Tektronix®

4023
COMPUTER DISPLAY TERMINAL

SERVICE MANUAL

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4023
COMPUTER DISPLAY TERMINAL

SERVICE MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

MANUAL PART NO. 070-1617-00
PRODUCT GROUP 11

First Printing JAN 1974
Revised MAY 1981

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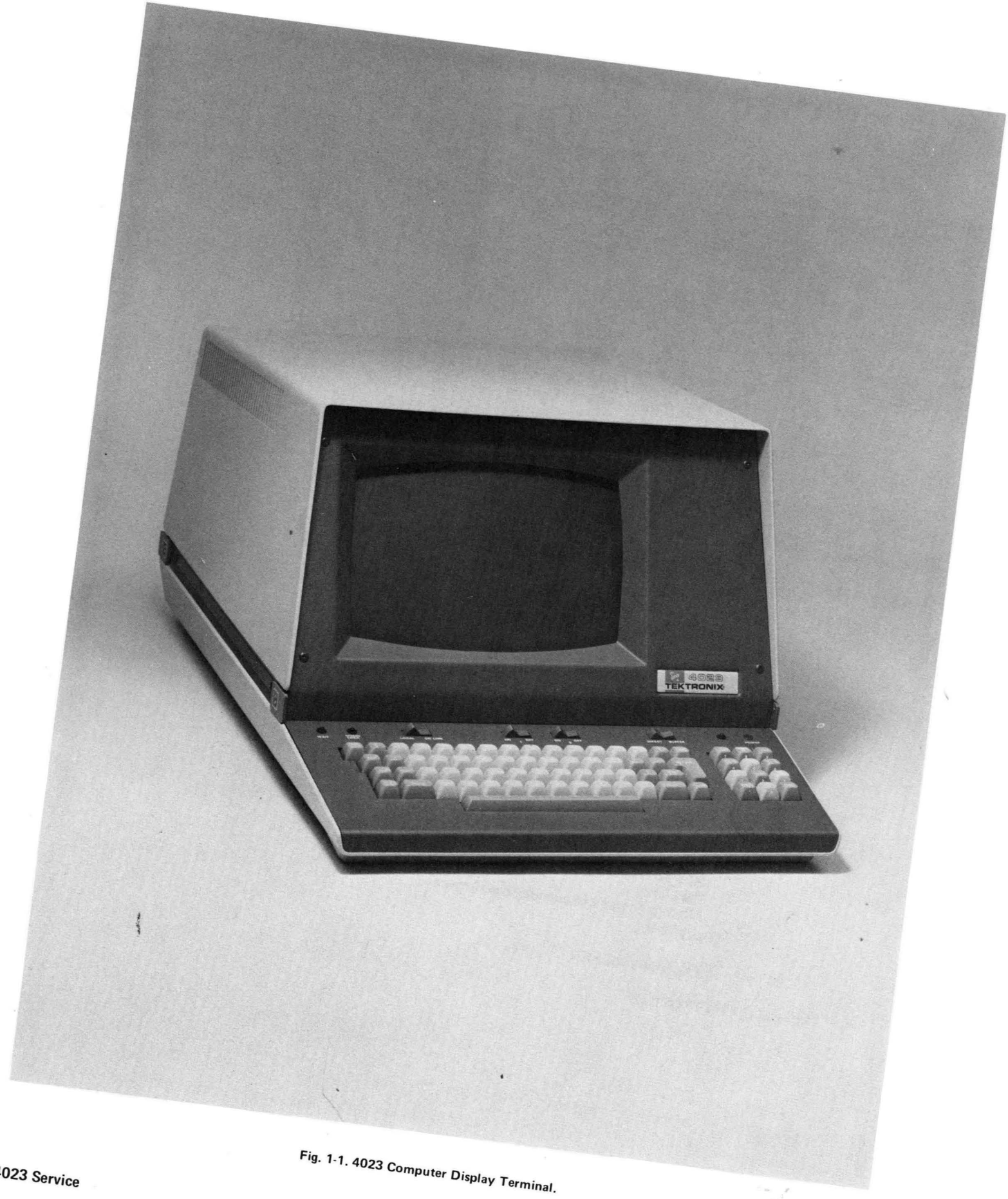


Fig. 1-1. 4023 Computer Display Terminal.

INSTALLATION AND OPERATION

This manual is a part of the following set of documents which describe the 4023 Refreshed Computer Display Terminal:

4023 USERS MANUAL, Tektronix Part No. 070-1621-00.

Contents—An explanation of how to operate and program the 4023.

4023 SERVICE MANUAL, Tektronix Part No. 070-1617-00.

Contents—A comprehensive explanation of the 4023. It includes operation, characteristics, servicing, adjustment, circuit description, and parts lists.

Optional items used with the Terminal are explained in separate manuals.

INTRODUCTION

The 4023 Computer Display Terminal interfaces between man and computer by permitting inputs through an integral keyboard and providing a display 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 Terminal has the ability to have copies made of its display, via a Hard Copy Unit.

INSTALLATION

GENERAL

Installation consists of desk-mounting the Terminal, selecting the proper operating voltage and fuse size, setting the desired strap options, and connecting the Terminal to the computer. These steps are discussed in the following paragraphs.

MOUNTING THE TERMINAL

Desk-Mounting consists of simply setting the Terminal on a desk or other surface. The air vents on the bottom and sides should be kept free of obstructions to permit air flow through the unit.

A dimensional drawing is provided in Fig. 1-2 as an installation aid.

CIRCUITRY ACCESS

The display unit cover must be removed to permit access to the Motherboard into which the Terminal Control cards, interface cards, and optional accessory cards are installed. Removing the display unit cover opens a line voltage safety interlock switch, which automatically cuts power when the cover is removed. The switch actuator (located, in the top, left-rear corner) can be pulled up to permit Terminal operation with the display unit cover removed.

WARNING

Dangerous voltages exist in the display unit area when the line cord is connected. Servicing should be done only by qualified technicians.

SELECTING STRAPPABLE OPTIONS

Strappable options are movable wire straps located on circuit cards inside the display unit, Figs. 1-3 and 1-4 show the strap option locations. These straps provide options for the operator and programmer and can be set at the user site by qualified technical personnel. The circuit cards (seven of them) plug into the Motherboard. See Fig. 1-5 for card locations on the Motherboard.

CAUTION

1. Do not remove or install circuit cards while the Terminal power is on.

2. The cards must be installed in the order shown in Fig. 1-5; otherwise, heat is not dissipated properly.

The positions of the straps are dependent upon computer and program requirements, and in some cases, upon user preference. The location and description of the movable strap options for the Keyboard Interface, Control, Timing, and Basic Data Communications Interface cards are shown in Figs. 1-3 and 1-4. Information on cut-strap options can be found in Section 2 of this manual. The Optional Data Communications Interface (021-0112-00) is to be installed in P8. The Standard Data Communications Interface (021-0111-00) is installed in P9. Detailed strappable option information for these two interfaces can be found in their respective manuals.

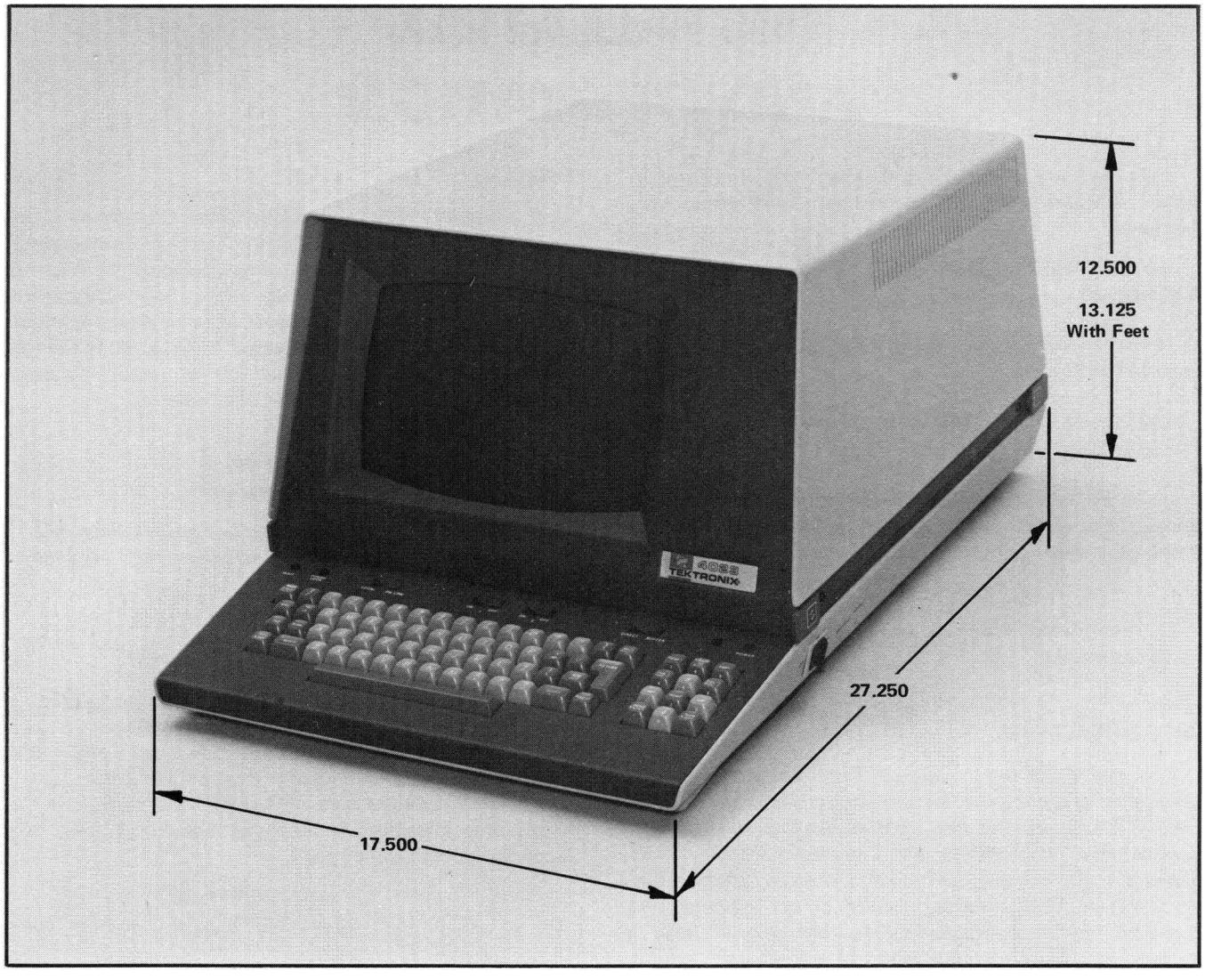


Fig. 1-2. Physical Dimensions.

AC Power Sources and Requirements

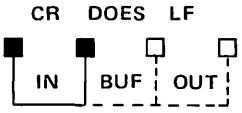
CAUTION

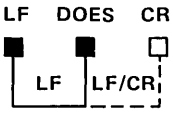
This Terminal is intended to be operated from a single phase, earth, referenced power source having one current carrying conductor (neutral) at ground (earth) potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a multiphase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

This Terminal is designed to operate from either a 110 or 220 volt nominal line voltage source that has a frequency of 48 to 440 Hz. In addition, any of three voltage ranges for 100 Vac or four voltage ranges for 220 Vac may be selected. Voltage, current and power requirements are listed below.

VOLTAGE, CURRENT, AND POWER REQUIREMENTS

VOLTAGE RANGE	FREQUENCY	LINE FUSE (slo blow)	INPUT POWER
100, 115, 120	48Hz or 440Hz	2A	220 W Max
200, 220, 230, 240		1.25A	





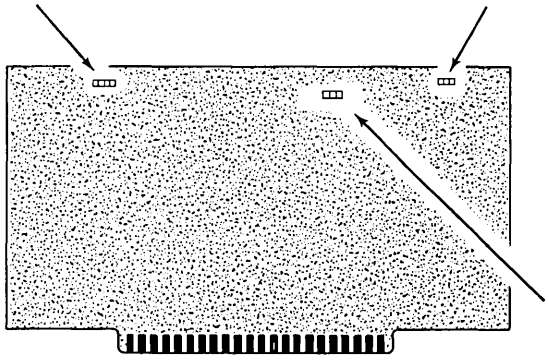
BUF—position with BUFFER selection permits a keyboard CR to also generate a linefeed.

IN position permits either a keyboard or computer generated CR to generate a simultaneous linefeed.

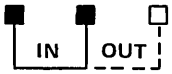
OUT position inhibits simultaneous linefeeds with CR, regardless of CR origin.

LF position performs a linefeed only upon receipt of a linefeed command.

LF/CR position causes a simultaneous carriage return function upon receipt of a linefeed command.

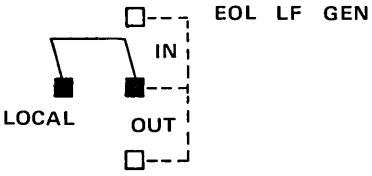


A. Keyboard Interface Card.



WRAP-AROUND

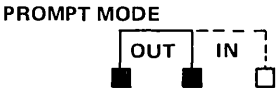
IN causes wrap-around when moving cursor past 80th character position. OUT disables wrap-around



LOCAL enables line feeds to be generated in LOCAL when transmitting from the Terminal buffer to an auxiliary device. Line feeds are not transmitted to the computer is on line.

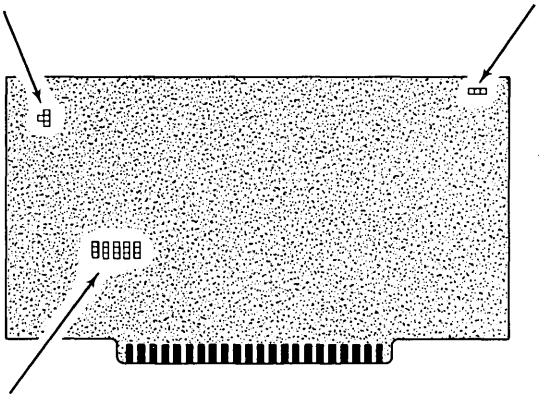
IN enables linefeeds to be generated by transmit circuits when operating in LOCAL or ON LINE with BUFFER selected.

OUT prevents linefeeds from being generated at end of a line.

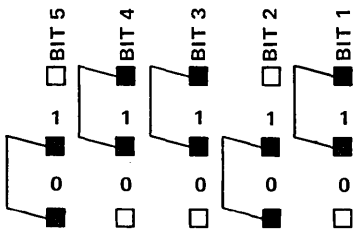


OUT is used when 4023 does not require a prompt character for data transmission from buffer a line at a time.

IN is used when 4023 is to receive a prompt character for data transmission from buffer.



B. Control Card.



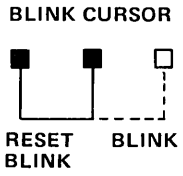
MESSAGE END

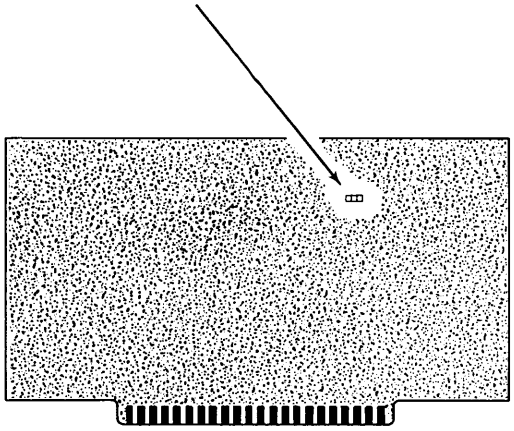
The Message End character is the last character sent in a buffer or Read Cursor transmission. The standard END character is strapped to be CR.

Fig. 1-3A & B. Options on the Keyboard Interface and Control cards that can be selected by strap placement.

