment.

17. (4010-1 Only) Hard Copy Amplitude Check/Adjustment (HC Y AMP, HC X AMP on Deflection Amp and Storage Board in pedestal)

a. Turn the Hard Copy Intensity (side of Terminal display unit—Fig. 4-13) fully clockwise.

b. Set the HC X AMP potentiometer (on extended card) fully counterclockwise. (This step assumes that the Terminal is wired so that the scan bar moves vertically on the display. If the Terminal is connected so that the bar moves horizontally, set the HC Y AMP potentiometer fully counterclockwise, rather than HC X AMP. Then adjust HC X AMP first in a manner similar to that described in the following steps.)

c. Put the LOCAL/LINE switch at LINE.

d. Press PAGE; then press 8 to write a page full of 8s.

e. Press MAKE COPY. The Hard Copy scan bar should store on the display area, but should be narrower than the stored 8s. (If no scan bar appears, Hard Copy Intensity on the side of the display unit may be in the wrong limit. If the scan bar appears and is wider than the stored 8 display, the HC X AMP potentiometer may be in the wrong limit.)

f. Check Hard Copy Y amplitude. The stored scan bar should extend approximately 1/4 inch below and 1/8 inch above the stored 8s, as in Fig. 4-14.

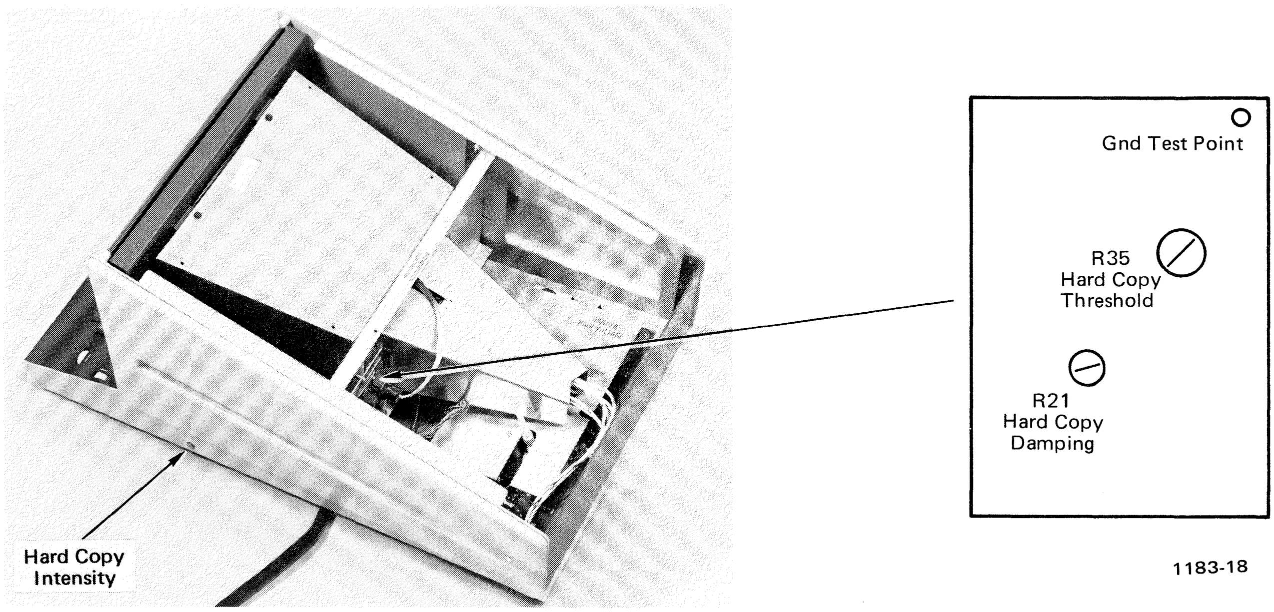


Fig. 4-13. Hard Copy Adjustment on Display Unit.

g. Adjust HC Y AMP (on extended card) in small increments, repeating steps d, e, and f until desired results are obtained. If the specified distance cannot be achieved both below and above the 8s, let the shorter end determine the setting.

h. Press PAGE and 8 to refill the page.

i. Insert the screwdriver in the HC X AMP potentiometer on the extended card.

j. Press MAKE COPY and adjust HC X AMP as the bar scans the display area, until the bar extends approximately 1/8 inch beyond each side. Again let the shorter end determine the setting. Press PAGE and 8 if necessary to refill the screen to complete the adjustment.

18. (4010-1 Only) Hard Copy Intensity Adjustment. (Hard Copy Intensity on side of display unit)

a. Press PAGE and MAKE COPY. Adjust Hard Copy Intensity (side of display unit) to a point just below that at which the scan bar stores. Repeat as necessary to eliminate storing at all points on the display area.

19. (4010-1 Only) Hard Copy Damping Check/Adjustment (R21—Hard Copy Damping on Hard Copy TARSIG Amplifier Board in display unit)

a. Set the test oscilloscope for 0.2 V/division and 0.5 μs/division. Connect the channel 1 probe to TP32 on the Hard Copy TARSIG Amplifier board, attaching the probe ground lead to the ground test point (Fig. 4-13).

b. Set the oscilloscope for external triggering and connect a probe from the external trigger jack to pin 2 on the extender card in the pedestal.

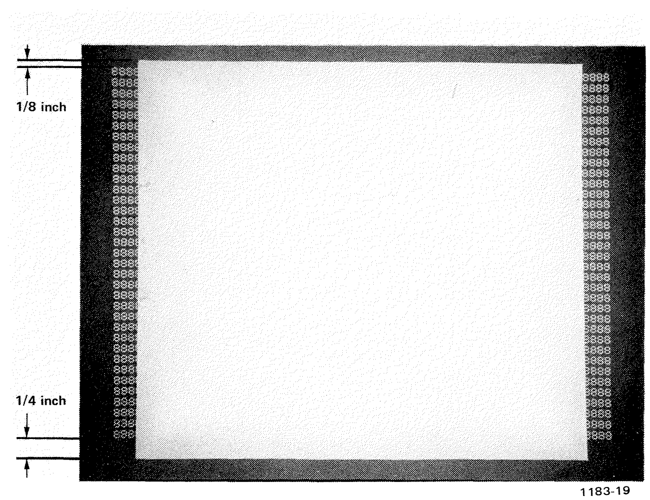


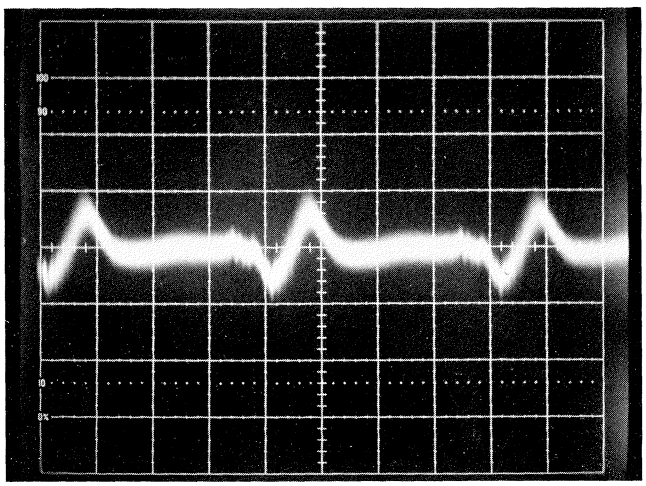
Fig. 4-14. HCY AMP Adjustment Display.

c. Press PAGE and then press MAKE COPY. Adjust the oscilloscope triggering to obtain a stable display. The pulses resulting from scanning an empty screen should appear as in Fig. 4-15A.

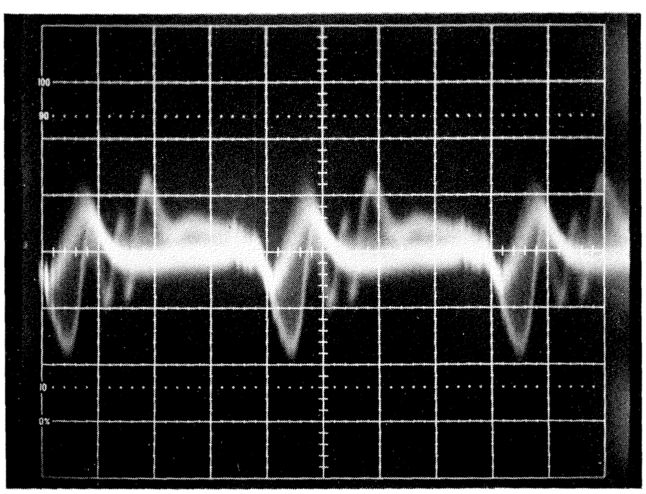
d. Preliminary adjustment. Adjust Hard Copy Damping (R21 on the Hard Copy TARSIG Amplifier board, Fig. 4-13) for maximum negative pulse amplitude with minimum ringing as in Fig. 4-15A.

e. Press 8 to fill the display. Then press MAKE COPY and observe the oscilloscope for a waveform as in Fig. 4-15B.

f. Readjust Hard Copy Damping to obtain maximum negative-going pulses with minimum ringing. The negative-going ringing should be half or less of the amplitude of the main negative-going pulses. See Fig. 4-15B.



(A) Waveform resulting from scanning an empty screen



(B) Waveform resulting from scanning a full screen 1183-20

Fig. 4-15. Hard Copy Damping waveforms; 0.2 V/division vertical, 0.5 μs/division horizontal.

20. (4010-1 Only) Hard Copy Threshold Check/Adjustment (R35—Hard Copy Threshold, on Hard Copy TARSIG Amplifier Board in display unit)

a. The oscilloscope remains connected as in step 19.

b. Connect a probe from channel 2 of the oscilloscope to TP30 on the Hard Copy TARSIG Amplifier board (Fig. 4-13). Connect the probe ground lead to ground.

c. Set the oscilloscope for alternate trace operation, with each channel set for 0.2 V/division; sweep rate 0.5 μs/division. (Neither channel should be inverted.) Set both input switches to ground and set both traces to the same reference point. Then switch both input switches to DC.

d. Press PAGE and 8 to refill the display.

e. Press MAKE COPY and observe the oscilloscope display for a waveform as in Fig. 4-16. The channel 1 display (TP32) should be above the channel 2 display, and the written pulses should overlap for approximately 1/3 of the distance between the two traces. Ringing should remain well separated. (Trace separation will probably end up being between 0.4 and 0.8 V.)

f. Adjust Hard Copy Threshold (R35, Fig. 4-13) to obtain a display as in Fig. 4-16.

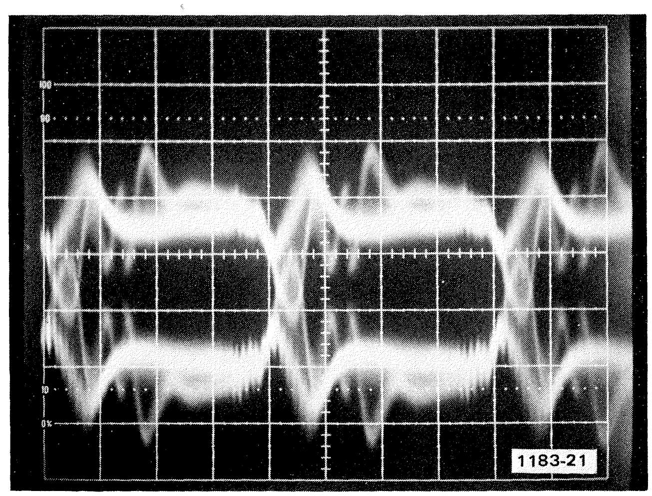


Fig. 4-16. Hard Copy Threshold Waveform; 0.2 V/division vertical, 0.5 V/division horizontal.

21. (4010-1 Only) Hard Copy Writing Check

a. Re-install the paper in the Hard Copy Unit or engage the paper drive, as appropriate.

b. Press PAGE and 8 to write a full page on the display unit.

c. Press MAKE COPY.

d. Examine the copy for writing quality. Assuming that the Hard Copy Unit is properly adjusted, writing quality is controlled by the following adjustments in the Terminal:

Condition	Possible Fixes
Information does not copy or information drop-out occurs	Increase Hard Copy Intensity setting on side of display unit (step 18) Adjust R35 to increase pulse overlap (step 20); Adjust R21 to increase pulse amplitude at TP32 (step 19); Adjust HC INTERR (top-left in pedestal) for 300 ns pulses at pin 2 on extender card (step 16).
Excessive background writing (noise)	Inverse of all fixes appearing immediately above.
Information missing around perimeter	Underscan caused by HC X AMP and/or HC Y AMP (top-left in pedestal) set too low (step 17).
Copy too small	HC X AMP and/or HC Y AMP set too high; step 17.

e. If the copy appears satisfactory, make five copies of the same full page display. The fifth copy should remain satisfactory, with minimum degradation due to repetitive scanning of the displayed data.

f. Disconnect the probes from the display unit.

22. Restoring Original Conditions

a. Turn the Terminal OFF and disconnect the line plug from the power source.

b. Remove the transformer protection plate and the line fuse.

c. If necessary, rewire the Terminal transformer to its previous configuration.

d. Replace the transformer protection plate.

e. Reset the option straps on TC-1 and the Interface Card to the condition recorded in the Preliminary Procedure.

f. Remove the jumper straps which were installed in the Preliminary Procedure. (Data Communication Interface 021-0065-00 on J360 and U67; Optional Data Communication Interface 021-0074-00 between U68 and U47; TTY Port Interface on J161 and J162.)

g. Reconnect the output cable to the Interface Card if a Data Communication Interface 021-0065-00 or a TTY Port Interface is installed; reset the rear panel switches to their previous positions if an Optional Data Communication Interface 021-0074-00 is in use.

h. Remove the extender card and install the Deflection Amp and Storage Card directly into the mother board, being careful not to disturb the adjustments. Replace the three screws (through the back of the pedestal) into the heat sink.

i. Install any accessory cards which are to be used with the Terminal. If desired, check them out, referring to their documentation.

j. Check that the proper fuse is installed in the pedestal cover (2 A slow blow for 115 V, 1.25 A slow blow for 230 V) and then replace the cover.

k. If desired, install the display unit on the pedestal unit, following the procedure in Fig. 3-1.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
00779	AMP, INC.	P. O. BOX 3608	HARRISBURG, PA 17105
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P. O. BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY CO.	1201 2ND ST. SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P. O. BOX 5012	DALLAS, TX 75222
01963	CHERRY ELECTRICAL PRODUCTS CORP.	3600 SUNSET AVE.	WAUKEGAN, IL 60085
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03888	KDI PYROFILM CORP.	60 S. JEFFERSON RD.	WHIPPANY, NJ 07981
04222	AVX CERAMICS., DIVISION OF AVX CORP.	P.O. BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PRODUCTS DIV.	5005 E. MCDOWELL RD.	PHOENIX, AZ 85036
05347	ULTRONIX, INC.	461 N 22ND ST.	GRAND JUNCTION, CO 81501
05397	UNION CARBIDE CORP., MATERIALS SYSTEMS DIVISION	11901 MADISON AVE.	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS ST.	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPT.	NELA PK.	CLEVELAND, OH 44112
12040	NATIONAL SEMICONDUCTOR CORP.	P.O. BOX 443, COMMERCE DRIVE	DANBURY, CT 06810
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON ST.	DOVER, NH 03820
12969	UNITRODE CORP.	580 PLEASANT ST.	WATERTOWN, MA 02172
14099	SEMTECH CORP.	652 MITCHELL ROAD	NEWBURY PARK, CA 91320
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15818	TELEDYNE SEMICONDUCTOR	1300 TERRA BELLA AVE.	MOUNTAIN VIEW, CA 94043
16758	DELCO ELECTRONICS, DIV. OF GENERAL MOTORS CORP.	700 E. FIRMIN ST.	KOKOMO, IN 46901
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
18657	TOKYO SHIBAURA ELECTRIC CO., LTD.		TOKYO, JAPAN
21845	SOLITRON DEVICES, INC., TRANSISTOR DIV.	1177 BLUE HERON BLVD.	RIVIERA BEACH, FL 33404
22753	U. I. D. ELECTRONICS CORP.	4105 PEMBROKE RD.	HOLLYWOOD, FL 33021
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SAN YSIDRO WAY	SANTA CLARA, CA 95051
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
32159	WEST-CAP ARIZONA	2201 E. ELVIRA ROAD	TUCSON, AZ 85706
32293	INTERSIL, INC.	10900 N. TANTAU AVE.	CUPERTINO, CA 95014
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	P O BOX 5825, 19070 REYES AVE.	COMPTON, CA 90224
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97005
80740	BECKMAN INSTRUMENTS, INC.	2500 HARBOR BLVD.	FULLERTON, CA 92634
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
83003	VARO, INC.	P O BOX 411, 2203 WALNUT ST.	GARLAND, TX 75040
84411	TRW ELECTRONIC COMPONENTS, TRW CAPACITORS	112 W. FIRST ST.	OGALLALA, NB 69153
86684	RCA CORP., ELECTRONIC COMPONENTS	415 S. 5TH ST.	HARRISON, NJ 07029
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY CO., INC.	3029 E. WASHINGTON ST.	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS CO., DIVISION OF P.R. MALLORY AND CO., INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NB 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS		
CR540	150-1001-00			LAMP,LED:RED,2V,100MA	28480	5082-4403
CR542	150-1001-00			LAMP,LED:RED,2V,100MA	28480	5082-4403
CR544	150-1001-00			LAMP,LED:RED,2V,100MA	28480	5082-4403
R103	311-0608-00	B010100	B010199	RES.,VAR,NONWIR:2K OHM,10%,0.75W	01121	W8156
R103	311-0632-00	B010200		RES.,VAR,NONWIR:2K OHM,10%,0.50W	01121	W7366
R530	311-1095-00	B010100	B055352	RES.,VAR,NONWIR:10K OHM,20%,0.50W	12697	382-CM40386
R530	311-1844-00	B055353		RES.,VAR,NONWIR:10K OHM,20%,0.50W	01121	W8350
R532	311-1095-00	B010100	B055352	RES.,VAR,NONWIR:10K OHM,20%,0.50W	12697	382-CM40386
R532	311-1844-00	B055353		RES.,VAR,NONWIR:10K OHM,20%,0.50W	01121	W8350
S535	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
S536	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
S537	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
S538	260-1274-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412-SR
V1	154-0662-10	B010100	B059999	ELECTRON TUBE:CRT	80009	154-0662-10
V1	154-0740-00	B060000		ELECTRON TUBE:CRT	80009	154-0740-00
				PEDESTAL CHASSIS		
C501	283-0022-00	XB020000	B059999X	CAP.,FXD,CER DI:0.02UF,1400VDCAC	91418	AU203P1421R0
C502	283-0022-00	XB020000	B059999X	CAP.,FXD,CER DI:0.02UF,1400VDCAC	91418	AU203P1421R0
CR502	152-0274-00			SEMICOND DEVICE:SILICON,100V,10A	80009	152-0274-00
CR503	152-0274-00			SEMICOND DEVICE:SILICON,100V,10A	80009	152-0274-00
F501[1]	159-0023-00	B010100	B059999	FUSE,CARTRIDGE:3AG,2A,250V,SLOW-BLOW	71400	MDX 2
F501[1]	159-0005-00	B060000		FUSE,CARTRIDGE:3AG,3A,125V,30 SEC,CER	71400	MDA 3
F501[2]	159-0041-00			FUSE,CARTRIDGE:3AG,1.25A,250V,SLOW BLOW	71400	MDX 1 25/100
Q510	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q515	151-0337-00	B010100	B059999	TRANSISTOR:SILICON,NPN	21845	93SX287
Q515	151-0470-00	B060000		TRANSISTOR:SILICON,NPN	80009	151-0470-00
Q520	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
R501	302-0104-00	XB020000	B059999X	RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
S501	260-1179-01			SWITCH,ROCKER:DPST,10A,250VAC	80009	260-1179-01
T501	120-0768-00	B010100	B019999	XFMR,PWR:LV	80009	120-0768-00
T501	120-0768-01	B020000	B059999	XFMR,PWR:LV	80009	120-0768-00
T501	120-1038-00	B060000		XFMR,PWR:LV	80009	120-1038-00
				A1 ASSEMBLY TC-1		
A1	670-1728-00	B010100	B010479	CKT CARD ASSY:TC-1	80009	670-1728-00
A1	670-1728-01	B010480		CKT CARD ASSY:TC-1	80009	670-1728-01
A1	670-1728-02			CKT CARD ASSY:TC-1	80009	670-1728-02

[1]For 115V operation only.
[2]For 230V operation only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1[1]	670-1728-03			CKT CARD ASSY:TC-1	80009	670-1728-03
C3	283-0602-00			CAP.,FXD,MICA D:53PF,5%,300V	00853	D153E530J0
C6	283-0602-00			CAP.,FXD,MICA D:53PF,5%,300V	00853	D153E530J0
C8	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C12	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C17	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C20	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C21[2]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C23	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C29	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C74	290-0512-00	B010100	B010479	CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C74	290-0529-00	B010480		CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C90	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C91	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C92	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C93	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
CR9[3]	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	80009	152-0075-00
CR10	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR10	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR11	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR11	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR64	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR64	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR65	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR65	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR66	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR66	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR80	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR80	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR81	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR81	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR82	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR82	152-0141-02	B020000		SEMICOND DEVICF:SILICON,30V,150MA	07910	1N4152
VR19[4]	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
VR73	152-0280-00	B010100	B010479	SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N753A
VR73	152-0309-00	B010480		SEMICOND DEVICE:ZENER,1W,6.2V,5%	04713	1N3828A
VR74	152-0278-00	XB010480		SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
Q19	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q21[2]	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q65	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q89	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
R3	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
R4	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R5	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R6	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
R7	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R12	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R17	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R19	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R20	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R21	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

[1]Replaced by new 670-1728-05.
[2]-02 and up only.
[3]-03 only.
[4]**-00 and -01 only.**

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R22[1]	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R23	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R24	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R25	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R28	311-1285-00			RES.,VAR,NONWIR:25K OHM,+/-10%,0.5W	32997	3319W-L58-253
R29	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R31	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R35	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R37	315-0472-00	XB010131		RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R38	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R40	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R43	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R50	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R51	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R52	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R53	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R54	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R55	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R60	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R61	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R62	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R64	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R65	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R66	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R67	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R68	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R69	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R71	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R73	301-0820-00	B010100	B010479X	RES.,FXD,CMPSN:82 OHM,5%,0.50W	01121	EB8205
R80	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R81	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R82	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R83	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R84	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R85	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
U1	156-0174-00			MICROCIRCUIT,DI:DUAL J-K MS,FLIP-FLOP	01295	SN74111N
U3	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U5	156-0140-00			MICROCIRCUIT,DI:HEX.BFR,15V,TTL	01295	SN7417N
U7	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U8	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U9	156-0150-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7437N
U11	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U13	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U15	156-0042-00			MICROCIRCUIT,DI:J-K M/S FLIP-FLOP	01295	SN7476N
U17	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U19	156-0042-00			MICROCIRCUIT,DI:J-K M/S FLIP-FLOP	01295	SN7476N
U21	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U22	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U23	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U24	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U25	156-0144-00			MICROCIRCUIT,DI:3-INPUT POS NAND GATE	01295	SN7412N
U27	156-0150-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7437N
U29	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N

[1]-02 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U31	156-0142-00			MICROCIRCUIT,DI:50 MHZ PRESETTABLE BIN CNTR	80009	156-0142-00
U33	156-0142-00			MICROCIRCUIT,DI:50 MHZ PRESETTABLE BIN CNTR	80009	156-0142-00
U35	156-0142-00			MICROCIRCUIT,DI:50 MHZ PRESETTABLE BIN CNTR	80009	156-0142-00
U37	156-0142-00			MICROCIRCUIT,DI:50 MHZ PRESETTABLE BIN CNTR	80009	156-0142-00
U39	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U61	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U63	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U64	156-0111-00			MICROCIRCUIT,DI:SNGL BCD-TO-DEC DEC/DRIVER	01295	SN74145N
U65	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U67	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U69	156-0143-00			MICROCIRCUIT,DI:RETRIGGERABLE MONOST/MV	01295	SN74122N
U71	156-0034-00			MICROCIRCUIT,DI:DUAL 4-INPUT NAND GATE	80009	156-0034-00
U73	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U74	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U75	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U77	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U79	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U81	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U83	156-0129-00			MICROCIRCUIT,DI:QUAD 2-INPUT GATE	01295	SN7408N
U85	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U87	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U88	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U89	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U91	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U93	156-0147-00			MICROCIRCUIT,DI:ROM 64 X 5 X 7 CHAR GEN	18324	N2513/CM2140N
U97	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U99	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	07263	9390PC
Y4	158-0072-00			XTAL UNIT,QTZ:4.9152 MHZ,0.05%	80009	158-0072-00

A1 ASSEMBLY TC-1

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1728-05			CKT BOARD ASSY:TC-1	80009	670-1728-05
C7	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C24	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C47	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C60	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C61	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C62	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
C87	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C89	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C97	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C102	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C122	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C165	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C202	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C225	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C227	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C247	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C278	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C298	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C365	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C396	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C402	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C438	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C445	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C451	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C461	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C467	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C478	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C497	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
CR9	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR102	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR181	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR184	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR187	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR190	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR193	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR196	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR476	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
L58	108-0317-00			COIL,RF:15UH	32159	71501M
L65	108-0317-00			COIL,RF:15UH	32159	71501M
Q23	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q25	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q85	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q226	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
R1	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R2	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R3	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R4	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R16	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R22	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R34	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R41	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R83	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R84	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R85	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R88	311-1285-00			RES.,VAR,NONWIR:25K OHM,+/-10%,0.5W	32997	3319W-L58-253
R98	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R116	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R141	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R179	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R180	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R182	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R183	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R185	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R186	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R188	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R189	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R191	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R192	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R194	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R195	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R223	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R224	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R302	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R425	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R428	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R429	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R462	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
U11	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U21	156-0174-00			MICROCIRCUIT,DI:DUAL J-K MS,FLIP-FLOP	01295	SN74111N
U34	156-0536-00			MICROCIRCUIT,DI:PRESETTABLE DECADE/BIN CNTR	01295	SN74177N
U41	156-0536-00			MICROCIRCUIT,DI:PRESETTABLE DECADE/BIN CNTR	01295	SN74177N
U45	156-0536-00			MICROCIRCUIT,DI:PRESETTABLE DECADE/BIN CNTR	01295	SN74177N
U51	156-0536-00			MICROCIRCUIT,DI:PRESETTABLE DECADE/BIN CNTR	01295	SN74177N
U71	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U75	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U81	156-0143-00			MICROCIRCUIT,DI:RETRIGGERABLE MONOST/MV	01295	SN74122N
U91	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U101	156-0172-00			MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	80009	156-0172-00
U111	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U121	156-0473-00			MICROCIRCUIT,DI:DUAL 5-INPUT NAND GATE TTL	27014	DM8092N
U131	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U135	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U141	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U145	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U151	156-0042-00			MICROCIRCUIT,DI:J-K M/S FLIP-FLOP	01295	SN7476N
U161	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U165	156-0042-00			MICROCIRCUIT,DI:J-K M/S FLIP-FLOP	01295	SN7476N
U171	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U175	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U201	156-0111-00			MICROCIRCUIT,DI:SNGL BCD-TO-DEC DEC/DRIVER	01295	SN74145N
U211	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U221	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U235	156-0129-00			MICROCIRCUIT,DI:QUAD 2-INPUT GATE	01295	SN7408N
U241	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U245	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U251	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U261	156-0150-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7437N
U265	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U271	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U275	156-0144-00			MICROCIRCUIT,DI:3-INPUT POS NAND GATE	01295	SN7412N
U281	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U285	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	07263	9390PC
U291	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U331	156-0150-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7437N
U335	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U341	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U345	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U351	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U361	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U365	156-0140-00			MICROCIRCUIT,DI:HEX.BFR,15V,TTL	01295	SN7417N
U371	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U375	307-0422-00			RES.,FXD,FILM:15 RES. NETWORK	73138	898-1-R242J
U401	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U415	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
U481	156-0147-00			MICROCIRCUIT,DI:ROM 64 X 5 X 7 CHAR GEN	18324	N2513/CM2140N
VR398	152-0309-00			SEMICOND DEVICE:ZENER,1W,6.2V,5%	04713	1N3828A
VR498	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	07910	1N4372A
Y62	158-0072-00			XTAL UNIT,QTZ:4.9152 MHZ,0.05%	80009	158-0072-00

A2 ASSEMBLY TC-2

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A2	670-1729-00	B010100	B019999	CKT CARD ASSY:TC-2	80009	670-1729-00
A2	670-1729-01	B020000	B021369	CKT CARD ASSY:TC-2	80009	670-1729-01
A2	670-1729-02	B021370		CKT CARD ASSY:TC-2	80009	670-1729-02
C60	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C61	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C62	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C63	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C70	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C71	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C72	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C77	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C81	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1
C82	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C86	281-0658-00			CAP.,FXD,CER DI:6.2PF,+/-0.25PF,500V	72982	301-000C0H0629C
C88	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075 E474M
C94	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C96	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C97	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C98	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
CR5	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR5	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR6	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR6	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR7	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR7	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR8	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR8	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR9	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR15	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR15	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR16	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR16	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR17	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR17	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR18	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR18	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR19	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR19	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR35	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR35	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR36	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR36	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR37	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR37	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR38	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR38	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR39	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR39	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR45	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR45	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR46	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR46	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR47	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR47	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR48	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR48	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR49	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR49	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR90	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR90	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
Q1	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q41	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q43	151-1005-00	B010100	B019999	TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q43[1]	151-1042-00	B020000	B021559	SEMICOND DVC SE:MATCHED PAIR FET	80009	151-1042-00
Q43	151-1078-00	B021560		TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1078-00
Q45	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q47	151-1005-00	B010100	B019999	TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q47[2]	151-1042-00	B020000	B021559	SEMICOND DVC SE:MATCHED PAIR FET	80009	151-1042-00
Q47	151-1078-00	B021560		TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1078-00
R3	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R4	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R5	323-0510-00			RES.,FXD,FILM:2M OHM,1%,0.50W	75042	CECTO-2004F
R6	322-0693-00			RES.,FXD,FILM:1.036M OHM,1%,0.25W	91637	MFF1421G10363F
R7	322-0694-00			RES.,FXD,FILM:517K OHM,1%,0.25W	91637	MFF1421G51702F
R8	322-0695-00			RES.,FXD,FILM:258K OHM,1%,0.25W	91637	MFF1421G25802F
R9	322-0696-00			RES.,FXD,FILM:129K OHM,1%,0.25W	91637	MFF1421G12902F
R15	322-0697-02			RES.,FXD,FILM:64.37K OHM,0.5%,0.25W	91637	MFF1421D64371D
R16	308-0697-00			RES.,FXD,WW:32.14K OHM,1%,0.125W	91637	WWP2258032141B
R17	308-0698-00			RES.,FXD,WW:16.046K OHM,0.1%,0.125W	91637	WWP225-A16046B
R18	308-0699-00			RES.,FXD,WW:8.115K OHM,0.1%,0.125W	05347	203PA-80111A
R19	308-0658-00			RES.,FXD,WW:4K OHM,0.01%,0.125W	91637	WWP225-A40000L
R21	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R23	321-0221-00			RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R25	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R26	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R28	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R33	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R34	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R35	323-0510-00			RES.,FXD,FILM:2M OHM,1%,0.50W	75042	CECTO-2004F

[1]Furnished as a matched pair with Q47.
[2]Furnished as a matched pair with Q43.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R36	322-0693-00			RES.,FXD,FILM:1.036M OHM,1%,0.25W	91637	MFF1421G10363F
R37	322-0694-00			RES.,FXD,FILM:517K OHM,1%,0.25W	91637	MFF1421G51702F
R38	322-0695-00			RES.,FXD,FILM:258K OHM,1%,0.25W	91637	MFF1421G25802F
R39	322-0696-00			RES.,FXD,FILM:129K OHM,1%,0.25W	91637	MFF1421G12902F
R45	322-0697-02			RES.,FXD,FILM:64.37K OHM,0.5%,0.25W	91637	MFF1421D64371D
R46	308-0697-00			RES.,FXD,WW:32.14K OHM,1%,0.125W	91637	WWP2258032141B
R47	308-0698-00			RES.,FXD,WW:16.046K OHM,0.1%,0.125W	91637	WWP225-A16046B
R48	308-0699-00			RES.,FXD,WW:8.115K OHM,0.1%,0.125W	05347	203PA-80111A
R49	308-0658-00			RES.,FXD,WW:4K OHM,0.01%,0.125W	91637	WWP225-A40000L
R51	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R53	315-0203-00	B010100	B010226	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R53	321-0316-00	B010227	B019999	RES.,FXD,FILM:19.1K OHM,1%,0.125W	91637	MFF1816G19101F
R53	321-0315-00	B020000		RES.,FXD,FILM:18.7K OHM,1%,0.125W	91637	MFF1816G18701F
R54	315-0103-00	B010100	B010226	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R54	321-0289-00	B010227		RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R56	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R58	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R60	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R61	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R62	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R65	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R67	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R70	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R71	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R72	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R75	315-0203-00	B010100	B010226	RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R75	321-0316-00	B010227	B019999	RES.,FXD,FILM:19.1K OHM,1%,0.125W	91637	MFF1816G19101F
R75	321-0315-00	B020000		RES.,FXD,FILM:18.7K OHM,1%,0.125W	91637	MFF1816G18701F
R76	315-0103-00	B010100	B010226	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R76	321-0289-00	B010227		RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R78	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R80	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R85	311-1134-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	72XW-51-0-503M
R86	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R90	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R91	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R92	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R93	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R96	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R98	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
U1	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U3	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U5	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U7	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U9	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U10	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U11	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U12	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U13	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U15	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U17	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U19	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U19	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U21	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U23	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U25	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U27	156-0042-00			MICROCIRCUIT,DI:J-K M/S FLIP-FLOP	01295	SN7476N
U29	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U31	156-0061-00			MICROCIRCUIT,DI:SGL,BCD TO DEC DECODER	01295	SN7442N
U33	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U34	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U35	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U36	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U37	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U38	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U38	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U39	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U39	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U41	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U42	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U43	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U44	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U45	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U47	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U48	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U49	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U51	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U53	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U55	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U57	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U59	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U61	156-0034-00			MICROCIRCUIT,DI:DUAL 4-INPUT NAND GATE	80009	156-0034-00
U62	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U63	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U64	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U65	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U66	156-0144-00			MICROCIRCUIT,DI:3-INPUT POS NAND GATE	01295	SN7412N
U67	156-0129-00			MICROCIRCUIT,DI:QUAD 2-INPUT GATE	01295	SN7408N
U68	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U69	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U70	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U71	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U73	156-0152-00			MICROCIRCUIT,DI:DUAL 5-BIT BUFFER-REG	18324	N8201N
U75	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U75	156-0105-00	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U77	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U77	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U79	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U79	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A2 ASSEMBLY TC-2		
A2	670-1729-05			CKT CARD ASSY:TC-2	80009	670-1729-05
A2	670-1729-06			CKT CARD ASSY:TC-2	80009	670-1729-06
A2	670-1729-07			CKT CARD ASSY:TC-2	80009	670-1729-07
A2	670-1729-08			CKT CARD ASSY:TC-2	80009	670-1729-08
A2	670-1729-09			CKT CARD ASSY:TC-2	80009	670-1729-09
A2	670-1729-10			CKT CARD ASSY:TC-2	80009	670-1729-10
A2	670-1729-12			CKT CARD ASSY:TC-2	80009	670-1729-12
C9	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C26[1]	281-0543-00			CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C29[2]	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C29[3]	281-0517-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	72982	308-000C0G0390K
C31[4]	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C38	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C40[2]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C70[2]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C84	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C88	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C89	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C90	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C128[2]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C149	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C159[2]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C171	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C174	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C175	285-0596-00			CAP.,FXD,PLSTC:0.01UF,1%,100V	14752	410B1B103F
C176	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C201	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C202	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1
C209	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C241	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C276	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C280	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C282	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C286	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C301[5]	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075 E474M
C301[2]	283-0190-00			CAP.,FXD,CER DI:0.47UF,5%,50V	72982	8141N077W5R474J
C329	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C359	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C374[2]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
CR28[1]	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	80009	152-0075-00
CR180	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR181	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR182	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR183	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR185	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR186	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR187	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR188	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR189	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR190	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR283	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR285	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

[1]-06 and up only.
[2]-09 and -10 only.
[3]-12 and up only.
[4]-06, -07, and -08 only.
[5]-05, -06, -07, -08 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR381	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR382	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR383	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR384	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR385	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR386	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR387	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR388	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR389	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
Q77	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q78	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q79	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q80	151-1078-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1078-00
Q85	151-1078-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1078-00
Q273	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SBA8129
Q274	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q275	151-0126-00			TRANSISTOR:SILICON,NPN	15818	2N2484
Q277	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q278	151-0126-00			TRANSISTOR:SILICON,NPN	15818	2N2484
R27[1]	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R29[2]	311-1134-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	72XW-51-0-503M
R30[3]	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
R30[4]	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R31[5]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R31[6]	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R32[7]	311-1134-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	72XW-51-0-503M
R39	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R72	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R73[8]	321-0315-00			RES.,FXD,FILM:18.7K OHM,1%,0.125W	91637	MFF1816G18701F
R73[9]	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	MFF1816G18201F
R74	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R75	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R76	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R77	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R83	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R86	308-0697-00			RES.,FXD,WW:32.14K OHM,1%,0.125W	91637	WWP2258032141B
R87	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R88	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R89	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R90[10]	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R90[11]	315-0396-00			RES.,FXD,CMPSN:39M OHM,5%,0.25W	01121	CB3965
R175[10]	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R175[11]	315-0396-00			RES.,FXD,CMPSN:39M OHM,5%,0.25W	01121	CB3965
R176	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R177	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	91637	MFF1816G15402F
R178	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R182	308-0698-00			RES.,FXD,WW:16.046K OHM,0.1%,0.125W	91637	WWP225-A16046B
R183	308-0658-00			RES.,FXD,WW:4K OHM,0.01%,0.125W	91637	WWP225-A40000L
R186	308-0699-00			RES.,FXD,WW:8.115K OHM,0.1%,0.125W	05347	203PA-80111A
R187	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R191	322-0696-00			RES.,FXD,FILM:129K OHM,1%,0.25W	91637	MFF1421G12902F
R192	323-0510-00			RES.,FXD,FILM:2M OHM,1%,0.50W	75042	CECT0-2004F
R193	322-0693-00			RES.,FXD,FILM:1.036M OHM,1%,0.25W	91637	MFF1421G10363F

[1] -06, -07, and -08 only.
[2] -05, -06, -07, and -08 only.
[3] -06,-07,-08,-09 and -10 only.
[4] -12 and up only.
[5] -05 only.
[6] -06 and up only.
[7] -09 and up only.
[8] -05, -06, and -07 only.
[9] -08 and up only.
[10] -05, and -06 only.
[11] -07 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R194	322-0694-00			RES.,FXD,FILM:517K OHM,1%,0.25W	91637	MFF1421G51702F
R195	322-0697-02			RES.,FXD,FILM:64.37K OHM,0.5%,0.25W	91637	MFF1421D64371D
R196	322-0695-00			RES.,FXD,FILM:258K OHM,1%,0.25W	91637	MFF1421G25802F
R201 [1]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R201 [2]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R241	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R261	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R264	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R265	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R273	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R274 [3]	321-0315-00			RES.,FXD,FILM:18.7K OHM,1%,0.125W	91637	MFF1816G18701F
R274 [4]	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	91637	MFF1816G18201F
R275	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R276	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R277	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R278	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R280	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R281	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R283	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R284	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R285	321-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.125W	91637	MFF1816G15000F
R286 [3]	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R286 [4]	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R287 [3]	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R287 [4]	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	91637	MFF1816G20500F
R288	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R289	321-0272-00			RES.,FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R290	321-0221-00			RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R303	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R309	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R331	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R345	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R349	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R350 [2]	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R380	308-0697-00			RES.,FXD,WW:32.14K OHM,1%,0.125W	91637	WWP2258032141B
R381	308-0698-00			RES.,FXD,WW:16.046K OHM,0.1%,0.125W	91637	WWP225-A16046B
R382	308-0699-00			RES.,FXD,WW:8.115K OHM,0.1%,0.125W	05347	203PA-80111A
R387	308-0658-00			RES.,FXD,WW:4K OHM,0.01%,0.125W	91637	WWP225-A40000L
R391	322-0697-02			RES.,FXD,FILM:64.37K OHM,0.5%,0.25W	91637	MFF1421D64371D
R392	322-0696-00			RES.,FXD,FILM:129K OHM,1%,0.25W	91637	MFF1421G12902F
R393	323-0510-00			RES.,FXD,FILM:2M OHM,1%,0.50W	75042	CECTO-2004F
R394	322-0693-00			RES.,FXD,FILM:1.036M OHM,1%,0.25W	91637	MFF1421G10363F
R395	322-0694-00			RES.,FXD,FILM:517K OHM,1%,0.25W	91637	MFF1421G51702F
R396	322-0695-00			RES.,FXD,FILM:258K OHM,1%,0.25W	91637	MFF1421G25802F
U9	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U31	156-0172-00			MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	80009	156-0172-00
U39	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U41	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U49	156-0061-00			MICROCIRCUIT,DI:SGL,BCD TO DEC DECODER	01295	SN7442N
U51	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U59	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U61	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U69	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00

[1] -05, -06, -07, and -08 only.
[2] -09 and up only.
[3] -05, -06, and -07 only.
[4] -08 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U71	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U91	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U92	156-0067-07			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U109	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U129	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U131	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U139	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U141	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U149	156-0047-00			MICROCIRCUIT,DI:TPL 3-INPUT POS NAND GATE	80009	156-0047-00
U151	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U159	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U161	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
U169	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
U171	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U179	156-0067-07			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U181	156-0067-07			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U189	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U191	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U201	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U209	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U229	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	01295	SN7473N
U231	156-0034-00			MICROCIRCUIT,DI:DUAL 4-INPUT NAND GATE	80009	156-0034-00
U239	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U241	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U249	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U251	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U259	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U261	156-0144-00			MICROCIRCUIT,DI:3-INPUT POS NAND GATE	01295	SN7412N
U271	156-0152-00			MICROCIRCUIT,DI:DUAL 5-BIT BUFFER-REG	18324	N8201N
U291	156-0067-07			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U292	156-0067-07			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U301	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U309	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U329	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U331	156-0042-00			MICROCIRCUIT,DI:J-K M/S FLIP-FLOP	01295	SN7476N
U339	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U341	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
U349	156-0129-00			MICROCIRCUIT,DI:QUAD 2-INPUT GATE	01295	SN7408N
U351	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U359	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U361	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U369	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U371	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U378	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U379	156-0058-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7404N
U389	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039
U391	156-0106-00			MICROCIRCUIT,LI:MONOLITHIC,6-DIODE ARRAY	86684	CA3039

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A3 ASSEMBLY MOTHER		
A3	670-1734-00			CKT BOARD ASSY:MOTHER	80009	670-1734-00
A3	670-1734-02			CKT BOARD ASSY:MOTHER	80009	670-1734-02
C4	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
CR3	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR4	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR4	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
J201	131-1147-00			CONNECTOR,RCPT:	00779	PE1-14180
J202	131-1147-00			CONNECTOR,RCPT:	00779	PE1-14180
J203	131-1147-00			CONNECTOR,RCPT:	00779	PE1-14180
J204	131-1147-00			CONNECTOR,RCPT:	00779	PE1-14180
R4	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R7	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R8	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R10	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R12	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R14	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R16	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R18	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R20	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R22	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R24	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R28	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R30	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R32	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R34	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R36	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R38	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R40	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R42	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R44	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R46	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R48	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R50	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R52	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R54	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R56	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R58	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R60	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R62	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R64	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R66	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R68	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R70	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R72	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R74	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R76	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R78	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R80	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R82	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R84	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R86	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R88	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R90	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R92	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825

A4 ASSEMBLY DEFLECTION AMPL AND STORAGE (4010 ONLY)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4	670-1974-00	B010100	B010499	CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1974-00
A4	670-1974-01	B010500	B019999	CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1974-01
A4	670-1974-02	B020000	B020954	CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1974-02
A4	670-1974-03	B020955		CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1974-03
A4	670-1974-04			CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1974-04
A4	670-1974-05			CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1974-05
C103	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C106	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C117	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C119	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C163	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C166	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C177	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C190[1]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C190[2]	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C192[1]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C192[2]	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C193	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C194	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C195	283-0068-00	B010100	B010499X	CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C198	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C210	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C230	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C233[1]	283-0068-00	XB020000		CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C233[2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C234[1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C234[2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C240[1]	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C244	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C247[1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C247[2]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C249[3]	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C267[3]	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C270[3]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C276	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C279[1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C279[2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C288	290-0260-00			CAP.,FXD,ELCTLT:50UF,+75-10%,200V	56289	34D506G200GL4
C320[1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C320[2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C322[1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C322[2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C324	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C326	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL

[1]-00, -01, -02, -03, and -04 only.
[2]-05 and up only.
[3]-00, -01, -02, and -03 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C328	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C330	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C332	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR64	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR64	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR65	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR65	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR67	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR67	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR68	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR68	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR107	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR107	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR108	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR108	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR124	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR124	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR125	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR125	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR127	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR127	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR128	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR128	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR167	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR167	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR168	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR168	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR202	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR202	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR211	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR211	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR234	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR234	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR279	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR279	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR289	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR291	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR293	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR293[1]	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR293[2]	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
Q5	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q7	151-0373-00			TRANSISTOR:SILICON,PNP	04713	SJE925
Q9	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q11	151-0373-00			TRANSISTOR:SILICON,PNP	04713	SJE925
Q19	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q31	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q33	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q35	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q39	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
Q47	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q51	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q55	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q57	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q58	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q59	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
Q65	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q67	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q69	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q75	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q77	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q85	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q93	151-0286-00			TRANSISTOR:SILICON,NPN	18657	2SC515
Q95	151-0241-00			TRANSISTOR:SILICON,NPN	02735	39625
Q97	151-0241-00			TRANSISTOR:SILICON,NPN	02735	39625
Q99	151-0241-00	B010100	B019999	TRANSISTOR:SILICON,NPN	02735	39625
Q99	151-0210-00	B020000		TRANSISTOR:SILICON,NPN	02735	39626
Q109	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q115	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q117	151-0149-00			TRANSISTOR:SILICON,NPN	02735	60010
Q135	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q137 [1]	151-0150-00			TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q137 [2]	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
R60	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R62	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R65	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R67	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R68	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R70	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R71	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R73	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R75	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R77	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R80	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R81	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R83	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R85	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R86	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R90	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R91	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R93	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R94	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R96	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R97	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R100	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R102	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R103	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R104	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R106	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R109	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R111	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R112	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R113	308-0221-00			RES.,FXD,WW:400 OHM,5%,4UH	80009	308-0221-00
R114	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151
R115	311-1328-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5553
R116	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R117	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R119	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R120	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R122	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R125	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R127	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R128	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R130	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R131	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R133	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R135	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R136[1]	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R137	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R140	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R141	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R143	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R145	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R146	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R150	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R151	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R153	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R154	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R156	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R157	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R160	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R162	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R163	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R164	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R166	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R169	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R171	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R172	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R173	303-0221-00			RES.,FXD,CMPSN:220 OHM,5%,1W	01121	GB2215
R174	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151
R175	311-1328-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5553
R176	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500J0151
R177	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R194	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R198	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R202	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R203	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R204	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R205	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R206	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R210	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R211	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R212	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R214	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R216	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R218	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R219	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R220	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R221	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R222	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R223	323-0452-00			RES.,FXD,FILM:499K OHM,1%,0.50W	75042	CECT0-4993F
R225	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R227	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R230	305-0104-00			RES.,FXD,CMPSN:100K OHM,5%,2W	01121	HB1045
R231	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R232	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R233	301-0474-00	XB020000		RES.,FXD,CMPSN:470K OHM,5%,0.50W	01121	EB4745
R234	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R236	303-0224-00			RES.,FXD,CMPSN:220K OHM,5%,1W	01121	GB2245
R237	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R240[1]	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R240[2]	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R241[2]	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R242	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R244	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R246[1]	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R247	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R248	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R249	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R251	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R252	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R253	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R255	321-0307-00			RES.,FXD,FILM:15.4K OHM,1%,0.125W	91637	MFF1816G15401F
R256	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R257	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R260	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R261	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R262	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R263	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R265	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R266	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R267[1]	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R268	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
R270[1]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R271	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R273	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R275	305-0683-00			RES.,FXD,CMPSN:68K OHM,5%,2W	01121	HB6835
R277	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R279	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R281	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R283	323-0398-00			RES.,FXD,FILM:137K OHM,1%,0.50W	91637	MFF1226G13702F
R285	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R287	305-0104-00			RES.,FXD,CMPSN:100K OHM,5%,2W	01121	HB1045
R289	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R291	306-0124-00			RES.,FXD,CMPSN:120K OHM,10%,2W	01121	HB1241
R295	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R300	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R301	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R302	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R304[3]	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R304[4]	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R305[3]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735

[1]-00, -01, -02, and -03 only.
[2]-04 and up only.
[3]-00, -01, -02, -03, and -04 only.
[4]-05 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R305[1]	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R320	301-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.50W	01121	EB1005
R322	301-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.50W	01121	EB1005
R324	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R328	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
U13	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U33	156-0093-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7416N
U45	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U45	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U65	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U65	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U87	155-0035-00			MICROCIRCUIT,LI:QUAD OPERATIONAL AMPL	80009	155-0035-00
U91	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U91	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U93	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U103[2]	156-0149-00			MICROCIRCUIT,DI:DUAL 4-INPUT ST	01295	SN7413N
U105	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U105	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U107[3]	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U107[2]	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U111	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U111	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
VR119	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	07910	CD332305
VR233	152-0059-00	XB020000		SEMICOND DEVICE:ZENER,1W,12.6V,5%	04713	SZ50601
VR287	152-0087-00			SEMICOND DEVICE:ZENER,1W,100V,5%	04713	1N3044B
VR292	152-0440-00	B010100	B010499	SEMICOND DEVICE:ZENER,1.5W,150V,5%	04713	1N3817B
VR292	152-0298-00	B010500		SEMICOND DEVICE:ZENER,1.5W,140V,5%	04713	SZ12010

A4 ASSEMBLY DEFLECTION AMPL AND STORAGE (4010-1 ONLY)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4	670-1727-00	B010100	B010499	CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1727-00
A4	670-1727-01	B010500	B019999	CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1727-01
A4	670-1727-02	B020000	B020954	CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1727-02
A4	670-1727-03	B020955		CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1727-03
A4	670-1727-04			CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1727-04
A4	670-1727-05			CKT BOARD ASSY:DEFLECTION AMPL AND STORAGE	80009	670-1727-05
C33[2]	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C46[3]	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C48[3]	283-0081-00			CAP.,FXD,CER DI:0.1UF,+80-20%,25V	56289	36C600
C52	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C103	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C106	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C117	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C119	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C163	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C166	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C177	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C190[4]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C190[1]	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1

[1] -05 and up only.
[2] -04 and up only.
[3] -00, -01, -02, -03 only.
[4] -00, -01, -02, -03, and -04 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C192 [1]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C192 [2]	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C193	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C194	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C195	283-0068-00	B010100	B010499X	CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C196	283-0220-00	XB010500		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075W5R103M
C198	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C199	283-0220-00	XB010500		CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N075W5R103M
C210	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C230	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C233 [1]	283-0068-00	XB020000		CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C233 [2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C234 [1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C234 [2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C240 [1]	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C244	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C247 [1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C247 [2]	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C249 [3]	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C267 [3]	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C270 [3]	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C276	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C279 [1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C279 [2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C288	290-0260-00			CAP.,FXD,ELCTLT:50UF,+75-10%,200V	56289	34D506G200GL4
C320 [1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C320 [2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C322 [1]	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C322 [2]	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C324	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C326	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C328	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C330	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C332	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR4	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR4	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR9	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR9	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR10	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR10	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR11	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR11	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR24	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR24	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR29	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR29	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR30	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR30	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR31	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR31	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR40	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR40	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR64	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152

[1]-00, -01, -02, -03, and -04 only.
[2]-05 and up only.
[3]-00, -01, -02, and -03 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR64	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR65	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR65	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR67	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR67	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR68	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR68	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR107	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR107	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR108	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR108	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR124	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR124	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR125	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR125	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR127	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR127	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR128	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR128	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR167	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR167	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR168	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR168	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR202	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR202	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR211	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR211	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR234	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR234	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR279	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR279	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR289	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR291	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR293	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR293[1]	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR293[2]	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
Q5	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q7	151-0373-00			TRANSISTOR:SILICON,PNP	04713	SJE925
Q9	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE2801	04713	SJE924
Q11	151-0373-00			TRANSISTOR:SILICON,PNP	04713	SJE925
Q19	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q31	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q33	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q35	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q39	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
Q47	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q51	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q55	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q57	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q58	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q59	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00

[1]-00, -01, -02, -03 and -04 only.
[2]-05 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q65	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q67	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q69	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q75	151-0341-00			TRANSISTOR:SILICON,NPN	07263	2N3565
Q77	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q85	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q93	151-0286-00			TRANSISTOR:SILICON,NPN	18657	2SC515
Q95	151-0241-00			TRANSISTOR:SILICON,NPN	02735	39625
Q97	151-0241-00			TRANSISTOR:SILICON,NPN	02735	39625
Q99	151-0241-00	B010100	B019999	TRANSISTOR:SILICON,NPN	02735	39625
Q99	151-0210-00	B020000		TRANSISTOR:SILICON,NPN	02735	39626
Q105	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q109	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q115	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q117	151-0149-00			TRANSISTOR:SILICON,NPN	02735	60010
Q125	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q135	151-0219-00			TRANSISTOR:SILICON,PNP	80009	151-0219-00
Q137 [1]	151-0150-00			TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q137 [2]	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
R1	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R2	321-0705-00			RES.,FXD,FILM:41.7K OHM,1%,0.125W	91637	MFF1816G41701F
R3	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R4	311-1290-00			RES.,VAR,NONWIR:1M OHM,10%,0.50W	73138	62-336-0
R5	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R6	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R7	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R8	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R9	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R10	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R11	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R12	301-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.50W	01121	EB2425
R20	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R21	321-0705-00			RES.,FXD,FILM:41.7K OHM,1%,0.125W	91637	MFF1816G41701F
R22	311-1290-00			RES.,VAR,NONWIR:1M OHM,10%,0.50W	73138	62-336-0
R23	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R24	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R25	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R26	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R27 [3]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R29	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R30	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R31	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R32	301-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.50W	01121	EB2425
R35 [3]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R36	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R37	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R40	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R44 [4]	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R44 [3]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R46 [4]	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R48 [4]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R50	315-0102-00	B010100	B010130	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R50	315-0471-00	B010131		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715

[1] -00, -01, -02, -03, and -04 only.
[2] -05 and up only.
[3] -04 and up only.
[4] -00, -01, -02, and -03 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R51	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R52	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R53	311-1282-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329W-L58-502
R55	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R60	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R62	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R65	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R67	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R68	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R70	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R71	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R73	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R75	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R77	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R80	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R81	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R83	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R85	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R86	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R90	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R91	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R93	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R94	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R96	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R97	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R100	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R102	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R103	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R104	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R106	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R109	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R111	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R112	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R113	303-0221-00			RES.,FXD,CMPSN:220 OHM,5%,1W	01121	GB2215
R114	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151
R115	311-1328-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5553
R116	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151
R117	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R119	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R120	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R122	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R125	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R127	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R128	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R130	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R131	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R133	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R135	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R136[1]	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R137	321-0261-00			RES.,FXD,FILM:5.11K OHM,1%,0.125W	91637	MFF1816G51100F
R140	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R141	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R143	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F

[1]-05 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R145	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R146	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R150	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R151	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	91637	MFF1816G14301F
R153	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R154	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R156	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R157	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R160	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R162	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R163	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R164	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R166	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R169	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R171	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R172	308-0058-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500K
R173	303-0221-00			RES.,FXD,CMPSN:220 OHM,5%,1W	01121	GB2215
R174	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151
R175	311-1328-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5553
R176	308-0365-00			RES.,FXD,WW:1.5 OHM,5%,3W	56289	242EX1R500JQ151
R177	321-0204-00			RES.,FXD,FILM:1.3K OHM,1%,0.125W	91637	MFF1816G13000F
R194	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R196	315-0100-02	XB020955		RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R198	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R199	315-0100-02	XB020955		RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R202	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R203	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R204	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R205	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R206	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R210	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R211	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R212	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R214	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R216	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R218	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R219	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R220	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	91637	MFF1816G23201F
R221	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R222	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R223	323-0452-00			RES.,FXD,FILM:499K OHM,1%,0.50W	75042	CECTO-4993F
R225	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R227	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R230	305-0104-00			RES.,FXD,CMPSN:100K OHM,5%,2W	01121	HB1045
R231	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R232	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R233	301-0474-00	XB020000		RES.,FXD,CMPSN:470K OHM,5%,0.50W	01121	EB4745
R234	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R236	303-0224-00			RES.,FXD,CMPSN:220K OHM,5%,1W	01121	GB2245
R237	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R240[1]	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R240[2]	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R241[2]	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725

[1]-00, -01, -02, and -03 only.
[2]-04 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R242	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R244	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R246 [1]	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R247	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R248	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R249	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R251	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R252	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R253	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R255	321-0307-00			RES.,FXD,FILM:15.4K OHM,1%,0.125W	91637	MFF1816G15401F
R256	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R257	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R260	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R261	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R262	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R263	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R265	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R266	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R267 [1]	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R268	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
R270 [1]	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R271	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R273	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R275	305-0683-00			RES.,FXD,CMPSN:68K OHM,5%,2W	01121	HB6835
R277	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R279	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R281	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R283	323-0398-00			RES.,FXD,FILM:137K OHM,1%,0.50W	91637	MFF1226G13702F
R285	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R287	305-0104-00			RES.,FXD,CMPSN:100K OHM,5%,2W	01121	HB1045
R289	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R291	306-0124-00			RES.,FXD,CMPSN:120K OHM,10%,2W	01121	HB1241
R295	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R300	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R301	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R302	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R304 [2]	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R304 [3]	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R305 [2]	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R305 [3]	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R320	301-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.50W	01121	EB1005
R322	301-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.50W	01121	EB1005
R324	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R328	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
U3	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U3	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U13	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U23	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U23	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U33	156-0093-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7416N
U43	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U43	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U45	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00

[1]-00, -01, -02, and -03 only.
[2]-00, -01, -02, -03, and -04 only.
[3]-05 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U45	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U63	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U63	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U65	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U65	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U81	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U83	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U87	155-0035-00			MICROCIRCUIT,LI:QUAD OPERATIONAL AMPL	80009	155-0035-00
U91	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U91	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U93	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U101	156-0112-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7426N
U103 [1]	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U103 [2]	156-0149-00			MICROCIRCUIT,DI:DUAL 4-INPUT ST	01295	SN7413N
U105	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U105	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U107 [1]	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U107 [2]	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U111	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U111	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
VR219	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	07910	CD332305
VR233	152-0059-00	XB020000		SEMICOND DEVICE:ZENER,1W,12.6V,5%	04713	SZ50601
VR287	152-0087-00			SEMICOND DEVICE:ZENER,1W,100V,5%	04713	1N3044B
VR292	152-0440-00	B010100	B010499	SEMICOND DEVICE:ZENER,1.5W,150V,5%	04713	1N3817B
VR292	152-0289-00	B010500		SEMICOND DEVICE:ZENER,0.4W,180V,5%	07910	1N991B

A5 ASSEMBLY H.V. AND Z AXIS

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A5	670-1731-00	B010100	B019999	CKT BOARD ASSY:H.V. AND Z AXIS	80009	670-1731-00
A5	670-1731-01	B020000		CKT BOARD ASSY:H.V. AND Z AXIS	80009	670-1731-01
C22	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
C29	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C31	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	72982	301-000C0G0220K
C32	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C34	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C39	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C41	290-0215-00	B010100	B019999	CAP.,FXD,ELCTLT:100UF,+75-10%,25V	56289	30D107G025DD9
C41	290-0559-00	B020000		CAP.,FXD,ELCTLT:22UF,20%,35V	56289	196D226X0035MA1
C47	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C58	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C59	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C61	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C62	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C70	283-0034-00			CAP.,FXD,CER DI:0.005UF,20%,4000V	56289	41C107A
C72	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C73	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C74	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C75	283-0291-00			CAP.,FXD,CER DI:25PF,10%,6000V	72982	3878546C0G250K
C89	283-0008-00			CAP.,FXD,CER DI:0.1UF,500V	72982	8151N501 E104M
C91	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C93	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A

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[2]-04 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C101	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C105	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C106	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C111	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C113	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C121	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C130	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C140	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C142	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C148	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C170	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C174	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C180	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C184	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
CR25	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR25	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR31	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR31	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR32	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR37	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR39	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR43	152-0412-00			SEMICOND DEVICE:SILICON,50V,3A	04713	SR1936
CR47	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR54	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR54	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR57	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR57	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR61	152-0408-00			SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
CR62	152-0408-00			SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
CR71	152-0408-00			SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
CR72	152-0408-00			SEMICOND DEVICE:SILICON,10KV,5MA	83003	H345
CR90	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR92	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR94	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR96	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR115	152-0061-00	XB010370		SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR117	152-0185-00	XB010370	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR117	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR118	152-0185-00	B010100	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR118	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR119	152-0185-00	XB010370	B019999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR119	152-0141-02	B020000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR121	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR130	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR134	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR144	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
DS35	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS36	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS37	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS60	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS61	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS62	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T

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DS65	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS66	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS67	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS73	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS90	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS91	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS92	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS93	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS154	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
L47	108-0234-00			COIL,RF:130UH	80009	108-0234-00
L149	108-0213-00			COIL,RF:2.5MH	76493	8862-2.5
Q35	151-0126-00			TRANSISTOR:SILICON,NPN	15818	2N2484
Q37	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
Q53	151-0124-00			TRANSISTOR:SILICON,NPN,SEL FROM 2N3501	80009	151-0124-00
Q57	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q98	151-0347-00	XB010370		TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q99	151-0190-02			TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q101	151-0256-00			TRANSISTOR:SILICON,NPN	16758	7305762
Q103	151-0334-00			TRANSISTOR:SILICON,NPN	80009	151-0334-00
Q105	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q107	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q115	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
Q135	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q137	151-1004-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1004-00
Q139	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q151	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
Q153	151-0169-00			TRANSISTOR:SILICON,NPN	80009	151-0169-00
R1	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R4	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R6	315-0244-00			RES.,FXD,CMPSN:240K OHM,5%,0.25W	01121	CB2445
R7	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R8	315-0303-00			RES.,FXD,CMPSN:30K OHM,5%,0.25W	01121	CB3035
R10	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R11	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R13	321-0241-00			RES.,FXD,FILM:3.16K OHM,1%,0.125W	91637	MFF1816G31600F
R14	321-0255-00			RES.,FXD,FILM:4.42K OHM,1%,0.125W	91637	MFF1816G44200F
R16	321-0330-00			RES.,FXD,FILM:26.7K OHM,1%,0.125W	91637	MFF1816G26701F
R20	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R21	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R22	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R25	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R26	321-0306-00			RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R27	316-0335-00			RES.,FXD,CMPSN:3.3M OHM,10%,0.25W	01121	CB3351
R29	315-0100-02			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R31	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R34	305-0104-00			RES.,FXD,CMPSN:100K OHM,5%,2W	01121	HB1045
R35	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R37	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R39	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R41	308-0244-00			RES.,FXD,WW:0.3 OHM,10%,2W	91637	RS2B162ER3000K
R43	315-0103-00	XB020000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

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R45	308-0244-00			RES.,FXD,WW:0.3 OHM,10%,2W	91637	RS2B162ER3000K
R50	301-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.50W	01121	EB2725
R51	315-0221-00	XB020000		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R52	315-0152-00	B010100	B019999	RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R52	302-0152-00	B020000		RES.,FXD,CMPSN:1.5K OHM,10%,0.50W	01121	EB1521
R55	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R57	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R58	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R62	316-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R63A,B	307-0316-00			RES.,FXD,FILM:26.8M/15M OHM,2%	80009	307-0316-00
R64	311-1323-00			RES.,VAR,NONWIR:5M OHM,10%,2W	01121	12M658
R67	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R68	301-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.50W	01121	EB1015
R73	301-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.50W	01121	EB2735
R75	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R77A,B	307-0314-00			RES.,FXD,FILM:VOLTAGE DIVIDER	80009	307-0314-00
R78	322-0481-00			RES.,FXD,FILM:1M OHM,1%,0.25W	75042	CEBTO-1004F
R80	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	91637	MFF1816G49902F
R81	316-0824-00			RES.,FXD,CMPSN:820K OHM,10%,0.25W	01121	CB8241
R82	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R84	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R86	306-0185-00	B010100	B019999	RES.,FXD,CMPSN:1.8M OHM,10%,2W	01121	HB1851
R86	306-0125-00	B020000		RES.,FXD,CMPSN:1.2M OHM,10%,2W	01121	HB1251
R88	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R89	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R90	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R92	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R93	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R94	301-0395-00			RES.,FXD,CMPSN:3.9M OHM,5%,0.50W	01121	EB3955
R96	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R97	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R98	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R100	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R101	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R102	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R104	321-0309-00			RES.,FXD,FILM:16.2K OHM,1%,0.125W	91637	MFF1816G16201F
R105	321-0411-00			RES.,FXD,FILM:187K OHM,1%,0.125W	91637	MFF1816G18702F
R106	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R108	316-0335-00			RES.,FXD,CMPSN:3.3M OHM,10%,0.25W	01121	CB3351
R109	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R111	315-0220-01			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R112	308-0211-00	B010100	B010369	RES.,FXD,WW:12K OHM,5%,5W	91637	RS2A-B12001J
R112	308-0054-00	B010370		RES.,FXD,WW:10K OHM,5%,5W	91637	RS5-B10001J
R113	305-0123-00			RES.,FXD,CMPSN:12K OHM,5%,2W	01121	HB1235
R114	321-0417-00	B010100	B010369	RES.,FXD,FILM:215K OHM,1%,0.125W	91637	MFF1816G21502F
R114	321-0391-00	B010370		RES.,FXD,FILM:115K OHM,1%,0.125K	91637	MFF1816G11502F
R115	321-0366-00	XB010370		RES.,FXD,FILM:63.4K OHM,1%,0.125W	91637	MFF1816G63401F
R116	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
R117	315-0682-00	XB010370		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R118	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R119	315-0432-00	XB010370		RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R120	315-0513-00	B010100	B010322	RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R120	303-0513-00	B010323		RES.,FXD,CMPSN:51K OHM,5%,1W	01121	GB5135

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R121	316-0100-00			RES.,FXD,CMPSN:10 OHM,10%,0.25W	01121	CB1001
R122	316-0472-00	XB010370		RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R123	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R130	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	32997	3386F-T04-104
R131	316-0472-00	B010100	B010369	RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R131	315-0102-00	B010370		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R132	321-0332-00	B010100	B010369	RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R132	321-0267-00	B010370		RES.,FXD,FILM:5.9K OHM,1%,0.125W	91637	MFF1816G59000F
R134	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R136	321-0301-00	B010100	B010369	RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R136	321-0293-00	B010370		RES.,FXD,FILM:11K OHM,1%,0.125W	91637	MFF1816G11001F
R140	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R142	315-0220-01			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R143	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R144	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R145	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R146	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R148	315-0470-03			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R149	308-0054-00			RES.,FXD,WW:10K OHM,5%,5W	91637	RS5-B10001J
R152	316-0221-00			RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R154	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R170	315-0100-02			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R174	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R180	315-0100-02			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R184	315-0220-01			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
T50	120-0769-00			XFMR,PWR:	80009	120-0769-00
U119	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U119	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U157	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U157	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07

A6 ASSEMBLY L.V. POWER SUPPLY

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6	670-1726-00	B010100	B019999	CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1726-00
A6	670-1726-01	B020000	B021845	CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1726-01
A6	670-1726-02	B021846		CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1726-02
A6	670-1726-03			CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1726-03
A6 [1]	670-1726-04			CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-1726-04
C9A, C9B	290-0549-00			CAP.,FXD,ELCTLT:150UF,400VDC/250VDC	56289	68D20193
C23	290-0568-00			CAP.,FXD,ELCTLT:4500UF,+75-10%,25V	56289	66D10411
C29	290-0535-00	B010100	B010451	CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C29	290-0534-00	B010452		CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C31	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C34	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C35	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C39	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C41	290-0422-00			CAP.,FXD,ELCTLT:54,000UF,+75-10%,15V	56289	36D543G015CC2A
C42	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL

[1]Replaced by new 670-4216-00.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C43	290-0524-00	B010100	B010451	CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C43	290-0534-00	B010452		CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C44	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C45	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C46	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C50	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C53	290-0568-00			CAP.,FXD,ELCTLT:4500UF,+75-10%,25V	56289	66D10411
C58	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C59	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C60	290-0529-00	B010100	B010451X	CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C61	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C62	281-0523-00	XB020000		CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C66	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C119	283-0067-00	XB020000		CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
CR13	152-0200-00			SEMICOND DEVICE:SILICON,400V,1500MA	80009	152-0200-00
CR21	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR23	152-0462-00			SEMICOND DEVICE:SILICON,200V,2.5A	04713	SDA10228
CR47	152-0185-00	B010100	B010451X	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR53	152-0462-00			SEMICOND DEVICE:SILICON,200V,2.5A	04713	SDA10228
CR55	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR58	152-0233-00			SEMICOND DEVICE:SILICON,85V,100MA	07910	CD61128
CR60	152-0185-00	B010100	B010451X	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR61	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
F21	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
F41	159-0013-00			FUSE,CARTRIDGE:3AG,6A,125V,7SEC	71400	MTH6
F61	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
Q29	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q73	151-0087-00	B010100	B019999	TRANSISTOR:SILICON,PNP	01295	2N2905S
Q73	151-0134-00	B020000		TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q75	151-0331-00			TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q97	151-0515-01			TRANSISTOR:50V,8A	04713	2N4441
Q99	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q117	151-0337-00	XB010452		TRANSISTOR:SILICON,NPN	21845	93SX287
Q119	151-0302-00	XB010452		TRANSISTOR:SILICON,NPN	04713	2N2222A
R9	304-0184-00			RES.,FXD,CMPSN:180K OHM,10%,1W	01121	GB1841
R23	303-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,1W	01121	GB1825
R25	305-0273-00	B010100	B019999	RES.,FXD,CMPSN:27K OHM,5%,2W	01121	HB2735
R25	322-0197-00	B020000		RES.,FXD,FILM:1.1K OHM,1%,0.25W	75042	CEBT0-1101F
R26	321-0178-00	B010100	B010451	RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698R0F
R26	321-0181-00	B010452		RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R27	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R28	321-0256-00	B010100	B019999	RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R28	321-0262-00	B020000	B021845	RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R28	321-0251-00	B021846		RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R29	315-0102-00	B010100	B010451	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R29	315-0103-00	B010452		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R30	315-0204-00	B010100	B019999X	RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R31	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	91637	MFF1816G64900F
R32	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
R34	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R35	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R36	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R37	305-0823-00			RES.,FXD,CMPSN:82K OHM,5%,2W	01121	HB8235
R43	315-0102-00	B010100	B010451	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R43	315-0103-00	B010452		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R44	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R45	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R46	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R47	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R49	315-0102-00	B010100	B010451X	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R50	315-0271-00	B010100	B010451	RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R50	311-1228-00	B010452		RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R51	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R52	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R53	303-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,1W	01121	GB1825
R54	304-0152-00	B010100	B019999X	RES.,FXD,CMPSN:1.5K OHM,10%,1W	01121	GB1521
R57[1]	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R57[2]	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R58[1]	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R58[2]	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R59	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R61	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R63	301-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.50W	01121	EB1515
R64	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
U69	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U69	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U71	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U71	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
U77	156-0067-00	B010100	B019999	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U77	156-0067-07	B020000		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-07
VR25	152-0461-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N821
VR35	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	07910	CD332305
VR47	152-0279-00	XB020000		SEMICOND DEVICD:ZENER,0.4W,5.1V,5%	07910	CE332305
VR49	152-0175-00	B010100	B010451X	SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	1N752A
VR60	152-0149-00	B010100	B019999X	SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	1N961B
VR119	152-0229-00	B010100	B010451	SEMICOND DEVICE:ZENER,1W,5%,39V	04713	1N3034B
VR119	152-0283-00	B010452		SEMICOND DEVICE:ZENER,0.4W,43V,5%	04713	1N976B

A6 ASSEMBLY L.V. POWER SUPPLY

Ckt No.	Tektronix Part No.	Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6	670-4216-00			CKT BOARD ASSY:L.V. POWER SUPPLY	80009	670-4216-00
C5	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C33	290-0549-00			CAP.,FXD,ELCTLT:150UF,400VDC/250VDC	56289	68D20193
C55	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C59	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301055X5P102K
C68	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C71	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C73	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C159	283-0212-00			CAP.,FXD,CER DI:2UF,20%,50V	72982	8141N064Z5U0205M
C161	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364

[1]-00, -01, and -02 only.
[2]-03 and -04 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C165	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C168	283-0142-00			CAP.,FXD,CER DI:0.0027UF,5%,200V	72982	875-551B272J
C169	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C170	290-0301-00			CAP.,FXD,ELCTLT:10UF,10%,20V	56289	150D106X9020B2
C172	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C175	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C180	283-0358-00			CAP.,FXD,CER DI:0.01UF,+80-20%,1.4KV	91418	AU0103Z1421R0
C205	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C274	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C276	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C280	283-0358-00			CAP.,FXD,CER DI:0.01UF,+80-20%,1.4KV	91418	AU0103Z1421R0
CR31	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR69	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR155	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR161	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR163	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR165	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR225	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR226	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR229	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR230	152-0423-00			SEMICOND DEVICE:SILICON,300V,3A	04713	1N5000
CR241	152-0200-00			SEMICOND DEVICE:SILICON,400V,1500MA	80009	152-0200-00
CR275	152-0233-00			SEMICOND DEVICE:SILICON,85V,100MA	07910	CD61128
F135	159-0126-00			FUSE,CARTRIDGE:3AG,2.5A,250V,0.65 SEC	71400	AGC2-1/2
F139	159-0126-00			FUSE,CARTRIDGE:3AG,2.5A,250V,0.65 SEC	71400	AGC2-1/2
F145	159-0038-00			FUSE,CARTRIDGE:3AG,15A,32V,FAST-BLOW	71400	MDL 15A
Q55	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	12040	NS7348
Q61	151-0188-00			TRANSISTOR:SILICON,PNP	01295	2N3906
Q65	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q75	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q80	151-0528-00			TRANSISTOR:SILICON,SCR	04713	2N6400
Q155	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q161	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q165	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q175	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q178	151-0103-00			TRANSISTOR:SILICON,NPN	04713	2N2219A
Q265	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q270	151-0323-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE521	80009	151-0323-00
Q275	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q278	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
R27	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
R45	308-0757-00			RES.,FXD,WW:0.025 OHM,3%,5W	91637	LVR5-GR0250H
R50	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R55	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R56	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R57	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R58	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R64	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R65	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R66	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R67	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R68	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R72	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R73	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R75	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R77	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	MFF1816G732R0F
R79	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R121	305-0121-00			RES.,FXD,CMPSN:120K OHM,5%,2W	01121	HB1215
R135	303-0623-00			RES.,FXD,CMPSN:62K OHM,5%,1W	01121	GB6235
R156	311-1221-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	32997	3386F-T04-500
R157	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R159	321-0111-00			RES.,FXD,FILM:140 OHM,1%,0.125W	91637	MFF1816G140R0F
R160	321-0247-00			RES.,FXD,FILM:3.65K OHM,1%,0.125W	91637	MFF1816G36500F
R161	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R165	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R166	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R167	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R171	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R172	321-0604-00			RES.,FXD,FILM:30K OHM,0.25%,0.125W	91637	MFF1816D30001C
R173	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R174	321-0603-00			RES.,FXD,FILM:15K OHM,0.25%,0.125W	91637	MFF1816D15001C
R175	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R177	308-0679-00			RES.,FXD,WW:0.51 OHM,5%,2W	75042	BWH-R5100J
R178	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R179	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R180	307-0413-00			RES.,FXD,CMPSN:3.3M OHM,10%,1W	03888	FL1-3304K10%
R249	303-0823-00			RES.,FXD,CMPSN:82K OHM,5%,1W	01121	GB8235
R265	305-0271-00			RES.,FXD,CMPSN:270 OHM,5%,2W	01121	HB2715
R266	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R267	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R268	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R269	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R271	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R272	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R274	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R275	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R276	304-0181-00			RES.,FXD,CMPSN:180 OHM,10%,1W	01121	GB1811
R278	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R279	307-0106-00			RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R280	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
U170	156-0067-01			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-01
U175	156-0071-01			MICROCIRCUIT,LI:VOLTAGE REGULATOR	80009	156-0071-01
U270	156-0067-01			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-01
VR155	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	04713	1N976B
VR158	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	81483	6965112

A7 ASSEMBLY KEYBOARD

Ckt No.	Tektronix Part No.	Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A7	119-0304-00	B010100	B055574	KEYBOARD ASSY:	01963	B76-07AA
A7	119-0304-02	B055575		KEYBOARD ASSY:	01963	OBD

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1[1]	283-0660-00	B010100	B055574X	CAP.,FXD,MICA D:510PF,2%,500V	00853	D155F511G0
C2	285-0917-00			CAP.,FXD,PLSTC:0.0022UF,5%,200V	84411	TEK36-222-5-2
C3	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
C5	290-0136-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	162D225X0020CD2
R1	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R2	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R3	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R4	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R5	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R6	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R7	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R8	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R9	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R10	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
S1-S51	260-1393-00			SWITCH,PUSH:SPST,NO KEYBOARD SWITCH	01963	M61-0100
	260-1393-01			SWITCH,PUSH:SPST,NO KEYBOARD SWITCH	01963	M51-0101
Z1	156-0169-00			MICROCIRCUIT,LI:HEX. INVERTER	04713	MC836P
Z2	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
Z3	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
Z4	156-0081-00			MICROCIRCUIT,LI:SGL RETRIGGERABLE MV	07263	9601PC
Z5	156-0078-00			MICROCIRCUIT,DI:4 TO 16 LINE DECODER	01295	SN74154N
Z6	156-0075-00			MICROCIRCUIT,DI:SNGL 8-BIT DATA SEL MUX	80009	156-0075-00
Z7	156-0040-00			MICROCIRCUIT,DI:QUAD LATCH,TTL	80009	156-0040-00
Z8	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
Z9	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
Z10	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
Z11	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
Z12	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
Z13	156-0062-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS EXCL GATE	04713	MC7486P

A8 ASSEMBLY DISPLAY INTERCONNECT

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A8	670-1732-00			CKT BOARD ASSY:DISPLAY INTERCONNECT	80009	670-1732-00
R3	315-0680-02			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R5	315-0680-02			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R7	315-0680-02			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805

A9 ASSEMBLY HARD COPY AMPLIFIER

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A9	670-1744-00			CKT BOARD ASSY:HARD COPY AMPLIFIER	80009	670-1744-00
A9	670-1744-01			CKT BOARD ASSY:HARD COPY AMPL(4010-1 ONLY)	80009	670-1744-01
C3	283-0008-00			CAP.,FXD,CER DI:0.1UF,500V	72982	8151N501 E104M
C4	283-0008-00			CAP.,FXD,CER DI:0.1UF,500V	72982	8151N501 E104M
C8	290-0285-00			CAP.,FXD,ELCTLT:4UF,+50-10%,200V	56289	30D1800

[1] 119-0304-00 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C10	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N080651475M
C11	283-0194-00			CAP.,FXD,CER DI:4.7UF,20%,50V	72982	8151N080651475M
C21	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C24	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C26	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C27	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C30	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C31	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C32	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C40	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651104Z
C42	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651104Z
C46	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651104Z
C48	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C51	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651104Z
C54	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C70	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C75	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR6	152-0426-00			SEMICOND DEVICE:SILICON,400V,400MA	01295	G2017-1
CR7	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	14099	SC6
L3	108-0324-00			COIL,RF:10MH	76493	70F102A1
L5	108-0324-00			COIL,RF:10MH	76493	70F102A1
L7	108-0324-00			COIL,RF:10MH	76493	70F102A1
L10	108-0205-00	B010100	B010451X	COIL,RF:1MH	76493	8209
L12	108-0205-00	B010100	B010451X	COIL,RF:1MH	76493	8209
Q43	151-0087-00	B010100	B019999	TRANSISTOR:SILICON,PNP	01295	2N2905S
Q43	151-0134-00	B020000		TRANSISTOR:SILICON,PNP	80009	151-0134-00
R3	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R5	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R7	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R8	302-0104-00			RES.,FXD,CMPSN:100K OHM,10%,0.50W	01121	EB1041
R21 [1]	311-0633-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	80740	62-58-3
R21 [2]	311-1263-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	32997	3329P-L58-102
R24	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R25	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R26	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R27	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R30	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R32	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R33	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R34	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R35	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R40	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R42	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R45	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R46	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R48	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R49	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R51	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	91637	MFF1816G16500F
R52	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	91637	MFF1816G24900F
R54	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R56	301-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.50W	01121	EB1515

[1]-00 only.
[2]-01 and up only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R70	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R75	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
T20	120-0691-00			XFMR,TOROID:2 WINDINGS	80009	120-0691-00
T21	120-0681-00			XFMR,TOROID:(3) 12 TURN WINDINGS	80009	120-0681-00
T22	120-0459-00			XFMR,TOROID:10 TURNS,BIFILAR	80009	120-0459-00
U5	156-0162-00			MICROCIRCUIT,LI:DIFFERENTIAL VIDEO AMPL	80009	156-0162-00
U45	156-0162-00			MICROCIRCUIT,LI:DIFFERENTIAL VIDEO AMPL	80009	156-0162-00
U61	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	27014	DM74121N
U65	156-0096-00			MICROCIRCUIT,LI:VOLTAGE COMPARATOR	27014	LM311H

CIRCUIT DESCRIPTION

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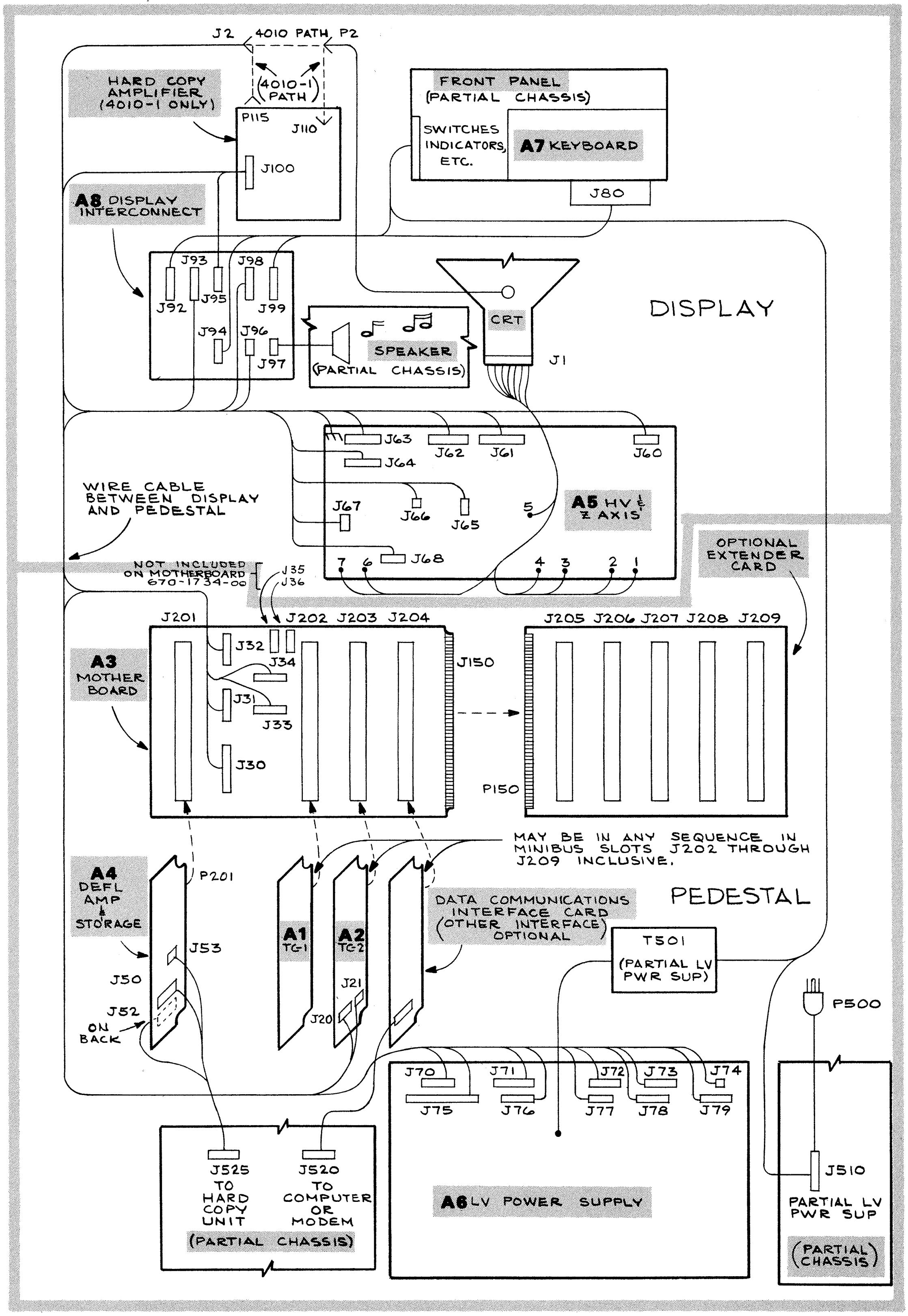

J2
4010 PATH
P2
(4010-1) PATH
HARD COPY AMPLIFIER (4010-1 ONLY)
P115
J110
J100
FRONT PANEL (PARTIAL CHASSIS)
SWITCHES INDICATORS, ETC.
A7 KEYBOARD
J80
A8 DISPLAY INTERCONNECT
J93
J98
J92
J95
J99
J94
J96
J97
SPEAKER (PARTIAL CHASSIS)
CRT
J1
DISPLAY
J63
J62
J61
J60
J64
J67
J66
J65
5
A5 HV & Z AXIS
J68
7 6 4 3 2 1
WIRE CABLE BETWEEN DISPLAY AND PEDESTAL
NOT INCLUDED ON MOTHERBOARD 670-1734-00
J35
J36
OPTIONAL EXTENDER CARD
J201
J202 J203 J204
J205 J206 J207 J208 J209
J32
J34
J150
A3 MOTHER BOARD
J31
J33
J30
P150
MAY BE IN ANY SEQUENCE IN MINIBUS SLOTS J202 THROUGH J209 INCLUSIVE.
A4 DEFL AMP & STORAGE
P201
A1 TG-1
A2 TG-2
DATA COMMUNICATIONS INTERFACE CARD (OTHER INTERFACE) OPTIONAL
PEDESTAL
T501 (PARTIAL LV PWR SUP)
J53
J50
J52 ON BACK
J21
J20
P500
J70
J71
J72
J73
J74
J75
J76
J77
J78
J79
J525 TO HARD COPY UNIT
J520 TO COMPUTER OR MODEM
(PARTIAL CHASSIS)
A6 LV POWER SUPPLY
J510
PARTIAL LV PWR SUP
(PARTIAL CHASSIS)

@

GENERAL INFORMATION

Introduction

The description of Terminal concepts and circuit operation is separate from the block diagrams and circuit schematics. This allows the reader to have the diagram available while reading the text. When troubleshooting, select the proper schematic diagram for the board number installed in your instrument. Assembly numbers (Ax) on the schematic diagrams and the board numbers (670-0000-00) are a guide to the parts listing for the board in the Electrical Parts List. Assembly numbers are also given on the Connector and Wiring Diagram Fig. 6-1.

This section also contains a Wire List, and a Dictionary of Line Titles that will prove beneficial in understanding logic flow on the Interconnection Mother Board (minibus). A Wire List Explanation shows how to use the Wire List in conjunction with the Connectors and Wiring Diagram (Fig. 6-1) and the Interconnecting Mother Board diagrams. The Dictionary of Line Titles should be read before any of the block diagram or circuit descriptions. The Wire List Explanation should be read before attempting to trace signals between schematics.

Diagrams and Circuit Description Information

The circuit descriptions with the block diagrams and schematics will allow those not familiar with 4010 operation to progress from a basic understanding to a fairly detailed understanding of 4010 concepts and operation. It is recommended that those unfamiliar with 4010 operation read the following block diagrams and their respective descriptions in the following order.

1. Terminal/Computer Communication Concepts. This block diagram (on DATA FLOW tab) with its description will acquaint you with the basics of Terminal/computer operation. It will also introduce for the first time the basic electrical sections of the Terminal, namely, Keyboard, Terminal Control Logic and the Display Unit.

2. Terminal Data Flow Block Diagram and Description. This block acquaints you with the basic data flow within the 4010. It shows the tie-in of the major electrical components for the Alphanumeric Mode, the Graphic Plot Mode, and the Graphic Input Mode.

3. Alphanumeric Block Mode Diagram and Description. This block shows the operation and logic tie-in of TC-1 and TC-2 in the Alpha Mode.

4. Graphic Modes Block Diagram and Description. This block provides the logic tie-in of TC-1 and TC-2, for Graphic Plot and Graphic Input Mode operation.

5. Display Unit Block Diagram and Description. This block diagram and description gives a basic understanding of the circuitry associated with the Display Unit.

The above block diagrams and associated descriptions will, in most cases, aid in isolating a problem to a specific circuit card. Should you desire to further isolate the problem they will provide you with enough information as to where to go next.

DICTIONARY OF LINE TITLES

General

The following is a description of interconnecting (minibus) signals and the explanation of their purpose and operation. Signals are shown in their active states. Those with bars indicate that the source must pull the signal line low to be active. Those without bars indicate that the source must pull the signal line high to be active.

$\overline{\text{BIT 1}}$–$\overline{\text{BIT 8}}$	Data to and from the Terminal/computer.
$\overline{\text{SEND}}$	Indicates data is to be sent as a full 8-bit byte (do not add parity).
$\overline{\text{CPUNT}}$	Means data is about to be sent to the minibus by the computer (Interface). Must be sent at least 5 microseconds before data is placed on $\overline{\text{BIT1-8}}$ lines and must remain low until after the trailing edge of the strobe(s) associated with the transfer.

$\overline{\mathrm{TSTROBE}}$	Strobes data into the Terminal to be displayed on the screen, etc. 1.6 microsecond pulse synchronized to the 614 kHz clock.
$\overline{\mathrm{CSTROBE}}$	Strobes data to the computer. Pulse width 1.6 microseconds sync'd to the clock. Must not occur more than 2 microseconds after $\overline{\mathrm{CPUNT}}$ goes low. $\overline{\mathrm{TSTROBE}}$ may be asserted simultaneously (from the same source) to provide local copy to the Terminal.
$\overline{\mathrm{TBUSY}}$	Terminal is busy writing a character or vector, etc. $\overline{\mathrm{TBUSY}}$ controls the timing of data transmitted to the Terminal. Upon receipt of a byte of data, the Terminal will assert $\overline{\mathrm{TBUSY}}$ by the trailing edge of $\overline{\mathrm{TSTROBE}}$ if the byte is to make the Terminal busy. No condition, with the exception of MARG, shall assert $\overline{\mathrm{TBUSY}}$ except momentarily. (MARG can be patched out of $\overline{\mathrm{TBUSY}}$.) The Terminal will, however, accept data if $\overline{\mathrm{TBUSY}}$ is high or low although the results in that case are not defined. $\overline{\mathrm{TBUSY}}$ does not inhibit transmission of data from the Keyboard to the computer.
$\overline{\mathrm{CBUSY}}$	Computer (Interface) is busy accepting a character. Controls the timing of coordinate data transmitted to the computer. A low on $\overline{\mathrm{CBUSY}}$ will not inhibit the Keyboard, allowing Keyboard interrupts when $\overline{\mathrm{CPUNT}}$ is not asserted. Interfaces which must lock out the Keyboard should do so with $\overline{\mathrm{KLOCK}}$.
$\overline{\mathrm{TSUP}}$	Suppresses Terminal response to $\overline{\mathrm{TSTROBE}}$. $\overline{\mathrm{TSUP}}$ should be used by auxiliary devices which need to blank the Terminal to incoming data, such as a paper tape punch when punching binary data. $\overline{\mathrm{BTSUP}}$ should be asserted in response to $\overline{\mathrm{CPUNT}}$ by devices (such as buffers used in error correction schemes) intended to intercept data on behalf of the Terminal. In such cases the assertion of $\overline{\mathrm{BTSUP}}$ should be delayed 2 clock periods to avoid interference with copy of locally generated data.
$\overline{\mathrm{BTSUP}}$	Blanks the entire Terminal (including aux devices to data). A typical use is in a multi-drop system to suppress messages to other terminals. If the Keyboard is to be active while the Terminal is blanked to incoming data, $\overline{\mathrm{BTSUP}}$ should be asserted only in response to $\overline{\mathrm{CPUNT}}$, delayed two clock cycles from the beginning of $\overline{\mathrm{CPUNT}}$.
LCE	Indicates last character sent to Terminal was the ESC (Escape) control character.
$\overline{\mathrm{CSUP}}$	Inhibits the Interface from accepting $\overline{\mathrm{CSTROBE}}$. This signal is used by devices such as line buffers which need to intercept data destined for the computer.
$\overline{\mathrm{KLOCK}}$	Inhibits Keyboard. Normally held at a high level.
$\overline{\mathrm{TAPEFETCH}}$	A pulse or level provided by (typically) some small computer interface to cause a paper tape reader or analagous device to read data.
$\overline{\mathrm{Z}}$	Z axis information.
$\overline{\mathrm{UP}}$ $\overline{\mathrm{DOWN}}$ $\overline{\mathrm{LEFT}}$ $\overline{\mathrm{RIGHT}}$	Counting pulses for X and Y Registers.
MARG	Indicates that the Terminal is at Margin 1. With a directly connected Interface this corresponds to Page Full. High active.
$\overline{\mathrm{EOL}}$	Indicates that the X Register is counting past the right margin (end of line). Used by the Automatic Carriage Return/Line Feed logic. When in the Alpha Mode, $\overline{\mathrm{EOL}}$ going active causes an Automatic Carriage Return (CR)/Line Feed (LF) function.
$\overline{\mathrm{TOPEN}}$	Disables Top-of-Page circuit allowing an increased number of lines. Not brought out to minibus except by straps. Activation of $\overline{\mathrm{TOPEN}}$ depends upon user requirements.

$\overline{\text{HOME}}$ — Master reset for all logic. Origin in Keyboard (Reset key) and TC-1 when power is initialized.

$\overline{\text{HIY}}$, $\overline{\text{LOY}}$, $\overline{\text{HIX}}$, $\overline{\text{LOXE}}$ — Used to load data into the Y or X Data Latches and (LOXE) to draw vectors.

$\overline{\text{GRAF}}$ — Originates in TC-1. Asserting a low on $\overline{\text{GRAF}}$ will set Graphic Plot Mode.

$\overline{\text{NOLI}}$ — Suppresses Linear Interpolation vector drawing and timing circuitry on TC-1 and TC-2. Asserted by TC-1 when in Alpha Mode.

$\overline{\text{DRBUSY}}$ — If not during an ERASE cycle:

> Asserted by the Hard Copy Unit to set up the display for hard copy readout.
>
> $\overline{\text{DRBUSY}}$ should be asserted before the trailing edge of $\overline{\text{MAKE COPY}}$ in order to hold the Terminal in BUSY during the scan.

If during an ERASE cycle:

> Asserted by the display for the duration of the erase cycle, during which information may not be written on the screen.

$\overline{\text{HCU}}$ — Indicates that the Hard Copy Unit is capable of accepting a $\overline{\text{MAKE COPY}}$ request.

$\overline{\text{AUXSENSE}}$ — Status bit line reserved for auxiliary device(s). Note that $\overline{\text{HCU}}$ may also be used by aux device(s) if no Hard Copy Unit is connected and powered up. Disables Graphic Lookahead. (Graphic Lookahead is the ability of TC-1 and TC-2 to pre-load the Graphic data bytes, HIY, LOY, and HIX while the current vector is being drawn. Receipt of the LOXE Byte is delayed until the current vector drawing is completed.)

$\overline{\text{GIN}}$ — When originating in TC-2, indicates that the cross-hair cursor is on or that coordinate information is being transmitted to the computer. Disables the Alpha Cursor, Top of Page, Margin Shifter, and CR/LF circuits. Sets Echoplex Suppression. Asserted by TC-1 or options when entering Graphic Plot Mode in order to insure that the Character Generator is disabled.

$\overline{\text{FPAUSE}}$ — Indicates that the X Register has folded over in the process of normal counting. Will go active with CR, FF, ETB (control characters), or RESET ($\overline{\text{HOME}}$ signal). Used to generate the pause required for proper operation of the Auto Linefeed circuit when used with a clocked interface. (Also used internally on TC-2 in Graphic Input Mode.)

$\overline{\text{ECHO}}$ — Directs input sources to assert $\overline{\text{TSTROBE}}$ as well as $\overline{\text{CSTROBE}}$ when sending data to the computer to provide a local copy on the screen of data entered into the computer.

$\overline{\text{LOCAL}}$ — Directs input sources to assert $\overline{\text{TSTROBE}}$ providing screen display in the absence of computer echo. The Interface(s) may also use this line. Originates in Keyboard switch.

$\overline{\text{SEND 8}}$ — Directs the Interface to accept full 8-bit binary data instead of providing its own data for the 8th bit. (The Keyboard does not provide an 8th bit of data.)

$\overline{\text{SWITCH 1}}$, $\overline{\text{SWITCH 2}}$ — Asserted by Keyboard switches SW1 and SW2. Their use is dependent upon program.

$\overline{\text{FUZZ}}$ — Causes the display to defocus the writing beam. Active during Alpha Mode.

$\overline{\text{INQUIRE}}$ — Set active when the ENQ Control Character is preceded by ESC. Sent by computer when requesting Terminal status.

$\overline{\text{CURSE}}$ — Set active when the SUB Control Character is preceded by ESC; Initiates Graphic Input Mode.

$\overline{\text{PAGE}}$ — Set active when the FF Control Character is preceded by ESC; also Page key. Causes the display to erase the screen. 1.6 microseconds wide minimum.

CR(H) — Causes X Register to set back to left side (Margin 0) of display.

$\overline{\text{MAKE COPY}}$ — Set active when the ETB Control Character is preceded by ESC. 866 μs width minimum. $\overline{\text{MAKE COPY}}$ can be activated by Make Copy switch on Keyboard.

$\overline{\text{INDICATOR 1}}$
$\overline{\text{INDICATOR 2}}$ — Turns on the light-emitting diode indicators in the Keyboard area.

NOTE

The above control characters are patchable except CR. Pulse width = 1.6 microseconds for all Control Characters.

$\overline{\text{BREAK}}$ — Signal from the Keyboard to the Interface for computer signaling.

NOTE

On some Interfaces, $\overline{\text{BREAK}}$ may be pulled up to +15 volts. Data signals may also be present on $\overline{\text{BREAK}}$.

$\overline{\text{SPEAK}}$ — Audio connection to the loudspeaker. Other terminal of speaker is at 5 volts. Bypassed by a 0.01 microfarad capacitor.

XMAT
YMAT — Analog signals representing the beam location within the character matrix. Originate on TC-1.

X
Y — Analog signals from TC-2 to display. −5 to +5 volts covers the screen. Positive signal corresponds to down and left deflection. 0 volts represents the physical center of the screen.

VIEW — Controls the flood guns in the CRT display unit. A high turns the guns on. As long as the Terminal is in Graphic Input or Hard Copy operation, and for about 90 seconds after the last information sent to the Terminal, TC-1 will allow a steady high on view. Otherwise, after 90 seconds, TC-1 places the display in "hold mode" by placing a 75 Hz signal with 12.5% duty factor on VIEW. An optional devices can place the display in non-store by pulling VIEW low.

614 kHz
4.9 MHz — Clock signals.

WIRING INFORMATION

The following interconnecting references are provided to facilitate signal tracing:

Wire List—Explains signal paths through cables.

Connectors and Wiring Diagram—Depicts locations and identity of connectors.

Mother Board Diagrams (Connectors and Wiring Diagram)—Shows connector locations on Mother Board and lists interconnecting lines.

Display Interconnect Diagram—Shows chassis circuitry and Display Interconnect Board signal distribution.

From/To Addresses—Contained on schematics. List source or destination of subject signal. Does not list interconnecting points.

For most purposes, signal tracing consists of reading the address from the line on the schematic, and going to that location. Since all cards on the Mother Board (except A4) are interchangeable, addresses for these are simply listed as TO or FROM A3-BUS, followed by the specific pin number. These lines are applicable to all cards which can be inserted into the minibus connectors (TC-1, TC-2, Interface, Optional Extender).

In the event of cable trouble, it may be necessary to trace signals from point to point through all connectors. Start with the connector and pin number. If it is a harmonic connector, go to that connector in the Wire List. If it is a board-edge connector, go to that connector on the Mother Board diagram. Opposite the connector and pin number is listed the interconnecting point or points.

Examples of Signal Tracing

Example 1. Follow $\overline{\text{HIY}}$ from TC-1 to its destination. Since $\overline{\text{HIY}}$ is on an interchangeable board, its P202-J connector is common to pin J on all cards connected to the Mother Board, except A4 connected to J201. To determine if the signal goes elsewhere, look on the Mother Board diagram under minibus pin J. No other points are listed.

Example 2. Follow $\overline{\text{MAKE COPY}}$, which is generated on TC-1. Again, it is a connection on the minibus and goes to pin $\overline{\text{C}}$ on all minibus connectors. Look on TC-2 and the Interface card to determine if it is used there. Then check the Mother Board diagram. It shows that minibus pin $\overline{\text{C}}$ also connects to J201-B and J34-5. Going to J34 in the Wire List shows that pin 5 connects to P93 in A8. Refer to A8 on the Display Interconnect Diagram. The Display Interconnect Diagram discloses that it connects through J92-2 to the Make Copy switch, which also is a source for the signal. Since the Mother Board also indicated it connects to J201-B, go to the Connectors diagram (Fig. 6-1) and determine that P201 is on assembly A4. On the Hard Copy Adapter schematic (part of A4), find $\overline{\text{MAKE COPY}}$ and note that it leaves on J50-6. Refer to the Wire List and find that J50-6 goes to pin 11 of J525, the Hard Copy Unit connector plug.

Example 3. On the Keyboard schematic, locate KSTROBE on P80-6. Go to the Wire List and find that it connects to P21-2 on assembly A2, the TC-2 card. Referring to TC-2 confirms this.

WIRE LIST

From J1 and J2, CRT Connectors

Line Name	From		To		Location/ Assembly	Wire Color Code
	Plug and/or Jack	Pin	Plug and/or Jack	Pin		
W.G. FIL	1	1	Soldered to Board A5			9-1
W.G. FIL	1	2				9-2
W.G. Cathode	1	3				9-3
CONTROL	1	4				9-4
Focus	1	5				9-5
ANODE 1	1	6				9-6
ANODE 2	1	7				9-7
+20 V FIL	2	1	76		A6	2-3
−20 V	2	2	78		A6	7-1
CE 2	2	3	32	7	A3	9-5
S.T.B.	2	4	32	3	A3	9-2 Coax (See Note A)
F.G. ANODE	2	6	67	2	A5	9-4
F.G. CATHODE	2	7	32	5	A3	9-7
S.T.B. SHIELD	2	See Note B	32	1	A3	9-2 Coax Shield (See Note C)
Spare	2	NC	32	2	A3	9-1 Coax (See Note D)
Spare	2	NC	32	1	A3	9-1 Coax Shield (See Note D)

Note A: Was 2-N shielded in early instruments.

Note B: Soldered to 0-N wire which goes to ground lug on A-5.

Note C: Was 8-N shield in early instruments.

Note D: Not contained in early instruments.

WIRE LIST

From J20 and J21 Connectors on Assembly 2, TC-2 Circuit Card

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
GND	20	1	80	8	A7	0-N
X POT	20	2	99	6	A8	4-9
Y Pot	20	3	99	2	A8	9-2
b5	20	4	80	10	A7	9-18
b4	20	5	80	12	A7	9-26
b3	20	6	80	13	A7	9-28
b2	20	7	80	14	A7	9-27
b1	21	1	80	15	A7	9-25
KSTROBE	21	2	80	6	A7	9-24
b6	21	3	80	11	A7	9-17
+5 V (b8)	21	4	80	5	A7	9-16
b7	21	5	80	9	A7	9-23
SPARE	21	6	93	7	A8	9-35

WIRE LIST

From Connectors J30 and J31 on Assembly 3, Mother Board

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
						0-N
$\overline{\text{LOCAL}}$	30	1	93	8	A5	9-01
GND (Focus Shield)	30	2	62	1	A5	9-N } coax
DYNAMIC FOCUS	30	3	62	2	A5	9-N } coax
X DEF Coil (6-N)	30	4	63	2	A5	6-N
X DEF Coil (3-N)	30	5	63	3	A5	3-N
Hard Copy GND	30	6	100	2	A9	
$\overline{\text{HCU INT}}$	30	7	66	1	A5	9-12
$\overline{\text{TARSIG}}$	30	8	100	5	A9	9-13
$\overline{\text{Z}}$	30	9	65	2	A5	9-2 } coax
GND (Z Shield)	30	10	65	1	A5	9-2 } coax
+328 V	31	1	71	1	A6	9-5
+175 V	31	2	71	3	A6	9-0
DEF AMP GND	31	3	75		A6	0-N
GND	31	4	75	see note 1	A6	0-N
+20 V	31	5	76	see note 1	A6	2-35
−20 V	31	6	78	see note 1	A6	7-1
+5 V	31	7	72	see note 1	A6	2-0
+5 V	31	8	72	see note 1	A6	2-0
+15 V	31	9	70	see note 1	A6	2-1
−15 V	31	10	73	see note 1	A6	7-0

NOTE 1: These wires can be connected to any pin of their respective plug. For example, P31 pin 5 can be connected to any of P76 pins 1—3.

WIRE LIST

From Connectors J32, J33, and J34 on Assembly 3, Mother Board

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
GND (S.T.B. Shield)	32	1	2	Notes E & F		9-1 & 9-2 Coax Shield
S.T.B. Spare	32	2	2	See Note F		9-1 Coax
S.T.B.	32	3	2	4	CRT	9-2 Coax (See Note G)
F.G. ANODE	32	4	67	1	A5	9-4
F.G. CATHODE	32	5	2	7	CRT	9-7
FUZZ	32	6	62	3	A5	9-36
CE-2	32	7	2	5	CRT	9-5
PAGE	32	8	80	1	A7	9-34
SHIFT	32	9	80	7	A7	9-6
SPEAK	32	10	96	1	A8	9-3
Y DEF Coil (1-N)	33	1	63	1	A5	1-N
INDICATOR 1	33	2	93	4	A8	9-04
INDICATOR 2	33	3	93	3	A3	9-05
BREAK	33	4	80	3	A7	9-14
CURSE						
Y DEF Coil (4-N)	34	1	63	4	A5	4-N
HOME (Reset)	34	2	80	2	A7	9-15
SWITCH 1	34	3	93	6	A8	9-02
SWITCH 2	34	4	93	5	A8	9-03
MAKE COPY	34	5	93	2	A8	9-06

Note E: Connects to ground on A5, via P2.
Note F: In early instruments, the shield from 32-1 and 0-N from 32-2 were connected together and tied to ground on A5.
Note G: Was a 9-2 in early instruments.

WIRE LIST

From Connectors J50 and J52 on Assembly 4, Deflection Amp & Storage Board

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
FAST RAMP	50	1	J525	3	Through cable to Hard Copy Unit.	2-N of 0-N COAX
FAST RAMP GND	50	2	J525	4		0-N of 8-N COAX
SLOW RAMP	50	3	J525	1		2-N of 8-2 COAX
SLOW RAMP GND	50	4	J525	2		0-N of 8-2 COAX
TARSIG	50	5	J525	7		9-1 COAX
MAKE COPY	50	6	J525	11		9-4
HCU	50	7	J525	13		9-3
INTERROGATE	50	8	J525	5		9-2 COAX
READ	50	9	J525	9		0-9
GND	52	1,2,3,4	J525	CHASSIS gnd		0-N WIRE
	52	5 (not used)				
WAIT	52	6*	J525	14		9-5

*Later models only: J53 on earlier models.

WIRE LIST

From J60, J61, J62, J63, J64, J65, J66 and J67 on Assembly 5, High Voltage Z Axis

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
GROUND (+20 V)	60	1	75	see note 1	A6	0-N
+20 V	60	2	76	see note 1	A6	2-N
GND	61	1	75	see note 1	A6	0-N
−15 V	61	2	73		A6	7-0
+5 V	61	3	72		A6	2-0
+15 V	61	4	70		A6	2-1
+175 V	61	5	71	4	A6	9-0
+328 V	61	6	71	2	A6	9-5
GND	62	1	30	2	A3	9-N coax
DYNAMIC FOCUS	62	2	30	3	A3	9-N
$\overline{\text{FUZZ}}$	62	3	32	6	A3	9-36
Y DEF COIL	63	1	33	1	A3	1-N
X DEF COIL	63	2	30	4	A3	6-N
X DEF COIL	63	3	30	5	A3	3-N
Y DEF COIL	63	4	34	1	A4	4-N
Y DEF COIL	64	1				0-N
	64	2	Pin not present			
X DEF COIL	64	3*				2-N
X DEF COIL	64	4*				6-N
	64	5	(Pin not present)			
Y DEF COIL	64	6				4-N
GND	65	1	30	10	A3	9-0 coax
$\overline{\text{Z}}$	65	2	30	9	A3	9-0
$\overline{\text{HCU INT}}$	66	1	30	7	A3	9-12
	67	1	32	4	A3	9-4
	67	2	2	6	CRT	9-4

*Early instruments have these two leads exchanged.

WIRE LIST

From J70, J71, J72, J73, J74, J75, J76, J77, J78, and J79 on Assembly A-6, Power Supply Board

Line Name	From Plug and/or Jack	From Pin	To Plug and/or Jack	To Pin	Location/ Assembly	Wire Color Code
+15 V	70	* 1	31	9	A3	2-1
+15 V	70	* 2	99	7	A8	2-1
+15 V	70	* 3	61	4	A5	2-1
+20 V FIL	71	1	2	1	CRT	2-3
+328 V	71	2	31	1	A3	9-5
+328 V	71	3	61	6	A5	9-5
+175 V	71	4	31	2	A3	9-0
+175 V	71	5	61	5	A5	9-0
+5 V	72	* 1				
+5 V	72	* 2				
+5 V	72	* 3	31	8	A3	2-0
+5 V	72	* 4	61	3	A5	2-0
+5 V	72	* 5	31	7	A3	2-0
+5 V	72	* 6	80	4	A7	2-0
−15 V	73	* 1	61	2	A5	7-0
−15 V	73	* 2	31	10	A3	7-0
−15 V	73	* 3	99	1	A8	7-0
	74	1			Heat Sink Q515 base	9-7

*Parallel connected on Power Supply board.

WIRE LIST

From J70, J71, J72, J73, J74, J75, J76, J77, J78, and J79 on Assembly A-6, Power Supply Board

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
	75	1*				
GROUND	75	2*	99	4	A8	0-N
GROUND	75	3*	31	3	A3	0-N
GROUND	75	4*	31	4	A3	0-N
GROUND	75	5*		1	A3	0-N
GROUND	75	6*				
GROUND	75	7*	61	1	A5	0-N
GROUND	75	8*				0-N } shield cut off
GROUND	75	9*				0-N } shield cut off
GROUND	75	10*	60	1	A5	0-N
+20 V	76	1	60	2	A5	2-N
+20 V	76	2	31	5	A3	2-35
+20 V	76	3				
+15 V	77	1			Q510 Emitter	2-1
	77	2			Q510 Base	9-5
+20 V	77	3			Q510 Collector	2-3
−20 V	78	1*	2	2	CRT	7-1
−20 V	78	2*	31	6	A3	7-1
−20 V	78	3*	empty			
−20 V	79	1			Q520 Emitter	7-1
−15 V	79	2			Q520 Collector	7-0
	79	3			Q520 Base	9-2

*Parallel connected on Power Supply board.

WIRE LIST

From J80, Assembly 7, Keyboard Circuit Card

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
$\overline{\text{PAGE}}$	80	1	32	8	A3	9-34
$\overline{\text{HOME}}$ (Reset Key)	80	2	34	2	A3	9-15
$\overline{\text{BREAK}}$	80	3	33	4	A3	9-14
+5 VDC	80	4	72		A6	2-0
+5 VDC (b8)	80	5	21	4	A2	9-16
+5 VDC (b8)	80	5	98	5	A8	2-0
KSTROBE	80	6	21	2	A2	9-24
$\overline{\text{SHIFT}}$	80	7	32	9	A3	9-6
GND	80	8	20	1	A2	0-N
b7	80	9	21	5	A2	9-23
b5	80	10	20	4	A2	9-18
b6	80	11	21	3	A2	9-17
b4	80	12	20	5	A2	9-26
b3	80	13	20	6	A2	9-28
b2	80	14	20	7	A2	9-27
b1	80	15	21	1	A2	9-25

*Connected on keyboard end.

WIRE LIST

From J92, J93, J94, J95, J96, J97, J98, and J99
Assembly 8, Display Interconnect

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/ Assembly	Wire Color Code
Spare	92 see note 2	1				
$\overline{\text{MAKE COPY}}$		2			S538 Rocker Switch on Keyboard	9-06
$\overline{\text{INDICATOR 2}}$		3			Ind 2 cathode (plug)	9-05
$\overline{\text{INDICATOR 1}}$		4			Ind 1—cathode (plug)	9-04
$\overline{\text{SWITCH 2}}$		5			S537 Rocker Switch on Keyboard	9-03
$\overline{\text{SWITCH 1}}$		6			S536 Rocker Switch on Keyboard	9-02
Spare		7				
$\overline{\text{LOCAL}}$		8			LOCAL/LINE Switch	9-01
Spare		1				
$\overline{\text{MAKE COPY}}$		2	34	5	A3	9-06
$\overline{\text{INDICATOR 2}}$		3	33	3	A4	9-06
$\overline{\text{INDICATOR 1}}$		4	33	2	A3	9-04
$\overline{\text{SWITCH 2}}$		5	34	4	A3	9-03
$\overline{\text{SWITCH 1}}$		6	34	3	A3	9-02
Spare		7	21	6	A2	9-35
$\overline{\text{LOCAL}}$	93 see note 2	8	30	1	A3	9-01
(CR542 SOURCE)	94	1			Indicator 2 anode (plug)	9-16
(CR540 SOURCE)	94	2			Indicator 1 anode (plug)	9-15
(CR544 SOURCE)	94	3			Power Indicator (plug)	9-14

***NOTE 2: P92 and P93 may be interchanged on A8 without effect.**

WIRE LIST

From J92, J93, J94, J95, J96, J97, J98, and J99
Assembly 8, Display Interconnect

Line Name		From Plug and/or Jack	From Pin	To Plug and/or Jack	To Pin	Location/ Assembly	Wire Color Code
−15 VDC		95	1	100	3	A9	7-0
GND		95	2	100			
+5 VDC		95	3	100	4	A9	2-0
+15 VDC		95	4	100	1	A9	2-1
$\overline{\text{SPEAK}}$	see note 3	96	1	32	10	A3	9-3
Empty	see note 3	96	2				
$\overline{\text{SPEAK}}$	see note 3	97	1			Speaker	9-56
+5 V	see note 3	97	2			Speaker	2-0
−15 V	see note 4	98	1			Both Pots	7-0
Y Pot	see note 4	98	2			Y Pot	9-2
	see note 4	98	3				
GND	see note 4	98	4			S1, 2, 3	0-N
+5 V	see note 4	98	5	80	5	A7	2-0
X Pot	see note 4	98	6			Y Pot	4-9
+15 V	see note 4	98	7			Both Pots	2-1
−15 V	see note 4	99	1	73	see note 1	A6	7-0
Y Pot	see note 4	99	2	20	3	A2	9-2
	see note 4	99	3				
GND	see note 4	99	4	75	see note 1	A6	0-N
+5 V	see note 4	99	5	80	5	A7	2-0
X Pot	see note 4	99	6	20	2	A2	4-9
+15 V	see note 4	99	7	70	see note 1	A6	2-1

NOTE 3: P96 and P97 can be interchanged on A8 without effect.
NOTE 4: P98 and P99 can be interchanged on A8 without effect.

WIRE LIST

From J100, J110, and J115, Assembly 9 (4010-1) TARSIG Hard Copy Amplifier

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/Assembly	Wire Color Code
+15 V	100	1	J95	4	A8	2-1
Hard Copy GND	100	2	30	6	A3	
−15 V	100	3	J95	1	A8	7-0
+5 V	100	4	J95	3	A8	2-0
TARSIG	100	5	30	8	A3	9-13
Connects to P2 (CRT neck)	110					
Connects to J2 (cable)	115					
+20 V (Regulated Fil.)	110	1	2	1	TO CRT	
−20 V	110	2	2	2	TO CRT	
CE (1)	110	3	2	3	TO CRT	
STB	110	4	2	4	TO CRT	
CE (2)	110	5	2	5	TO CRT	
FG ANODE	110	6	2	6	TO CRT	
FG Cathode	110	7	2	7	TO CRT	
+20 V	115	1	2	1	To Deflection Amp and Storage Board, A4	
−20 V	115	2	2	2	To Deflection Amp and Storage Board, A4	
	115	3	2	3	To Deflection Amp and Storage Board, A4	
STB	115	4	2	4	To Deflection Amp and Storage Board, A4	
CE	115	5	2	5	To Deflection Amp and Storage Board, A4	
FG ANODE	115	6	2	6	To Deflection Amp and Storage Board, A4	
FG CATHODE	115	7	2	7	To Deflection Amp and Storage Board, A4	

WIRE LIST

From J525, Output Connector

Line Name	From: Plug and/or Jack	From: Pin	To: Plug and/or Jack	To: Pin	Location/Assembly	Wire Color Code
SLOW RAMP	J525	1	50	3		2-N of 8-2 COAX
SLOW RAMP GND	J525	2	50	4		0-N of 8-2 COAX
FAST RAMP	J525	3	50	1		2-N of 8-N COAX
FAST RAMP GND	J525	4	50	2		0-N of 8-N COAX
$\overline{\text{INTERROGATE}}$	J525	5	50	8		9-2 COAX
$\overline{\text{INTERROGATE GND}}$		6				
$\overline{\text{TARSIG}}$	J525	7	50	5		9-1 COAX
$\overline{\text{TARSIG GND}}$		8				
$\overline{\text{READ}}$	J525	9	50	9		0-9
$\overline{\text{MAKE COPY}}$	J525	11	50	6		9-4
$\overline{\text{HCU}}$	J525	13	50	7		9-3
$\overline{\text{WAIT}}$	J525	14	52	6		9-5
GND	J525	15	52	1,2,3,4		0-N

BASIC CONCEPTS OF COMPUTER/TERMINAL COMMUNICATIONS (Refer to DATA FLOW BLOCK DIAGRAM)

General

The 4010 Computer Display Terminal is a device that permits a person to deal directly with a computer. (All references to the 4010 apply equally to the 4010-1. Where reference is to the 4010-1 only, it will be stated as such.) By using the Keyboard, which is similar to a typewriter keyboard, a person can question or instruct the computer and the computer's response is returned to that person by way of the display screen, either alphanumerically or graphically (charts, graphs, pictures, etc.).

The Terminal/Computer Communications block diagram is shown in the Data Flow block diagram. The different sections are the Computer, the Terminal (which includes the Keyboard, the Display Unit, and the Terminal Control circuitry) and the Communication Link.

Computer

The Computer can speak and act only through the use of binary numbers. The job of the Computer then, is to accept the data from the Terminal (commands from the Keyboard or other input devices), act on it by performing the indicated instruction and return its response to the Terminal.

Terminal

The Terminal acts as a translator between the operator and a computer. Its job is to take the data from the computer and translate it into a language or graphic form that makes the data understandable to the operator. This is the function of the 4010 Computer Terminal.

Display Unit. The Display Unit presents data visually for both alphanumeric and graphic operation by accepting X and Y (writing beam position) and Z (writing beam on or off) signals from the Terminal Control circuitry. These signals combine in the Display Unit to give a visual representation on the display screen of the data interchange between the operator and the Computer.

The 4010 Display Unit contains a storage-type CRT (cathode ray tube). The data being displayed has only to be written once. The characteristics of the storage tube allow the image of the data to be retained for a long period of time (up to one hour without damage to the display screen) without having to continually redraw it, as would be necessary if a television-type CRT were used.

Keyboard. The Keyboard provides the operator with a readily understandable means of inputting data to the Computer. It is an electromechanical device which, as a result of the operator's depressing any one of its keys, produces a binary data word that is distinctive for that key. This binary representation of the key depressed provides the Terminal Control Logic and the Computer circuits with a form of data they can understand.

Terminal Control Logic. This circuitry accepts data from either the Computer or the Keyboard. This circuitry also provides synchronization so that the data is handled in the proper sequence. When data is accepted by the Terminal Control Logic circuits, it routes this data to the Computer and/or the Terminal Display Unit, depending upon the data source and the function requested by the data. The Terminal Control Logic circuits interpret this data as either an alphabetic character or number, as coordinate points on an X-Y axis (for beam positioning), as a special function to be performed (backspace, ring bell, etc.) or as mode control information. Another function of the Terminal Control Logic is to allow the X and Y coordinates of any point on the display area of the screen to be sent from the Terminal to the Computer when commanded to do so.

Communication Link

Direct. When the Computer is located near the Terminal (as in the same building), a direct hook-up is the most practical. This type of communication link can best be thought of as simply plugging the Terminal into the Computer, just as you would plug a radio into a wall socket.

Modem (telephone hook-up). In most cases the computer will be located a considerable distance from the Terminal, making a direct connection impractical. In such cases, the transfer of information between the Computer and Terminal must be by other means. The most convenient and readily available means of transmission is the standard telephone and telephone lines. However, the Terminal and Computer cannot be hooked directly to the telephone because of the low frequency response of the telephone lines; therefore, the telephone hook-up consists of a modulator-demodulator (MODEM) which enables (modulates) the data on a voice frequency tone for transmission over the lines and decodes (demodulates) the data at the receiving end. Both the computer end and the Terminal end of the telephone line have MODEMS. Both ends operate the same. Thus, by the use of telephone lines and the MODEM, the distant computer can be reached as easily as dialing your next door neighbor.

DATA FLOW BLOCK DIAGRAM DESCRIPTION

General

The 4010 logic operation is controlled by three logic cards. These are TC-1, TC-2, and Computer Interface. Each card has 72 interconnecting pins. The same pins on each card are connected to one another by a plug-in connector board. This connector board is called a minibus. The minibus is designed to accommodate transmission between any devices connected to it.

Data is placed on seven data lines with open collector TTL buffers. The destination of data is determined by the use of strobe signals. Asserting a computer strobe ($\overline{\text{CSTROBE}}$) causes data to be transmitted to the computer. Asserting a terminal strobe ($\overline{\text{TSTROBE}}$) causes data to be transmitted to the Terminal. Data may be sent to both by asserting $\overline{\text{CSTROBE}}$ and $\overline{\text{TSTROBE}}$ simultaneously. Strobe signals are normally synchronized with the system clock (614 kHz).

Timing of data is controlled by $\overline{\text{TBUSY}}$ (terminal busy), $\overline{\text{CBUSY}}$ (computer busy). $\overline{\text{TBUSY}}$ and $\overline{\text{CBUSY}}$ control the rate of data transmission to devices responding to $\overline{\text{TSTROBE}}$ and $\overline{\text{CSTROBE}}$ respectively. The device receiving the data must enable its busy signal before the trailing edge of its respective input strobe if it is to be considered busy. If the device transmitting the data does not sense a busy signal before the trailing edge, it may presume that the data was accepted and present the next data immediately.

$\overline{\text{CPUNT}}$ (controlled by the interface), controls the interleaving of data transmission. Interleaving is the process of data being transmitted in either direction (to the computer, or from the computer) on the same data lines. Data from the computer is preceded by $\overline{\text{CPUNT}}$ to inhibit the Terminal and any other device (other than the interface card) from placing data on the minibus.

The 4010 operates in any of three basic modes.

Alphanumeric Mode (Alpha). An operating mode that transmits or displays alphanumeric characters and symbols for information purposes (address files, etc.).

Graphic Plot Mode (Graph). An operating mode that displays information in graphic form (graphs, charts, pictures, etc.).

Graphic Input Mode (Gin). An operating mode that provides the computer with a specific location on the display screen. Entails the generation of a "crosshair" cursor.

Alpha Mode

Keyboard Entered Data. Refer to the Data Flow Block Diagram. When the User enters data at the Keyboard, the key pressed is coded in its ASCII equivalent and sent to the Multiplexer on seven parallel lines, b1-b7. A Keyboard strobe signal termed KSTROBE accompanies the Keyboard bits to the Multiplexer. KSTROBE causes the computer strobe signal ($\overline{\text{CSTROBE}}$) to go active, and causes the Multiplexer to place the keyboard bits on the minibus as $\overline{\text{BIT 1—BIT 7}}$. Then, $\overline{\text{CSTROBE}}$ strobes the bits through the Interface Card and to the computer. If the $\overline{\text{ECHO}}$ signal from the Interface Card is low, $\overline{\text{TSTROBE}}$ goes active along with $\overline{\text{CSTROBE}}$. This allows the 4010 circuitry to generate a "local" copy of the data sent to the computer. This occurs in the following manner.

$\overline{\text{TSTROBE}}$ enters the Column Decoder to allow $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ to generate an $\overline{\text{ALPHA STROBE}}$ signal. This signal latches the character code bits $\overline{\text{BIT 1—BIT 5}}$ and $\overline{\text{BIT 7}}$, into the Character Generator. The Character Generator then decodes the bits and sends X and Y Matrix signals to the X and Y Digital to Analog circuits. $\overline{\text{TBUSY}}$ goes active at the same time, preventing reception of more data until the character is drawn. The X and Y DEFLECTION signals to the Display change in accordance with the X and Y MATRIX signals. The Z AXIS signal causes the display beam to either write or not write each specific X-Y Matrix coordinate. The composite of written points forms the desired character.

If the data bits contain the code for a Control Character, it is indicated by the $\overline{\text{BIT 6—BIT 7}}$ combination, and detected by the Column Decoder. The Column Decoder then outputs a $\overline{\text{CTRL CHAR STB}}$ signal to the Control Character Decoder. This circuit decodes $\overline{\text{BIT 1—BIT 5}}$ and outputs the function signal called for to the Format Effector. The Format Effector then initiates the function. For example, if the data bits contain the code for a SPACE, the Format Effector outputs the required number of pulses on the $\overline{\text{RIGHT}}$ line. At the same time, $\overline{\text{TBUSY}}$ goes active until the function is completed ($\overline{\text{TBUSY}}$ performs the same function as previously explained). These pulses increment the digital output of the X Register, causing the output of the X and Y Digital to Analog circuit to change accordingly. Thus, the display beam repositions one space.

Referring back to the Keyboard, you will notice a signal termed $\overline{\text{LOCAL}}$ that inputs to the Multiplexer. If the Local/Line switch is in Local, $\overline{\text{LOCAL}}$ goes active and $\overline{\text{CSTROBE}}$ is inhibited. No data can be sent to the computer under this condition. Only $\overline{\text{TSTROBE}}$ will go active to produce results as previously explained.

Computer Entered Data. Data from the computer enters the Interface Card. The Interface Card then generates TSTROBE and CPUNT. CPUNT is a signal that precedes the computer data to the minibus. Its purpose is to prepare the Terminal for data reception. Depending upon the code of the data bits, they are either strobed into the Control Character Decoder or the Character Generator. The Terminal logic then processes the data as previously explained. Notice that TBUSY inputs to the Interface Card. TBUSY is generated by the Format Effector and/or the Character Generator to inhibit data reception from the computer until the Terminal completes the function.

Graphic Plot Mode

General. The Graphic Plot Mode permits lines (vectors) to be drawn on the CRT by addressing the beam to a point on the display screen. As the beam moves to that point, the Z Axis signal goes active to draw the vector.

Since the X and Y Registers each contain ten bits, twenty bits are required to address a certain position. These must be received in four bytes of five bits each, with each byte accompanied by two bits of steering data. The steering bits indicate X or Y, as well as whether the byte should be loaded as five most significant bits or five least significant bits. Data flow in the Graphic Plot Mode occurs in the following manner.

Refer to the Data Flow Block Diagram. When the Control Character bits for a GS that set the Graphic Plot Mode are received by the Interface Card, TSTROBE and CPUNT go active. BIT 1–BIT 7 are then placed on the minibus. The Column Decoder is activated by TSTROBE and detects from BIT 6 and BIT 7 that a Control Character has been received. It then causes the CTRL CHAR STB signal to activate the Control Character Decoder, which then decodes the remaining data bits (BITS 1–5) and initiates the Special Function signals that set Terminal logic for Graphic Plot Mode. The next data bits received from the computer contain the first five bits of the coordinate address. BIT 6 and BIT 7 are decoded by the Column Decoder and the BYTE LOAD goes active, loading in BIT 1–BIT 5 into the Graphic Data Latches. The next two bytes are received and loaded into the Latches in the same manner. With the reception of the fourth byte, all twenty bits of data are loaded into the X and Y Registers (10 into the X Register, and 10 into the Y Register). This causes the digital output of the X and Y Registers to change suddenly to the value set by the twenty bits of input data, causing the output of the X and Y Digital-to-Analog circuits to change accordingly. At the same time the 20 bits of data are loaded into the X and Y Registers, the fourth BYTE LOAD pulse from the Column Decoder enables the Format Effector to output a Z Vector Enable signal. This turns on the display beam while the X and Y DEFLECTION signals change, causing a vector to be written. When the Vector Enable signal goes active, TBUSY also goes active to prevent the reception of more data from the computer until the vector is drawn.

Graphic Input Mode (GIN)

General. The Graphic Input Mode is used to send graphic data to the computer. This entails the generation of a full-screen cross-hair cursor that can be positioned to any point on the viewable display area. The positioning of the cross-hair cursor is performed by the use of two position controls (potentiometers) which are located to the right of the Keyboard.

Refer to the Data Flow Block Diagram. The initiation of the GIN Mode occurs in much the same manner as the Graphic Plot Mode. The Control Characters (ESC and SUB) that initiate the GIN Mode are received from the computer and cause the Control Character Decoder to output a CURSE signal that is sent to the Cross-hair Generator. The cross-hair cursor is then drawn on the screen of the CRT in the following manner.

When initialized by the CURSE signal from the Control Character Decoder, the Crosshair Generator circuit sends DOWN pulses to the Y Register. These pulses cause the Y Register to increment, moving the display beam downward. As the Y Register increments with each pulse from the Crosshair Generator, the Y Digital output changes accordingly. The Y Digital-to-Analog Circuit converts the Y Digital input to its comparative analog value, outputting it as the Y DEFLECTION voltage to the Display Unit. With each pulse, the Crosshair Generator sets the Z Axis line active to draw the point. Notice that the X and Y DEFLECTION voltages are being sampled by the Crosshair Generator. When the deflection voltage just passes the voltage being input from the Y Position Pot, the Crosshair Generator switches the count to the X axis. The Y Register maintains its value while the X Register is being incremented by RIGHT signals from the Crosshair Generator. Like the Y Register, it increments until the X Deflection voltage just passes the voltage input from the X Position Pot. When this occurs, the circuit once again switches to the Y Register. The above-stated sequence repeats itself until the Terminal receives a command to send the intersection point to the computer.

The sending of the data to the computer can be done under User control, or computer control.

When the User wishes to send the intersection point, he strikes a Keyboard key. The Keyboard character bits go to the computer as explained in the description of Alpha Mode operation. The Terminal will not be affected, because the Multiplexer does not generate a TSTROBE signal.

$\overline{\text{CBUSY}}$ goes active during the time that it takes the computer to receive the Keyboard character data bits. When the computer completes the receiving process, $\overline{\text{CBUSY}}$ goes inactive. This causes the Multiplexer to send an active $\overline{\text{GO DIGITIZE}}$ signal to the Crosshair Generator. The next time the Crosshair Generator reaches the intersection point it stops the counting sequence. The X and Y Registers are held at the digital equivalent of the X and Y Position Pot analog voltages. When the counting sequence stops, the Crosshair Generator sends a $\overline{\text{PT FOUND}}$ signal back to the Multiplexer. This causes the Multiplexer to send the 20 bits of X and Y Digital information to the minibus in four bytes. With each 5-bit byte, the Multiplexer sets $\overline{\text{BIT 6}}$-$\overline{\text{BIT 7}}$ low and generates the $\overline{\text{CSTROBE}}$ signal. This causes the data to be sent to the computer.

The computer can also request the coordinates of the Cross-hair Cursor by sending the Control Character ESC followed by the Control Character ENQ (Inquire). When ENQ is decoded by the Control Character Decoder, the $\overline{\text{INQUIRE}}$ signal to the Multiplexer goes high. The operation of the Graphic Input circuitry is then the same as if $\overline{\text{CBUSY}}$ went inactive after a Keyboard character had been sent.

ALPHA MODE BLOCK DIAGRAM DESCRIPTION

General. When operating in the Alpha Mode, the 4010 presents data in the form of alphanumeric characters and special symbols. It can display a total of 63 different characters. Although lower-case alphabetic characters can be received, they are written as upper-case. Some of the characteristics of the Alpha Mode are as follows:

1. The characters are generated by a 5 X 8 dot matrix contained within a Read Only Memory (ROM) device (the Character Generator uses only 7 of the 8 available "row" outputs of the ROM). The ROM has 64 character selection capability, with one character (DEL) being suppressed.

2. Alphanumeric data can be displayed on 35 lines, with each line containing up to 74 characters.

3. The Alpha Cursor is a pulsating 5 X 7 dot matrix that indicates where the next character will be displayed.

4. There are two margins, termed Margin 0 and Margin 1. Margin 0 is the left side of the display screen and Margin 1 is the vertical center of the display screen.

5. The Terminal performs an automatic Carriage Return/Line Feed when spacing past the end of a line.

The main purpose of the Alpha Mode Description is to show how the Terminal processes alphanumeric data for display purposes.

Power Initialization. Refer to the Alpha Mode Block Diagram. When power is first applied, the Home circuit (located in the upper-left corner of the diagram) applies a low on the $\overline{\text{HOME}}$ line, placing the Terminal in Alpha Mode. Further switching to Alpha Mode occurs in the following manner.

When $\overline{\text{HOME}}$ goes low, it causes the Graf Flipflop to set $\overline{\text{NOLT}}$ active. With $\overline{\text{NOLT}}$ active, the X and Y Filters are disabled, permitting the X and Y Analog voltages to pass through to the Deflection Amplifier circuitry unaffected. $\overline{\text{NOLT}}$ also enters the Column Decoder to allow three different combinations of $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ to generate the $\overline{\text{ALPHA STB}}$ signal.

Referring back to the $\overline{\text{HOME}}$ signal, notice that it also causes the output of U69C to go high. This clears the X and Y Registers, causing the display beam to position to Home (upper-left corner of the Display screen). A few milliseconds after initialization, when the power has stabilized, the $\overline{\text{HOME}}$ signal goes inactive.

The display screen attains a "fully written" condition at turn-on. The screen must be erased before entering any data. This is accomplished by pressing the Page key. This causes the screen to be erased and set to the normal viewing level. (For effect of $\overline{\text{PAGE}}$ on display circuits, refer to the Display Unit Block diagrams and descriptions.)

Processing Control Characters. When the data bits of a Control Character are placed on the minibus, the $\overline{\text{TSTROBE}}$ signal is generated. $\overline{\text{TSTROBE}}$ activates the $\overline{\text{TERM STB}}$ signal from the Terminal Strobe Gating circuit. The $\overline{\text{TERM STB}}$ signal enables the Column Decoder to process $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ (both are high when the data bits contain the code for a Control Character) and output an active Control Character Strobe ($\overline{\text{CTRL CHAR STB}}$) signal. This signal is used to enable the Control Character Decoder. Data bits $\overline{\text{BIT 1}}$–$\overline{\text{BIT 4}}$ and $\overline{\text{BIT 5}}$ and its complement, input to the Control Character Decoder. The Control Character Decoder then decodes the input data and activates the respective output line. For example, the Line Feed (LF) Control Character bits activate the $\overline{\text{LF}}$ signal.

The Escape circuit is shown as part of the Control Character Decoder circuit. This circuit makes it more difficult to accidentally generate one of four special output signals — $\overline{\text{PAGE}}$, $\overline{\text{CURSE}}$, $\overline{\text{MAKE COPY}}$, and $\overline{\text{INQUIRE}}$. These signals are the result of a two-Control Character sequence. First, the Escape (ESC) Control Character is received to prepare the Escape Circuit for the next Control Character. This is followed by the command that selects the specific function. For example, to activate the $\overline{\text{MAKE COPY}}$ signal (which activates the Hard Copy Unit) the ESC Control Character is first received; it is followed by the ETB (End of Tape Block) Control Character. The decoding of ETB by the Control Character Decoder then causes the Escape Circuit to activate the $\overline{\text{MAKE COPY}}$ signal. The remaining three output signals from the Escape Circuit are similarly activated: ESC and FF (Form Feed) activate PAGE; ESC and SUB (Substitute) activate $\overline{\text{CURSE}}$ and ESC and ENQ (Inquire) activate $\overline{\text{INQUIRE}}$. The Escape circuit is cleared when the CLEAR signal from the Terminal Strobe Gating circuit goes active. This occurs when the $\overline{\text{TSTROBE}}$ signal ends, unless the ESC character is being input. This means that the character following ESC disarms the circuit, regardless of whether or not it contains one of the commands of execution.

The signals from the Control Character Decoder are input to the Format Effector. The input signals $\overline{\text{HT}}$, $\overline{\text{BS}}$, $\overline{\text{LF}}$, and $\overline{\text{VT}}$ direct it to output a predetermined number of pulses on either the $\overline{\text{RIGHT}}$, $\overline{\text{LEFT}}$, $\overline{\text{DOWN}}$, or $\overline{\text{UP}}$ signal lines. To backspace the Alpha Cursor, the BS Control

Character must be sent. BS causes the Control Character Decoder to activate the BS signal. BS then causes the Format Effector to output 14 pulses on the LEFT line. At the same time, TBUSY goes active, holding the Terminal in a "BUSY" condition until the function is completed. These pulses decrement the output of the X Register 14 counts, causing the output of the X Digital to Analog circuit to change its analog output value accordingly. This new value of X ANALOG voltage passes unaffected through the X Filter circuit (the Filter circuits are inhibited by NOLI) and causes the X Deflection Amplifiers to deflect the display beam one space to the left. Similar action occurs when the Terminal receives a Horizontal Tab (HT) Control Character. The only difference is that when HT is decoded, the HT signal goes active, causing the Format Effector to pulse the RIGHT line 14 times. The X Deflection Amplifier then deflects the display beam one space to the right.

To move the display beam up or down, the Vertical Tab (VT) or the Line Feed (LF) Control Characters must be sent. VT causes the Format Effector to pulse the UP line 22 times. LF causes the Format Effector to pulse the DOWN line 22 times. The resultant action from the Y Register through the Y Digital to Analog and Y Filter circuits is similar to that of the X Register. The end result is to move the display beam either up or down one line of type.

When any of the input lines to the Format Effector go active, TBUSY is also activated. TBUSY is used by the Computer Interface Card to slow down the transmission rate from the computer to allow the Terminal time to process the data. The standard 4010/4010-1 is capable of receiving and processing alphanumeric data up to 9600 baud. TBUSY must be used for higher baud rates.

Control Characters such as BEL and CR cause the Format Effector to activate TBUSY for a predetermined period of time. BEL causes the Format Effector to output a 1200 Hz bell signal on the SPEAK line. When the predetermined span of time has elapsed, the Format Effector ends the SPEAK signal and at the same time ends TBUSY. The CR signal causes the Format Effector to output the CR signal and at the same time sets TBUSY active. CR inputs on the CLEAR input of the X Register, setting its outputs and the display beam to the predetermined margin position.

If GS has set the Graphic Plot Mode, the Alpha Mode can be re-established by sending any of the following Control Characters: US, CR, or ESC and FF (PAGE). Pressing the Page or Reset keys will also re-establish the Alpha Mode. The above signals are input to the Graf FF to set NOLI active and GRAF inactive. The Format Effector activates TBUSY to give the Terminal logic time to reset to the Alpha Mode.

Processing Alphanumeric Characters. The Character Generator circuitry is capable of generating 63 distinct alphanumeric characters and special symbols. When no characters are being generated, the Character Generator outputs signals that draw a pulsating 5 X 7 dot matrix. This is the alpha cursor which indicates the beam writing position. The operation of the Character Generator is as follows.

When TSTROBE goes active, upon receipt of a character, the Terminal Strobe gating circuit activates the TERM STB signal. TERM STB causes the Alpha Cursor Suppress circuit to set the SUPPRESS signal active. The SUPPRESS signal presets the Y Matrix (Y MAT) and X Matrix (X MAT) signals to put the display beam in the proper position to begin drawing the character.

The TERM STB signal also activates the Column Decoder which decodes BIT 6 and BIT 7 and outputs the Alpha Strobe (ALPHA STB) signal. This allows the Character Generator to receive the BIT 1–BIT 5 and BIT 7 data bits, and at the same time sets the Character in Progress (CHAR IN PROG) signal active. The CHAR IN PROG signal causes the Format Effector to set TBUSY active, thus preventing the reception of more data until the drawing of the character is completed.

Each of the 63 distinct characters that the Character Generator can produce has its own 5 X 7 dot matrix within a Read Only Memory (ROM) device in the Character Generator. The data bits (BIT 1–BIT 5, BIT 7) are used to address the matrix of the specified character or symbol within the ROM. Timing signals from the Format Effector then cause the Character Generator to scan through the matrix one dot at a time. As the Character Generator scans the matrix, it outputs the X MAT and Y MAT analog voltages. These voltages are input to their respective Digital to Analog circuits to cause the Deflection Amplifier circuitry to position the display beam through the 5 X 7 dot matrix.

As the ROM matrix is scanned, it indicates if a dot is to be written or not. The dot to be written causes the WRITE DOT signal to the Format Effector to go active. The Format Effector then outputs an active Z signal that causes the display beam to write a dot. The composite of the unblanked matrix dots forms the specified character on the display screen.

When the Character Generator has completed scanning the matrix, the Character Complete (CHAR COMP) signal goes active. This causes the Format Effector to output 14 pulses on the RIGHT line, thus, spacing the alpha cursor to the next character position. The CHAR IN PROG signal ends, ending TBUSY. The Terminal can now receive the next byte of data.

View Signal Operation. The purpose of the VIEW signal is to prolong the life of the CRT. If no new data is being entered, this signal is modulated by a 75 Hz signal which provides a duty time of 12 1/2% for the VIEW signal. The result to the display screen is a dimming of the displayed data and the suppressing of the Alpha Cursor. The View Multi and Gating circuit operates in the following manner.

The View Multi is basically a one-shot multivibrator that, when triggered, allows the VIEW signal to remain high for approximately 90 seconds. The View Multi is triggered whenever any one of its various input control signals pulse high. If no activity occurs within 90 seconds, the VIEW signal from the View Multi ends. This action places the 75 Hz signal on the VIEW line. At the same time, the $\overline{\text{VIEW}}$ signal to the Alpha Cursor Suppress circuit goes active. $\overline{\text{VIEW}}$ holds the SUPPRESS signal active, suppressing the $\overline{\text{WRITE DOT}}$, X MAT and Y MAT signals that were drawing the alpha cursor. The entering of new data restores the data and the alpha cursor to view.

Alpha Cursor Suppress. Three signals that suppress the alpha cursor and hold VIEW high are:

$\overline{\text{DR BUSY}}$—Asserted by the Hard Copy Unit during character processing.

$\overline{\text{GRAF}}$—Asserted by the Graf FF during graphic operation.

$\overline{\text{GIN}}$—Asserted by the Multiplexer during Graphic Input Mode.

Character Generator Inhibit. This circuit is used to inhibit the Character Generator when $\overline{\text{GIN}}$ goes active. ($\overline{\text{GIN}}$ goes active when the mode of operation is set to Graphic Input Mode.) This prevents the Character Generator from responding to the $\overline{\text{ALPHA STB}}$ signal caused by sending the "Header Character" to the computer. The Header Character initiates the sequence of data bytes that contain the graphic data to be sent to the computer. For a more detailed explanation of the Graphic Input Mode, refer to the Graphic Operation Block Diagram Description.

The $\overline{\text{LOCAL}}$ signal from the Keyboard goes active when the Local/Line switch is in the Local position. This sets the $\overline{\text{INH}}$ signal inactive, allowing the Character Generator to respond to alphanumeric data entered from the Keyboard.

The $\overline{\text{TBUSY}}$ signal is also used to enable character generation. When the Graphic Plot Mode is activated the $\overline{\text{GS}}$ signal will pull the $\overline{\text{GIN}}$ line low, causing the $\overline{\text{INH}}$ signal to go active. If it is desired to display alphanumeric data in conjunction with Graphic Plot Operation, the Character Generator must be enabled. This is done by sending the CR or US Control Character to the Terminal, switching it to Alpha Mode. (Sending US allows the first alphanumeric character or symbol to be displayed at the ending point of the last vector.) $\overline{\text{TBUSY}}$ then goes active, causing the $\overline{\text{INH}}$ signal to go inactive, enabling the Character Generator to respond to $\overline{\text{ALPHA STB}}$ signals.

X Register. The X Register outputs 10 bits of BCD (binary coded decimal) data which provide a count from 0 to 1023. The Register is capable of counting up or down to any number within this range. Each bit of data is input to the X Digital to Analog on its own line (all ten lines are drawn as one on the Block Diagram). In Alpha Mode operation, the signals that increment and decrement the X Register are $\overline{\text{RIGHT}}$ and $\overline{\text{LEFT}}$ respectively. Each pulse increments or decrements the count by one. The X Register is cleared when power is first applied ($\overline{\text{HOME}}$ goes active) or a $\overline{\text{PAGE}}$ signal is received. This causes the CLEAR signal from U69C to set all 10 output bits low, causing the display beam to position to the left hand margin. When the count increments to 1023, an End of Line ($\overline{\text{EOL}}$) signal is sent to the Format Effector. This causes the Format Effector to output a CR signal, clearing the Register, once again causing the display beam to position to the left hand margin.

Y Register and Top-of-Page Detect Operation. The operation of the Y Register is similar to the X Register. The main difference is that when the Y Register is cleared, all its outputs go high; pulsing the $\overline{\text{DOWN}}$ line decrements the count; pulsing the $\overline{\text{UP}}$ line increments the count. Because the display screen is not as high as it is wide, not all the 1023 points are viewable, as they are for the X Register. Therefore, when the Y Register is cleared the alpha cursor is positioned off-screen beyond the top of the page. The purpose of the Top-of-Page Detect circuit is to decrement the count from the Y Register by pulsing the $\overline{\text{DOWN}}$ line until the top-of-page position is reached. The top-of-page position represents a Y Register count of 767, and is also known as the Home position for the Y Register. It operates in the following manner.

When the Y Register outputs a count greater than 767 (1023 when it is cleared), the two Most Significant Bits of the Y Register (2 MSBY) are high. This activates the Top-of-Page Detect circuit which begins pulsing the $\overline{\text{DOWN}}$ line. When the count of 767 is reached, the 2nd MSB of the Y Register goes low, inhibiting the $\overline{\text{DOWN}}$ pulses. Thus, the top-of-page has been detected and the Alpha Cursor is positioned in view at the top of the display screen.

Margin Shifter Operation. Left and Right margins are established as a result of the lower and upper limits of the X Register. There is another margin that can be established at mid-page (X = 512) to provide an increased number of lines on which to enter data.

The Left Margin is referred to as Margin 0, the center margin as Margin 1. Margin 0 is always established as a result of $\overline{\text{PAGE}}$ or $\overline{\text{HOME}}$ signals. The establishing of Margin 1 occurs in the following manner.

When the last line of type for Margin 0 has been reached and all desired data entered on that line, a CR and an LF code bit must be received by the Terminal to position the Alpha Cursor to Margin 1. (The order in which they are sent is immaterial.)The LF causes the Y Register to space past the bottom line of type which sets the MARG signal to the X Register active (the MARG signal is actually an eleventh bit from the Y Register that carries a BCD weight of 1024). When it goes active, it causes the MSB of the X Register (512) to remain high. This causes Margin 1 to be set.

At the same time that LF causes MARG to go high, it causes the Top-of-Page circuit to activate. The Alpha Cursor then positions to the top of the page. But, this time the MSB from the X Register is held high, and the alpha cursor is at the top-of-page, center of screen. CR signals will not clear the Margin 1 position. This can be cleared by again spacing the Y Register past the bottom line of the page (unless break on page full has been strapped). When this occurs, the MARG signal goes inactive. Margin 1 can also be cleared by activating the $\overline{\text{HOME}}$ or $\overline{\text{PAGE}}$ signals.

Digital to Analog Conversion. The X and Y Digital to Analog (D/A) converter circuits operate similar to one another. Their purpose is to convert the digital output of their respective Registers into the equivalent analog voltage. These circuits also sum the X and Y analog MAT signals (from the Character Generator) with the X and Y analog signals, respectively. The outputs of these circuits pass directly through their respective Filter circuits (unaffected in Alpha Mode) and are input to the X and Y Deflection Amplifier circuitry to position the display beam.

GRAPHIC MODES BLOCK DIAGRAM

General

The 4010 processes graphic data in two formats. It can accept graphic data from the computer to draw vectors. This is termed Graphic Plot Mode. It can send graphic data to the computer. This is known as Graphic Input Mode.

Graphic data from the computer causes the 4010 to write vectors on the Display as specified by X and Y coordinate data. The 4010 requires 20 bits of data to represent the axis address (10 bits for X and 10 bits for Y). This data is supplied to the Terminal by the computer in 4 seven-bit bytes. The two most significant bits are steering data; the five least significant bits contain the coordinate information.

Graphic Plot Mode Description

Refer to the Graphic Operation Block Diagram. Graphic Plot Mode operation is as follows.

Graphic Mode Initialization. The 4010 logic is designed so that when the Terminal is first turned on, the Home circuit resets all logic to the Alpha Mode. Notice the Home circuit of the Block Diagram. When power is first turned on (initialized), it outputs a $\overline{\text{HOME}}$ signal. This causes the Graf F/F to output signals that set the Alpha Mode. $\overline{\text{GRAF}}$ goes high (inactive); $\overline{\text{NOLI}}$ goes low to inhibit the linear interpolation circuitry in TC-2. $\overline{\text{NOLI}}$ also inputs to the Column Decoder. Initialization of the Graphic Plot Mode begins with the Control Character GS. GS is usually initialized under program control, but can be sent from the Keyboard by pressing the CRTL and SHIFT and M keys simultaneously. For the purposes of this discussion, assume that the GS has been entered from the computer and is placed on the minibus.

When the GS data is placed on the minibus, $\overline{\text{TSTROBE}}$ goes active to enable the Terminal Strobe gating circuitry to input a low $\overline{\text{TERM STB}}$ signal to the Column Decoder. When $\overline{\text{TERM STB}}$ goes active, the $\overline{\text{CTRL CHAR STB}}$ signal is sent to the Control Character Decoder to allow it to process the GS data bits at its inputs. The Control Character Decoder outputs a low $\overline{\text{GS}}$ signal to the GRAF F/F. This action switches the output states of the F/F; $\overline{\text{GRAF}}$ goes low, and $\overline{\text{NOLI}}$ goes high. $\overline{\text{NOLI}}$ going high enables the X and Y Filter circuits.

Even though the $\overline{\text{NOLI}}$ input to the Column Decoder is high, the proper combinations of $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ will still generate the $\overline{\text{CTRL CHAR STB}}$. Thus, no matter whether operating in alpha or graphics, a $\overline{\text{CTRL CHAR STB}}$ can be generated to enable the Control Character Decoder.

Alpha Circuits Inhibited. In Graphic Plot Mode, the following Alpha Mode circuits are inhibited.

1. Character Generator
2. Auto CR/LF
3. View/Hold
4. Cursor Refresher
5. Top-of-Page Detect
6. Margin Shifter
7. Right Margin

Explanations on how the above circuits are inhibited will be given in that order.

With $\overline{\text{NOLI}}$ set high, the Column Decoder is prevented from outputting an active $\overline{\text{ALPHA STROBE}}$ signal to the Character Generator. With the $\overline{\text{ALPHA STROBE}}$ inhibited, $\overline{\text{BIT 1–BIT 5, 7}}$ cannot be input to the Character Generator. $\overline{\text{GRAF}}$ also enters the Alpha Cursor Supress circuit to cause a high-going SUPPRESS signal that resets the Character Generator to the Column 0, Row 0 position of the Character Matrix. The $\overline{\text{77 kHz}}$ pulses that clock the Character Generator through the matrix are also inhibited. Thus, the Character Generator is prevented from applying any voltages to the X and Y Digital to Analog circuits that might cause displacement of the beam while drawing a vector.

The same SUPPRESS signal that disabled the Character Generator also disables the Auto CR/LF and View/Hold Circuits. As long as the SUPPRESS signal is high, $\overline{\text{LF}}$ signals from the Control Character Decoder will not activate an automatic carriage return and line feed function. The high SUPPRESS signal inhibits the View Hold circuit. This allows the displayed vectors to remain visible continually. (This is why the Terminal should be returned to Alpha mode immediately after any plotting is finished to allow the View Multi to time the display into Hold.) The SUPPRESS signal is also input to the Cursor Refresher circuit to inhibit the generation of the Alpha Cursor.

When $\overline{\text{GRAF}}$ goes low, the output of U67 inhibits the Top-of-Page Detect and Margin Shifter circuits.

Data Loading. $\overline{\text{BIT 1}}$–$\overline{\text{BIT 5}}$ are placed immediately at the input to the Y Data Latch with the arrival of the first coordinate data byte from the computer. $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ are decoded by the Column Decoder and Graphic Byte Decoder circuits. When the decoding occurs, $\overline{\text{HIY}}$ from the

Graphic Byte Decoder goes low and strobes the five most significant bits of the Y coordinate address into the appropriate portion of the Y latch. As each following byte arrives on the minibus, BIT 6 and BIT 7 are decoded to enable the Graphic Byte Decoder to Strobe the LOY and HIX bytes into their appropriate latches. With the arrival of the LOX byte, LOXE goes low. Notice that there is no latch for the LOX bits. The LOX bits are strobed directly into the X Register. With the arrival of the LOX Byte, the LOXE signal simultaneously loads all twenty bits of coordinate data into the X and Y Registers. This causes the output of the X and Y D/A's to immediately change to the new coordinate position. Now that the outputs of the X and Y D/As are at the new position, the X and Y Filters begin linearly changing the X and Y signals to the new values. The display beam must now be turned on to draw the vector.

Vector Enabling. LOXE also enters the Format Effector, Pulse Shaper and Vector Enable Blocks. In the Format Effector, LOXE is used as a preset input to time the 2.6 ms PAUSE signal that is used to activate the Z signal needed to draw the vector. The LOXE input to the Pulse Shaper generates the LOAD pulse that loads LOXE into the Format Effector. The first vector to be drawn is always dark; therefore, the VECTOR ENABLE output from the Vector Enable circuit is low, inhibiting the Z Axis circuit. With the arrival of the Low Order X bits of the next vector string, the VECTOR ENABLE signal goes high. This enables the Z Axis circuit to output an active Z signal to draw the vector. When the Format Effector has ended the 2.6 ms PAUSE signal, the Z signal is inhibited. Thus, the Z signal combined with the movement of the X & Y inputs from the Filter circuits causes the vector to be drawn.

A Z Control circuit is contained on TC-2 circuit cards No. 670-1729-05 and above. This chops the Z signal during short vector intensity more consistent with long vector intensity. The LOXE, NOLI, X D/A, Y D/A, and three clock signals (not shown) are fed into the circuit to hold CGZSUP high for vectors more than approximately one-half inch long, and to place a 12 1/2% duty cycle high on the CGZSUP line while vectors less than approximately one-half inch are being drawn.

Return to Alpha. When vector plotting is completed, it is best to return the 4010 to Alpha Mode. This allows the Terminal to time into Hold Mode to prevent possible damage to the Display Screen.

Alpha Mode is re-established by resetting the GRAF F/F. The following Control characters will set Alpha Mode: CR, US or ESC plus FF (PAGE).

In addition, the following Keyboard keys will reset the Terminal to Alpha Mode: Page or Reset.

Graphic Input Mode Description

Graphic Input Initialization. Graphic Input Mode is set by the Control Characters ESC plus SUB. When they are received and decoded by the Control Character Decoder, the Escape circuitry outputs the CURSE signal (see TC-1 discussion on Escape circuitry for description on operation of Escape). CURSE inputs to the GRAF F/F to set NOLI low and GRAF high. NOLI going low inhibits the X & Y Filter circuits, thus allowing the outputs of the X & Y Filter circuits to pass directly through the Filter circuits unaffected. CURSE is processed in the Multiplexer circuitry, causing output GIN to go active. When GIN goes active it causes the SUPPRESS signal from the Character Generator Suppress circuit to go high. The Automatic CR/LF, View/Hold, and Cursor Refresher circuits are inhibited as previously explained in Graphic Plot operation. GIN also inhibits the Graphic Byte Decoder during Graphic Input Mode. (The Column Decoder can still output the CRTL CHAR STB to the Control Character Decoder. Thus, Control Characters can still be processed.) The Top-of-Page Detect and the Margin Shifter circuits are also inhibited when GIN causes the output of U67 to go low. The 4010 logic circuitry is now set for Graphic Input operation.

Cross-Hair Generator. When CURSE goes low, the Cross-hair Generator is activated. When first activated, the Cross-hair Generator begins sending DOWN pulses to the Y Register. Each time it pulses, it sends a short Z pulse to turn on the display beam. As the Y Register output decrements, it causes the output of the Y D/A to change accordingly. Thus, the display beam begins moving in the down direction. The output of the Y D/A is being sampled by the Cross-hair Generator. When this voltage changes to the point where it just passes the voltage from the Y position Potentiometer, the counting pulses switch to the RIGHT line. This is known as "Y coincidence". The Y Register maintains its value while the X Register is incremented. The output of the X Register increments once with each low RIGHT pulse, causing the output of the X D/A to change accordingly. When the analog voltage at the output of the X D/A just passes the voltage input to the Cross-hair Generator from the X Position Pot, "X Coincidence" is reached, and the count once again switches to the Y Register. See Fig. 6-2 for illustration showing the generation of the Crosshair cursor.

Foldover. If the X Register begins counting to the right of the X Coincidence Point, the count continues to increment from the X Register until count 1023 is reached. When this occurs, the Most Significant Bit (MSB) of the X Register causes the Margin Shifter to output an End of Line (EOL) signal. This signal is input to the Crosshair Generator to inhibit the count of the X Register. This delay allows the display beam time to return to the left side of the display and stabilize before the count resumes. This is known as Foldover (see Fig. 6-2). The signal from the Crosshair Generator (as a result of this action) is FPAUSE. It inputs to the Format Effector to inhibit its functions during the time FPAUSE is active (0.5 ms). The count then continues from 0 until X Coincidence is reached. When the count switches to the Y Register, the Crosshair Generator outputs $\overline{\text{DOWN}}$ pulses until the bottom of the page is reached. When this occurs, the beam folds over to the top of the page, but the Y Register continues to increment with no Foldover Pause. No Foldover Pause is needed in the Y Axis, because Foldover positions the beam off-screen. By the time the beam appears in the display area of the screen, it has had time to stabilize. The Y Register continues incrementing until coincidence again occurs; the X Register starts incrementing and the cycle repeats itself until commanded to do otherwise.

When the User sends the Header Character, Keyboard bits b1-b7 are inverted by the Multiplexer and placed onto the minibus lines as $\overline{\text{BIT 1}}$–$\overline{\text{BIT 7}}$. KSTROBE (which

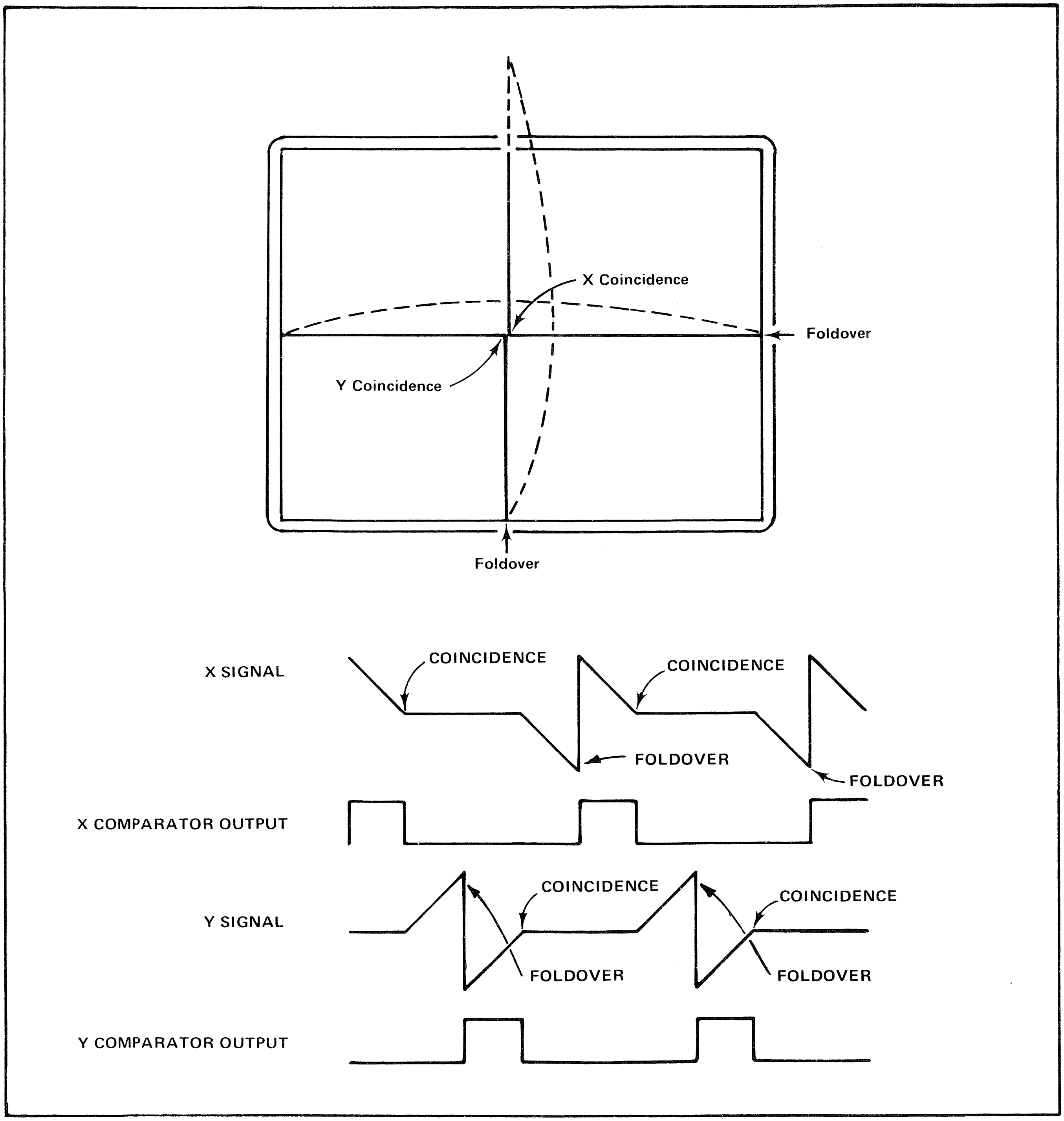


Fig. 6-2. Drawing a Crosshair Cursor Display.

accompanied the Keyboard bits) then generates the $\overline{\text{CSTROBE}}$ signal that strobes the data bits through the Interface card and to the computer. After the Header Character is accepted by the computer, the $\overline{\text{CBUSY}}$ line returns high, causing the $\overline{\text{GO DIGITIZE}}$ signal to go active. This causes the Crosshair Generator to stop the counting sequence when the next coincidence occurs. The digital representations of the voltages from the X and Y Position Pots are then held at the outputs of the X and Y Registers while the Crosshair Generator sends a $\overline{\text{PT FOUND}}$ signal back to the Multiplexer.

$\overline{\text{PT FOUND}}$ causes the Multiplexer to sample the five HIX bits from the X Register and place them along with code bits $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ on the minibus. Once again $\overline{\text{CSTROBE}}$ is generated and the HIX byte is sent to the computer. When $\overline{\text{CBUSY}}$ again goes inactive, the LOX bits are sampled by the Multiplexer and the process repeats, until all four coordinate bytes are sent to the computer. These may be followed by CR and/or EOT bytes if the circuit strap option is wired to do so.

The computer can request the coordinates of the crosshair by sending ESC plus SUB to initiate the GIN Mode as previously explained. Next, ESC plus ENQ is sent to set $\overline{\text{INQUIRE}}$ low. Upon the receipt of $\overline{\text{INQUIRE}}$, the Multiplexer will send the coordinates of the intersection point to the computer as previously explained. However, in the place of the Keyboard character, the Multiplexer will send the Terminal Status Bits to the computer, $\overline{\text{MARG}}$, $\overline{\text{NOLI}}$, $\overline{\text{AUXSENSE}}$, $\overline{\text{HCU}}$, and $\overline{\text{GRAF}}$.

The computer can also request the status of the Terminal by sending ESC plus ENQ. In this case, only $\overline{\text{INQUIRE}}$ is activated and the Terminal status bits plus the location of the display beam (lower left corner of the alpha cursor) are sent to the computer.

KEYBOARD DESCRIPTION

Refer to the Keyboard schematic. The Keyboard consists of the following principal circuits: an Oscillator, the 4 LSB Counter, the Character Decoder, the Character Detector, the 3 MSB Counter, the Bit 5 Control circuit, the Bit 7 Control circuit, and the Character Output Gates. Their combined purpose is to generate a coded character output on seven data lines labeled b1 through b7, and to develop a strobe output labeled KSTROBE to accompany the data bits.

Assume that characters are not being entered at the Keyboard. The Oscillator generates a symmetrical output pulse which is applied to Z9D, Z4, and Z7B. Z9D causes the 4 LSB Counter to continuously cycle through its 16 counts. Each time it completes a cycle, it feeds a pulse to a 3 MSB Counter, causing it to advance one. The 3 MSB Counter eventually cycles through its 8 counts and the entire performance is repeated. During this operation, the W output from the Character Detector holds a low on the Z4 gate. The pin 8 output of Z4 remains low, inhibiting outputs from the Character Output Gates.

When a character key is pressed, contact is made between an output of the Character Decoder and an input of the Character Detector. The output (ABC inputs) combination from the 3 MSB Counter into the Character Detector eventually reaches a code that selects the closed key. Since the 4 LSB Counter continues to cycle, a low is eventually placed on the closed key. This low is applied to the Character Detector, causing its W output to go high. This high provides enabling voltage to Strobe Generator Z4. When the Z13B output returns low, it causes a pulse of at least 7 milliseconds from the Strobe Generator. The 0 output from the Strobe Generator goes to Z9D to prevent additional clock pulses from affecting the 4 LSB Counter. At the same time, this low from the Strobe Generator goes to the Shift Latch and the Control Latch to gate through either the low or high from those devices as determined by the position of the Shift and/or Control keys.