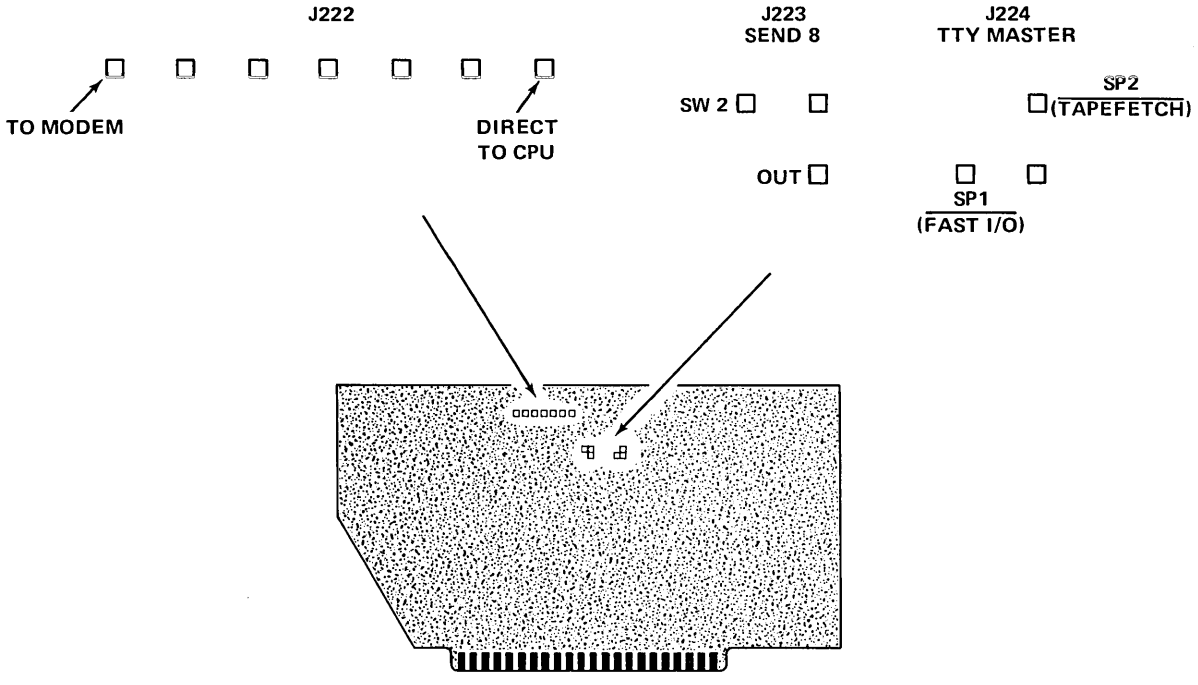
RESET BLINK position causes cursor to blink when RESET key is pressed.

BLINK position causes cursor to blink continuously.





A. Timing Card.



B. Interface Card.

Fig. 1-4A & B. Options on the Timing and Standard Interface card that can be selected by strap placement.

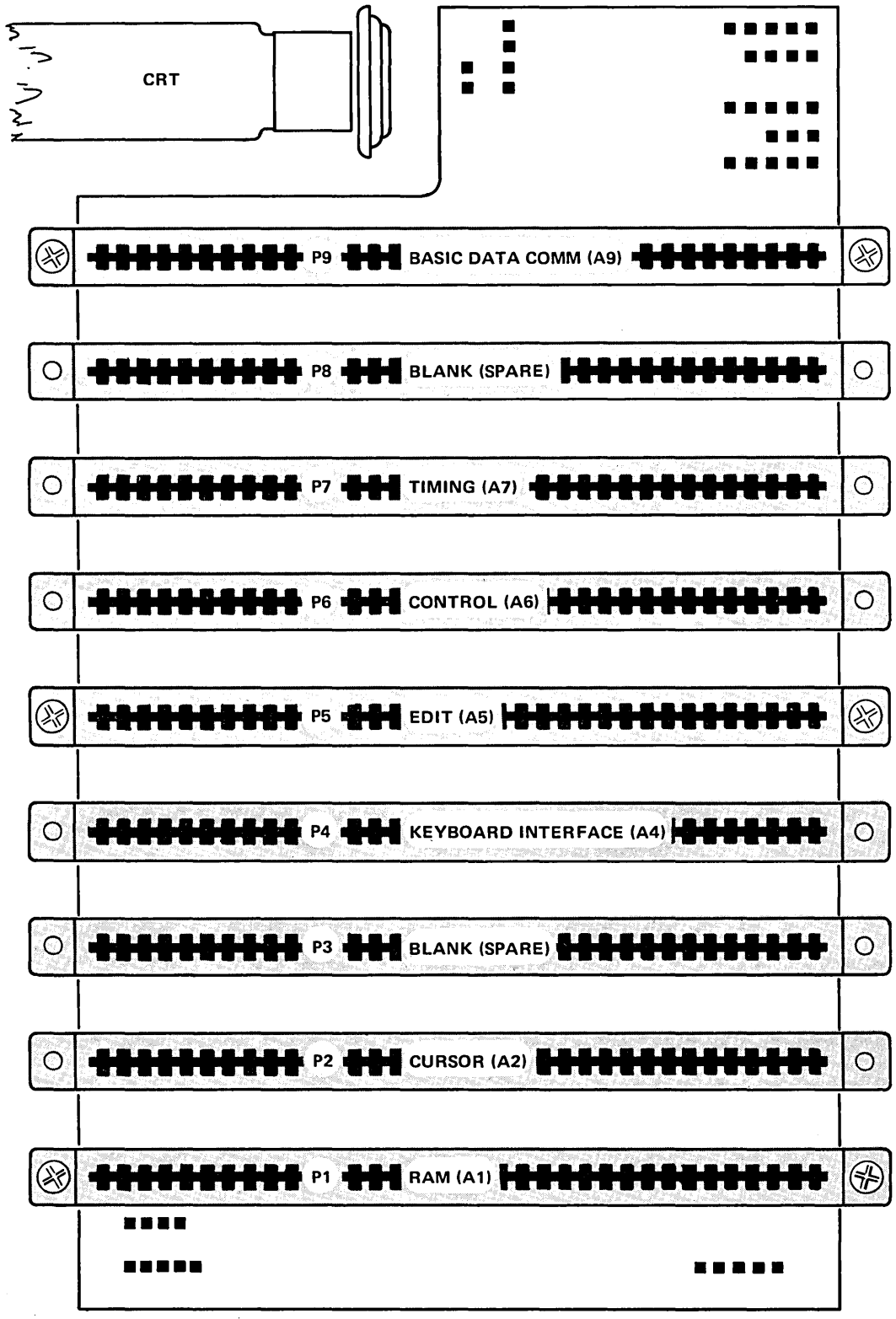


Fig. 1-5. Motherboard (minibus) connector assignments.

A fuse and a transformer jumper arrangement permit the Terminal to be modified to suit the voltage supply. A tag on the back panel of the Terminal identifies the internal voltage setting for which the Terminal is wired when shipped from the factory. If, for any reason, the jumper arrangement is changed, changing the internal voltage setting, cross out the old setting and write the new voltage setting on a tag. Attach the tag to the rear panel or the line cord.

The fuse is located in the bottom-left corner of the back panel. The Transformer and jumper arrangement are located inside the display unit in the left rear corner (see Fig. 1-6). Removing the display unit provides access to the jumper arrangement. This consists of removing two screws at the top of the rear panel. The display unit cover can be removed. Wiring instructions are shown on the metal protection cover directly above the transformer wiring connectors. See Fig. 1-6.

WARNING

Dangerous voltages exist at several places inside the display unit. Disconnect the Terminal from the power source before changing transformer connections. (In the event the power was on when the cover was removed, a safety interlock switch disables the power supply. Pulling the switch up allows the Terminal to be operated with the cover off.)

AC POWER CORD AND GROUNDING REQUIREMENTS

This instrument has a three-wire power cord with a three-wire terminal polarized plug for connection to the power source and safety earth. See Fig. 1-7 for USA standard plugs. The Safety Earth terminal of the plug is directly connected to the instrument frame for electric-shock protection. Insert this plug only in a mating outlet with a safety earth contact or otherwise connect the frame of the Terminal to a safety earth system. The color coding of the cord conductors is in accordance with recognized standards as shown below. In other jurisdictions, replace the USA standard plug with a plug that satisfies local authorities.

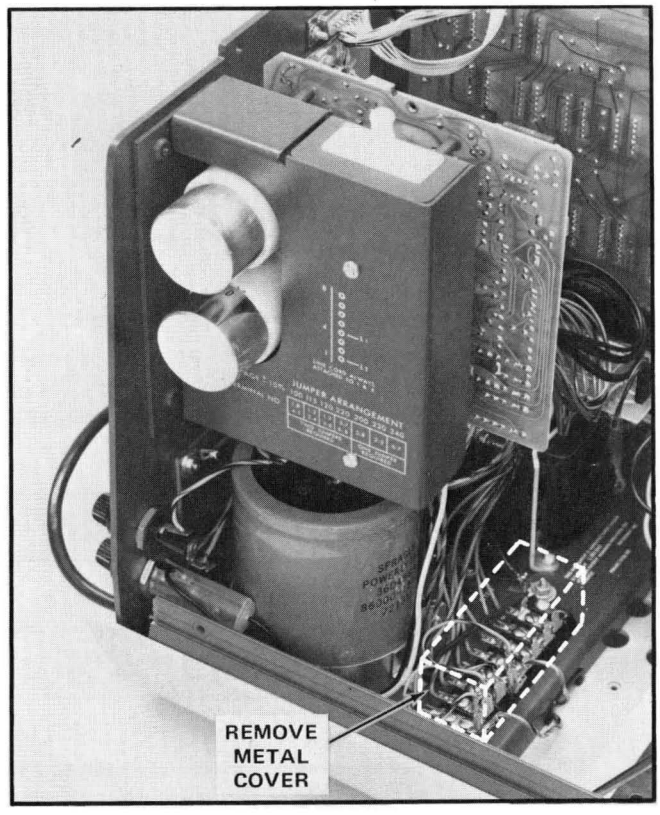
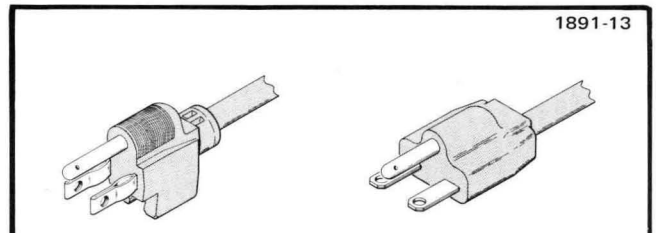


Fig. 1-6. Location of Transformer wiring connectors.



Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Fig. 1-7. Transformer terminal jumper arrangement.

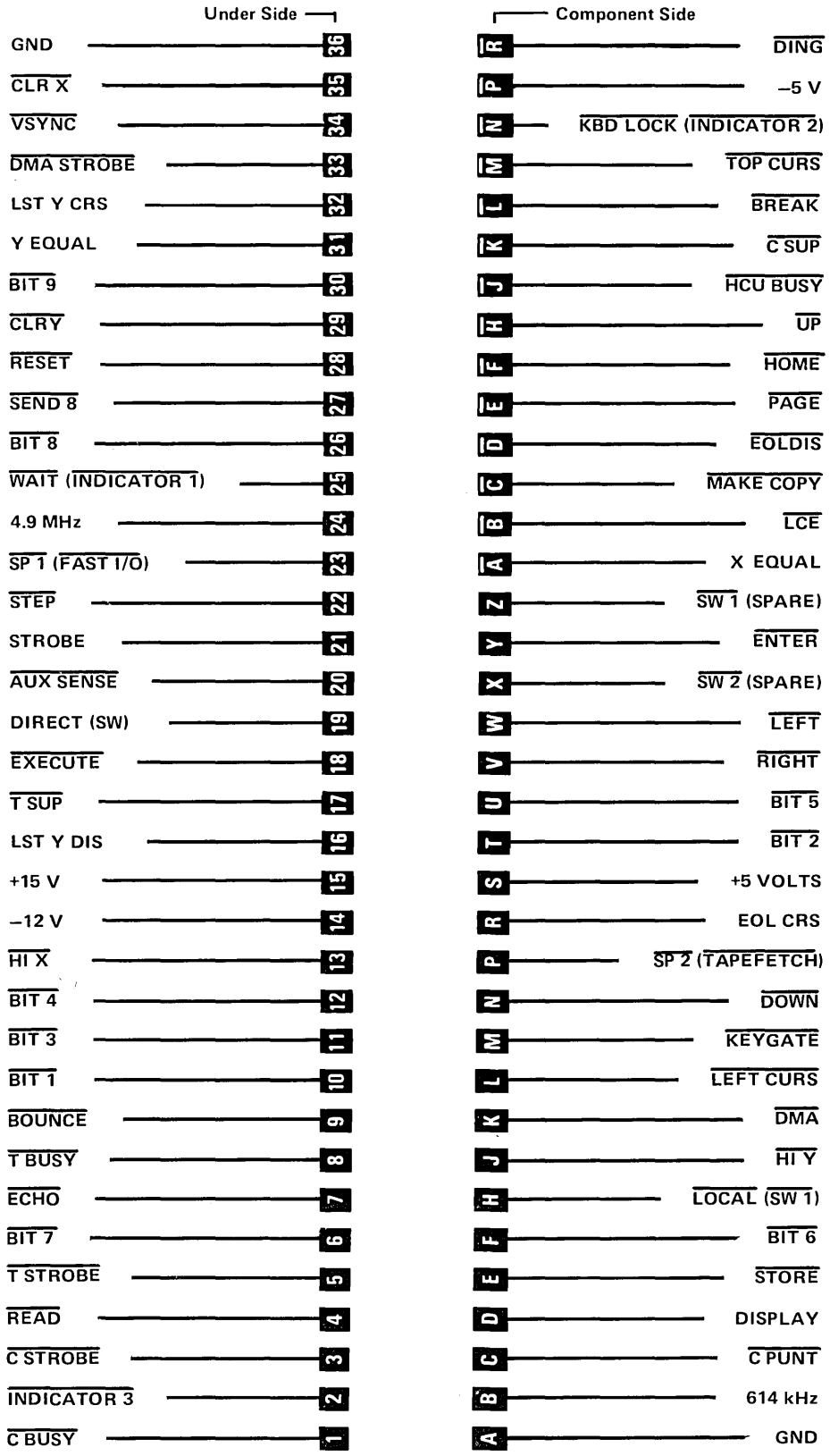


Fig. 1-8. Card-edge connector pin assignments.

SPARE SWITCH (SW1 AND SW2) CONNECTIONS

Connection to SWITCH 1 and SWITCH 2 is provided at pin Z and X, respectively. Fig. 1-8 shows location of pins Z and X on the circuit card edge connectors.

Depressing the left side of a switch provides a ground connection for the respective switch; the other position of the switch results in an open circuit.

SPARE INDICATOR CONNECTION

Connection to spare Indicator 3 is provided at pin 2 of the card-edge connector.

REAR PANEL CONNECTORS

J190 – HARD COPY CONNECTOR. This is a fifteen pin female connector with signals for sending video out of the 4023. It can be used by the Hard Copy Unit or other devices for connections up to 200 feet (15-foot and 200-foot cables are available).

VIDEO CONNECTORS. The Monitor connection is a 75-ohm BNC connector for composite video. The number of video monitors to which the 4023 can provide acceptable video depends on the type of monitor, the cable distance to the furthest monitor, and the type of connecting cable used. Single loop-through is used, with a single 75-ohm termination on the end of the string of monitors.

CONTROL DESCRIPTIONS

GENERAL

This information describes the controls that can be manipulated by the operator at the Terminal. These include console switches, alphanumeric keys, and special purpose keys that control cursor positioning, editing, transmission, and other functions.

With the exception of the Power switch, the Display controls, and the Interface controls, all operator controls and indicators are located on the keyboard console. The Power switch and Display controls are on the lower right side of the display unit. The Interface controls are located on the back panel of the display unit.

DISPLAY & POWER CONTROLS

POWER	Provides power ON-OFF control for the Terminal.
BRIGHTNESS	Adjusts brightness of the characters. Adjust for operator convenience.
CONTRAST	Changes the difference in display intensity between white and gray. Adjust for operator convenience.