The high from the 1 output of the Strobe Generator goes to the Character Output Gates, placing data on the b1 through b7 lines. When the Z13B output again goes low, it toggles Z7B, causing it to develop a high KSTROBE signal to strobe the data into the Terminal circuits.

The lows from Z13B are applied continuously to Z4, maintaining it in its one-set condition while the Keyboard key is held down. When the key is released, the high from the Character Detector is removed from Z4, permitting it to return to its zero-set state. This ends the b1-b7 output. The KSTROBE output ends on the next negative-going output of Z13B.

TC-1 BLOCK DIAGRAM DESCRIPTION

Introduction

The Operation of TC-1 can be best understood when it is broken down into three basic blocks of operation. These blocks are called Input/Decoding, Format Effector, and Character Generator. The three sections will be discussed in detail, beginning with the Input/Decoding section, then the Format Effector, then finally the Character Generator. Basically, the Input/Decoding Section decodes the various input signals and data for Terminal operations. The Format Effector Section is used to initiate a number of functions mainly associated with Alpha Mode. The Character Generator Section generates the alphanumeric characters and symbols.

Input/Decoding

General. Refer to the TC-1 Block Diagram and the TC-1 Schematic. The Input/Decoding Section contains the following circuits:

Home—When power is turned on, this circuit outputs the $\overline{\text{HOME}}$ signal that sets Terminal logic to Alpha Mode.

Column Decoder—Outputs signals that enable the Control Character Decoder, Character Generator, or Graphic Byte Decoder circuits.

Control Character Decoder—Decodes Control Characters used by the 4010.

Escape Flip-Flop—Used to prevent accidental activation of $\overline{\text{PAGE}}$, $\overline{\text{CURSE}}$, $\overline{\text{MAKE COPY}}$, and $\overline{\text{INQUIRE}}$ signals.

Page, Curse, Make Copy, and Inquire Circuits—Used in conjunction with Escape Flip-flop to prevent accidental activation of their respective outputs.

Graf Flip-flop—Sets Graphic Plot Mode.

Graphic Byte Decoder—Activated during Graphic Plot Mode to strobe coordinate address bytes into proper latch on TC-2.

Data Enable Gate—Strobes alphanumeric data into Character Generator.

Rubout Suppressor—Disables Data Enable Gate when DEL (Rubout) is received by the Terminal.

The description of the Input/Decoding Section will be given in that order. For the purpose of the description, assume that data is present on the minibus.

Home. Refer to the upper left corner of the Block Diagram. The purpose of this circuit is to reset all logic to the Alpha Mode when power is turned on (initialized). When power is turned on, the Home circuit applies a low pulse on the $\overline{\text{HOME}}$ line. If a Hard Copy Unit is connected to the 4010, this will prevent a copy from being generated due to voltage fluctuations that occur when power is initiated. Pulling the $\overline{\text{HOME}}$ line low resets Terminal logic to the Alpha Mode by inputting to the Graf Flip-flop (F/F) to set $\overline{\text{GRAF}}$ high and $\overline{\text{NOLI}}$ (No Linear Interpolation) low. $\overline{\text{HOME}}$ also resets the X and Y Registers (in TC-2) to position the writing beam to the Home position (upper-left corner of Display Screen). After the power stabilizes, the Home circuit is deactivated.

Column Decoder. Basically, the Column Decoder is a binary to decimal decoder. The inputs to the Column Decoder are as follows:

1. $\overline{\text{TERMINAL STROBE}}$ ($\overline{\text{TERM STB}}$) from U7B.
2. $\overline{\text{NOLI}}$ from Graf Flip-flop.
3. $\overline{\text{BIT 7}}$ from minibus.
4. $\overline{\text{BIT 6}}$ from minibus.

For any of the outputs from the Column Decoder to be active, $\overline{\text{TERM STB}}$ must be low. $\overline{\text{TERM STB}}$ goes low when $\overline{\text{TSTROBE}}$ is low, and when $\overline{\text{BTSUP}}$ and $\overline{\text{TSUP}}$ are high. This allows $\overline{\text{NOLI}}$, $\overline{\text{BIT 7}}$ and $\overline{\text{BIT 6}}$ to set the outputs.

Referring to the ASCII Code Chart in Fig. 6-3, notice that Columns 0 and 1 contain Control Characters; Columns 2 and 3 contain numerals and symbols; Columns 4 and 5 contain upper-case alpha characters and a few special symbols. Notice that $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ are the same for each group of two columns. The purpose of the Column Decoder, then, is to select these columns, two at a time. This is done by the distinct combinations of $\overline{\text{BIT 6}}$, $\overline{\text{BIT 7}}$, and $\overline{\text{NOLI}}$.

Refer to Fig. 6-4. In the Alpha Mode, the Column Decoder outputs an $\overline{\text{ALPHA STROBE}}$ signal that is used to enable the Character Latches through the Data Enable Gate. For $\overline{\text{ALPHA STROBE}}$ to become active, $\overline{\text{NOLI}}$ must be low, indicating that the Terminal is in Alpha Mode operation.

In the Alpha Mode, the only other output from the Column Decoder is the Control Character Strobe signal ($\overline{\text{CTRL CHAR STB}}$). For example, if $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ are both high, the Column Decoder will output the $\overline{\text{CRTL CHAR STB}}$ signal; thus providing an enabling voltage for the Control Character Decoder circuit. All other combina-

ASCII CODE FUNCTIONS

BITS		B_7 B_6 B_5		Ø Ø Ø	Ø Ø 1	Ø 1 Ø	Ø 1 1	1 Ø Ø	1 Ø 1	1 1 Ø	1 1 1
B_4	B_3	B_2	B_1	CONTROL		HIGH X & Y GRAPHIC INPUT		LOW X		LOW Y	
Ø	Ø	Ø	Ø	NUL Ø	DLE 16	SP 32	Ø 48	@ 64	P 8Ø	` 96	p 112
Ø	Ø	Ø	1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	a 97	q 113
Ø	Ø	1	Ø	STX 2	DC2 18	" 34	2 5Ø	B 66	R 82	b 98	r 114
Ø	Ø	1	1	ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
Ø	1	Ø	Ø	EOT 4	DC4 2Ø	$ 36	4 52	D 68	T 84	d 1ØØ	t 116
Ø	1	Ø	1	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 1Ø1	u 117
Ø	1	1	Ø	ACK 6	SYN 22	& 38	6 54	F 7Ø	V 86	f 1Ø2	v 118
Ø	1	1	1	BEL 7 BELL	ETB 23	' 39	7 55	G 71	W 87	g 1Ø3	w 119
1	Ø	Ø	Ø	BS 8 BACK SPACE	CAN 24	(4Ø	8 56	H 72	X 88	h 1Ø4	x 12Ø
1	Ø	Ø	1	HT 9	EM 25	) 41	9 57	I 73	Y 89	i 1Ø5	y 121
1	Ø	1	Ø	LF 1Ø LINE FEED	SUB 26	* 42	: 58	J 74	Z 9Ø	j 1Ø6	z 122
1	Ø	1	1	VT 11	ESC 27	+ 43	; 59	K 75	[91	k 1Ø7	{ 123
1	1	Ø	Ø	FF 12	FS 28	, 44	< 6Ø	L 76	\ 92	l 1Ø8	¦ 124
1	1	Ø	1	CR 13 RETURN	GS 29	- 45	= 61	M 77	] 93	m 1Ø9	} 125
1	1	1	Ø	SO 14	RS 3Ø	. 46	> 62	N 78	^ 94	n 11Ø	~ 126
1	1	1	1	SI 15	US 31	/ 47	? 63	O 79	_ 95	o 111	RUBOUT (DEL) 127

Fig. 6-3. ASCII Code Chart Illustration. The shaded characters show those that can not be transmitted with the TTY lock on.

tions of BIT 7 and BIT 6 will provide an ALPHA STROBE signal for the Data Enable Gate.

When the Graphic Plot Mode is set, NOLI goes high. No ALPHA STROBE will be generated. Instead, the combinations of BIT 7 and BIT 6 are decoded by the Column Decoder to generate code data to the Graphic Byte Decoder, and to generate CRTL CHAR STB. For an example, assume that BIT 7 and BIT 6 are 0-1, respectively. With TERM STB low and NOLI high, the Column Decoder will output code data to the Graphic Byte Decoder, which in turn sets LOXE low. If BIT 6 and BIT 7 both go high, the Column Decoder outputs the CTRL CHAR STB. Thus, no matter the mode of operation, the Column Decoder will always output the CTRL CHAR STB signal in response to highs on BIT 6 and BIT 7.

Control Character Decoder. The Control Character Decoder consists of two 4-line to 10-line decoders.

As a result of the enabling signals (CTRL CHAR STB and BIT 5) and the data (BITS 1—4), the Control Character Decoder will output low signals for the following Control Characters: US, BEL, VT, HT, BS, CR, LF, ENQ, GS, ESC, FF, SUB, ETB, SI, and SO. The Control Character signals are then processed by the applicable circuitry in TC-1 to perform the desired function.

Escape. Four Control Characters are dependent upon a preparatory command to arm the circuitry before they can be executed. The preparatory command is Escape (ESC) and the dependent commands are Form Feed (FF), which can be used to either exit the Terminal from Graphic Plot Mode or to initiate a PAGE (erase) signal; Substitute (SUB), which initiates the Graphic Input Mode and starts the Crosshair cursor; End of Tape Block (ETB), which activates the MAKE COPY pulse to turn on the Hard Copy Unit; and Inquire (ENQ), which is sent to request Terminal Status. The purpose of the Escape circuitry is to prevent accidental activation of these signals.

Assume that the ESC data bits are placed on the minibus. The Escape circuitry functions in the following manner. With BTSUP and TSUP inactive, TSTROBE (which accompanies the data bits) enables the Column Decoder to generate the CTRL CHAR STB signal. This signal permits the Control Character Decoder to decode BIT 1—BIT 5; the ESC signal goes active and "arms" the Escape Flip-flop, setting LCE (Last Character to Escape) high. The arrival of the data bits for the next portion of the two-character sequence activates the required function. ETB will activate MAKE COPY; FF will activate PAGE; SUB will activate CURSE; and ENQ will activate INQUIRE. LCE will return low when the next TSTROBE pulse ends following the escape sequence. The positive-going CLEAR signal from U8A (which occurs whenever TSTROBE ends) disarms the Escape F/F unless the ESC character accompanies TSTROBE. Thus, the Escape FF is always disarmed by the character following the ESC input, regardless of whether it was FF, ETB, SUB, ENQ, or some other character.

Page-Curse-Make Copy-Inquire. These four circuits comprise an additional portion of the Escape circuitry. The Page circuit is composed of a simple logic circuit. LCE must be high and FF must be low to activate the PAGE signal. PAGE is used to erase the display and to also pulse the

INPUT SIGNAL					
TERM STB	NOLI	BIT7	BIT6	RESULTANT SIGNAL	COLUMNS OF ASCII CODE CHART
0	0	0	0	ALPHA STB	6 and 7 (LOW CASE)
0	0	0	1	ALPHA STB	4 and 5 (UPPER CASE)
0	0	1	0	ALPHA STB	2 and 3 (SYMBOLS & NUMERALS)
0	0	1	1	CTRL CHAR STB	0 and 1 (CTRL CHARACTERS)
0	1	0	0	LOY	6 and 7 (5 LSB or Y ADDRESS)
0	1	0	1	LOXE	4 and 5 (5 LSB of X ADDRESS)
0	1	1	0	HIY HIX	2 and 3 (5 MSB of Y ADDRESS)* 2 and 3 (5 MSB of X ADDRESS)*
0	1	1	1	CTRL CHAR STB	0 and 1 (CTRL CHARACTERS)

*Preceding signal determines whether HIY or HIX goes active.

*HIY goes active following a GS or the LOXE signal; HIX goes active following the LOY signal.

Fig. 6-4. Logic Table for Column Decoder and Graphic Byte Decoder.

4010 out of Graphic operation. The Curse circuit is also composed of a simple logic circuit. LCE must be high and $\overline{\text{SUB}}$ must be low in order to activate the $\overline{\text{CURSE}}$ signal. $\overline{\text{CURSE}}$ is used to switch the Terminal into the Graphic Input Mode by activating the Crosshair Generator in TC-2. The Make Copy circuit must have LCE high and $\overline{\text{ETB}}$ low in order to activate the $\overline{\text{MAKE COPY}}$ pulse. The 600 Hz input from the Alpha Cursor Counter is used to develop a $\overline{\text{MAKE COPY}}$ pulse of the desired width. $\overline{\text{HOME}}$ inhibits the Make Copy circuit when power is turned on. Notice that MAKE COPY inputs to the Terminal Busy circuit. This keeps the Terminal Busy ($\overline{\text{TBUSY}}$ goes low) until the Hard Copy Unit asserts $\overline{\text{DRBUSY}}$ to sustain the busy condition. This holds the 4010 in a busy condition from the time $\overline{\text{MAKE COPY}}$ is activated to the time the Hard Copy Unit completes the copy ($\overline{\text{DRBUSY}}$ goes high).

Graf Flip-flop (F/F). The Graf F/F is used to switch the Terminal in and out of the Graphic Plot Mode. The GS Control Character sets the Graphic Plot Mode. $\overline{\text{NOLT}}$ goes high to enable the Linear Interpolation circuitry in TC-2. $\overline{\text{GRAF}}$ goes low and is used to set other Terminal circuitry for Graphic Plot operation. The signals $\overline{\text{PAGE}}$, $\overline{\text{CURSE}}$, $\overline{\text{HOME}}$, will reset the Graf F/F to the Alpha Mode. The Control Characters US and CR can also reset the Graf F/F to the Alpha Mode.

When $\overline{\text{GS}}$ sets $\overline{\text{GRAF}}$ low and $\overline{\text{NOLT}}$ high, $\overline{\text{NOLT}}$ enables the Column Decoder to allow $\overline{\text{BIT 7}}$ and $\overline{\text{BIT 6}}$ to control the Byte Enable lines to the Graphic Byte decoder.

Graphic Byte Decoder. This circuit is used to generate the graphic byte output signals $\overline{\text{HIY}}$, $\overline{\text{LOY}}$, $\overline{\text{HIX}}$, and $\overline{\text{LOXE}}$. These signals are used to load the four graphic bytes into the Data latches on TC-2. When the 4010 receives graphic plot data, it arrives in a sequence of four, seven-bit bytes for each coordinate point addressed. Five of the bits contain coordinate information and 2 of the bits (bits 6 and 7) contain steering data. The steering data designates the specific byte as being either High Order Y (HIY), Low Order Y (LOY), High Order X (HIX) or Low Order X (LOX). For the sake of this discussion we will assume that data is being received in that order. (For other graphic byte sequences, see the 4010/4010-1 User's Manual.) The Graphic Byte Decoder operates in the following manner.

When the 4010 receives a GS Control Character, it activates the $\overline{\text{GS}}$ signal from the Control Character Decoder. This signal sets the Graphic Plot Mode as previously explained. With $\overline{\text{NOLT}}$ inactive (high), the Column Decoder will now interpret $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ as BYTE ENABLE information for the Graphic Byte Decoder. The Graphic byte code bits are as follows:

BYTE	BIT 7	BIT 6	
HIY	0	1	Most significant 5 bits of Y
LOY	1	1	Least significant 5 bits of Y
HIX	0	1	Most significant 5 bits of X
LOX	1	0	Least significant 5 bits of X

Notice that the HIY and HIX bits have the same bit 7 and bit 6 configuration. The problem of interpreting which byte is which is accomplished by the $\overline{\text{GS}}$ signal and the LOX byte. On the first vector string, the $\overline{\text{GS}}$ signal (through U5F) sets the Graphic Byte Decoder to interpret the first high order code as being HIY; thus, the $\overline{\text{HIY}}$ signal is activated. The Graphic Byte Decoder interprets the next high order code as being HIX; subsequently the $\overline{\text{HIX}}$ signal is activated. On succeeding vector strings, the LOX code sets the Graphic Byte Decoder to interpret the following high order code as being HIY.

Notice that the $\overline{\text{GIN}}$ signal inputs to the Graphic Byte Decoder. Its purpose is to inhibit the Decoder during the sending of graphic input data to the computer.

Data Enable Gate. This circuit puts out an ENABLE signal to the Character Generator circuitry whenever $\overline{\text{ALPHA STROBE}}$ and DELETE are both low. The ENABLE signal then latches the data bits into the Character Generator.

Rubout Suppressor. The main purpose of this circuit is to suppress the data code 127 (DEL). The Character Generator will neither space nor print because the Rubout Suppressor circuit detects the DEL code and sends a high DELETE signal to the Data Enable Gate. This action prevents the $\overline{\text{ALPHA STROBE}}$ signal from generating an ENABLE signal, thus inhibiting the Character Latches. This prevents the DEL code bits from being input to the Character Generator.

Format Effector

General. The Format Effector operates from a predetermined set of inputs to position the alpha (pulsating) cursor over the face of the display screen. It will also generate timing pauses when switching out of Graphics, when initiating a Carriage Return, when ringing the bell, and when drawing a vector.

Its basic function is to take the decoded output of the Control Character Decoder and transform it into the desired result. For example, if the function desired is to move the alpha cursor one space, the Format Effector will output 22 pulses on the $\overline{\text{RIGHT}}$ line. This will increment the X Register in TC-2, thus moving the alpha cursor one space. Each pulse will increment the X Register one count. Each count from the Register will move the Display beam one Tekpoint. A Tekpoint refers to one of the 1024 programmable locations that are available in both the X and Y Axes. Another example is a Carriage Return. With a Carriage Return, the Control Character Decoder outputs the $\overline{\text{CR}}$ signal. The Format effector circuitry inverts the $\overline{\text{CR}}$ to CR, which sets the X Register back to zero. At the same time, the Format Effector generates a pause in Terminal operation, causing the Terminal to go to a "busy" condition. This pause is of sufficient length to allow the display beam to position back to the left side of the screen before the Terminal will accept and process further data.

The Format Effector contains the following circuits:

System Clock—Provides timing signals for Terminal operation.

Alpha Cursor Counter—Controls the positioning of the alpha cursor as well as various other functions.

Pulse Shaper—Provides a pulse that loads preset data into the Alpha Cursor Counter circuit.

Direction Latch—Remembers the direction of last alpha cursor movement. Its output changes when new direction command is received.

Direction Enable Gates—Enables $\overline{\text{LEFT}}$, $\overline{\text{RIGHT}}$, $\overline{\text{UP}}$, or $\overline{\text{DOWN}}$ lines dependent upon respective signals from Direction Latches and the enabling signals from the Alpha Cursor Counter.

Terminal Busy—Outputs a $\overline{\text{TBUSY}}$ signal that prevents the Terminal from receiving any further data until the Terminal operation being performed is completed.

Auto Carriage Return/Line Feed (Auto CR/LF)—Performs an automatic Carriage Return with the receipt of the LF Control Character. Processes the CR signal to activate a Carriage Return.

Vector/Bell Enable—Outputs signals that activate vector drawing and bell ringing.

Z Axis—Controls the state of the X signal that turns the display beam on and off.

Bell—Provides the drive signal for the speaker that gives the audible "bell" tone.

View/Hold—Provides an enabling signal (VIEW) for the CRT flood guns so that data can be viewed. When in Hold operation, VIEW is set at a reduced duty factor, thus prolonging the life of the CRT.

Cursor Refresher—Provides logic that allows the 5 X 7 dot matrix of the Character Generator to be displayed but not stored, thus generating the alpha cursor.

Defocus—Provides uniform focusing in Alpha Mode. In Graphic operation it allows the display beam to become slightly defocused so that the vectors will not appear as a series of dots.

Basically, the operation of the circuits will be described in that order. However, in some cases it is more practical to combine the descriptions of several blocks.

Block Description

System Clock. The System Clock is a Crystal Controlled oscillator that outputs two square wave frequencies to the minibus—4.9 MHz and 614 kHz. It also outputs a 2.45 MHz square wave for use by the Alpha Cursor Counter and the Auto CR/LF circuits.

Pulse Shaper. The Pulse Shaper generates a $\overline{\text{LOAD}}$ pulse that is used to strobe data from the preset lines into the Alpha Cursor Counter. The $\overline{\text{LOAD}}$ pulse is shorter than any of the inputs to the Pulse Shaper Circuit. This allows the $\overline{\text{LOAD}}$ pulse to come and go while the data on the preset lines is still valid. All inputs to the Pulse Shaper will activate the $\overline{\text{LOAD}}$ pulse. The $\overline{\text{LOAD}}$ pulse is inverted and inputs to the Vector/Bell Enable and Direction Latch circuits as a LOAD signal.

Alpha Cursor Counter, Direction Latch, and Direction Enable Gates. The Alpha Cursor Counter is composed of 4, four-bit counter elements. Depending upon preset inputs to the counter, it will add or subtract the required number of pulses to initiate the function required by the Control Character Decoder. This circuit also generates pauses in Terminal operation; such as that required for a Carriage Return, (as previously explained), and coming out of Graphics operation. It also provides a 2.6 ms pause that activates the $\overline{\text{Z}}$ signal when drawing a vector. Finally, it provides various timing signals that are used by other TC-1 circuits.

The Clock input to the Alpha Cursor Counter is a 2.45 MHz square-wave from the System Clock. The Counter counts continuously except when a low is applied on the $\overline{\text{LOAD}}$ input line. As the Counter circuitry is counting it is putting out the following square wave signals for use by other TC-1 circuits.

5 Hz and 37 Hz. Used in the Cursor Refresher Circuit

75 Hz, 150 Hz, 300 Hz. Used in the View/Hold Circuit.

600 Hz. Used in the Make Copy Circuit.

1200 Hz. Used in the Bell Circuit.

19 kHz and 77 kHz. Used by the Character Generator.

1.25 MHz. Used to increment the Direction Enable Gates and to clear the Column reset circuitry located in the Character Generator circuitry.

Basically, the Alpha Cursor Counter is a programmable counter, referred to as such because it contains a number of preset (program) lines that "program" the Alpha Cursor Counter to output various signals that perform a specific function. The data loaded into the Counter from the preset lines determines a number that the Counter will start counting from. These preset inputs are, $\overline{\text{LOXE}}$ (Low Order X) which sets the 2.6 ms pause that activates the Z signal to draw a vector; the Bell inputs that determine how long the bell will ring; The $\overline{\text{CR}}$ input that initiates the pause needed to perform the Carriage Return; and finally BS (Backspace), $\overline{\text{HT}}$ (Horizontal Tab), $\overline{\text{VT}}$ (Vertical Tab) and $\overline{\text{LF}}$ (Line Feed). (Notice that the same preset line is used for both directions of horizontal movement; similarly, one preset line is used for both directions of vertical movement. This is because that for either a BS or an HT, the horizontal movement is 14 Tekpoints. For either a VT or an LF, the vertical movement is 22 Tekpoints.) Each of the eight functions that the Counter will perform corresponds to a definite value on the preset input lines. These lines determine how long it will take for the Counter to count up to the point where a zero-to-one transition is obtained on its Most Significant Bit (MSB) output. If either a LEFT, RIGHT, UP, or DOWN signal is being output by the Direction Latch, this length of time determines how many 1.25 MHz pulses are placed on the $\overline{\text{LEFT}}$, $\overline{\text{RIGHT}}$, $\overline{\text{UP}}$, or $\overline{\text{DOWN}}$ line, as well as how long $\overline{\text{TBUSY}}$ stays active. In all cases, the MSB signal being low determines how long it will take for a Terminal pause, as reflected by the $\overline{\text{TBUSY}}$ signal.

For an over-all example of how the Format Effector processes a direction command, assume that the Control Character HT (space) has been received by the Terminal. $\overline{\text{HT}}$ inputs to the Pulse Shaper circuit and causes the $\overline{\text{LOAD}}$ pulse to go low. LOAD then strobes the $\overline{\text{HT}}$ signal into the Direction Latch, activating the RIGHT signal; $\overline{\text{LOAD}}$ simultaneously loads the preset data into the Alpha Cursor Counter causing the MSB signal to go low. With MSB low, $\overline{\text{TBUSY}}$ goes active and the 1.25 MHz signal can clock the Direction Enable Gates. With the RIGHT signal from the Direction Latch high, every time the 1.25 MHz signal goes low, a low-going transition takes place on the $\overline{\text{RIGHT}}$ line, incrementing the X Register in TC-2. After 14 positive-to-negative transitions of the 1.25 MHz signal, the MSB signal will go high. This prevents the 1.25 MHz signal from enabling further $\overline{\text{RIGHT}}$ pulses. It also ends the $\overline{\text{TBUSY}}$ signal.

The $\overline{\text{FPAUSE}}$ signal is an output of TC-2. Its purpose is to disable the Alpha Cursor Counter circuit when the X Register in TC-2 resets from 1023 back to 0. Here it is used to generate the pause required for proper operation of the Auto Carriage Return Line Feed circuit when used with a clocked interface. It does not cause the MSB signal to go low. It simply stops the counting sequence for approximately 0.5 ms.

Terminal Busy. The purpose of the Terminal Busy circuit is to inhibit the reception of data from either the Keyboard or the computer. Any of the following functions will cause $\overline{\text{TBUSY}}$ to go active low; when an alphanumeric character is being generated ($\overline{\text{CHAR IN PROG}}$); when a Hard Copy is being generated ($\overline{\text{MAKE COPY}}$ and $\overline{\text{DRBUSY}}$); and when the Most Significant Bit (MSB) output of the Alpha Cursor Counter is low (as is the case when it is performing one of the eight functions).

Automatic Carriage Return/Line Feed. When the Control Character Decoder outputs an $\overline{\text{LF}}$ signal, the Auto CR/LF circuit will in turn output an $\overline{\text{LF}}$ signal to the Pulse Shaper and Direction Latch circuits to cause the Line Feed to occur. Notice that the Control Character signal $\overline{\text{CR}}$ also inputs to this circuit. This signal is inverted and outputs on the CR line. The Auto CR/LF circuit can be strapped (see Strappable Options Section of the Manual) to give an automatic Carriage Return when $\overline{\text{LF}}$ goes active. If the strap is in place for an automatic Carriage Return with Line Feed, $\overline{\text{LF}}$ also generates the CR signal.

The $\overline{\text{EOL}}$ (End of Line) input (from TC-2) activates an automatic Carriage Return and Line Feed when spacing past the right margin. An active SUPPRESS signal from the Alpha Cursor Suppress circuit inhibits the operation of the automatic CR/LF circuit.

Vector/Bell Enable. When the Control Character $\overline{\text{BEL}}$ goes low, it enters the Pulse Shaper to generate the $\overline{\text{LOAD}}$ pulse. $\overline{\text{BEL}}$ then gets strobed into the Vector/Bell Enable circuit by the LOAD pulse. The circuit then outputs BELL and $\overline{\text{BELL}}$ to generate the Bell tone. For more on how the Bell Circuit works, see the explanation on the Bell Circuit. This circuit is also used to enable or disable the Z axis during the drawing of a vector (Linear Interpolation). It functions in the following manner.

Circuitry within the Vector/Bell Enable circuit keeps the VECTOR ENABLE signal to U73B low for the first vector following GS. This is known as a "Dark Vector". With the receipt of the next vector, the $\overline{\text{LOXE}}$ signal, causes the Vector/Bell Enable circuit to set the VECTOR ENABLE signal high. VECTOR ENABLE provides an enabling voltage to one side of the Vector Enable Gate U73B. The $\overline{\text{LOXE}}$ signal also inputs to the Alpha Cursor Counter to preset the inputs for a 2.6 ms pause. The $\overline{\text{LOAD}}$ signal then sets the 2.6 ms PAUSE line to U73B high. U73B is now enabled and sends a low $\overline{\text{DRAW}}$ signal to the Z Axis Circuit. This action sets the $\overline{\text{Z}}$ signal low to draw the vector. 2.6 ms later, the 2.6 ms PAUSE line goes low, disabling the Z Axis Circuit.

Z Axis. The Z Axis circuitry is used to enable or disable the $\overline{\text{Z}}$ signal. $\overline{\text{Z}}$ is an active low signal that is used to turn the writing beam on. The effect that $\overline{\text{DRAW}}$, $\overline{\text{TOP ROW SUPPRESS}}$, $\overline{\text{WRITE DOT}}$, and REFRESH have upon Z Axis operation is described in the block from which they originate.

Bell. When the Control Character BEL is received, $\overline{\text{BEL}}$ goes low from the Control Character Decoder. $\overline{\text{BEL}}$ inputs to the Pulse Shaper circuit to generate a $\overline{\text{LOAD}}$ pulse that is inverted to latch $\overline{\text{BEL}}$ into the Vector/Bell Enable Circuit. This causes the Bell and $\overline{\text{BELL}}$ signals to go low and high respectively. While the $\overline{\text{LOAD}}$ pulse is active low, it latches the BELL and $\overline{\text{BELL}}$ inputs into the Alpha Cursor Counter and the Counter starts counting. The $\overline{\text{LOAD}}$ pulse also causes the MSB output of the Counter to go low. This low MSB signal with the high $\overline{\text{BELL}}$ signal from the Vector/Bell Enable circuit allows the 1200 Hz square wave signal to drive the Bell circuit, thus generating the 1200 Hz tone. When the Counter counts up to the point where the MSB goes high (as determined by the preset input from the Vector/Bell Enable circuit) the Bell circuit is disabled.

View/Hold. The purpose of the View/Hold Circuit is to prolong the life of the display tube. In the Alpha Mode, as long as data is being entered into the Terminal, the VIEW signal is high, allowing data to be displayed. However, if no new data is entered for a period of about 90 seconds the VIEW signal becomes driven by a 75 Hz signal from the Alpha Cursor Counter. This action provides a 12 1/2% duty time for the VIEW signal, thus dimming the display. This is known as "Hold" Mode. The display can be returned to normal viewing level by entering new data.

For the above action to take place, the input signals must be in the following states:

1. SUPPRESS—Low
2. $\overline{\text{HOME}}$—High
3. $\overline{\text{SHIFT}}$—High
4. $\overline{\text{RESET/SUPPRESS}}$—High

Notice also that this circuit inputs a signal called $\overline{\text{VIEW}}$ to the Cursor Refresher Circuit. When the 90 second period occurs, this signal goes low to inhibit the Alpha Cursor during the time the Terminal is in hold.

If either the $\overline{\text{GRAF}}$, $\overline{\text{GIN}}$, $\overline{\text{DRBUSY}}$ or $\overline{\text{TERM STB}}$ signals go active, the SUPPRESS signal from the Alpha Cursor Suppress circuit goes high. This keeps the view signal active.

Cursor Refresher. The Alpha Cursor is a pulsating display of the 5 X 7 dot matrix within the Character Generator. When the Terminal is in the Alpha Mode and no new data is being entered, the Character Generator will cycle through the dot matrix 75 times each second (for explanation on how the characters are generated, see the Character Generator Description). Each time a dot of the matrix is to be displayed, the $\overline{\text{WRITE DOT}}$ signal from the Character Generator will go low to enable the Z Axis circuit. The $\overline{\text{77 kHz}}$ signal is input to the Cursor Refresher Circuit, causing the REFRESH line to go high. This causes $\overline{\text{Z}}$ to blank between dots. However, under these circumstances the Matrix will store, because the Z Axis Circuit has no way of knowing whether a character is being generated or the Character Generator is just cycling through the matrix. Therefore, the width of the $\overline{\text{Z}}$ pulse must be limited to prevent storing of the Alpha Cursor when no characters are being generated. This is the purpose of the Cursor Refresher. Not only does it prevent the character Matrix from storing, but it also causes the Matrix to "blink", thereby drawing the User's attention to the location of the writing beam.

A 5 Hz square wave is placed at the input to the Cursor Refresher Circuit. The 37.5 Hz square wave, and the CARRY signal (from the Column Counter in the Character Generator) combine to give a short pulse that fires a one-shot multi in the Cursor Refresher circuit. The on time of this multi is only 0.75 ms. But, in this span of time, the Character Generator is permitted to scan completely through the matrix, once. Referring to Fig. 6-5 you will notice a drawing of the composite signal as viewed on the REFRESH and $\overline{\text{Z}}$ lines when the multi is on. Notice that there are five sequences of 8 pulses each. Each of these pulses corresponds to one dot in the matrix; each set of eight pulses corresponds to one column of the matrix; the five sequences of pulses corresponds to the entire matrix. Note, however, that when viewing the $\overline{\text{Z}}$ signal, the eighth pulse for each column is missing. This is because the top (eighth) row of the matrix is inhibited by the $\overline{\text{TOP ROW SUPPRESS}}$ signal to the Z Axis circuit. This gives us the 5 X 7 matrix. Notice also the space between columns. This span of time is caused by the $\overline{\text{RESET/SUPPRESS}}$ signal that originates in the Top of Column Pause circuit of the Character Generator. Each time the count switches to another column, the display beam needs sufficient time to settle down before the count can continue; hence, the pause at the top of each column.

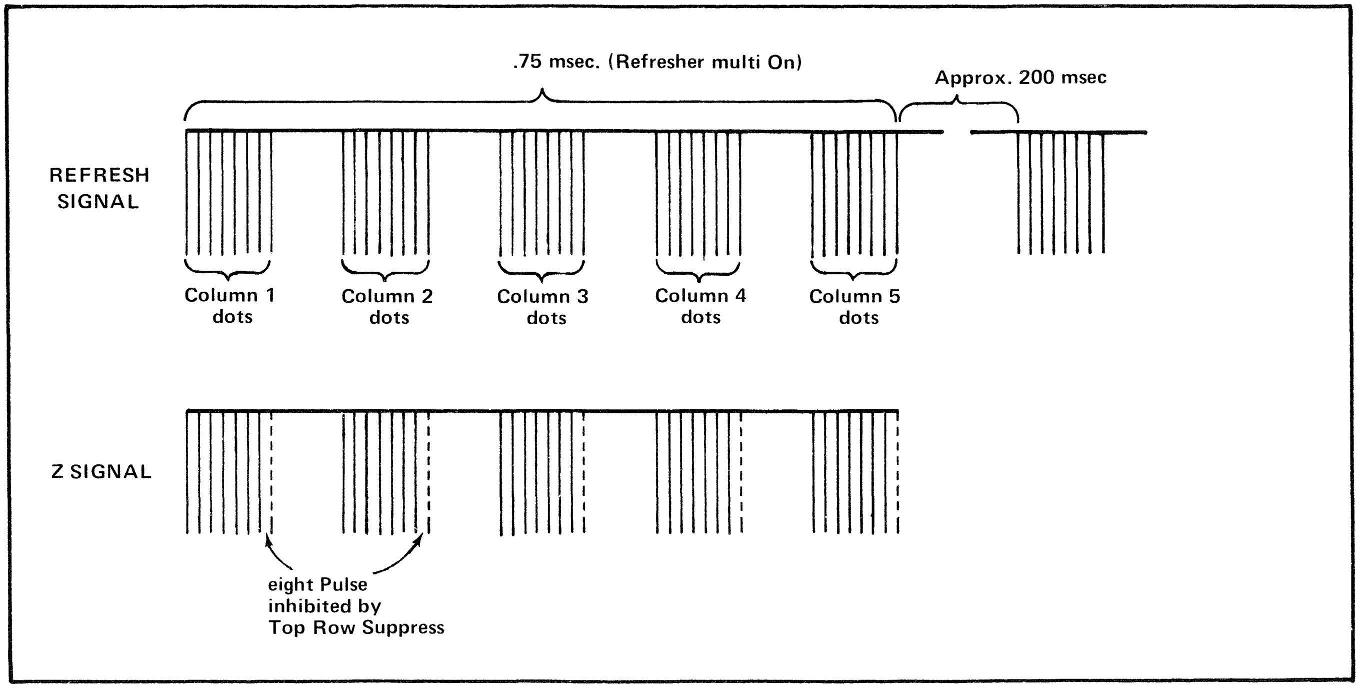


Fig. 6-5. Illustration of Refresh and Z signals During Generation of the Alpha Cursor.

The above-stated action occurs approximately five times each second. The blinking of the pulsating Alpha Cursor is the result of this 5 Hertz repetition rate. The whole process has combined to give a signal of short enough pulse width so as not to store the matrix on the screen.

The $\overline{\text{VIEW}}$ signal inputs to the Cursor Refresher circuit to inhibit the Alpha Cursor when the View/Hold circuit sets the Terminal to the Hold Mode. The $\overline{\text{VIEW}}$ signal must be low to inhibit the Alpha Cursor. The $\overline{\text{TERM STB}}$ input from U7B will inhibit the cursor Refresh circuit while $\overline{\text{TSTROBE}}$ is active.

Defocus. The Defocus circuit is used to generate the $\overline{\text{FUZZ}}$ signal. $\overline{\text{FUZZ}}$ is low in Alpha Mode to provide uniform focusing. It goes high during graphic operation to slightly defocus the display beam.

Character Generator

General. The Character Generator performs its function by cycling through a rectangular dot matrix. See Fig. 6-6. Although the matrix is formed by the coordinates of eight rows and five columns, the eighth (or upper) row is always blanked during character writing.

Characters are formed by cycling through each of the matrix positions and writing a dot in each of the positions required for forming a character. Cycling sequence consists of selecting column one, rippling through rows 8 through 1, then selecting column 2, repeating the row selection, etc. For example, if the letter L were to be written, dots would be written for each row position in column 1. Only the row 1 dots would be written when the character generator cycles through the eight rows of the remaining four columns.

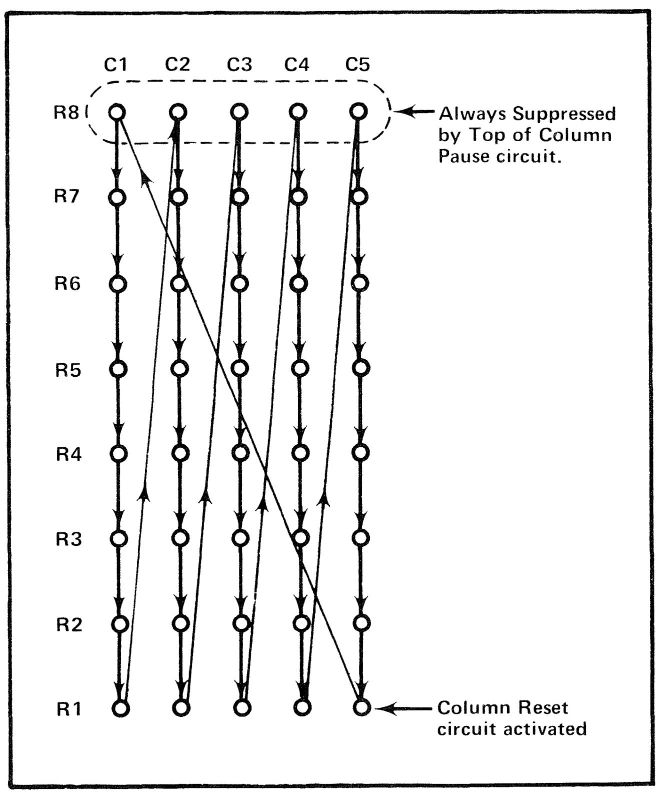


Fig. 6-6. Character Generator Matrix.

In the absence of a character input, the Character Generator continuously cycles through the matrix, writing all dots in rows 7 through 1, forming a non-storing cursor. When a character is ordered written, the matrix is scanned, dots are written to store the character, and then a pulse is sent to the Format Effector to advance the X Register one character position to prepare for the next character.

The principal circuits which perform these functions within the Character Generator are as follows:

Read Only Memory (ROM)—Programmed by the character being processed; emits each of eight sets of data on five parallel lines, the set being determined by the Row Counter; the five parallel lines represent the five columns of the character writing matrix. The ROM has 64-character selection capability. This consists of the middle four columns of the ASCII Code Chart. None of the lower case alphanumeric symbols can be generated; although eliminating character $\overline{\text{BIT 6}}$ from the ROM permits characters from the right two columns of the ASCII Code Chart to be accepted and written as characters from an equivalent position in the two columns to the left.

Column Counter—sequentially selects columns one through five, causing the CRT beam to deflect in the X direction; selects the appropriate column out of the five outputs of the ROM for Z axis control.

Row Counter—cycles through the eight rows at each column selection; its output causes the CRT beam to deflect in the Y direction; it also causes the ROM to emit five bits of writing information consistent with the selected row.

Z Multiplexer—emits an output controlled by one of the five signals from the ROM. The selection is controlled by the inputs from the Column Decoder.

Additional circuits instrumental to the Character Generator operation are:

Alpha Cursor Suppress—prevents operation during graphics modes, during hard copy writing, etc.

ROM Selector—selects ROM A or ROM B (if ROM B is installed).

Character Latches—loads character bits into the Character Generator with the receipt of an active ENABLE signal.

Character Status—activates the generation of a character. Sets $\overline{\text{TBUSY}}$ active; completes the character generation process by sending a signal to the Format Effector to space to the next character position.

Z Enable Gate—sends 77 kHz $\overline{\text{Z ENABLE}}$ pulses to the Z Multiplexer.

Y Matrix Digital to Analog—converts the digital output of the Row Counter into its analog equivalent for display beam positioning. Also sends a $\overline{\text{TOP ROW SUPPRESS}}$ signal to the Z Axis circuit that suppresses the eighth row of dots.

X Matrix Digital to Analog—converts the digital output of the Column Counter into its equivalent analog voltage for display beam positioning.

Top of Column Pause—provides a pause in the scanning sequence to allow the display beam time to position to the top of the matrix and stabilize.

Column Reset—resets the Column Counter to column 1.

Terminal Strobe ($\overline{\text{TERM STB}}$) signal—presets the outputs of the Character Generator circuitry so as to be in position to begin displaying a character immediately when commanded.

Echoplex Suppressor—inhibits character generation.

Selecting the ROM. Refer to the TC-1 Block Diagram. The standard 4010 is provided with one Read Only Memory circuit; however, space is provided on TC-1 for an additional Read Only Memory device. The selection of the Read Only Memory device is controlled by the output of the Read Only Memory Selector Circuit. The ROM chips are connected in parallel, with the exceptions of the ROM Select line. Under normal operation ROM A will be selected. The alternate, ROM B is selected by pressing Switch 2 on the Front Panel or by sending Control Character SO. ROM A is selected by sending Control Character SI, by pressing the Reset key, or when power is turned which activates the $\overline{\text{HOME}}$ signal.

Presetting the Character Generator. When the data bits for an alphanumeric character are received by the Terminal, $\overline{\text{TSTROBE}}$ activates the $\overline{\text{TERM STB}}$ signal. $\overline{\text{TERM STB}}$ going active causes the Column Reset circuit to output a COLUMN RESET pulse that resets the Column Counter to Column 1. $\overline{\text{TERM STB}}$ also inputs to the Alpha Cursor Suppress circuit, causing it to activate the SUPPRESS signal. This signal inputs to the Top of Column Pause circuit, the Row Counter circuit, and the Y Matrix Digital to Analog circuit, causing these circuits to inhibit the scanning sequence that had been drawing the non-storing pulsating cursor. The Row Counter outputs are all set low. This represents the Row 8 position of the character matrix. Even though the low Row Counter inputs to the Y Matrix Digital to Analog signify the Row 8 position, the output of the Y Matrix Digital to Analog is held at the Row 1 position of the character matrix by the active SUPPRESS signal. When $\overline{\text{TSTROBE}}$ goes inactive, SUPPRESS also goes inactive, allowing the low outputs of the Row Counter to set the output of the Y Matrix Digital to Analog circuit to the Row 8 position. The sequence in which $\overline{\text{TSTROBE}}$ goes inactive will be explained in more detail in the "Scanning the Character Matrix" description.

SUPPRESS also goes active when operating in Graphic Plot and Gin modes or when the Hard Copy Unit is making a copy of the displayed data. During the operation of these modes, the SUPPRESS signal holds the display beam in the Row 1, Column 1 position of the character matrix.

When $\overline{\text{TERM STB}}$ causes the $\overline{\text{ALPHA STB}}$ signal to go active, the data bits ($\overline{\text{BIT 1}}$–$\overline{\text{BIT 5}}$ and $\overline{\text{BIT 7}}$) that contain the alphanumeric character are strobed through the Character Latches by the ENABLE signal (the DELETE signal from the Rubout Suppressor must be inactive). The Character bits then select the address of the character within the ROM device.

The ENABLE signal also activates the $\overline{\text{CHAR IN PROG}}$ signal from the Character Status circuit. This signal inputs to the Terminal Busy circuit to hold $\overline{\text{TBUSY}}$ active until the Character Generator has completed drawing the Character. The complement of the $\overline{\text{CHAR IN PROG}}$ signal enables the Z Enable Gate, allowing it to pulse the Z Multiplexer with 77 kHz square wave signals.

Scanning the Character Matrix. $\overline{\text{BIT 1}}$–$\overline{\text{BIT 5}}$ and $\overline{\text{BIT 7}}$ applied to the data inputs of the ROM select the writing signals pertaining to the character being input. The BCD, ROW, inputs from the Row Counter, sequentially scan the matrix rows in the ROM at a 77 kHz rate. The combination of data select and Row scanning inputs results in dot disclosure information on the five output lines of the ROM to the Z Multiplexer circuit. The five lines represent each of the five columns of the matrix. With this information in mind, let's follow the Character Generator through the scanning sequence.

When the $\overline{\text{TSTROBE}}$ signal ends, $\overline{\text{TERM STB}}$ goes inactive, causing the SUPPRESS signal from the Alpha Cursor Suppress circuit to go inactive. SUPPRESS going inactive allows the output of the Y Matrix Digital to Analog circuit to set the Display beam to the row 8, column 1 position of the matrix. The eighth row of dots is not used; therefore, a $\overline{\text{TOP ROW SUPPRESS}}$ signal is sent to the Z Axis circuit to inhibit the $\overline{\text{Z}}$ signal. SUPPRESS going inactive also enables the Row Counter. With the first 77 kHz signal, the Row Counter will advance to the row 7 position. This causes the ROM device to send all 5 dots of row 7 information to the Z Multiplexer. However, because the Column Counter output signifies that column 1 is being counted, it sets the Z Multiplexer to look at the COLUMN 1 DOT inputs from the ROM. If the ROM signifies that the dot is to be written, the COLUMN 1 DOT output is high. When the 77 kHz signal causes the $\overline{\text{Z ENABLE}}$ to go low, the output of the Z Multiplexer ($\overline{\text{WRITE DOT}}$) also goes low to cause the Z Axis circuit to output a $\overline{\text{Z}}$ signal to write the dot.

The above process repeats itself; the 77 kHz pulses cause the Row Counter to count from 1 to 7, selecting row 7 to row 1 respectively; with each advance of the Row counter the Y Matrix Digital to Analog will change accordingly, positioning the display beam to follow the scanning sequence.

When the Row Counter resets state 0, the state 4 goes low. This causes the Column Counter output to advance to column 2. The output of the X Digital to Analog circuit changes and positions the display beam to the column 2 position. Resetting the Row Counter to state 0 once again causes the $\overline{\text{TOP ROW SUPPRESS}}$ signal from the Y Matrix to go active, but, the counting sequence cannot continue because the state 4 line going low activated the Top of column Pause circuit, inhibiting the 77 kHz pulses that clock the Row Counter. The Top of Column Pause circuit provides a 60 μs delay in the counting sequence to allow the display beam time to deflect to the row 8 position and stabilize. The 19 kHz signal input from the Alpha Cursor Counter ends the delay and the scanning sequence continues in the described manner; except that this time the output of the Column Counter has set the Z Multiplexer to output dot information from the COLUMN 2 DOTS output of the ROM. The above sequence repeats until all five columns of the Character matrix have been scanned. It takes about 700 microseconds to scan the character matrix once.

Resetting the Character Generator. When the Row Counter resets to state 0 when counting past Row 1, Column 5 (see Fig. 6-6), the low-going most significant bit of the Row Counter again causes the Top of Column pause circuit to generate the 60 μs pause. It also causes the Column Counter to activate the CARRY signal. (The CARRY signal actually signifies a count of five from the Column Counter.) The CARRY signal inputs to the Top of Column Pause circuit to generate the $\overline{\text{RESET/SUPPRESS}}$ signal that activates the COLUMN RESET signal from the Column Reset circuit. The COLUMN RESET signal resets the Column Counter back to Column 1.

When the CARRY signal went active it caused a CHAR COMP signal to be sent from the Character Status circuit to the Pulse Shaper circuit. This signal causes the Format Effector circuitry to advance the display beam one character space. On the trailing edge of the CARRY signal (caused by the COLUMN RESET signal resetting the Column Counter to Column 1), the $\overline{\text{CHAR IN PROG}}$ signal (that is holding the Terminal busy) ends. The CHAR COMP pulse also ends and the CHAR IN PROG signal (that has been enabling the Z Enable Gate) goes low. This completes the resetting of the Character Generator in the normal sequence.

Echoplex Suppress. When either the Graphic Input or the Graphic Plot Mode is initiated, the output of the Echoplex Suppress circuit becomes active. Its purpose is to prevent the Character Status circuit from responding to ENABLE signals generated by the $\overline{\text{ALPHA STB}}$ signal. In the Graphic Input Mode, data is sent from the Terminal to the computer. This data is placed on the data lines of the minibus. Therefore, the Echoplex Suppress circuit prevents the Character Generator from responding to that data.

The two signals that will reset the Echoplex Suppress circuit are, $\overline{\text{LOCAL}}$ and $\overline{\text{TBUSY}}$. The $\overline{\text{LOCAL}}$ signal becomes active when the LOCAL/LINE switch on the Keyboard is placed in the LOCAL position. This low active signal causes $\overline{\text{ECHO INH}}$ (Echo Inhibit) to go inactive (high), thus allowing the Character Generator to print the Alphanumeric characters when in the Local Mode. $\overline{\text{TBUSY}}$ allows the Character Generator to switch back to Alpha Mode from Graphic Plot Mode. To accomplish this $\overline{\text{TBUSY}}$ must go active.

TC-2

BLOCK DIAGRAM DESCRIPTION

Introduction

Refer to the TC-2 Detailed Block Diagram. As in the case of TC-1, TC-2 can be divided into blocks which perform specific functions. When possible, each block will be described as a separate entity. However, in some cases, it is difficult to obtain an over-view of circuit operation by discussing each block as an entity. In such cases, groups of blocks will be described in a sequence of operations (such as those needed to generate the crosshair cursor).

Below is a list of blocks that contain the greater part of TC-2 circuitry. A short description of each is given.

X Latch, Y Latch—data latches used when operating in the Graphic Plot Mode; provide storage for three 5-bit bytes of the 20-bit coordinate address.

X and Y Registers—each Register contains three 4-bit up-down counters, whose 10 bits of output data can be set by serial or parallel inputs.

Top-of-Page Detect Circuit—in the Alpha Mode, this circuit keeps the display beam in the viewable area of the Y Axis.

Margin Shifter—sets Margin 0 (left side of Display) or Margin 1 (center of Display).

Terminal Busy—places the Terminal in a "busy" condition, inhibiting the placing of data on the minibus by the keyboard, computer, or any other device that might be connected to the minibus.

X and Y Digital to Analog (D/A) Circuits—convert the digital outputs of the X and Y Registers into their equivalent analog voltage.

X and Y Filters—in the Alpha Mode, these circuits will not affect the output of the X and Y D/A's. In the Graphic Plot Mode they are enabled to provide a linear rate of change for the X and Y signals.

Data Multiplexer—depending upon the output of the Multiplexer Control circuit, the Data Multiplexer will place one of eight data bytes onto the minibus.

Strobe Logic—provides a signal that enables the Data Multiplexer to place the data bytes onto the minibus; also provides strobe signals to enable the computer and/or the Terminal to accept and process data.

Bits 6 and 7 Logic—places the complement of keyboard bits 6 and 7 onto their respective minibus data lines; also codes $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ with each 5-bit byte of data from the Data Multiplexer when operating in the Graphic Input Mode.

Multiplexer Control—controls the output of the Data Multiplexer; also inputs various signals to the Strobe Logic circuit to aid in the generation of the strobe signals, and aid in the digitization of the voltage from the X and Y Position Pots.

Crosshair Generator Circuitry—generates the crosshair cursor by sending a sequence of pulses that increment the X and Y Registers. With each register increment, a Z axis pulse is generated to draw the point. Rapidly counting through the Registers provides a crosshair type cursor, bright enough to be visible, yet dim enough so as not to store.

Z Control Circuit—(Circuit Cards 670-1729-05 and above)—Controls vector intensity when vectors less than approximately one-half inch long are being drawn.

Block Description

X and Y Data Latches. The X and Y Data Latches are used in the Graphic Plot Mode to provide storage for three of the 5-bit coordinate address bytes. In this mode of operation, data is sent from the computer to draw graphics, charts, figures, etc. on the Display screen. It takes twenty bits of data to establish a new coordinate address. However, only seven bits of data can be received from the computer at any one time; therefore, each coordinate address is divided into 4 seven-bit bytes. Two of the bits contain code data, and are used to develop load signals ($\overline{\text{HIY}}$, $\overline{\text{LOY}}$, $\overline{\text{HIX}}$, and $\overline{\text{LOXE}}$). Each load signal then loads its respective 5 bits of coordinate data into the appropriate latches. The High Order Y bits are first sent from the computer. The $\overline{\text{HIY}}$ signal decoded from the two most significant code bits loads the remaining five data bits into the five Most Significant Bit (MSB) portion of the Y Data Latch. In like manner the Low Order Y and High Order X bits are loaded into their respective latches. When the fourth byte (Low Order X needed to complete the coordinate address) is received from the computer, $\overline{\text{LOXE}}$ parallel loads all 20 bits into the X and Y Registers. Notice that the Low Order X bits are presented directly to the low order X inputs of the X Register. No storage is needed because they are the last bits received.

X Register (Counter). The X Register is a ten-bit, up-down counter. It is loaded either serially by the $\overline{\text{LEFT}}$ and $\overline{\text{RIGHT}}$ signals or it is loaded in parallel by the ten parallel inputs that contain the X coordinate address in graphic plot operation. In Alpha and Graphic Input Mode, the Register is loaded serially. Each low-going $\overline{\text{LEFT}}$ or $\overline{\text{RIGHT}}$ signal will decrement or increment the output one count. The 10 outputs provide a count from 0 to 1023. Each count represents one Tekpoint, which simply means that the display beam can be positioned to any one of 1024 separate locations in the X Axis.

Either the CR (Carriage Return), $\overline{\text{HOME}}$ or $\overline{\text{PAGE}}$ signal will reset the X Register to zero. $\overline{\text{HOME}}$ goes active when terminal power is initialized or when the RESET key is pressed. $\overline{\text{PAGE}}$ goes active when the Page key is pressed or Control characters ESC plus FF are received by the Terminal.

Y Register (Counter) and Top-of-Page Detect. Like the X Register, the Y Register is loaded either in series (by $\overline{\text{UP}}$ or $\overline{\text{DOWN}}$) or in parallel when receiving 10 bits of data from the Y Data Latch. This register is also capable of outputting a count of 0 to 1023. In the X Register, all 1024 of the separate tek-points are viewable. In the Y Axis only 780 of the 1024 tek-points are viewable. When a $\overline{\text{PAGE}}$ or $\overline{\text{HOME}}$ signal zeros the Y Register (the outputs of the Y Register are connected to inverters), the alpha cursor does not position to the bottom of the screen; instead, because of the inverters, it positions off the top of the screen in the Y Axis. Therefore, circuitry is needed to bring the alpha cursor in view, to the Home position (upper left). This is accomplished by the Top-of-Page Detect circuit.

When the Y Register is zeroed by $\overline{\text{PAGE}}$ or $\overline{\text{HOME}}$, the outputs from the inverters go high, positioning the display beam off-screen at a count of 1023. The two most significant bits from the inverters are sensed by the Top-of-Page Detect Circuit. When both go high, the Top-of-Page Detect circuit places the 614 kHz square wave on the $\overline{\text{DOWN}}$ line, and immediately the display beam begins moving in the down direction. When the count from the Y Register has incremented 256 counts, the 2nd MSB goes low, inhibiting the Top-of-Page Detector circuit and removing the 614 kHz signal from the $\overline{\text{DOWN}}$ line. Thus, the count is stopped at 767 (1023 minus 256 = 767). Notice, that the $\overline{\text{DOWN}}$ signal going active increments the Y Register. This is true because of the complementary fashion in which the Register is designed. Even though the $\overline{\text{DOWN}}$ pulses increment the Register, the actual output is decrementing because of the inverters on the output lines.

The MARG signal output is actually an eleventh bit of the Y Register, and constitutes a count of 1024. It goes high when the Y Register counts past the bottom line of the page (1023). This signal inputs to the Terminal Busy, Multiplexer, Margin Shifter and Found circuit (Part of Crosshair Generator circuits). Its purpose can be found in the descriptions of each of those blocks.

Terminal Busy. When activated, this circuit holds the Terminal in a "busy" condition. $\overline{\text{TBUSY}}$ goes active low when the $\overline{\text{COUNT IN PROG}}$ signal from the Top-of-Page Detect circuit goes low. This action prevents the reception of data when the Register is counting down to the Home position. This circuit also contains a strappable option that works in conjunction with the MARG signal from the Y Counter. In the event the User wishes to view a full page of alphanumeric data, the hardware strap on TC-2 can be installed to make $\overline{\text{TBUSY}}$ go active when spacing past the last line of type. To clear the condition the User must send the $\overline{\text{PAGE}}$ signal by pressing the PAGE key on the keyboard, or $\overline{\text{HOME}}$ by pressing the Reset key, or by sending control characters ESC and FF.

Margin Shifter. For the Margin Shifter circuit to function, the junction strap in the Terminal Busy circuit must be installed in the position that does not give an active $\overline{\text{TBUSY}}$ signal when MARG goes high. Margin 1 is set in the following manner. When in the Alpha Mode, both $\overline{\text{GIN}}$ and $\overline{\text{GRAF}}$ will be inactive. This allows an inactive $\overline{\text{GRAPHICS}}$ signal to be input to the Margin Shifter circuit. When MARG goes high (when spacing past the bottom line of type of the display screen), and a carriage return has zeroed the X Register, MARG and $\overline{\text{GRAPHICS}}$ combine to put a high on the Most Significant Bit (512) input to the X Digital to Analog circuit. This enables the X D/A circuit to set a constant output voltage level that corresponds to the center of the Display Screen. Repeated Carriage Returns will not set the 512 bit low as long as the MARG and $\overline{\text{GRAPHICS}}$ signals are high. $\overline{\text{PAGE}}$ or $\overline{\text{HOME}}$ will inhibit Margin 1 by resetting the X and Y Registers to zero (the Y Register must be zeroed to set MARG inactive).

X and Y Digital to Analog (D/A) Circuits. These circuits convert the digital outputs of the Registers into their respective analog values. Both consist of a diode switching network. Depending upon the logic state of the Registers, the D/A circuits will cause a voltage change to occur on the outputs. Notice also, that the X and Y Matrix signals (X MAT, Y MAT) from the Character Generator in TC-1 are summed in their respective D/A circuit.

X and Y Filters. The outputs of the X & Y D/A Analog circuits are input to their respective filter. When operating in the Alpha or GIN Mode, $\overline{\text{NOLI}}$ (No Linear Interpolation) will be low. This allows the X and Y analog voltages to pass directly through the circuit to minibus pins M and P.

The Filter circuits are put in use when drawing vectors in the Graphic Plot Mode. When the Graphic Plot Mode is set, $\overline{\text{NOLI}}$ goes high, activating linear filters within the X and Y Filter circuits.

When $\overline{\text{LOXE}}$ simultaneously loads the 20 bits of data into the X and Y Registers, it causes an almost instantaneous change in voltage to occur at the outputs of the X and Y Digital to Analog circuits. This sudden change in voltage cannot be sent directly to the Display Amplifiers because the rate of change is non-linear. In other words, the vector drawn might be very fast at the start and very slow at the end; thus, hardly storing at the beginning and storing very bright at the end, or maybe even over-shooting the defined end point. The filter network overcomes these problems. It provides a linear rate of change in the X and Y output voltages to feed the Deflection Amplifier circuitry.

Data Multiplexer. The purpose of the Data Multiplexer is to place five bits (one byte) of data on to the minibus. There are 8 different bytes of data that the Multiplexer will place on the minibus. These include the Keyboard bits (b1-b5), Terminal Status Bits, High Order X bits, Low Order X bits, High Order Y bits, Low Order Y bits, Carriage Return bits, and End of Text (EOT) bits. The type of byte being placed on the minibus depends on the state of the 0–7 State Counter circuit.

When data is being sent from the Keyboard the 0–7 State Counter will be in its "0" state. This causes the 5 least significant bits of the keyboard character to pass directly through the Multiplexer and onto the minibus lines. Thus, for this type of operation it acts as a Keyboard to minibus interface. Keyboard data cannot be placed onto the minibus lines until the DATA ENABLE signal from the Strobe Logic circuit goes high. This happens when KSTROBE goes high. (More will be explained about KSTROBE in the description of the Data Logic circuit.) The other types of data bytes are used in the Graphic Input Mode and will be covered in the descriptions of circuits to follow.

$\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ are placed on the minibus through a special gating network labeled BITS 6 and 7 Gating. When data is being sent from the Keyboard, the Step Counter will be in State 0. This state allows the gating circuit to place the complements of keyboard Bits 6 and 7 on the minibus when the DATA ENABLE signal goes high as previously explained. BIT 8 is not used in the 4010 logic. During the transmission of the graphic input data, the State Counter outputs sets $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ low.

Strobe Logic. This circuit mainly controls the various strobe signals associated with Terminal and/or computer operation. $\overline{\text{CSTROBE}}$ is generated when data is destined for computer use. $\overline{\text{TSTROBE}}$ is generated when data is destined for Terminal use. $\overline{\text{ECHO}}$, which is usually held to ground by a hardwire strap on the Interface card, will enable $\overline{\text{TSTROBE}}$ when sending data to the computer in Line operation, thus providing a local copy on the screen of data sent to the computer. $\overline{\text{LOCAL}}$ originates from the Local Line switch on the Keyboard. It directs input sources to assert $\overline{\text{TSTROBE}}$ to provide a screen display of Keyboard data when operating in Local.

KSTROBE goes active high when data is entered from the keyboard. It is used to generate the $\overline{\text{TSTROBE}}$ and $\overline{\text{CSTROBE}}$ signals that route data to its destination. For example, if operating in Local, $\overline{\text{LOCAL}}$ will be active low, directing the Strobe Logic circuit to generate $\overline{\text{TSTROBE}}$; thus the Keyboard data is routed only for Terminal use and not for use by the computer. If operation is Line, $\overline{\text{KSTROBE}}$ directs the Strobe Logic circuit to generate $\overline{\text{CSTROBE}}$; thus routing the Data bits to the computer (if $\overline{\text{ECHO}}$ is low, $\overline{\text{TSTROBE}}$ is also generated). When entering data from the Keyboard, each time $\overline{\text{TSTROBE}}$ or $\overline{\text{CSTROBE}}$ is generated, the DATA ENABLE signal must go high to allow the Data Multiplexer to place the five Keyboard bits onto the minibus.

$\overline{\text{KLOCK}}$ is normally held high on the minibus. Should the User ever have need to inhibit the Keyboard, pulling $\overline{\text{KLOCK}}$ low will prevent KSTROBE from affecting the Strobe Logic circuit, thus providing a Keyboard lock.

$\overline{\text{CPUNT}}$ is asserted by the Interface Card to prepare the Terminal for data reception from the computer. $\overline{\text{DRBUSY}}$ is asserted by the Hard Copy Unit, inhibiting the Strobe Logic circuitry until it has completed making a copy of the display.

BITS 6 and 7 Logic. When sending data from the Keyboard, this circuit places the complements of Keyboard bits (b6 and b7) onto their respective minibus lines. When operating in the Graphic Input Mode, coding signals from the State Decoder set $\overline{\text{BIT 6}}$ and $\overline{\text{BIT 7}}$ low.

Z Control. This circuit is used only in Graph Mode while drawing vectors. It is then enabled by a high $\overline{\text{NOLI}}$ signal. When $\overline{\text{LOXE}}$ initiates a vector, the circuit becomes armed and a 10 μs delay is initiated. If the vector being drawn is less than approximately one-half inch, the three clock pulses (307 kHz, 153 kHz, and 77 kHz) combine to hold $\overline{\text{CGZSUP}}$ low for 11.4 μs out of every 13 μs. The 1.6 μs pulses generated while $\overline{\text{CGZSUP}}$ is high cause dots to be written on the screen. These dots are close enough together to appear as a continuous line. If the vector being drawn is more than approximately one-half inch long, the X D/A or Y D/A signal is large enough to reset the circuit before the 10 μs delay elapses, preventing $\overline{\text{CGZSUP}}$ from going low. The beam is then permitted to be left on during vector drawing.

Crosshair Generator. The Crosshair Generator contains the circuitry needed to generate the crosshair cursor. Its purpose is to reflect the digital equivalent of the X & Y Position Pots at the output of the X & Y Registers. The crosshair cursor is generated by alternately incrementing the X and Y Registers. This alternately sweeps the display beam left-to-right and top-to-bottom on the CRT.

The Crosshair Generator is activated when $\overline{\text{CURSE}}$ goes active. $\overline{\text{CURSE}}$ inputs to the Found circuit and sets $\overline{\text{FOUND}}$ high and FOUND low. $\overline{\text{FOUND}}$ enables the Clock circuit which begins sending CLOCK pulses to the Axis Switching and Switch Control circuits. The FOUND signal going low also causes the Strobe Logic circuit to output a low active $\overline{\text{GIN}}$ signal which inputs to U67B; thus, inhibiting the Top-of-Page Detect and Margin Shifter circuits. $\overline{\text{CURSE}}$ also presets the Axis Switching circuit to output a low going $\overline{\text{DOWN}}$ pulse each time the Q output of the Clock circuit pulses high. Each time the $\overline{\text{DOWN}}$ line pulses low, the Y register increments, causing the display beam to move down one tekpoint. With each beam movement, the 38 kHz STEP pulse causes an active $\overline{\text{Z}}$ signal from U309A (U44C on TC-2 boards with numbers 670-1729-04 and lower) to write (but not store) the point.

As the Y Register increments, moving the display beam downward, the output from the Y D/A circuit changes accordingly. It is monitored by the Y Comparator circuit in the Crosshair Generator. When the Y Register has incremented to the point where the voltage from the Y D/A equals, or slightly passes, the voltage from the Y Position Pot, the Y Comparator sends a low $\overline{\text{Y COIN}}$ signal to the Memory Gates. While the $\overline{\text{DOWN}}$ line is pulsing, the DOWN signal from the Axis Switching circuit to the Memory Gates is high. When $\overline{\text{Y COIN}}$ goes low, the Memory Gates output a low $\overline{\text{SET}}$ signal to the Switch Control circuit. FOR TC-2 BOARDS WITH NUMBERS 670-1729-04 AND LOWER, THE FOLLOWING OCCURS: The next $\overline{\text{Q}}$ CLOCK pulse clocks the low $\overline{\text{SET}}$ signal into the Switch Control circuit, causing the $\overline{\text{STEP INH}}$ signal to U67D to go low. This inhibits further STEP pulses that were activating $\overline{\text{DOWN}}$ and $\overline{\text{Z}}$ signals. On the next positive going Q CLOCK pulse, the $\overline{\text{SWITCH}}$ signal goes high. When the positive portion of the Q CLOCK pulse ends, the $\overline{\text{SWITCH}}$ signal goes low, putting a low on the DOWN line and a high on the RIGHT line. FOR TC-2 BOARDS WITH NUMBERS 670-1729-05 AND UP, THE FOLLOWING OCCURS: When $\overline{\text{Y COIN}}$ goes low, the Memory Gates output a low $\overline{\text{SET}}$ signal to the Switch Control Circuit. The next $\overline{\text{STEP}}$ pulse clocks the low set signal into the Switch Control circuit, which enables the $\overline{\text{INHIBIT}}$ signal. $\overline{\text{INHIBIT}}$ prevents further $\overline{\text{STEP}}$ signals from activating $\overline{\text{DOWN}}$ and $\overline{\text{Z}}$ signals. On the next positive-going STEP pulse, the $\overline{\text{SWITCH}}$ signal goes high. When the positive portion of the STEP signal ends, the $\overline{\text{SWITCH}}$ signal goes low, putting a low on the DOWN line and a high on the RIGHT line. THIS ENDS DIFFERENCES IN CIRCUIT OPERATION FOR THIS PARAGRAPH.

FOR TC-2 BOARD NUMBERS 670-1729-04 AND LOWER: The end of the high Q CLOCK pulse also causes the $\overline{\text{STEP INH}}$ signal to U67D to go high. Once again, U67D outputs STEP pulses to the Axis Switching circuit. This time the $\overline{\text{RIGHT}}$ line is being pulsed because of the high on the RIGHT line.

FOR TC-2 BOARD NUMBERS 670-1729-05 AND UP: The end of the high STEP pulse also causes the $\overline{\text{INHIBIT}}$ signal to U309A and Axis Switching circuit to go high. Once again U309A begins outputting active $\overline{\text{Z}}$ signals. Also, with $\overline{\text{INHIBIT}}$ high, the $\overline{\text{RIGHT}}$ line can be pulsed because of the high on the RIGHT line.

FOR TC-2 BOARD NUMBERS 670-1729-04 AND LOWER: With U67D enabled, the clock circuit sends out pulses through U67D to generate $\overline{\text{Z}}$ and $\overline{\text{RIGHT}}$ signals until the X Register reaches or slightly passes the value selected by the X Position Pot. When this happens, the output of the X Comparator goes low. With the RIGHT signal from the Axis Switching circuit high, the Memory Gates will output another low SET signal to the Switch Control circuit. This low permits the Crosshair Generator circuitry to switch from X to Y in a manner similar to that described for Y to X switching.

FOR TC-2 BOARD NUMBERS 670-1729-05 AND UP: With U309A enabled, STEP pulses the $\overline{\text{Z}}$ line until the X Register reaches or slightly passes the value selected by the X Position Pot.

Foldover. Each time the X Register counts through zero, the display beam must reposition to the left side of the screen. The Register can reset much faster than the display beam can be positioned to the left. Therefore, the counting sequence is interrupted for a short period of time to allow the beam to position to the left and stabilize. When the X Register reaches a count of 1023 the Margin Shifter circuit outputs a low $\overline{\text{EOL}}$ (End of Line) signal. This signal is felt by the Fold Pause circuit in the Crosshair Generator. $\overline{\text{EOL}}$ triggers a one-shot multi within the Fold Pause circuit, causing $\overline{\text{FPAUSE}}$ to go low for .5 ms. $\overline{\text{FPAUSE}}$ then inhibits the output of the Clock circuit, preventing further $\overline{\text{RIGHT}}$ pulses. After .5 ms $\overline{\text{FPAUSE}}$ ends and the X Register continues to increment.

No pause is needed in the foldover of the Y Register. This is because when the Y Register sets back to zero, the display beam is positioned off-screen. By the time the Y Register increments enough to bring the display beam in view, it has had adequate time to stabilize.

The above operation of the Crosshair Generator continues until the mode is changed or until the 0 to 7 State Counter is incremented to respond to a Keyboard signal (Header Character) or an $\overline{\text{INQUIRE}}$ signal.

Multiplexer Control and Digitization. The Crosshair Generator reflects the digital equivalent of the X and Y Position Pots at the outputs of the X and Y Registers. The process of obtaining the digital equivalent of the position Pot voltages and sending this to the Computer in digital form is known as "digitization". Digitization occurs in a set sequence that is controlled by the Multiplexer Control circuit.

NOTE

The MARG signal must be inactive, otherwise digitization will not occur. This prevents a "page full condition" (terminal busy) when switching back to the Alpha mode.

To begin with, assume that the crosshair cursor is running as explained in the preceding description. The 0 to 7 State output is at State 0. When it is decided to send the point at which the crosshairs intersect, the user will strike a Keyboard key. This causes the Keyboard bits to be placed on the minibus by the Multiplexer and sent to the computer (see Fig. 6-7). When the computer has finished receiving the Keyboard data, $\overline{\text{CBUSY}}$ goes high, advancing the State Counter to State 1. When the Counter advances to State 1, the State Decoder circuit outputs a low on the STATE 0 line which inputs to the State Counter. With STATE 0 low, the State Counter will be able to advance one count each time $\overline{\text{CBUSY}}$ goes inactive (high).

The STATE 0 signal in conjunction with the 614 kHz timing signal will next cause a $\overline{\text{PREP}}$ signal to be sent to the Strobe Logic circuit. This causes the $\overline{\text{GO DIGITIZE}}$ signal to go low. The next time the Crosshair Generator reaches

DATA MULTIPLEXER TRUTH TABLE

The X is irrelevent when used to indicate an output.

STATE 4 C Pin 11	STATE 2 B Pin 10	STATE 1 A Pin 9	Keyboard Bit D0 Pin 4	Terminal Status Bit D1 Pin 3	HIX Bit D2 Pin 2	LOX Bit D3 Pin 1	HIY Bit D4 Pin 15	LOY Bit D5 Pin 14	CR Bit D6 Pin 13	EOT Bit D7 Pin 12	OUTPUT Y Pin 5
0	0	0	0	X	X	X	X	X	X	X	0
0	0	0	1	X	X	X	X	X	X	X	1
0	0	1	X	0	X	X	X	X	X	X	0
0	0	1	X	1	X	X	X	X	X	X	1
0	1	0	X	X	0	X	X	X	X	X	0
0	1	0	X	X	1	X	X	X	X	X	1
0	1	1	X	X	X	0	X	X	X	X	0
0	1	1	X	X	X	1	X	X	X	X	1
1	0	0	X	X	X	X	0	X	X	X	0
1	0	0	X	X	X	X	1	X	X	X	1
1	0	1	X	X	X	X	X	0	X	X	0
1	0	1	X	X	X	X	X	1	X	X	1
1	1	0	X	X	X	X	X	X	0	X	0
1	1	0	X	X	X	X	X	X	1	X	1
1	1	1	X	X	X	X	X	X	X	0	0
1	1	1	X	X	X	X	X	X	X	1	

Fig. 6-7. Data Multiplexer Truth Table.

coincidence, a $\overline{\text{PTFOUND}}$ signal is sent to the Found circuit. This causes $\overline{\text{FOUND}}$ to go low, inhibiting the output of the Clock and stopping the count at the Coincidence Point. The outputs of the X and Y Registers then reflect the digital equivalent of the voltage selected by the Position Pots. The low going $\overline{\text{PT FOUND}}$ signal also causes STATE 2 ADVANCE to go low, advancing the State Counter to State 2.

With the PREP signal and the FOUND signals now high, $\overline{\text{CSTROBE}}$ and DATA ENABLE from the Strobe Logic circuit will activate. When DATA ENABLE goes high, the Multiplexer will sample the 5 most significant bits (High Order X) of the X Register and send them along with BIT 6 and $\overline{\text{BIT 7}}$ coded by the Bit 6 & 7 Logic circuit) to the computer. When the bits are received by the computer, $\overline{\text{CBUSY}}$ once again goes high, advancing the State Counter to State 3. In turn, the Low Order X, High Order Y and Low Order Y bits are sent to the computer. The State Counter has now advanced to State 5. At this point it can either return to State 0 or send the Carriage Return (CR) bits and/or the End of Text (EOT) bits. This action is dependent upon the placing of the Option Straps.

The computer can request the coordinates of the crosshair cursor independent of the user. First it must send ESC plus SUB causing $\overline{\text{CURSE}}$ to go low to initiate the Crosshair Generator. The computer can then send ESC plus ENQ, causing $\overline{\text{INQUIRE}}$ to go low and the circuitry responds just as though $\overline{\text{CBUSY}}$ had been received after a Keyboard character was sent as previously described.

NOTE

A 20 millisecond delay must occur between ESC and SUB and the sending of ESC plus ENQ. This delay provides sufficient time for both X and Y coincidence to occur.

The computer can also request another form of Graphic Input data independent of the User. This is known as Terminal Status information. For example, when the computer sends ESC plus ENQ, $\overline{\text{INQUIRE}}$ goes low. This causes the State Counter to advance to State 1, sending the Terminal Status bits MARG, $\overline{\text{GRAF}}$, $\overline{\text{NOLI}}$, $\overline{\text{HCU}}$ and $\overline{\text{AUXSENSE}}$ to the computer. The circuitry then responds just as though $\overline{\text{CBUSY}}$ had just been received after a Keyboard character was sent as previously described.

DISPLAY UNIT

Display Unit Block Diagram Description

See the block diagram of the Display Unit (exclusive of Keyboard and hard copy consideration) in the pullout pages. The writing portion of the Display Unit consists of a High Voltage and Z Axis circuit, a Deflection Amplifier circuit, X and Y Deflection Coils, and the writing components of the CRT—namely the Cathode, Control Grid, and Focus Anode. The storage section consists of the Storage circuitry and the storage components of the CRT—the Flood Gun Cathode (FGC), the Flood Gun Anode (FGA), the Collimation Electrode (CE), and the Storage Backplate (STB). The writing portion of the display unit controls beam positioning and writing, while the storage portion controls and maintains the intensity of stored information.

Positioning information is received in the form of X and Y analog signals into the Deflection Amplifiers. These generate a positioning current in the X deflection coil and Y deflection coil, and also cause a DYNAMIC FOCUS signal to be sent to the High Voltage and Z Axis circuit. This DYNAMIC FOCUS signal is minimum for center screen positions, and maximum for edge positions. (Dynamic Focus is necessary because focusing is partially dependent on beam travel distance, and the beam must travel further in reaching the edges of the CRT than it does in reaching the center of the CRT.) The $\overline{\text{FUZZ}}$ signal is high during alphanumeric operation to provide uniform focusing throughout the CRT area. During Graphics operation, $\overline{\text{FUZZ}}$ goes low and permits optimum focusing of graphic vectors. The $\overline{\text{Z}}$ signals into the High Voltage and Z Axis circuit control the Grid Bias. The $\overline{\text{HCU INT}}$ signal modifies the CRT intensity to accommodate hard copy operation. Additional information regarding hard copy writing is available elsewhere in this section.

The storage circuitry responds to two input signals and provides the cathode-ray tube with four operating voltages. Assuming that $\overline{\text{PAGE}}$ and VIEW are both high, the Flood Gun Cathode continuously emits electrons which are accelerated by the Flood Gun Anode. These strike the Storage Backplate where they continuously reinforce the stored information. If no inputs are received by the Terminal for approximately 90 seconds, the signal goes low, causing the Flood Gun Anode voltage to drop to a level below that of the cathode. This reduces the flow of electrons from the Flood Gun Cathode and drops the CRT Intensity below viewing level.

The $\overline{\text{PAGE}}$ signal causes the CRT and Storage circuits to go through an Erase cycle. The four storage signals then cycle through a change in voltages which causes the CRT to become totally written and then to completely erase. A description of this cycle of operation follows.

HIGH-VOLTAGE AND Z AXIS CIRCUITS

Block Diagram Description. Refer to the block diagram of the high-voltage circuits. These circuits control the filament supply, the cathode supply, the control grid supply, and the focus supply for the writing gun of the CRT. A high voltage multivibrator drives a transformer to produce the various voltages required by the circuits. The multivibrator receives drive from one of the secondary windings and also receives biasing voltage for its control amplifier from a secondary winding. In addition, a high voltage feedback signal is applied to the multivibrator to keep the high voltage at a given value. CR71 and CR72 help to provide a −3850 cathode voltage supply, and filament voltage is obtained from a secondary winding of T50. The control grid circuit and filament circuit are both referenced to the −3850 power supply.

A tap from a secondary winding (which powers the high-voltage supply) sends additional voltage to the control-grid supply to enable it to provide a control-grid voltage which is more negative than the cathode voltage. The actual difference between the two is a function of the Intensity Control circuit and the Z Axis Signal Amplifier. If the $\overline{\text{HCU INT}}$ and $\overline{\text{Z}}$ signals are high, this difference is approximately 100 volts. When $\overline{\text{HCU INT}}$ is low, this difference increases to approximately 115 volts. When $\overline{\text{HCU INT}}$ is high and $\overline{\text{Z}}$ is low, this difference becomes approximately 50 volts, permitting stored writing to occur.

Another secondary winding of T50 provides the Focus Supply circuit with enough drive to develop negative high voltage for the focus anode. Focus Adjust permits optimum overall focusing. A dynamic focus amplifier works in conjunction with the high voltage focus supply. The DYNAMIC FOCUS signal compensates for defocusing due to the writing beam deflection from CRT center to CRT edge. There are two dynamic focus adjustments. Alpha Focus provides for uniform character focusing throughout the display area in Alphanumeric Mode. The Vector Focus adjustment permits optimum vector focusing, and is only effective during Vector Modes when $\overline{\text{FUZZ}}$ is low.

High-Voltage Oscillator. Refer to the High-Voltage schematic diagram. Oscillator Q101 provides current to the primary winding of T50. When current in this winding is increasing, a secondary winding provides positive voltage to the base of Q101. When Q101 collector current reaches Beta times its base drive, Q101 unsaturates and the primary winding voltage decreases. When the voltage at the base of Q101 becomes sufficiently low, Q101 stops conduction, causing a further decrease in the primary voltage. This causes a negative voltage to be applied to the base of Q101, driving this transistor further into cut-off. When C47 discharges sufficiently, the voltage at the collector of Q103 rises and the cycle repeats itself. The Q101 drive current is obtained by charging capacitor C47. However, part of the C47 charging current is also obtained from Q103. Therefore, changes in Q103 collector current affect the drive to Q101. Q103 current is controlled by a feedback from the high-voltage circuit, adjustable by R82.

High-Voltage Supply. Power for this supply is provided by the 8-13 winding. Voltage from this secondary is doubled by C70, CR71, CR72, and C72. The filtered −3850 volts is then applied to the cathode of the CRT. The unfiltered high voltage is connected through R67 and R68 to the two sides of the filament supply, elevating it to the proximity of the voltage on the cathode.

Control-Grid Supply. The −3850 cathode voltage is felt on C93, via CR94, R93, and R92. Assuming that pin 14 of the transformer is at zero volts, C93 charges to 3850 volts. With $\overline{\text{HCU INT}}$ high, the voltage at the wiper of R130 is at approximately +100 V. During one-half cycle of operation, pin 14 of T50 goes positive, with R130 limiting the bias signal to about +100 V at the R86-CR130 junction. This causes C93 to charge an additional 100 volts, ending up with approximately 3950 volts across it. Assume that $\overline{\text{HCU INT}}$ and $\overline{\text{Z}}$ are both high. The voltage at the top of DS154 is then at approximately +5 volts. When pin 14 of T50 swings negative, CR90 conducts and clamps the bias signal from going below +4.5 V. However, the 95 volt decrease on one side of C93 causes the other side to decrease by an equal amount. As the high voltage side of C93 goes negative to −3945, CR94 becomes back-biased. Since the low-voltage side of C91 is at approximately +5 volts, C91 now charges toward −3945 volts. With C91 charged to −3945 V, the CRT grid is placed 95 volts below the cathode voltage, blanking the writing beam.

Intensity Control Circuit. When the Hard Copy Unit is not in use, $\overline{\text{HCU INT}}$ is high, permitting Q35 to conduct. This places about 0.2 volt on the negative input of U119. U119 (a high-gain operational amplifier) and Q115 form a non-inverting voltage input feedback amplifier. Its +173 V output is set by the R104 current multiplied by the value of R105 resistance. With Q35 conducting, the Hard Copy Intensity adjustment ($\overline{\text{HCU INT}}$) has no effect.

The +173 volts from Q115 is applied to the Q37 circuit where approximately 100 volts is selected at the wiper of R130. (This is variable between approximately 55 and 145 volts due to CRT bias requirements.) This voltage is then used as mentioned in the Control Grid Supply description.

When a hard copy is commanded, the $\overline{\text{HCU INT}}$ line goes low, turning Q35 off. This causes the voltage at the negative input of U119 to go positive, depending on the setting of R103. The change in voltage at the negative input to U119 is matched at the U119 positive input, thus increasing current through R104. This current increase produces a higher voltage across R105, increasing the +173 V to a new level (not to exceed 213 V). This causes the voltage at the wiper of R130 to increase by the same amount. This increase permits C93 in the Control Grid Supply circuit to charge to a higher value when the bias signal at the CR130-R86 junction goes positive. With the voltage at the top of DS154 still +5 volts, C91 is permitted to increase its charge accordingly, increasing the voltage difference between the Control Grid and the cathode of the CRT. This increase in bias is necessary for hard copy operation.

When $\overline{\text{Z}}$ goes low to command the beam to write, the Beam writing voltage at the top of DS154 pulses to one of several different levels. These levels are dependent on the mode of operation. When operating in alpha, the voltage level is approximately 45 volts; when making a Hard Copy the level will be up to 8 volts above the alpha level. When operating in graph (vector plot) the voltage level is approximately 75 volts. The beam writing voltage at the top of DS154 is controlled by the base of voltage of Q99, and it is this voltage that is dependent upon the mode of operation.

When in Alpha Mode, $\overline{\text{FUZZ}}$ is low, switching Q98 on by way of CR117. With Q98 on, CR115 conducts, placing about 14.5 volts at the R117-R115 junction. This provides a biasing network for the base of Q99 that consists of R115-R114-R116. This combination provides Q99 with a bias voltage of about 45 volts.

When making a hard copy the $\overline{\text{HCU INT}}$ signal, by way of CR119, has similar effect upon voltage at the base of Q99. However, the voltage at the top of R114 increases because of the $\overline{\text{HCU INT}}$ signal through CR96. This causes the voltage at the base of Q99 to be as much as 8 volts above that caused by $\overline{\text{FUZZ}}$. The actual difference is determined by the setting of the Hard Copy Intensity control R103.

When in Graphic Plot mode ($\overline{\text{FUZZ}}$ is high) and a hard copy is not being made ($\overline{\text{HCU INT}}$ is high), Q98 is not conducting, thus preventing CR115 from conducting. This effectively deletes R115 as a biasing component for Q99. This allows the base potential for Q99 to be pulled up to about 75 volts.

Z Signal Amplifier Circuit. When $\overline{\text{Z}}$ is high, Q53 is turned on via bias network R140, R143, R144, R145 and R146. Q53's collector pulls down to about +6 V. Diode CR144 keeps Q53 from saturating for turn-off speed considerations. This is used as a reference voltage for the Control Grid Supply circuit as previously explained.

When $\overline{Z}$ goes low to command the beam to write, Q53 cuts off and its collector voltage rises toward +175 volts. However, the biasing voltage for the base of Q99 holds the emitter voltage of Q57 to either 45-53 or 75 volts, depending upon the mode of operation. When the collector of Q53 rises to the voltage value on the emitter of Q57, CR121 goes into conduction and holds the collector of Q53 at that value. This voltage now replaces the +5 volts that had been present at the top of DS154.

The change in voltage at the top of DS154 has an effect on the CRT Control Grid Bias. When the bias signal at the CR130-R86 junction drops to approximately 50 volts, CR90 goes into conduction and holds it at that value rather than permitting it to go to +5 V as before. The voltage swing at the CR90-C93 junction is therefore limited to +50 volts. In addition, since the low-voltage side follows suit, this decreases the voltage difference between grid and cathode to approximately 50 volts, permitting information to be written on the CRT. L149 increases the switching action during writing time, by helping to overcome the capacitance inherent in the Control Grid circuit.

Focus Circuit. The Focus circuit is designed to provide optimum focusing in all modes of operation. The circuit consists of a floating Focus High-Voltage Power Supply, Alpha and Vector Focusing adjust circuits, a Constant Current circuit, an Operational Amplifier, and a grounded-base amplifier used as a logic switch.

Operation of the circuit during Alphanumeric Mode with the cursor in a corner of the CRT will be explained first. Under this circumstance approximately 8 volts of focus correction signal is received at the DYNAMIC FOCUS input. Since this 8 volts is applied to voltage divider R25 and R26, it causes approximately 0 volts at the negative input of amplifier U157. U157 drives Q153 until the Q153 collector voltage is sufficiently positive to drive the positive input of U157 to a point of balance with the negative input. With the positive input at 0 volts, no current flows through R21 or R20. In Alphanumeric Mode $\overline{\text{FUZZ}}$ is low, turning Q137 off. This enables Vector Focus Adjust R10. Constant current circuit Q135 causes 0.3 milliampere to enter the circuit through the Q135 collector. The 0.3 mA is the only current flowing through feedback resistor R22, setting the R22-R35 junction (via feedback operation) to 150 volts. Approximately 150 volts is therefore felt at the emitter of Q151, providing a reference voltage for one side of the floating Focus High Voltage Power Supply. The Focus High Voltage Power Supply generates approximately −3850 volts, just as the cathode circuit high voltage winding does. A portion of this voltage is picked off by the Focus Adjust potentiometer and applied to the Focus Grid of the CRT. Note that with Q137 cut off and 0 volts on both sides of R20, neither the Vector Focus or the Alpha Focus has any control; focusing is totally dependent upon the position of R64 for CRT corner focus.

When the beam is moved to the center of the CRT while in Alphanumeric Mode, the Dynamic Focus voltage returns to approximately 0. The R25, R26 voltage divider applies approximately −5 volts to the negative input of U157. This causes U157 to drive Q153 until its collector is sufficiently low to permit the positive input of U157 to reach the value present on the negative input—approximately −5 volts. With the Alpha Focus potentiometer near midrange, R20 and R21 now demand approximately 0.08 mA of current. With 0.3 mA available from Q135, this leaves approximately 0.22 mA available to flow through R22, indicating that the collector of Q153 must be at approximately +105 volts. The focus reference voltage at the emitter of Q151 is therefore approximately +105 volts. Since current now is flowing through R20, the Alpha Focus control is effective and can be made to set the Q151 voltage to any value between approximately 85 and 115 volts, thereby controlling the focusing of the display near center of the CRT.

When Graphics Mode is selected, $\overline{\text{FUZZ}}$ goes high and turns Q139 off. This causes Q137 to act as an effective short circuit enabling the Vector Focus potentiometer. As with the Alpha Focus control, Vector Focus R10 only has effect on the display when the CRT beam is not located at any of the extreme corners of the CRT.

In summary, the circuit allows R64 (Focus Adjust) to adjust for good corner focus, R20 (Alpha Focus) to adjust for best alphanumeric focus when $\overline{\text{FUZZ}}$ is low, and R10 (Vector Focus) to adjust for best center screen focus when $\overline{\text{FUZZ}}$ is high.

Miscellaneous Components. A number of neon lamps appear in various parts of the high voltage circuit. These lamps are intended primarily as arc protection devices. At any time a radical change occurs in the voltage of any section of the high voltage circuit, these lamps fire and cause the remainder of the circuitry to stay electrically close together to avoid breakdown between the circuits.

DEFLECTION AMPLIFIER DESCRIPTION

General

The Deflection Amplifier circuit uses the X and Y analog voltages and amplifies them to provide the drive signals to the X and Y deflection coils. This circuit also generates a dynamic focus signal which is used in the high-voltage circuit.

Block Diagram Description

Refer to the Deflection Amp block diagram. The circuits making up the deflection amplifiers are the X Absolute Value Amplifier, the Y Absolute Value Amplifier, the X^2 and Y^2 circuits, the $X^2 + Y^2$ Amplifier, the X Geometry Multiplier, the Y Geometry Multiplier, the X Deflection Amplifier, and the Y Deflection Amplifier.

The X and Y signals are each applied to three circuits within the deflection amplifiers. The X signal goes to the X Absolute Value Amplifier to generate a positive output signal regardless of the polarity of the X Input signal. Then it is squared and applied to the $X^2 + Y^2$ Amplifier. Here it is combined with the positive signal from the Y^2 circuit to develop the Dynamic Focus signal which goes to the X Geometry Multiplier and the Y Geometry Multiplier, as well as going to the high voltage circuits. The X input signal is also applied to the X Geometry Multiplier circuit, where it combines with the Dynamic Focus signal to generate an X Geometry signal. The X signal, X Geometry signal and a Feedback signal from the X Deflection Amplifier combine at the summation point at the input to the X Deflection Amplifier. The output of the X Deflection Amplifier provides the drive for the X Deflection coil. The Y Deflection Amplifier circuit functions in a similar manner.

Detailed Description

Refer to the Deflection Amplifier schematic.

Because of the similarity between the X circuitry and the Y circuitry, only the X circuits will be explained here. The X absolute value amplifier consists of two operational amplifiers, each of which has one input referenced to ground. If a negative signal is applied, U87A develops a positive-going output which back-biases CR64 and forward-biases CR65, permitting the signal to be felt at the emitter and base of Q85. The negative signal is simultaneously applied to the positive input of U87B, causing its output to go negative. CR68 becomes back-biased, preventing the signal from affecting the output. CR67 becomes forward-biased, permitting feedback to pin 6 to offset the input signal. If the X input goes positive, U87B develops a positive output, forward-biasing CR68 and transmitting the signal to Q85. The positive applied to U87A causes its output to go negative, back biasing CR65 and forward biasing CR64, holding pin 2 at ground potential.

X^2 amplifier Q85 is cut off under no-signal conditions. Positive voltages applied to R73 cause the transistor to conduct. However, the same positive voltage being applied to R73 is also applied to the R70-R71 voltage divider. This causes the current through one side of Q85 to be less than the current through the side which has its base grounded. The output signals taken from the collectors of Q85 are then approximately equal to the square of the input voltage. They combine with the signals from Q69 in the Y^2 Amplifier, with the resultant signal being applied to the push-pull inputs of U105. U105 develops an $X^2 + Y^2$ output which it applies to the emitter of Q65. Q65 has a portion of the X input signal applied to the base of one-half of the transistor, causing outputs at the collectors of Q65 which are approximately equal to $KX(X^2 + Y^2)$. These are applied to push-pull amplifier U65, developing an output signal which is used as geometry correction. A portion of this is picked off by R93 and applied through R94 to the summation point at pin 3 of U45. Here it combines with the X signal from R100, the positioning signal from R96, and the Feedback signal from R115. U45 responds by developing an in-phase output signal which drives pin 2 of U45 to a value equal to that at pin 3. Q47 amplifies and inverts the output of U45, applying it to complementary emitter-followers Q5 and Q7.

Under no-signal conditions, the R111-R112 junction is at zero volts, resulting in no current through the X Deflection coil. If U45 outputs a negative voltage, Q47 develops a positive at its collector which is felt through the emitters of Q5 and Q7. The R111-R112 junction goes positive, causing electron flow up through the coil. If the pin 6 output of U45 goes positive, Q47 delivers a negative through the base-emitter junctions of Q5 and Q7, causing electron flow down through the X Deflection coil. Q67 provides relatively constant current to Q47 to optimize its operation.

It should be noted that operational amplifier U45 is located within the encompassing operational amplifier which includes inverter Q47, emitter-followers Q5 and Q7, and the feedback network which includes R117. Although the summation point is the positive input of operational amplifier U45, inverter Q47 causes the summation point to be the negative input of the total X Deflection Amplifier.

STORAGE CIRCUITS

Block Diagram Description. Refer to the block diagram of the storage circuits. The circuit controls the storage and erasure of data on the face of the CRT. The storage circuit consists of the following sections: The Fade Positive Multivibrator, the Erase Multivibrator, Storage Backplate Amplifier, Collimation Electrode Control, Collimation Electrode Amplifier, and View Control.

With $\overline{\text{PAGE}}$ high and low the output voltages are at the levels shown in the waveform diagram (on the same page as the storage block diagram). When a VIEW signal is received, the anode voltage goes positive, permitting stored information to become bright enough for viewing on the CRT. Data can then be written.

When a $\overline{\text{PAGE}}$ signal arrives, it causes the CRT face to become flooded, causing storage to occur over the entire screen. Immediately following this, the voltage is lowered to a point where all stored data erases. The sequence which causes this starts with the low going $\overline{\text{PAGE}}$ signal arriving at the Fade Positive Multivibrator. This causes a 12 millisecond low pulse to go to the View Control circuit, causing the anode and cathode to decrease their voltage by approximately 100 volts as shown in the waveform diagram. Simultaneously, the Fade Positive Multivibrator applies a 12 millisecond high pulse to the Collimation Electrode Control circuit where it initiates a negative-going $\overline{\text{DR BUSY}}$ signal. $\overline{\text{DR BUSY}}$ is applied to the Fade Positive Multivibrator to disable it until the erase cycle is completed. The 12 ms high pulse also causes the Collimation Electrode Amplifier to generate a 12 millisecond positive-going pulse on the Collimation Electrode Line.

When the 12 millisecond pulses from the Fade Positive Multivibrator end, the anode and cathode voltages from the View Control Circuit return to their quiescent value. The negative transmission into the Erase Multivibrator causes a signal to return to the Fade Positive Multivibrator, reinforcing the $\overline{\text{DR BUSY}}$ signal which prevents $\overline{\text{PAGE}}$ signals from entering. In addition, this signal from the Erase Multivibrator goes to the Collimation Electrode Control to sustain the $\overline{\text{DR BUSY}}$ signal and to change the Collimation Electrode Voltage to a value below that which occurs at quiescence. At the same time, the Erase Multivibrator causes the Storage Backplate Amplifier to drive the Storage Backplate Voltage to zero, from where it rises exponentially toward its previous voltage.

The signal from the Erase Multivibrator ends after approximately 700 milliseconds, causing the Collimation Electrode Control to set the Collimation Electrode Voltage positive for 12 milliseconds. When this 12 millisecond period expires, all voltages return to their quiescent levels.

Refer to the waveform diagram. The positive-going Collimation Electrode Voltage and the negative-going voltage on the Floodgun Anode and Cathode together cause flooding of the CRT Faceplate, providing uniform storage over the entire area. After the 12 millisecond pulses elapse, the collimation electrode returns to a value lower than quiescence to prevent any storing to occur until the end of the cycle. At the same time that the voltage pulses end, the Storage Backplate Voltage goes to zero to erase the face of the CRT. 700 milliseconds later the Storage Backplate Voltage has returned to normal, the Collimation Electrode Voltage returns to normal, and the $\overline{\text{DR BUSY}}$ signal returns high, indicating that erasing has been completed.

Detailed Description. Refer to the schematic of the Storage circuit. The Erase Multivibrator and Storage Backplate Control Amplifier (which determine the backplate voltage) will be discussed first. Under quiescent conditions, −15 volts is applied through R212, R211, and CR211 to hold Q35 in conduction. This causes Q55 to be in conduction with approximately −15 volts on its collector. The voltage at the R211, R212 junction is approximately −2.4 volts, causing C210 to charge approximately 12.5 volts. The base of Q57 is held at approximately −1.2 volts by the Q35 base-to-emitter junction and by CR211. This holds the emitter of Q57 at −1.8 volts, which holds the emitter of Q58 at −1.2 volts. Referring to Q39, it can be seen that its emitter holds its base at approximately +0.6 volt, holding the base of Q19 at zero volts. 1.2 volts thus exists between the emitter of Q58 and the base of Q19. With the Op Level control at mid-position, about 1/3 of a milliampere flows between the emitter of Q58 and the base of Q19. Very little of this passes through the Q19 base-emitter junction, leaving the majority of it to flow through R223. Multiplying this 1/3 milliampere by the R223 value (499 kΩ) provides approximately +180 volts at the emitter of Q95. The Q19, Q39, Q93, and Q95 circuit serves as a driver amplifier to sustain this voltage. The +180 volts at the emitter of Q95 is felt at the Storage Backplate Anode of the CRT.

After $\overline{\text{PAGE}}$ has been applied to U93 and the 12 millisecond multivibrator pulse expires, the negative transition is felt through C247 into Q55, turning this transistor off. Its collector goes toward zero volts. Since C210 has a 12.5 volt charge on it, the right side of this capacitor goes positive and the capacitor attempts to discharge through R210 and R212. The C210-R212 junction rises to approximately 12 volts and turns Q35 off. With Q35 cut off, its collector goes towards −15 volts, holding Q55 cut off. The positive voltage at the CR211-R211 junction is felt through the base-emitter circuit of Q57 and the emitter-base circuit of Q58. The positive potential at the emitter of Q58 causes zero volts to appear at the R219, R220 junction. With zero volts at the base of Q19, no current is demanded through

R222, and therefore none flows through R223. This causes the operational amplifier to place a zero volt output on the Storage Backplate (STB) anode.

During the next 700 ms, C210 discharges exponentially, changing the voltage being applied to the base of Q57. The STB voltage changes toward 180 V. After approximately 700 milliseconds, C210 discharges to the point where the voltage at the cathode of CR211 drops to about −1 volt, causing it and Q35 to go back into conduction. When this happens, the Storage Backplate voltage has been returned to its quiescent level. With Q35 in conduction, Q55 goes back into conduction, permitting C210 to again charge to its quiescent value.

Note that while Q35 is conducting, Q75 is held in conduction and places a low at pin 13 of U33F. This holds an enabling high on pin 5 of U93. However, during the 700 ns erase pulse, Q35 is cut off, holding Q75 cut off. The high Q75 collector voltage causes U33F to place a low on pin 5 of U93, blocking $\overline{\text{PAGE}}$ pulses until erasing has been completed.

The Collimation Electrode circuit will be discussed next. Under quiescent conditions, both inputs to U13D are low, placing a low at Pin 8 of U13C. This same low is felt at Pin 5 of U13B and is applied to R267. The low of R267 causes a high out of U33D. The U13B output remains low, causing a second low to be applied to U13C. The U13C output is therefore high, holding Q33 cut off. With Q33 cut off, its collector circuit delivers about one third of a milliampere of current to the null point at the base of Q77 in the Collimation Electrode Amplifier.

Since both inputs to U13A are low, U13A causes a low out of U33C, causing Q115 to be turned on. This holds about −0.2 V on its collector, delivering about 0.3 mA to the null point at Q77. In addition, R268 current flows into this point and is equal to about 0.25 mA. The combined currents flowing through R283 cause the output of the operational amplifier to be at approximately 80 volts.

When $\overline{\text{PAGE}}$ is received and the Pin 6 output of U93 goes high, U13D, U33A and U33D cause $\overline{\text{DR BUSY}}$ to occur. This is routed back to disable U93 so that no additional $\overline{\text{PAGE}}$ signals can affect the circuit until the erase cycle ends. Highs appear at the Pin 8 input of U13C and Pin 2 input of U13A. This causes Q33 to turn on and Q115 to turn off. The emitter circuit of Q33 now delivers about 0.13 mA, while the Q115 circuit delivers approximately 1.25 mA to the base of Q77. Again, this current combines with that from R268 and flows through R270, causing the output of Q97 to reach approximately 200 volts, which is applied to the Collimation Electrode of the CRT. When the 12 millisecond pulse from U93 expires, the high is removed from Pin 2 of U13A, causing Q115 to go into conduction. Since Q75 (in the Erase Multivibrator circuit) delivers a high to Pin 11 of U13D, a high is maintained on Pin 8 of U13C, holding Q33 in conduction. With both transistors in conduction, Q33 delivers about 0.13 mA while Q115 delivers about .03 mA. These combine with the .25 mA from R268. The current through R270 causes the Collimation Electrode Voltage to drop to approximately 30 volts.

This situation continues until the 700 ms erase period ends and Q75 is again put in conduction. At this time, Pin 11 of U13D goes low, applying a low at Pin 8 of U13C and Pin 5 of U13B. The low from the collector of Q75 is also applied to U107, which delivers a 12 millisecond pulse to Pin 6 of U13B. With lows on Pin 5 and Pin 6, U13B places a high on U13C and U13A. This causes Q33 to go into conduction and Q115 to turn off. The Collimation Electrode Voltage now rises to approximately 200 volts where it remains until U107 ends its 12 millisecond pulse. Then a high is placed at Pin 6 of U13B, putting a low into U13A and U13C. The outputs of these two devices return high, causing Q33 to turn off and Q115 to conduct. This restores the Collimation Electrode to its quiescent operating value of approximately 80 volts.

Note that the U13D output was low throughout the time the high 12 milliseconds pulse was being emitted by Pin 6 of U93, and during the time that Q75 was cut off. This causes U33A to apply a high to R267, charging C267. The resulting low from U33D held $\overline{\text{DR BUSY}}$ low, indicating that the CRT was erasing. In addition, when the collector of U75 went low, it caused U107 to create a 12 millisecond pulse which extended the low $\overline{\text{DR BUSY}}$ signal by that amount.

Notice that the $\overline{\text{WAIT}}$ signal inputs to the positive input of U93 and also holds the pin 6 input of U13B low. $\overline{\text{WAIT}}$ originates from the Hard Copy Unit (from those Hard Copy Units equipped with the Multiplexer option) and is used here to prevent an erase function during the time $\overline{\text{WAIT}}$ is active. (See the description of the $\overline{\text{WAIT}}$ signal in the Detailed Circuit Description of the Hard Copy Circuits.)

The View Control circuit quiescently holds the Flood Gun Cathode at approximately zero volts and the anode at about 150 volts. A voltage divider in the base of Q99 includes diode CR289, which conducts to hold the cathode near zero volts. Zener diode VR292 conducts to raise the voltage at the base of Q99 to approximately +150 volts. This is felt through the base-to-emitter circuit of Q99, where it is applied to the anode of the flood guns. Since U93 (in the Fade Positive Multivibrator) has its Pin 1 high under quiescent conditions, U33B delivers a low to the base of Q117, holding that transistor cut off. Zener diode VR287 conducts and causes +100 volts to be placed on the left plate of C288. With the anode of CR289 very near ground potential, C288 charges to approximately 100 volts.

When a $\overline{\text{PAGE}}$ signal is received, Pin 1 of U93 goes low, causing U33B to deliver a high to the base of Q117. This transistor conducts and places the left plate of C288 near ground potential. With the left plate going negative by 100 V, the right plate is driven negative by an equal amount, placing a —100 V signal on the cathode of the flood guns. Since VR292 is still conducting, the voltage on the base of Q99 drops to +50 V. The cathode of Q99 and the CRT flood gun anode are thus caused to change in step with the CRT cathode voltage. After the 12 ms pulse from U93 elapses, the voltages return to their previous levels, 0 and +150 volts.

Under viewing conditions, the VIEW signal is high, holding Q135 cut off, which holds Q137 cut off and permits the just described situation to exist. However, when the viewing period has elapsed and the VIEW signal goes low, Q135 goes into conduction, causing Q137 to conduct. This back-biases CR291 and places approximately —15 volts on the base of Q99. The Q99 cathode voltage and flood gun anode voltage drop to about —15.6 V turning the flood gun off and dropping the CRT intensity below viewing level.

HARD COPY CIRCUITS

Block Diagram Description. If the Terminal is equipped with Hard Copy option, the circuitry shown in the Hard Copy Block Diagram is incorporated. Its overall purpose is to provide the Hard Copy Unit with a command for initiating a hard copy and then supplying the Hard Copy Unit with writing information, coincident with data stored on the CRT.

Whenever the Hard Copy Unit is attached and energized, a $\overline{\text{HCU}}$ signal is presented to the Terminal to advise of its availability. Whenever a $\overline{\text{MAKE COPY}}$ signal is initiated at the Display Unit, or is initiated by an ESC ETB sequence from the computer, the $\overline{\text{MAKE COPY}}$ command is applied to the Hard Copy Unit where it causes several outputs. A $\overline{\text{READ}}$ signal and a $\overline{\text{WAIT}}$ signal are applied to the Terminal to indicate that a hard copy is being made. This causes the Terminal to generate a $\overline{\text{DR BUSY}}$ signal to disable Keyboard and computer inputs to the Terminal. The Terminal also generates an $\overline{\text{HCU INT}}$ signal to modify the cathode and control grid voltages of the Display Unit writing circuits. $\overline{\text{READ}}$ causes the Deflection circuits to select X and Y inputs from the Hard Copy Unit rather than from the Terminal circuits. In addition, the $\overline{\text{READ}}$ signal places enabling voltages on the Z circuit and the TARSIG circuits within the Deflection Amplifier and Storage board.

The Hard Copy Unit provides a positive-going slow ramp to the Y Deflection circuits in the Terminal to cause the Terminal to sweep vertically one time. As it sweeps, a succession of fast ramps is supplied to the X Deflection circuits. This causes repetitive horizontal sweeps during the vertical sweep. The ramp signals are supplied to the readout circuits in the Hard Copy Unit at the same time they are being provided to the Terminal, permitting both units to be evaluating the same point on the display.

During each fast ramp, the Hard Copy Unit supplies repetitive $\overline{\text{INTERROGATE}}$ signals to the Terminal. These cause $\overline{\text{Z}}$ signals to be sent from the Deflection Amp and Storage board to the High Voltage and Z axis board in the Display Unit. There they cause a change in the writing gun control grid voltage, turning the writing beam on. If writing exists on the storage backplate in the position indicated by the deflection coils, the resultant current in the storage backplate circuit causes a TARSIG signal to be generated on the Hard Copy TARSIG Amplifier board. This is sent to the Pedestal section where it is gated through by the $\overline{\text{READ}}$ signal. This results in $\overline{\text{TARSIG}}$ being sent to the Hard Copy Unit. The Hard Copy Unit then writes a point at the position commanded by the fast and slow ramps. When the slow ramp ends, Hard Copy operation is discontinued and all signal lines except $\overline{\text{HCU}}$ return to their inactive status. Control of the deflection circuit is returned to the X and Y signals from the Terminal.

Detailed Circuit Description. Refer to the Hard Copy Selector schematic. If the Terminal is not equipped for Hard Copy, the X and Y signals are routed through a strap to the X and Y Deflection Amplifiers and none of the Hard Copy Selector components are contained on the circuit board. When the Hard Copy circuitry is included, the X and Y straps are removed and the circuitry is as shown. The X and Y outputs are each the output of one of two amplifiers, as selected by the Q105-Q125 circuit.

With Hard Copy not selected, the $\overline{\text{READ}}$ signal is high, placing a high on the base of Q105. This causes Q125 to place lows at the CR9-CR10 and the CR29-CR30 junctions. CR9 and CR29 are forward biased, placing lows at the positive inputs of U3 and U43. Their outputs are driven sufficiently low to back-bias CR4 and CR24, disconnecting the amplifiers from the output circuit. At the same time, diodes CR10 and CR30 become back-biased, preventing Q125 from affecting either U23 or U63. This permits the X and Y signals to control the X and Y outputs to the deflection amplifier circuit. Each amplifier has a gain of one, since the full voltage outputs are felt at the negative inputs of the amplifiers.

When a Hard Copy is commanded, $\overline{\text{READ}}$ goes low, causing the emitter of Q125 to go high. This places highs at the negative input of U23 and U63, causing their outputs to go low. CR11 and CR31 become back-biased, preventing U23 and U63 from affecting the X and Y outputs. CR9 and CR29 are also reverse-biased, permitting the HCX ramp and HCY ramp to control the X and Y outputs to the Deflection Amplifiers. The output amplitudes can be controlled by adjusting R4 and R22, which determine the amount of voltage being presented to the amplifiers. J51 (located in the output circuit) permits the X and the Y Deflection Amplifiers to both be controlled by the Y signal. This permits simultaneous application of equal drive signals to both axis for calibration purposes.

The $\overline{\text{READ}}$ signal also controls U81D, U103, U101B, and U101C. When $\overline{\text{READ}}$ is high, the outputs of these circuits rest at their inactive state. When $\overline{\text{READ}}$ goes low, $\overline{\text{HC INT}}$ goes low, $\overline{\text{DR BUSY}}$ goes low, $\overline{\text{TARSIG}}$ is put under the control of the TARSIG input signal, while $\overline{\text{Z}}$ is placed under the control of $\overline{\text{INTERROGATE}}$. While $\overline{\text{READ}}$ is low, U83 causes a $\overline{\text{Z}}$ pulse (0.2 to 0.6 μs, variable) to occur in response to each $\overline{\text{INTERROGATE}}$ signal. When $\overline{\text{READ}}$ returns high, U103 places a 150 microsecond low on U81B, holding $\overline{\text{DR BUSY}}$ low for that additional period.

The $\overline{\text{WAIT}}$ signal is an input from the Hard Copy Unit (if the Hard Copy Unit is equiped with the Multiplexer option). When the Terminal issues a Make Copy request, the Hard Copy Unit responds back to the Terminal with the $\overline{\text{WAIT}}$ signal. $\overline{\text{WAIT}}$ is used to hold $\overline{\text{DR BUSY}}$ active until the Hard Copy Unit has completed making the copy. When the copy is completed $\overline{\text{WAIT}}$ and $\overline{\text{READ}}$ go inactive. $\overline{\text{READ going}}$ inactive causes U103 to fire, thus sustaining $\overline{\text{DR BUSY}}$ as explained in the preceding paragraph.

Refer to the Hard Copy TARSIG Amplifier schematic diagram. If the Terminal is not equipped with Hard Copy circuitry, T2 is connected directly to J2. With Hard Copy circuitry installed, T2 connects to J115 and J2 connects to J110. Inserting the Hard Copy TARSIG Amplifier board in the connector's path permits the STB current to be monitored. Since this current reflects whether a written or non-written area is being scanned, it provides information for the hard copy writing. Filtering is provided to the remaining T2-J2 lines to minimize circuit noise.

information for hard copy writing. Filtering is provided to the remaining T2-J2 lines to minimize circuit noise.

The storage backplate signals are coupled through T20 and applied to differential amplifier U5 which has a gain of approximately 400. Its output is amplified by approximately 10 in U45 and applied to comparator U65. U65 provides a negative output pulse in response to STB signals of an amplitude determined by threshold potentiometer R35. R35 permits the voltage at the positive input of U65 to be set between 0 and +2.3 volts. The U65 output pulses are applied to one-shot multivibrator U61, which responds by generating 20.4 μs (approximate) positive going TARSIG pulses.

LOW-VOLTAGE POWER SUPPLY

Refer to the Low-Voltage Power Supply schematic. This power supply has regulated outputs of −15 volts, +5 volts, and +15 volts. It also has unregulated outputs of −20 volts, +20 volts, +175 volts, +328 volts, and +503 volts.

The unregulated supplies will be discussed first. All of these except for +175 volts obtain their power from conventional, full-wave bridge rectifier circuits. The +175 volt supply uses a full wave center-tapped transformer configuration. The sources for the 503 volts, 328 volts, +175 volts and +20 volts are connected in series aiding, with each supply being referenced to the next lower supply. For example, three windings are in series to provide power for the +503 volt circuit. Two windings are connected in series to provide the power for the 328 volt output, etc.

Three fuses provide protection for the power supply circuits. F21 fuses the +15 volt and +20 volt supplies. F41 fuses the +5 volt supply and F61 fuses the −20 volt and −15 volt supplies.

Regulated Supplies

VR25 develops the 6.2 volts which is used as reference for the +15 volt and +5 volt supplies. A portion of this is picked off by R27 and is applied as reference to the positive inputs of U69 and U77. The regulated +15 volt output is applied through a voltage divider to the negative input of U69 to provide regulating drive to that amplifier. Outputs from U69 are applied through VR35 to Q29 to control the drive current to series regulator Q510.

The regulated +5 volts is applied through R44 to the negative input of U77. U77 compares this against the voltage at the positive input to generate a regulating output voltage, which is applied to Q75 to control the drive current to series regulator Q515. Q99 and Q97 provide the +5 volt circuits with over-voltage protection. Under normal conditions the +5 volts applied to the emitter of Q99 is insufficient to cause the device to conduct. If the +5 volt line should go as high as 5.5 to 7 volts, 1.2 volts at approximately 50 mA is applied to the gate of Q97. This causes Q97 to conduct, immediately lowering the +5 volt line to approximately 1 volt. The associated surge of current causes F41 to open up, removing power from the circuit.

The −15 Volt regulator uses ground for a reference at the input of U71. The negative input receives its signal from a comparison between the +15 volt supply and the −15 volt supply applied through voltage divider R57 and R58. Any deviations on the −15 volt line cause drive to U71 which provides a signal to the error amplifier Q73. This controls the drive to Q520, regulating the −15 volt supply.

HEAVY DUTY POWER SUPPLY

Refer to the H.D. Power Supply schematic 670-4216-00 and the drawing showing the component locations for the supply. This Heavy Duty supply may be used in place of the supply labeled "Low-Voltage Power Supply" to supply additional current for extra interface requirements.

When the instrument is equipped with the H.D. Power Supply, the power requirements will increase from a maximum of 192 to 235 watts. The shipping weight will increase about 5 pounds.

Line Voltage Straps

Power is supplied to the instrument from P500 through the power switch, fuse, filter, and line voltage straps to the transformer primary. The diagram is drawn showing the 100 to 120-volt strap plugged into the MED position for 115-volt $\pm10\%$ line voltage. For 200 to 240-volt operation, use the 200 to 240-volt strap plugged into the appropriate position as shown on the diagram instructions. See Fig. 6-8 for the proper strap configurations. Note that one 200 to 240-volt strap can be used with two configurations by changing one pin to the appropriate pin 8 or 9 position. The unused strap is stored nearby plugged onto two ground pins on the circuit board.

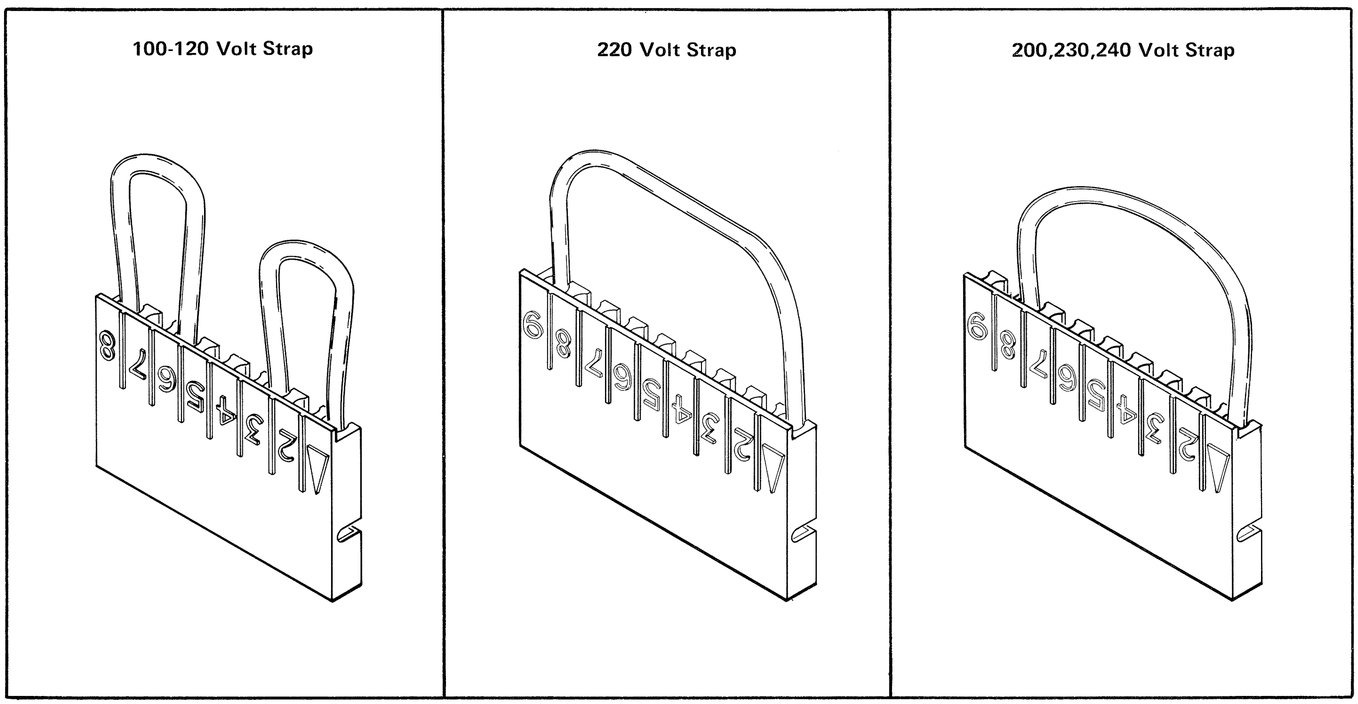


Fig. 6-8. Line Voltage Strap Configurations.

General Information

This supply has regulated outputs of −15, +5, and +15 volts. It also contains unregulated outputs of −20, +20, +175, and +328 volts. A regulated supply for the filaments in the CRT flood guns is referenced to the −20-volt unregulated supply.

Three fuses provide protection for the power supply circuits. F139 fuses the +15 and +20 volt supplies. F145 fuses the +5 volt supply and F135 fuses the −20 and −15 volt supplies.

Regulated Supplies

Voltage reference for the +15 and +5 volt regulated supplies is supplied by U175 and set by R27. The +15 volt regulated output supplies the voltage reference for the −15 volt supply. VR155, a 43-volt zener supplies reference for the CRT filament flood guns.

+15 Volt. U175 regulator drives Q178 to drive Q510 series pass transistor. Current limiting is provided by R177 and Q175.

U175 compares the +5-volt reference set by R27 and the +5 volts (from the +15-volt output through divider resistors R172 and R174). U175 output at pin 11 drives Q178 to drive Q510 to regulate the +15-volt output.

Supply current through R177 is limited to about 1.2 Amperes when the voltage across R177 turns on Q175 to turn off Q178.

+5 Volt. Regulation is accomplished by U170, Q65, Q270, and Q515. Current limiting and foldback functions add Q155, Q55, and Q61. For overvoltage protection, a crowbar circuit is used consisting of Q75 and Q80.

U170 compares the +5 volts reference set by R27 to the +5 volt supply voltage (+5-volt Sense, or if not used to the +5-volt supply output through R79). R72, C68, and CR69 are active on power up to prevent overshoot of the +5 volts. U170 output is amplified by Q65 and Q270 to drive the series pass transistor Q515.

Q155, VR158, and R157 form a constant current source which supplies current to the emitters of dual transistor Q55. Q55 forms a differential pair to sense the supply current through the current sense resistor R45. R156 sets the current (set at the factory for 10.6 A), at which current limiting begins. When an over-current condition occurs (above the condition set by R156), the output of Q55 causes Q61 to conduct and reduce the conduction of Q65 to lower the supply voltage. A further increase in supply current will result in a decrease in the supply voltage to a point of "foldback" (in the case of a short on the supply). The minimum output current of the supply for foldback is about 3 A, and is set by CR161 and CR165 biasing Q55.

The crowbar circuit is adjusted by R50 for 4.8 volts at the base of Q75. If the supply voltage exceeds 5.5 volts, Q75 turns on to turn on the crowbar SCR Q80 which pulls the +5 volts supply down to about 1 volt. Once the crowbar SCR is turned on, the power must be turned off and back on to release the SCR Q80.

−15 Volt. Variations in the −15-volt supply are monitored by the R272/274 divider resistors and cause U270 to regulate the −15-volt supply through Q275, Q278, and the series pass transistor Q520. Current limiting is provided by Q165 and current sense resistor R167. Q165 starts current limiting the supply at about 1.2 Amps and reduces the conduction of Q275, Q278, and Q520 to lower the output voltage.

Flood Gun Filaments. The regulated supply for the flood gun filaments is set by VR155 (a 43-volt Zener) and referenced to the −20 V unregulated supply. Q161 and Q265 regulate the filaments voltage with one end of the filaments connected to −20 V unregulated.

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors = Ohms (Ω).

Symbols used on the diagrams comply with USA Standard Y32.2-1970.

Logic symbology complies with ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:

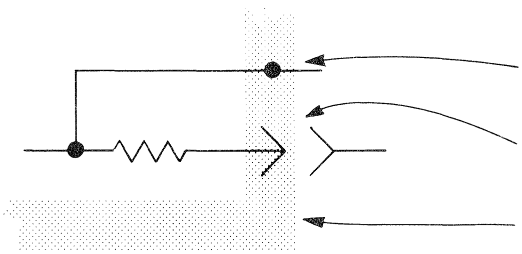

Screwdriver adjustment.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.


Square-pin contacts for strap option contacts and off-board plug connectors.

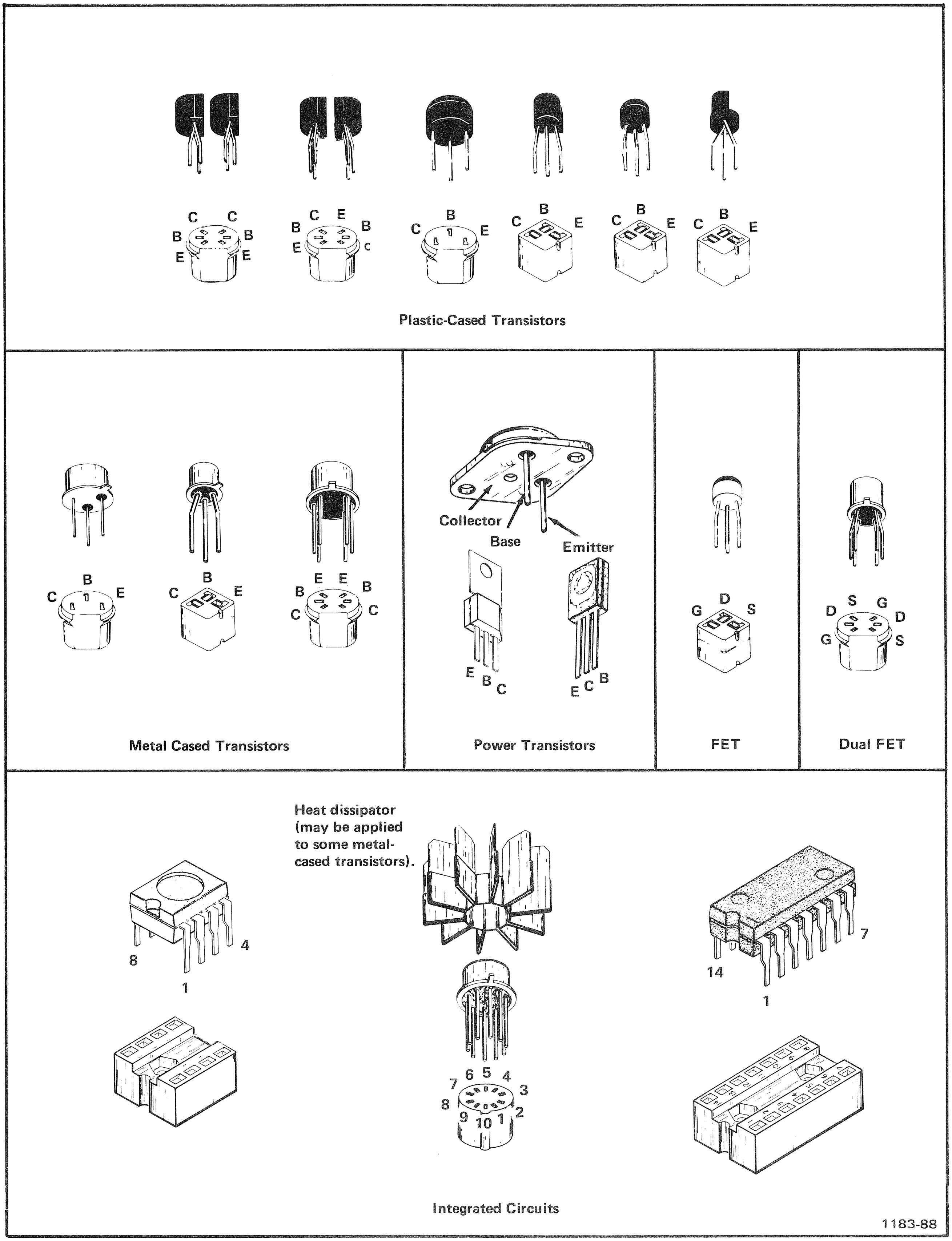

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

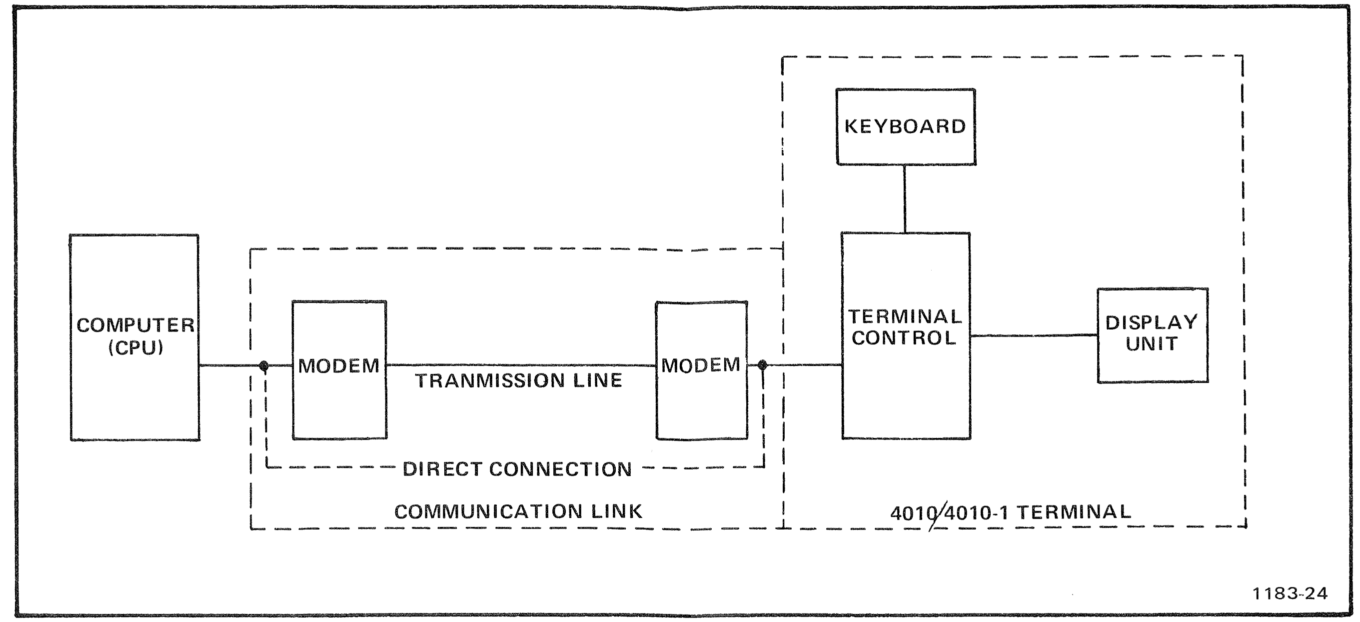
Tint encloses components located on circuit board.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

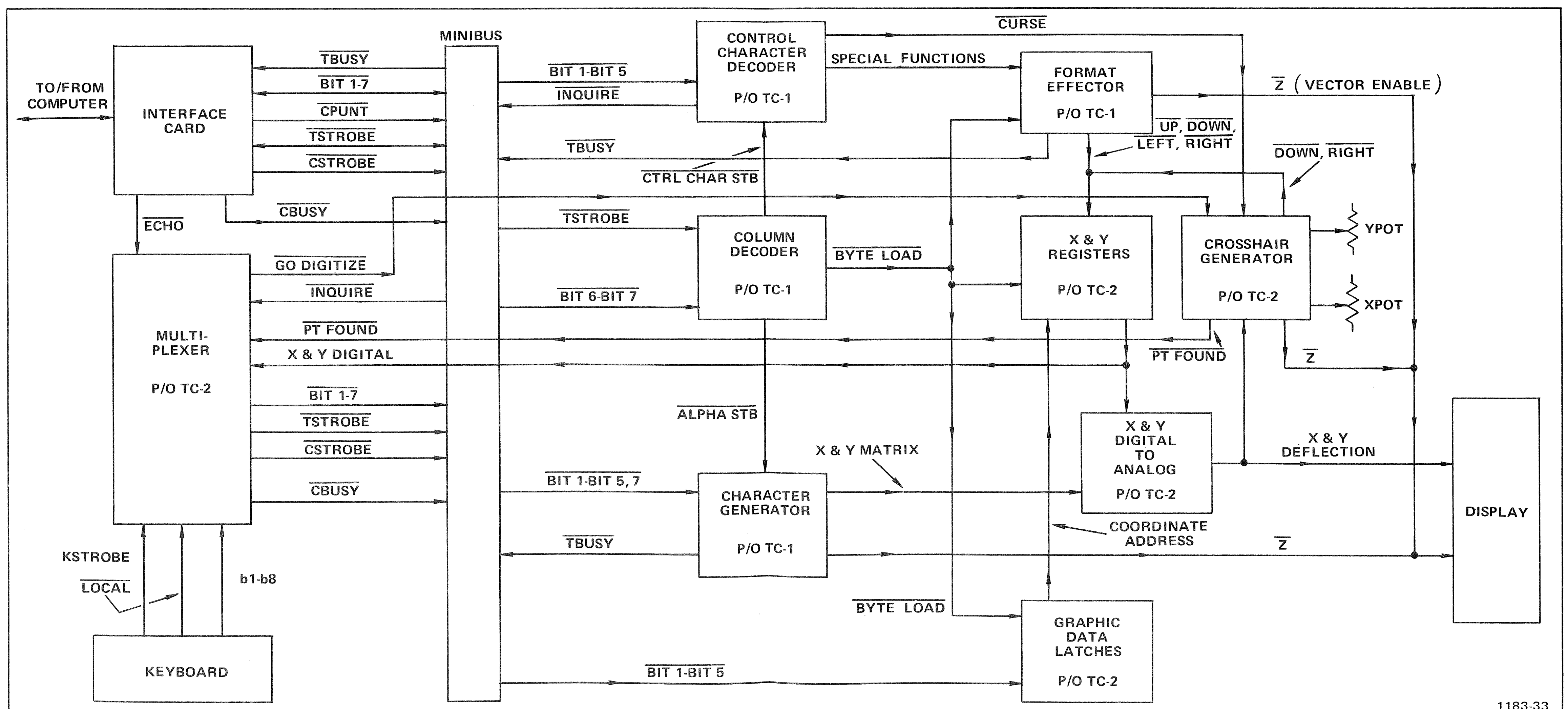
A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal



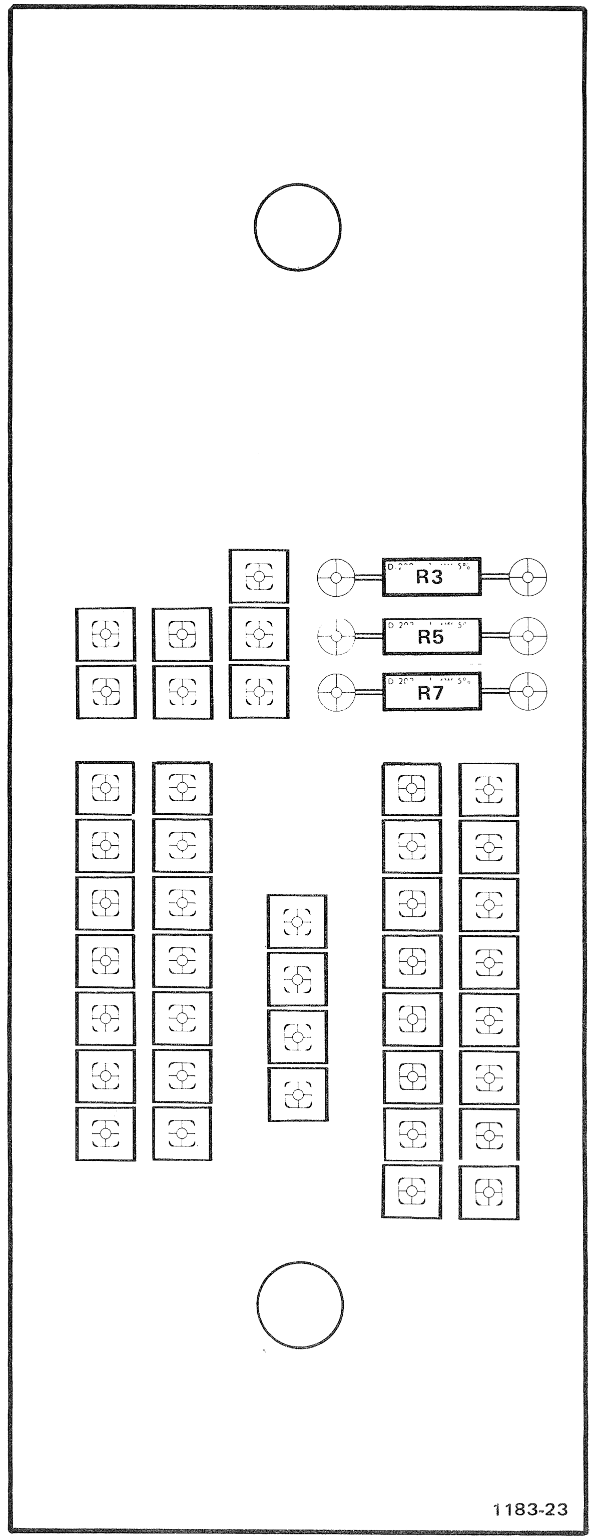
SEMICONDUCTOR INFORMATION



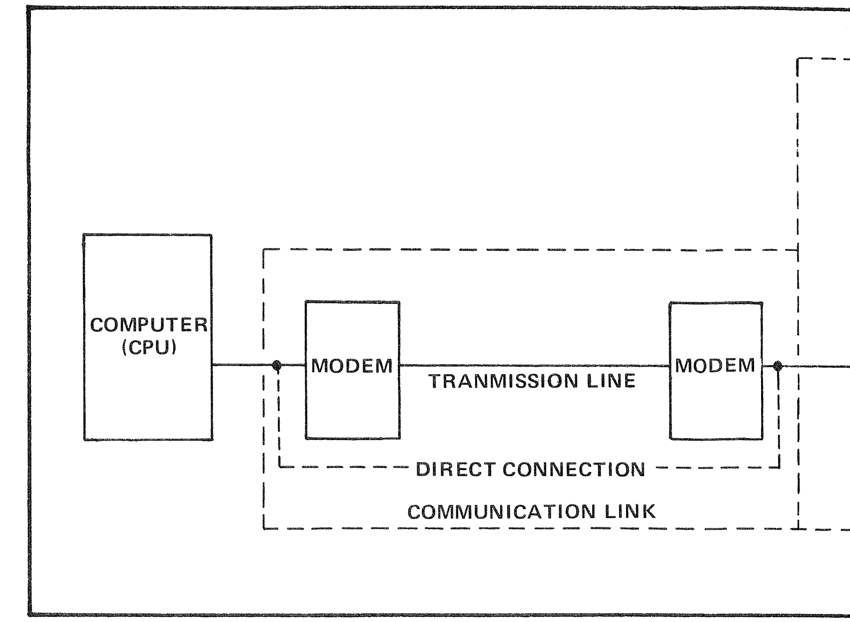
Terminal/Computer Communications Block Diagram.



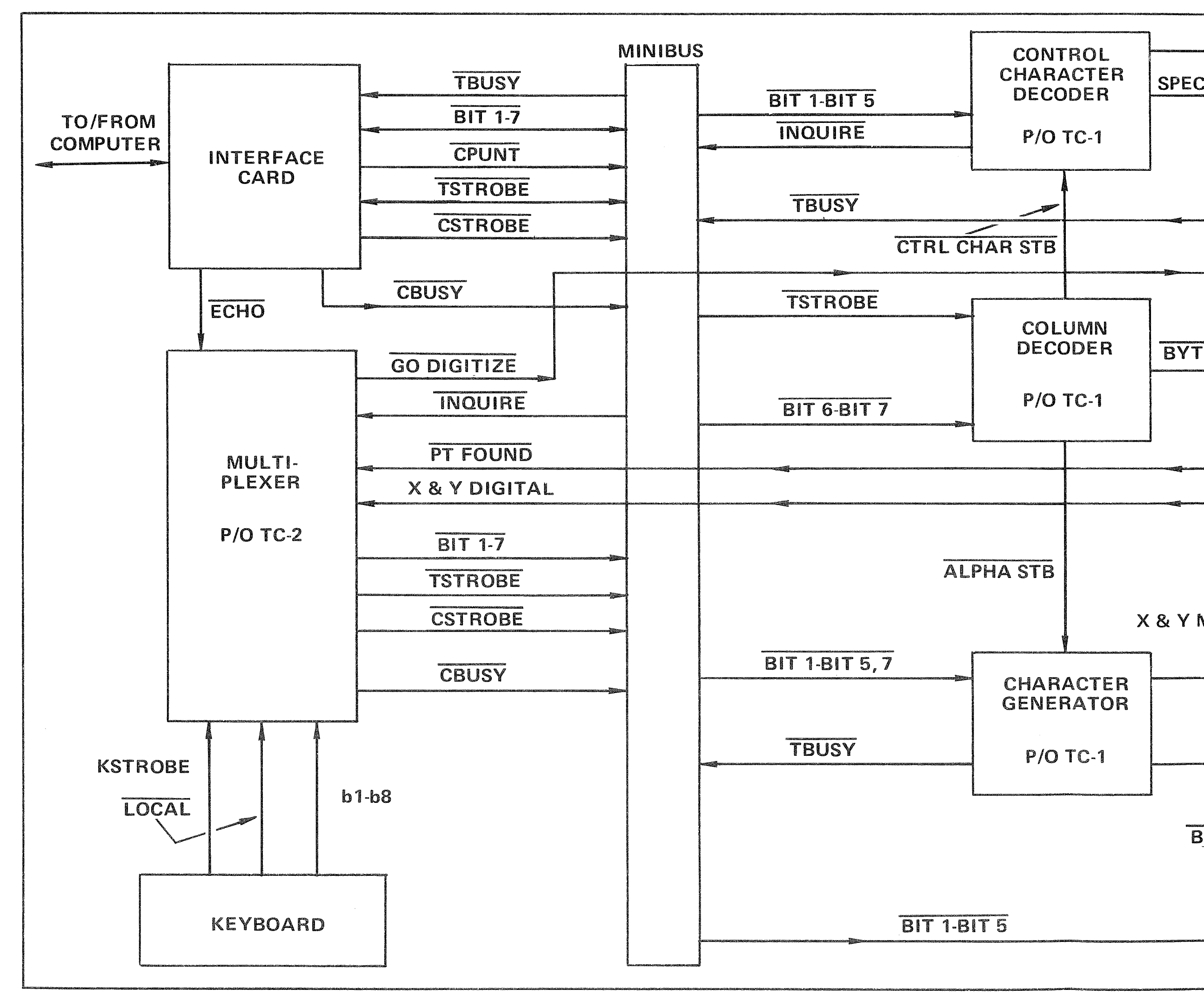
Terminal Data Flow Block Diagram.



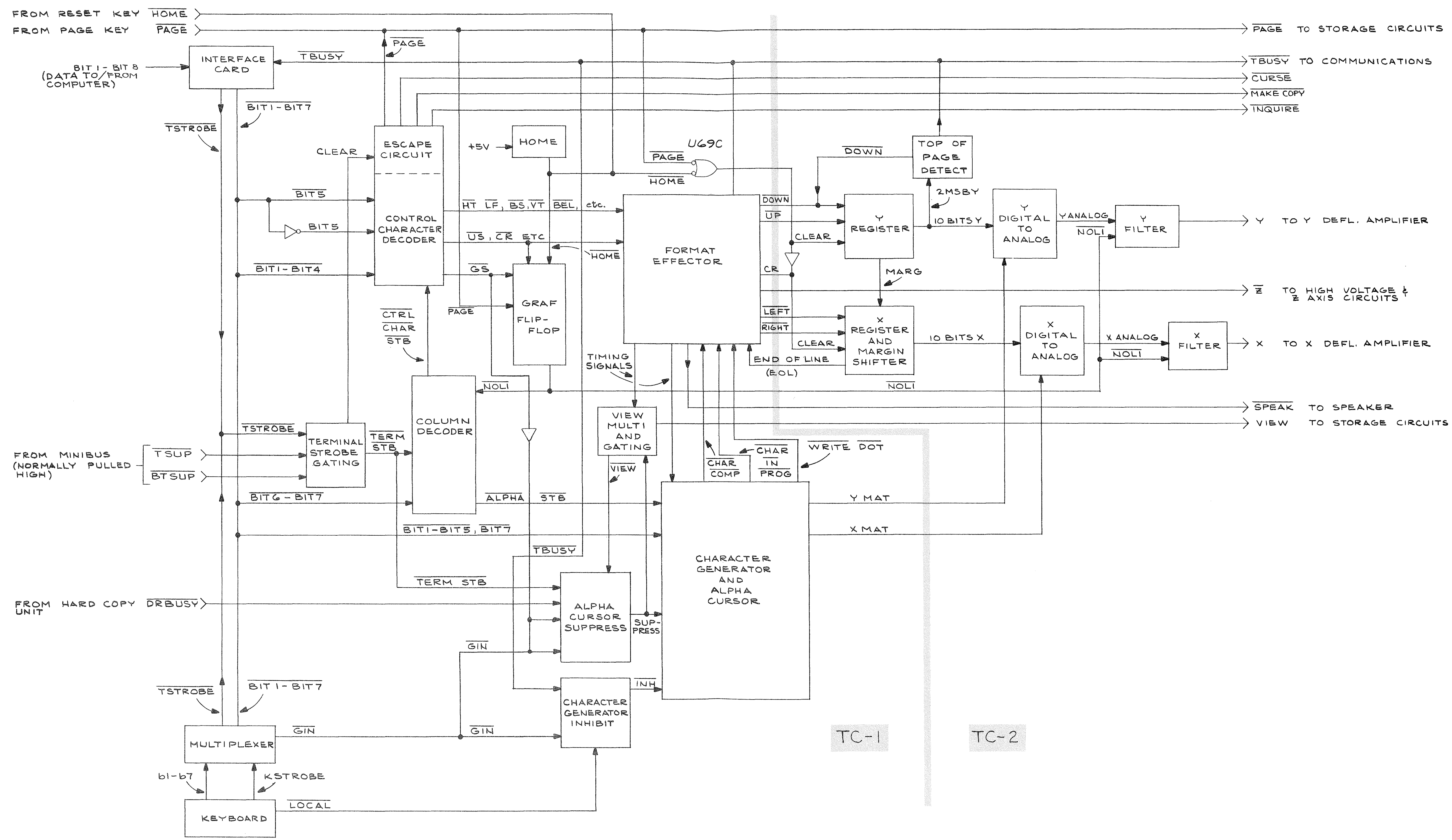
Display Interconnect Board Component Location.



Terminal/Computer Communications Blo



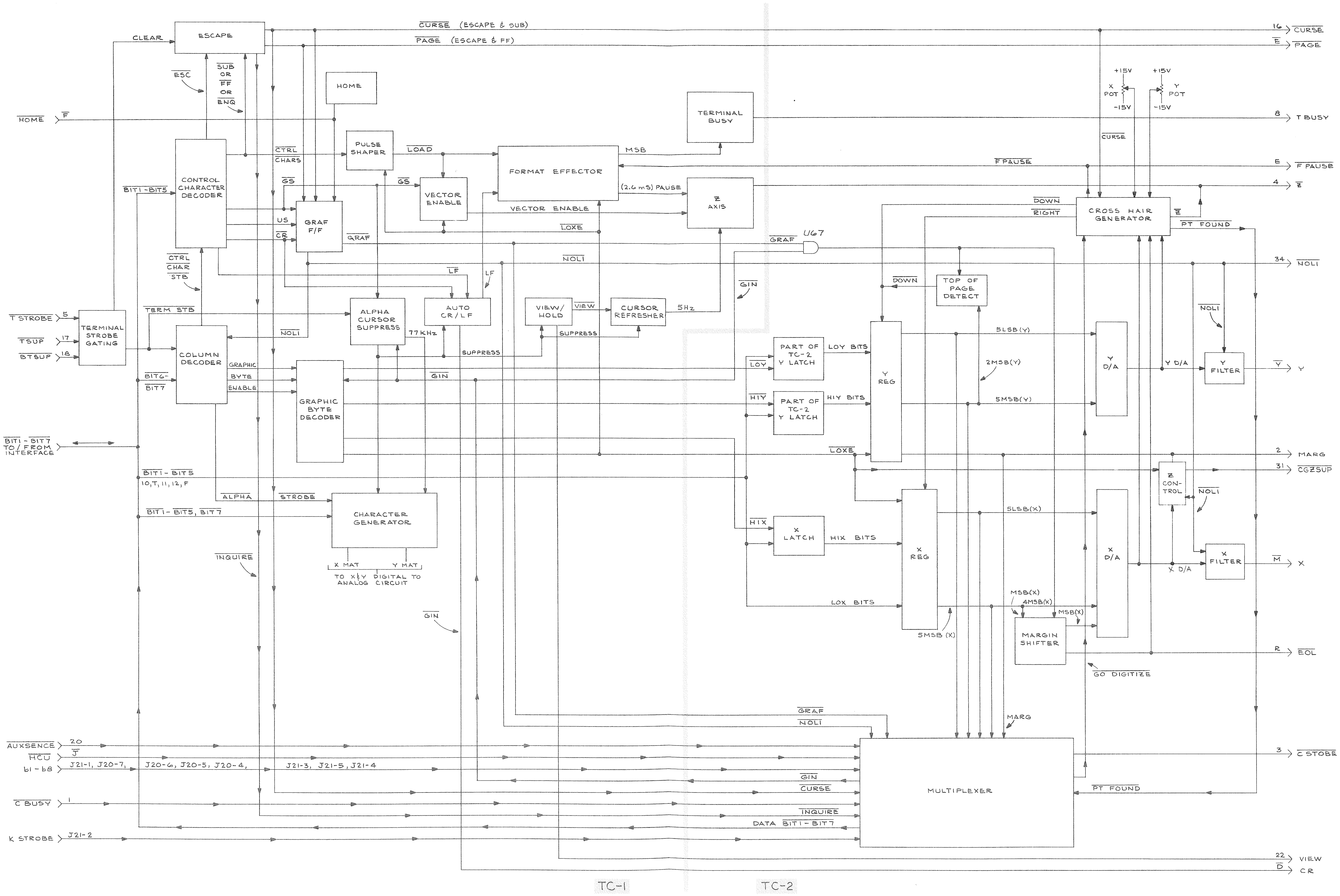
Terminal Data Flow Block Dia



REV. C, APRIL 1976
1183-53

ALPHA MODE BLOCK DIAGRAM 372 RH

ALPHA MODE BLOCK DIAGRAM

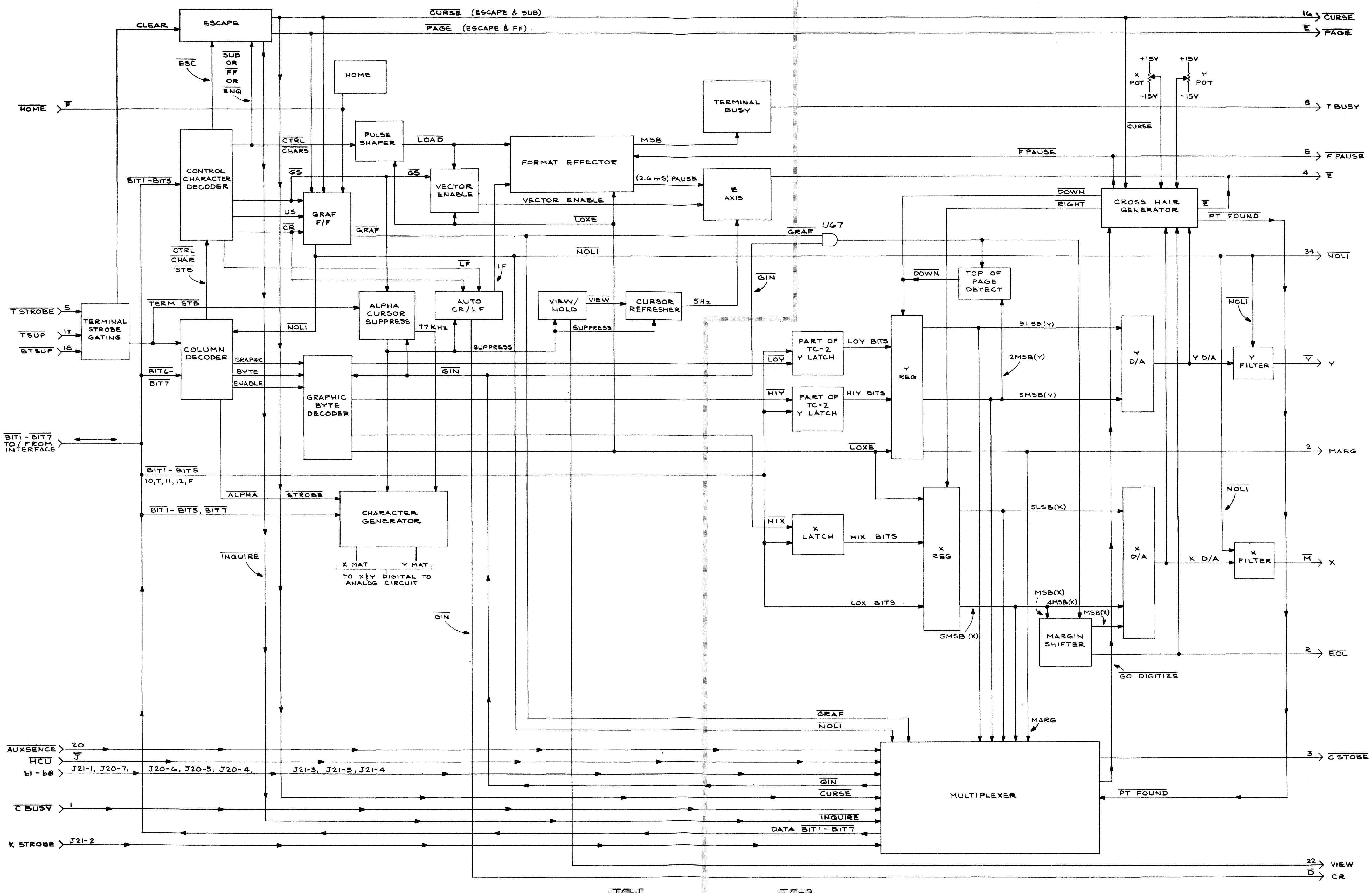


4010/4010-1

REV B, APRIL 1976
1183-55

670-1729-04 & UP GRAPHIC MODES BLOCK DIAGRAM RH

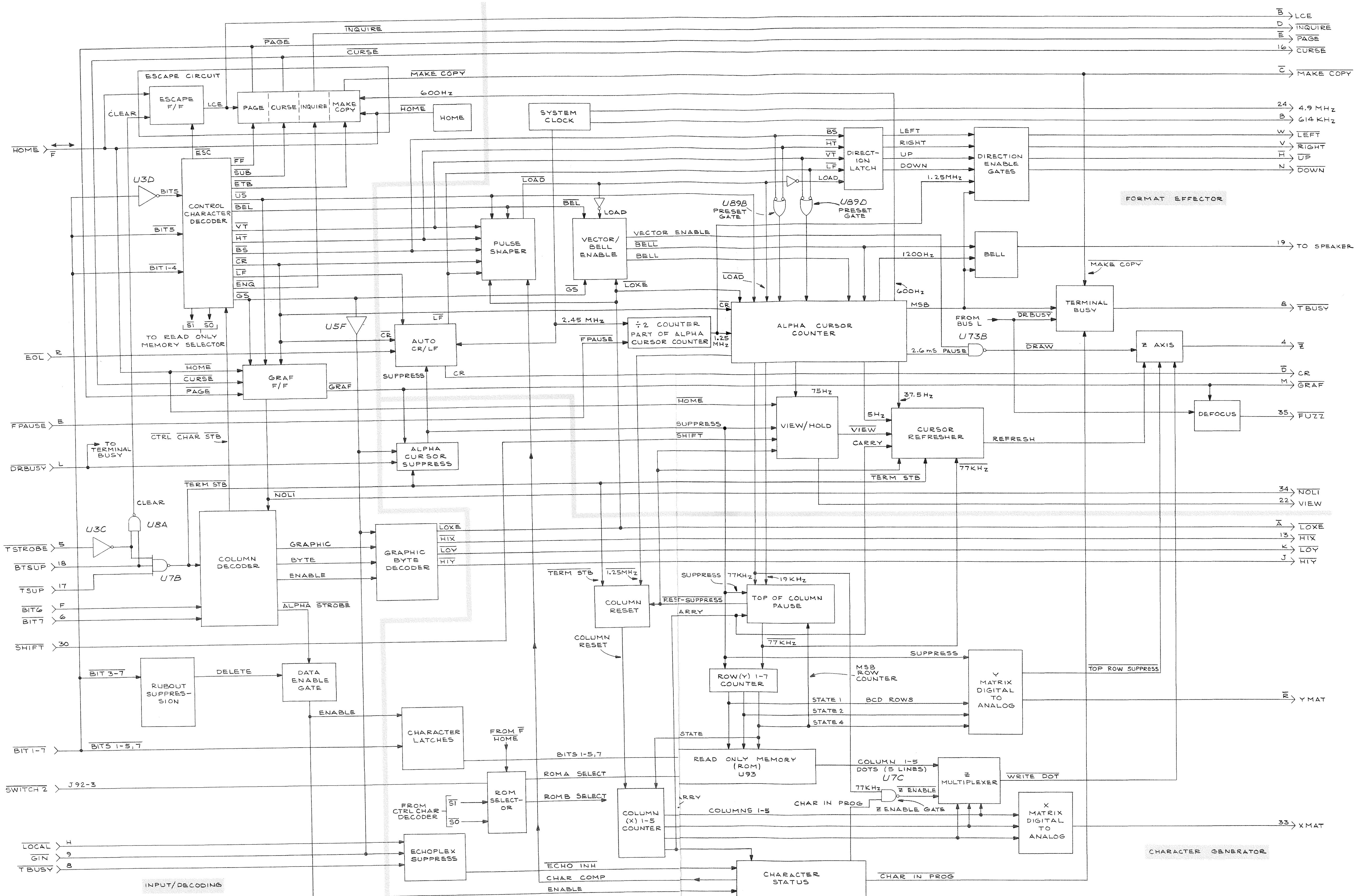
GRAPHIC MODES BLOCK
670-1729-04 & UP



4010/4010-1

REV. C, APRIL 1976
1183-54

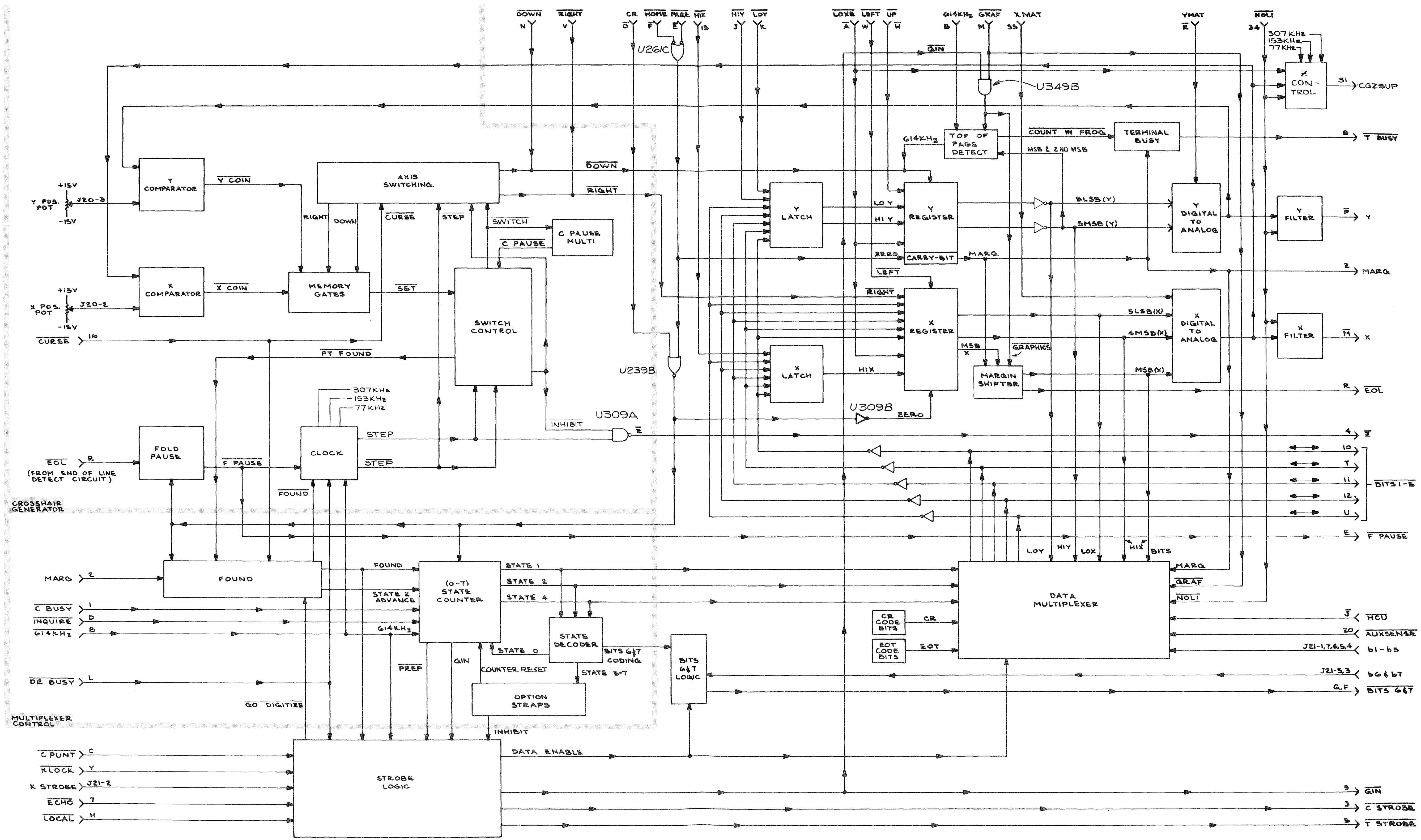
670-1729-03 & BELOW GRAPHIC MODES BLOCK DIAGRAM R.H.



4010/4010-1

REV. B, APRIL 1
1183-57

TC-1 DETAILED BLOCK DIAGRAM

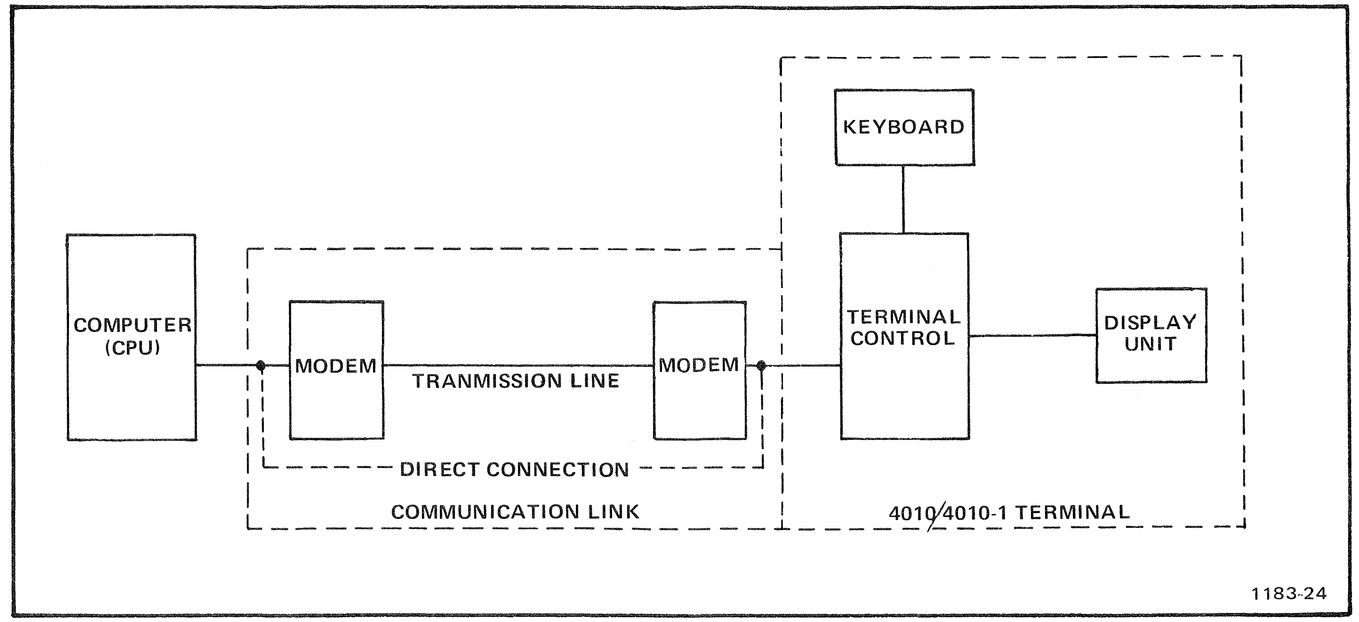


4010/4010-1

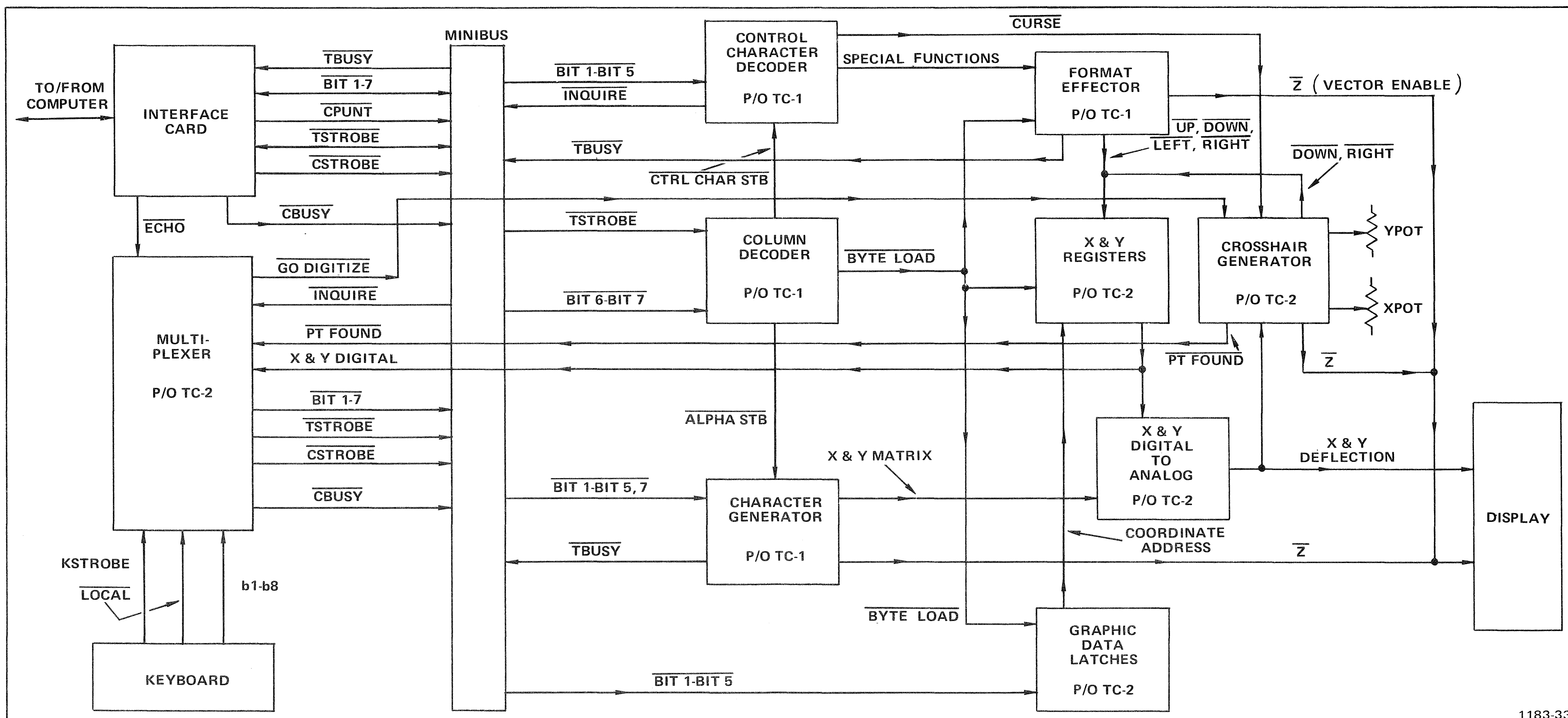
REV. C, APRIL 1976
(1461) 1183-77

670-1729-05 & UP TC-2 DETAILED BLOCK DIAGRAM

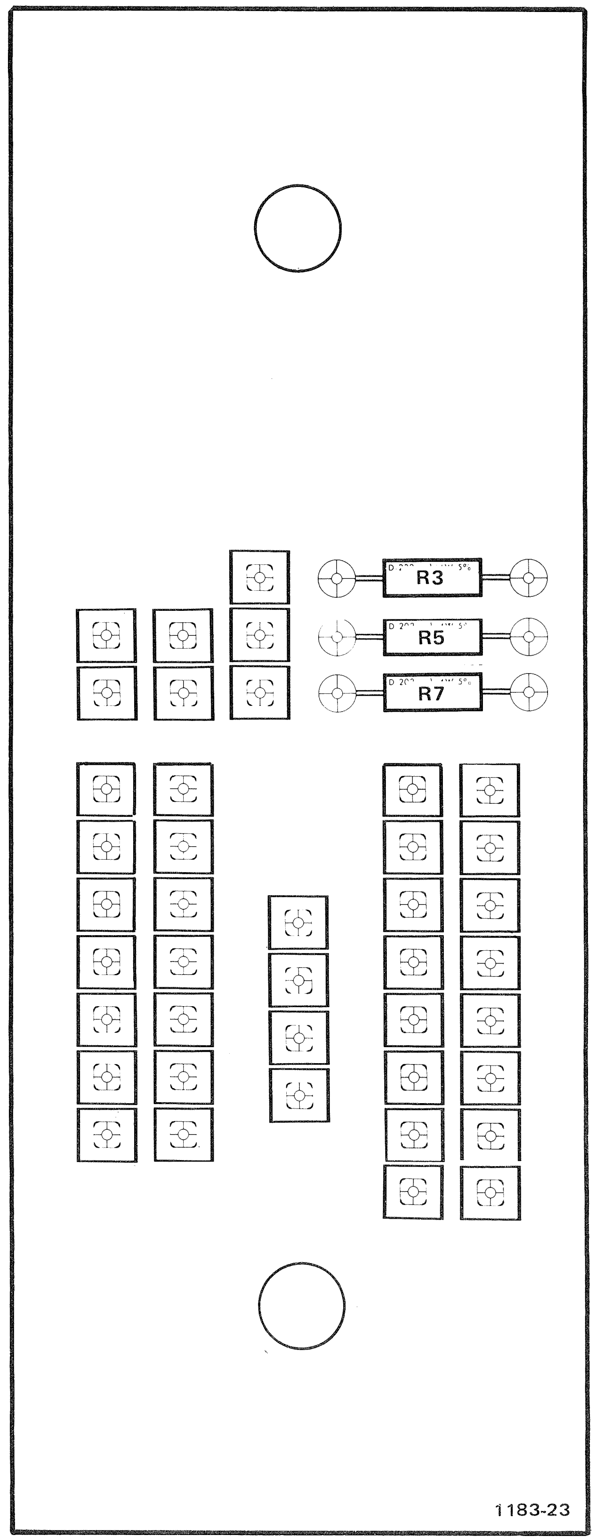
TC-2 BLOCK
670-1729-05 & UP



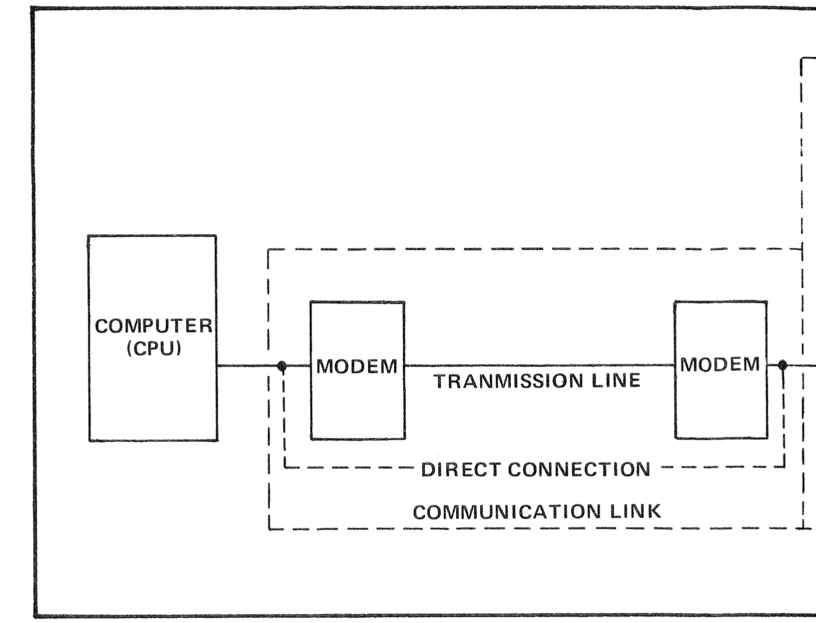
Terminal/Computer Communications Block Diagram.