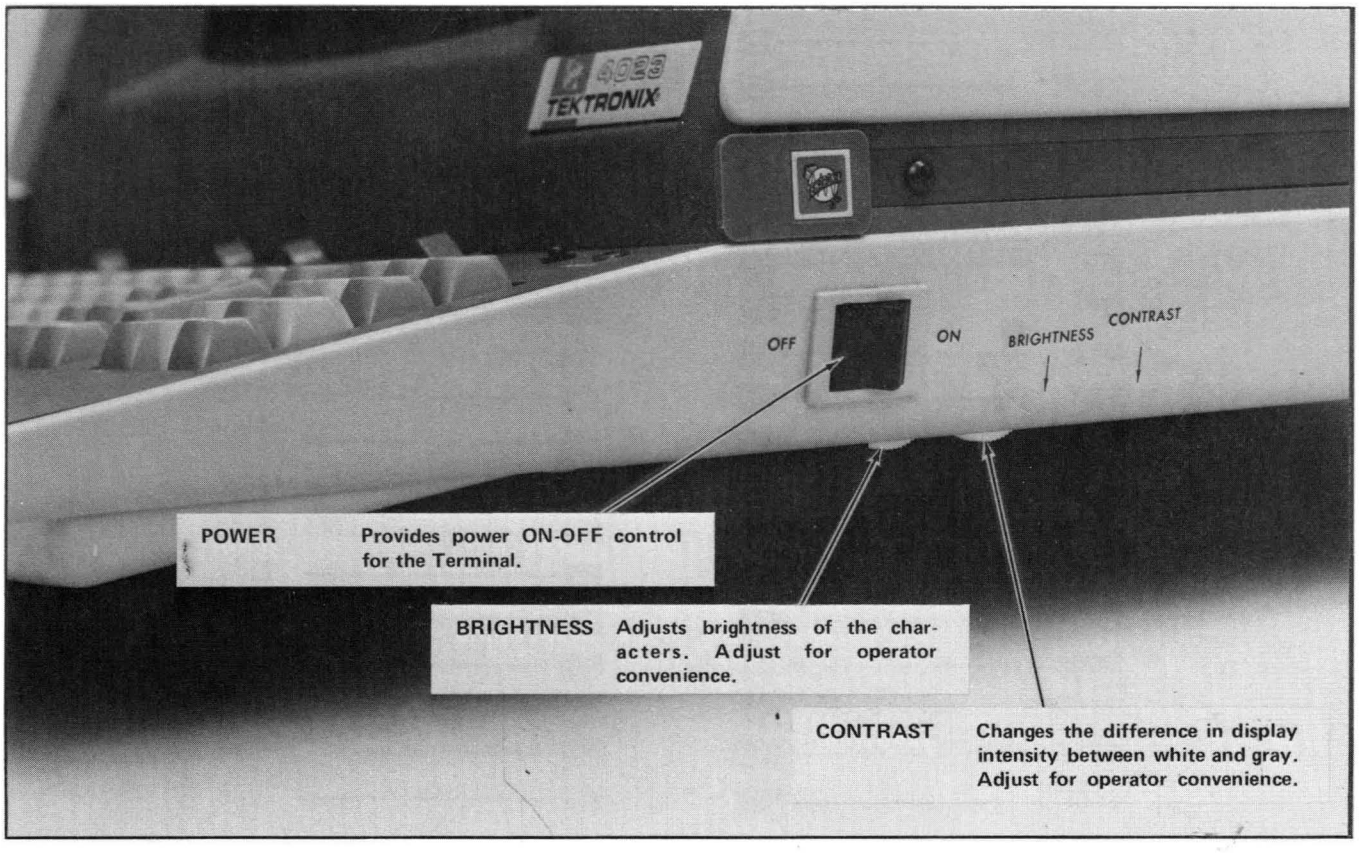


Fig. 1-9. Power and Display controls.

REAR PANEL CONTROLS

(Standard Data Communications Interface only)

BAUD RATE SELECTOR — An eight position rotary switch located on the rear panel that selects one of eight data transfer speeds from the 4023 to the computer.

ECHO IN OUT — IN position provides an "echo" that permits data to be displayed when transmitting with the DIRECT/BUFFER switch in DIRECT. OUT position disables the Terminal's echoing of its own data and would be used when the computer provides an echo of the Terminal transmission.

CONSOLE CONTROLS AND INDICATORS

Figure 1-11 shows the Terminal controls divided into three basic groups: the Console Controls and Indicators, the Keyboard, and the Function Pad Controls. A brief explanation of the controls in each group follows.

The console includes light-emitting diode indicators (LED's) and rocker switches. Individual descriptions follow.

Power Lamp — Illuminated by the +5 V supply when the power switch is turned on.

Indicator 3 — Multiple use lamp whose function is determined by the accessories and optional equipment used with the Terminal.

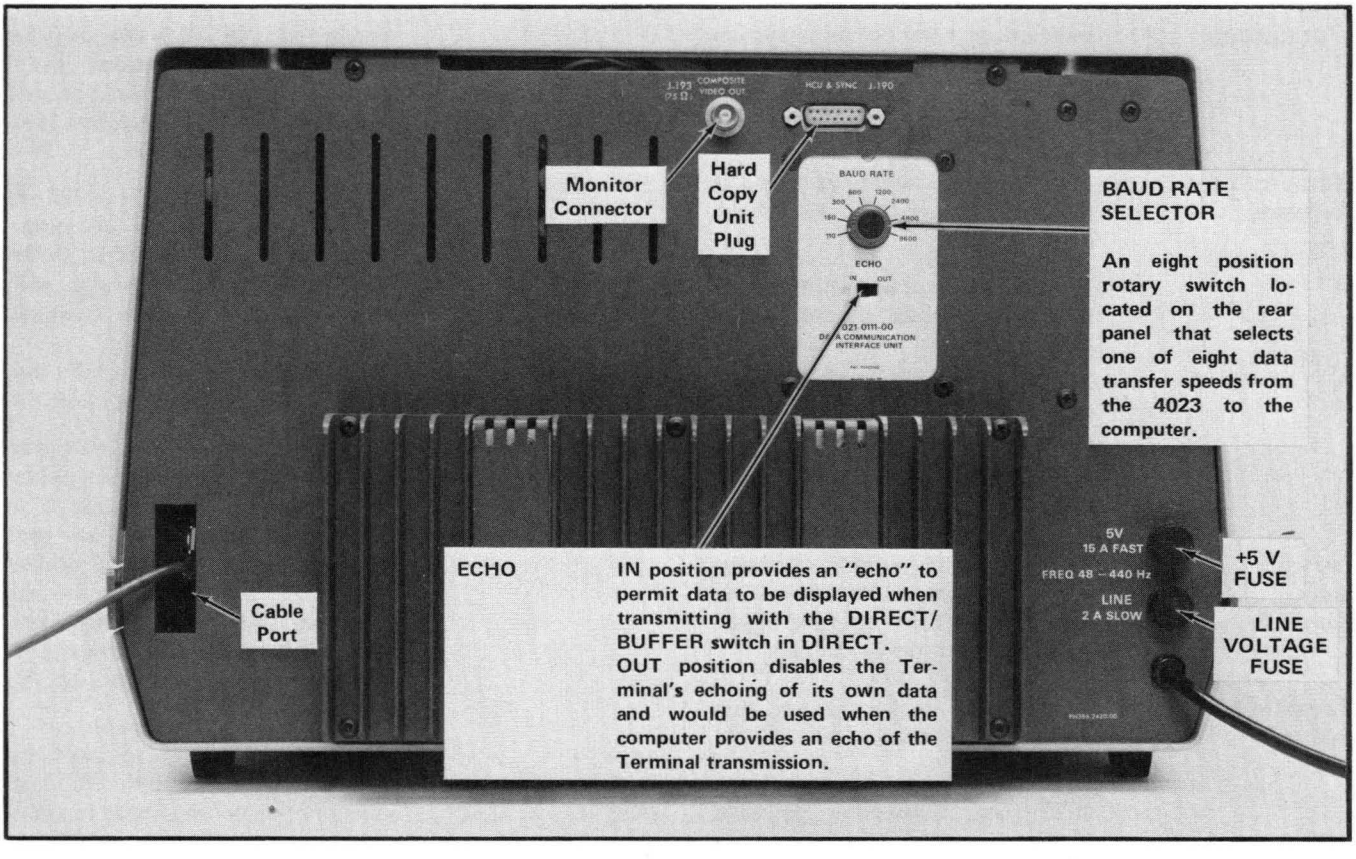


Fig. 1-10. Rear panel.

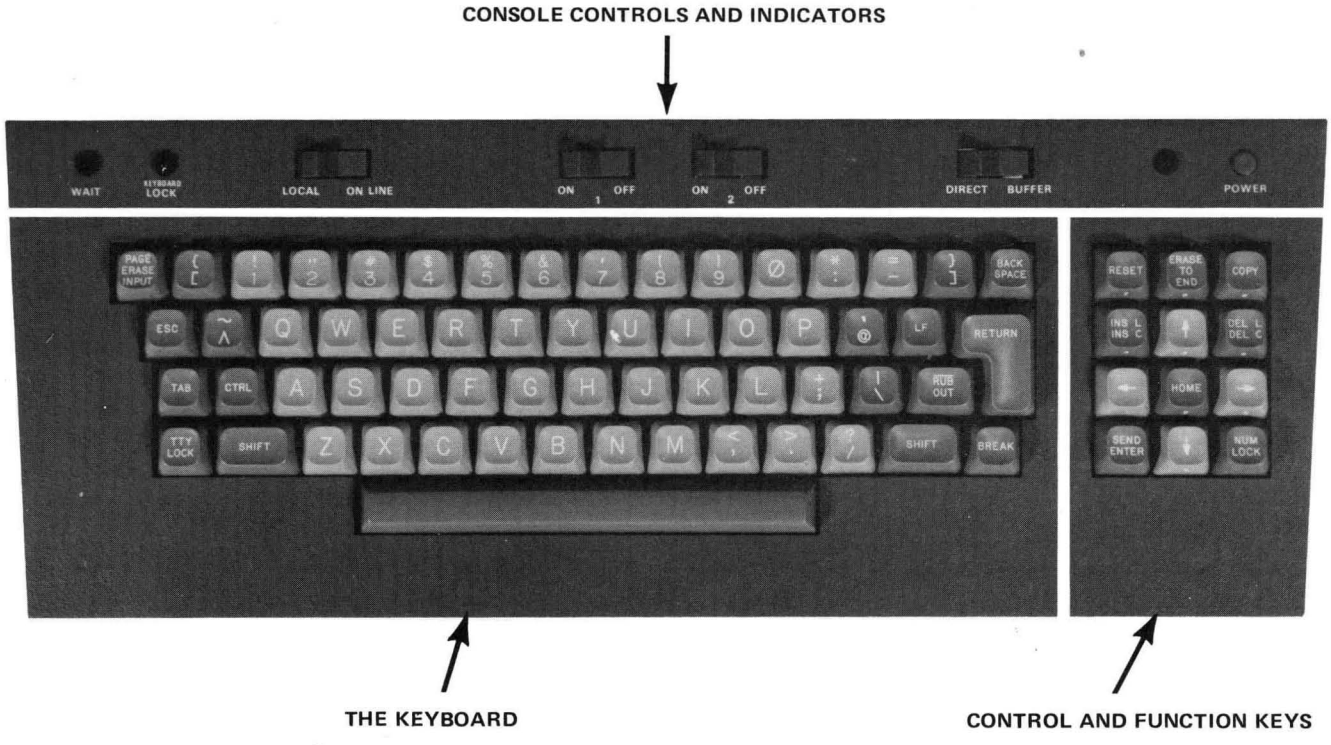


Fig. 1-11. Keyboard and console.

Wait Indicator — Indicates that the computer system cannot accept data from the 4023. Transmission sequence does not occur until the light is extinguished.

Keyboard Lock Indicator — Indicates that keyboard entry is inhibited because on of the following is occurring:

1. The 4023 is transmitting a message or a message transmission is pending.
2. The cursor is located in a protected field in which data is not normally changed.
3. The cursor is positioned on a Field Attribute Code.

Switch 1 and Switch 2 — Two-position rocker switches whose functions are determined by the accessories and optional equipment used with the Terminal.

Local/On Line Switch — Two-position rocker switch that performs the following:

LOCAL electrically disconnects the 4023 from the computer. However, the Terminal can still interact with other devices to which it may be connected. LOCAL is also used for operator familiarization, maintenance, or any other function that the Terminal can perform independent of the computer.

ON LINE permits the 4023 to communicate with the computer. Auxiliary devices connected to the Terminal can communicate with the computer and/or the Terminal.

Direct/Buffer Switch — Two-position rocker switch that provides the following functions:

DIRECT causes keyboard entries to be routed directly to the computer if the Terminal is On Line. If in Local, Keyboard entries are sent directly to any auxiliary devices that may be connected to the Terminal. An echo (either computer or local) condition must exist for keyboard entries to be displayed.

BUFFER position causes keyboard entries to be routed to the Terminal memory for editing, prior to transmitting the data to the computer (if on line), or to a peripheral.

THE KEYBOARD

The Keyboard's primary function is to act as a source of data for the computer. The display is used to provide a visual representation of the keyboard entries and Terminal/computer interchange.

The Keyboard has encoded keys that generate ASCII code, and function keys which generate switch closures. Most of the keys are used only for entering data and are designed for single key entry, dual key entry, and triple key entry. Most are familiar with typewriter keys. The 4023 keyboard shown in Fig. 1-9 is equipped to perform as an input for ASCII or TTY codes. ASCII characters are shown on the key caps and are represented by the key code as follows.

Letter keys	Unshifted provide lower case; shifted provides upper case.
Number keys	Unshifted provides numeral; shifted provides character shown on front surface of key.
Control Character keys	Control character keys that transmit control characters are: ESC, TAB (HT), BACKSPACE (BS), LF, and RETURN (CR). When these keys are pressed, the appropriate control character is transmitted regardless of SHIFT key position.
All others	Unshifted (lower) or Shifted (upper) characters as shown on top surface of key caps.

TTY LOCK KEYBOARD ENTRY. Lower case letters (alpha) characters cannot be transmitted when the TTY LOCK key is depressed, regardless of the position of the SHIFT key.

REPEAT ENTRIES. Character transmission occurs when a key is pressed. If the key is held down, a 0.5 second delay (approx.) occurs, after which the character is repeatedly entered at a 10 Hz rate. If CTRL or SHIFT is used with a character key, the original selected code continues to be transmitted as long as the character key is held down, even if CTRL or SHIFT are subsequently released.

CONTROL KEYS. The following keys do not directly enter characters for transmission, but control operation of the keyboard or Terminal. Some of them are used independently, while others are used in combination with other control keys or character keys.

PAGE-ERASE INPUT	When pressed alone, causes all unprotected data stored in Terminal memory to be erased, and the cursor moves to the home position. This function is normally used with formatted displays. When pressed while SHIFT is held down, performs a PAGE function. The memory is cleared, the logic is set to initial condition, and the cursor moves to home.
CTRL	Causes letter keys to transmit control characters if CTRL is held down before the letter key is pressed. It may be used in conjunction with SHIFT and a character key to form a control character.
SHIFT	Performs no function when used alone. When held down, it causes some keys to enter a shifted character while the character key is pressed. It is also used in combination with CTRL and some letter keys for entering control characters.
TTY LOCK	Causes letter keys to transmit the TTY character set, regardless of position of SHIFT key. The following are not transmitted: \ } ¦ ~
BREAK	Generates a $\overline{\text{BREAK}}$ signal, which is sent to the interface unit. Any resulting interrupt signal is interface dependent.
RUBOUT	Not a control key but a character key. When pressed, the RUBOUT (127_{10}) character is transmitted. Use of this key is program dependent.

FUNCTION PAD CONTROLS

This useful, dual-purpose group of controls is located to the right of the keyboard. They provide control over data transmission, editing, cursor positioning, and reset functions. With the NUM LOCK key pressed, these keys function as a numeric pad to aid in entry of numeric data.

RESET	A multiple purpose key that performs the following (depending on operating configuration): 1. Blinks the cursor; cursor quits blinking when key is released.

2. Pressing RESET while simultaneously entering a control character will store that control character in Terminal memory.

3. If the optional Rulings Character Set has been installed and selected, pressing RESET causes the standard character set to be re-selected.

4. RESET terminates a buffer transmission.

5. Inhibits an $\overline{\text{LCE}}$ condition as long as RESET is held down. (See $\overline{\text{LCE}}$ signal description in "Definition of Line Titles" in Section 6.)

6. Clears a Make Copy request (will not terminate a copy in progress).

7. With formatted displays, holding RESET down enables data to be keyed into a protected field: Alpha characters can also be keyed into a non-alpha field.

8. With formatted displays, pressing ERASE TO END with RESET held down, causes erasure of data in a protected field from the cursor position to the end of that field (or the end of the line).

9. When using 4-line roll-up, pressing RESET allows 4 more lines to roll-up (used with flagged interfaces only).

ERASE TO END — With a formatted display, pressing this key when the cursor resides in an unprotected field causes erasure of all data from the cursor location to the end of that field. With no fields contained in a line, data is erased from the cursor position to the end of the line.

COPY — With a Hard Copy Unit connected to the Terminal, pressing this key activates the Hard Copy Unit to make a copy (on paper) of the displayed information.

INS L
INS C — Pressing this key without SHIFT causes an Insert Character function. A SPACE character is entered at the cursor location, and data at the cursor position and to the right of the cursor moves right. Data moved past the right margin is lost. The function repeats if the key is held down. Pressing with SHIFT causes an Insert Line function. The line where the cursor resides moves down one line, with all lines below doing likewise. Data in the 24th line is lost. The cursor remains stationary and the line where it resides is filled with SPACE (SP) characters. This function also repeats when the keys remain held down.