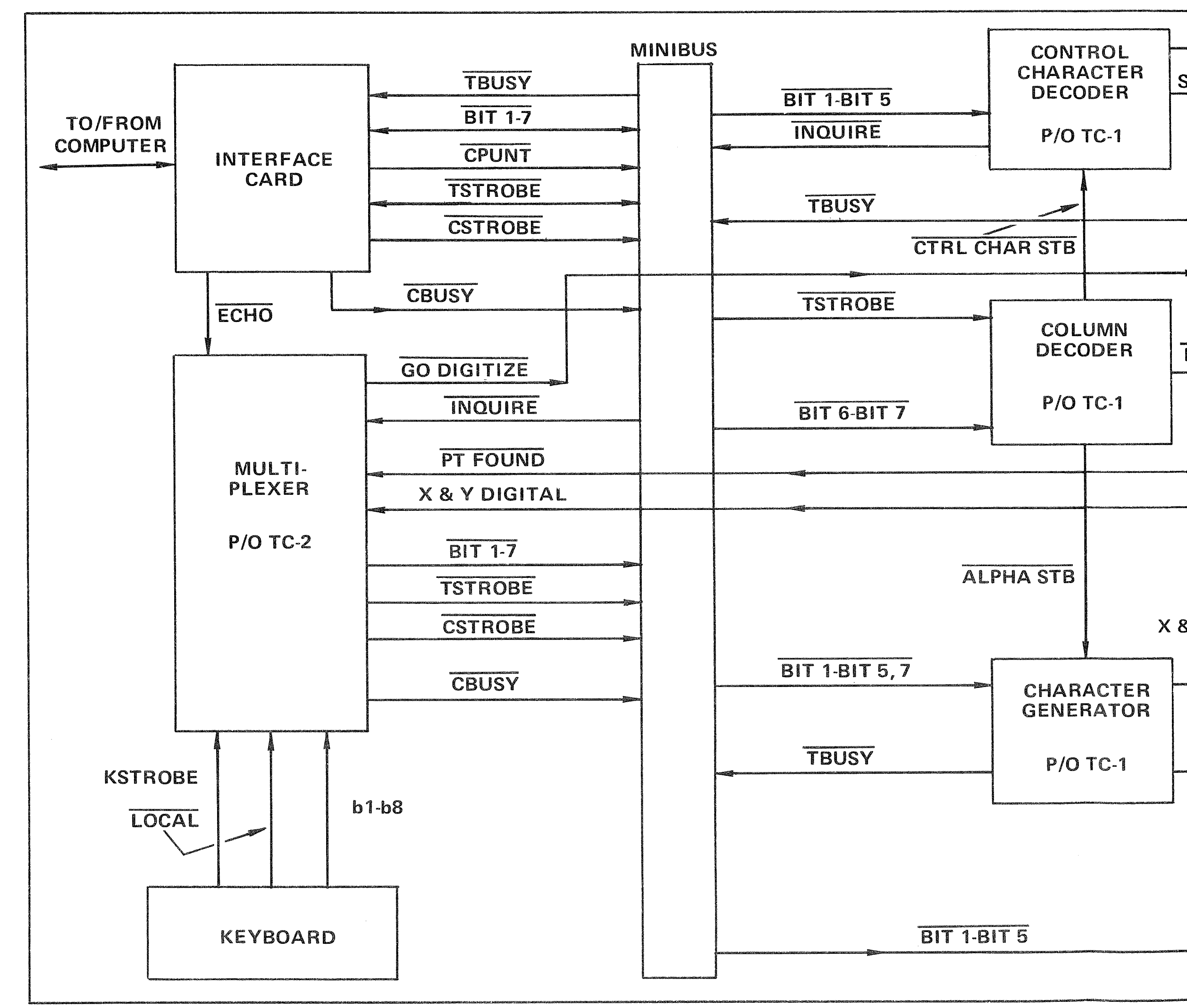
Terminal Data Flow Block Diagram.



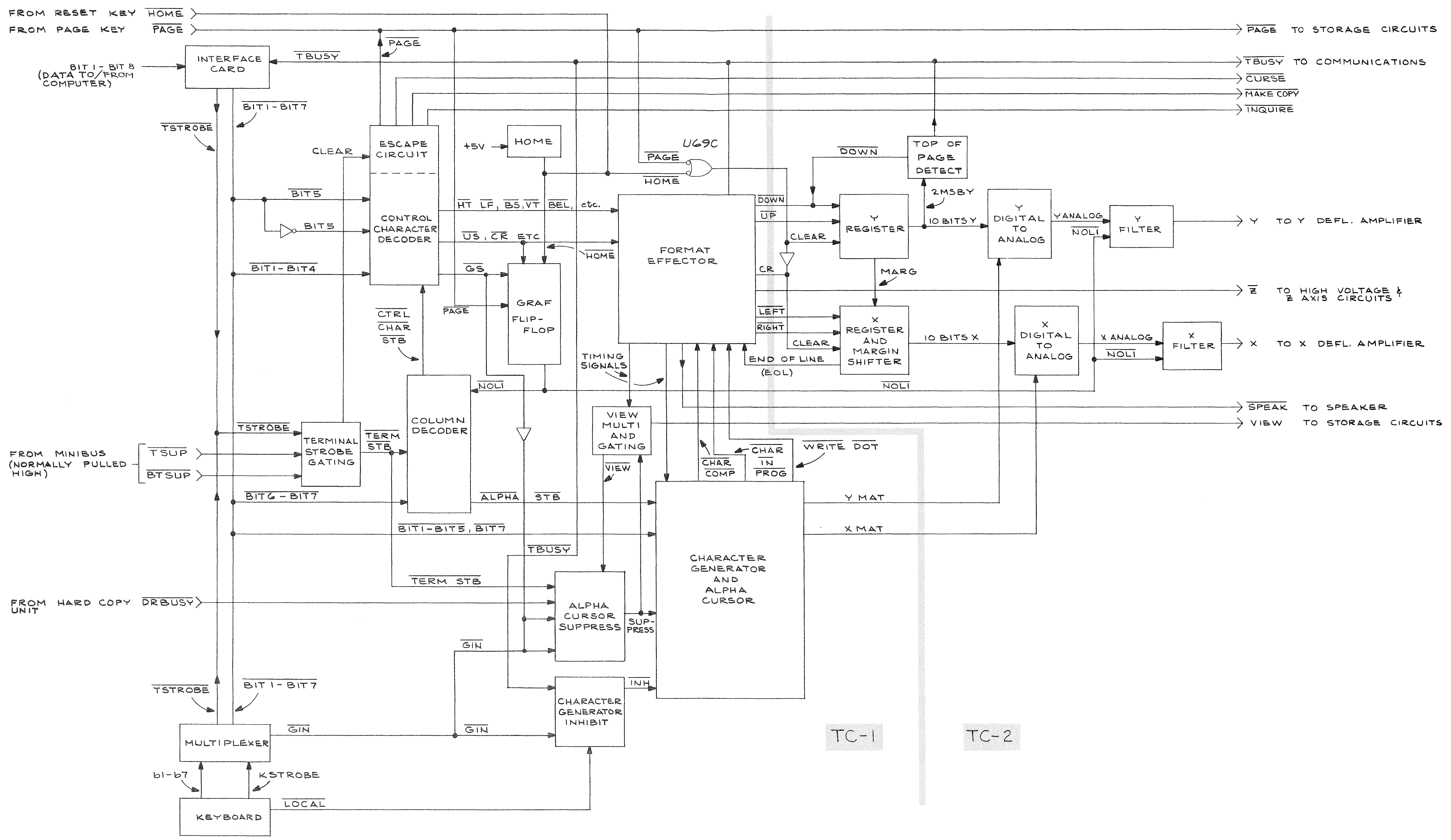
Display Interconnect Board Component Location.



Terminal/Computer Communications



Terminal Data Flow Bloc

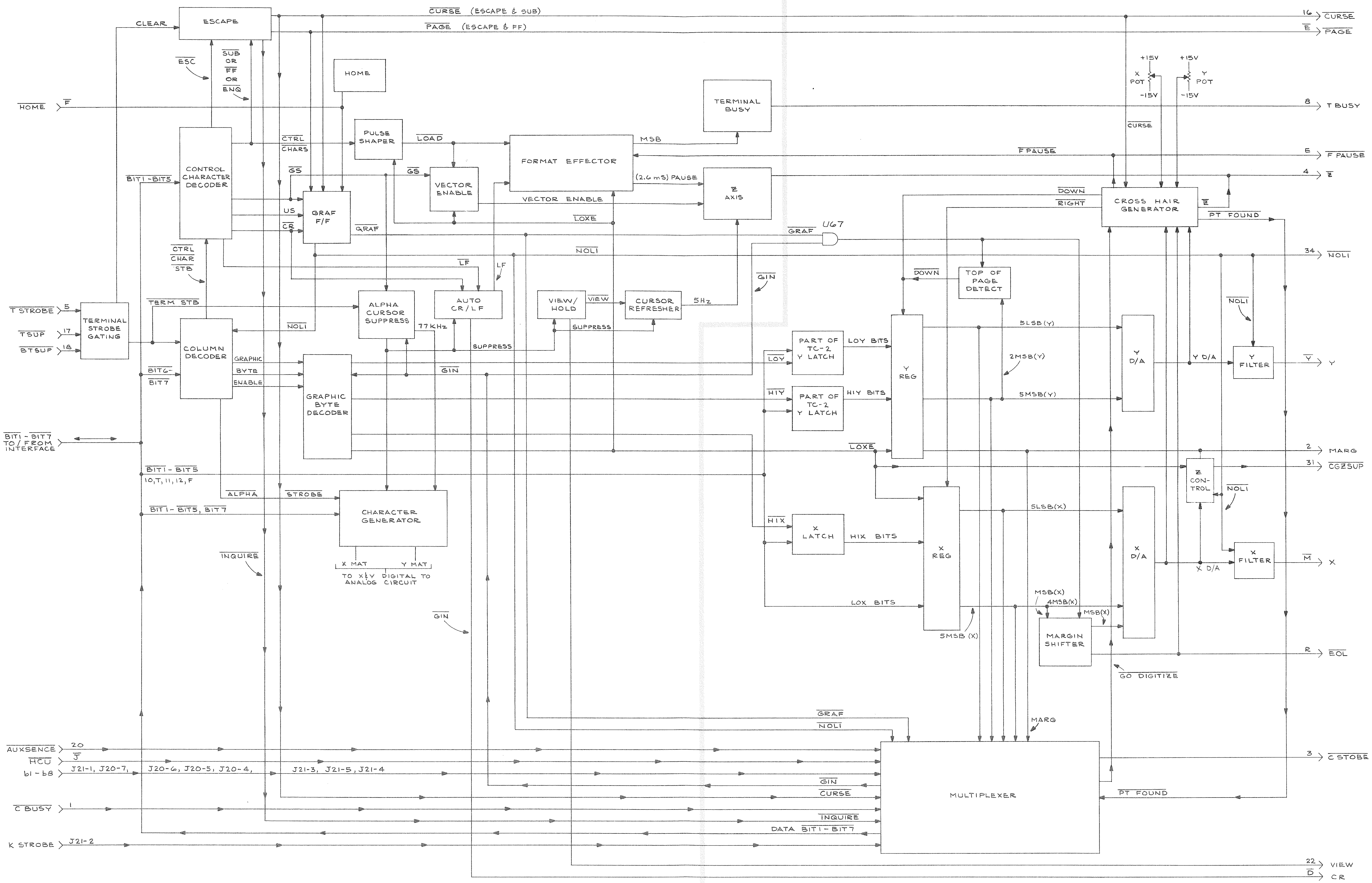


4010/4010-1

REV. C, APRIL 1976
1183-53

ALPHA MODE BLOCK DIAGRAM 372 RH

ALPHA MODE BLOCK DIAGRAM

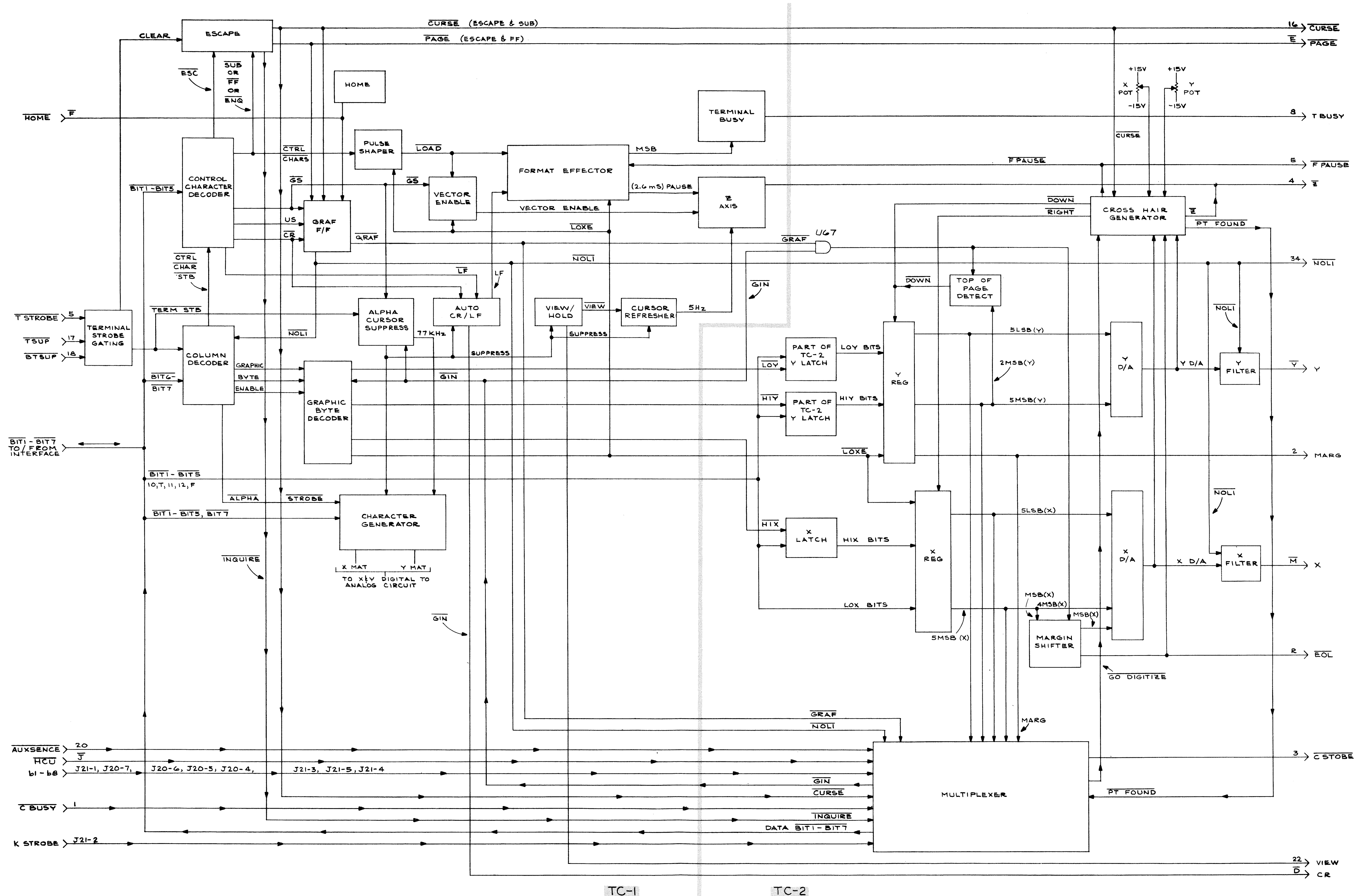


4010/4010-1

REV. B, APRIL 1976
1183-55

670-1729-04 & UP GRAPHIC MODES BLOCK DIAGRAM RH

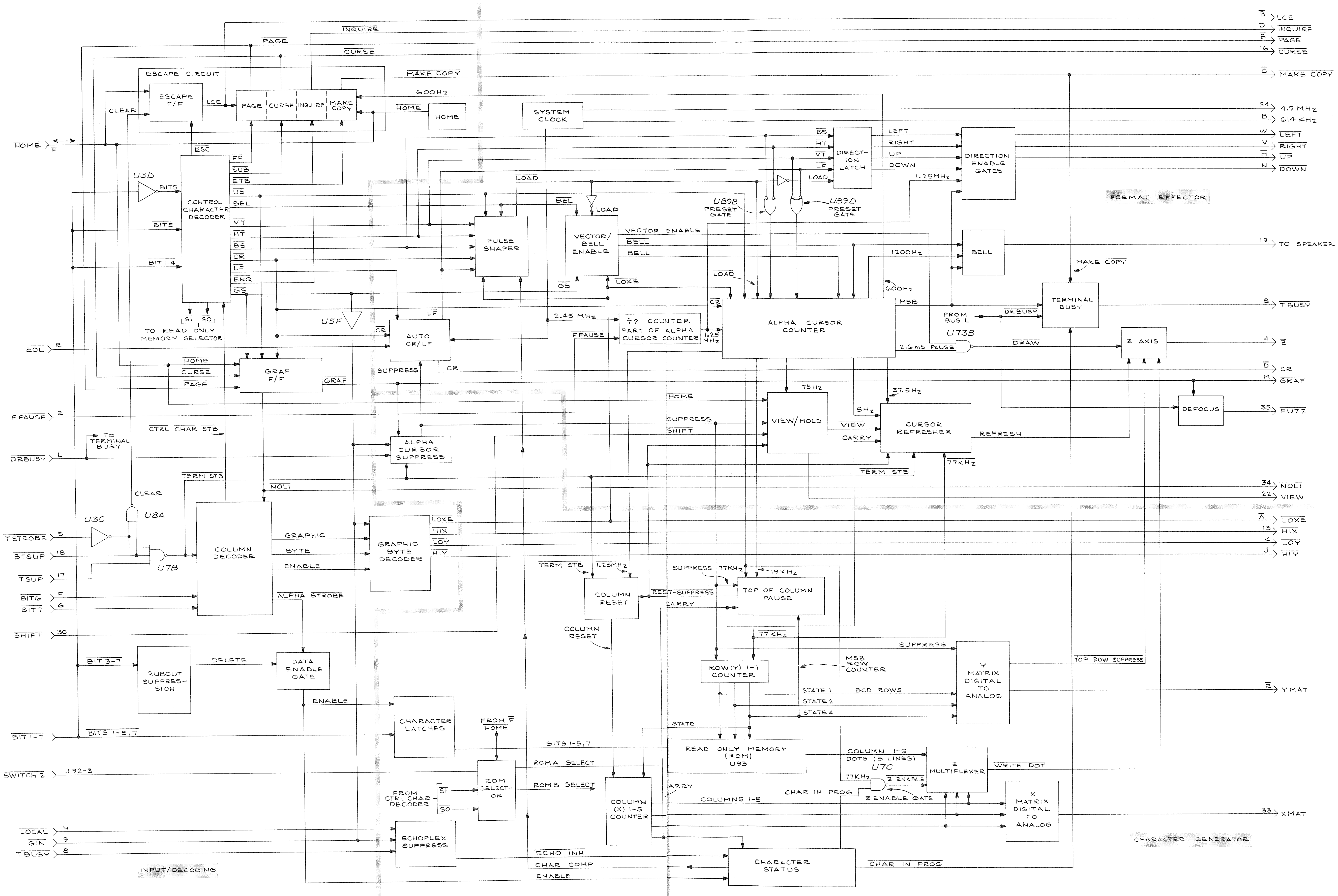
GRAPHIC MODES BLOCK
670-1729-04 & UP



4010/4010-1

REV. C, APRIL 1976
1163-54

670-1729-03 & BELOW GRAPHIC MODES BLOCK DIAGRAM

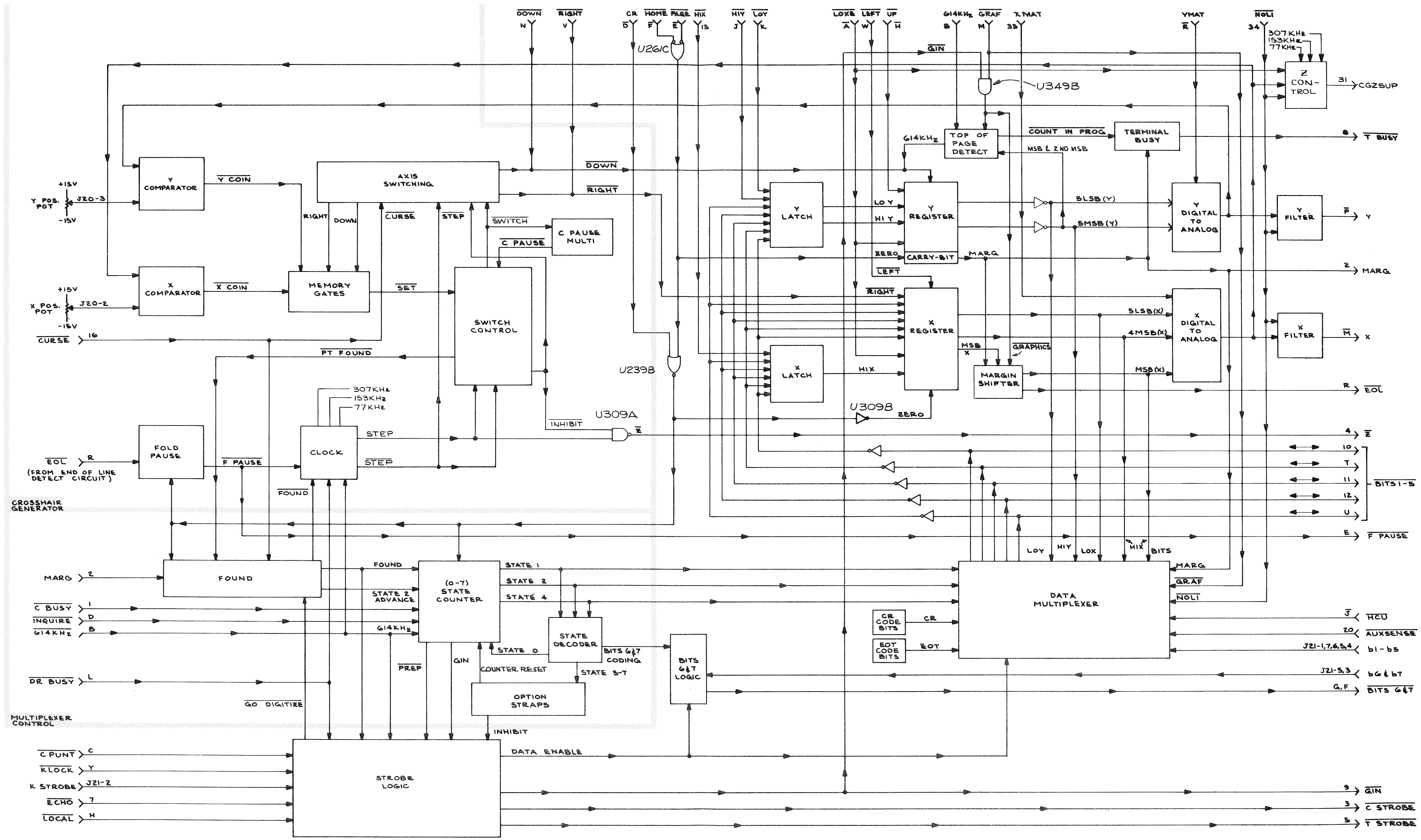


4010/4010-1

REV. B, APRIL 1976
1183-57

TC-1 DETAILED BLOCK DIAGRAM

TC-1 BLOCK

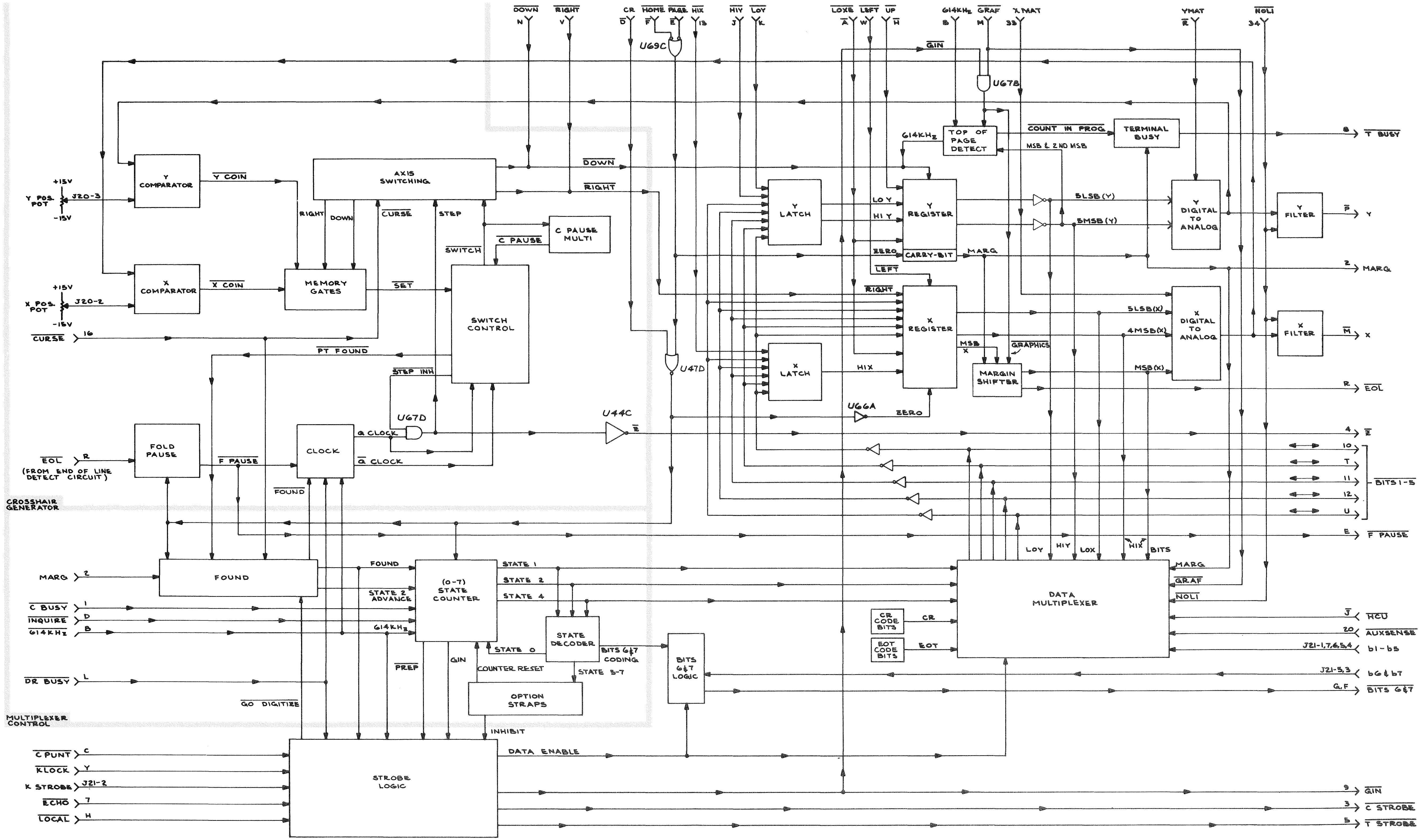


4010/4010-1

REV. C, APRIL 1976
(1461) 1183-77

670-1729-05 & UP **TC-2 DETAILED BLOCK DIAGRAM** RH

TC-2 BLOCK
670-1729-05 & UP

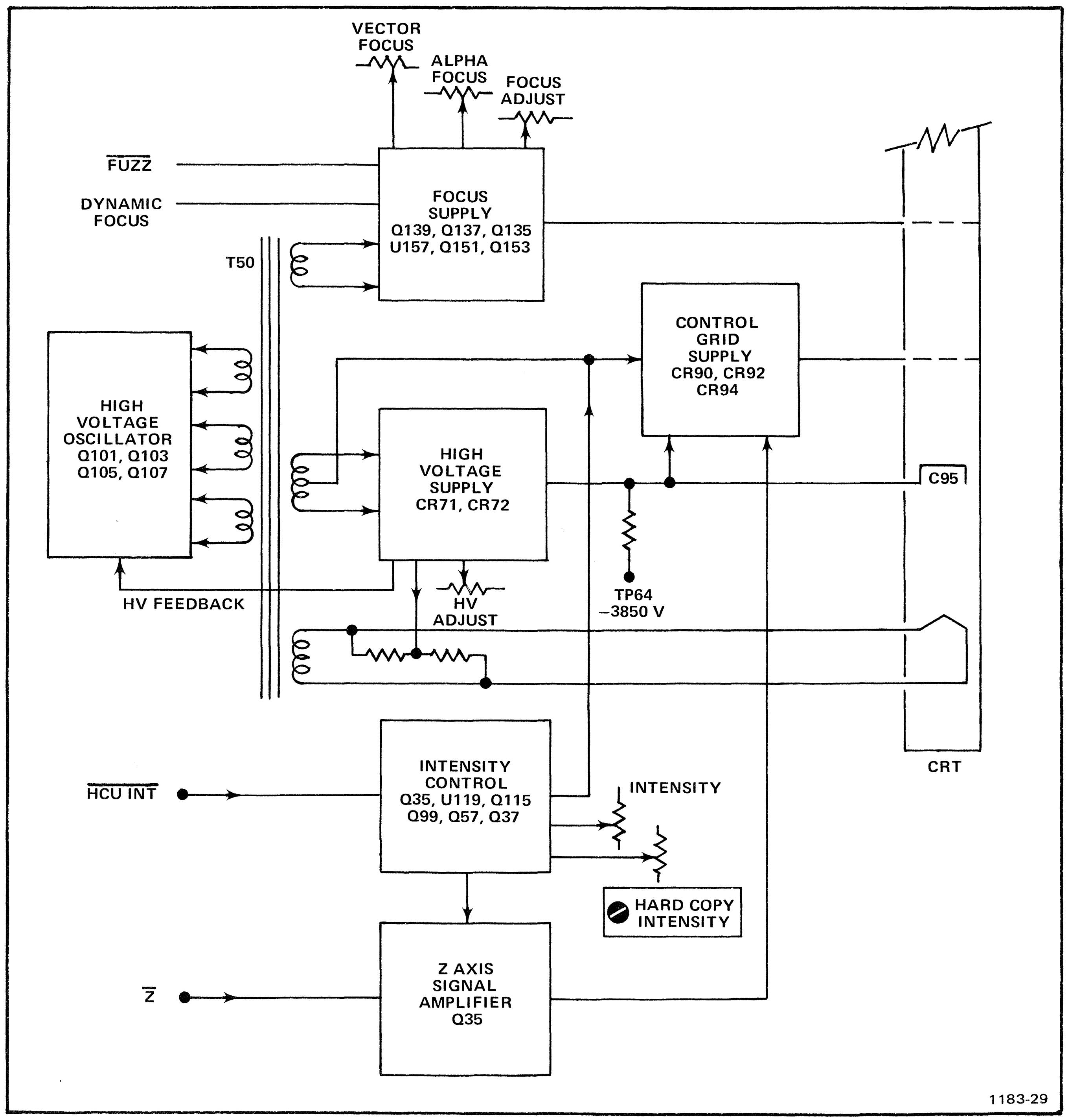


4010/4010-1

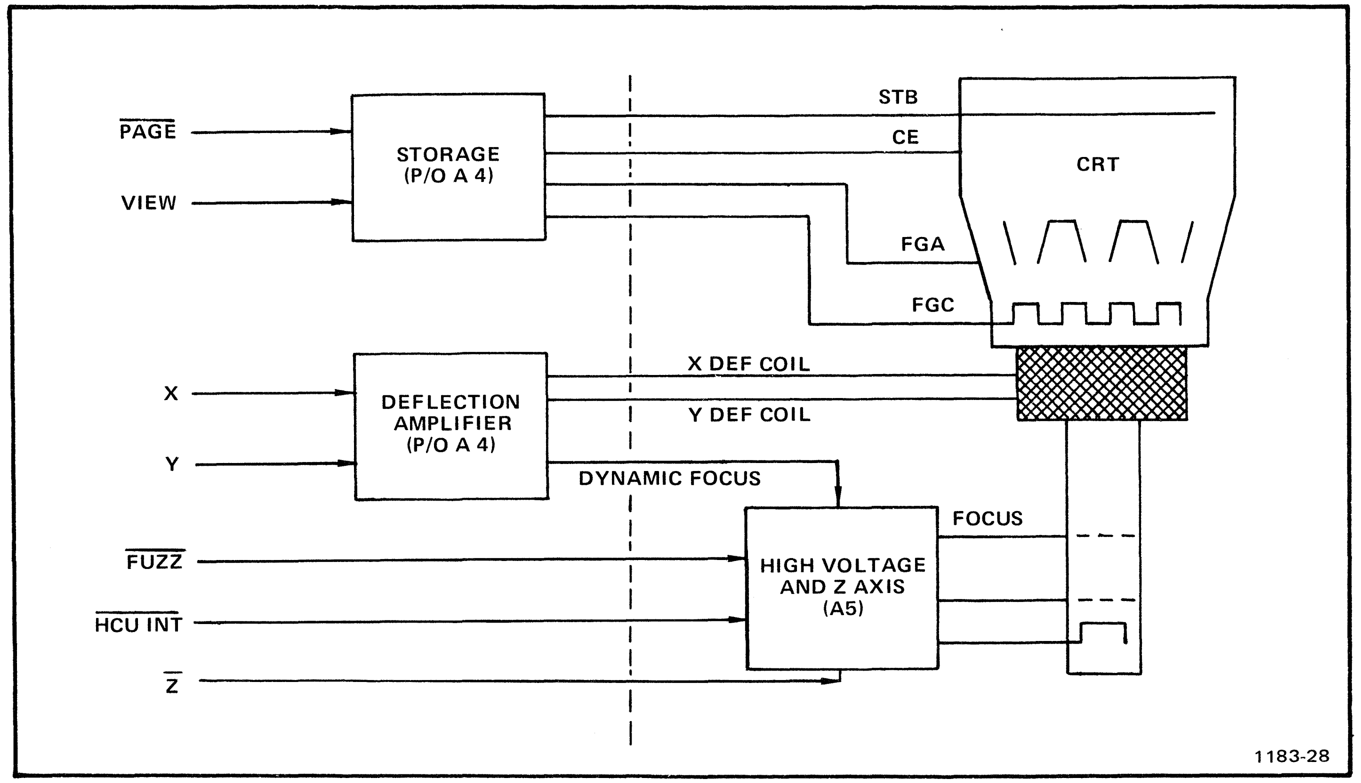
REV. C, APRIL 1976
(1461) 1183-78

670-1729-04 & BELOW **TC-2 DETAILED BLOCK DIAGRAM**

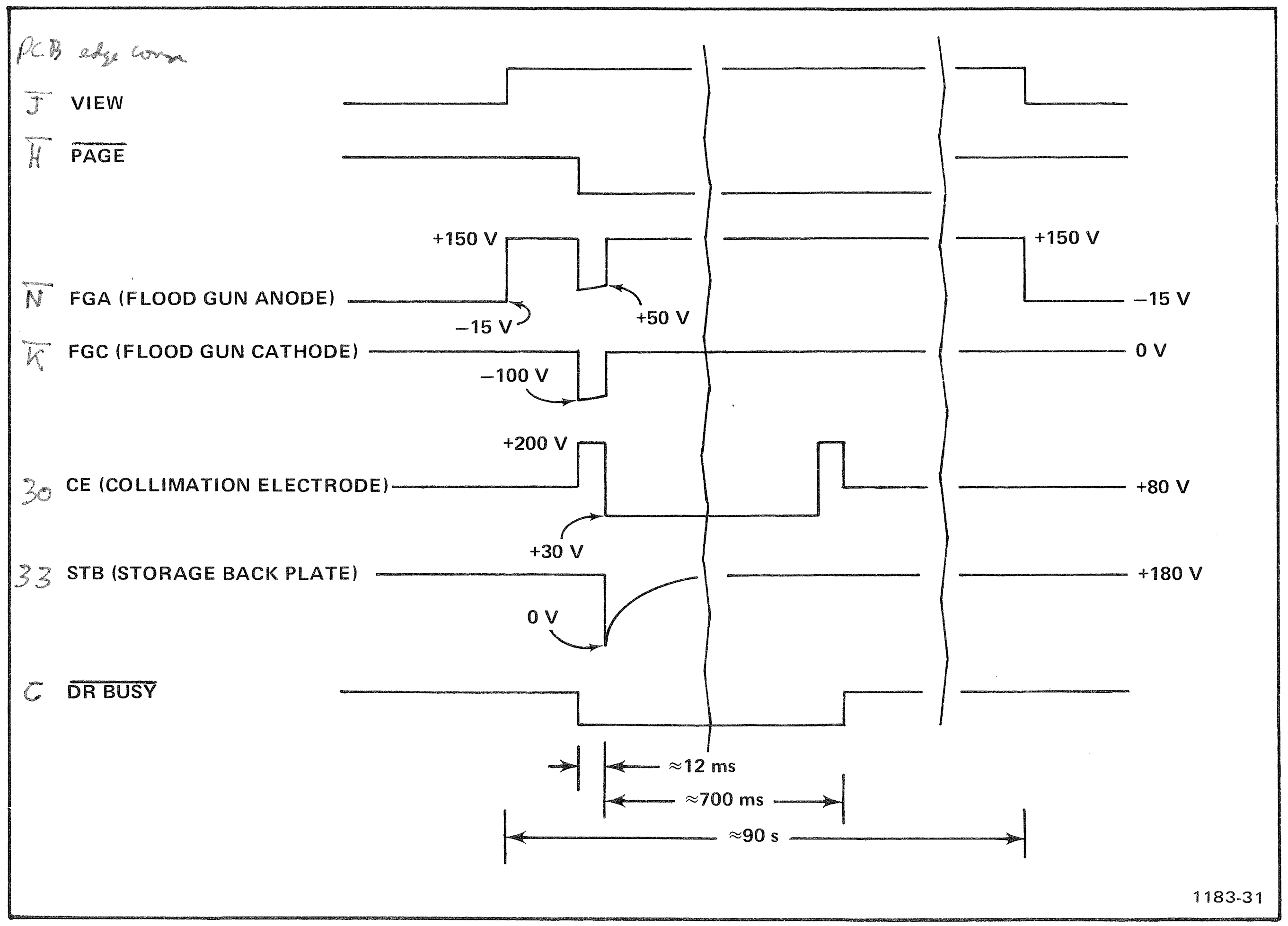
TC-2 BLOCK
670-1729-04 & BELOW



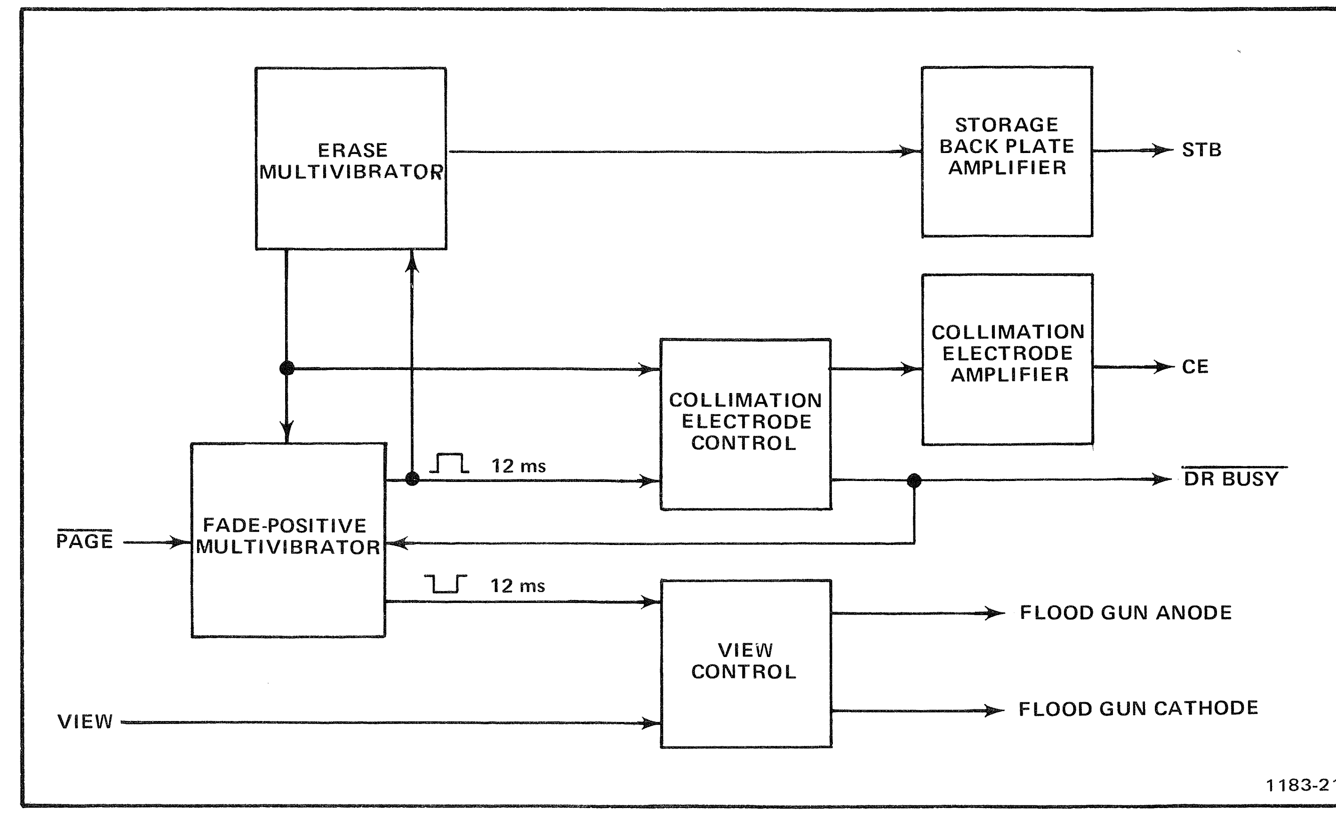
High Voltage and Z Axis Block Diagram



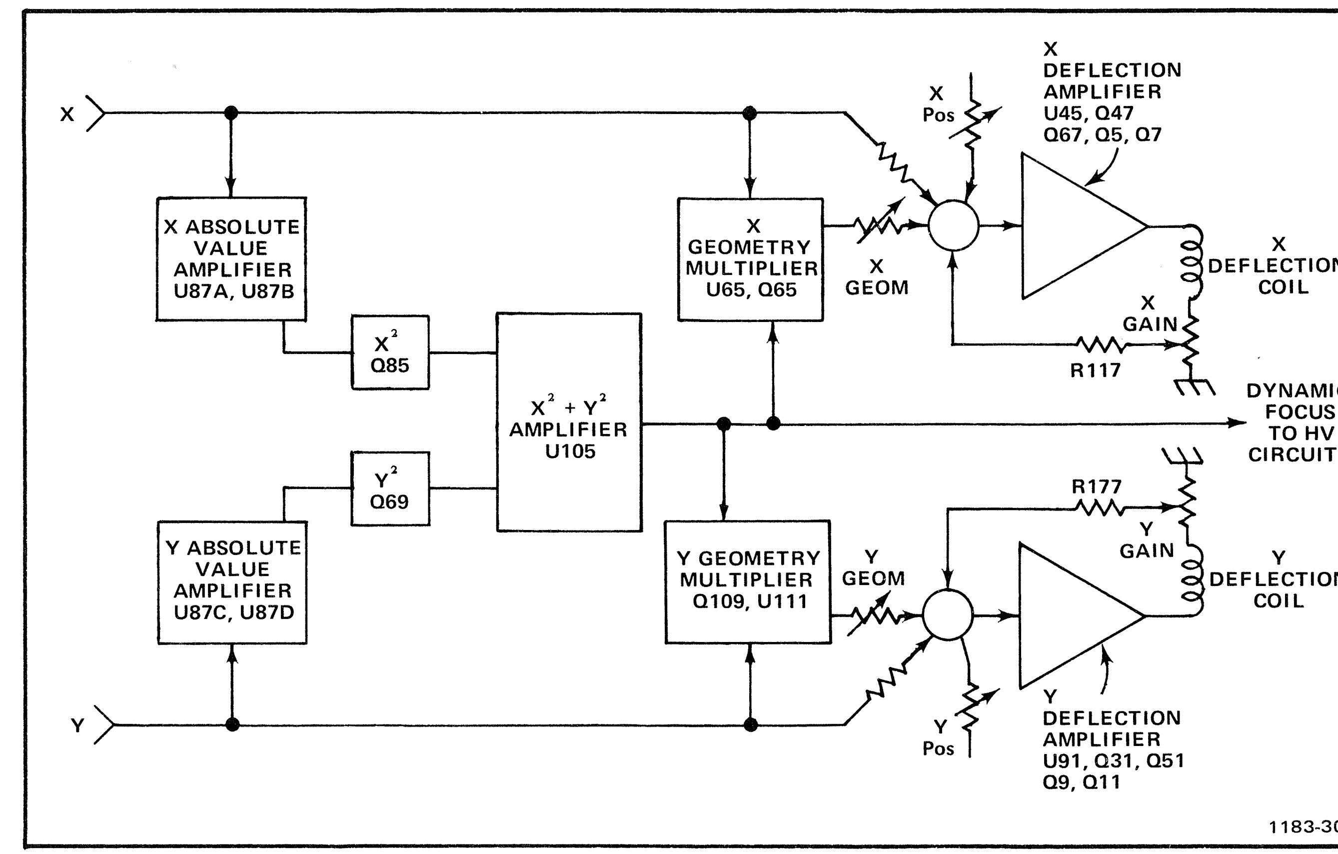
Display Unit Block Diagram



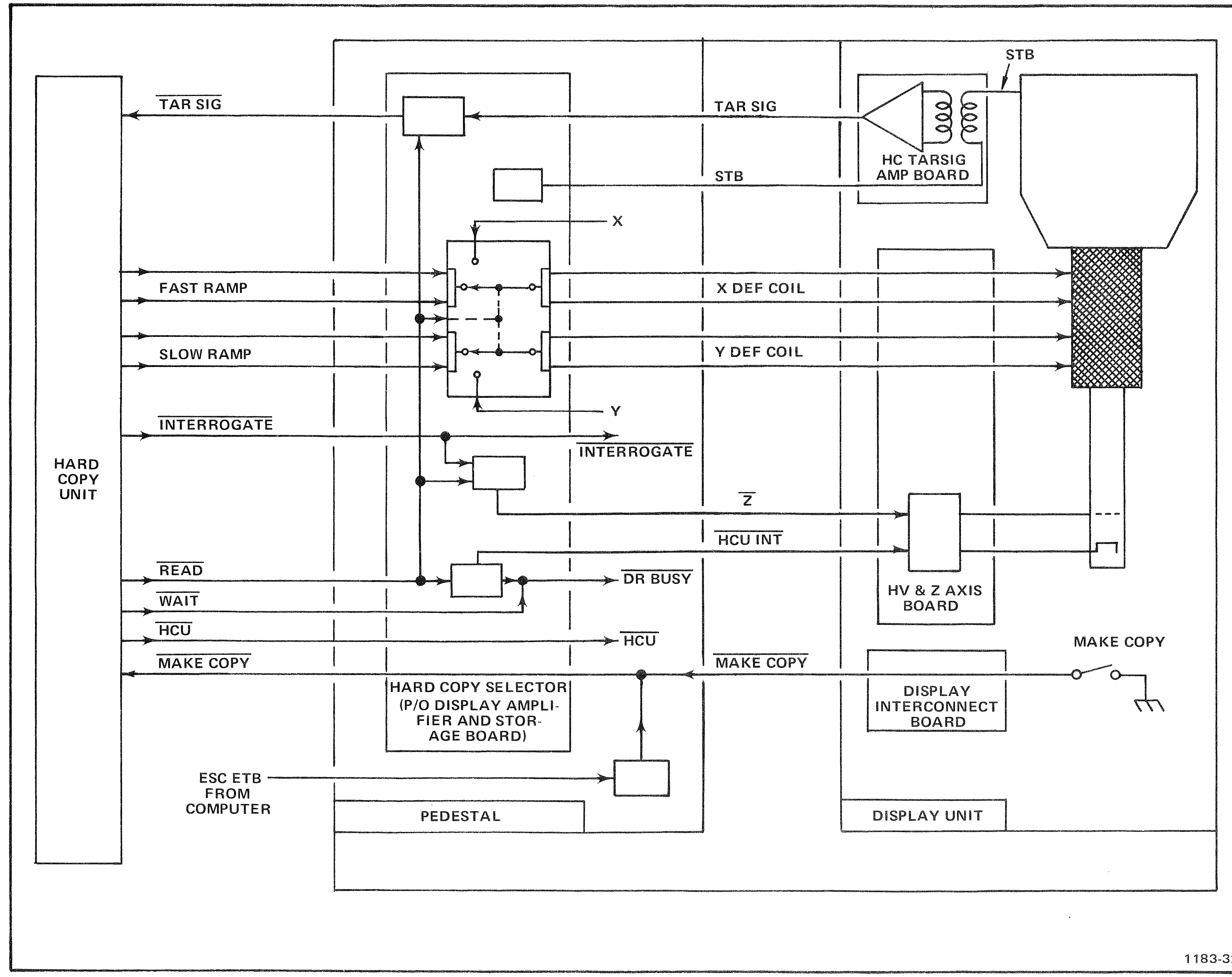
Storage Circuit Waveforms.



Storage Circuit Block Diagram.

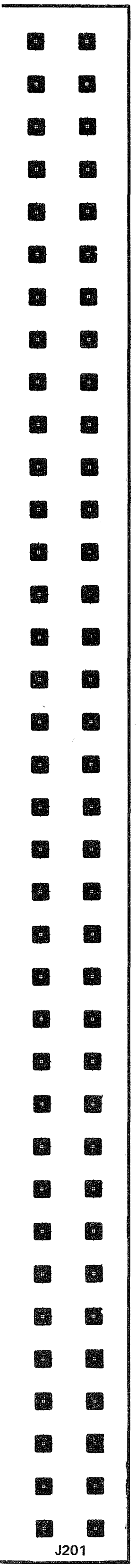


Deflection Amplifier Block Diagram.

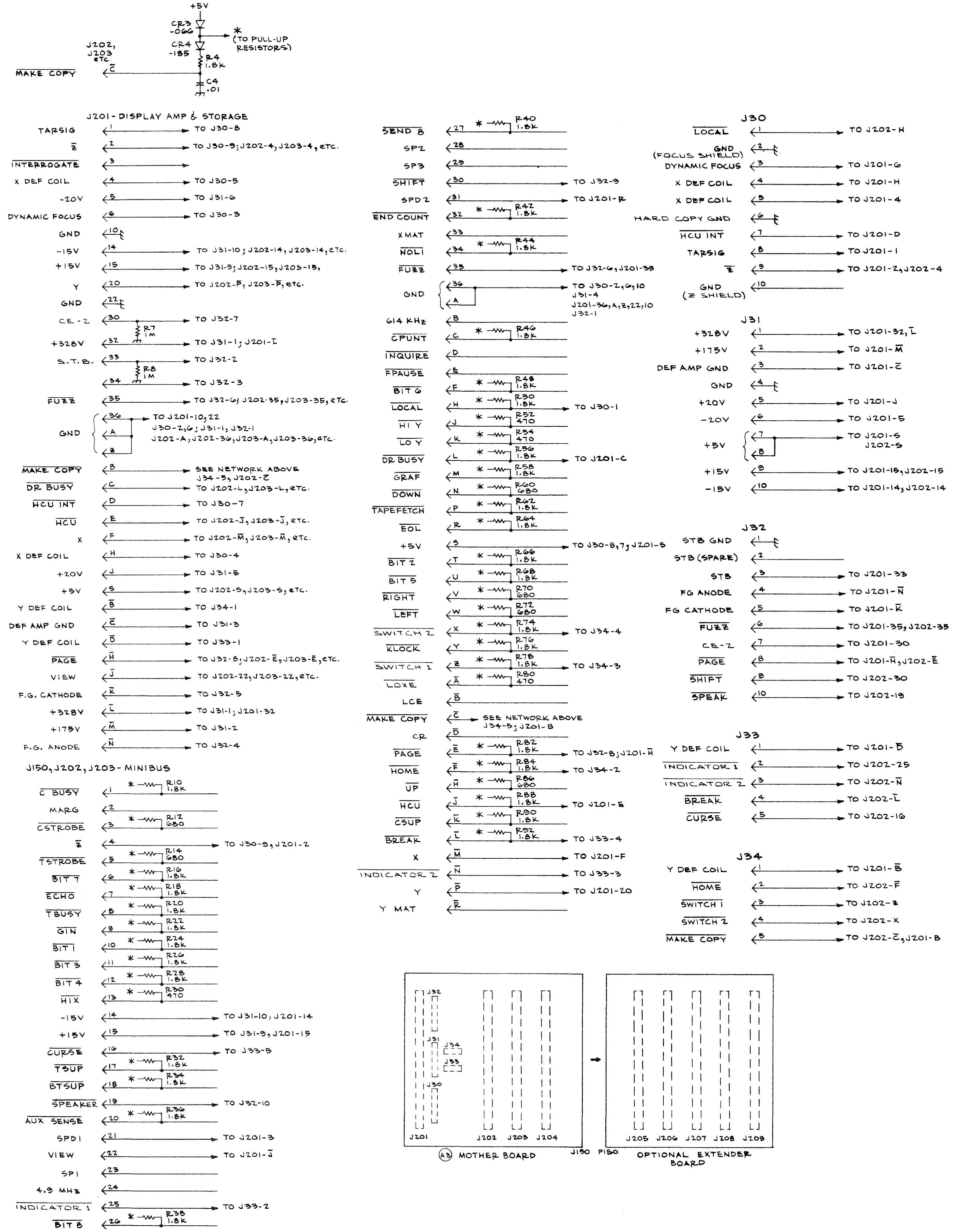


Hard Copy Operation Block Diagram.

HARD COPY BLOCK DIA

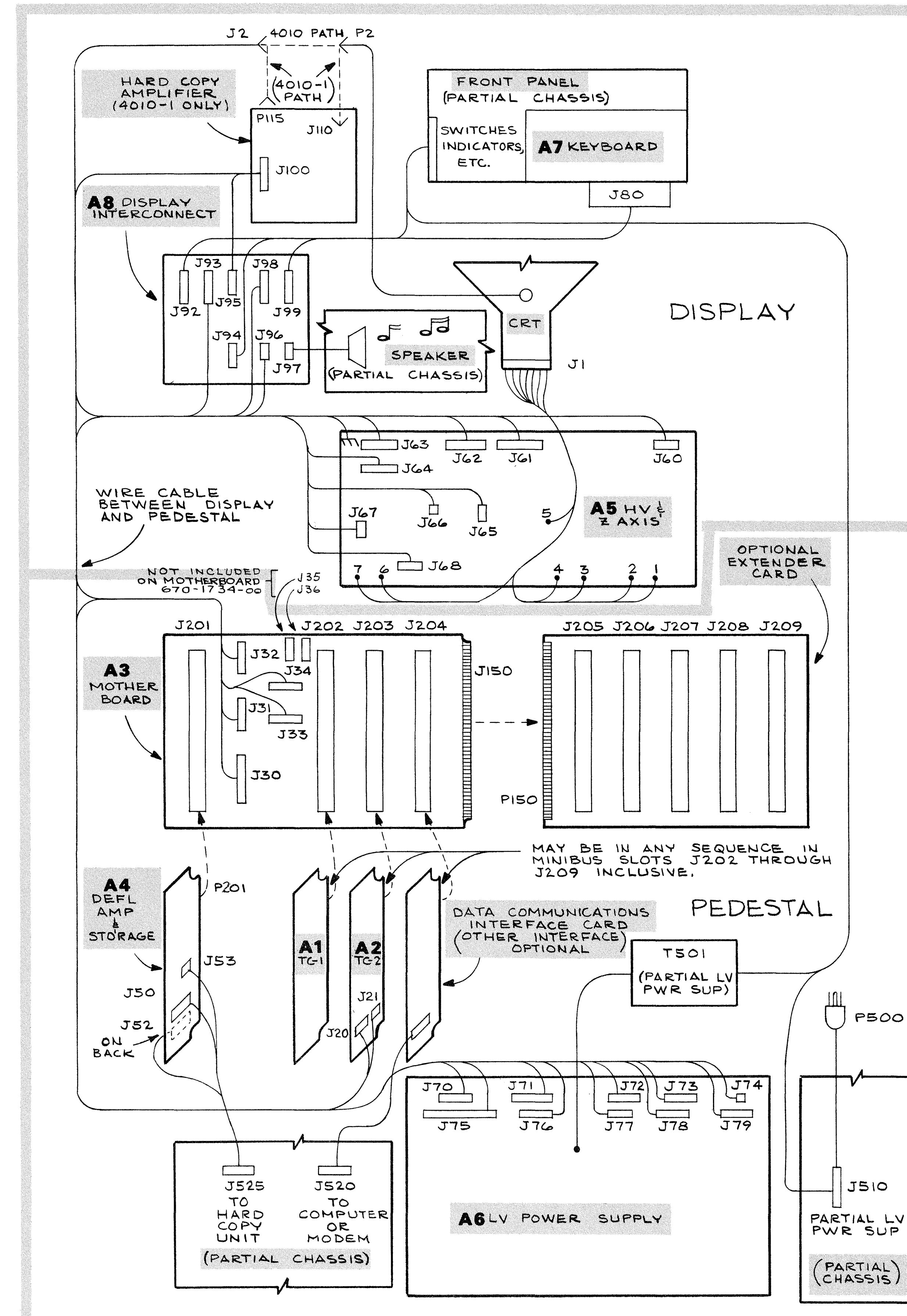


1183-51

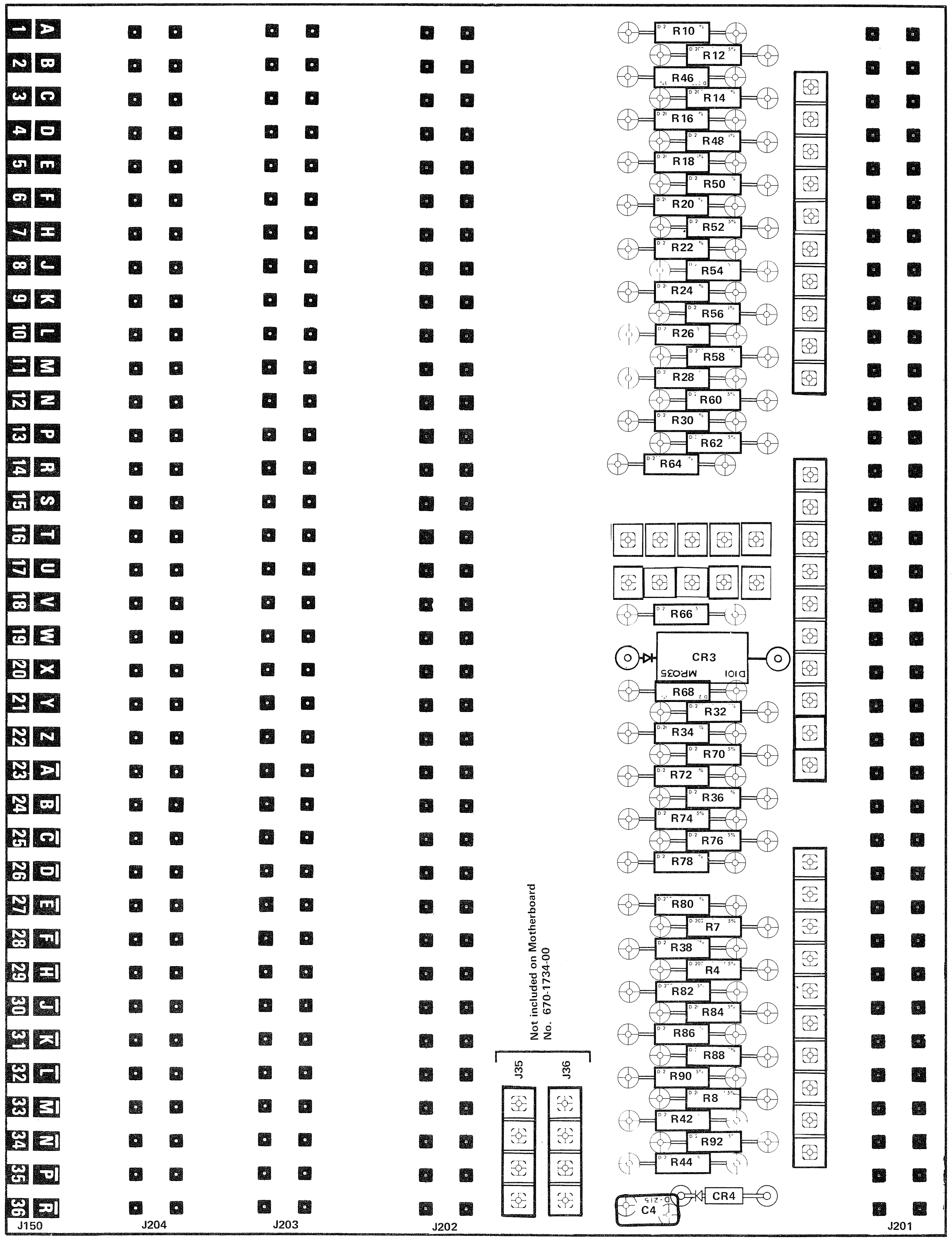


REV.C, APRIL 1976
1183-50

A3 670-1734-00 MOTHER BOARD 1

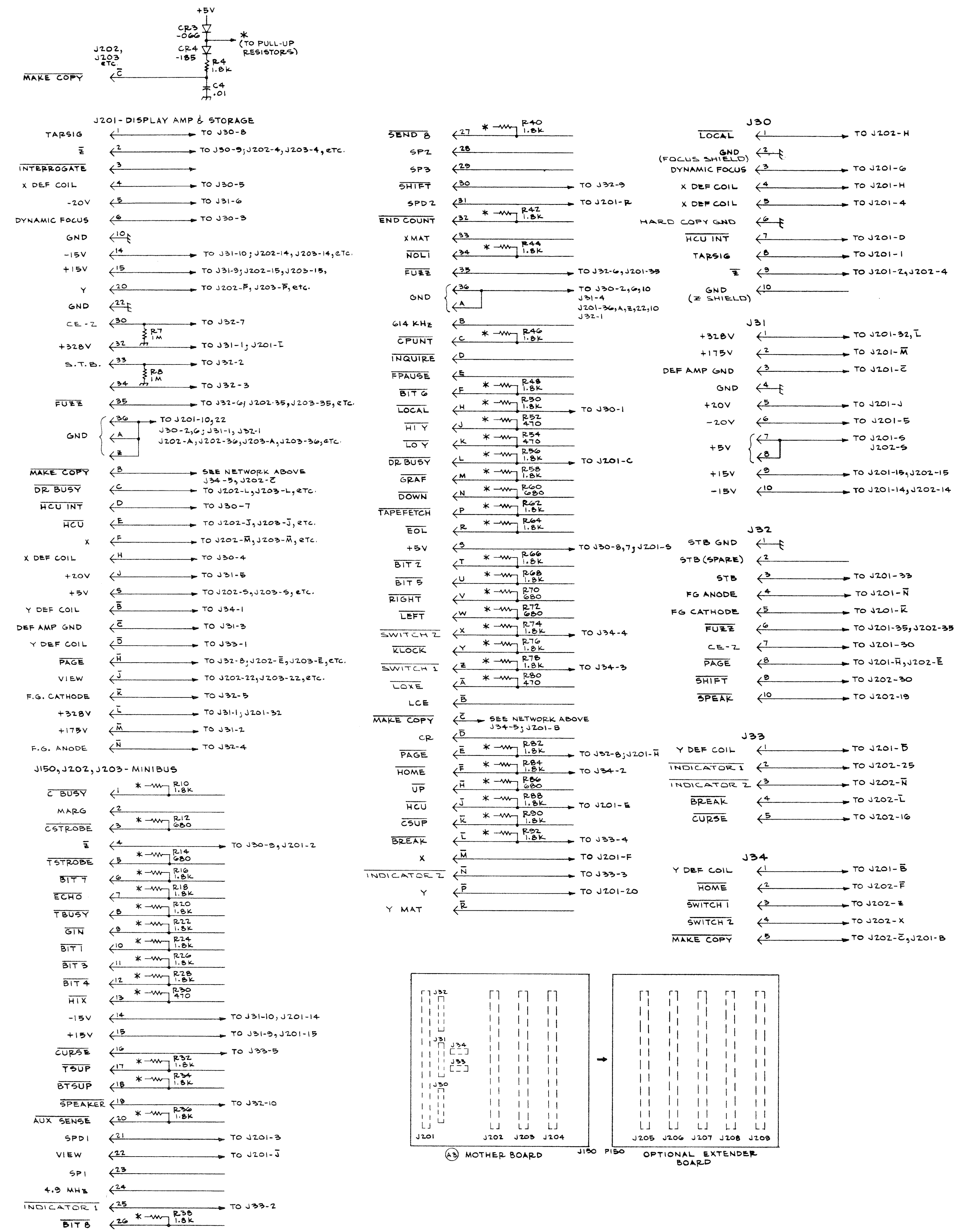


1183-49



1183-51

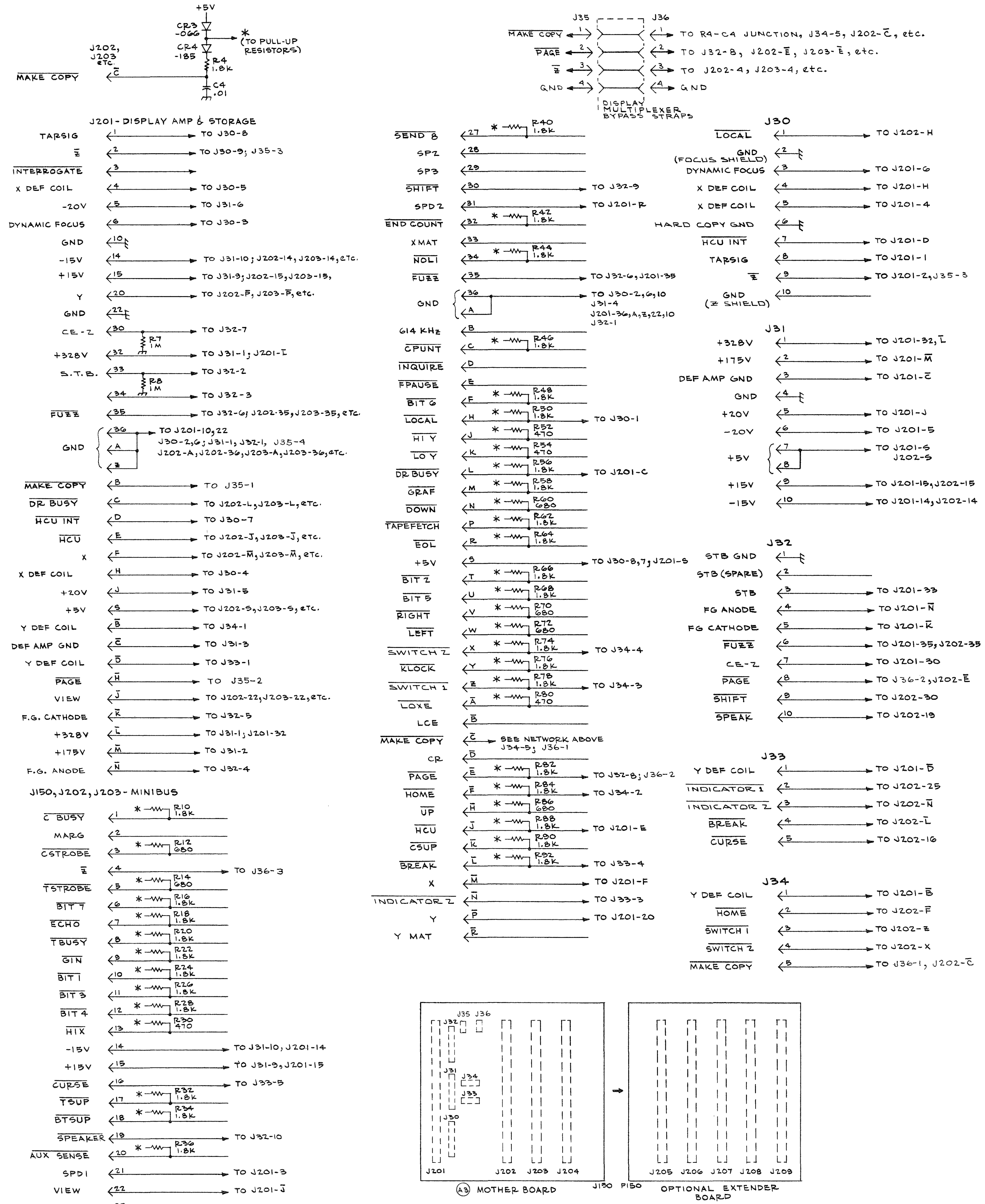
Mother Board Component Locations.



4010/4010-1

REV. C, APRIL 1976
1183-50

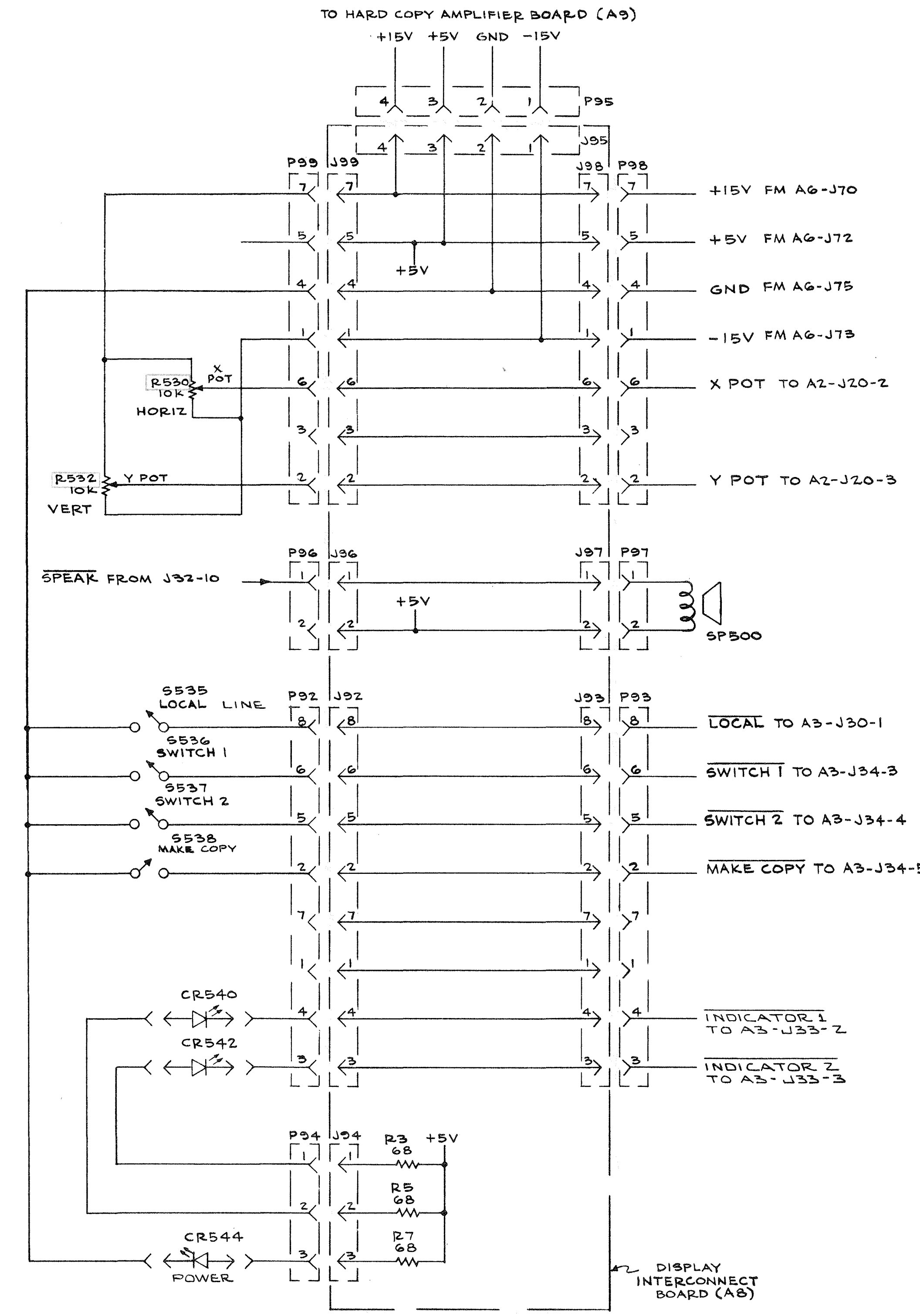
A3 670-1734-00 MOTHER BOARD 1



4010/4010-1

REV. E, APRIL 1976
1183-52

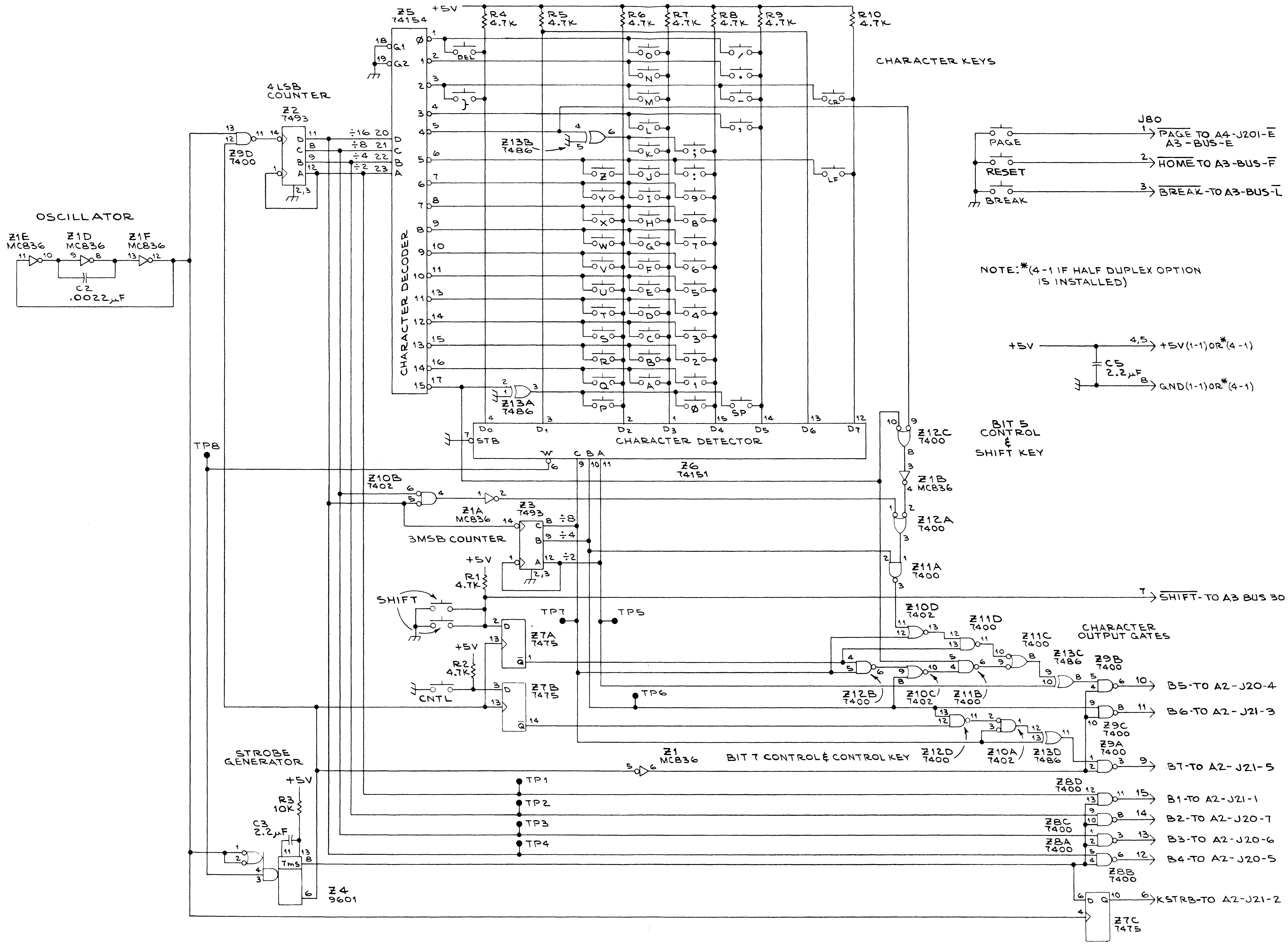
A3 670-1734-02 MOTHER BOARD 2



SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.

4010/4010-1 1183-37 DISPLAY INTERCONNECT

DISPLAY INTERCONNECT
MOTHER BOARD 670-1734-02 2



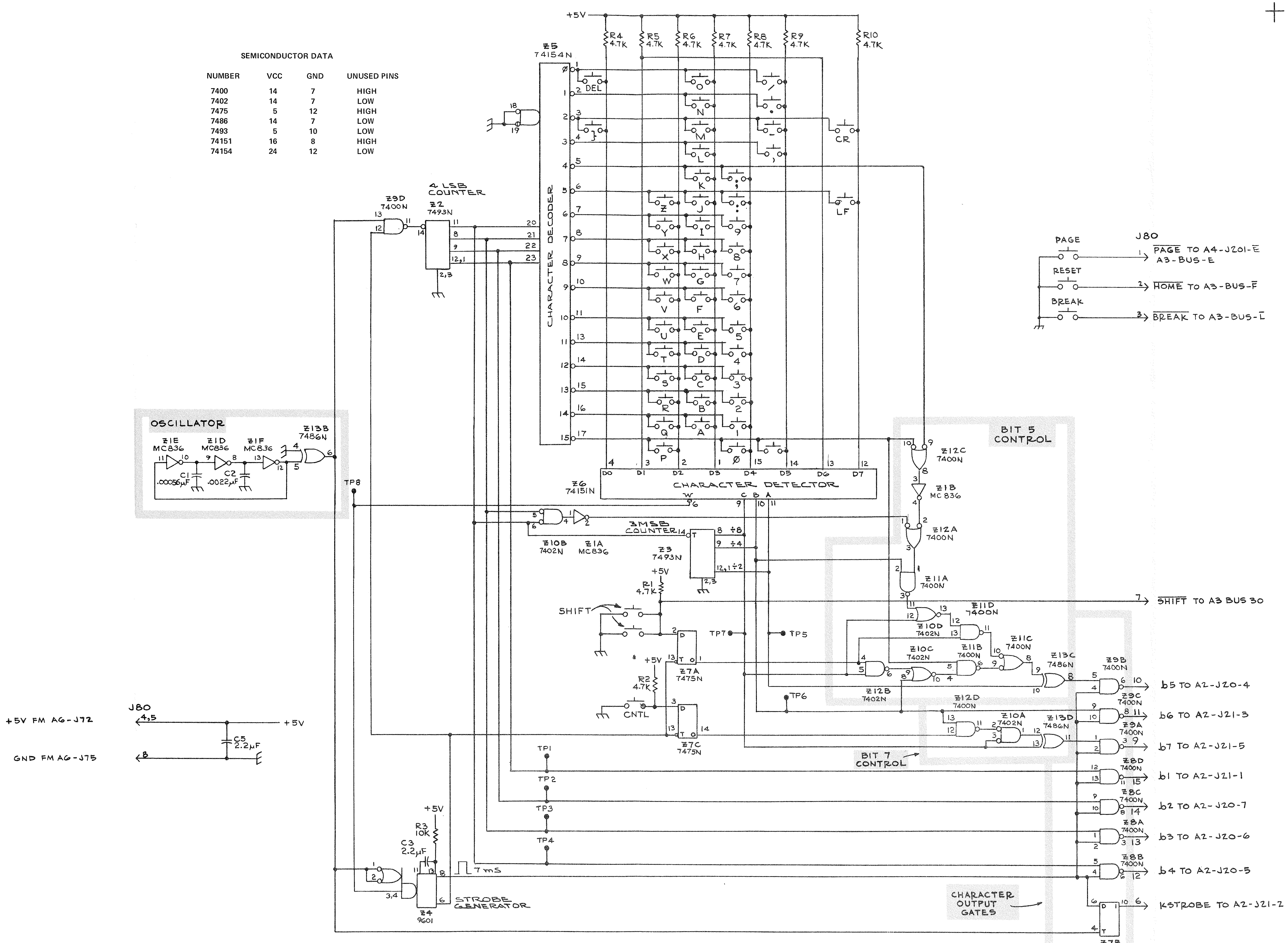
@ 1183-67

A8 119-0304-02 KEYBOARD 3

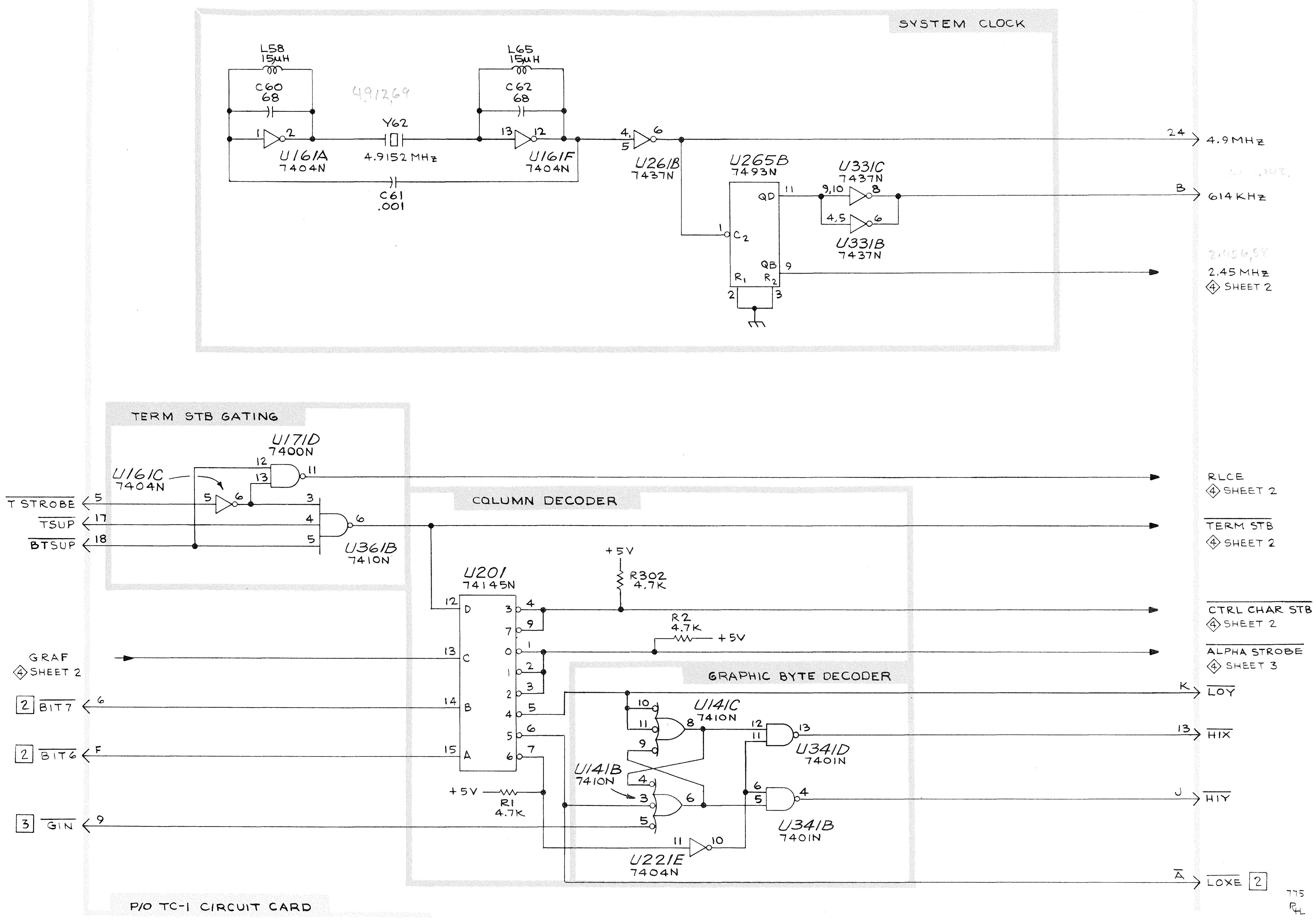
KEYBOARD A8 119-0304-02

SEMICONDUCTOR DATA

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7475	5	12	HIGH
7486	14	7	LOW
7493	5	10	LOW
74151	16	8	HIGH
74154	24	12	LOW



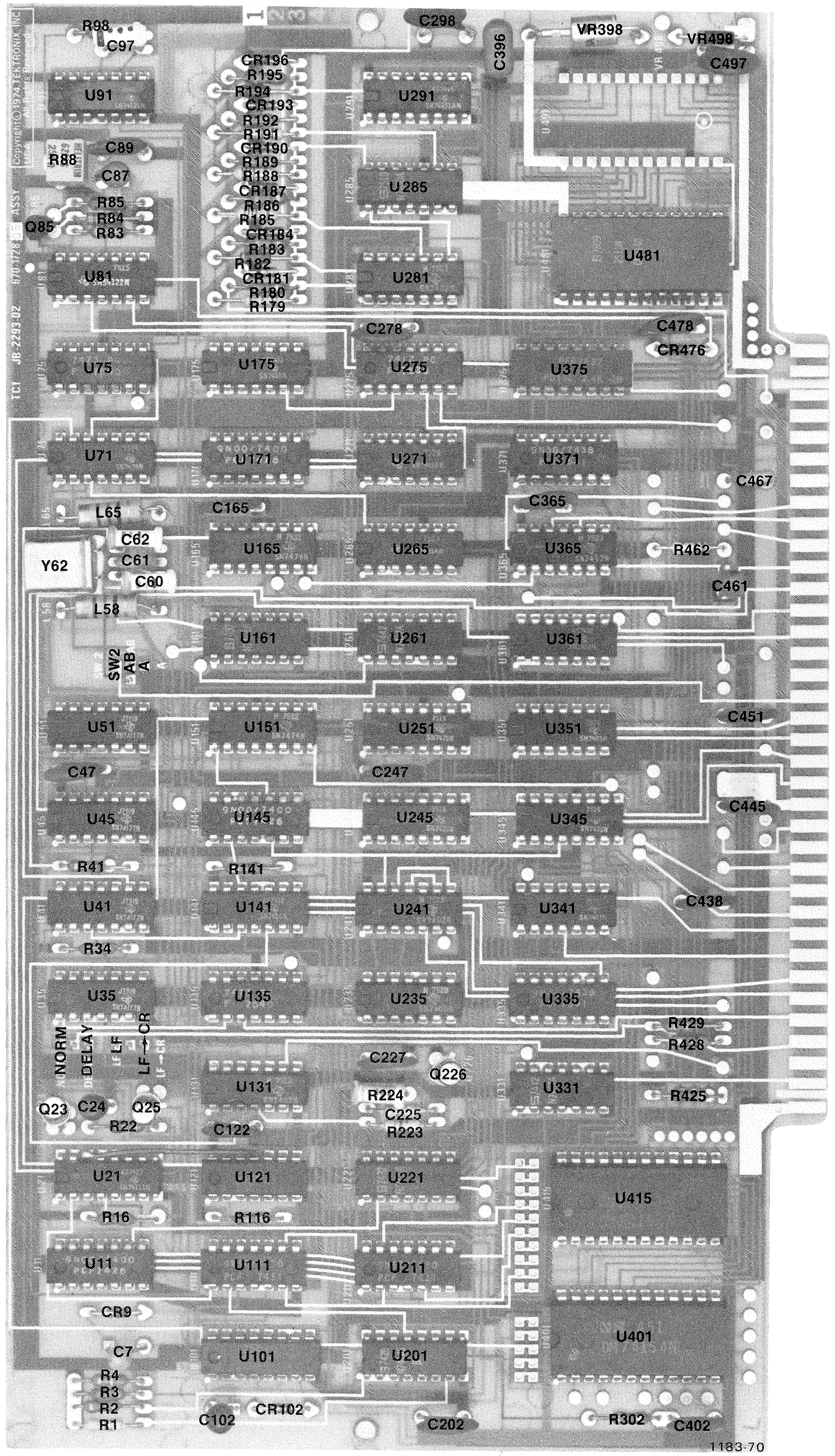
A7-KEYBOARD CIRCUIT CARD



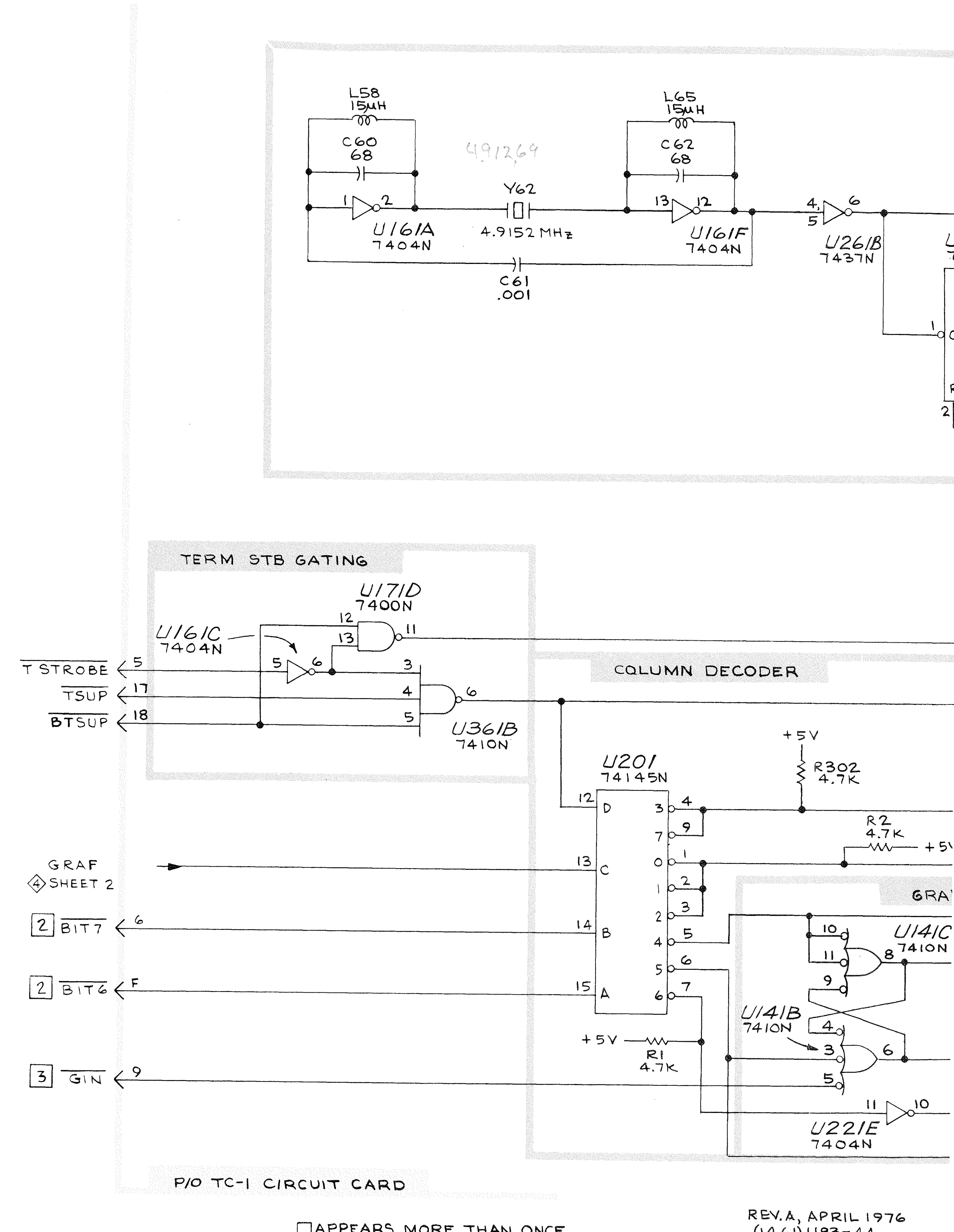
4010/4010-1

☐APPEARS MORE THAN ONCE

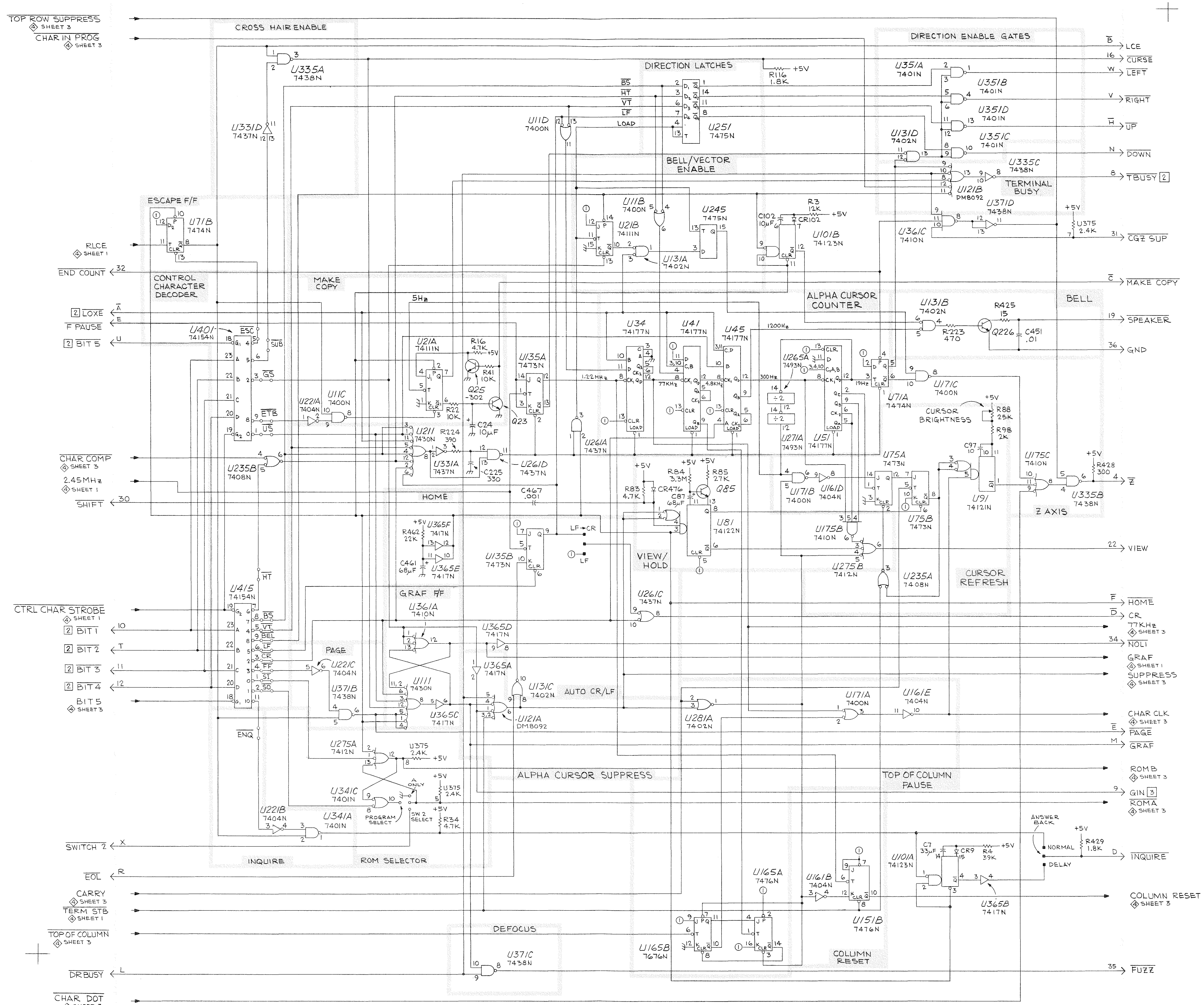
REV. A, APRIL 1976
(1461) 1183-44



TC-1 Component Locations (670-1728-05).



4010/4010-1



P/O TC-1 CIRCUIT BOARD

4010/4010-1

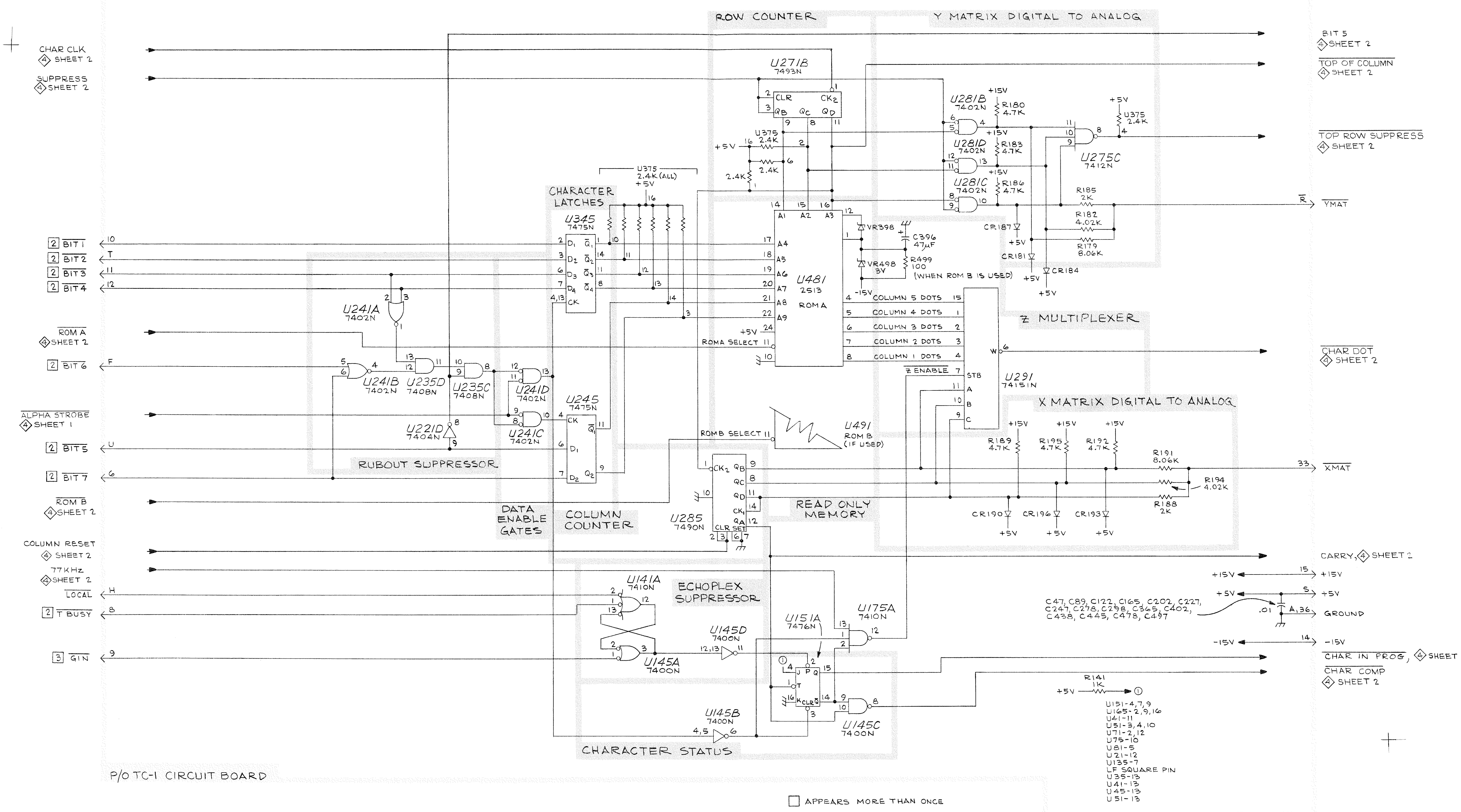
REV. A, APRIL 1976
1183-68

☐ APPEARS MORE THAN ONCE.

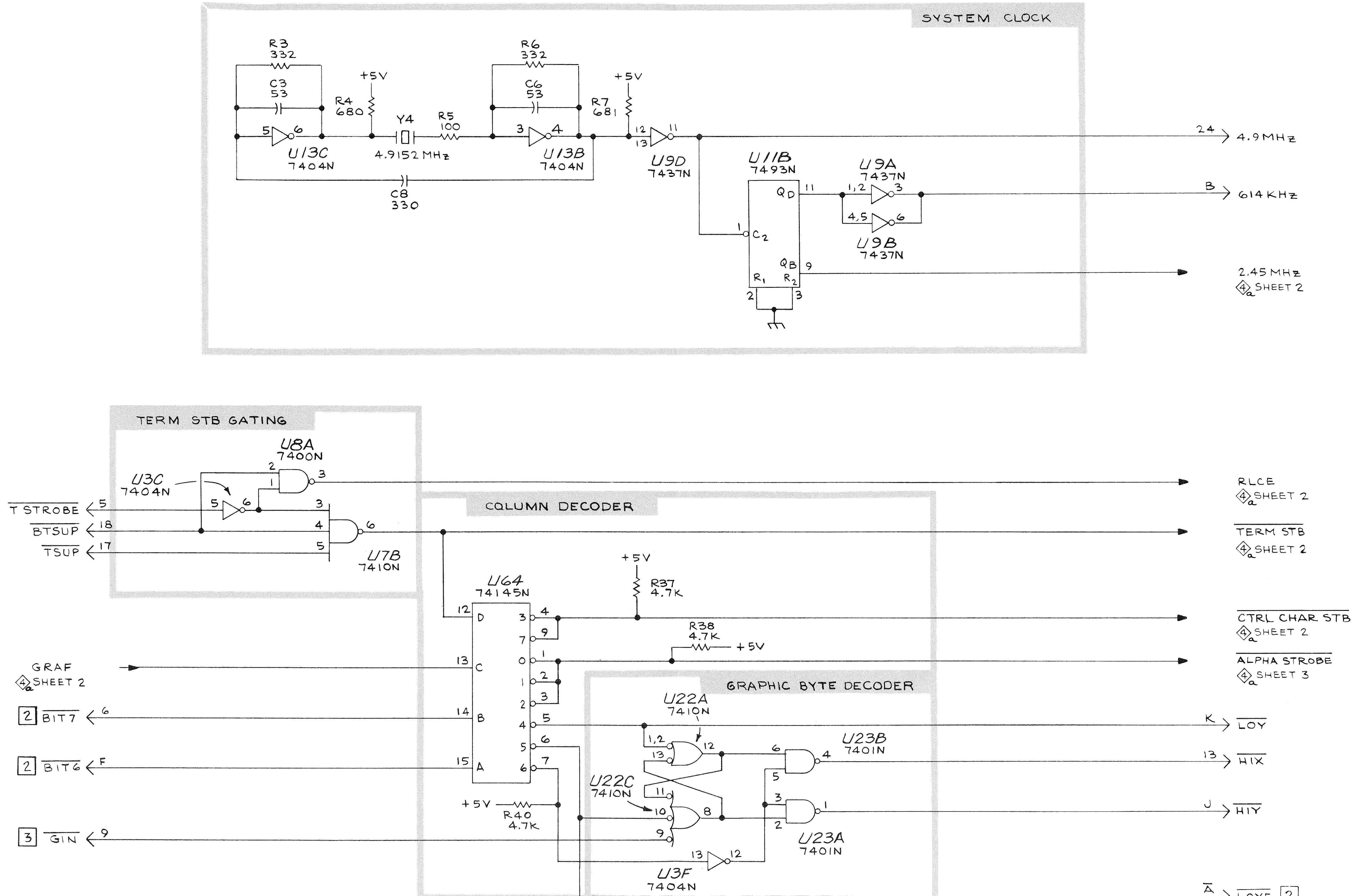
A1 670-1728-05

TC-1 ④ SHEET 2 OF 3

SHEET 2 OF 3 TC-1
A1 670-1728-05



ROW COUNTER
Y MATRIX DIGITAL TO ANALOG
CHARACTER LATCHES
RUBOUT SUPPRESSOR
DATA ENABLE GATES
COLUMN COUNTER
Z MULTIPLEXER
X MATRIX DIGITAL TO ANALOG
READ ONLY MEMORY
ECHOPLEX SUPPRESSOR
CHARACTER STATUS
P/O TC-1 CIRCUIT BOARD
CHAR CLK
SHEET 2
SUPPRESS
SHEET 2
BIT 1
BIT 2
BIT 3
BIT 4
ROM A
SHEET 2
BIT 6
ALPHA STROBE
SHEET 1
BIT 5
BIT 7
ROM B
SHEET 2
COLUMN RESET
SHEET 2
77KHz
SHEET 2
LOCAL
T BUSY
GIN
BIT 5
SHEET 2
TOP OF COLUMN
SHEET 2
TOP ROW SUPPRESS
SHEET 2
YMAT
CHAR DOT
SHEET 2
XMAT
CARRY, SHEET 2
+15V
+5V
GROUND
-15V
CHAR IN PROG, SHEET 2
CHAR COMP
SHEET 2
U271B 7493N
U281B 7402N
U281D 7402N
U281C 7402N
U275C 7412N
U345 7475N
U481 2513 ROM A
U291 74151N
U241A 7402N
U241B 7402N
U235D 7408N
U235C 7408N
U241D 7402N
U241C 7402N
U245 7475N
U221D 7404N
U491 ROM B (IF USED)
U285 7490N
U141A 7410N
U145A 7400N
U145D 7400N
U151A 7476N
U175A 7410N
U145B 7400N
U145C 7400N
COLUMN 5 DOTS
COLUMN 4 DOTS
COLUMN 3 DOTS
COLUMN 2 DOTS
COLUMN 1 DOTS
Z ENABLE
ROMA SELECT
ROMB SELECT
(WHEN ROM B IS USED)
C47, C89, C122, C165, C202, C227, C247, C278, C298, C365, C402, C438, C445, C478, C497
U151-4,7,9
U165-2,9,16
U41-11
U51-3,4,10
U71-2,12
U75-10
U81-5
U21-12
U135-7
LF SQUARE PIN
U35-13
U41-13
U45-13
U51-13
APPEARS MORE THAN ONCE



P/O TC-1 CIRCUIT CARD

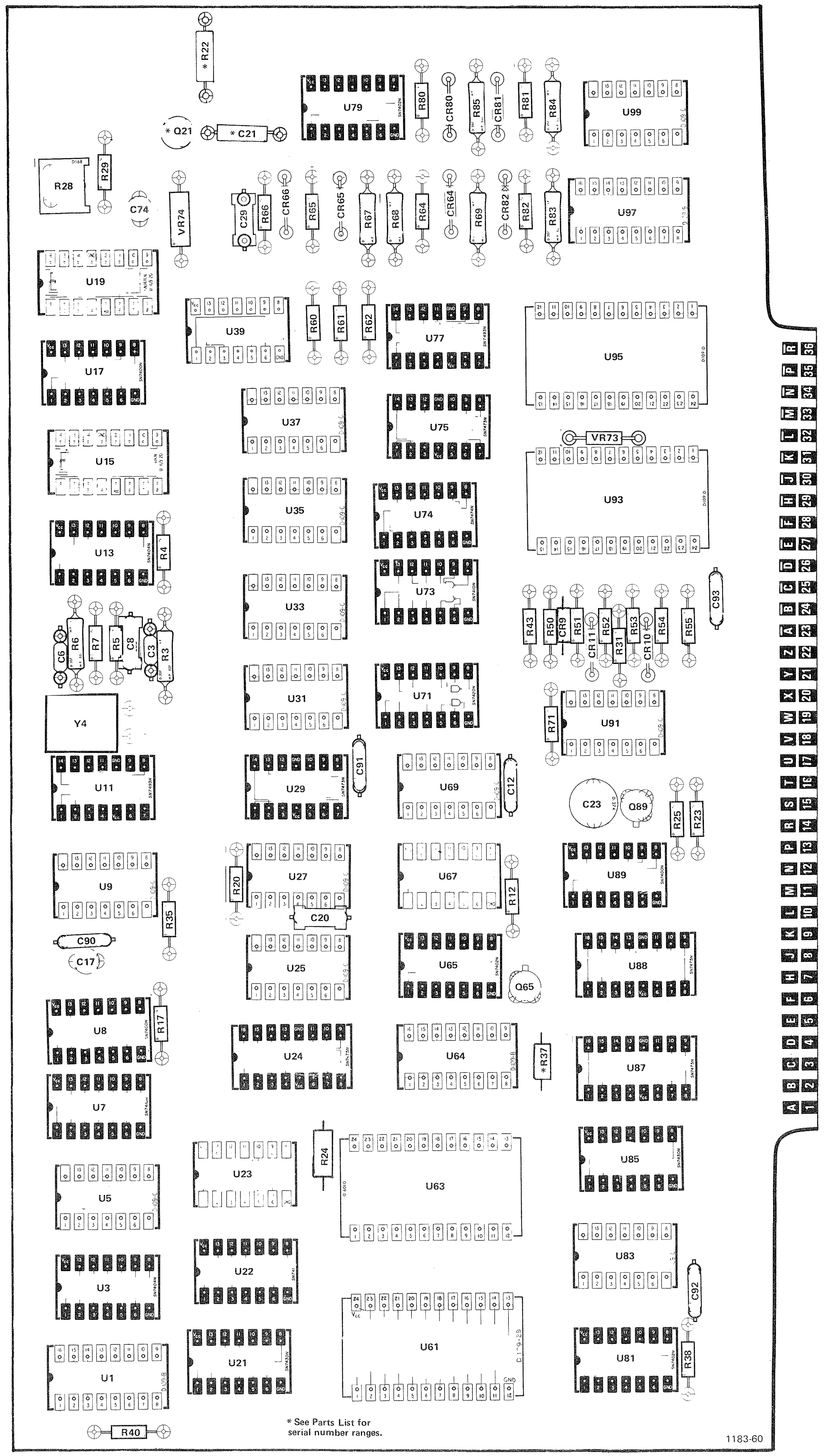
□APPEARS MORE THAN ONCE

REV. F, APRIL 1976
(1461) 1183-38

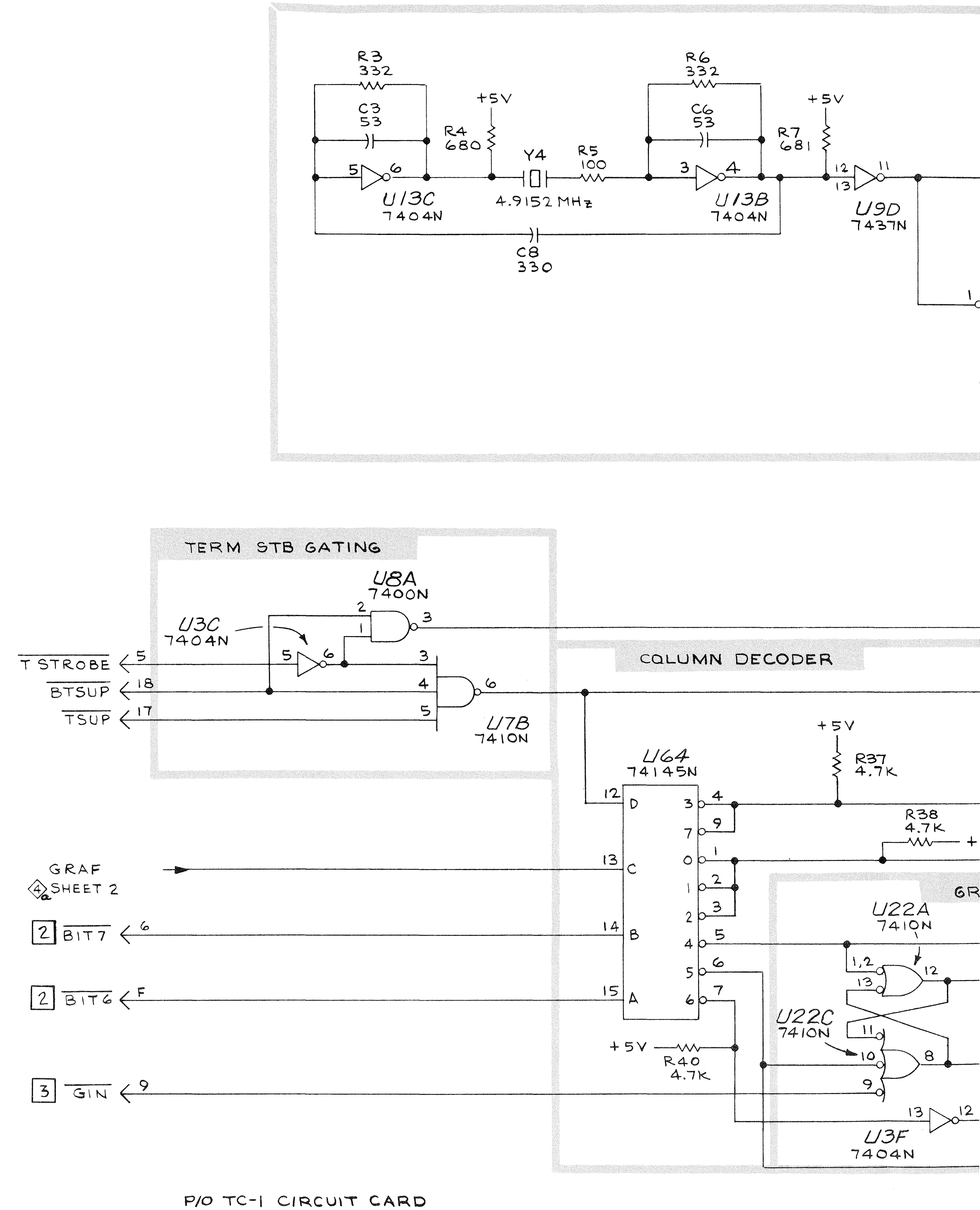
4010/4010-1

A1 670-1728-02,03 TC-1 4a SHEET 1 OF 3

SHEET 1 OF 3 TC-1
A1 670-1728-02,03

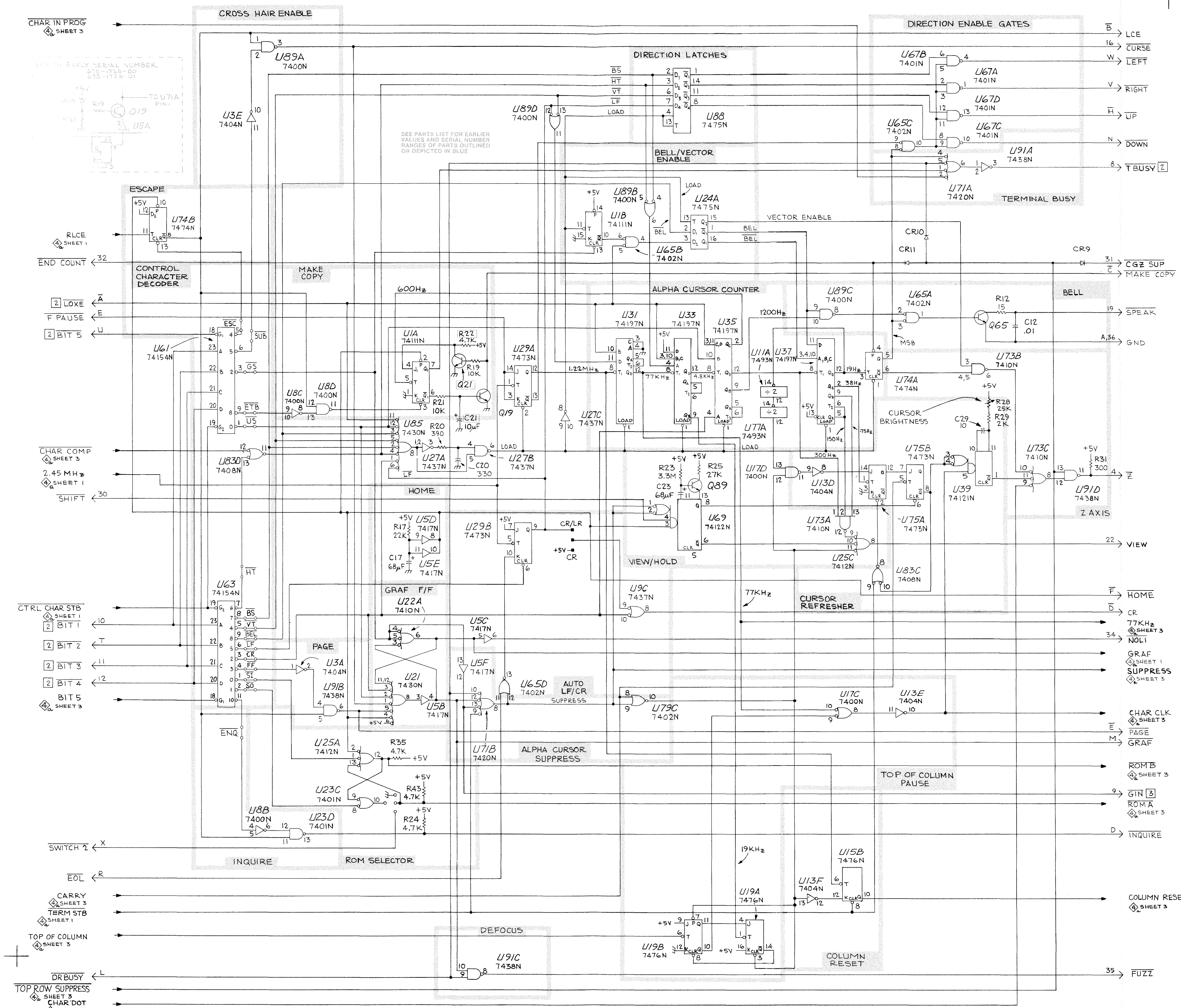


TC-1 Component Locations (670-1728-02,03).



REV. F, APRIL 1976
(1461) 1183-38

4010/4010-1



P/O TC-1 CIRCUIT BOARD

4010/4010-1

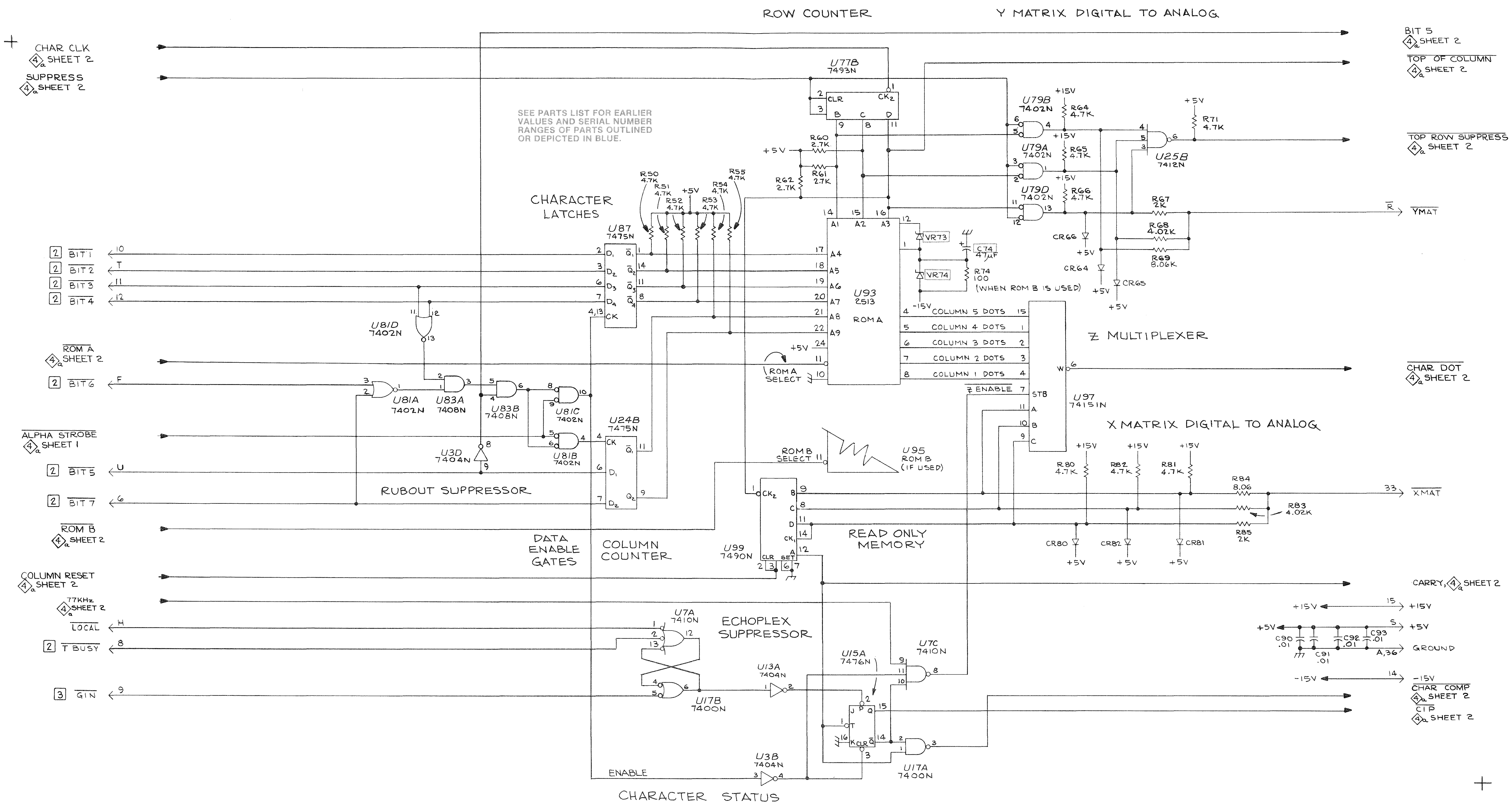
REV. F, APRIL 1976
(1461)1183-71

☐ APPEARS MORE THAN ONCE

A1 670-1728-02,03

TC-1 4a SHEET 2 OF 3

SHEET 2 OF 3 TC-1
A1 670-1728-02,03



P/O TC-1 CIRCUIT BOARD

☐ APPEARS MORE THAN ONCE

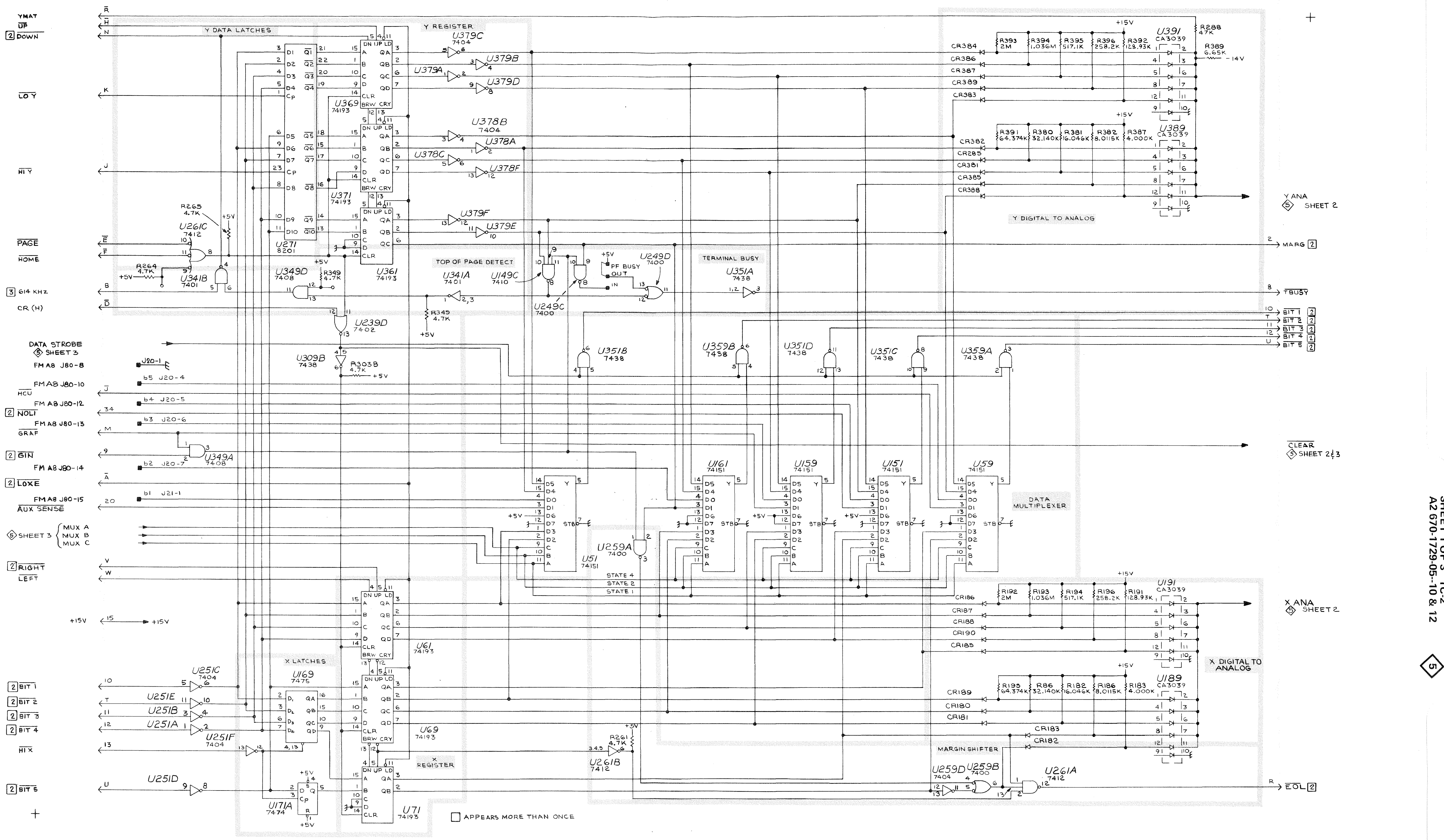
4010/4010-1

REV. F, APRIL 1976
1183-72

A1 670-1728-02,03 TC-1 4a SHEET 3 OF 3 476 RH

SHEET 3 OF 3 TC-1
A1 670-1728-02,03

Parts List for
l number ranges.

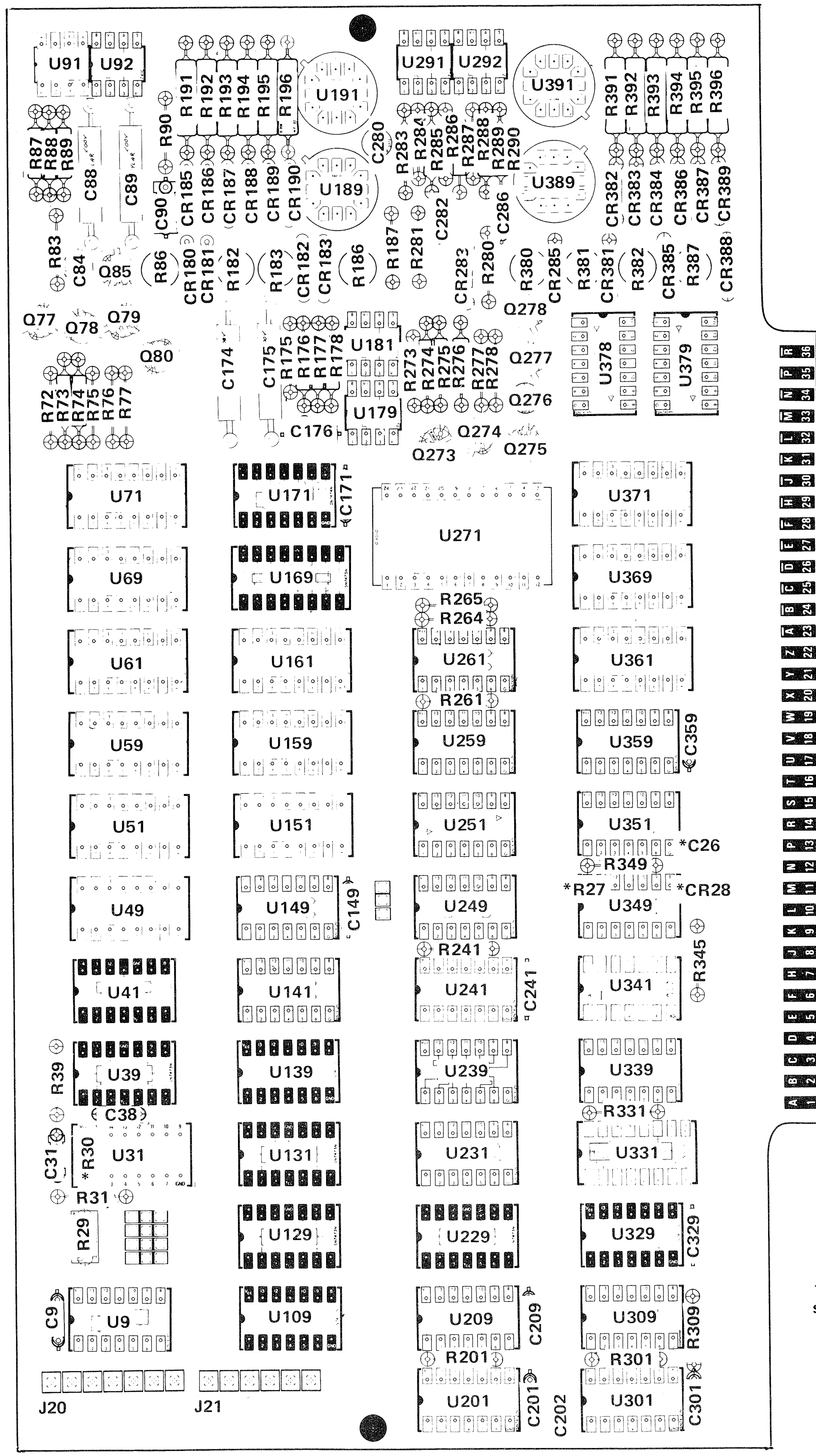


P/O A2 TC-2 CARD

4010/4010-1

REV. D, APRIL 1976
(1461) 1183-87

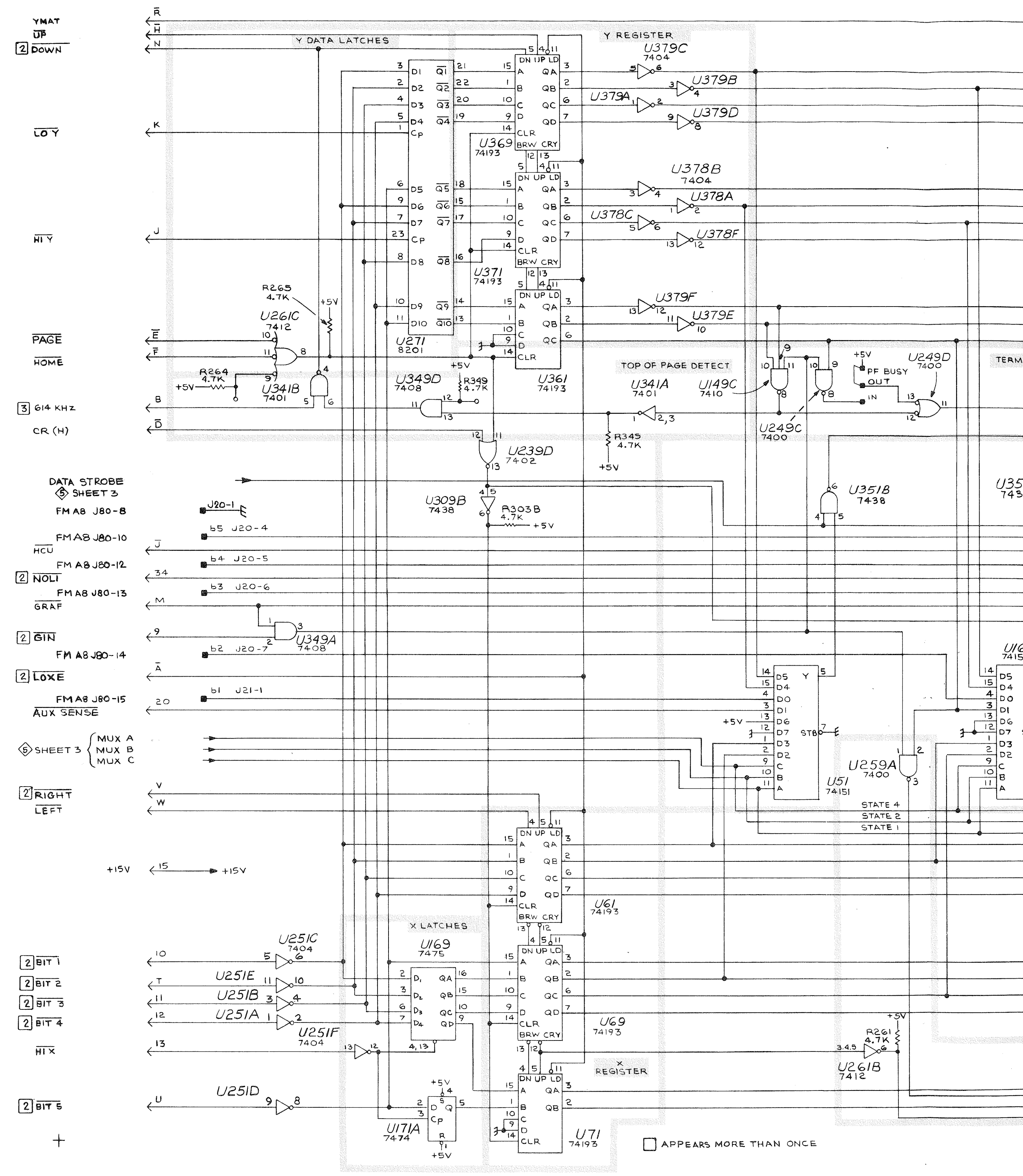
A2 670-1729-05—10 & 12 TC-2 (5) SHEET 1 OF 3



*See Parts List for serial number ranges.

(1461)1183-74

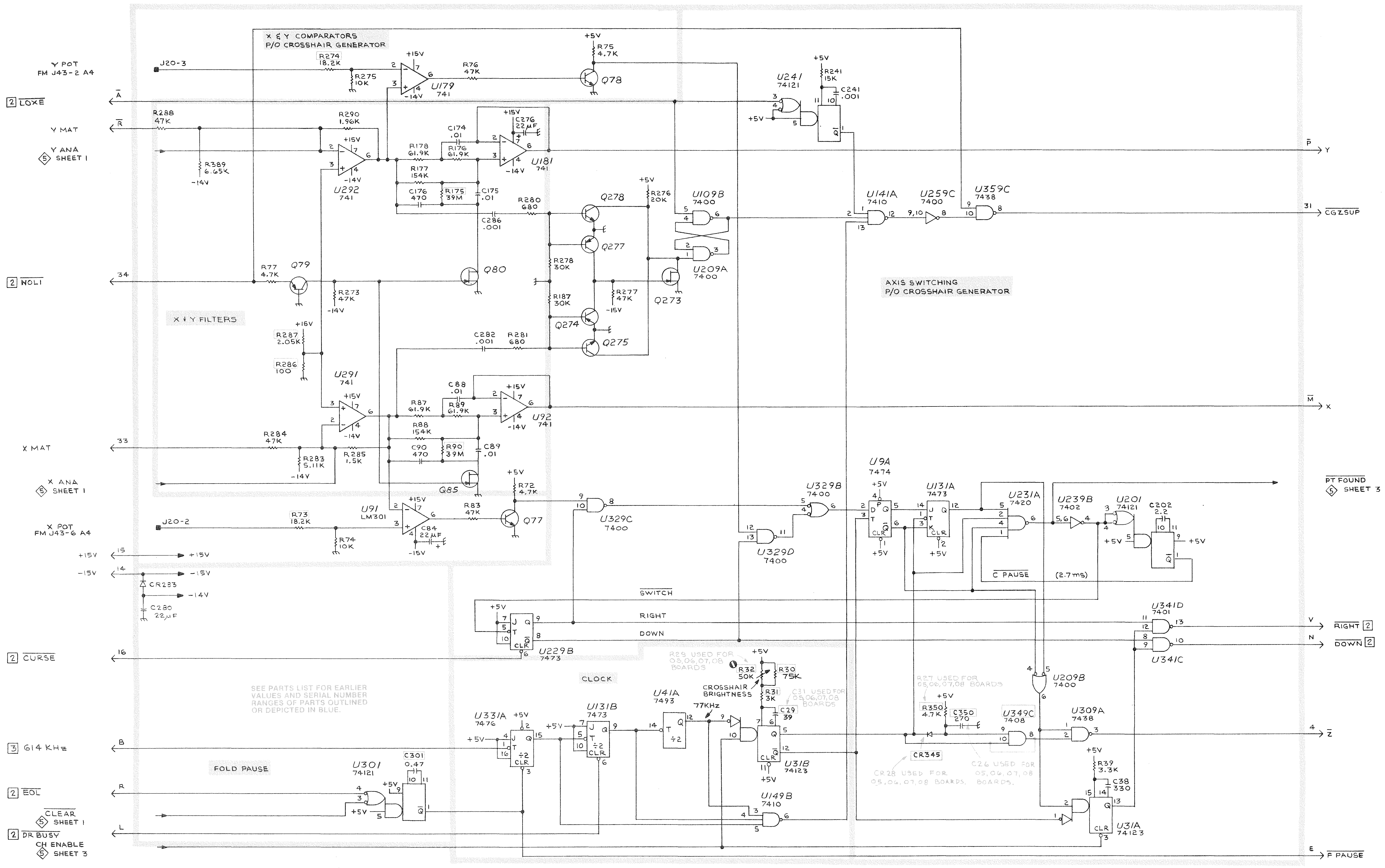
TC-2 Component Locations (670-1729-05—10 & 12).



P/O A2 TC-2 CARD

4010/4010-1

REV. D, A
(1461)118



P/O A2 TC-2 CARD

☐ APPEARS MORE THAN ONCE

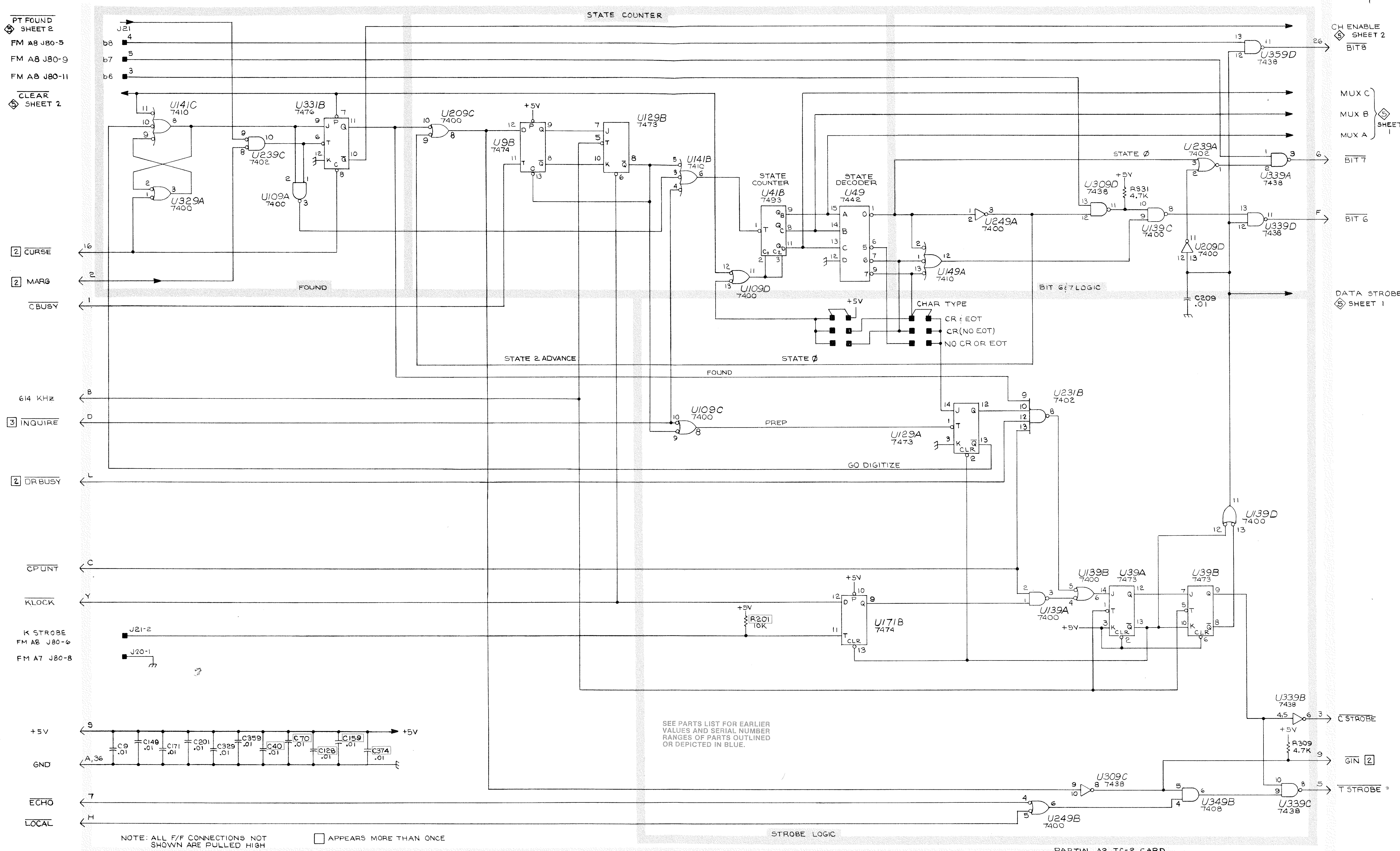
4010/4010-1

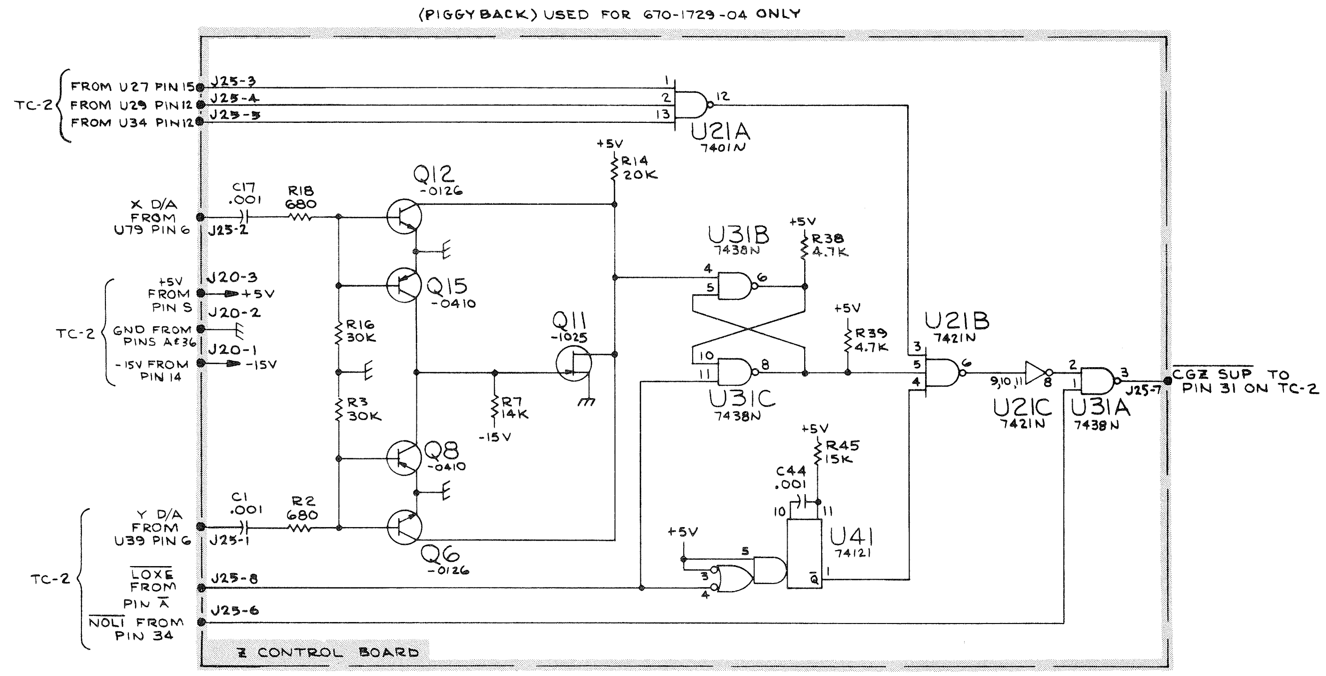
REV. D, APRIL 1976
(1461) 1183-80

A2 670-1729-05-10&12 TC-2 ⑤ SHEET 2 OF 3

SHEET 2 OF 3 TC-2
A2 670-1729-05-10 & 12

⑤

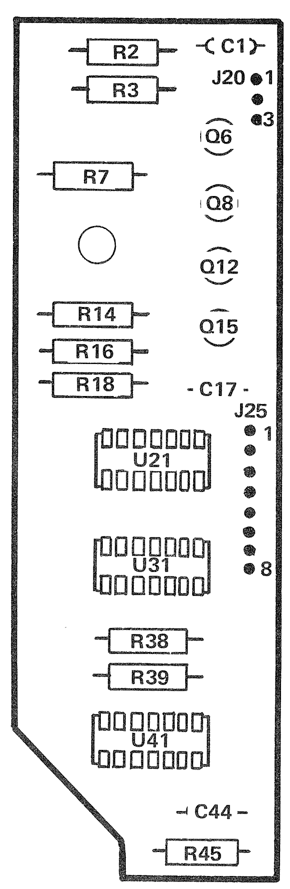

STATE COUNTER
PT FOUND
SHEET 2
FM A8 J80-5
FM A8 J80-9
FM A8 J80-11
CLEAR
SHEET 2
CURSE
MARG
CBUSY
614 KHz
INQUIRE
DRBUSY
CPUNT
KLOCK
K STROBE
FM A8 J80-6
FM A7 J80-8
+5V
GND
ECHO
LOCAL
FOUND
STATE 2 ADVANCE
STATE Ø
PREP
GO DIGITIZE
STATE COUNTER
STATE DECODER
CHAR TYPE
CR & EOT
CR (NO EOT)
NO CR OR EOT
BIT 6/7 LOGIC
CH ENABLE
SHEET 2
BIT 8
MUX C
MUX B
MUX A
SHEET 1
BIT 7
BIT 6
DATA STROBE
SHEET 1
C STROBE
GIN
T STROBE
STROBE LOGIC
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN BLUE.
NOTE: ALL F/F CONNECTIONS NOT SHOWN ARE PULLED HIGH
APPEARS MORE THAN ONCE
PARTIAL A2 TC-2 CARD



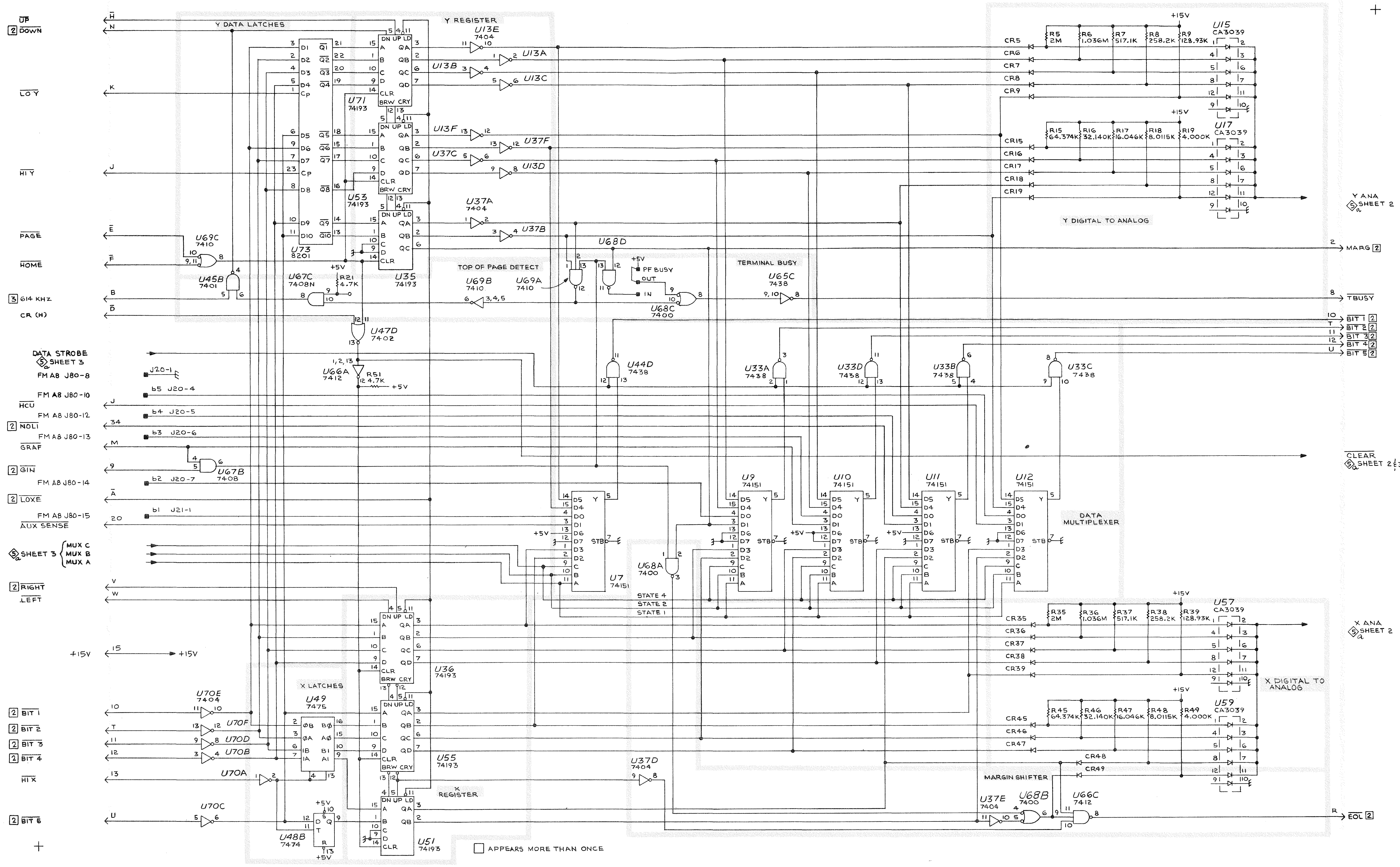
4010/4010-1

REV. A, APRIL 1976
(1461) 1183-82

670-3084-00 Z CONTROL BOARD
(PIGGYBACK FOR 670-1729-04 ONLY)



Z Control Component Locations (670-3084-00).



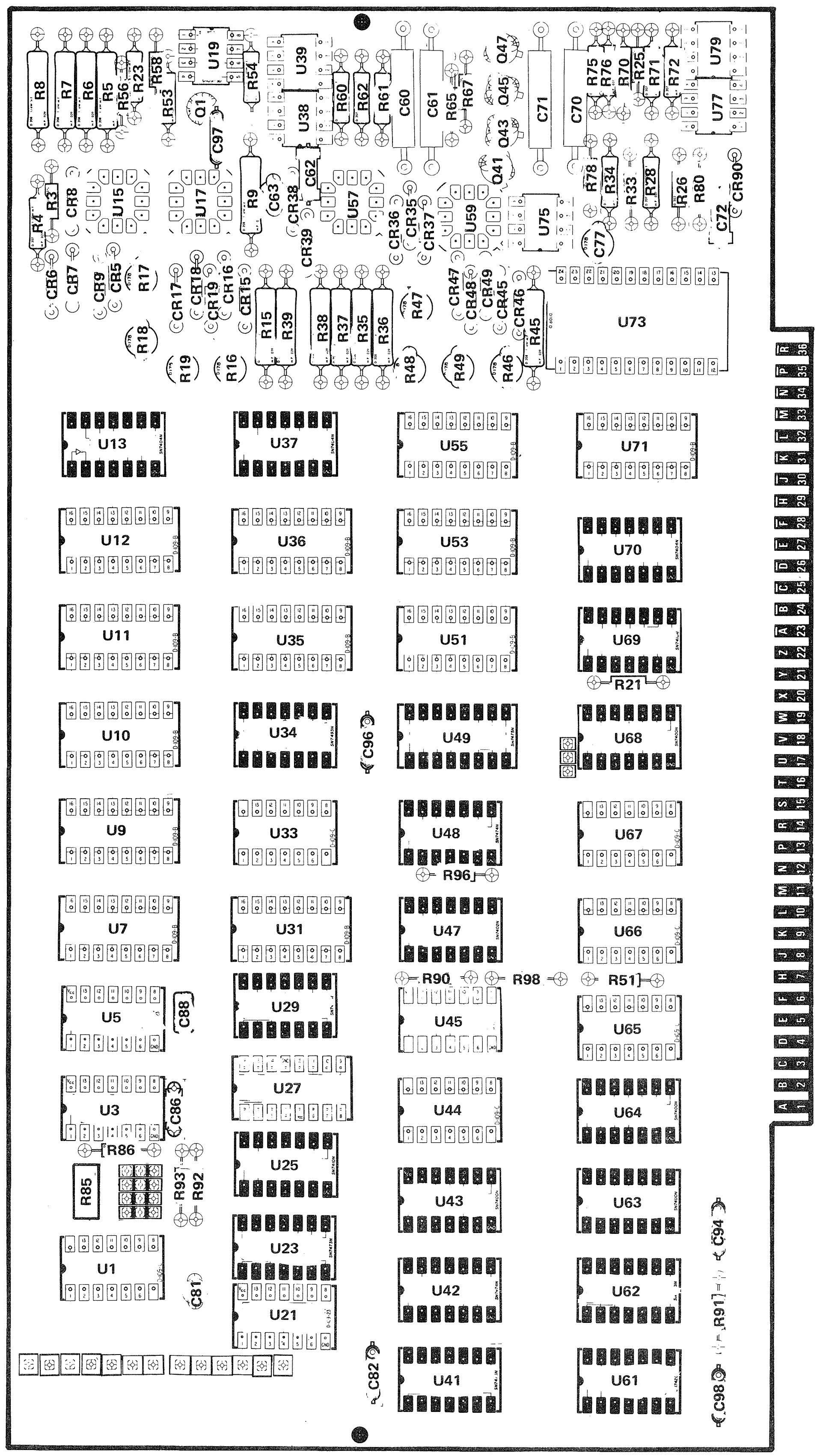
PARTIAL A2 TC-2 CARD

4010/4010-1

REV. E, APRIL 1976
(1461) 1183-83

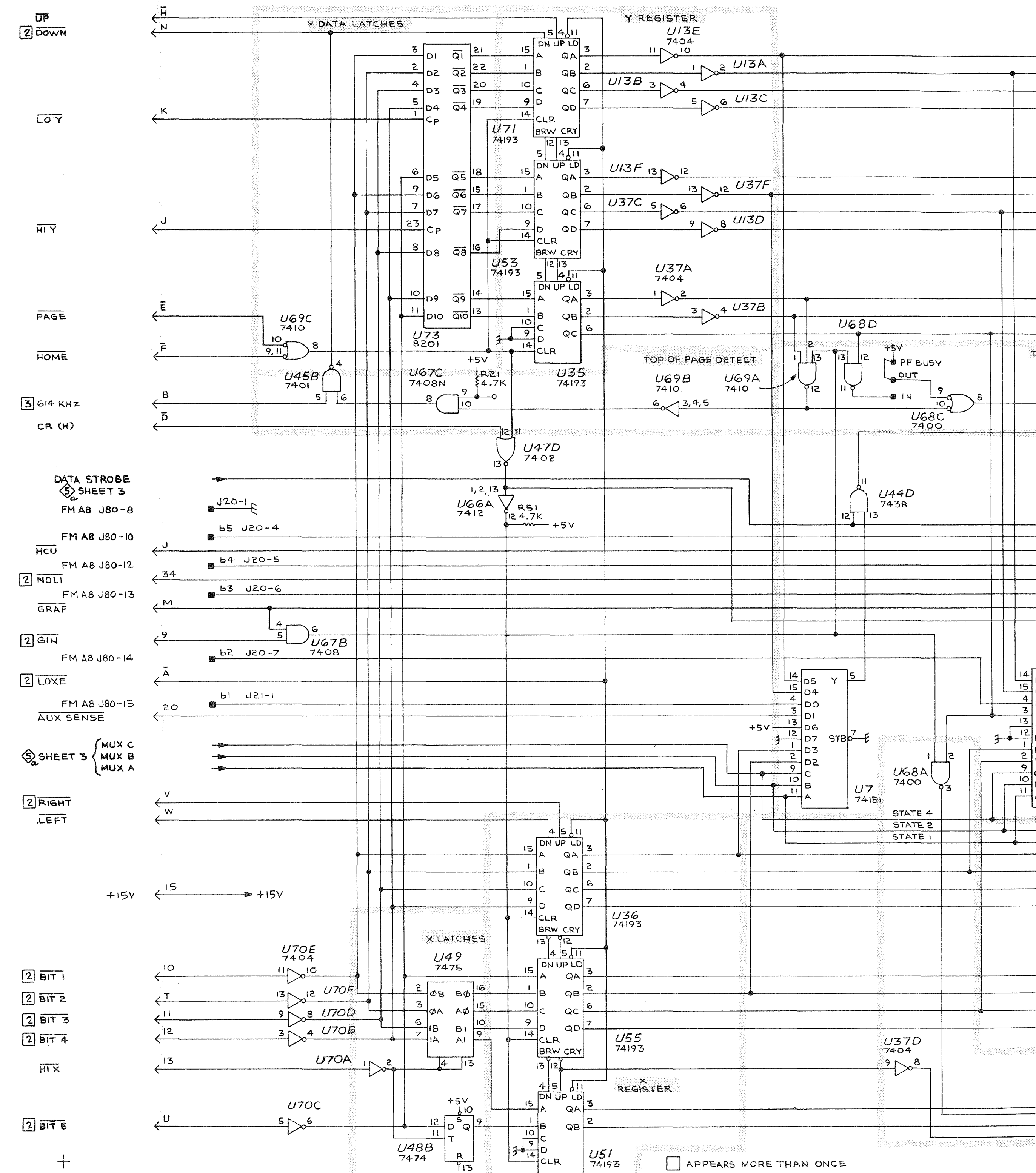
A2 670-1729-04 & BELOW TC-2 5a SHEET 1 OF 3

SHEET 1 OF 3 TC-2
A2 670-1729-04 & BELOW 5a



TC-2 Component Locations (670-1729-04 and below).