DEL L
DEL C — Pressing this key without SHIFT causes the character at cursor location to be deleted. All characters to right of cursor move left one position. A NUL character resides at the right-most character position on the line. This function also repeats. Pressing with SHIFT causes a Delete Line function. The line where the cursor resides is lost and replaced by the line immediately below. All other lines below also move up one line. The line vacated by the last line moved up is filled with NUL characters. This function also repeats when the keys remain held down.

SEND
ENTER — Pressing this key without SHIFT initiates the Enter transmission sequence. Pressed with SHIFT initiates the Send transmission sequence. (See Operation Descriptions for explanation of Enter and Send.)

CURSOR (Direction Shift) Keys — A group of four non-encoded keys that provide directional movements of left, right, up, and down for the cursor. A momentary push moves the cursor one character or line position in the direction indicated on the key cap. Holding the key causes the function to repeat.

HOME — Moves the cursor to the home position. Home is the first character position of the first line. (Also terminates a buffer transmission.)

NUM LOCK — Pressing this switch enables function Pad keys to be used as a numeric pad. Specific numeric inputs provided by individual keys are embossed on the front surface of the key caps. NUM LOCK must be pressed a second time to restore normal Function Pad Controls.

OPERATING MODES

GENERAL

The 4023 is both a transmitting and a receiving device. Standard interface hardware provides Full Duplex only. Full or Half Duplex can be achieved by use of an Optional Data Communications Interface. Data can be transmitted to the computer directly from the keyboard, from the keyboard via the Terminal buffer (memory), or from an optional auxiliary unit. Data received by the Terminal can be displayed, or can control other functions in the Terminal or at auxiliary units.

Data transmitted to the computer can be echoed back to the receiving circuits by the computer, the modem, or by selecting Local Echo at the interface unit. Under Local Echo conditions, data from the keyboard or auxiliary unit is simultaneously sent to the computer and the 4023 receiving circuits. Printable characters from the computer enter the Terminal memory and are displayed. The computer can write anywhere on the screen regardless of fields.

The LOCAL/ON LINE switch must be in the ON LINE position to communicate with the computer. The LOCAL position allows the Terminal to operate independent of the computer. Local operation permits keyboard or auxiliary unit data to be written on the display or otherwise executed by the Terminal.

The Data Entry Modes are: Direct Entry, Buffer Entry, and Buffer Form Fill-out Entry. They function as follows: (Table 2-4 in Section 2 provides a brief description of data transfer in DIRECT and BUFFER.)

NOTE

The following is a discussion of operation of the standard Terminal. Strappable options and other options can modify the description.

DIRECT ENTRY

Placing the DIRECT/BUFFER switch to DIRECT sets the Direct Entry Mode. This mode is interactive by character (similar to Teletype). Destination of data depends on the position of the LOCAL/ON LINE switch. In the ON LINE position, data entered from the keyboard (keyed data) is sent directly to the computer. Data from the keyboard is not sent to the Terminal memory for display unless the computer echoes the data, or the modem or the interface unit supplies local echo. Roll-up occurs with a cursor movement past the last line on the display. When ON LINE, the Direct Entry Mode can operate in full or half duplex (depending on the interface unit used). Placing the LOCAL/ON LINE switch to LOCAL causes all keyboard data to go directly to the auxiliary device (such as a mag storage unit). The data is not sent to the Terminal memory for display, unless a local echo condition exists.

BUFFER ENTRY

This mode is set when the DIRECT/BUFFER switch is set to BUFFER. Keyed data is stored in memory and is displayed, allowing text editing before data entry. Buffer Entry Mode is used for either non-formatted or formatted operations. When no Field Attribute Codes (FACs) are used, the entire message is transmittable. Video is displayed white on black background with normal intensity. Pressing either the ENTER or SEND key initiates the buffer transmission sequence. As in the Direct Entry Mode, the destination of data is determined by the position of the LOCAL/ON LINE switch.

ENTER KEY ENTRY. Pressing the ENTER/SEND key without SHIFT causes an ETX code (A Message Separator) to store in memory (if display is non-formatted) at the cursor location. Storing the ETX in memory causes a rectangular marker to be displayed at the cursor position. The cursor moves rapidly back through the text, seeking either a start of text message (previous Message Separator) or the home position, then sends the stored message. Transmission of data continues until the cursor reaches the ETX code, at which time the Terminal sends an End Code and performs a carriage return. (The End Code can be strapped to be any desired control character. Standard strap setting is for a CR code.)

Fig. 1-12 is an illustration of the 4023 display during a typical 4023/computer entry interchange using the buffer. Assume that the cursor was originally at the home position. The operator keys into the Terminal memory the first line, edits if necessary, then presses the ENTER key. The cursor moves rapidly back through the text, searching for a previously stored Message Separator or the home position, in this case, the home position. Data entry then begins at the home position. Data entry continues to the ETX code that was stored when the ENTER key was pressed, at which time the 4023 sends an End Code and performs a carriage return function.

The first character of the computer response is an LF (line feed) code that positions the cursor down one line. Thus combined with the carriage return executed by the Terminal, the cursor is positioned to the first character position of a new line. Computer response continues. . .

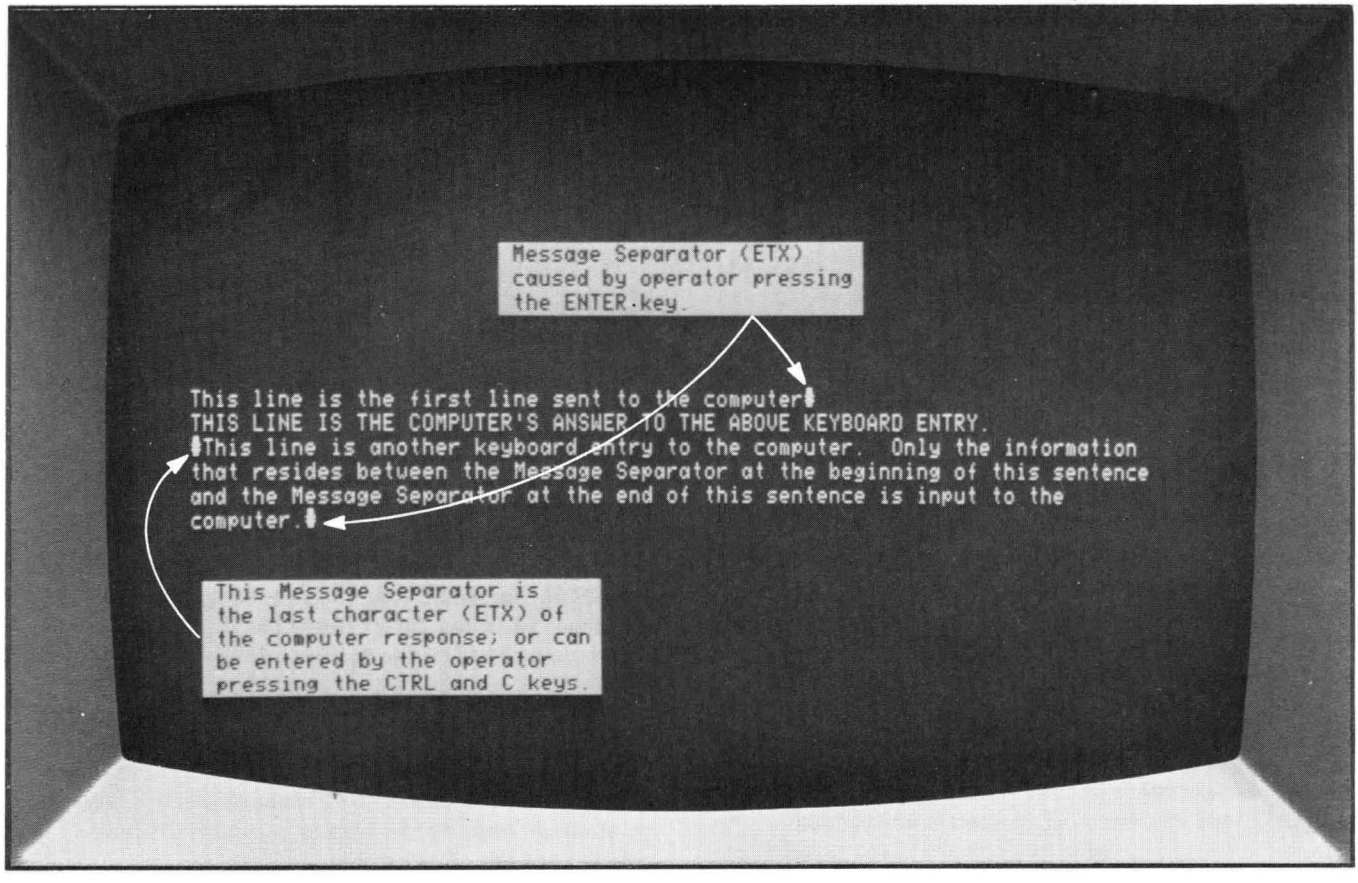


Fig. 1-12. Buffer transmission illustration.

If the software does not provide an ETX at the end of this message, the operator may store a Message Separator by simultaneously pressing the RESET and CR keys. The CR stores but is not executed. This provides a Message Separator between the computer response and the following buffer entry. As with the ETX code, the storing of CR displays a visible retangular block. This Message Separator marks the beginning of text for the next message to be entered by the operator.

SEND KEY ENTRY. The SEND key can also be used to initiate buffer entry. However, it will not store a Message Separator; the message to be sent is controlled by existing Message Separators. As when the ENTER key is pressed, buffer entry is from the preceding Message Separator (or home). If no Message Separator was previously stored at the cursor location prior to pressing SEND, cursor movement continues to the last character position of the last line. The Terminal then transmits an End character and executes a carriage return.

USE OF MESSAGE SEPARATORS. Figure 1-13 shows how the Message Separators can be used to input specific data. Assume that the string of data shown is a computer response to the Terminal. The operator wishes to input back to the computer a specific line (or lines). Using the cursor position keys, the cursor is positioned to the beginning of the data that is to be input, at which point a CR is stored by simultaneously pressing RESET and RETURN. Next, by using the cursor position controls, the cursor is positioned at the end of the data to be input. Pressing ENTER causes an ETX to store. The data, bracketed by the two message separators (CR and ETX), is then transmitted.

BUFFER FORM FILL-OUT ENTRY

Any Field Attribute Code stored in memory sets the Buffer Form Fill-Out Mode. When Terminal logic receives the US control character, logic is set to interpret the next character received as being a Field Attribute Code (FAC). This mode is normally used when inputting form information to the computer. Fig. 1-14 illustrates a form that might be used by a bank. The illustrated square symbol that precedes each data field symbolizes the position in Terminal memory occupied by the Field Attribute Code. The Field Attribute Code identifies the data field that follows. If no other field codes appear in the line, the field extends to the end of the line. When no field codes appear in a line

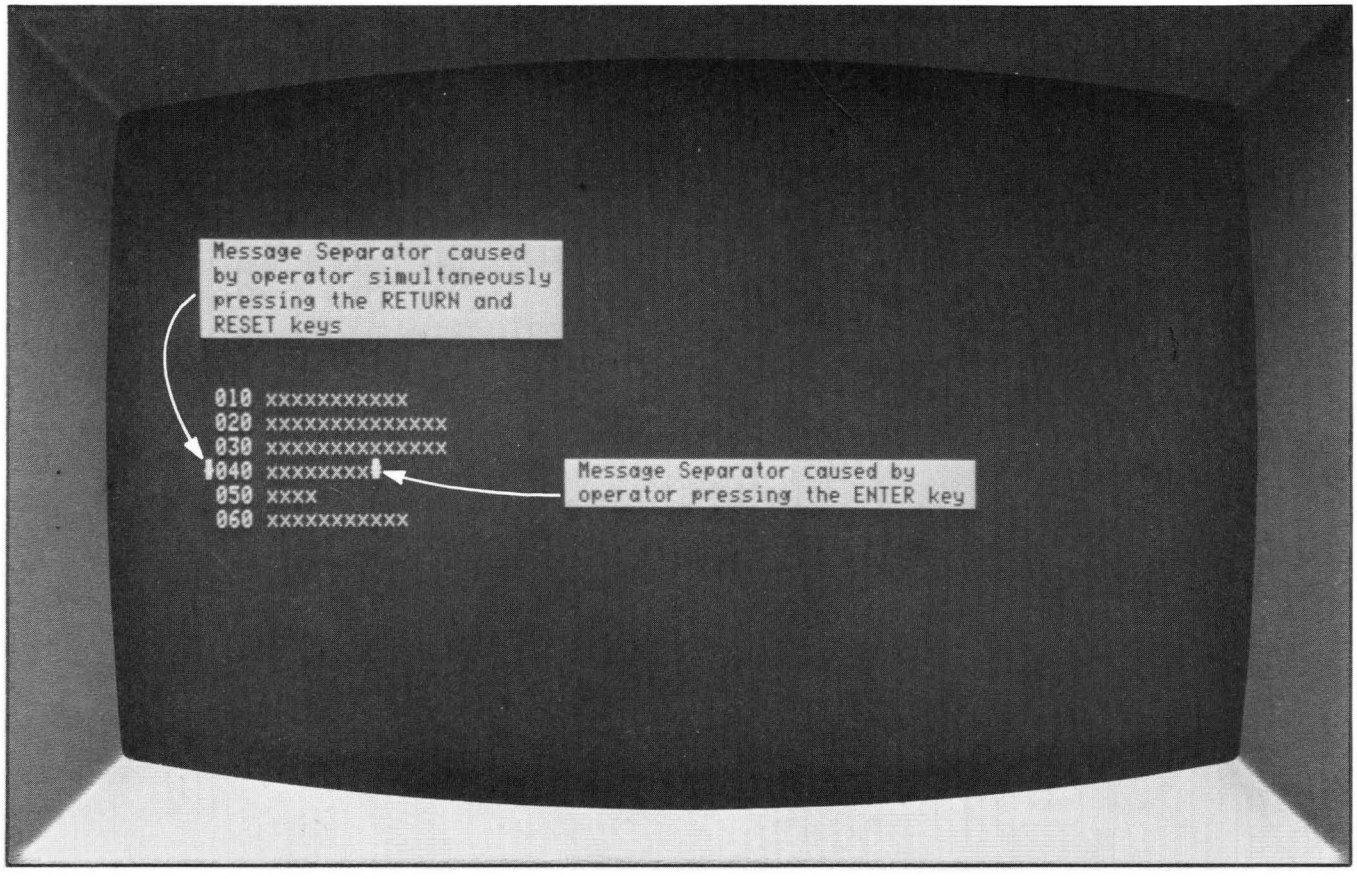


Fig. 1-13. Using Message Separators for selective input.

of data, the input circuits interpret the line as containing normal (transmittable alphanumeric) data.

Note the character that appears in the character space preceding each field. These characters represent the Field Attribute Code and are not normally visible. However, Fig. 1-14 illustrates the codes and the position in memory that each occupies. Fields identified by the code for the ASCII "N" specify that all data extending to the next FAC (or to the end of the line, if no other field codes exist in the line) as protected, non-transmittable data. The operator cannot alter the data, (unless RESET is pressed). This data is normally the form heading information that resembles the source document. Those fields identified by the code for the ASCII "@" character contain data that is transmittable and unprotected. Data in these fields can be altered and transmitted. Both alpha and numeric data can be input to these fields. Fields identified by the code for the ASCII "A" character contain data that is transmittable, non-alpha only. (Only those characters that reside in columns 2 and 3 of the ASCII Code chart can be keyed into a non-alpha field.) Alpha data cannot be entered into these fields from the keyboard unless the RESET key is held down while simultaneously entering alpha data. Those fields identified by the code for the ASCII "Λ" character blank the line up to the next FAC, or the end of line.

NOTE

The computer can write anywhere regardless of fields.

TRANSMITTING FORM FILL-OUT DATA VIA ENTER. With the form displayed, the operator can key the input data into memory, or change the input data already displayed. If necessary, all input data can be cleared by pressing the ERASE INPUT key, or just one input field can be cleared (or part of an input field can be cleared by using the ERASE TO END key). The operator can use the TAB key to move the cursor from one input field to the next. When all necessary inputs have been keyed into memory, the operator can press the SEND-ENTER key (without SHIFT).