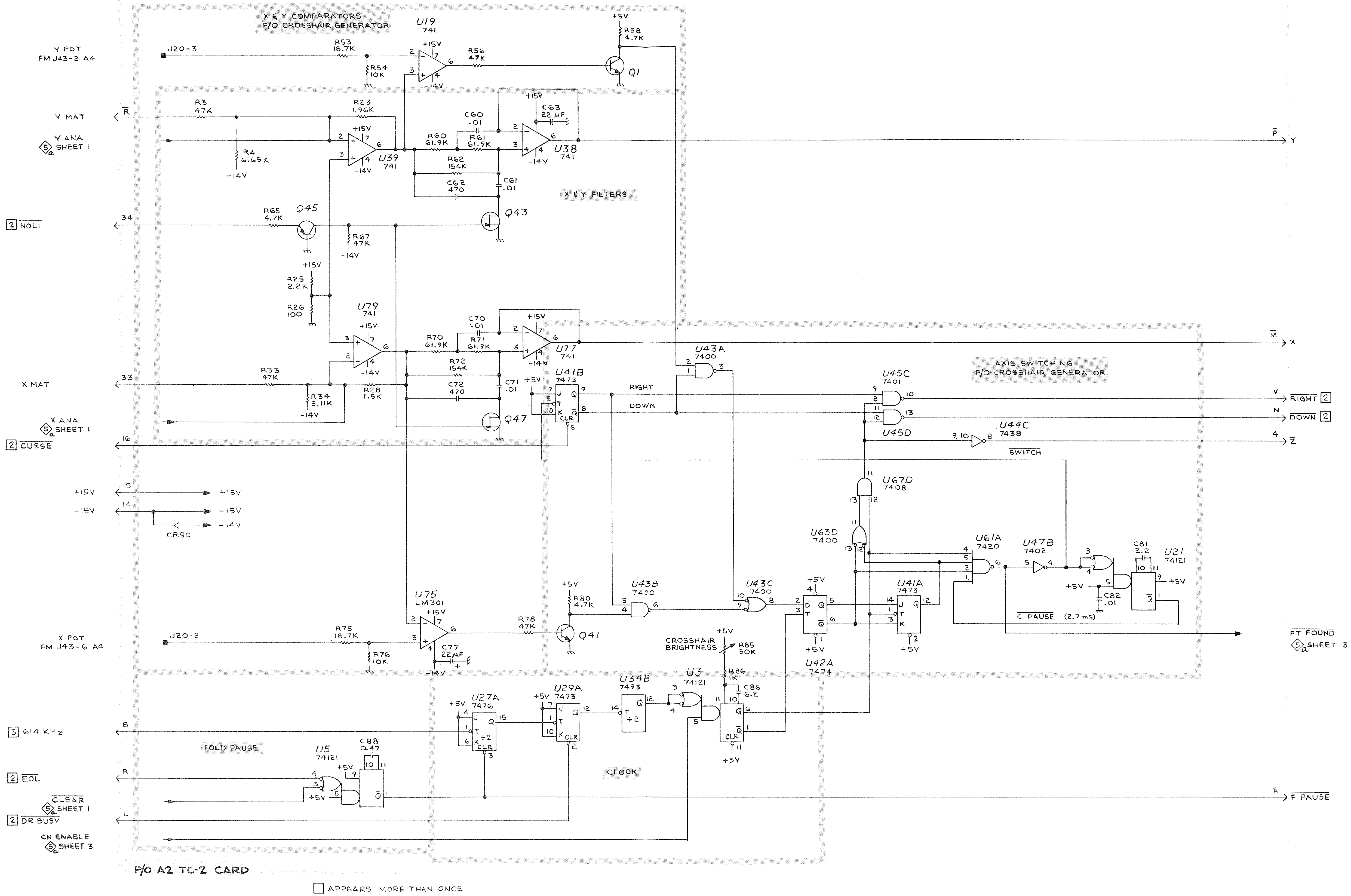
(1461)1183-76



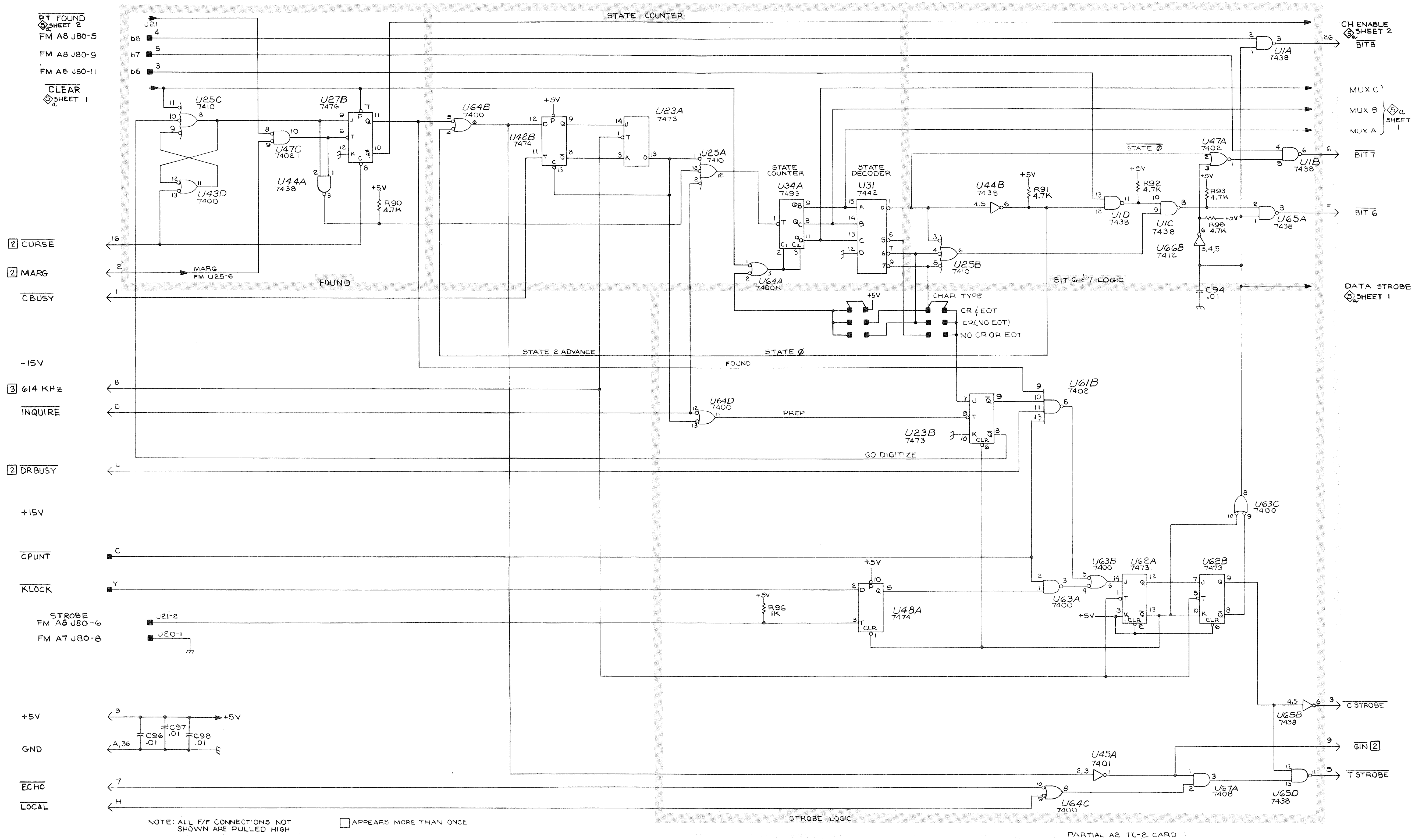
PARTIAL A2 TC-2 CARD

4010/4010-1

REV. E
(1461)



SHEET 2 OF 3 TC-2
A2 670-1729-04 & BELOW

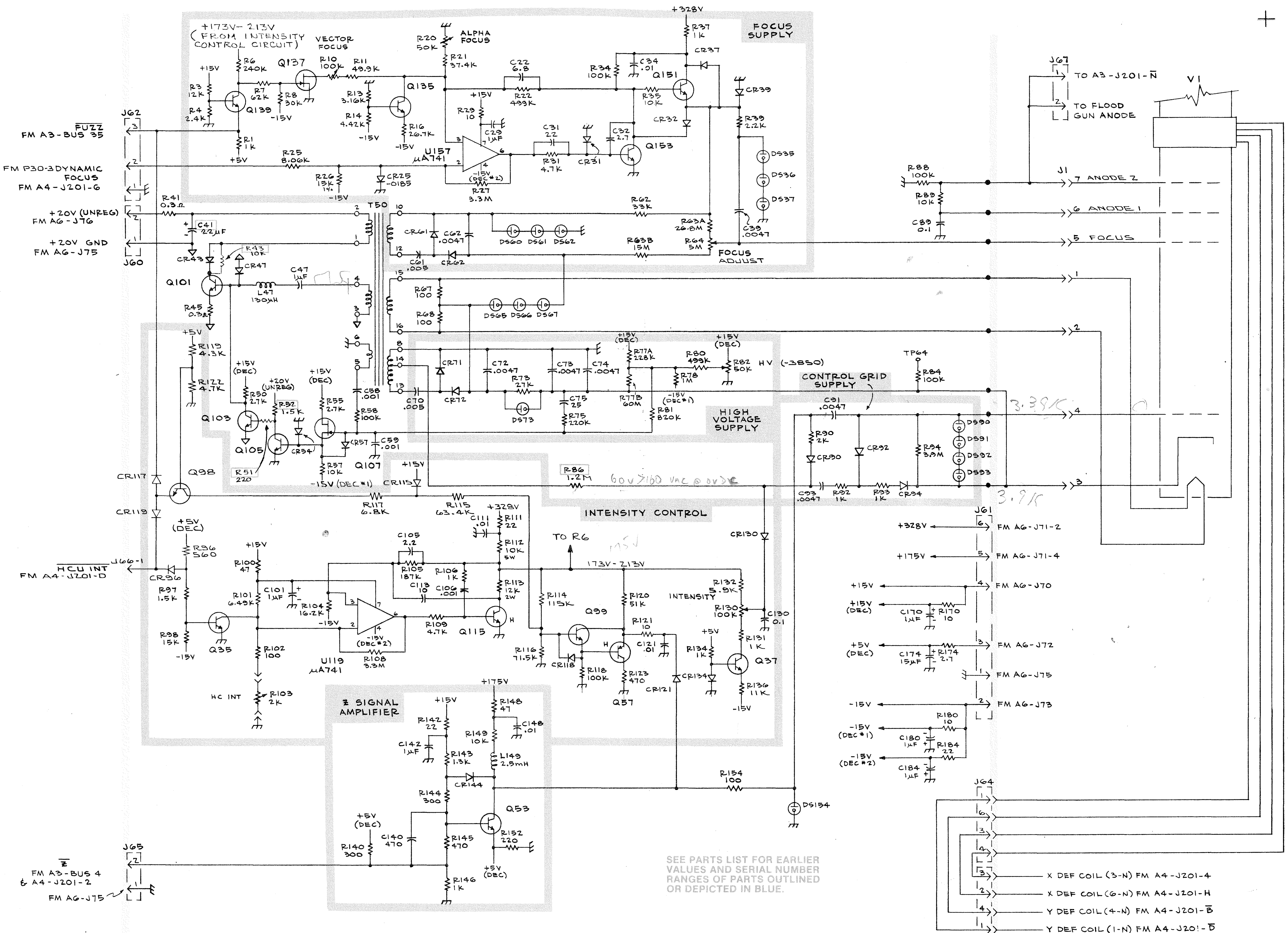


4010/4010-1

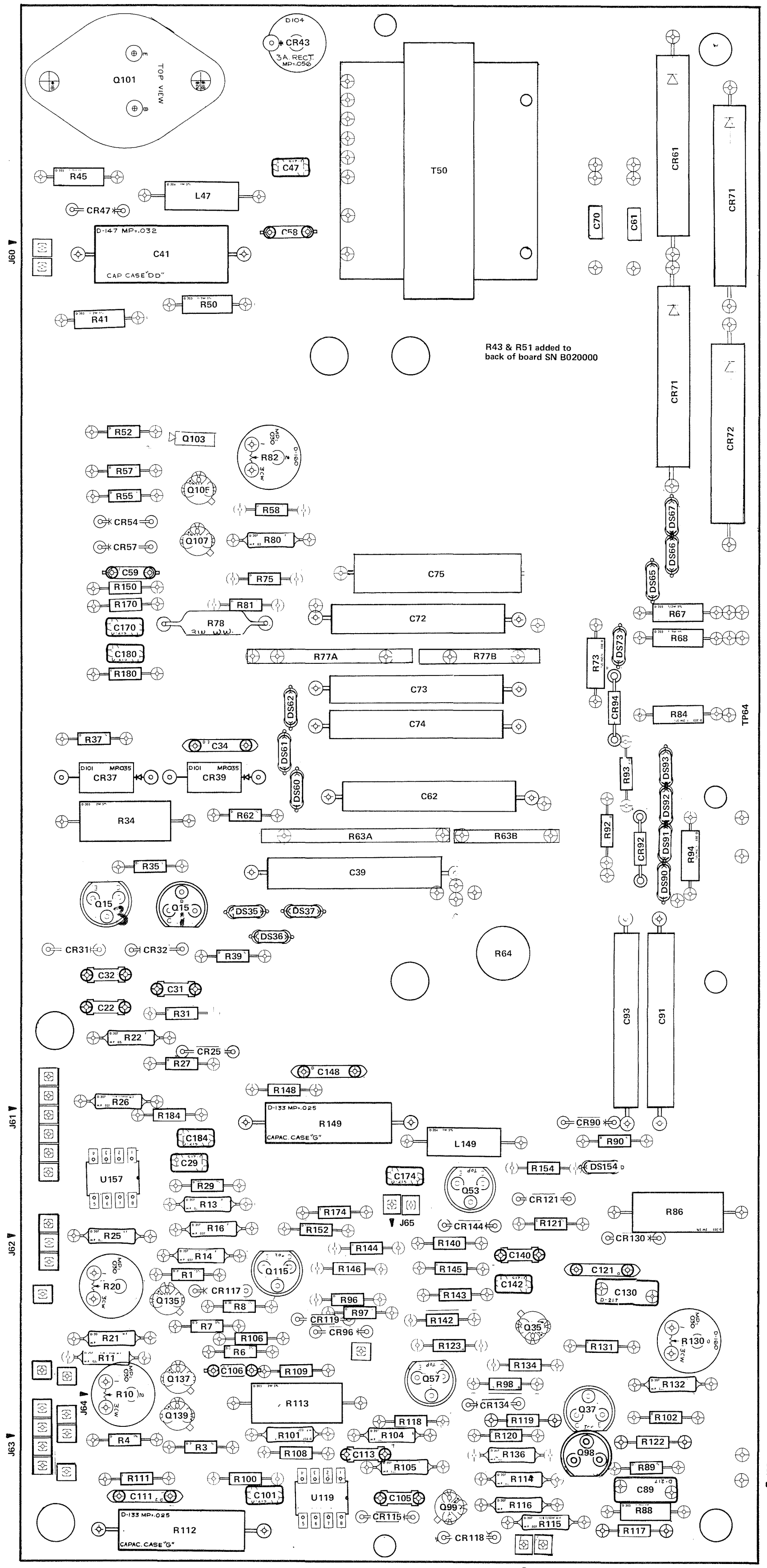
REV. E, APRIL 1976
(1461) 1183-85

A2 670-1729-04 & BELOW TC-2 5a SHEET 3 OF 3

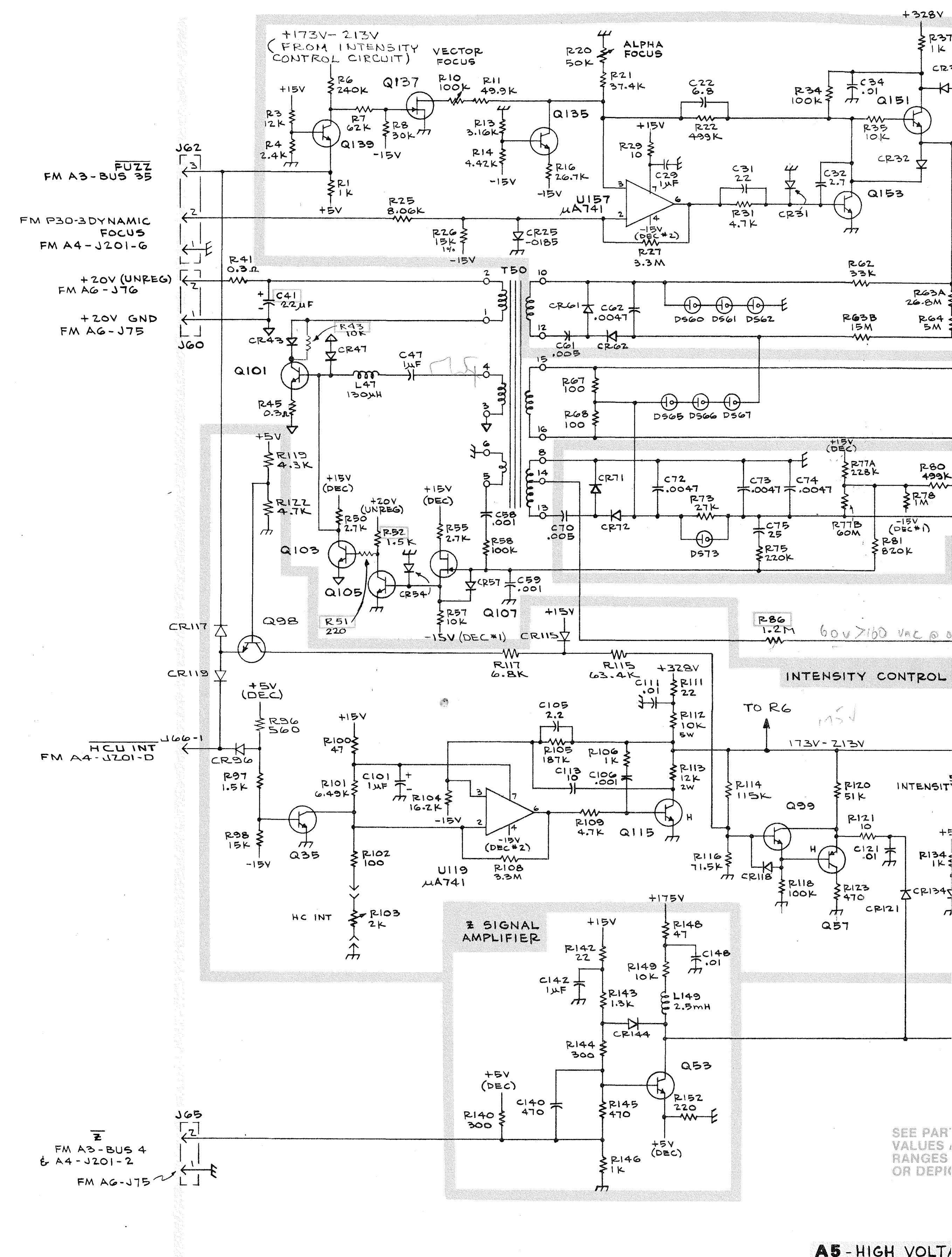
SHEET 3 OF 3 TC-2
A2 670-1729-04 & BELOW 5a



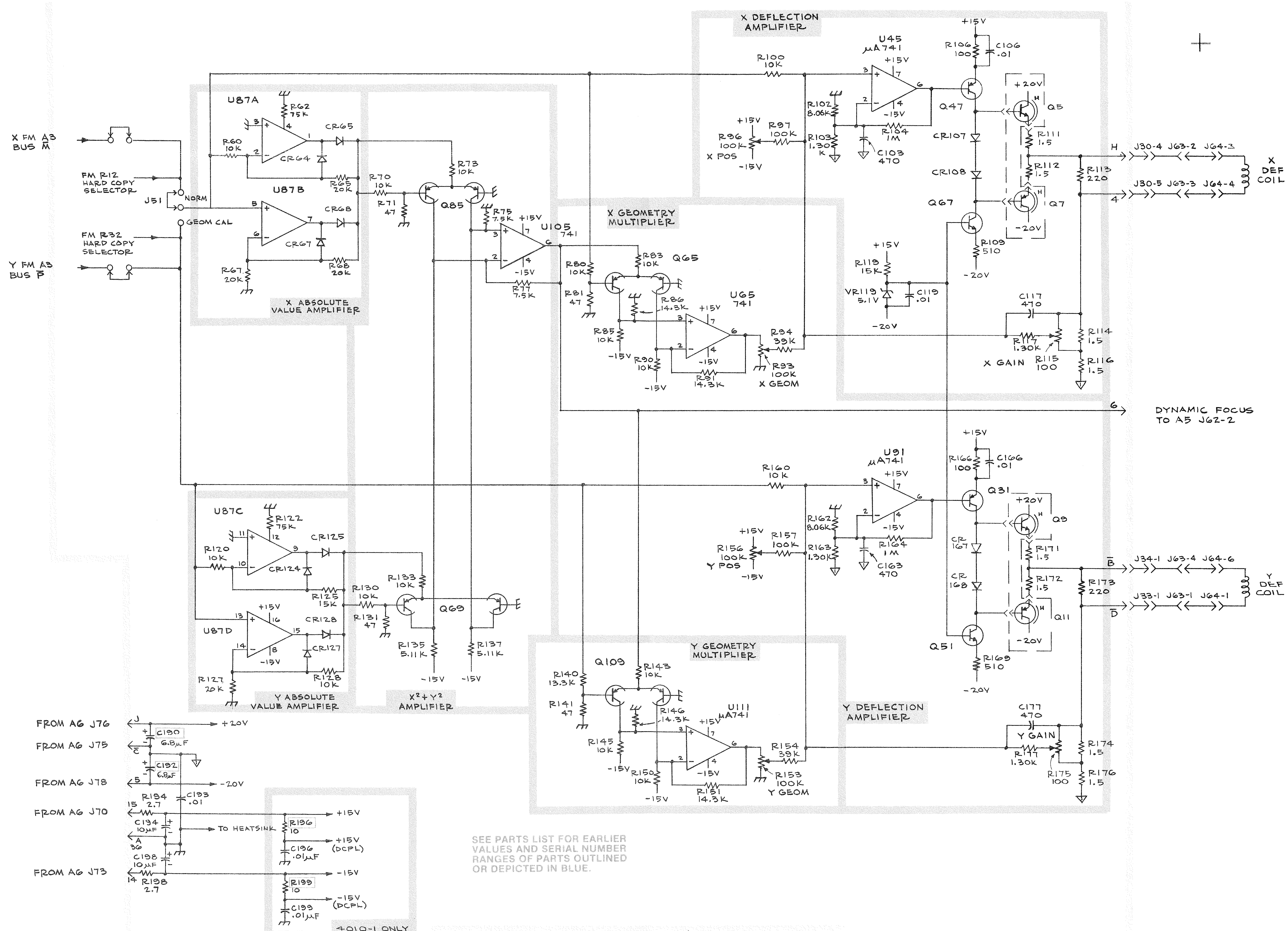
A5-HIGH VOLTAGE & Z AXIS BOARD



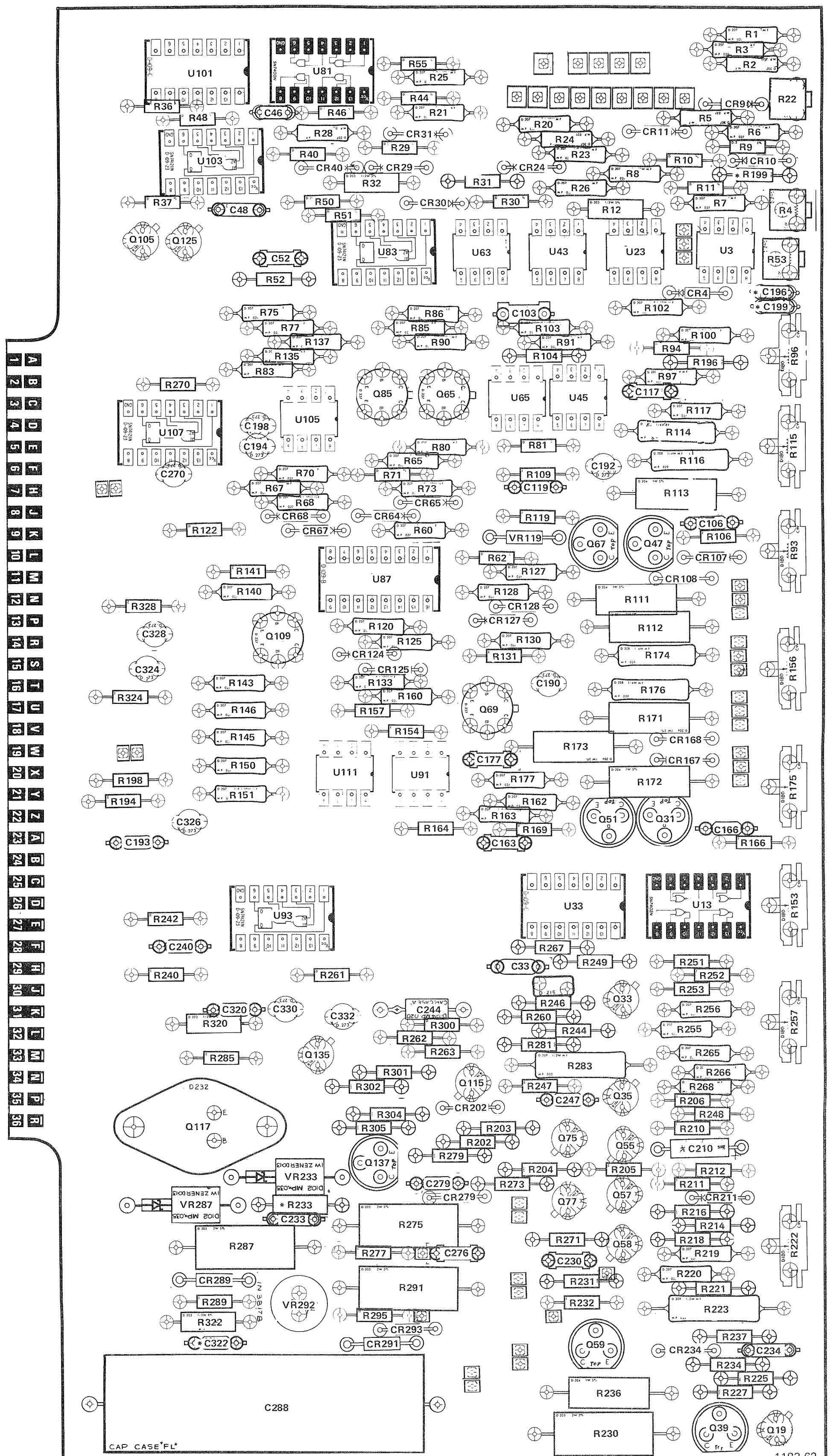
High Voltage Component Locations.



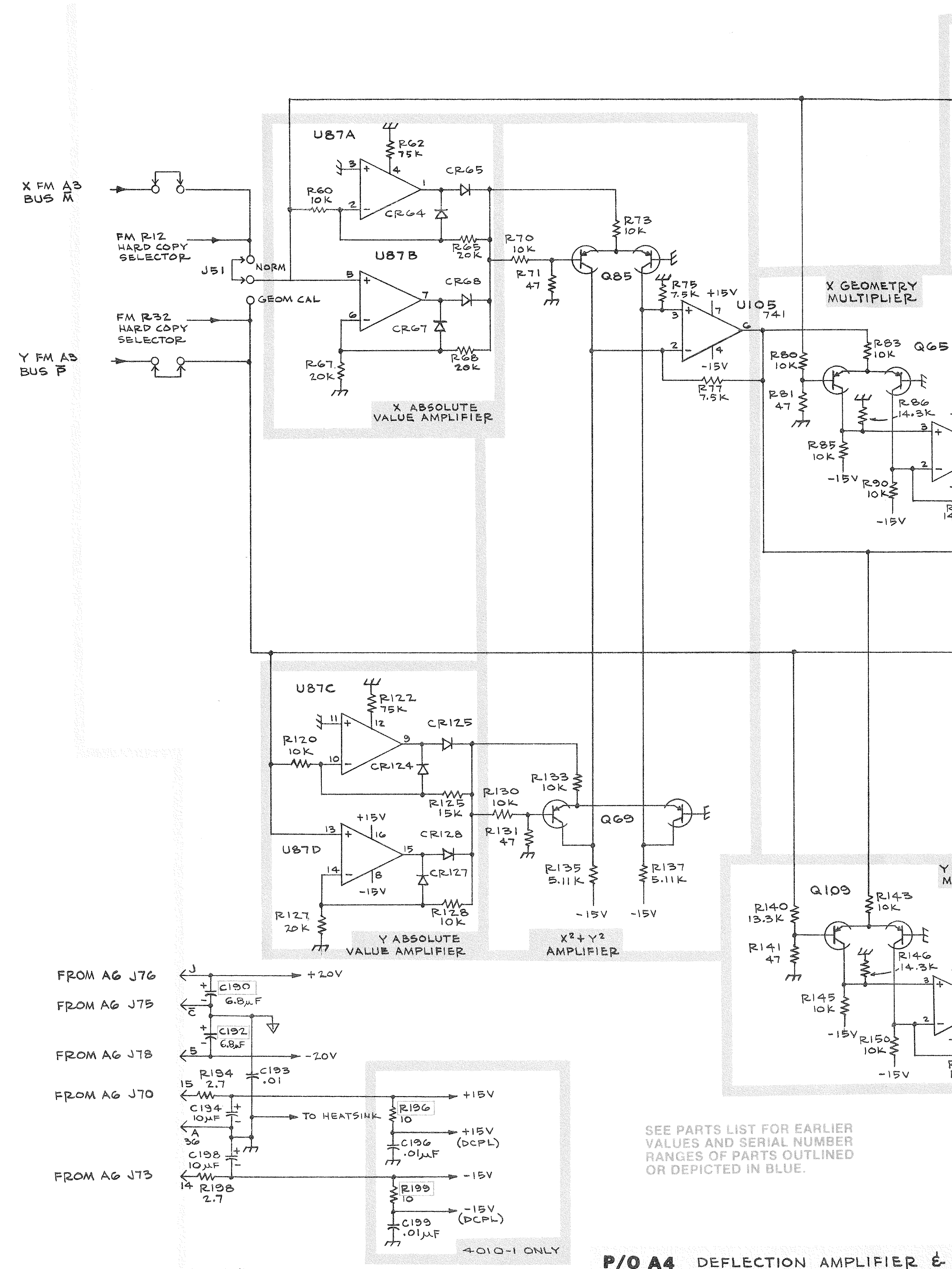
A5 - HIGH VOLTA



P/O A4 DEFLECTION AMPLIFIER & STORAGE BOARD

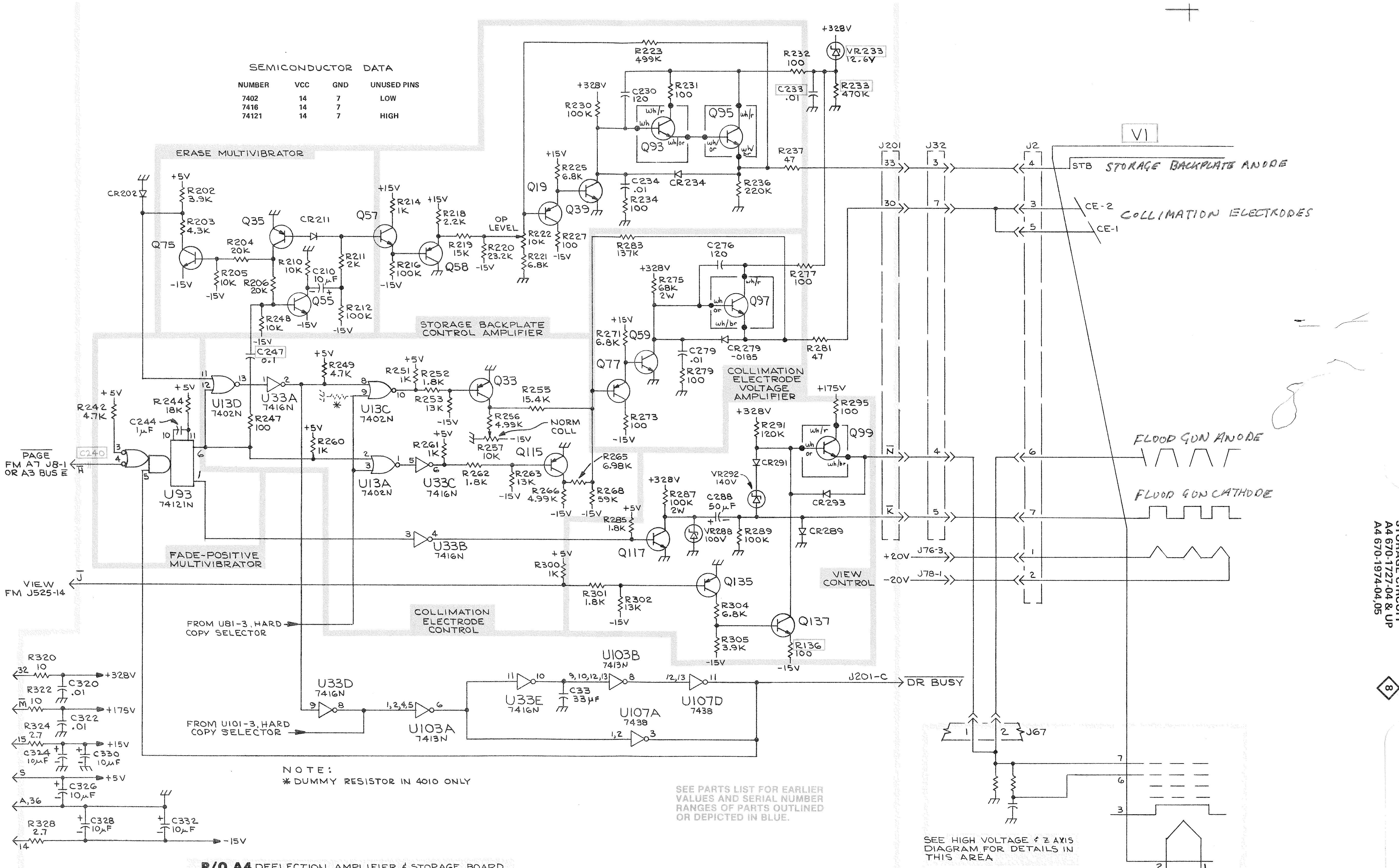


Deflection Amp and Storage Component Locations — 670-1727-03 & below (4010-1 only) & 670-1974-03 & below (4010 only).



4010/4010-1

REV. E, APRIL 1976
1183-40

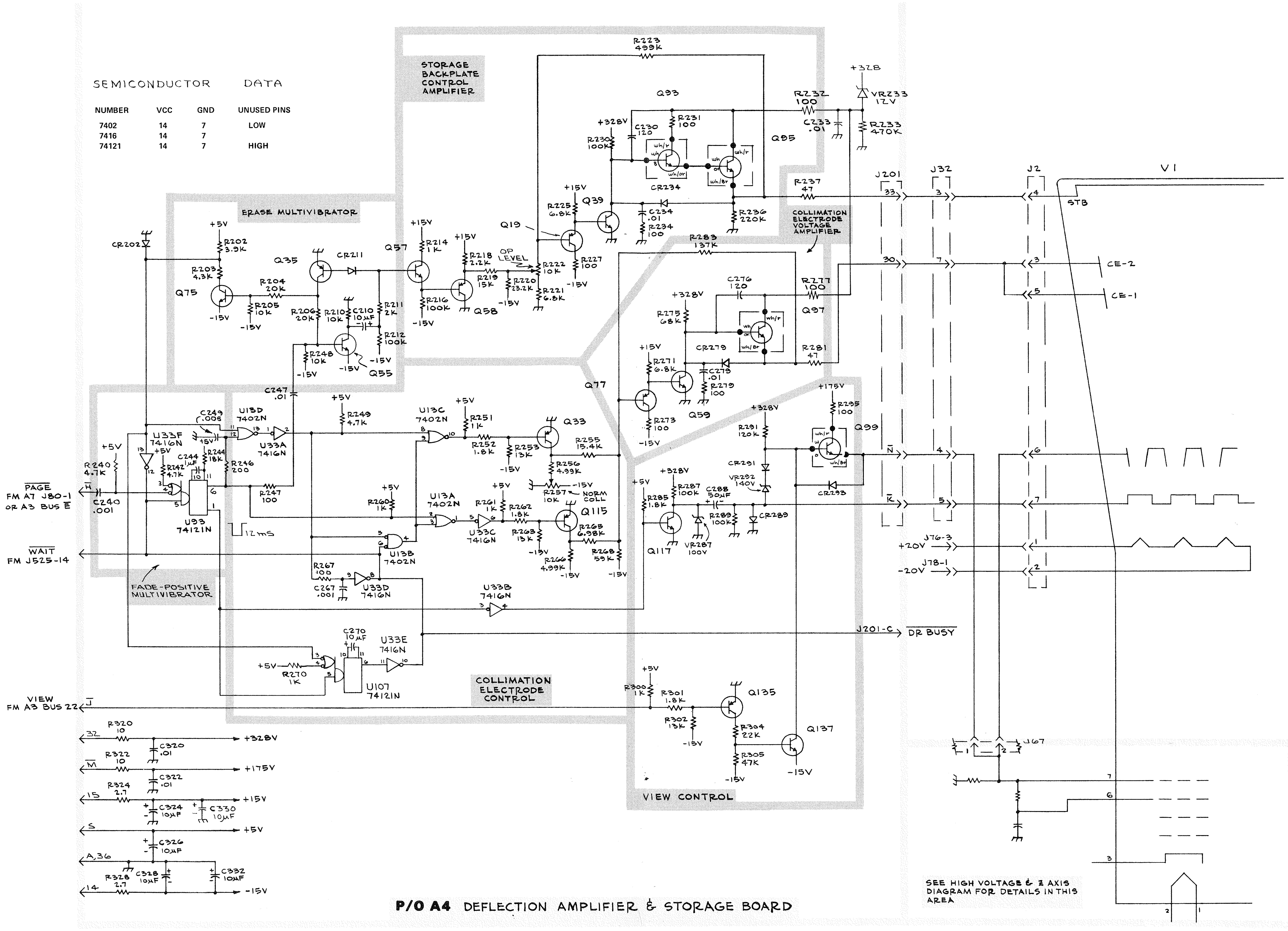


4010/4010-1

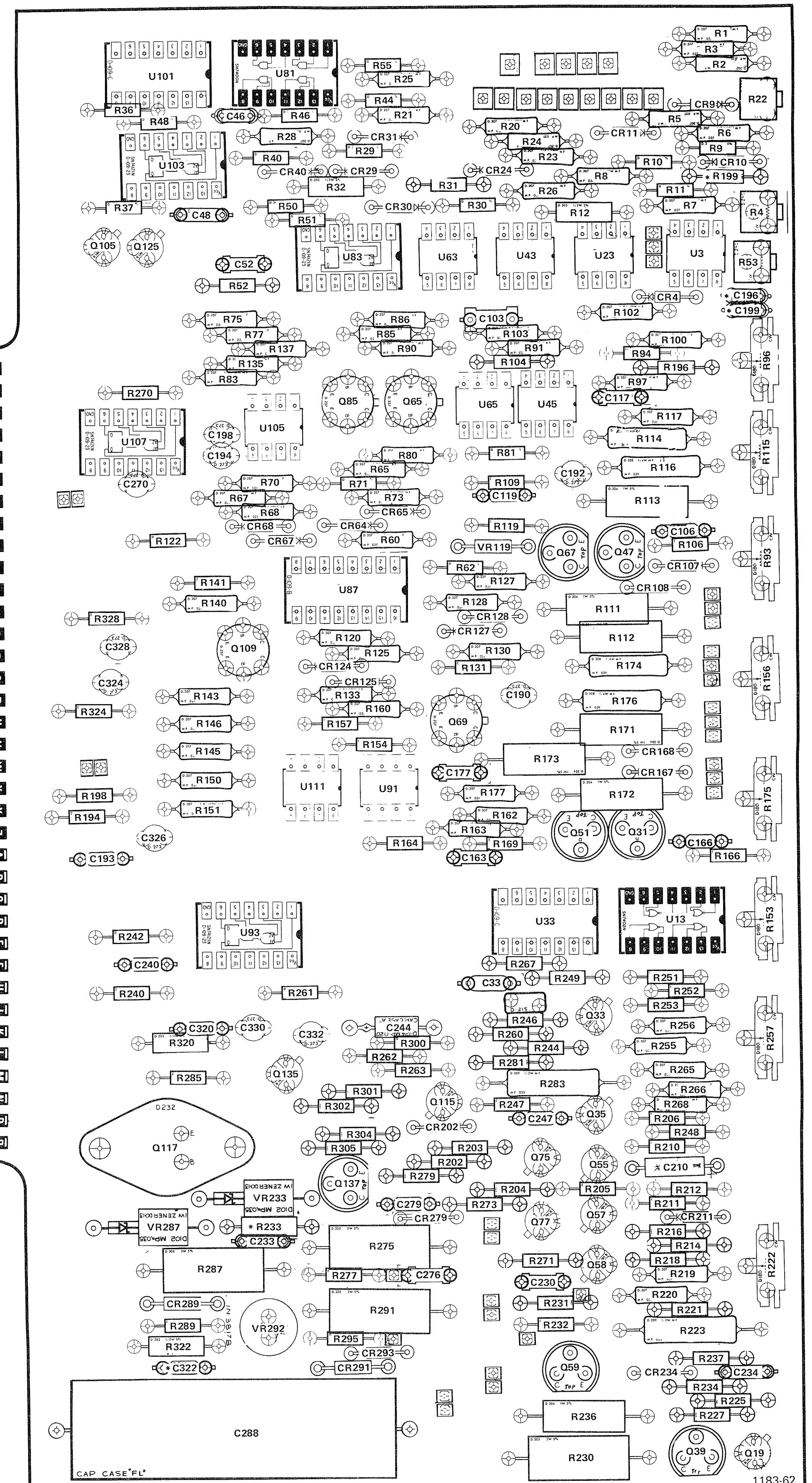
REV. D, APRIL 1976
1183-42

STORAGE CIRCUIT 8
670-1727-04 & UP
670-1974-04,05

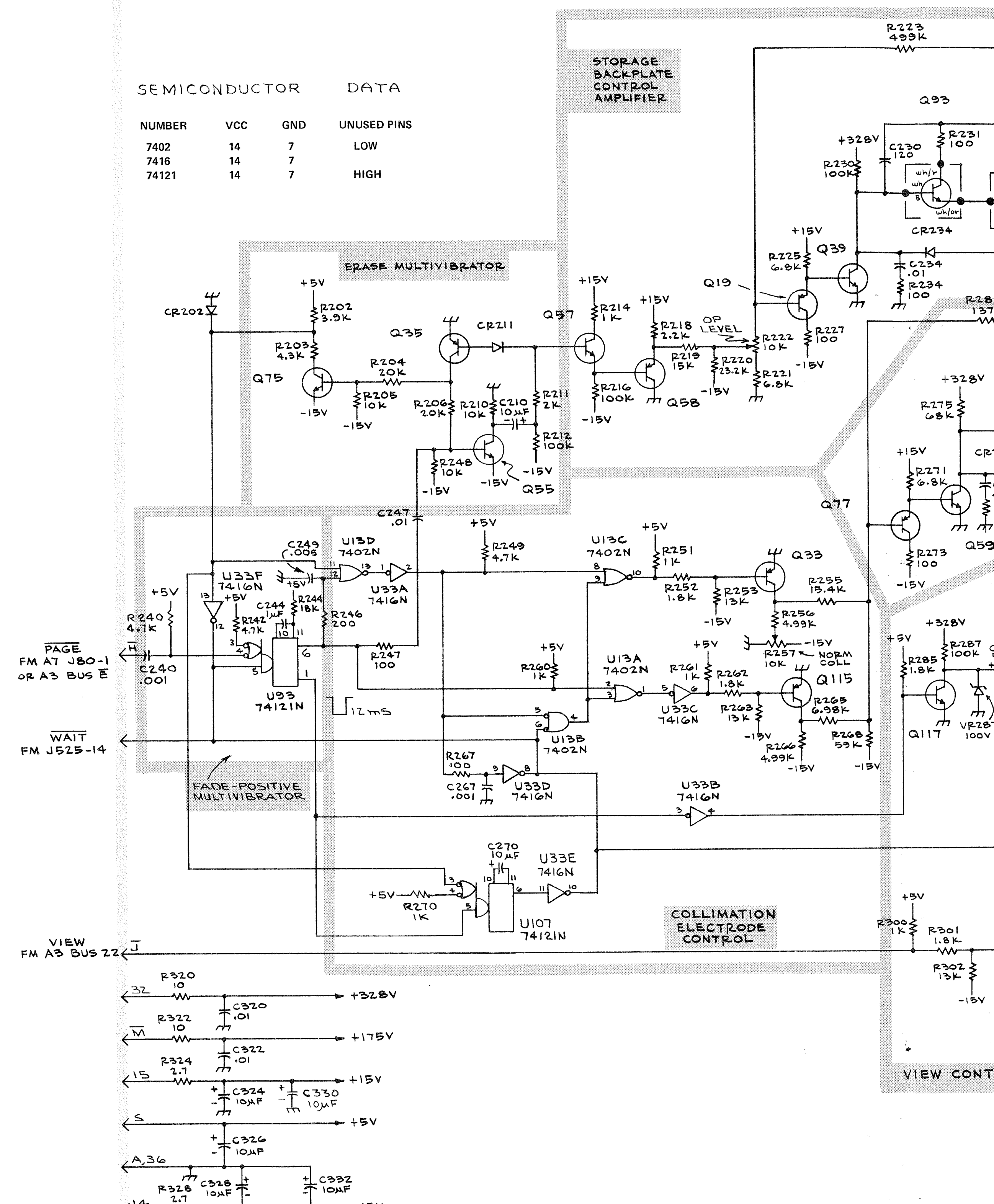
OURS
05



P/O A4 DEFLECTION AMPLIFIER & STORAGE BOARD



Deflection Amp and Storage Component Locations — 670-1727-03 & below (4010-1 only) & 670-1974-03 & below (4010 only).



SEMICONDUCTOR DATA

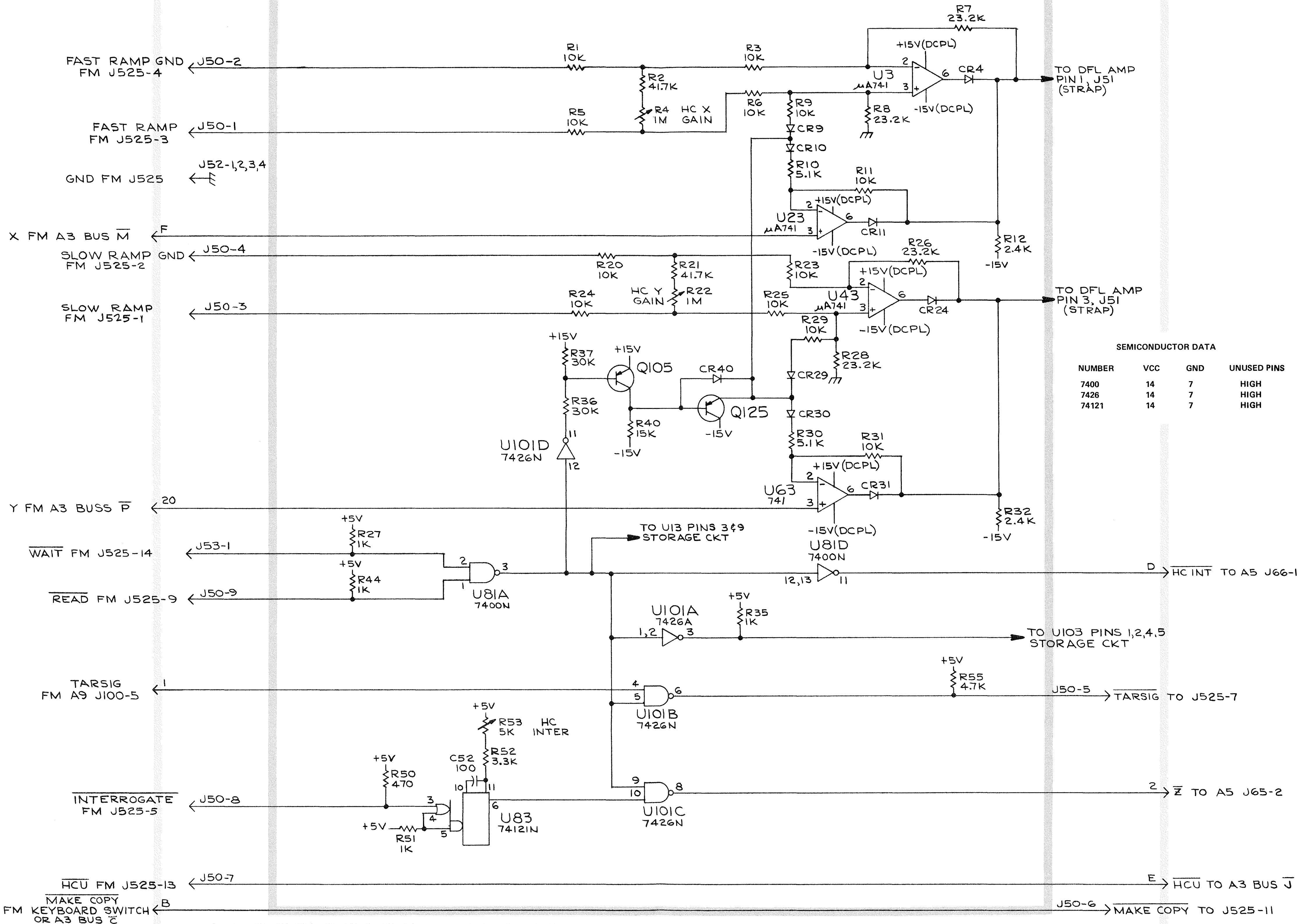
NUMBER	VCC	GND	UNUSED PINS
7402	14	7	LOW
7416	14	7	
74121	14	7	HIGH

P/O A4 DEFLECTION AMPLIFIER & STORA

4010/4010-1

REV. F, APRIL 1

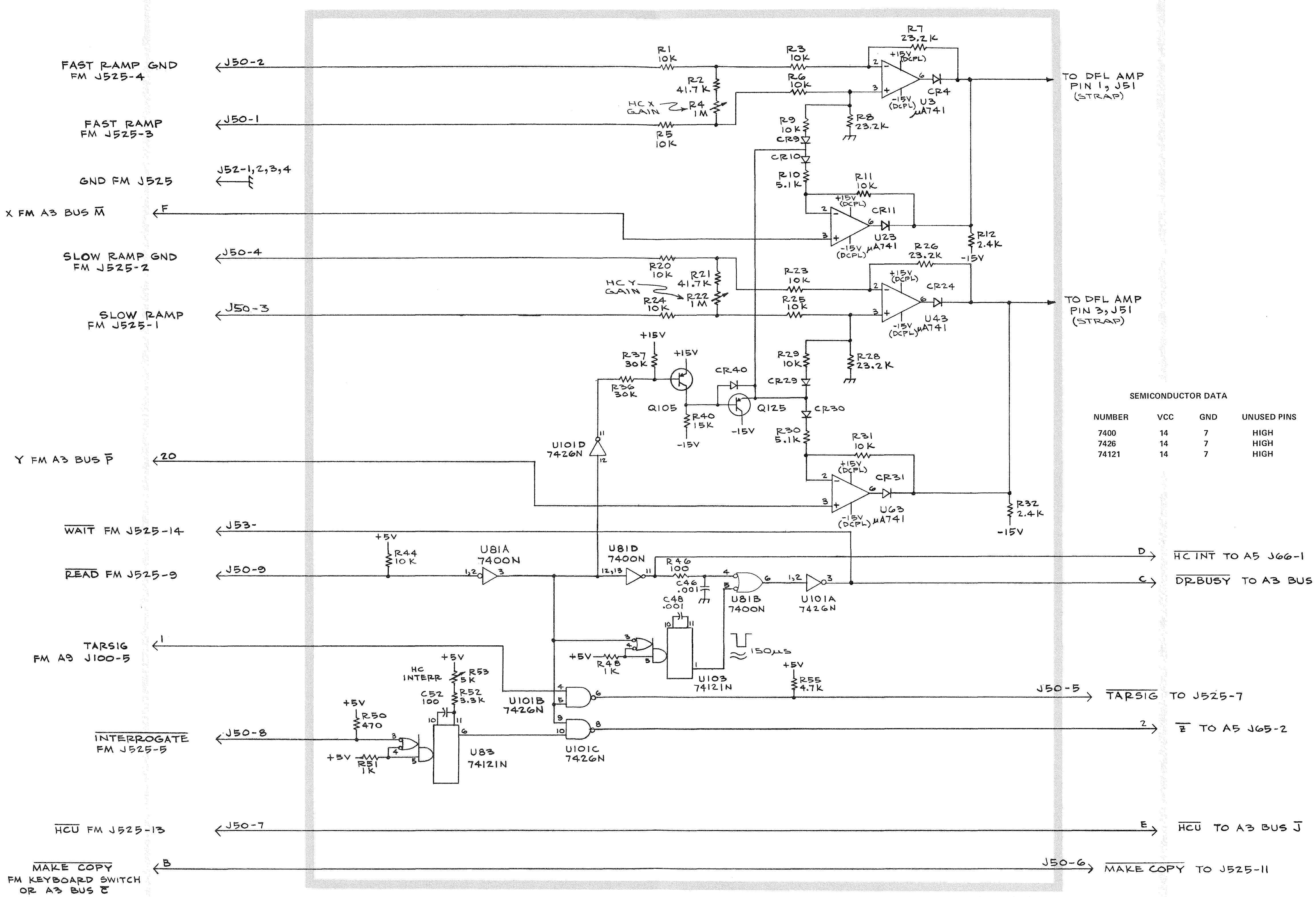
1183-41



SEMICONDUCTOR DATA

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7426	14	7	HIGH
74121	14	7	HIGH

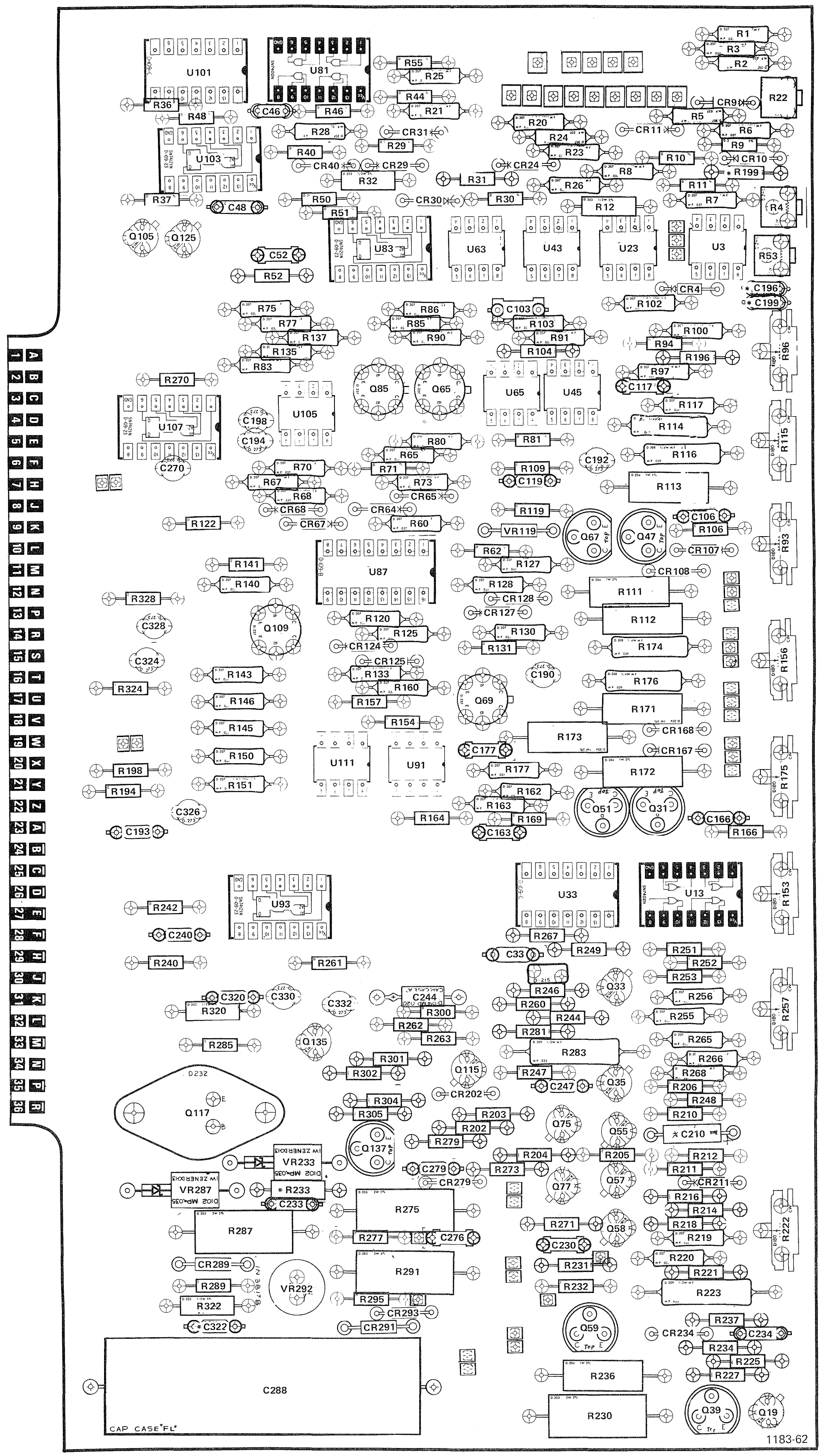
P/O A4 DEFLECTION AMPLIFIER & STORAGE BOARD



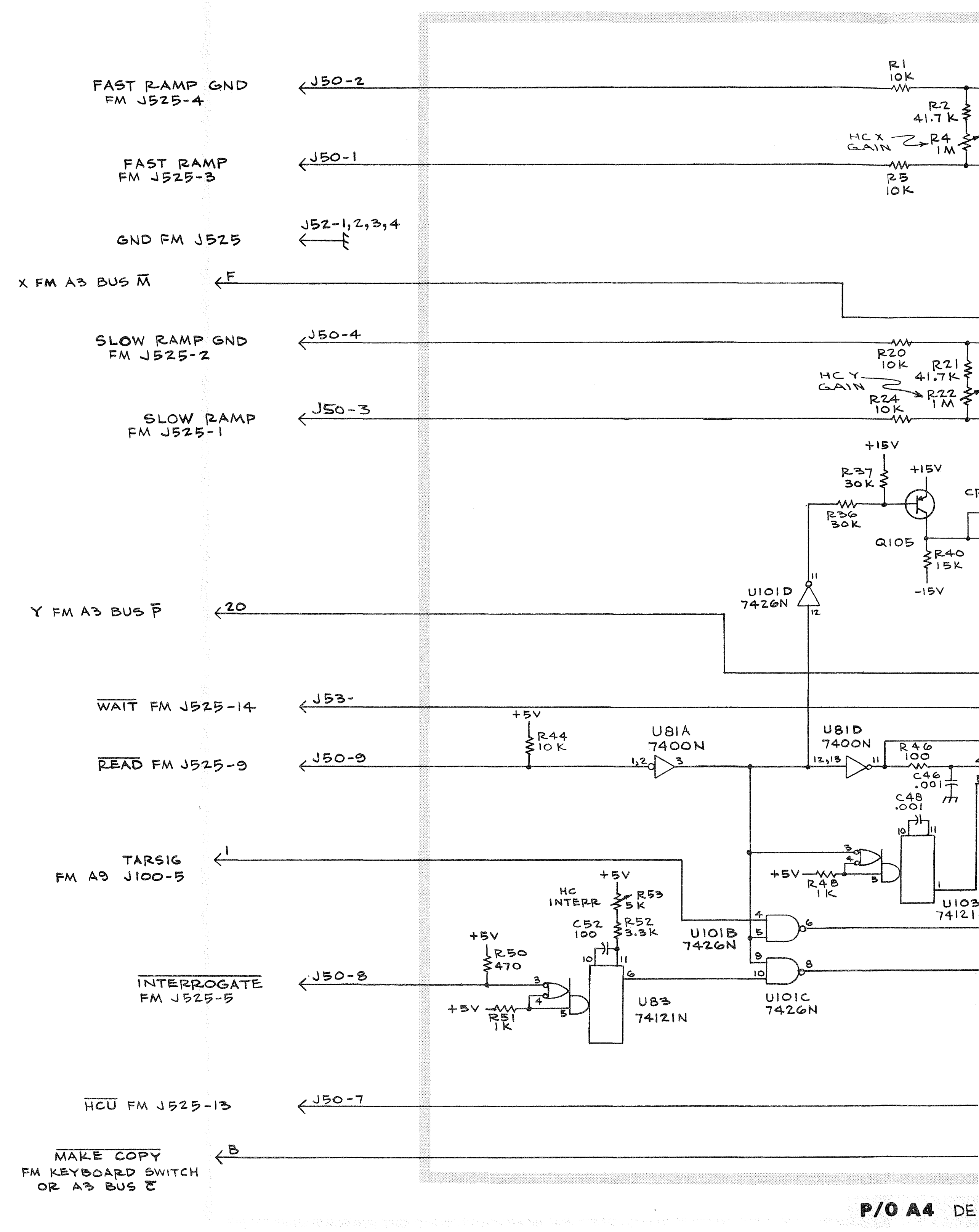
SEMICONDUCTOR DATA

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7426	14	7	HIGH
74121	14	7	HIGH

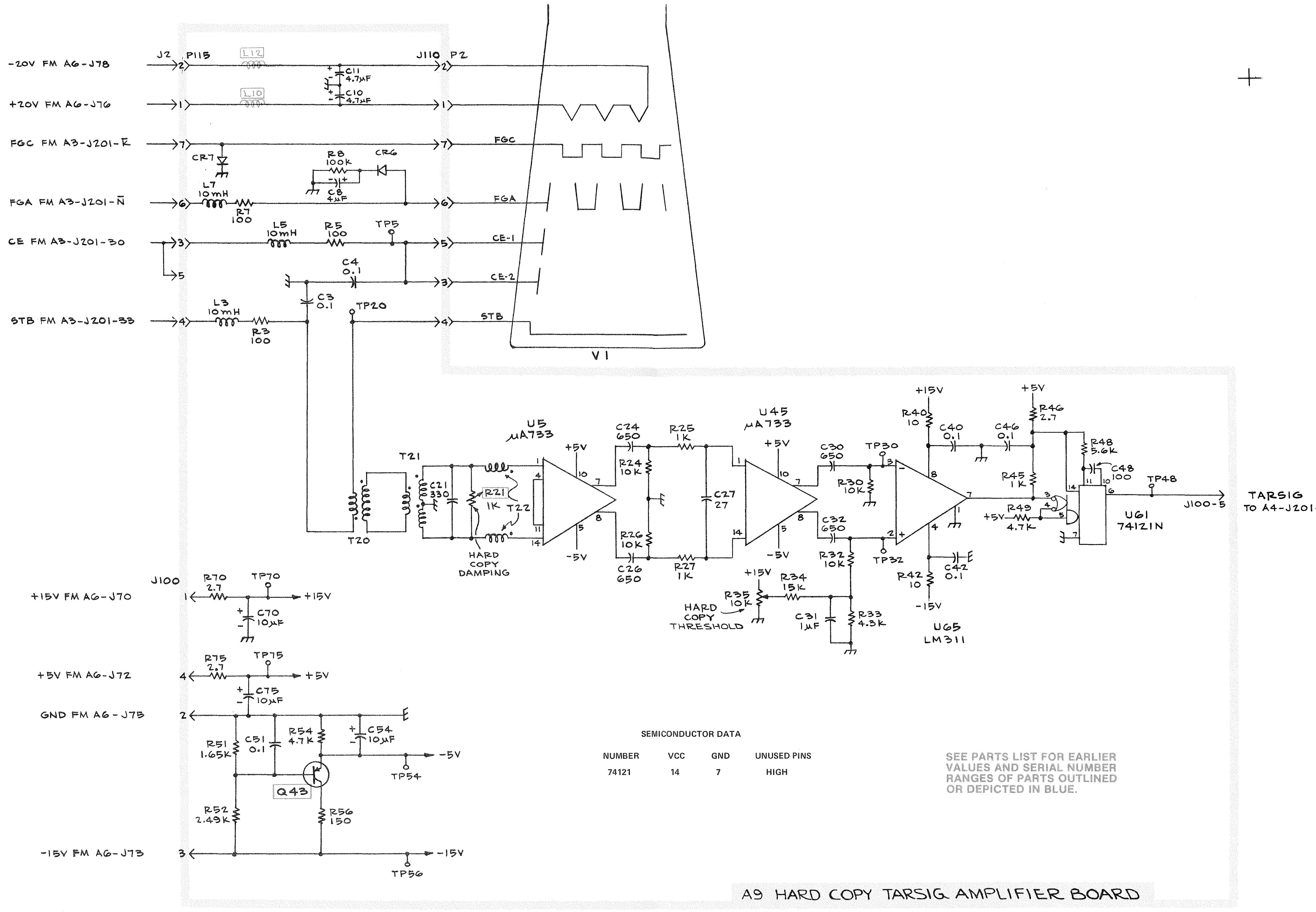
P/O A4 DEFLECTION AMPLIFIER & STORAGE BOARD



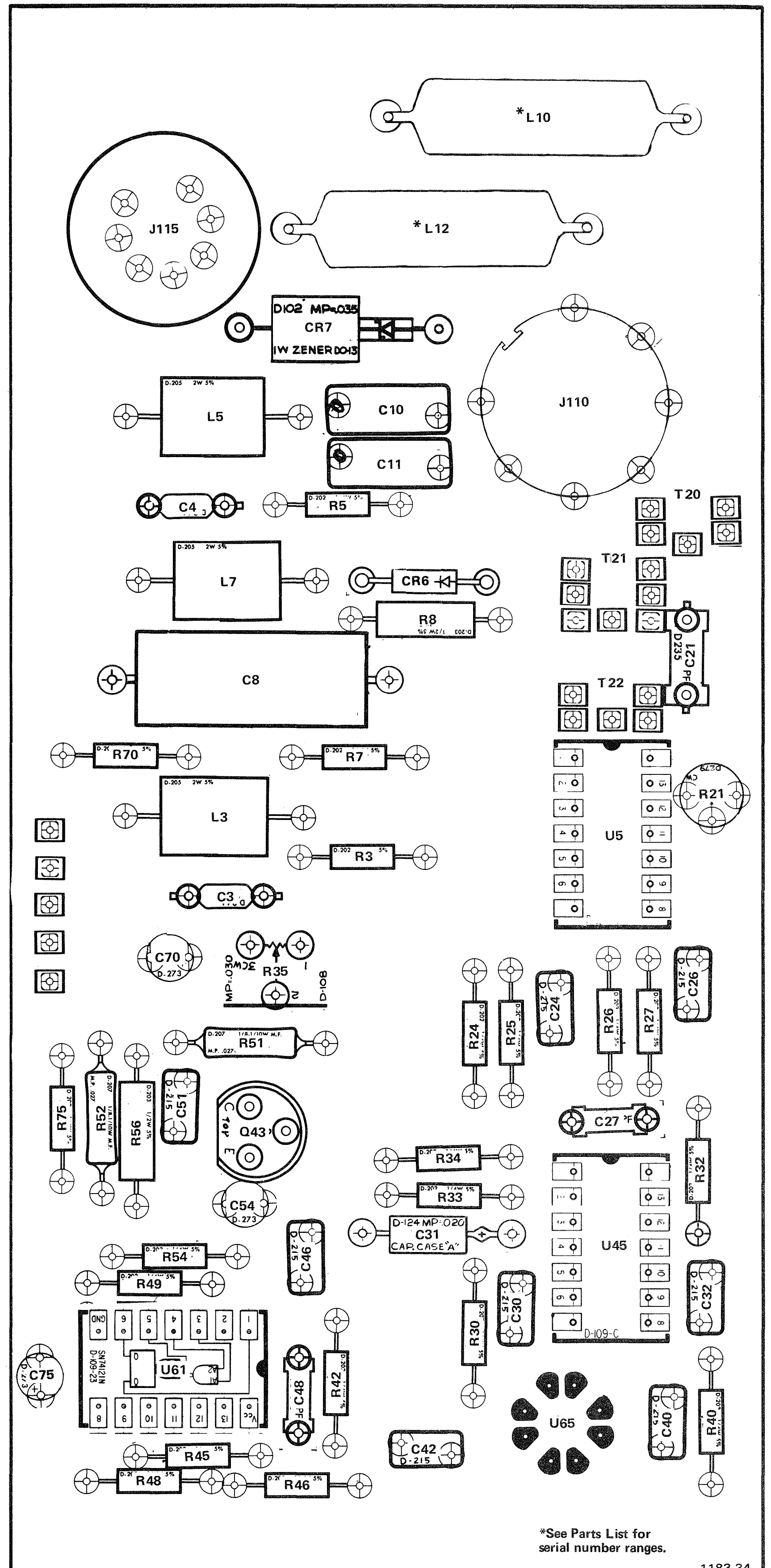
Deflection Amp and Storage Component Locations — 670-1727-03 & below (4010-1 only) & 670-1974-03 & below (4010 only).



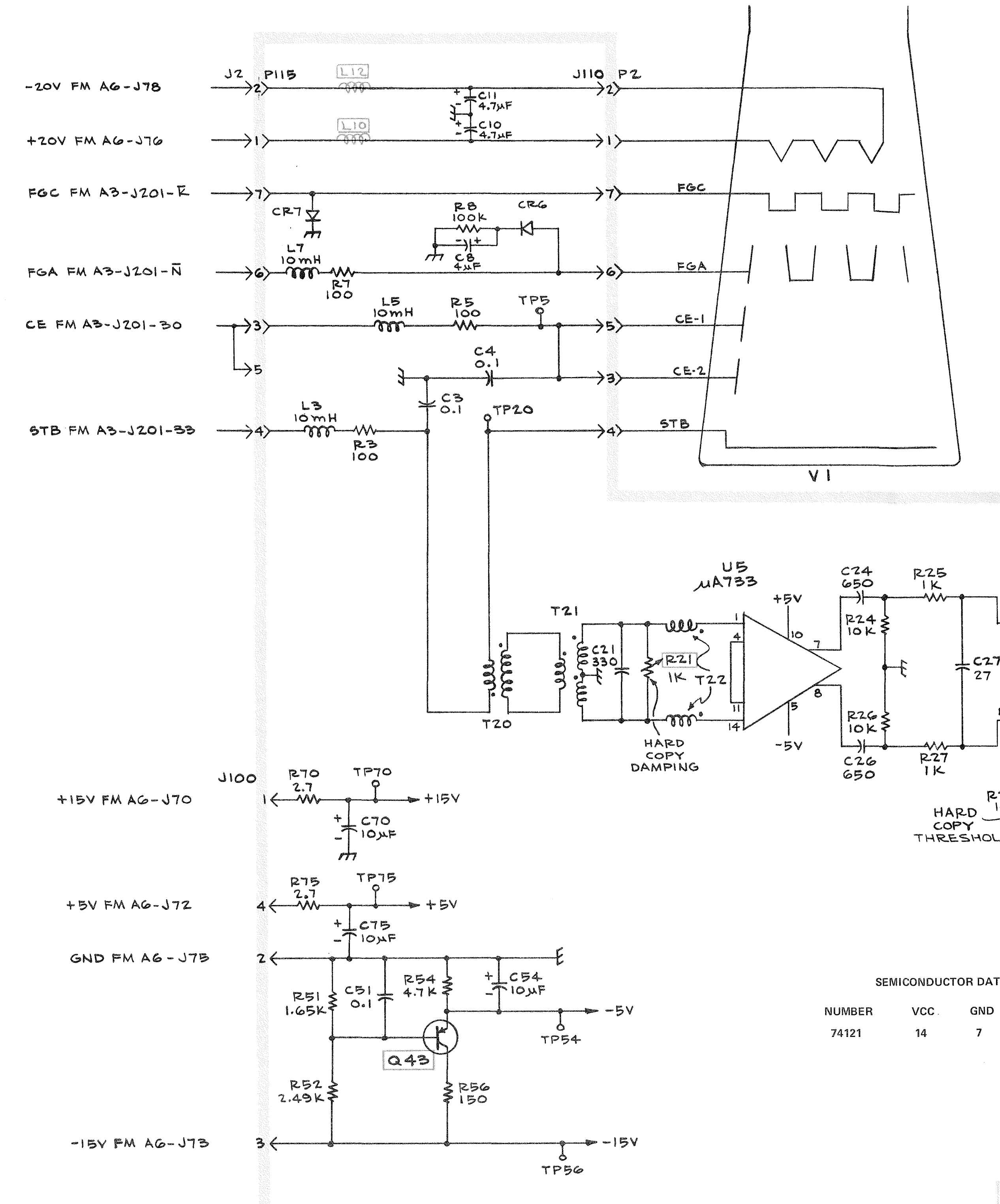
REV. E, APRIL 1976
1183-63



NUMBER	VCC	GND	UNUSED PINS
74121	14	7	HIGH

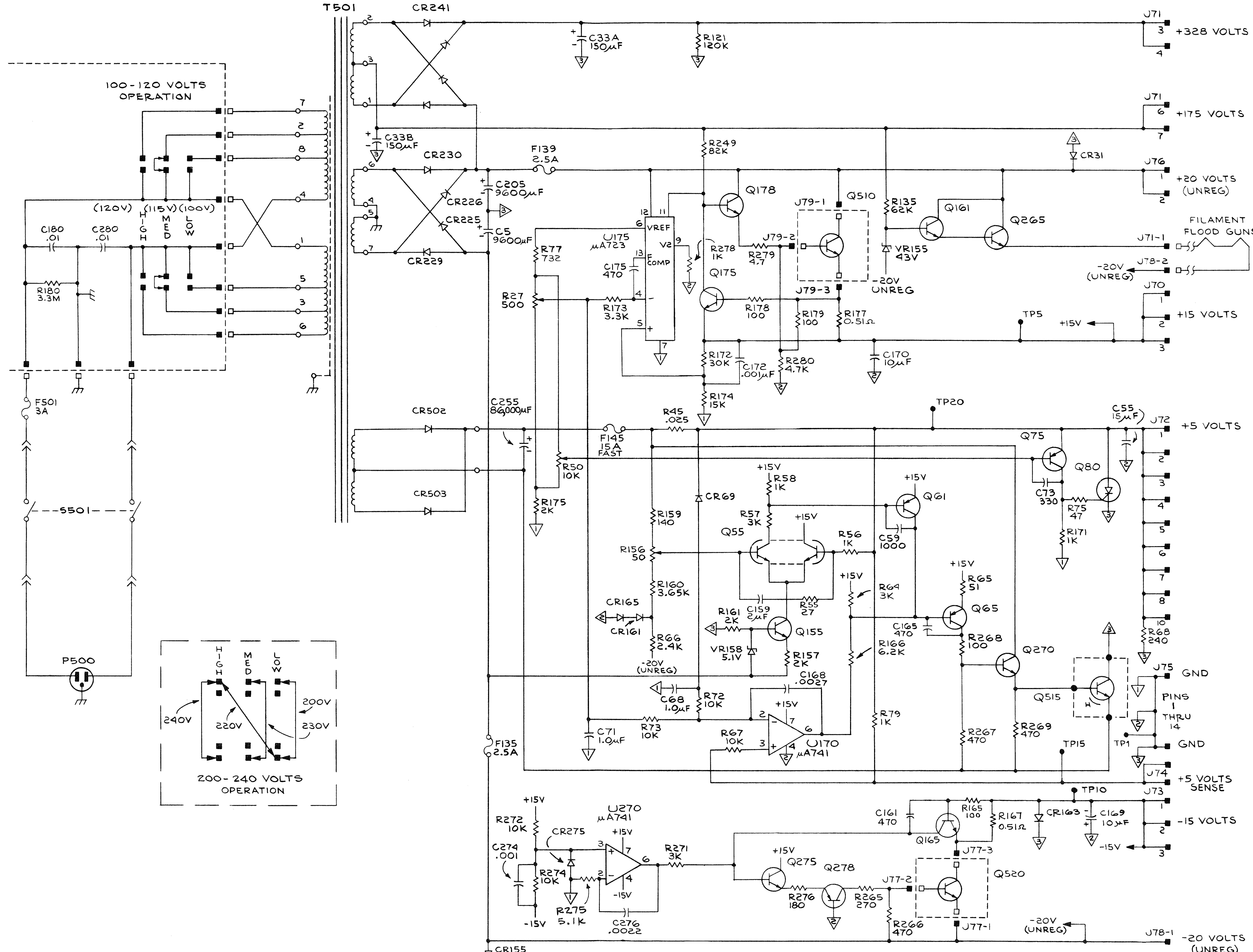


Hard Copy Tarsig Amp Component Locations.



SEMICONDUCTOR DAT

NUMBER	VCC	GND
74121	14	7

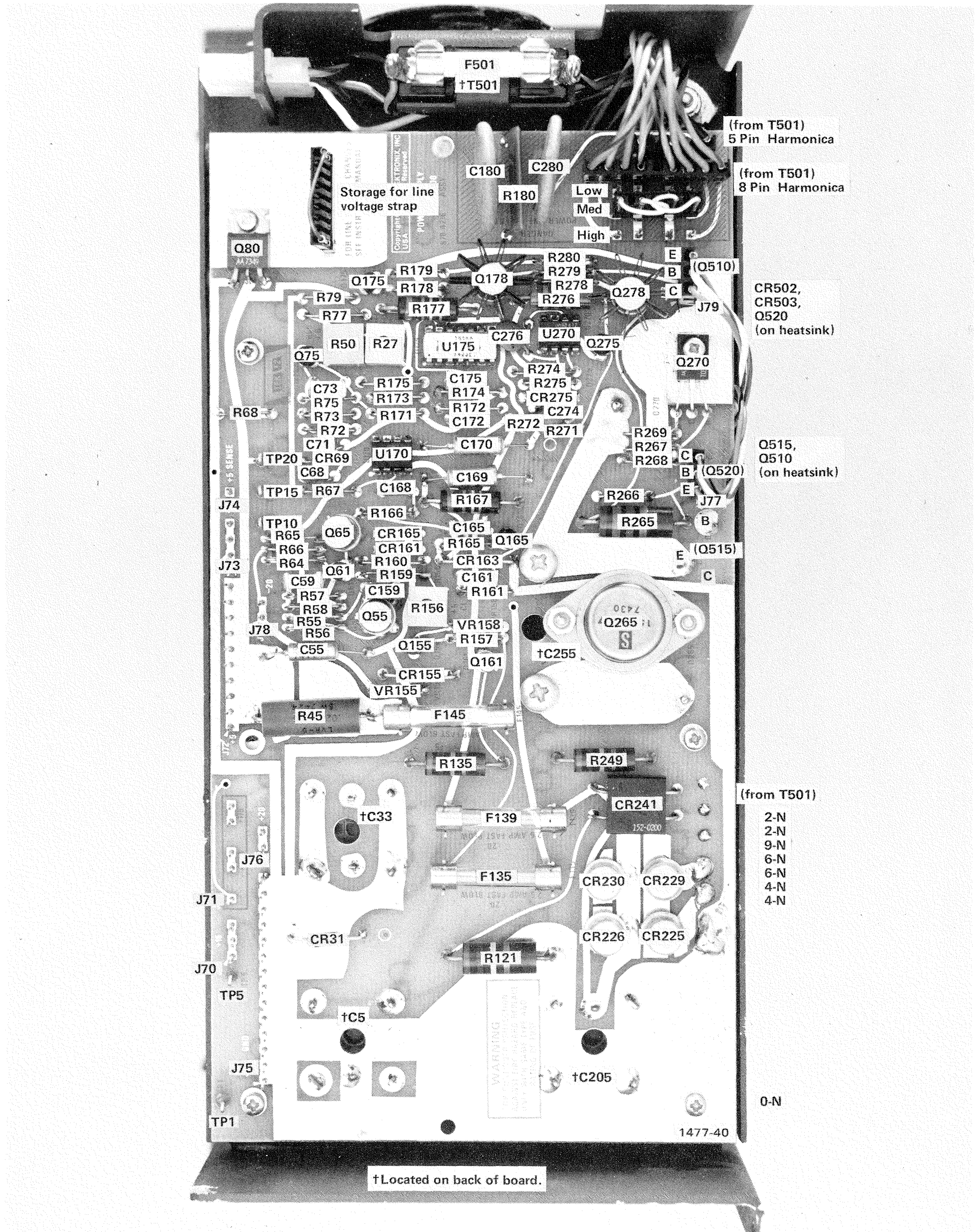


4010/4010-1

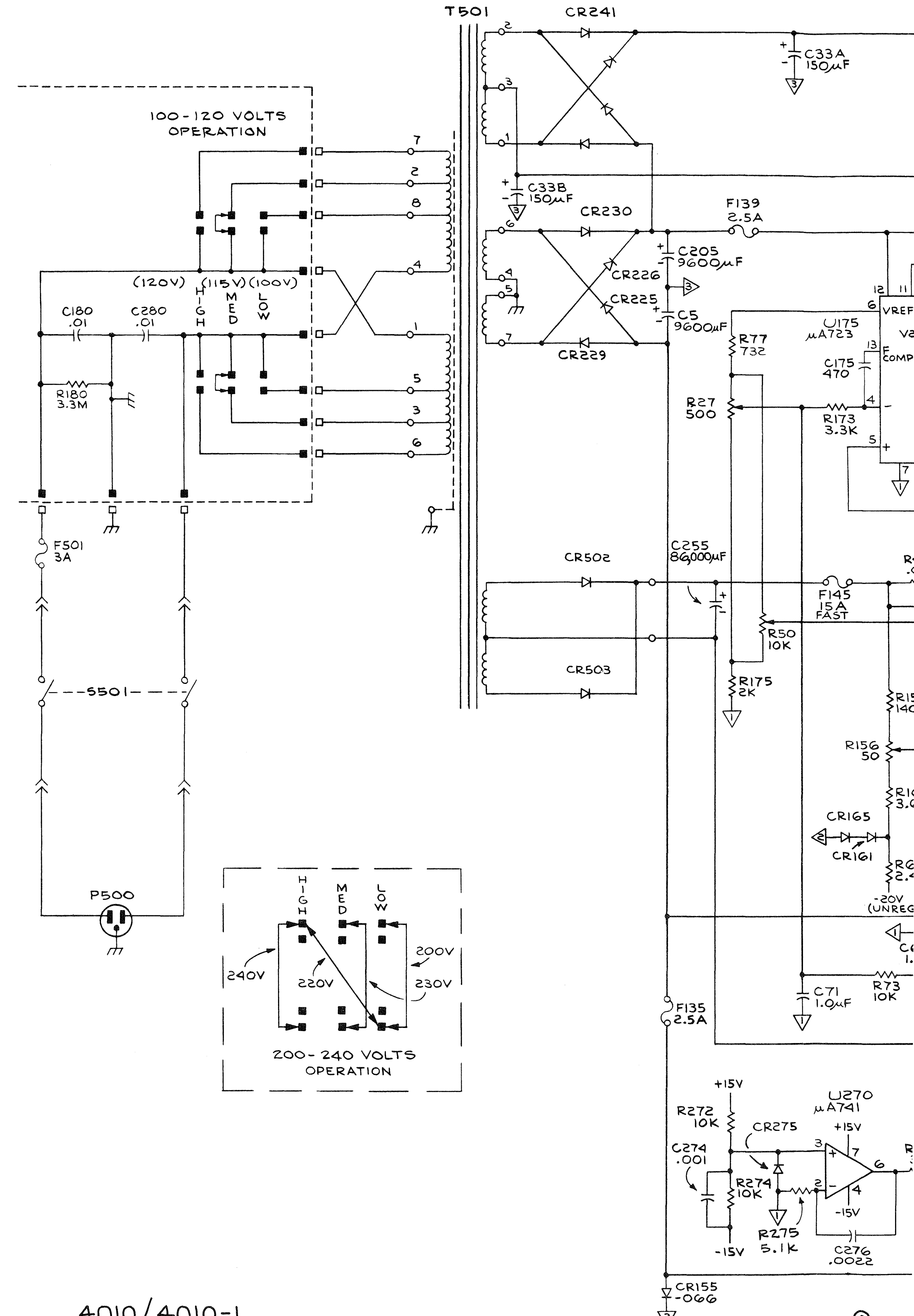
@ (1477)1183-86

A7 670-4216-00 H. D. POWER SUPPLY ⟨11⟩

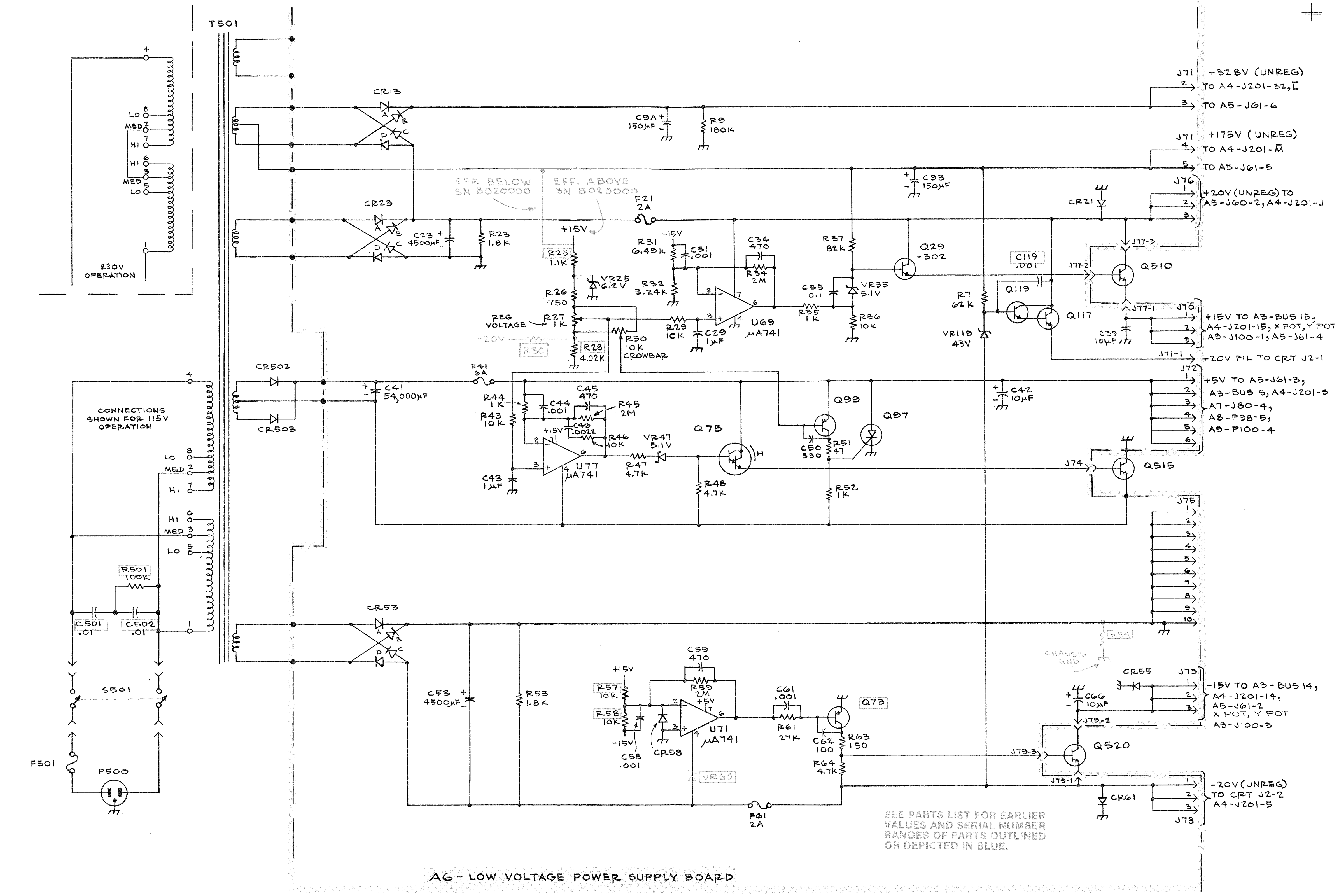
HD POWER SUPPLY
A6 670-4216-00



H.D. Power Supply Component Locations (670-4216-00).



(1477)1183-86

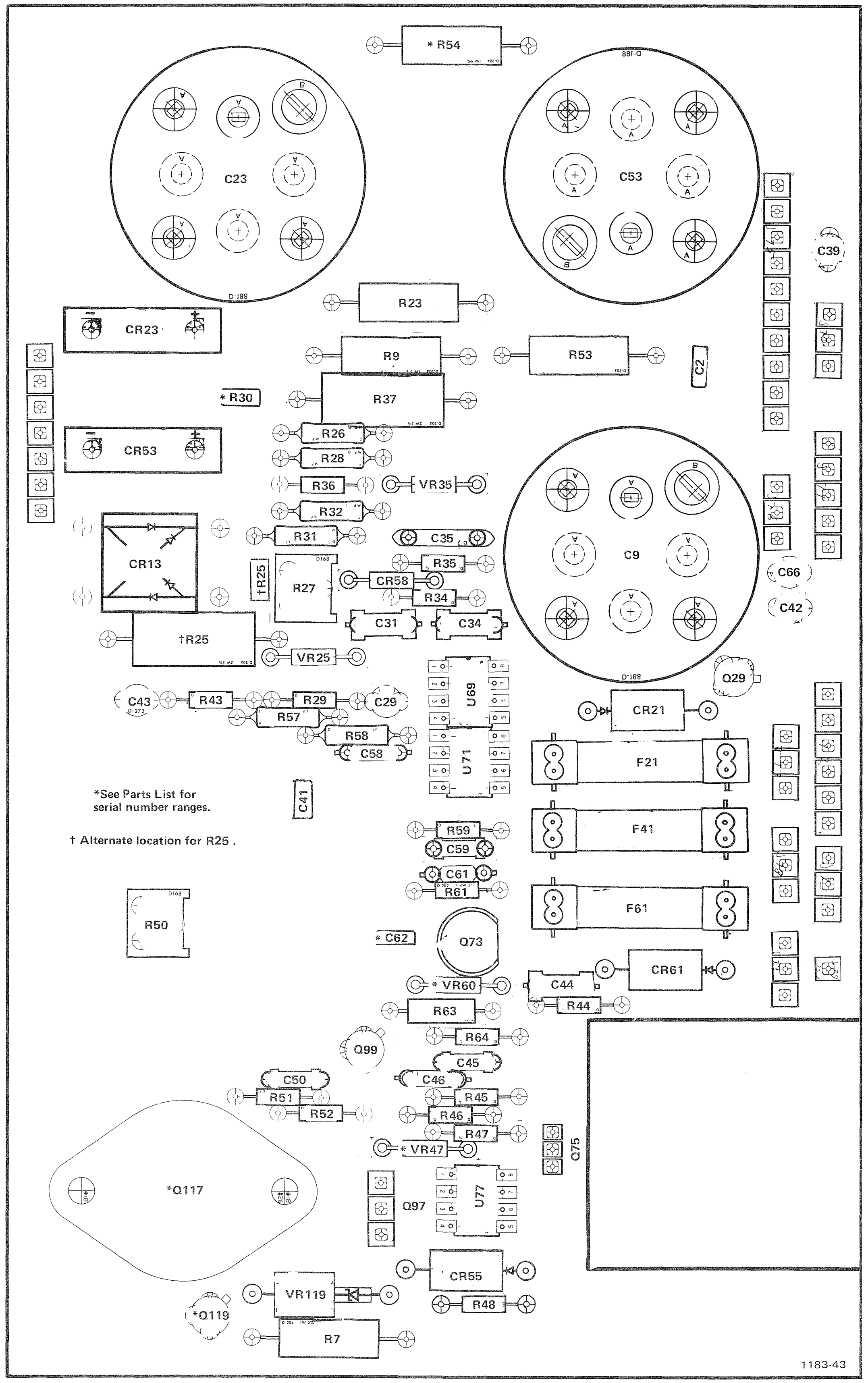


4010/4010-1

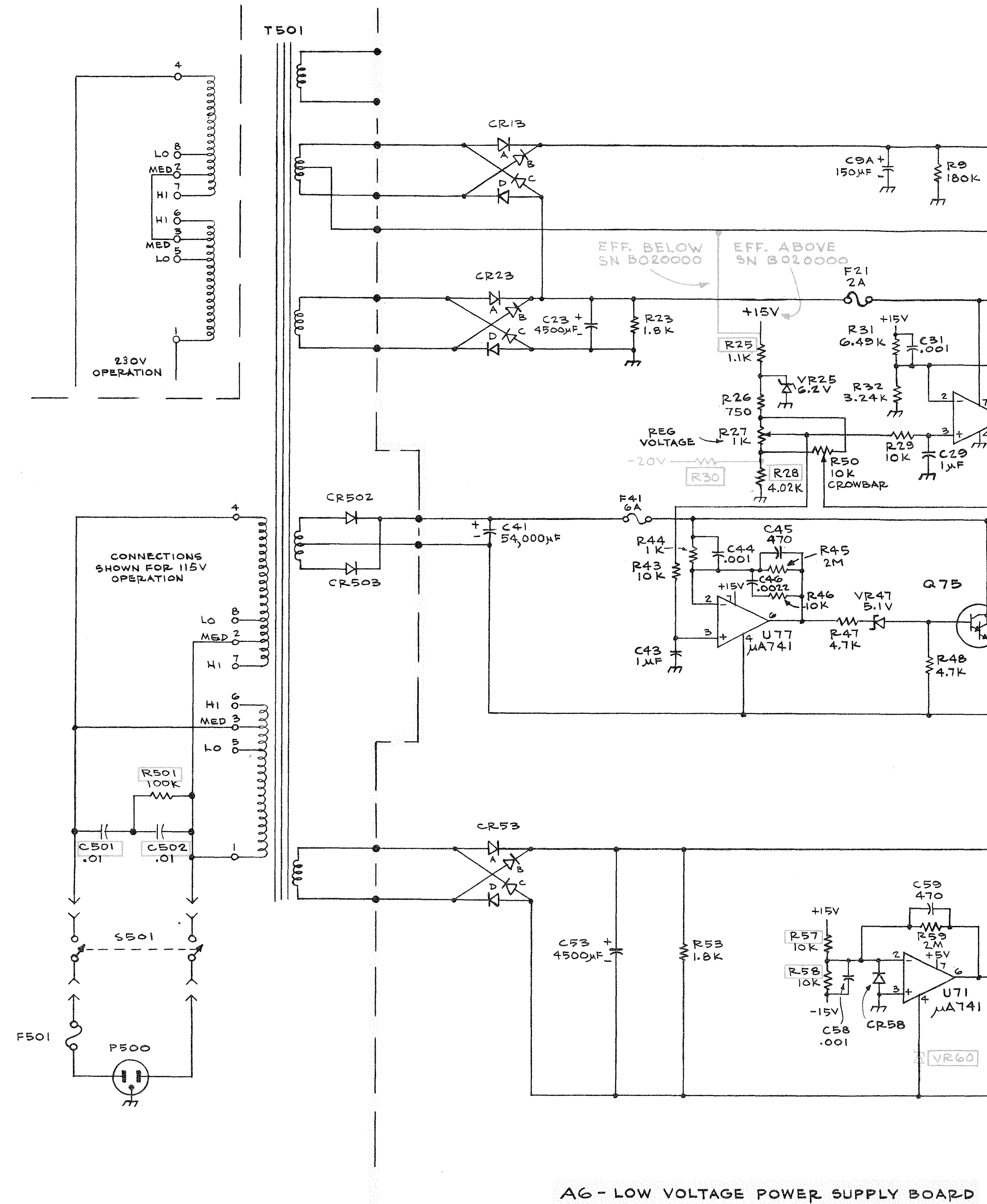
REV. F, APRIL 1976
1183-66

A6 670-1726-02,03,04 LV POWER SUPPLY 11a

1073



LV Power Supply Component Locations.



A6 - LOW VOLTAGE POWER SUPPLY BOARD

REV. F, APRIL 1976
1183-66

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
--- * ---
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
--- * ---
Parts of Detail Part
Attaching parts for Parts of Detail Part
--- * ---

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol --- * --- indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICOND	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SQ	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPLG	COUPLING	IC	INTEGRATED CIRCUIT	RTNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
0000C	GETTIG ENGINEERING AND MANUFACTURING CO.		SPRINGMILL, PA 16875
00779	AMP, INC.	P. O. BOX 3608	HARRISBURG, PA 17105
00866	GOE ENGINEERING CO., INC.	P. O. BOX 3485	CITY OF INDUSTRY, CA 91746
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P. O. BOX 5012	DALLAS, TX 75222
01963	CHERRY ELECTRICAL PRODUCTS CORP.	3600 SUNSET AVE.	WAUKEGAN, IL 60085
02107	SPARTA MFG. CO.	ROUTE NO. 2, BOX 128	DOVER, OH 44622
02735	RCA CORP., SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
05574	VIKING INDUSTRIES, INC.	21001 NORDOFF STREET	CHATSWORTH, CA 19311
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06915	RICHCO PLASTIC CO.	5825 N. TRIPP AVE.	CHICAGO, IL 60646
06982	MOORE, HOWARD J., CO.	105 E. 16TH ST.	NEW YORK, NY 10003
07109	OAKTRON INDUSTRIES, INC.	704 30TH ST.	MONROE, WI 53566
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12327	FREEWAY CORP.	9301 ALLEN DR.	CLEVELAND, OH 44125
12360	ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORP.	351 CONNECTICUT AVE.	SOUTH NORWALK, CT 06856
16428	BELDEN CORP.	P. O. BOX 1101	RICHMOND, IN 47374
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
26365	GRIES REPRODUCER CO., DIV. OF COATS AND CLARK INC.	125 BEECHWOOD AVE.	NEW ROCHELLE, NY 10802
27264	MOLEX PRODUCTS CO.	5224 KATRINE AVE.	DOWNERS GROVE, IL 60515
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
70903	BELDEN CORP.	2000 S BATAVIA AVENUE	GENEVA, IL 60134
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	5757 N. GREEN BAY AVE.	MILWAUKEE, WI 53201
71785	TRW ELECTRONIC COMPONENTS, CINCH CONNECTOR OPERATIONS	1501 MORSE AVE.	ELK GROVE VILLAGE, IL 60007
72653	G. C. ELECTRONICS CO., A DIVISION OF HYDROMETALS, INC.	400 S. WYMAN ST.	ROCKFORD, IL 61101
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74921	ITEN FIBRE CO., THE	4001 BENEFIT AVE., P O BOX 9	ASHTABULA, OH 44004
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78553	EATON CORP., ENGINEERED FASTENERS DIV., TINNERMAN PLANT	P O BOX 6688, 8700 BROOKPARK RD.	CLEVELAND, OH 44101
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97005
81044	MILLER, ROBERT E., AND COMPANY, INC.	50 BROADWAY, RM 1103	NEW YORK, NY 10004
83309	ELECTRICAL SPECIALITY CO., SUBSIDIARY OF BELDEN CORP.	213 E. HARRIS AVE.	SOUTH SAN FRANCISCO, CA 9408
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86044	CALIFORNIA GASKET AND WASHER CO.	1601 W. 134 STREET	GARDENA, CA 90249
89663	REESE, J. RAMSEY, INC.	71 MURRAY ST.	NEW YORK, NY 10007
95354	METHODE MANUFACTURING CORP.	1700 SO. HICKS RD.	ROLLING MEADOWS, IL 60008
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98410	ETC, DIV.	990 E. 67TH STREET	CLEVELAND, OH 44103

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	331-0299-01			1	MASK,CRT SCALE:4010	80009	331-0299-01
	331-0299-04			1	MASK,CRT SCALE:4010-1	80009	331-0299-04
					(ATTACHING PARTS)		
-2	211-0581-00			4	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. MASK INCLUDES:		
-3	334-1844-00			1	. PLATE IDENT:4010	80009	334-1844-00
	334-1844-01			1	. PLATE IDENT:4010-1	80009	334-1844-01
	610-0544-00			1	ASSY,KEYBOARD:4010/4010-1	80009	610-0544-00
					(ATTACHING PARTS)		
-4	211-0507-00	B010100	B049999	6	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	211-0510-00	B050000		6	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0006-00			4	WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
	----- -----			-	. KEYBOARD ASSEMBLY INCLUDES:		
-5	----- -----			1	. KEYBOARD,CMPTR:(SEE A7 EPL)		
					(ATTACHING PARTS)		
-6	211-0516-00			6	. SCREW,MACHINE:6-32 X 0.875 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. . CKT BOARD ASSEMBLY INCLUDES:		
-7	----- -----			51	. . SWITCH,KEYBOARD:(SEE S1 THRU S51)		
	----- -----			2	. . SWITCH,KEYBOARD:HEAVY DUTY(SEE EPL)		
-8	366-1525-00	B010100	B055574	1	. . SET,KEYTOP:53 KNOBS	01963	D99-53AB
	366-1664-00	B055575		1	. . SET,KEYTOP:53 KNOBS	01963	B99-99AC
	366-1525-01			1	. . . PUSHBUTTON:EXCLAMATION POINT/1	01963	028-3081
	366-1525-02			1	. . . PUSHBUTTON:DBL QUOTE/2	01963	028-3082
	366-1525-03			1	. . . PUSHBUTTON:POUND OR NUMBER/3	01963	028-3083
	366-1525-04			1	. . . PUSHBUTTON:PERCENT/5	01963	028-3085
	366-1525-05			1	. . . PUSHBUTTON:AMPERSAND/6	01963	028-3086
	366-1525-06			1	. . . PUSHBUTTON:SINGLE QUOTE/7	01963	028-3087
	366-1525-07			1	. . . PUSHBUTTON:LEFT PARENTHESIS/8	01963	028-3088
	366-1525-08			1	. . . PUSHBUTTON:RIGHT PARENTHESIS/9	01963	028-3089
	366-1525-09			1	. . . PUSHBUTTON:ZERO	01963	028-3090
	366-1525-10			1	. . . PUSHBUTTON:ASTERISK/COLON	01963	028-3091
	366-1525-11			1	. . . PUSHBUTTON:HYPHEN/EQUAL	01963	028-1715
	366-1525-12			1	. . . PUSHBUTTON:PAGE	01963	028-3093
	366-1525-13			1	. . . PUSHBUTTON:ALT MODE	01963	028-3094
	366-1525-14			1	. . . PUSHBUTTON:Q	01963	028-3095
	366-1525-15			1	. . . PUSHBUTTON:W	01963	028-3096
	366-1525-16	B010100	B055574	1	. . . PUSHBUTTON:WRU/E	01963	028-3097
	366-1525-53	B055575		1	. . . PUSHBUTTON:E	01963	028-1957
	366-3098-17	B010100	B055574	1	. . . PUSHBUTTON:TAPE/R	01963	028-3098
	366-1525-54	B055575		1	. . . PUSHBUTTON:R	01963	028-1973
	366-1525-18	B010100	B055574	1	. . . PUSHBUTTON:-~~TAPE~~-/T	01963	028-3099
	366-1525-55	B055575		1	. . . PUSHBUTTON:T	01963	028-1975
	366-1525-19			1	. . . PUSHBUTTON:Y	01963	028-3100
	366-1525-20			1	. . . PUSHBUTTON:U	01963	028-3101
	366-1525-21	B010100	B055574	1	. . . PUSHBUTTON:TAB/I	01963	028-3102
	366-1525-56	B055575		1	. . . PUSHBUTTON:I	01963	028-1958
	366-1525-22			1	. . . PUSHBUTTON:UNDERSCORE/O	01963	028-3103
	366-1525-23			1	. . . PUSHBUTTON:AT SIGN/P	01963	028-3104
	366-1525-24			1	. . . PUSHBUTTON:LINE FEED	01963	028-3105
	366-1525-25			1	. . . PUSHBUTTON:RETURN	01963	028-2968
	366-1525-26			1	. . . PUSHBUTTON:CTRL	01963	028-3106
	366-1525-27			1	. . . PUSHBUTTON:A	01963	028-3107
	366-1525-28	B010100	B055574	1	. . . PUSHBUTTON:X OFF/S	01963	028-3108
	366-1525-58	B055575		1	. . . PUSHBUTTON:S	01963	028-1974
	366-1525-29	B010100	B055574	1	. . . PUSHBUTTON:EOT/D	01963	028-3109
	366-1525-59	B055575		1	. . . PUSHBUTTON:D	01963	028-1953
	366-1525-30			1	. . . PUSHBUTTON:F	01963	028-3110
	366-1525-31			1	. . . PUSHBUTTON:G	01963	028-3111
	366-1525-32			1	. . . PUSHBUTTON:H	01963	028-3112
	366-1525-33			1	. . . PUSHBUTTON:J	01963	028-3113

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	366-1525-34			1	. . . PUSHBUTTON:LEFT BRACKET/K	01963	028-3114
	366-1525-35	B010100	B055574	1	. . . PUSHBUTTON:FORM/L	01963	028-3115
	366-1525-57	B055575		1	. . . PUSHBUTTON:L	01963	028-4696
	366-1525-36			1	. . . PUSHBUTTON:PLUS/SEMI-COLON	01963	028-3116
	366-1525-37			1	. . . PUSHBUTTON:RUB OUT	01963	028-3117
	366-1525-38			1	. . . PUSHBUTTON:RESET	01963	028-3118
	366-1525-39			1	. . . PUSHBUTTON:BREAK	01963	028-3119
	366-1525-40			2	. . . PUSHBUTTON:SHIFT	01963	028-2967
	366-1525-41			1	. . . PUSHBUTTON:Z	01963	028-3120
	366-1525-42			1	. . . PUSHBUTTON:X	01963	028-3121
	366-1525-43			1	. . . PUSHBUTTON:C	01963	028-3122
	366-1525-44			1	. . . PUSHBUTTON:V	01963	028-3123
	366-1525-45			1	. . . PUSHBUTTON:B	01963	028-3124
	366-1525-46			1	. . . PUSHBUTTON:TILDE/N	01963	028-3125
	366-1525-47			1	. . . PUSHBUTTON:RIGHT BRACKET/M	01963	028-3126
	366-1525-48			1	. . . PUSHBUTTON:LESS THAN/COMMA	01963	028-3127
	366-1525-49			1	. . . PUSHBUTTON:GREATER THAN/PERIOD	01963	028-3128
	366-1525-50			1	. . . PUSHBUTTON:SLASH/QUESTION MARK	01963	028-3129
	366-1525-51			1	. . . PUSHBUTTON:SPACE BAR	01963	028-1232
	366-1525-52			1	. . . PUSHBUTTON:DOLLAR SIGN/4	01963	028-3084
	119-0423-00			1	. . . SPACE BAR ASSY:	01963	99-0003
-9	----- -----			1	. SW,ROCKER:LOCAL LINE(SEE S535 EPL)		
	----- -----			2	. SW,ROCKER:AUX 1,AUX 2(SEE S536,S537 EPL)		
					(ATTACHING PARTS FOR EACH)		
-10	210-0406-00			2	. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-11	210-0004-00			2	. WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
-12	166-0024-00			2	. SPACER,SLEEVE:0.133 ID X 0.125 INCH L,BRS	71590	P1646XS
					- - - * - - -		
-13	----- -----			1	. SW,ROCKER:MAKE COPY(SEE S538 EPL)		
					(ATTACHING PARTS)		
	210-0406-00			2	. NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
	210-0004-00			2	. WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
	166-0024-00			2	. SPACER,SLEEVE:0.133 ID X 0.125 INCH L,BRS	71590	P1646XS
					- - - * - - -		
-14	366-0128-00	B010100	B019999	2	. KNOB:THUMBWHEEL	80009	366-0128-00
	366-0128-01	B020000		2	. KNOB:THUMBWHEEL	80009	366-0128-01
	----- -----			-	. . EACH KNOB INCLUDES:		
	213-0076-00			1	. . . SETSCREW:2-56 X 0.125 INCH,HEX.SOC STL	74445	OBD
-15	----- -----			2	. RES.,VAR:(SEE R530,R532 EPL)		
					(ATTACHING PARTS FOR EACH)		
-16	210-0583-00			2	. NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-17	210-0046-00			1	. WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
					- - - * - - -		
-18	407-0994-00			1	. BRACKET,ANGLE:RESISTOR MTG	80009	407-0994-00
					(ATTACHING PARTS)		
-19	210-0586-00			2	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-20	386-2096-00	B010100	B049999	1	. PANEL,KEYBOARD:	80009	386-2096-00
	386-2868-00	B050000		1	. PANEL,KEYBOARD:	80009	386-2868-00
-21	179-1762-00			1	. WIRING HARNESS:KEYBOARD	80009	179-1762-00
-22	131-0707-00			6	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-23	131-0621-00			14	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-24	352-0169-00			3	. . CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-25	352-0199-00			1	. . CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-26	352-0203-00			1	. . CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0203-00
-27	352-0204-00			1	. . CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-28	343-0003-00			1	CLAMP,LOOP:0.25 INCH DIA	95987	1-4 6R
					(ATTACHING PARTS)		
-29	211-0014-00			1	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-30	210-0851-00			1	WASHER,FLAT:0.119 ID X 0.375 INCH OD,STL	12327	OBD
-31	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-32	214-0702-00			1	KEY,CONN PLZN:T SHAPED MOLD ACETAL	80009	214-0702-00
	179-1757-02	B010100	B059999	1	WIRING HARNESS:MAIN,W/CONN	80009	179-1757-02
	179-1757-04	B060000		1	WIRING HARNESS:MAIN,W/CONN	80009	179-1757-04
-33	136-0148-00			1	. CONNECTOR,RCPT,:15 PIN	05574	2VK15S/1-2
	179-1757-00	B010100	B019999	1	. WIRING HARNESS:MAIN	80009	179-1757-00
	179-1757-01	B020000	B059999	1	. WIRING HARNESS:MAIN	80009	179-1757-01
	179-1757-03	B060000		1	. WIRING HARNESS:MAIN	80009	179-1757-03
-34	131-0621-00	B010100	B019999	107	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	131-0621-00	B020000		105	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	131-0622-00	B010100	B019999	4	. . CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	131-0622-00	B020000		6	. . CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	131-0792-00	B010100	B019999	15	. . CONTACT,ELEC:0.577"L,18-20 AWG WIRE	22526	46221
	131-0792-00	B020000		14	. . CONTACT,ELEC:0.577"L,18-20 AWG WIRE	22526	46221
-35	352-0197-00			2	. . CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-36	352-0198-00			6	. . CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0198-00
	352-0199-00			5	. . CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-37	352-0200-00			2	. . CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0200-00
-38	352-0201-00	B010100	B019999	5	. . CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
	352-0201-00	B020000		4	. . CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-39	352-0202-00	B010100	B019999	2	. . CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0202-00
	352-0202-00	B020000		3	. . CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0202-00
	352-0203-00			2	. . CONN BODY,PL,EL:7 WIRE BLACK	80009	352-0203-00
	352-0204-00			1	. . CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0204-00
-40	352-0206-00			4	. . CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0206-00
-41	200-0811-00			1	. . COVER,SKT TERM.:	80009	200-0811-00
-42	136-0271-00			1	. . SOCKET,PLUG-IN:7 PIN	71785	111-01-10-012
-43	407-0997-00			2	BRACKET,ANGLE:IMP SHIELD RET,9 INCH LONG	80009	407-0997-00
					(ATTACHING PARTS FOR EACH)		
-44	211-0065-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	77250	OBD
					- - - * - - -		
	----- -----			-	. EACH BRACKET INCLUDES:		
-45	124-0050-00			1	. PLASTIC STRIP:0.75W X 9.875" LG,FOAM TAPE	80009	124-0050-00
-46	426-0834-00	B010100	B021669	1	FR,IMPLOSION SH:	80009	426-0834-00
	426-0834-01	B021670		1	FR,IMPLOSION SH:	80009	426-0834-01
					(ATTACHING PARTS)		
-47	210-0445-00			4	NUT,PLAIN,HEX.:10-32 X 0.375 INCH,STL	83385	OBD
-48	361-0168-00			4	SPACER,SLEEVE:0.198 ID X 0.250 OD X 0.986"L	80009	361-0168-00
-49	344-0233-00			4	CLIP,ELECTRICAL:CRT	80009	344-0233-00
					- - - * - - -		
-50	337-1608-00[1]			1	SHLD,IMPLOSION:	80009	337-1608-00
	337-1482-00[2]			1	SHLD,IMPLOSION:	80009	337-1482-00
-51	386-2100-00			1	SUPPORT,CRT:FRONT	80009	386-2100-00
					(ATTACHING PARTS)		
	211-0507-00			4	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0006-00			4	WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
-52	----- -----			1	CRT ASSY:(SEE V1 EPL)		
-53	354-0316-01			1	. RING,CRT MTG:NEOPRENE	80009	354-0316-01
	175-1314-00	B010100	B059999	1	. CA ASSY,SP,ELEC:	80009	175-1314-00
-54	131-1187-00	B010100	B059999	1	. . COVER,CONN,PLUG:	95354	C-850-1V
-55	131-1188-00	B010100	B059999	1	. . CONNECTOR,PLUG,:7 PIN,MINIATURE	95354	MM-850
-56	175-0830-00	B010100	B059999	FT	. . WIRE,ELECTRICAL:7 WIRE RIBBON	08261	TEK-175-0830-00
	136-0538-00	B060000		1	SKT,PLUG-IN ELEC:ANODE ASSEMBLY	80009	136-0538-00
	131-1188-00			1	. CONNECTOR,PLUG,:7 PIN,MINIATURE	95354	MM-850
	131-1187-00			2	. COVER,CONN,PLUG:	95354	C-850-1V
	175-0830-00			FT	. WIRE,ELECTRICAL:7 WIRE RIBBON	08261	TEK-175-0830-00
	136-0271-00	XB060000		1	. SOCKET,PLUG-IN:7 PIN	71785	111-01-10-012
-57	348-0013-00	XB010174		8	FOOT,CABINET:BLACK RUBBER	70485	1561
-58	337-1519-00	XB010174		1	SHLD,ELCTRN TUB:FRONT	80009	337-1519-00
					(ATTACHING PARTS)		
-59	211-0507-00	XB010174		4	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		

[1]4010 only
[2]4010-1 only

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-60	386-2097-00			1	SUPPORT,CRT:CENTER	80009	386-2097-00
					(ATTACHING PARTS)		
	212-0023-00			4	SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0008-00			4	WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-61	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-62	210-0805-00			2	WASHER,FLAT:0.204 ID X 0.438 INCH OD,STL	12327	OBD
					- - - * - - -		
-63	----- -----[1]			1	CKT BOARD ASSY:HARD COPY(SEE A9 EPL)		
					(ATTACHING PARTS)		
-64	211-0116-00[1]			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSEMBLY INCLUDES:		
-65	131-1233-00[1]			7	. CONTACT,ELEC:0.340 INCH LONG	80009	131-1233-00
-66	214-0579-00[1]			9	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-67	131-0589-00[1]			5	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-68	352-0125-00[1]			3	. HOLDER,TOROID:MOLD ACETAL	80009	352-0125-00
-69	131-0633-00[1]	B010100	B010232	3	. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
	214-0506-00[1]	B010233		3	. CONTACT,ELEC:0.045 SQ X 0.375 INCH L	80009	214-0506-00
-70	136-0058-00[1]			1	. SOCKET,PLUG-IN:7 PIN	71785	111-51-11-014
-71	343-0003-00[1]			1	CLAMP,LOOP:0.25 INCH DIA	95987	1-4-6R
					(ATTACHING PARTS)		
-72	211-0097-00[1]			1	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-73	210-1001-00[1]			1	WASHER,FLAT:0.119 ID X 0.375" OD,BRS	12360	OBD
-74	210-0863-00[1]			1	WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
					- - - * - - -		
-75	119-0352-00			1	COIL,TUBE DEFL:	80009	119-0352-00
					(ATTACHING PARTS)		
-76	212-0023-00			2	SCREW,MACHINE:8-32 X 0.375 INCH,PNH STL	83385	OBD
-77	210-0458-00			2	NUT,PLAIN,EXT W:8-32 X 0.344 INCH,STL	83385	OBD
					- - - * - - -		
	----- -----			-	. YOKE ASSEMBLY INCLUDES:		
-78	348-0012-00			1	. GROMMET,RUBBER:	72653	1043-1M
-79	131-0792-00			4	. CONTACT,ELEC:0.577" L,18-20 AWG WIRE	22526	46221
-80	352-0202-00			1	. CONN BODY,PL,EL:6 WIRE BLACK	80009	352-0202-00
	407-1418-00	XB040000	B055199	1	BRACKET,YOKE:	80009	407-1418-00
	407-1418-01	B055200		1	BRACKET,YOKE:	80009	407-1418-01
-81	337-1520-00	B010100	B039999	1	SHIELD SECT,CRT:REAR	80009	337-1520-00
	337-1520-02	B040000		1	SHIELD SECT,CRT:REAR	80009	337-1520-02

[1] 4010-1 only

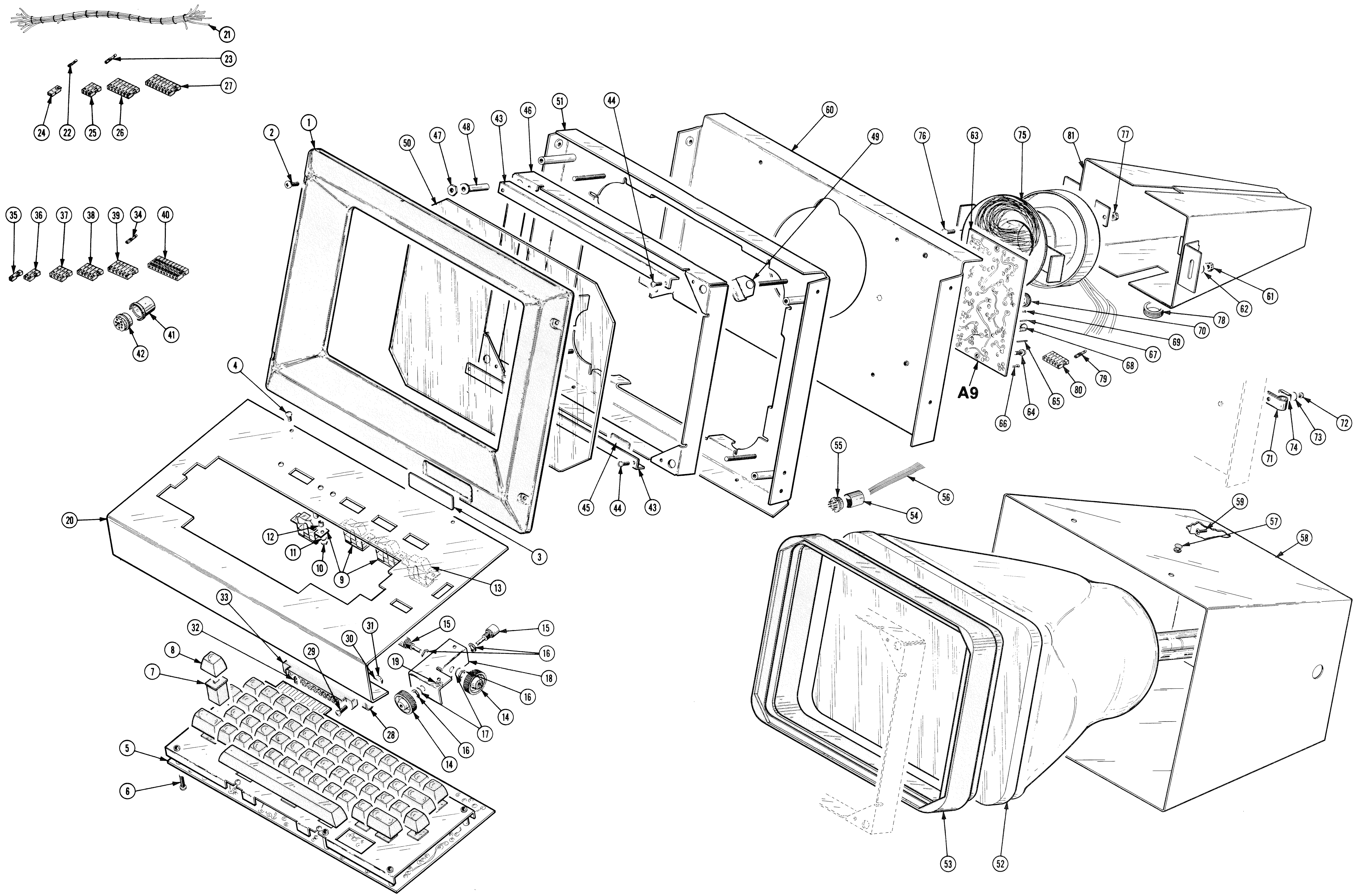


FIG. 1 KEYBOARD & CRT

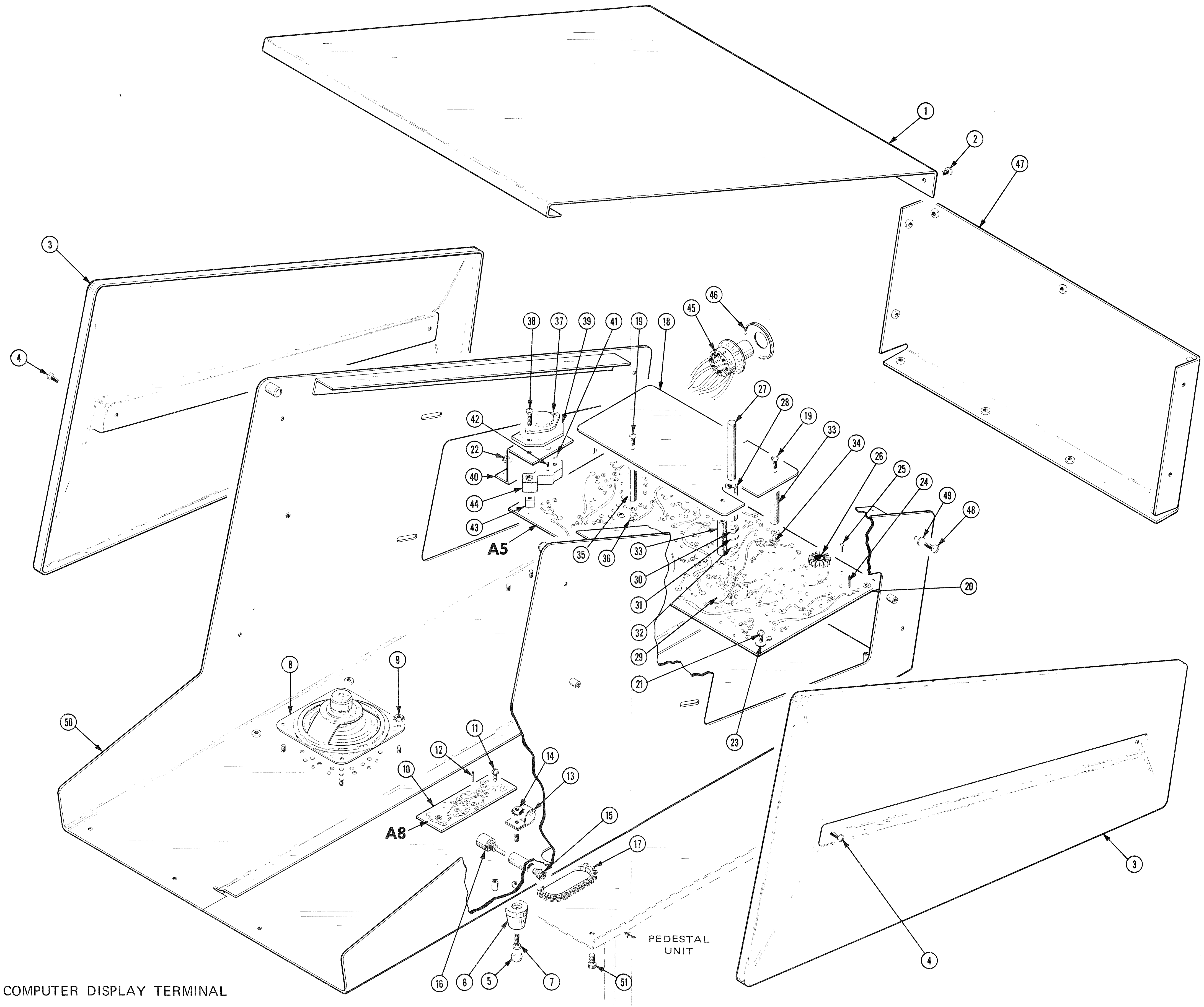

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	390-0236-00			1	CAB. TOP,DSPL UN:	80009	390-0236-00
					(ATTACHING PARTS)		
-2	211-0540-00			3	SCREW,MACHINE:6-32 X 0.50 INCH,TRH STL	83385	OBD
					- - - * - - -		
	334-2146-00			1	PLATER,IDENT:LEFT	80009	334-2146-00
	334-2147-00			1	PLATER,IDENT:RIGHT	80009	334-2147-00
-3	200-1290-01			2	COVER,SIDE TRIM:	80009	200-1290-01
					(ATTACHING PARTS FOR EACH)		
-4	211-0540-00			2	SCREW,MACHINE:6-32 X 0.50 INCH,TRH STL	83385	OBD
					- - - * - - -		
-5	348-0015-00			4	BUMPER,RUBBER:BLACK,0.4375 INCH DIA	70485	1732
-6	348-0014-00			4	FOOT,CABINET:BLACK PLASTIC	80009	348-0014-00
					(ATTACHING PARTS FOR EACH)		
-7	211-0513-00			1	SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
					- - - * - - -		
-8	119-0305-00			1	LOUDSPEAKER,PM:PERMANENT MAGNET,45 OHM,2W	07109	35A45C
					(ATTACHING PARTS)		
-9	210-0457-00			4	NUT,PLAIN,EXT:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-10	----- -----			1	CKT BOARD ASSY:DISPLAY INTERCONNECT(SEE A8 EPL)		
					(ATTACHING PARTS)		
-11	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSEMBLY INCLUDES:		
-12	131-0589-00			41	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-13	343-0603-01			1	CLAMP,LOOP:0.5 INCH DIA	80009	343-0603-01
					(ATTACHING PARTS)		
-14	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-15	366-0261-00			1	KNOB:0.312 OD X 0.406 INCH LONG	80009	366-0261-00
	214-0949-00			1	. SPR,HLCL,TRSN:0.282" OD X 0.125" LONG	80009	214-0949-00
-16	----- -----			1	RES.,VAR:HARD COPY INTENSITY(SEE R103 EPL)		
					(ATTACHING PARTS)		
	213-0020-00			1	SETSCREW:6-32 X 0.125 INCH,HEX.SOC STL	70276	OBD
					- - - * - - -		
-17	255-0334-00			1	PLASTIC CHANNEL:0.667 FT LONG	80009	255-0334-00
-18	337-1518-00	B010100	B059999	1	SHIELD,ELEC:HIGH VOLTAGE	80009	337-1518-00
	337-1518-01	B060000		1	SHIELD,ELEC:HIGH VOLTAGE	80009	337-1518-01
					(ATTACHING PARTS)		
-19	211-0097-00			3	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-20	----- -----			1	CKT BOARD ASSY:HV AND Z AXIS(SEE A5 EPL)		
					(ATTACHING PARTS)		
-21	211-0116-00			5	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-22	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-23	210-0201-00			1	TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
	211-0040-00	XB010370		1	SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSEMBLY INCLUDES:		
-24	131-0589-00			28	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-25	214-0579-00			1	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-26	214-1292-00			2	. HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
-27	129-0369-00			1	. INSULATOR,STDF:1.370 INCH,W/4-40 THREAD	80009	129-0369-00
-28	376-0011-00			1	. CPLG,SHAFT,RGD:1.266 INCH LONG,NYLON	80009	376-0011-00
	213-0048-00			2	. . SETSCREW:4-40 X 0.125 INCH,HEX. SOC STL	74445	OBD
-29	----- -----			1	. RES.,VAR:FOCUS(SEE R64 EPL)		
					(ATTACHING PARTS)		
-30	210-0413-00			1	. NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,STL	73743	3145-402
-31	210-0840-00			1	. WASHER,FLAT:0.39 ID X 0.562 INCH OD,STL	89663	644R
-32	210-0012-00			1	. WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
					- - - * - - -		
-33	129-0369-00			2	. INSULATOR,STDF:1.370 INCH,W/4-40 THREAD	80009	129-0369-00
					(ATTACHING PARTS FOR EACH)		
-34	211-0040-00			1	. SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-35	384-0616-00			1	. POST,ELEC-MECH:HEX,0.25 X 1.370 INCH LONG	80009	384-0616-00
					(ATTACHING PARTS)		
-36	211-0097-00			1	. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-37	----- -----			1	. TRANSISTOR:(SEE Q101 EPL)		
					(ATTACHING PARTS)		
-38	211-0513-00	B010100	B020109	2	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
	211-0511-00	B020110		2	. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
-39	214-1610-00			1	. HEAT SINK,ELEC:TRANSISTOR	80009	214-1610-00
-40	407-0993-00			1	. BRACKET,XSTR:	80009	407-0993-00
-41	166-0203-00			1	. SPACER,SLEEVE:0.18 ID X 0.062 L,PLSTC	80009	166-0203-00
-42	131-0847-00			2	. TERMINAL STUD:6-32 X 0.435 INCH LONG	80009	131-0847-00
-43	136-0384-00			2	. CONTACT,ELEC:FOR 0.04 DIAMETER PIN	00779	52120
-44	136-0361-00			1	. SOCKET,PLUG-IN:	80009	136-0361-00
	136-0486-00			1	. SKT,PL-IN ELEK:CRT ASSEMBLY	80009	136-0486-00
-45	136-0278-00			1	. . SOCKET,PLUG-IN:WITH PINS	80009	136-0278-00
	204-0322-00			1	. . . BODY,CRT SOCKET:	80009	204-0322-00
	214-0464-00			7	. . . CONTACT,ELEC:CRT	80009	214-0464-00
-46	200-0801-00	B010100	B010374X	1	. COVER,SOCKET,PL:ELECTRON TUBE,PLASTIC	80009	200-0801-00
	386-2071-00	B010100	B010369	1	SUPPORT,CKT CD:0.875 INCH LONG	06915	CBS-14R
	129-0080-00	B010370		1	POST,ELEC-MECH:0.875 INCH LONG	80009	129-0080-00
					(ATTACHING PARTS)		
	211-0009-00	XB010370		1	SCREW,MACHINE:4-40 X 0.250 INCH,OVH STL	83385	OBD
					- - - * - - -		
-47	386-2099-00	B010100	B049999	1	PANEL,REAR:	80009	386-2099-00
	386-2867-00	B050000		1	PANEL,REAR:	80009	386-2867-00
					(ATTACHING PARTS)		
-48	211-0507-00	B010100	B049999	6	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	211-0510-00	B050000		6	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-49	210-0006-00			6	WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
-50	437-0127-00	B010100	B049999	1	CAB.,DSPL UNIT:	80009	437-0127-00
	437-0136-00	B050000		1	CAB.,DSPL UNIT:	80009	437-0136-00
					(ATTACHING PARTS)		
-51	212-0507-00			4	SCREW,MACHINE:10-32 X 0.375 INCH,PNH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-1	200-1287-00	B010100	B019999	1	COVER,ACCESS:PEDESTAL,FRONT:	80009	200-1287-00
	200-1287-01	B020000	B059999	1	COVER,ACCESS:PEDESTAL,FRONT	80009	200-1287-01
	200-1287-02	B060000		1	COVER,ACCESS:PEDESTAL,FRONT	80009	200-1287-02
					(ATTACHING PARTS)		
-2	213-0302-00			6	SCREW,TPG,TF:6-20 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. FRONT COVER INCLUDES:		
-3	348-0102-00			2	. PAD,CUSHIONING:13.76 INCH LONG(CUT TO FIT)	80009	348-0102-00
-4	352-0102-00			1	FUSEHOLDER:0.262"ID TUBE FOR CRTG FUSE	80009	352-0102-00
					(ATTACHING PARTS)		
-5	210-0406-00			2	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-6	210-0004-00			2	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-7	386-2085-00	B010100	B049999	1	PLATE,MOUNTING:TOP	80009	386-2085-00
	386-2869-00	B050000		1	PLATE,MOUNTING:TOP	80009	386-2869-00
					(ATTACHING PARTS)		
-8	212-0043-00			4	SCREW,MACHINE:8-32 X 0.500 INCH,FLH STL	83385	OBD
					- - - * - - -		
-9	200-1288-00			1	COVER,ACCESS:REAR	80009	200-1288-00
					(ATTACHING PARTS)		
-10	213-0302-00			4	SCREW,TPG,TF:6-20 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
-11	200-1350-00			1	PLATE,COVER:REAR	80009	200-1350-00
					(ATTACHING PARTS)		
-12	211-0638-00			4	SCREW,MACHINE:6-32 X 0.738 INCH,THS	83385	OBD
					- - - * - - -		
-13	----- -----			1	CKT BOARD ASSY:TC-2(SEE A2 EPL)		
-14	131-0608-00			15	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	131-0787-00			13	. CONTACT,ELEC:0.64 INCH LONG	22526	47359
-15	131-0993-00			1	. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
	131-1207-00			1	. LINK,TERM.CONNE:	80009	131-1207-00
-16	131-0707-00			2	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-17	352-0162-00			1	. . CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
-18	----- -----			1	CKT BOARD ASSY:TC-1(SEE A1 EPL)		
-19	131-0608-00			7	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-20	131-0993-00			2	. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
-21	----- -----			1	CKT BD ASSY:DEFLECTION AMP/STORAGE(SEE A4 EPL)		
					(ATTACHING PARTS)		
-22	211-0638-00			3	SCREW,MACHINE:6-32 X 0.738 INCH,THS	83385	OBD
					- - - * - - -		
	----- -----			-	CKT BOARD ASSEMBLY INCLUDES:		
-23	131-0608-00			7	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
-24	131-0993-00 [1]			3	. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
	131-0993-00 [2]			1	. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
-25	131-0566-00 [3]			2	. LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	0000C	L-2007-1
-26	----- -----			1	. TRANSISTOR:(SEE Q117 EPL)		
					(ATTACHING PARTS)		
-27	210-0586-00			2	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-28	355-0159-00			2	. TERMINAL,STUD:0.156 HEX.X 0.58 INCH L,BRS	80009	355-0159-00
-29	----- -----			4	. TRANSISTOR:(SEE Q5,Q7,Q9,Q11 EPL)		
					(ATTACHING PARTS FOR EACH)		
-30	211-0014-00	B010100	B010374	1	. SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
	211-0511-00	B010375		1	. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-31	210-0071-00			1	. WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-32	210-0811-00			1	. WSHR,SHOULDERED:0.125 ID X 0.50 INCH OD	74921	6525
-33	210-0851-00	B010100	B010374	1	. WASHER,FLAT:0.119 ID X 0.375 INCH OD,STL	12327	OBD
	210-0803-00	B010375		1	. WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-34	210-0586-00	B010100	B010374	1	. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
	210-0407-00	B010375		1	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		

[1]4010 only
[2]4010-1 only
[3]Used with -04 suffix boards only

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-35	342-0136-00			4	. INSULATOR,WSHR:0.812 OD X 0.0025 INCH THK	80009	342-0136-00
-36	----- -----			4	. TRANSISTORS:(SEE Q93,Q95,Q97,Q99 EPL)		
					(ATTACHING PARTS FOR EACH)		
-37	211-0511-00			2	. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-38	210-0967-00			2	. WSHR,SHOULDERED:0.157 ID X 0.375 INCH OD	80009	210-0967-00
-39	210-0803-00			2	. WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-40	210-0202-00			1	. TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-41	210-0407-00			1	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-42	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-43	386-0143-00			4	. INSULATOR,PLATE:0.002 INCH MICA,FOR TO-2	02735	DF31A
-44	214-1669-00			1	. HEAT SINK,XSTR:	80009	214-1669-00
					(ATTACHING PARTS)		
-45	211-0507-00			6	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-46	384-0519-00			6	. POST,ELEC-MECH:HEX,0.25 X 0.562 INCH,	80009	384-0519-00
					(ATTACHING PARTS FOR EACH)		
-47	211-0601-00			1	. SCR,ASSEM WSHR:6-32 X 0.312 INCH,PNH BRS	80009	211-0601-00
					- - - * - - -		
-48	175-0826-00			FT	. WIRE,ELECTRICAL:3 WIRE RIBBON	08261	TEK-175-0826-00
-49	131-0707-00			8	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-50	352-0161-00			4	. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0161-00
-51	----- -----			1	CKT BOARD ASSY:MOTHER(SEE A3 EPL)		
					(ATTACHING PARTS)		
-52	211-0511-00			8	SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSEMBLY INCLUDES:		
-53	131-0589-00			40	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0589-00 [1]			48	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-54	131-0993-00 [1]			4	. LINK,TERM.CONNE:2 WIRE BLACK	00779	530153-2
-55	131-1148-00			8	. KEY,CONN PLZN:PLASTIC	00779	6711-6
-56	131-1147-00			4	. CONN,RCPT,ELEC:72 PIN	00779	PE1-14180
-57	441-1037-00			1	CHASSIS,TERM:CIRCUIT BOARD	80009	441-1037-00
					(ATTACHING PARTS)		
-58	213-0302-00			4	SCREW,TPG,TF:6-20 X 0.50 INCH,PNH STL	83385	OBD
					- - - * - - -		
-59	179-1808-00 [2]	B010100	B010359	1	WIRING HARNESS:HARD COPY	80009	179-1808-00
	179-1808-01 [2]	B010360		1	WIRING HARNESS:HARD COPY	80009	179-1808-01
					(ATTACHING PARTS)		
-60	129-0260-00 [2]			2	POST,ELEC-MECH:0.255 HEX.X 0.500 INCH L	80009	129-0260-00
-61	210-0586-00 [2]			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
	----- -----			-	. CABLE ASSEMBLY INCLUDES:		
-62	131-0458-00 [2]			1	. CONNECTOR,RCPT,:15 PIN,FEMALE	71468	DA15
-63	131-0621-00 [2]			8	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	131-0622-00 [2]			2	. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	131-0792-00 [2]			4	. CONTACT,ELEC:0.577"L,18-20 AWG WIRE	22526	46221
-64	131-1159-00 [2]			1	. CONTACT,ELEC:250 FASTEN	00779	60041-2
-65	352-0197-00 [2]			1	. CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
-66	352-0200-00 [2]			1	. CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0200-00
-67	352-0205-00 [2]			1	. CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
-68	407-1024-00 [2]			1	BRKT,CONN MTG:	80009	407-1024-00
					(ATTACHING PARTS)		
-69	211-0638-00 [2]			2	SCREW,MACHINE:6-32 X 0.738 INCH,THS	83385	OBD
-70	210-0457-00 [2]			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-71	351-0238-00			2	GUIDE,CKT BD:PLASTIC	80009	351-0238-00
					(ATTACHING PARTS FOR EACH)		
-72	211-0507-00			6	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-73	210-0457-00			6	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		

[1]Used on -02 suffix boards only
[2]4010-1 only

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-74	343-0603-01			1	CLAMP,LOOP:0.5 INCH DIA	80009	343-0603-01
					(ATTACHING PARTS)		
-75	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-76	348-0056-00			1	GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-77	255-0334-00			1	PLASTIC CHANNEL:0.667 FT LONG	80009	255-0334-00
-78	334-1917-00			1	MARKER,IDENT:	80009	334-1917-00
-79	----- -----			1	SWITCH,ROCKER:POWER(SEE S501 EPL)		
					(ATTACHING PARTS)		
-80	211-0541-00			2	SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-81	131-1249-00	B010100	B010263X	2	CONTACT,ELEC:QUICK DISCONNECT,4 CONTACT	00779	41478
					(ATTACHING PARTS FOR EACH)		
-82	211-0097-00	B010100	B010263X	2	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-83	210-0004-00	B010100	B010263X	2	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
-84	210-0586-00	B010100	B010263X	2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-85	124-0264-00			1	STRIP,TRIM:REAR	80009	124-0264-00
					(ATTACHING PARTS)		
-86	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-87	343-0005-00			2	CLAMP,LOOP:0.438 INCH	95987	7-16-6B
-88	343-0003-00			2	CLAMP,LOOP:0.25 INCH DIA	95987	1-4 6R
					(ATTACHING PARTS FOR EACH)		
-89	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-90	210-0863-00			1	WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
					- - - * - - -		
-91	348-0292-00			4	FOOT,CABINET:BASE	81044	EK-1
					(ATTACHING PARTS FOR EACH)		
-92	210-0411-00			1	NUT,PLAIN,HEX.:0.25-20 X 0.438 INCH STL	73743	OBD
					- - - * - - -		
-93	200-1378-00			4	CAP,TRIM:BLACK PLASTIC	80009	200-1378-00
-94	432-0073-00			1	BASE,PED UNIT:	80009	432-0073-00
					(ATTACHING PARTS)		
-95	213-0163-00			4	SCR,CAP,SOC. HD:0.25-32 X 0.625 INCH,STL	74445	OBD
-96	210-0853-00			4	WASHER,FLAT:0.25 ID X 0.50 OD	86044	OBD
					- - - * - - -		
-97	437-0130-00			1	CAP.,PED UNIT:	80009	437-0130-00
-98	220-0625-00			18	. NUT,SHEET SPR:6-32 THD,STL	78553	C8090-632-24
	179-1758-00			1	WIRING HARNESS:AC NO. 1	80009	179-1758-00
-99	131-0946-00			1	. CONN,BODY,RCPT:4 CONTACT,IN-LINE,FEMALE	27264	03-09-2041
-100	131-0945-00			4	. CONTACT,ELEC:0.865 INCH LONG,MALE,BRS	27264	02-09-2103

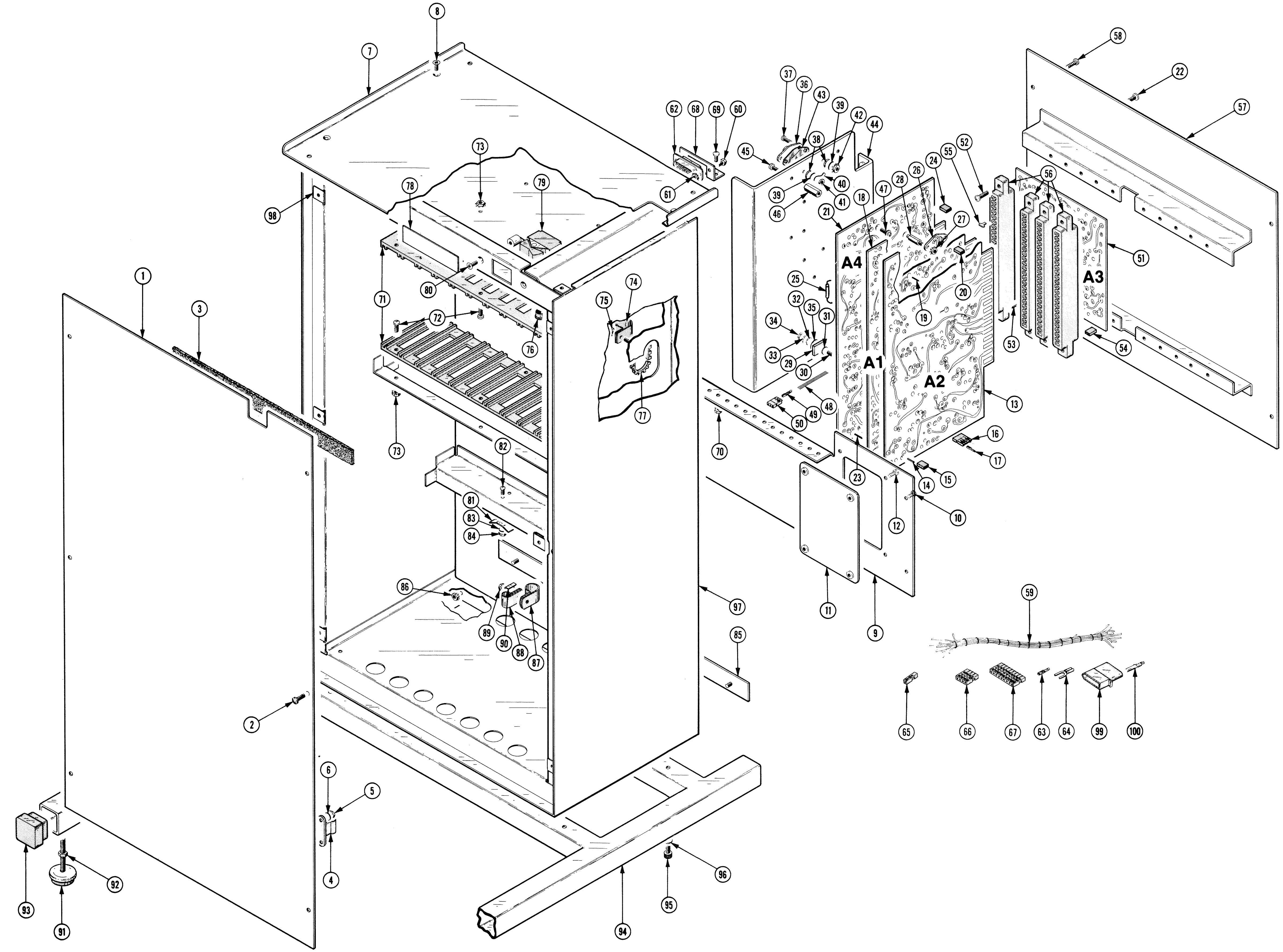
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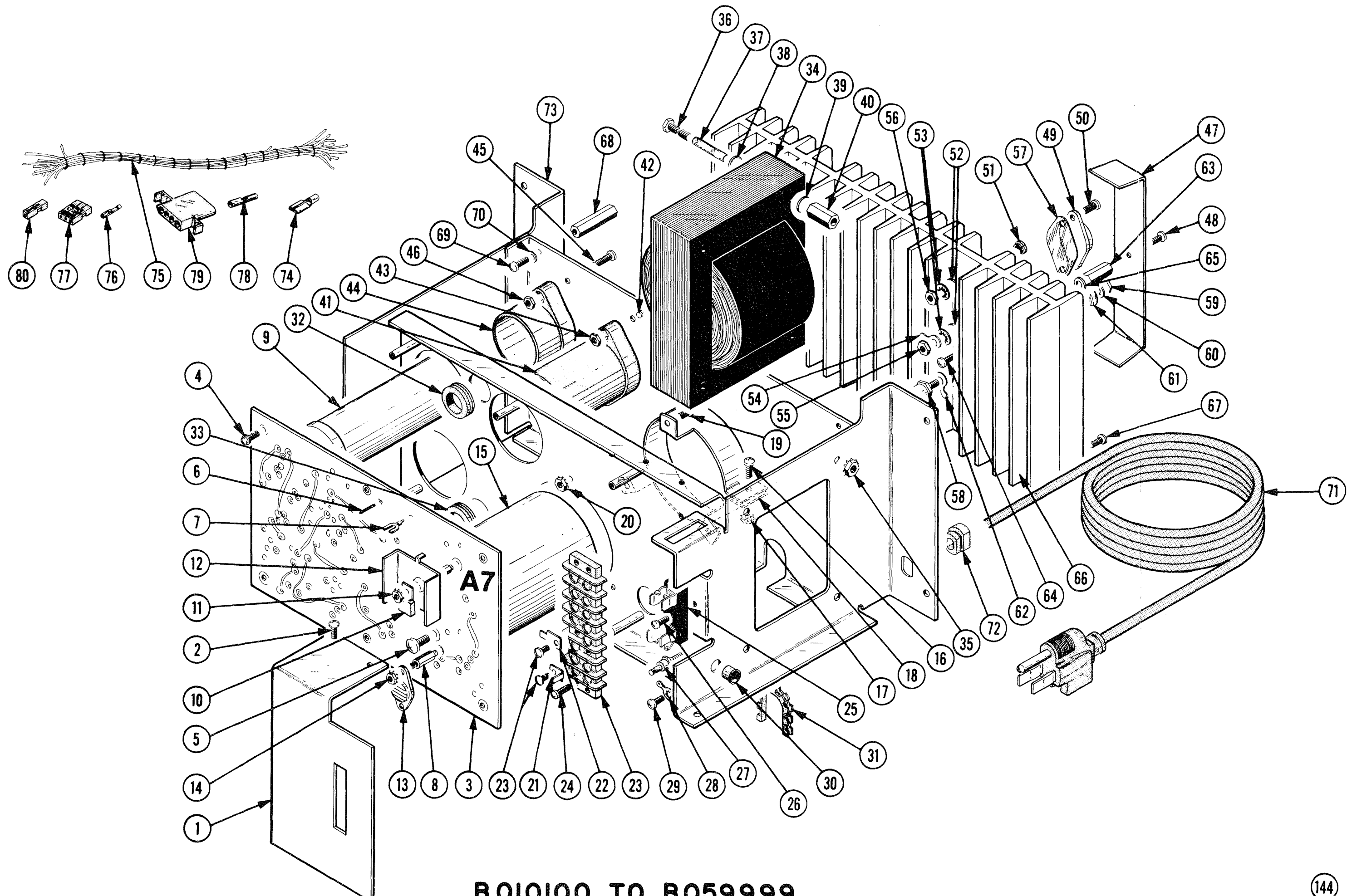
FIG. 4 POWER SUPPLY



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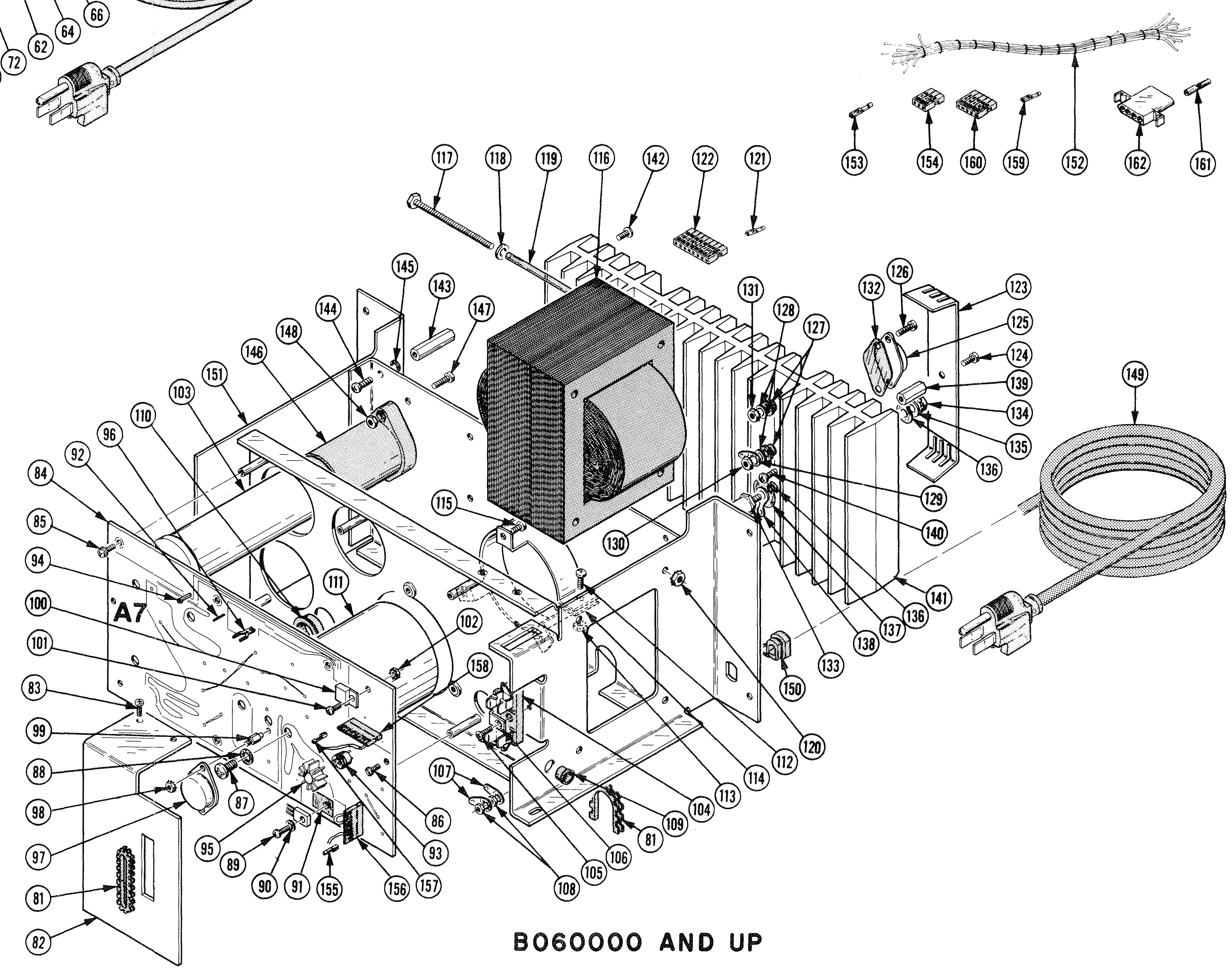

B060000 AND UP

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-	620-0225-00	B010100	B059999	1	POWER SUPPLY:	80009	620-0225-00
					(ATTACHING PARTS)		
	213-0302-00			4	SCREW,TPG,TF:6-20 X 0.50 INCH,PNH STL	83385	OBD
	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0006-00			2	WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
	----- -----			-	. POWER SUPPLY ASSEMBLY INCLUDES:		
-1	337-1629-00			1	. SHIELD,FUSE:	80009	337-1629-00
					(ATTACHING PARTS)		
-2	211-0097-00			2	. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-3	----- -----			1	. CKT BOARD ASSY:LV POWER SUPPLY(SEE A6 EPL)		
					(ATTACHING PARTS)		
-4	211-0116-00			6	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-5	212-0518-00			2	. SCREW,MACHINE:10-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. . CKT BOARD ASSEMBLY INCLUDES:		
-6	131-0589-00			40	. . CONTACT,ELEC:0.46 INCH LONG	22526	47350
-7	344-0154-00			6	. . CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-8	355-0159-00			3	. . TERMINAL,STUD:0.156 HEX X 0.58 INCH L,BRS	80009	355-0159-00
-9	----- -----			3	. . CAPACITORS:(SEE C9,C23,C53 EPL)		
-10	----- -----			1	. . TRANSISTOR:(SEE Q75 EPL)		
					(ATTACHING PARTS)		
-11	210-0586-00			1	. . NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
	210-0004-00			1	. . WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-12	214-1671-00			1	. . HEAT SINK,ELEC:TRANSISTOR	80009	214-1671-00
-13	----- -----			1	. . TRANSISTOR:(SEE Q117 EPL)		
					(ATTACHING PARTS)		
-14	210-0586-00			2	. . NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-15	----- -----			1	. CAPACITOR:(SEE C41 EPL)		
					(ATTACHING PARTS)		
-16	211-0513-00			1	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-17	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-18	343-0064-00			1	. CLAMP,LOOP:CAPACITOR MTG	80009	343-0064-00
					(ATTACHING PARTS)		
-19	211-0510-00			3	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-20	210-0457-00			3	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-21	210-0292-00			10	. TERMINAL,LUG:	98410	3701
-22	131-1247-00			9	. CONTACT,ELEC:	00779	61664-1
-23	124-0006-00			1	. TERMINAL BOARD:	71785	353-19-08-168
					(ATTACHING PARTS)		
-24	211-0198-00			2	. SCREW,MACHINE:4-40 X 0.438 INCH,RDH NYLON	77250	OBD
					- - - * - - -		
-25	352-0031-00			1	. FUSEHOLDER:3AG FUSE	75915	357001
					(ATTACHING PARTS)		
-26	211-0510-00			1	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-27	129-0006-00			1	. TERMINAL,STUD:INSULATED	00866	1700P
-28	210-0201-00			1	. TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
					(ATTACHING PARTS)		
-29	213-0044-00			1	. SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-30	348-0056-00			1	. GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-31	255-0334-00			1	. PLASTIC CHANNEL:0.667 FT LONG	80009	255-0334-00
-32	348-0012-00			1	. GROMMET,RUBBER:	72653	1043-1M
-33	348-0006-00			2	. GROMMET,RUBBER:0.562 ID X 0.875 INCH OD	70485	1720
-34	----- -----			1	. TRANSFORMER:POWER(SEE T501 EPL)		
					(ATTACHING PARTS)		
-35	220-0410-00			4	. NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-	----- -----			-	. . TRANSFORMER INCLUDES:		
-36	212-0515-00			4	. . SCREW,MACHINE:10-32 X 2.250" HEX.HD STL	83385	OBD
-37	166-0226-00			4	. . INSUL SLVG,ELEC:1.125 INCHES LONG	80009	166-0226-00
-38	210-0812-00			4	. . WASHER,NONMETAL:#10,FIBER	06982	OBD
-39	210-0805-00			4	. . WASHER,FLAT:0.204 ID X 0.438 INCH OD,STL	12327	OBD
-40	384-0597-00			4	. . ROD,SPACER:0.25 OD X 1.312 LONG,NYLON	80009	384-0597-00
-41	432-0048-00			2	. BASE,CAP.MTG:	80009	432-0048-00
					(ATTACHING PARTS FOR EACH)		
-42	211-0513-00			2	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-43	210-0407-00			2	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
-44	432-0048-01			1	. BASE,CAP. MTG:	80009	432-0048-01
					(ATTACHING PARTS)		
-45	211-0513-00			2	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-46	210-0407-00			2	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
-47	200-1330-00			2	. COVER,XSTR:	80009	200-1330-00
					(ATTACHING PARTS FOR EACH)		
-48	211-0537-00			1	. SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-49	----- -----			3	. TRANSISTORS:(SEE Q510,Q515,Q520 EPL)		
					(ATTACHING PARTS FOR EACH)		
-50	211-0513-00			2	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-51	210-0910-00			2	. WASHER,NONMETAL:0.188 ID X 0.313" OD,TEFLON	02107	1704B863
-52	210-0967-00			2	. WSHR,SHOULDERED:0.157 ID X 0.375 INCH OD	80009	210-0967-00
-53	210-0803-00			2	. WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-54	210-0202-00			1	. TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-55	210-0407-00			1	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-56	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-57	386-0978-00			3	. INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-58	----- -----			2	. SEMICOND DEVICE:(SEE CR502,CR503 EPL)		
					(ATTACHING PARTS FOR EACH)		
-59	220-0410-00			1	. NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
-60	210-0805-00			1	. WASHER,FLAT:0.204 ID X 0.438 INCH OD,STL	12327	OBD
-61	210-0909-00			1	. WASHER,FLAT:0.196 ID X 0.625 INCH OD,MICA	83309	OBD
	210-0910-00			1	. WASHER,NONMETAL:0.188 ID X 0.313" OD,TEFLON	02107	1704B863
-62	210-0224-00			1	. TERMINAL LUG:SINGLE	78189	2501-10-00-2220N
					- - - * - - -		
-63	384-0519-00			2	. POST,ELEC-MECH:HEX,0.25 X 0.562 INCH,	80009	384-0519-00
					(ATTACHING PARTS FOR EACH)		
-64	211-0510-00			1	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-65	210-0006-00			1	. WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
-66	214-1666-00			1	. HEAT SINK,XSTR:	80009	214-1666-00
					(ATTACHING PARTS)		
-67	211-0537-00			6	. SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-68	385-0122-00			6	. POST,ELEC-MECH:HEX,0.25 X 0.937 INCH LONG	80009	385-0122-00
					(ATTACHING PARTS FOR EACH)		
-69	211-0510-00			1	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-70	210-0006-00			1	. WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
-71	161-0033-07			1	. CABLE ASSY,PWR,:3 WIRE,92 INCH LONG	16428	KH8002
					(ATTACHING PARTS)		
-72	358-0161-00			1	. BSHG,STRAIN RLF:FOR 0.50 INCH HOLE,PLASTIC	28520	SR5P4
					- - - * - - -		
-73	437-0129-00			1	. CHAS,PWR SPLY:MAIN	80009	437-0129-00
-74	131-0861-00			4	. CONTACT,ELEC:QUICK DISCONNECT	00779	42617-2
-75	179-1760-00			1	. WIRING HARNESS:POWER NO. 1	80009	179-1760-00
-76	131-0621-00			3	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-77	352-0199-00			1	. . CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	179-1759-00			1	. WIRING HARNESS:AC NO. 2	80009	179-1759-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-78	131-0948-00			4	. . CONTACT,ELEC:0.865 INCH L,FEMALE,BRS	27264	02-09-1103
-79	131-0947-00			1	. . CONNECTOR BODY,:MALE,4 CONTACT	27264	03-09-1041
	179-1761-00			1	. WIRING HARNESS:POWER NO. 2	80009	179-1761-00
	131-0621-00			4	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-80	352-0197-00			1	. . CONN BODY,PL,EL:1 WIRE BLACK	80009	352-0197-00
	352-0199-00			1	. . CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	620-0225-01	B060000		1	POWER SUPPLY:LOW VOLTAGE	80009	620-0225-01
					(ATTACHING PARTS)		
	213-0302-00			4	SCREW,TPG,TF:6-20 X 0.50 INCH,PNH STL	83385	OBD
	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0006-00			2	WASHER,LOCK:INTL,0.146 IDX 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
	----- -----			-	. POWER SUPPLY ASSEMBLY INCLUDES:		
-81	255-0334-00			1	. PLASTIC CHANNEL:0.667 FT LONG	80009	255-0334-00
-82	337-2287-00			1	. SHIELD,ELEC:FUSE	80009	337-2287-00
					(ATTACHING PARTS)		
-83	211-0097-00			2	. SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-84	----- -----			1	. CKT BOARD ASSY:LV POWER SUPPLY		
					(ATTACHING PARTS)		
-85	211-0116-00			5	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-86	211-0040-00			1	. SCREW,MACHINE:4-40 X 0.25",BDGH PLSTC	26365	OBD
-87	212-0507-00			2	. SCREW,MACHINE:10-32 X 0.375 INCH,PNH STL	83385	OBD
-88	210-0010-00			2	. WASHER,LOCK:INT,0.20 ID X0.376" OD,STL	78189	1210-00-00-0541C
-89	211-0198-00			1	. SCREW,MACHINE:4-40 X 0.438 INCH,RDH NYLON	77250	OBD
-90	210-1122-00			1	. WASHER,LOCK:0.228 ID X 0.375 INCH OD,STL	78189	4704-04-02
-91	343-0202-00			1	. INSULATOR PLATE:TRANSISTOR,MICA	01295	10-21-023-106
					- - - * - - -		
	------ ----			-	. . CKT BOARD ASSEMBLY INCLUDES:		
-92	131-0589-00			72	. . CONTACT,ELEC:0.46 INCH LONG	22526	47350
-93	136-0183-00			2	. . SOCKET,PLUG-IN:3 PIN,ROUND	80009	136-0183-00
-94	214-0579-00			5	. . TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-95	214-1292-00			2	. . HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
-96	344-0154-00			6	. . CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
-97	----- -----			1	. . TRANSISTOR:(SEE Q265 EPL)		
					(ATTACHING PARTS)		
-98	210-0586-00			2	. . NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-99	355-0159-00			2	. . TERMINAL,STUD:0.156 HEX.X 0.58 INCH L,BRS	80009	355-0159-00
-100	----- -----			1	. . TRANSISTOR:(SEE Q80 EPL)		
					(ATTACHING PARTS)		
-101	211-0097-00			1	. . SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-102	210-0586-00			1	. . NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-103	----- -----			3	. . CAPACITORS:(SEE C3,C5,C205 EPL)		
-104	352-0031-00			1	. FUSEHOLDER:3AG FUSE	75915	357001
					(ATTACHING PARTS)		
-105	211-0512-00			1	. SCREW,MACHINE:6-32 X 0.50" 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-106	343-0559-00			1	. RTNR,FUSEHOLDER:	80009	343-0559-00
-107	210-0202-00			2	. TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
					(ATTACHING PARTS FOR EACH)		
-108	210-0407-00			1	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
-109	348-0056-00			1	. GROMMET,PLASTIC:0.375 INCH DIA	80009	348-0056-00
-110	348-0050-00			2	. GROMMET,PLASTIC:0.75 INCH DIA	80009	348-0050-00
-111	----- -----			1	. CAPACITOR:(SEE C255 EPL)		
					(ATTACHING PARTS)		
-112	211-0511-00			1	. SCREW,MACHINE:6-32 X 0.50 INCH,PNH STL	83385	OBD
-113	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-114	343-0067-01			1	. CLMAP,LOOP:CAPACITOR MTG	80009	343-0067-01
					(ATTACHING PARTS)		
-115	211-0590-00			3	. SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-116	----- -----			1	. TRANSFORMER:POWER(SEE T501 EPL)		
					(ATTACHING PARTS)		
-117	212-0511-00			4	. SCREW,MACHINE:10-32 X 3" LONG,HEX.HD STL	83385	OBD
-118	210-0812-00			4	. WASHER,NONMETAL:#10,FIBER	06982	OBD
-119	166-0434-00			4	. SPACER,SLEEVE:MYLAR	80009	166-0434-00
-120	220-0410-00			4	. NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
					- - - * - - -		
	----- -----			-	. . TRANSFORMER INCLUDES:		
-121	131-0621-00			8	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-122	352-0205-00			1	. . CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0205-00
-123	200-1330-00			2	. COVER,XSTR:	80009	200-1330-00
					(ATTACHING PARTS FOR EACH)		
-124	211-0504-00			1	. SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-125	----- -----			3	. TRANSISTORS:(SEE Q510,Q515,Q520 EPL)		
					(ATTACHING PARTS FOR EACH)		
-126	211-0513-00			2	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-127	210-0967-00			2	. WSHR,SHOULDERED:0.157 ID X 0.375 INCH OD	80009	210-0967-00
-128	210-0803-00			2	. WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-129	210-0202-00			1	. TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-130	210-0407-00			1	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-131	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-132	386-0978-00			3	. INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-133	----- -----			2	. SEMICOND DEVICE:(SEE CR502,CR503 EPL)		
					(ATTACHING PARTS FOR EACH)		
-134	220-0410-00			1	. NUT,EXTENDED WA:10-32 X 0.375 INCH,STL	83385	OBD
-135	210-0805-00			1	. WASHER,FLAT:0.204 ID X 0.438 INCH OD,STL	12327	OBD
-136	210-0905-00			2	. WASHER,FLAT:0.256 ID X 0.438 INCH OD,BRS	83385	OBD
-137	210-0910-00			1	. WASHER,NONMETAL:0.188 ID X 0.313" OD,TEFLON	02107	1704B863
-138	210-0224-00			1	. TERMIANL LUG:SINGLE	78189	2501-10-00-2220N
					- - - * - - -		
-139	384-0519-00			2	. POST,ELEC-MECH:HEX.,0.25 X 0.562 INCH,	80009	384-0519-00
					(ATTACHING PARTS FOR EACH)		
-140	211-0510-00			1	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-141	214-1666-00			1	. HEAT SINK,XSTR:	80009	214-1666-00
					(ATTACHING PARTS)		
-142	211-0537-00			6	. SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-143	385-0122-00			6	. POST,ELEC-MECH:HEX.,0.25 X 0.937 INCH LONG	80009	385-0122-00
					(ATTACHING PARTS FOR EACH)		
-144	211-0510-00			1	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-145	210-0006-00			1	. WASHER,LOCK:INTL,0.146 ID X 0.288 OD,STL	78189	1206-00-00-0541C
					- - - * - - -		
-146	432-0048-01			3	. BASE,CAP. MTG:	80009	432-0048-01
					(ATTACHING PARTS FOR EACH)		
-147	211-0513-00			2	. SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-148	210-0407-00			2	. NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
					- - - * - - -		
-149	161-0033-00			1	. CABLE ASSY,PWR,:POWER	70903	KH5442-290D
					(ATTACHING PARTS)		
-150	358-0161-00			1	. BSHG,STRAIN RLF:FOR 0.50 INCH HOLE,PLASTIC	28520	SR5P4
					- - - * - - -		
	----- -----			-	. . POWER CORD ASSEMBLY INCLUDES:		
	131-0948-00			2	. . CONTACT,ELEC:0.865 INCH L,FEMALE,BRS	27264	02-09-1103
-151	437-0199-00			1	. CHAS,PWR SPLY:MAIN	80009	437-0199-00
-152	179-1760-01			1	. WIRING HARNESS:POWER NO. 1	80009	179-1760-01
-153	131-0621-00			3	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-154	352-0199-00			1	. . CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
	179-1761-01			1	. WIRING HARNESS:POWER NO. 2	80009	179-1761-01
	131-0621-00			3	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	352-0199-00			1	. . CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-	131-1776-00			1	. LINK,TERM.CONNE:BLACK,2,26 AWG,600V	80009	131-1776-00
-155	131-0707-00			4	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-156	352-0166-00			1	. . CONN BODY,PL,EL:8 WIRE BLACK	80009	352-0166-00
	131-1925-00			1	. LINK,TERM,CONNE:26 AWG,1.75 LONG	80009	131-1925-00
-157	131-0707-00			2	. . CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-158	352-0167-00			1	. . CONN BODY,PL,EL:9 WIRE BLACK	80009	352-0167-00
-159	131-0621-00			3	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-160	352-0201-00			1	. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-161	131-0948-00			2	. CONTACT,ELEC:0.865 INCH L,FEMALE,BRS	27264	02-09-1103
-162	131-0947-00			1	. CONNECTOR BODY,:MALE,4 CONTACT	27264	03-09-1041

STANDARD ACCESSORIES

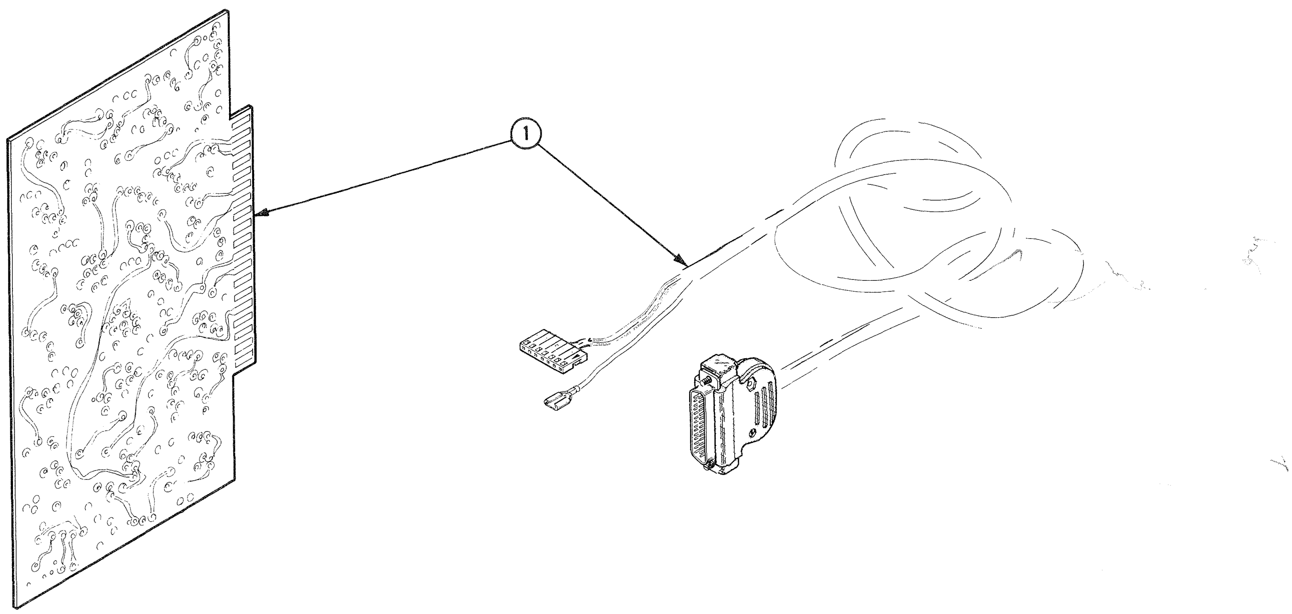

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
5-1	021-0065-00			1	INTERFACE ASSY:DATA COMMUNICATION	80009	021-0065-00
	070-1225-00	9 25		1	MANUAL,TECH:OPERATORS	80009	070-1225-00
	1458				Exchange Board $561.00		067-0653-00

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