The ENTER transmission sequence is used for normal form up-dating when FAC's are in memory. No ETX is stored when ENTER is pressed. Thus, no matter the cursor position, all input data can be entered. The cursor moves

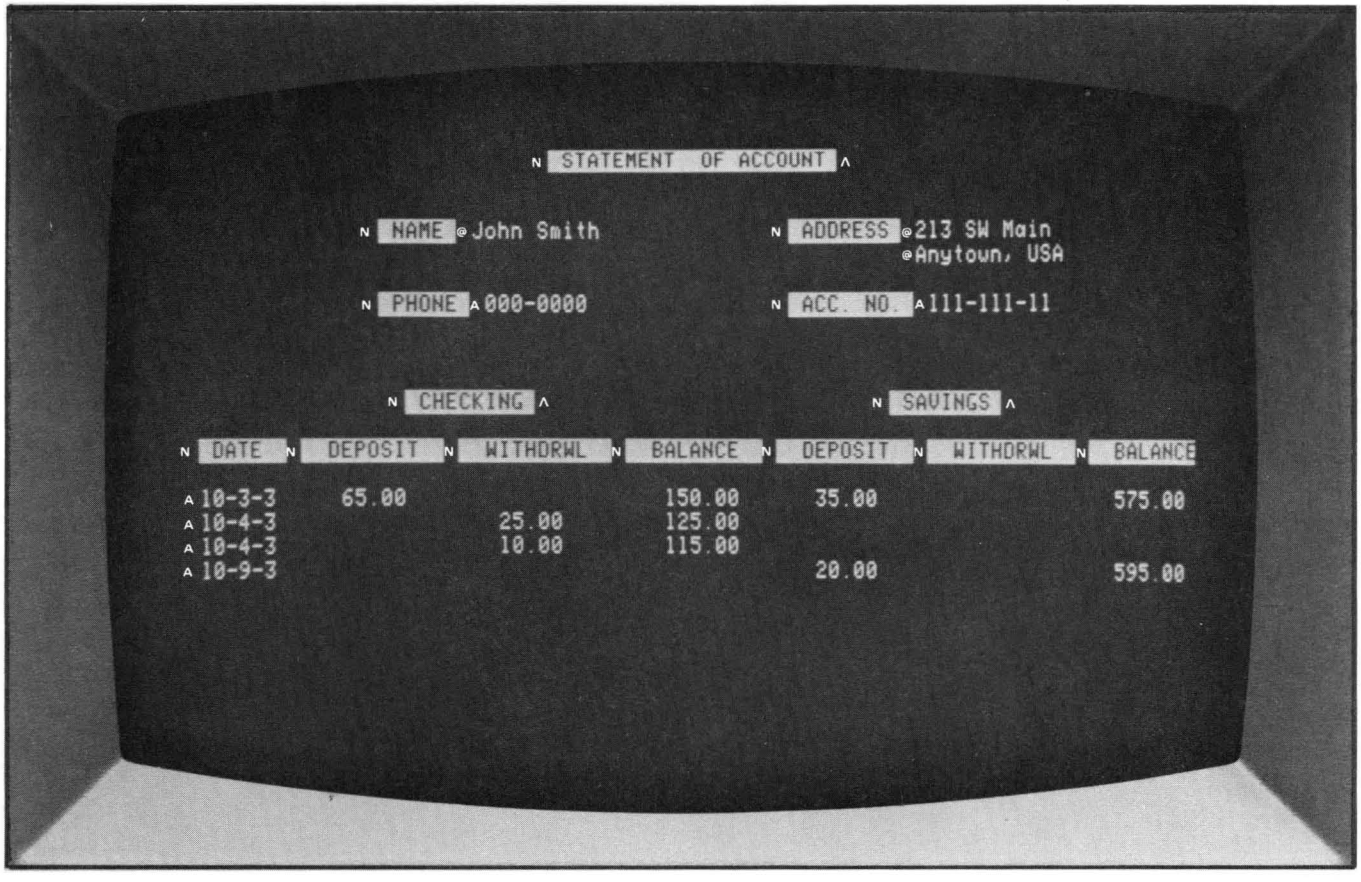


Fig. 1-14. Typical business form application for Field Attribute Codes.

backward through the text, seeking a previously stored Message Separator or the home position, and the KEY-LOCK indicator becomes lighted. When the system is ready to accept the data, the cursor moves through the text, causing transmittable data only to be entered to the computer. When the cursor reaches another previously stored Message Separator or the last line, last character position, an End character is transmitted, and the Terminal transmits the End character and performs a carriage return, positioning the cursor to the left margin on the 24th line. The KEYLOCK indicator goes out, signifying that the transmittable data has been entered.

TRANSMITTING FORM FILL-OUT DATA VIA SEND. Pressing the SEND key in Buffer Form Fill-Out Entry performs functions similiar to the ENTER key, except that all data (non-transmittable and transmittable) is input. The Send transmission function in Form Fill-Out can be used for programming or for storing a newly generated form onto a medium (such as a magnetic storage device) for later call-up.

NOTE

In Form Fill-Out operations, previously stored Message Separators are honored.

NUL SUPPRESSION

NUL characters reside in memory when the Terminal is turned on, or the screen is erased. NUL's are not transmitted during an Enter or a Send transmission sequence. This causes the transmitted message to be "compacted". If the memory has been entered to a storage medium, it will be read back in its "compacted" state. In other words, because the NUL's were suppressed when reading to the storage medium, no spacing is provided for later read-back to the Terminal. Therefore, where spacing between lines and characters is important (such as with formatted displays), use SP (SPACE) characters as required. The SP character can be transmitted, and when read back to the Terminal, will provide the necessary spaces between lines and characters.

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

The following characteristics are contained in the Alphabetic Listing:

ALPHABETIC LISTING

ACCESSORIES. See Table 2-1.

ADDRESS. A display position with reference to a grid of 80 by 24 characters with the 0, 0 address being at top left (also known as the first character position). Address is synonymous with Position Cursor and Read Cursor functions.

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 than 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.

BIT 8 AND BIT 9. See Table 2-3.

BLINK CURSOR STRAP. See Strappable Options, Table 2-12.

BUFFER. See Display Specifications, Table 2-5.

BUFFER TRANSMISSION. See Transmission, Buffer.

CARRIAGE RETURN. Return of cursor to the left margin occurs on receipt of CR or ESC FF; on receipt of LF (if it is strapped on Keyboard Interface Card to also perform a carriage return); by initializing or pressing PAGE-ERASE INPUT key or HOME key; or when wrap-around occurs when spacing past the last character position in a line.

CHARACTER EFFECT ON TERMINAL. Terminal recognizes characters contained in ASCII code, except for those not listed in the Code Effect Table. All alphanumeric and ruling characters except space and delete (RUBOUT) result in character writing and subsequent spacing. Space does not write visibly but is stored in memory and causes spacing; delete causes neither writing nor spacing. Control characters and control character sequences are decoded and perform specific functions as shown in Table 2-2. Additional use of control characters or control character sequences may be made by accessory devices connected through circuit cards to the Terminal minibus.

CHARACTER GENERATION. The standard Terminal contains 24 lines of 80 characters each, for a total of 1920 characters. The Terminal uses 262 non-interlaced horizontal sweeps of video to generate the display. Of the 262 lines, 22 lines are blanked. This allows 10 video sweeps per character line, thus a character line can be referred to as 10 video lines. To allow spacing between lines of alphanumeric characters, only 7 of the 10 video sweeps are used (lower case uses 8 video lines). Some of the optional ruling characters use all 10 video sweeps, in addition to filling in the space between ruling characters with video. This permits solid lines to be displayed for charts, graphs, and forms. Fig. 6-3 in the Circuit Description shows the relation between the character generator and the video sweeps. The upper left-hand corner of the display is illustrated, with character position 0, 0 being the home position. The crt electron beam sweeps video line 0 of character line 0, retraces, then sweeps video line 1 of character line 0, displaying information as commanded by the logic and video circuitry. The beam retraces and continues sweeping, displaying video one sweep at a time. Note that Fig. 6-3 provides an illustration of character generation for both alpha and optional ruling characters.

CHARACTER MATRIX. Characters in columns 2 through 5 of the ASCII code chart use a 5 x 7 dot matrix pattern to provide write information to the Terminal logic and video circuits. The lower case and optional ruling characters use a 5 by 8 dot matrix. This matrix is "spread" to a 7 x 10 dot matrix for ruling character generation.

CHARACTERS PER DISPLAY. See Display Specifications Table 2-5.

CHARACTERS PER LINE. 80 Characters per line.

CHARACTER SIZE. Limits determined by width and height adjustments. Nominal size, 80 by 120 mils.

CHARACTER TRANSMISSION. Depending upon the operation selected, the code for ASCII or TTY characters 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. RUBOUT sends the code for DEL. BIT 8 is sent normally high, or as determined by the data communication interface in use. The Motherboard can accept any eight-bit combination from accessory units for transmission to the computer.

CHARACTER TRANSMISSION OF FIELD ATTRIBUTE CODES. See Field Attribute Code Transmission.

CHARACTER TRANSMISSION IN READ CURSOR OPERATION. A sequence of characters is transmitted to the computer in response to a control character sequence from the computer. See Read Cursor Operation for details.

CHARACTER TYPE. The standard character type used on the Terminal display is ASCII. Optional ruling characters can be provided to display orthogonal characters for drawing charts, graphs, etc. If the Terminal has the optional rulings ability, the Terminal initializes with ASCII selected, and returns to ASCII in response to a Reset or Clear Page function; program selection for ASCII or rulings characters occurs in response to SI and SO, respectively (^{C}N and ^{C}O from keyboard).

NOTE

A superscript "^{C}" (and sometimes "^{S}") precedes an alpha to designate the simultaneous pressing of the CTRL (and SHIFT) and character keys, when keying control characters for the keyboard.

CHARACTER WRITING (KEYBOARD). The Terminal has writing capability for all ASCII characters. Since TTY is a subset of ASCII, TTY writing capability is included.

CHARACTER WRITING INHIBIT. See Keyboard Lock Conditions.

CHARACTERS, LOWER CASE. Lower case ASCII characters are accepted and written. Lower case letters cannot be transmitted from the keyboard while the TTY LOCK key is depressed.

CHARACTERS, RULING. An Optional character set that, when selected by the proper code, permits ASCII code to select specific ruling characters. This character set is accessed by SO (^{C}N from keyboard). The ASCII character set is reselected by SI (^{C}O from keyboard). See Fig. 2-2 for illustration of available ruling characters.

CLOCK. See Timing Specifications, Table 2-13.

COMPOSITE VIDEO. Similar to RS 330. Nominal source impedance and termination impedance is 75 ohms. Visible video is two-tone, white and gray.

CONSOLE LOCK STRAP. See Strappable Options Table 2-12.

CONTROL CHARACTER. See Character Effect on Terminal.

CONTROL CHARACTER SEQUENCE. See Character Effect on Terminal.

CONTROL CHARACTER STORAGE. Control characters keyed in from the keyboard or sent by the computer are not normally stored in Terminal memory; they are simply performed. Control characters (other than ETX) that are computer originated can never be stored. However, control characters can be stored from the keyboard by simultaneously holding down the RESET key when keying in the control character. RESET does not prevent HT, VT, ESC, FS, and US from being executed.

CONTROL CHARACTER TRANSMISSION. Control characters (excluding CR, NUL, and ETX) can be transmitted when stored in memory. When a control character is stored in memory, its position is indicated by a displayed block of about cursor size, at its respective position on the display. CR, LF, and BS are not executed when entered into memory with RESET. Only one-half of the control characters can be displayed. If Bit 1 of the control character is true, then the control character can be displayed.

CR DOES LF STRAP. See Strappable options, Table 2-12.

CURSOR. A seven-by-ten dot matrix which indicates the current writing position.

CURSOR ADDRESSING. See Position Cursor Operation.

CURSOR READING. See Read Cursor Operation.

DATA TRANSFER. See Data Transfer, Table 2-4.

DATA TRANSFER RATE. Interface dependent; limited to a maximum input/output (I/O) rate of 15720 characters per second. However, internal data transfer operations for editing and clear page functions are performed at 94,320 characters per second. This is known as Fast I/O. Fast I/O can be strapped to the input/output by strapping the Fast I/O strap on the Timing card. See Table 2-12 for more strap information.

DIRECT TRANSMISSION. This transmission mode is set when the DIRECT/BUFFER switch is set to DIRECT. Transmission is "direct" from keyboard. If keyboard entries are to be displayed, an echo condition must exist. (See Echo.)

DISPLAY AND LOGIC TIMING. See Table 2-13.

DISPLAY SIZE. See Display Specifications, Table 2-5.

DISPLAY CYCLE. While video is unblanked, data is read from the memory along with memory read cycles, and sent to the character generator, a shift register, and on to the screen as video.

DISPLAY CONTROLS. Operator display controls include brightness and contrast.

DISPLAY MEMORY. See Display Specifications, Table 2-5.

DISPLAY SPECIFICATIONS. Refer to Table 2-5.

ECHO. Consists of executing data at the Terminal as the data is being sent to the computer with DIRECT selected. Echoing can be caused by placing an ECHO command on the minibus, usually from the interface unit.

EDITING SPECIFICATIONS. See Table 2-6.

END CHARACTER. The last character in a message transmitted from the Terminal buffer. Strappable options on the Control Card allow any ASCII control character to be used as the End Character. Standard End Character is strapped to be CR. See Strappable Options, Table 2-12.

ENTER TRANSMISSION SEQUENCE. Normally used with BUFFER selected to transmit from one character to a full page of characters. Normal Sequence is:

Without Formatted Display

1. Set DIRECT/BUFFER switch to BUFFER.
2. Key in from keyboard necessary information.
3. Position cursor at end of data to be transmitted.
4. Press SEND-ENTER key; response is. . .

a. Message Separator (ETX code) is entered into memory at the cursor location.

b. Cursor moves to the home position or previously stored Message Separator.

c. Cursor moves at selected baud rate over data that is subsequently transmitted.

d. At end of each line a CR is transmitted. LF's can also be transmitted by placement of EOL LF GEN strap on Control Card.

e. Cursor reaches Message Separator, transmits the End character (CR is standard—can be strapped to be any ASCII control character), and performs a carriage return to position cursor at left margin of last line transmitted.

With Formatted Display

Same as above except ETX is not entered into memory, and only transmittable data residing between existing Message Separators is transmitted. If no Message Separators reside in memory, all displayed data is input.

Environmental Specifications. See Table 2-7.

EOL LF GEN Strap. See Strappable Options, Table 2-12.

FIELD ATTRIBUTE CODES (FAC). Field Attribute Codes (FAC's) are used to arrange displayed data as to its appearance, its transmission, and its protection. The FAC defines the field on the display and is stored in Terminal memory in the first character position of the field. It is protected from keyboard replacement regardless of the protection status of the field it defines. (Simultaneously pressing RESET will allow another character to be keyed over the FAC. Edit functions such as delete line and delete character will erase FAC's.) The field continues from the location of the FAC until another FAC or the end of the line is encountered.

FIELD ATTRIBUTE CODE TRANSMISSION. When data fields are transmitted, the US control character precedes the Field Attribute Code. US signals the program that the next character is a Field Attribute Code.

FORMATTED DISPLAY. Displayed data that has been specially arranged to resemble (for most purposes) a source document, can be set up through use of Field Attribute Codes. Field Attribute Codes are used to identify data in a line. One FAC can identify from 1 to 79 characters (the FAC occupies a character space in memory). Table 2-8 shows the available FAC's.

FULL PAGE FEATURE. A page full of data can be rapidly entered into memory and displayed by simultaneously holding down the PAGE-ERASE INPUT, SHIFT, and any character key, then, while still holding down the character key releasing the other two keys.

HARD COPY MODE. Permits copying of the Terminal display memory by a Hard Copy Unit. This mode is activated by a COPY switch on the Terminal keyboard, a Hard Copy unit, or by program command (ESC ^{C}G).

HOME POSITION. Top left corner of display that corresponds to the first character position on the first line. Cursor moves to that position upon initialization and upon receiving ESC FF. It also moves there by a Clear Page function, Erase Input function, or by pressing the HOME key.

INTERFACE SPECIFICATION. See documentation pertaining to specific interface unit.

KEYBOARD. 64/96 ASCII upper and lower case with auto repeat for any keys held down for more than 0.5 second.

KEYBOARD LOCK CONDITIONS. The keyboard is prevented from inputting to the Terminal buffer under the following conditions:

1. A message from the computer is pending or is in progress.

2. The cursor is positioned over a Field Attribute Code.

3. The cursor is positioned in a protected field.

4. When attempting to enter an alpha character into a non-alpha field.

LINE, CHARACTER. Consists of 80 character spaces. Data lines are made of ten horizontal video sweeps; seven for character display and three for spacing between lines. Some optional ruling characters use all ten video sweeps for character generation.

LF DOES CR STRAP. See Strappable Options, Table 2-12.

LINE FEED. Moves writing beam down one line. Occurs upon receipt of LF from keyboard or program. Standard Terminal configuration performs a line feed upon receipt of a CR. LF can also be strapped to simultaneously perform a CR. See both LF DOES CR and CR DOES LF straps in Table 2-12.

LOCAL OPERATION. Off-line operation used principally for operator training, formatting of data, equipment maintenance, and when data processing functions are with Terminal auxiliary units only. Local operation is selected by the LOCAL/ON LINE switch at the keyboard, and isolates the Terminal from the computer.

MEMORY SPECIFICATIONS. See Display Specifications, Table 2-5.

MESSAGE END STRAP. See Strappable Options, Table 2-12.

MESSAGE SEPARATOR. Storing the ETX or CR codes in memory provides a "message separator" for data entry purposes. Initiating an Enter sequence stores the ETX code at the cursor location. Message Separators are not stored when FAC's reside in memory. However, there are exceptions to this rule. See Table of Reset functions, Table 2-11.

MINIBUS (ALSO MOTHERBOARD). This board makes identical signals available at each of the board-edge connectors. See Dictionary of Line Titles and Wire List in Section 6 for details.

MONITORS. The 75 ohm monitor output connector is located on the Terminal back panel and provides composite video for monitors. The number of monitors to which the Terminal can provide acceptable video depends on the type of monitor, the distance to the furthest monitor, and the type of connecting cable used.

NON-ALPHA FIELDS. Fields into which only those characters listed in columns 2 and 3 of the ASCII Code Chart are normally entered. See ASCII Code Chart in Fig. 2-2.

NUL'S. NUL control characters reside in memory in those character spaces where data is not entered. NUL's are skipped during transmission to decrease transmitting time. Functions such as Clear Page, Erase, Input, Erase to End, Delete Character, and Delete Line enter NUL's into memory.

NUMERIC PAD. The cluster of 12 keys on the right of the keyboard provide a 10 key numeric input pad. This is in addition to their primary functions as explained in individual switch descriptions in Section 1. The NUM LOCK key initializes the numeric functions; NUM LOCK must be pressed again to re-establish the normal functions.

OPERATING FEATURES. Character Generation, Position Cursor, Read Cursor, Field Formatting, and Hard Copy Operation. See individual operating descriptions for details.

OPTIONS, STRAPPABLE. See Table 2-12 for strappable options for the basic Terminal; see Interface Unit documentation for strap options information pertaining to interface units.

PAGE FULL. A condition with BUFFER selected that occurs when line feeding past the 24th line that causes a Terminal busy ($\overline{\text{TBUSY}}$) signal.

PHYSICAL SPECIFICATIONS. See Table 2-9.

POSITION CURSOR OPERATION. An operating feature initiated by sending FS followed by X and Y address codes. This feature permits cursor addressing to any character position in memory.

POWER SUPPLY SPECIFICATION. See Table 2-10.

READ CYCLE. 636 nanoseconds long.

READ/WRITE CYCLE. 1.9 microseconds long.

PROMPT MODE STRAP. See Strappable Options, Table 2-12.

RECEIVE RATE. Capable of 15,720 characters per second.

RESETTING OPTIONAL RULINGS TO INITIAL CONDITIONS. If the Optional character set has previously been selected, the standard character set is reselected by sending SI (^{C}O from keyboard) or by pressing either the RESET key or the PAGE-ERASE INPUT key at the keyboard.

READ CURSOR OPERATION. See Transmission, Cursor Reading.

RESETTING HOME POSITION. The Terminal resets to home position (top-left of display area) in response to ESC FF from the computer. Home position also occurs when PAGE (Clear Page function), HOME, or ERASE INPUT is entered at the keyboard.

ROLL-UP. Roll-up occurs in DIRECT with a line feed past the bottom line of the display. All lines roll-up one line, with the top line rolling off the page. A new line is then available at the bottom on which to enter new data.

RULINGS CHARACTER SET. An optional character set that provides 32 "ruling" characters for drawing charts, forms, etc. This set is accessed by SO; SI reselects the normal character set. RESET or PAGE from the keyboard also reselects the normal character set.

SEND TRANSMISSION SEQUENCE. Similar to Enter Sequence. Variations are:

1. Initiated by simultaneously pressing the SHIFT and SEND-ENTER keys.

2. No Message Separator Stores at the cursor location.

3. With non-formatted displays, all data is transmitted to computer; unless Message Separators have previously been stored, in which case they are honored.

4. With formatted displays, all data (transmittable and non-transmittable) is transmitted. However, existing Message Separators are honored.

SPACE. The area in a line that is indicative of the respective character position in memory. There are 80 spaces per line and a total of 1920 characters per display.

STORAGE, CONTROL CHARACTER. See Control Character Storage.

STRAPPABLE OPTIONS. Optional operating features which can be selected by connectors within the Terminal. See Table 2-12.

TIMING. See Timing, Table 2-13.

TRANSMISSION. See Transmission sequence in question; Direct, Enter Sequence, Send Sequence, Transmission, and Cursor Reading Transmission.

TRANSMISSION, COMPUTER INITIATED. The computer can initiate transmission of buffer contents via one of two sequences, Send All or Send Transmittable Only. Send All is initiated when the Terminal receives ESC SO. All data whether defined by Field Attribute Codes as transmittable or not, is sent. Send Transmittable Only is initiated when the Terminal receives ESC SI. Data defined by Field Attribute Codes as transmittable, is sent, as is data not defined by a FAC.

TRANSMISSION, CURSOR READING. Data is transmitted as a series of bytes in response to an ESC] from the computer. The sequence of transmitted data from the Terminal is GS, X, Y, END. GS is the ASCII control character that identifies the following two bytes (X and Y) as cursor position data. X is the code for the character position in a line (0 through 79 + 32) and Y is the line number (0 through 23 + 32). End is the character that marks the end of transmission and is usually strapped to be CR.

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

VIDEO. See Composite Video.

WRAP-AROUND. A Terminal feature that causes an automatic carriage return/line feed to be performed when moving the cursor past the 80th character position.

TABLE 2-1

ACCESSORIES

ITEM	TEKTRONIX PART NUMBER
Standard Accessories	
Standard Data Communications Interface	021-0111-00
Standard Data Communications Interface Instruction Manual	070-1613-00
4023 Users Manual	070-1621-00
Optional Cabinet Colors	
Red	390-0340-07
Green	390-0340-08
Gold	390-0340-04
Optional Accessories	
4023 Service Manual	070-1617-00
Optional Data Communications Interface	021-0112-00
4023 Pedestal (stand only)	016-0568-00
Logic Extender Card (includes extender cable kit)	067-0659-00
72-Pin Extender Card (includes extender cable kit)	067-0696-00

TABLE 2-2

CODE EFFECT

ASCII CONTROL CHARACTER	KEYBOARD KEY COMBINATION	RESPONSE
SINGLE CHARACTER COMMANDS		
ETX (3_{10})	^{C}C (normally not keyed from keyboard)	End Of Text. Functions as a Message Separator when stored in the buffer. It is stored when the computer outputs the ETX to the Terminal as the last character of the computer transmission, or when the operator types CTRL C or presses the ENTER key with non-formatted displays. Storage is suppressed from the keyboard if there are any Field Attribute Codes in memory.
BEL (7_{10})	^{C}G	Activates the bell-like tone from the speaker.

TABLE 2-2 (cont)

CODE EFFECT (cont)

ASCII CONTROL CHARACTER	KEYBOARD KEY COMBINATION	RESPONSE
SINGLE CHARACTER COMMANDS (cont)		
BS (8_{10}) Backspace	^{C}H	Backspace—a format effector. Moves the cursor to the left one character. If the cursor is already at the left margin, the BS command has no effect.
HT (9_{10}) TAB	^{C}I or TAB key	Horizontal Tabulate—a format effector. In Buffer mode with formatted displays, HT tabs the cursor one character space beyond the FAC that describes an unprotected field. Used to tab the cursor from one field (any field) into the next input field. If no input field is available, the cursor returns to the Home position. When no Field Attribute Codes are stored (in DIRECT), HT performs a non-destructive direct space, i.e. moves cursor right one space.
LF (10_{10}) Line Feed	^{C}J or LF key	Line feed—a format effector. In Buffer operations, LF performs a line feed by moving the cursor down one line. It does not affect the horizontal position of the cursor unless strapped to give a CR with LF (see Strappable Options). An LF past the 24th line will cause the screen to roll up one line. If in Direct, LF's can be executed depending on mode configuration (see Strappable Options).
VT (11_{10})	^{C}K	Vertical Tab—a format effector. Performs a "back tab" function—the reverse of the HT function. If no input field is found, the cursor goes to the home position. Performs no function in DIRECT.
CR (13_{10}) Carriage Return	^{C}M	Carriage Return—a format effector. Moves the cursor to the first character position at the left margin. Can be strapped to provide a line feed with carriage return, thus establishing a new line at the left margin. Various effects to and from a CR are provided by strappable options. Can also be stored in memory for use as a Message Separator by having the operator simultaneously press RESET with RETURN.
SO (14_{10}) Rulings Set Select	^{C}N	Shift Out—Selects the optional (rulings) character set.
SI (15_{10}) Standard Set Select	^{C}O	Shift In—Selects the standard character set if the optional character set has previously been selected.

TABLE 2-2 (cont)

CODE EFFECT (cont)

ASCII CONTROL CHARACTER	KEYBOARD KEY COMBINATION	RESPONSE
SINGLE CHARACTER COMMANDS (cont)		
ESC (27_{10}) Arming Command	ESC key or ^{CS}K	First character of a special two-character sequence. ESC "arms" the Terminal to interpret the next character received (regardless of its normal function) as a special control or function. (See ESC BEL, ESC FF, ESC SO, ESC SI, ESC O, and ESC] .) The Character following ESC causes $\overline{\text{CBUSY}}$ to go active for 0.5 sec. Fast response would limit $\overline{\text{CBUSY}}$ to 60 ms. (See ESC Character Delay in Programming Considerations and also FAST RESPONSE strap under strappable options.)
FS (28_{10}) Set Cursor Addressing Mode	^{CS}L	Sets the Cursor Addressing Mode. When followed by the proper address codes, the cursor can be positioned to any character position on screen.
US (31_{10}) Field Separator (Field Attribute Code Substitute)	^{CS}O	Performs two functions: 1) Used in Buffer Form Fill-Out transmission sequences as a Field Segregator. The US code precedes the Field Attribute Code on the data string to identify the input data that follows as having been preceded by a FAC in Terminal memory. 2) When the Terminal receives a US code, Terminal logic is set to interpret the next character received as a Field Attribute Code.
TWO CHARACTER COMMANDS		
ESC BEL	ESC ^{C}G	Used to trigger a hard copy of the displayed data when using a Hard Copy Unit. ESC BEL is the computer addressed equivalent of the COPY button on the Terminal or Hard Copy Unit. The Hard Copy Unit can receive and print video (except for blink) onto paper. Multiple copies can be obtained under program control by commanding a copy to be made and immediately following it with the Read cursor command (ESC]). The action of making a copy delays the reading of the cursor until the copy is completed. When the Terminal responds with the cursor location, the program can use this as signifying that the copies is ready for another command.

TABLE 2-2 (cont)

CODE EFFECT (cont)

ASCII CONTROL CHARACTER	KEYBOARD KEY COMBINATION	RESPONSE
TWO CHARACTER COMMANDS (cont)		
ESC FF Clear Page	ESC ^{C}L	Clear screen command. Performs same function as PAGE. The screen is cleared, cursor positions to Home and all Terminal logic is initialized.
ESC SO Send Page	ESC ^{C}N	Initiates a send function. Causes all fields, normally transmittable or not, from the beginning to end of text, to be transmitted to the computer. If fields are contained on the display, the Field Attribute Codes are preceded by the US (31_{10}) character. When transmission of all data is completed (including ruling characters, if any), the cursor resides in the left-most character position on the last line of the message.
ESC SI (i.e. Send Transmittable Only)	ESC ^{C}O	Performs the same functions as ESC S0 with the exception that only transmittable fields are transmitted. (Rulings are not transmittable.)
ESC O (Same as ERASE INPUT key)	ESC O	Initiates the clear input sequence. Sets all unprotected data fields to NUL characters. Used in the Buffer Form Fill-Out Mode when it becomes necessary to clear the input data only (does not clear rulings). Do not confuse with the Clear Page Function. If FAC's or rulings are not present, the effect is the same as Clear Page.
ESC] Set Read Cursor Mode	ESC] (] = 93_{10})	Initiates the Read Cursor Mode. Causes cursor coordinates to be transmitted to the computer.

TABLE 2-3

DATA CODING

DATA LINK	BITS								
	9	8	7	6	5	4	3	2	1
ASCII DATA LINK		8[1]	7	6	5	4	3	2	1
BINARY TELETYPE		8[2]	7	6	5	4	3	2	1
MOTHERBOARD WITH $\overline{\text{SEND 8}}$ TRUE		8	7	6	5	4	3	2	1
MOTHERBOARD WITH MEMORY NORMAL	9	8	7	6	5	4	3	2	1

Normally, Bit 8 is for use internal to the 4023 and is not related to parity or used for binary data. Bit 9 is also for internal use. Bits 8 and 9 together tag the other 7 bits as follows:

BIT 9	BIT 8	Bits 1 – 7 are:
0	0	Normal ASCII Character
0	1	Field Attribute Code
1	0	Alternate Character
1	1	Invalid

TABLE 2-4

DATA TRANSFER

SWITCH POSITION	KEYBOARD DATA TRANSFER			BUFFER DATA TRANSFER[3]	
	DIRECT		BUFFER	DIRECT	BUFFER
	WITHOUT ECHO	WITH ECHO			
LOCAL	Peripheral	Peripheral and screen	Screen	Peripheral	Peripheral
ON LINE	Computer	Computer and screen	Screen	Computer	Computer

[1] ASCII Data Link has BIT 8 pulled high on Motherboard.

[2] With TTY Port Optional Data Communication Interfaces, BIT 8 can be used for Mark or Space, even or odd parity. With Standard Data Communications Interface asserting SEND 8 causes BIT 8 to be transmitted as received rom the minibus. With SEND 8 not true BIT 8 is used as a mark.

[3] As a result of an Enter or Send sequence activated from keyboard or by computer.

TABLE 2-5

DISPLAY (MONITOR) SPECIFICATIONS

CRT	TV type, 12" diagonal measurement.
Screen Size	10.5" by 8".
Deflection	Electromagnetic, raster scan.
Video	Composite video that can drive 525-line, TV-type broadcast monitors.
Character Generator	5 x 7 dot matrix read only memory for upper case; 5 x 8 dot matrix read only memory for lower case and optional ruling characters.
Refresh Buffer	2048 x 9 bits standard 24 line MOS RAM. 1024 x 9 bits optional 12 line MOS RAM.
Refresh Rate	60 Hz for each dot (frame rate equals field rate of 60 Hz). This can be strapped in Terminal for 50 Hz operation.
Intensity	Normal video, 30 foot lamberts; dim video, 15 foot lamberts.
Resolution	TV lines measured in accordance with EIA RS-375 and is adjusted for 100 percent.
Display Center	750 lines.
Display Corner	650 lines.
Geometry	Not more than 2% of active raster height.
Retrace and Delay Times	
Vertical Retrace	900 μs maximum.
Horizontal Retrace	7.0 μs maximum.
Horizontal Delay	4.0 μs maximum.

TABLE 2-6

EDITING SPECIFICATIONS[4]

FUNCTION	RESULT
Insert Character	A space is entered at the cursor position. All data from the cursor position moves right, leaving a space at the cursor position. Only the line where the cursor resides is affected.
Delete Character	The character where the cursor resides is deleted or replaced by a new character typed from the keyboard.
Insert Line	The line where the cursor resides and all lines below move down one line for each key depression. The bottom line is lost.
Delete Line	The line where the cursor resides is deleted and all lines below move up one line for each key depression.
Erase Input	Erases all unprotected information on the screen and positions the cursor to home.
Erase to End	Erases information from cursor position to end of line or unprotected field.

TABLE 2-7

ENVIRONMENTAL SPECIFICATIONS

Ambient Temperature	
Operating	+10°C to +40°C
Storage	−40°C to +65°C
Humidity	5.0% to 80% (noncondensing)
Inspecting and Testing Conditions	Unless otherwise specified, +25°C; humidity not greater than 55%.
Altitude	
Non-operating	to 50,000 feet
Operating	to 15,000 feet

[4]With the exception of Erase Input, the above operations can be performed only from the keyboard.

TABLE 2-8

FIELD ATTRIBUTE CODES

LOGIC EFFECT / DISPLAY EFFECT	TRANSMITTABLE				NON-TRANSMITTABLE			
	UNPROTECTED		PROTECTED		UNPROTECTED		PROTECTED	
	ALPHA-NUMERIC	NON ALPHA	NORMAL	DIM	ALPHA-NUMERIC	NON ALPHA	NORMAL	DIM
White on Black	@ (64_{10})	A (65_{10})	B (66_{10})	C (67_{10})	D (68_{10})	E (69_{10})	F (70_{10})	G (71_{10})
Black on White	H (72_{10})	I (73_{10})	J (74_{10})	K (75_{10})	L (76_{10})	M (77_{10})	N (78_{10})	O (79_{10})
Blinking	P (80_{10})	Q (81_{10})	R (82_{10})	S (83_{10})	T (84_{10})	U (85_{10})	V (86_{10})	W (87_{10})
Blanked	X (88_{10})	Y (89_{10})	Z (90_{10})	[(91_{10})	/ (92_{10})	] (93_{10})	Λ (94_{10})	— (95_{10})

To set up a field from the keyboard, key in US (^{CS}O) followed by one of the FAC's listed above. For example, sending ^{CS}O followed by H sets up an inverted, alphanumeric field that is unprotected and transmittable.

TABLE 2-9

PHYSICAL SPECIFICATIONS

Weight	About 46.5 lbs.
Shipping Weight	About 67 lbs.
Dimensions	
Height	About 12.500 inches.
Width	About 17.500 inches.
Length	About 27.250 inches.

TABLE 2-10

POWER SUPPLY SPECIFICATIONS

Line Voltage Ranges	115 VAC	230 VAC
Low	90 V to 110 V	180 V to 200 V
Med	105 V to 126 V	208 V to 252 V
High	112 V to 136 V	224 V to 272 V
Line Frequency Range	50 Hz to 60 Hz	
Power Consumption	220 watts maximum at 125 VAC	
Fuses		
115 VAC	2.0 A slo-blow	
230 VAC	1.25 A slo-blow	

TABLE 2-11

RESET KEY FUNCTIONS

The RESET key is a multiple purpose key that performs the following functions, depending on operation:

Blink Cursor	Blinks the cursor when pressed; cursor quits blinking when key is released.
Control Character Storage	Pressing RESET while simultaneously entering a control character will store that control character in Terminal memory.
Keying Into A Protected Field	With formatted displays, pressing RESET simultaneously with a character key will allow that character to be keyed into a protected field; alpha data can be keyed into a non-alpha field.
Rulings Character Set Disable	Disables optional ruling character set by reselecting the standard alphanumeric set.
Buffer Transmission Terminate	Pressing RESET while a buffer transmission sequence is in progress will terminate Buffer transmission.
ESC Over-Ride	Inhibits the effect of a previously received ESC control character during the time RESET is held down.
Make Copy Request Terminate	Terminates a Make Copy Request. Will not terminate a copy in progress.
Erase Protected Fields	With RESET pressed, the ERASE TO END key erases data in a protected field.

TABLE 2-12

STRAP OPTIONS

There are two types of strap options used in the 4023, Factory and On Site. Factory options are set at the factory and include modifying the board by installing or removing circuit card runs. Factory straps are normally operating configuration straps, that select the standard operation configuration when un-cut. On Site straps are movable wire straps located on the circuit boards. These straps can be moved at the user site by qualified technical personnel.

The Strap Options Table gives the strap name, its function, its location on the board in respect to the nearest integrated circuit, and its type (Factory on On Site). Listing of boards is by assembly number (A1, A2, etc.), and the straps are alphabetized for each assembly. The location of a specific strap on a board is indicated by a number in the IC Location column. This number corresponds to the nearest integrated circuit to which the strap is located. The strap name is also silk-screened on the board next to the strap to aid in locating the strap. The card location on the minibus can be found by referring to Fig. 1-5.

WARNING

Dangerous voltages exist inside the display unit. Before attempting to change any strap, or remove any circuit card for strap access, turn Terminal power off and disconnect the Terminal from the power source.

Some operating configurations require that more than one strap be set. The following information lists those operating configurations and the straps that must be sent to establish it. Strap name and locations are also given.

CONFIGURATION	STRAPS	BOARD
Optional Rulings Character Set Enable	BIT 9 RAMS IN	RAM Board
	RULINGS	Timing Board
Alternate Character Set Transmit Enable	ALT SET ERASE INPUT	Keyboard Interface
	ALT SET XMIT	Control Board
Optional 12 Lines Enable	12 LINE RAM	Ram Board
	12 LINE DISPLAY	Cursor Board
	12 LINE LSTY CRS	Cursor Board
	12 LINE ROLL-UP SET	Cursor Board
	12 LINE ROLL-UP	Edit Board
Roll-Up Operation	NO ROLL-UP	Edit Board
	ROLL 4	Edit Board
Keyboard Inhibit	CONSOLE LOCK	Keyboard Interface

The following is a listing of all the strap options that are available in the 4023.

RAM BOARD
(A1)
STRAP OPTIONS

STRAP NAME	IC LOCATION	TYPE: FACTORY or SITE	FUNCTION
BIT 8 RAMS OUT	81	FACTORY	Standard un-cut. Cut to eliminate BIT 8 RAMS. This inhibits Terminal response to Field Attribute Codes, thus, eliminating Buffer Form Fill-Out Mode. Cut configuration can be used for TTY subsitute operation.
BIT 9 RAMS IN	91	FACTORY	Standard un-cut. Cut to enable logic use of BIT 9 RAMS. Enabling BIT 9 permits the optional ruling character set to be enabled by control character SO. Standard character set is re-selected by SI.
12 LINE RAM	245	FACTORY	Standard un-cut. When cut, and straps on Cursor Board are placed properly, only 12 lines of Data are displayed.

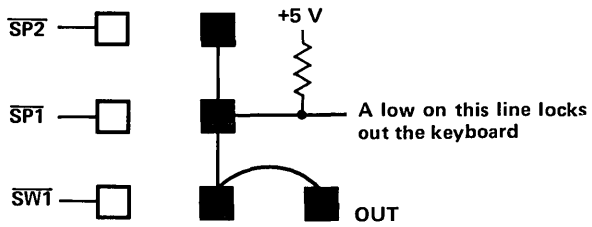
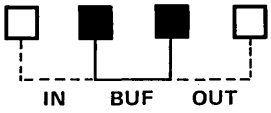
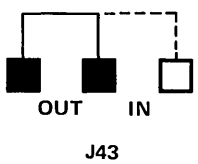
CURSOR BOARD
(A2)
STRAP OPTIONS

12 LINE ROLL-UP	121	FACTORY	Standard un-cut. Cut to enable roll-up with 12 lines.
12 LINE LSTY CRS	111	FACTORY	Standard un-cut. To enable 12 lines only, cut top strap, then strap center pad to lower pad.
12 LINE DISPLAY	321	FACTORY	Standard un-cut. To enable 12 lines, cut top strap, then strap center pad to lower pad.

KEYBOARD INTERFACE
(A4)
STRAP OPTIONS

ALT. SET ERASE INPUT	91	FACTORY	Standard un-cut prevents Erase Input from erasing the optional ruling characters. However, if the rulings characters are not protected, they can be keyed over. This strap would be cut if the Standard Lowercase ROM were replaced with an alternate ROM. Cutting allows alternate ROM characters to be erased by ERASE INPUT.
BRK FUL (Break on Full)	391	FACTORY	Standard un-cut. When cut, the Terminal will transmit a BREAK signal on the data link when line feeds, new lines or cursor controls try to move the cursor below the bottom last line. This is called Page Full.

KEYBOARD INTERFACE BOARD (cont)
(A4)
STRAP OPTIONS

STRAP NAME	IC LOCATION	TYPE: FACTORY or SITE	FUNCTION
BUSY FUL (Busy on Full)	371	FACTORY	Standard un-cut. When cut, the Terminal will not generate a terminal busy ($\overline{\text{TBUSY}}$) signal on page full.
CONSOLE LOCK 	351	SITE	Standard OUT. When the strap is placed so that one of the other minibus signals is strapped in, its going low will prevent operation of the keyboard. This includes character keys, clear, insert and delete character/line, etc.
CR DOES LF 	29	SITE	This strap can be positioned to affect the line feed circuits as follows: BUFFER—This is standard. With the console DIRECT/BUFFER switch to BUFFER, pressing the RETURN key will also perform a line feed. However, the computer generated CR will not generate a line feed. IN—Permits keyboard RETURN key and computer generated CR's to also perform line feeds. OUT—A carriage return does not simultaneously generate a line feed, regardless the origin of the carriage return.
FF ERASE	149	FACTORY	Standard un-cut. When cut, the Form Feed (FF) Control Character by itself will perform a clear page function. When not cut (standard) FF must be preceded by the ESC Control Character to perform the clear page function.
LF DOES CR 	89	SITE	The standard strap position (OUT) provides a line feed only upon receipt of the LF code. The IN position provides a carriage return with LF. When the Optional Data Communications Interface is used, Interface wiring will connect to this plug, permitting the LF—CR/LF switch on the Interface switch panel to control the Terminal effect caused by LF.

KEYBOARD INTERFACE BOARD (cont)
(A4)
STRAP OPTIONS

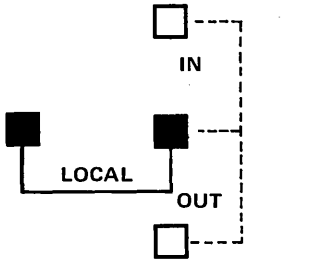
STRAP NAME	IC LOCATION	TYPE: FACTORY or SITE	FUNCTION
NO KEYBOARD INSTALLED	9	FACTORY	Standard un-cut. When cut, the 4023 ignores the KSTROBE input so that 4023 can be used without a keyboard.
WRAP-AROUND	69	SITE	IN enables wrap-around feature when spacing past the 80th character position. OUT disables wrap-around.

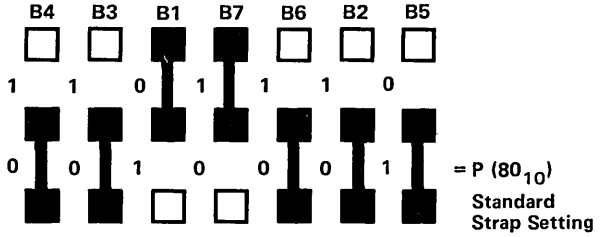
EDIT BOARD
(A5)
STRAP OPTIONS

ROLL-UP  OUT IN (Standard)	301	FACTORY	Standard un-cut permits roll-up to work in Direct Entry only. Cutting IN strap and strapping the OUT position, disables roll-up. When roll-up is disabled, $\overline{\text{TBUSY}}$ will occur on page full, thus stopping data from the computer without loss (only if connected via a TTY Port). BUSY FUL strap on keyboard Interface Card must not be cut.
ROLL 4  IN OUT (Standard)	101	FACTORY	Standard un-cut does not affect operation of ROLL circuitry; the Terminal goes busy on page full. When cut and strapped IN, and with the ROLL-UP strap in the standard configuration (IN), the Terminal will not go busy until after 4 lines of roll-up, stopping reception of data from the computer. RESET causes 4 more lines to roll-up. Roll-up 4 only would be used with TTY Port Interfaces. The BUSY FUL strap on keyboard Interface must not be cut.
12 LINE ROLL-UP	1	FACTORY	Standard un-cut. When cut, roll-up operates with 12 lines.

CONTROL BOARD (A6) STRAP OPTIONS

STRAP NAME	IC LOCATION	TYPE: FACTORY or SITE	FUNCTION
ALT SET XMIT	100	FACTORY	Normally BIT 9 true signifies that the character is part of the Rulings character set and is non-transmittable, regardless of Field Attribute Codes. When this strap is cut, this signifies that an alternate ROM is used for other characters. Their transmission is controlled by BIT 3 of the Field Attribute Code the same as normal alphanumeric data. Unless a special mod is ordered, the alternate set is indistinguishable from the normal character set in Buffer Entry Sequences.
AUTO CR AT END	75	FACTORY	Standard un-cut permits the Terminal to perform a carriage return at the end of the last line transmitted. (Clears x cursor register only; does not transmit CR.) When cut, the cursor remains at the end of the message when transmission is completed.
EOL LF GEN	1	SITE	A three-position strap that provides functions according to the following: LOCAL—Standard position that causes line feeds to be generated in local when displaying copies of screen data that originates from an auxiliary unit such as a magnetic tape unit. Line feeds are not transmitted to the computer if On Line. IN—Line feeds are generated by the send circuits when operating either in local or on line. OUT—Line feeds are never generated at the end of a line.
LINE PROMPT	350	FACTORY	A set of 7 factory straps that are used to select any of 128 ASCII characters for the "prompt" character. The uppercase P(80_{10}) is standard. The prompt character is an output from the computer that follows a line of Terminal input. When the Terminal completes a line of transmission, it performs a carriage return, then stops, awaiting the "prompt" from the computer. The receipt of the Prompt character is a signal to the Terminal to transmit another line. The Line Prompt straps are arranged as shown below. (The Prompt Character causes $\overline{\text{CBUSY}}$ to go active for about 0.5 sec.)





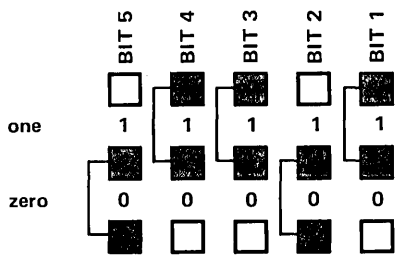
B1 – B7 – Bit 1 – Bit 7

1 – Strap must be between these two pins to select a logical 1 for that bit.

0 – Strap must be between these two pins to select a zero for that bit.

CONTROL BOARD (cont)
(A6)
STRAP OPTIONS

STRAP NAME	IC LOCATION	TYPE: FACTORY or SITE	FUNCTION
FAST RESPONSE	31	FACTORY	Strapping the FAST RESPONSE holes, provides a shorter time for $\overline{\text{CBUSY}}$. Time provided is 25 to 60 millisec and would be used with minicomputers or for a test setting. (Standard time for $\overline{\text{CBUSY}}$ is 460 msec ± 40%). This strap controls the length of $\overline{\text{CBUSY}}$ upon Terminal receipt of a Prompt Character, or an ESC character.
PROMPT MODE	85	SITE	Two position strap that provides the following: OUT—Standard strap position that sets the logic to not require a prompt from the computer for data transmission. IN—This position requires a prompt character from the computer for each line of buffer data entered to the computer. (See Line Prompt Strap for prompt character.)
MESSAGE END	320	SITE	The Message End character is the last character sent in a message transmitted from the Terminal. Any ASCII control character can be strapped. The standard character used is CR. The Message End Character is also the last character sent in a Read Cursor transmission. See strap illustration. Note that only Bits 1-5 of the specific control character are strapped.
TAPEFETCH PROMPT	89	FACTORY	Standard un-cut. When cut, this will enable the SP2 ($\overline{\text{TAPEFETCH}}$) minibus line to control the reading of the buffer to the computer, one character at a time (one character per tapefetch). $\overline{\text{TAPEFETCH}}$ is a signal originating from a TTY Port Interface associated with minicomputer paper tape reader control. The Tapefetch prompt operation permits the 4023 to emulate a high-speed reader.



= 5 least significant bits of the CR Character

TIMING BOARD
(A7)
STRAP OPTIONS

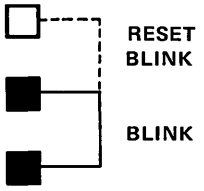
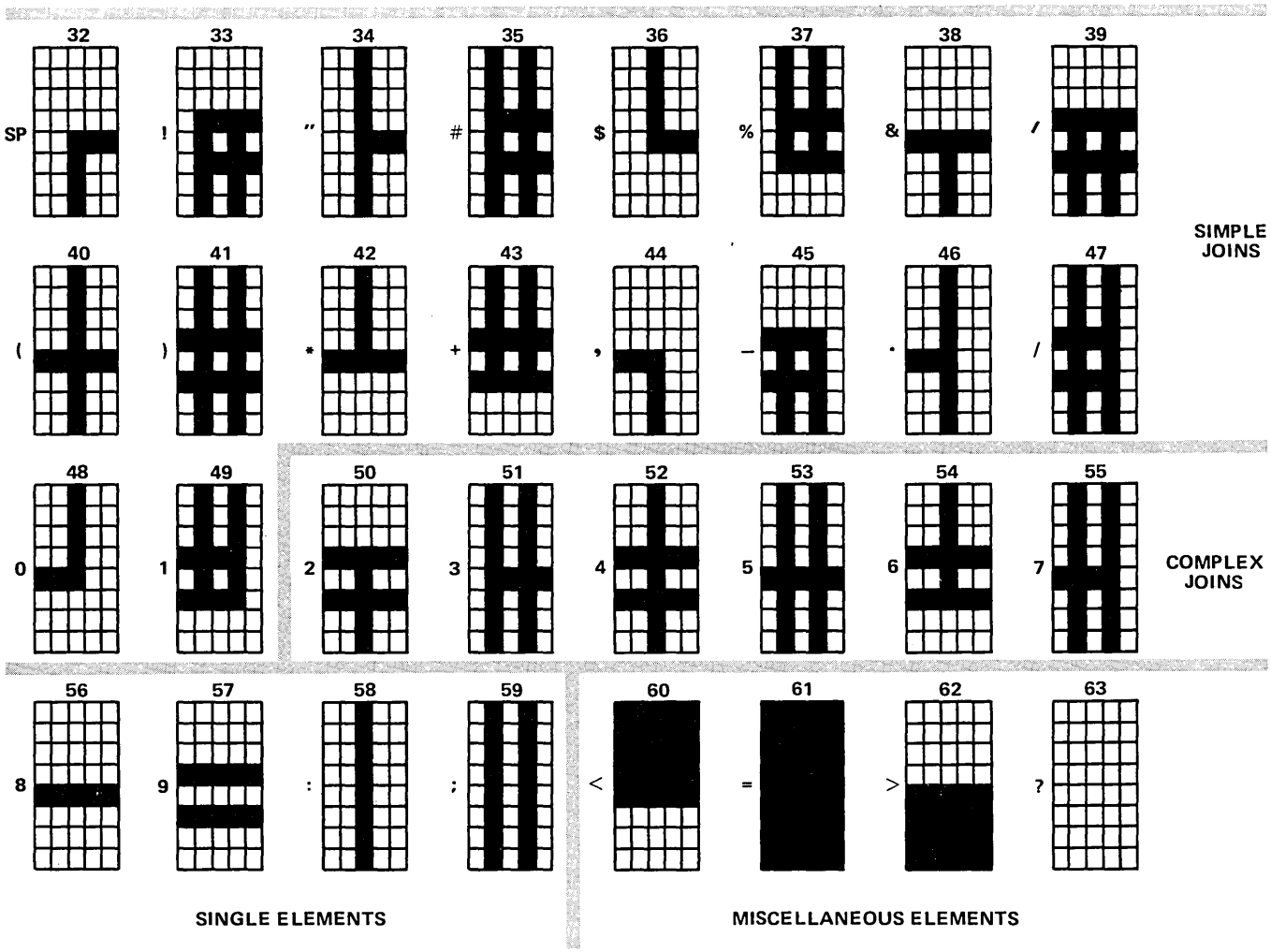
STRAP NAME	IC LOCATION	TYPE: FACTORY or SITE	FUNCTION
FAST I/O	301	FACTORY	When strapped, fast input/output occurs when a low is placed on pin 23 (SP1) of the minibus. This causes the screen to be blank when fast I/O occurs, and the input/output cycle (which is normally found in the horizontal interval), to repeat. Data transfer rates or position cursor rates increase to 94,320 characters per second, instead of the normal rate of 15,720. When not strapped, Fast I/O cannot occur.
LOWER CASE OUT	421	FACTORY	Standard un-cut. Cut to inhibit display of lower case alpha characters. Lower case codes will then print as upper case.
RULINGS	401	FACTORY	Standard un-cut. Cut when optional rulings set is to be used. This allows "spreading" of the ruling characters, thus causing continuity of characters (no breaks in the rulings).
50 Hz	431	FACTORY	Standard un-cut. Cut to enable timing to be compatible with 50 Hz power (provides a frame rate of 50 Hz).
BLINK CURSOR 		SITE	BLINK position causes cursor to blink continuously. In RESET BLINK (Standard) position, cursor blinks only when RESET key is pressed.

TABLE 2-13

TIMING
SPECIFICATIONS

Display and Logic Timing	
Master Oscillator	22.008 ± 0.25% MHz crystal oscillator divided as follows:
Video	11.004 MHz (22.008 ÷ 2)
Character	1.572 MHz (11.004 ÷ 7)
Horizontal Sweep	15.72 kHz (1.572 MHz ÷ 100)
Vertical	60 Hz retrace: (15.72 kHz ÷ 262) 50.06 Hz retrace: (15.72 kHz ÷ 314)
Input/Output Timing	
Master Oscillator	4.9152 ± 0.25% MHz crystal Oscillator divided at the interface unit to provide baud rates of: 110, 150, 300, 600, 1200, 2400, 4800, and 9600.



Note: Numbers 32-63 correspond to ASCII decimal code.

Fig. 2-1. Ruling Characters.

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
				CONTROL		NON ALPHA		FIELD CODES		LOWER CASE	
B_4	B_3	B_2	B_1	0	1	2	3	4	5	6	7
ø	ø	ø	ø	NUL ø	DLE 16	SP 32	ø 48	@ 64	P 8ø STANDARD PROMPT	\ 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 MESSAGE SEPARATOR	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 1ø0	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 * HARD COPY	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 HORIZ TAB	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 BACK TAB	ESC 27	+ 43	; 59	K 75	[91	k 1ø7	{ 123
1	1	ø	ø	FF 12 * CLEAR PAGE	FS 28 MOVE CURSOR	, 44	< 6ø	L 76	\ 92	l 1ø8	¦ 124
1	1	ø	1	CR 13 RETURN	GS 29	- 45	= 61	M 77	] 93 * READ CURSOR	m 1ø9	} 125 ALT MODE
1	1	1	ø	SO 14 RULINGS SET * XMIT ALL	RS 3ø	. 46	> 62	N 78	^ 94	n 11ø	~ 126
1	1	1	1	SI 15 RULINGS RESET * XMIT UNPROTECTED	US 31 **	/ 47	? 63	O 79 * CLEAR INPUT	_ 95	o 111	127 RUBOUT

* CHARACTER IS PRECEDED BY ESC CHAR TO PERFORM FUNCTION

** WHEN RECEIVED BY TERMINAL, NEXT CHARACTER IS INTERPRETED AS A FAC.
WHEN TRANSMITTING BUFFER CONTENTS, US IS TRANSMITTED INSTEAD OF THE FAC

Fig. 2-2. ASCII Code Chart.

MAINTENANCE

GENERAL INFORMATION

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.

DESK-MOUNTING

Desk-mounting consists of simply setting the Terminal on a desk or other surface. See Fig. 3-1. The air vents on the bottom, sides, and back should be kept free of obstructions.

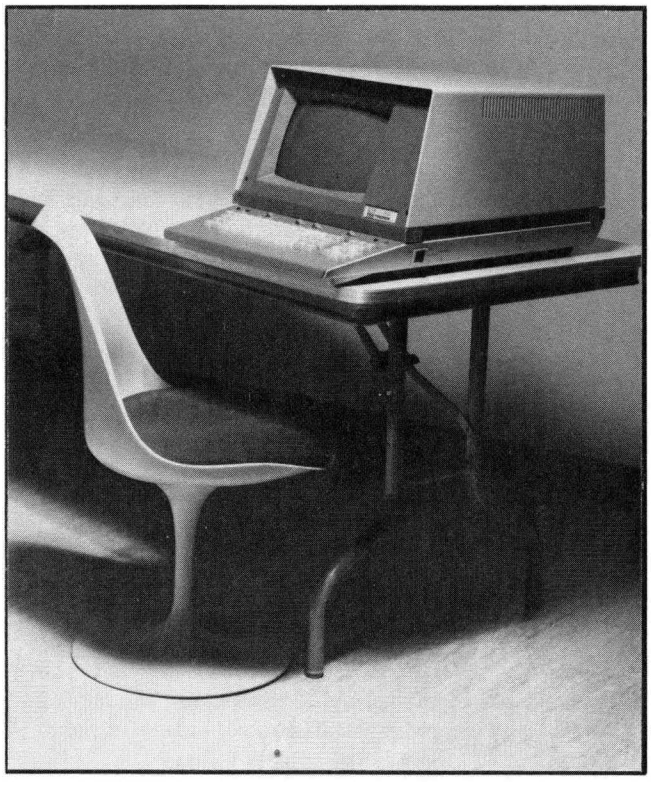


Fig. 3-1. Desk Mounting.

MOUNTING THE TERMINAL ON THE OPTIONAL PEDESTAL

A pedestal, on which the Terminal can be mounted, can be ordered from Tektronix, Inc. (PN 016-0568-00). Mounting the Terminal on the pedestal is accomplished by lifting the Terminal over the pedestal and installing four machine screws up through the pedestal top to fasten the Terminal in place. Adjust the four feet to a convenient position, and fasten the lock nuts.

SERVICING PROCEDURE

1. Disconnect the line cord from the power source.

2. Remove the top from the Terminal.

3. Using a vacuum cleaner, remove dust accumulation from within the unit. Use a soft-bristled brush to loosen dust that won't otherwise vacuum out. A soft cloth and a mild soap and water solution can be used to remove any really stubborn dirt.

4. Inspect the interior for broken leads, loose connections, heat-damaged components, etc. Correct as necessary. Investigate the cause of any heat-damaged components.

5. Wash the face of the crt, using a soft cloth and a mild soap and water solution.

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

7. Put the cover back on the Terminal

8. Clean the outside of the Terminal, using a soft cloth and a mild soap and water solution.

SOLDERED OPTIONS

In addition to strappable options, there are some options that can be selected by soldering or cutting soldered wires. To reduce the possibility of damage to the equipment, these changes should only be made by qualified technicians. These options are found in the Characteristics section. Information on use of these options is provided there.

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 ensures operator understanding of the Terminal features and operation.

CHARACTERISTICS. A complete explanation of the Terminal capabilities is contained in the Characteristics, 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.

CIRCUIT DIAGRAMS AND CIRCUIT DESCRIPTIONS. 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 on the aprons of their respective diagrams in Section 6 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 in the Diagrams section. Wire colors are also provided, using the standard code for resistors.

SEMICONDUCTOR INFORMATION. An illustration of semiconductors appears in Section 6 just preceding the diagrams, 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 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 revealed by the Performance Check or Adjustment Procedure. However, they should prove beneficial in most cases, and should aid in guiding a technician to the trouble area.

RECOMMENDED TROUBLESHOOTING EQUIPMENT

A Logic Extender Card, Tektronix Part No. 067-0659-00, 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 an 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. 067-0696-00. 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 −20 V to +400 V dc voltmeter and a 10 MHz frequency-response oscilloscope are recommended test equipment for troubleshooting low-voltage and logic circuits.

WARNING

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

The Motherboard can be completely disconnected and the supplies will still come up. However, when trouble-shooting 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	J152	7.5 Ω 30 W
−12 V	J150	15 Ω 10 W
+5 V	J153	0.5 Ω 100 W

DISASSEMBLY AND ASSEMBLY

ACCESS TO THE DISPLAY UNIT CIRCUITRY

For access to the circuits within the Terminal, remove the two screws on each side of the cover, and the two in back near the top. Then lift the cover off.

KEYBOARD INFORMATION

Perform the following procedure to get at the keyboard circuits:

1. Remove the Terminal cover.

2. Remove the three larger screws from the top rear of the keyboard.

3. Remove the three screws from the bottom-front of the keyboard panel.

4. Pull the keyboard forward, then up and 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 eight screws that hold the keyboard assembly to the keyboard panel.

Key caps can be removed by pulling them directly away from the keyboard. Use of a large pair of tweezers or a forceps is recommended.

Keys utilize reed switches whose solder contacts are accessible on the underside of the keyboard circuit board. Once the wires are unsoldered, the reeds can be extracted through the holes. Reverse the procedure for replacement.

Groups of keys are installed in assemblies which can be removed once the nuts are removed from the underside of the circuit board.

CIRCUIT CARD INFORMATION

ACCESS. For access, remove the Terminal cover.

CIRCUIT CARD REMOVAL. The circuit cards plug into the minibus and are held in by circuit card hold-down clamps. Remove these clamps, disconnect the cabling, then pull the card (cards) from the minibus.

CARD WIRING. Each card is assigned an assembly number starting with A1, the RAM card. Fig. 1-5 illustrates the order the card assemblies are inserted into the minibus. Cabling at the Keyboard Interface, Edit, and Control cards use the resistance color code to assure proper connection. The plugs that attach to the afore-mentioned three cards are colored accordingly. For example, the Keyboard Interface (A4), has three yellow plugs attached. The green plug attaches to A5; the blue to A6.

POWER SUPPLY CARD REMOVAL. Remove the cables that connect to the power supply circuit card. Unsolder the four wires that connect to the transformer. Then, remove the four screws that attach the card to the switch assembly.

REAR ASSEMBLY REMOVAL

The rear assembly consists of the power supply and the Motherboard. For disassembly, follow this procedure. Refer to the illustrations in the mechanical parts list as necessary during this procedure.

1. Remove the Terminal cover.

2. Disconnect the cabling from the minibus circuit cards. For convenience, it is suggested that you remove all the circuit cards and set them aside.

3. Disconnect P210, P208, P207, and P205 from the Motherboard.

4. Remove power switch wiring (see Fig. 3-2):

a. Remove the transformer wiring top cover and disconnect the grey-red-white and grey-red-black wires from the jumper strip.

b. Remove the cover that houses S1001 and disconnect the grey-black-brown and grey-white-brown wires from the NO 1 and NO 2 connections of S1001. Loosen the clamp and pull these wires through the clamp.

c. Disconnect the ground terminal using a 1/4 inch nut-driver or wrench.

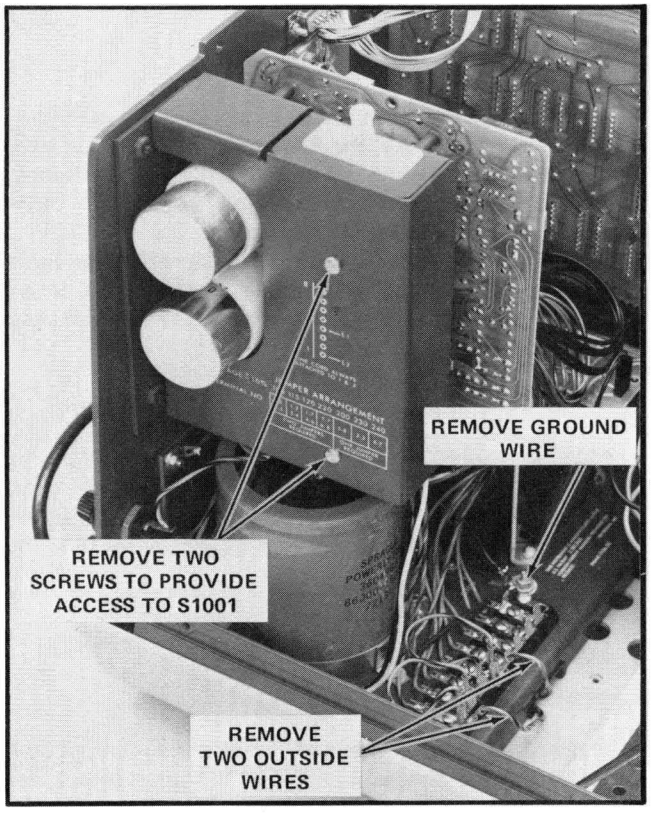


Fig. 3-2. POWER switch wiring.

5. Remove the three machine screws that hold the rear assembly to the mainframe. One screw is on the left, near the silk screening for C1006; the other two are on the right side, in line with the rear cable port.

6. Lift up on the assembly, tipping it back and pull the POWER switch wiring through the hole.

7. Lift the rear assembly away from the mainframe.

REAR ASSEMBLY INSTALLATION. The installation procedure is the reverse of the disassembly procedure.

MONITOR ASSEMBLY INFORMATION

The monitor assembly includes the crt, Deflection and High Voltage Circuit Board, and the mounting brackets. Refer to the Mechanical Parts Lists as necessary during the following descriptions.

MONITOR ASSEMBLY REMOVAL. The monitor assembly is best removed by following this procedure.

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.

When working around or directly with the crt, adequate electrical safety precautions need to be strictly observed. ALWAYS discharge to ground the High Voltage anode lead before removing the crt. High voltage can exist, even if the Terminal has not been operating for several days. Discharge by using a jumper strap similar to the one shown in Fig. 3-3. CONNECT STRAP TO GROUND FIRST.

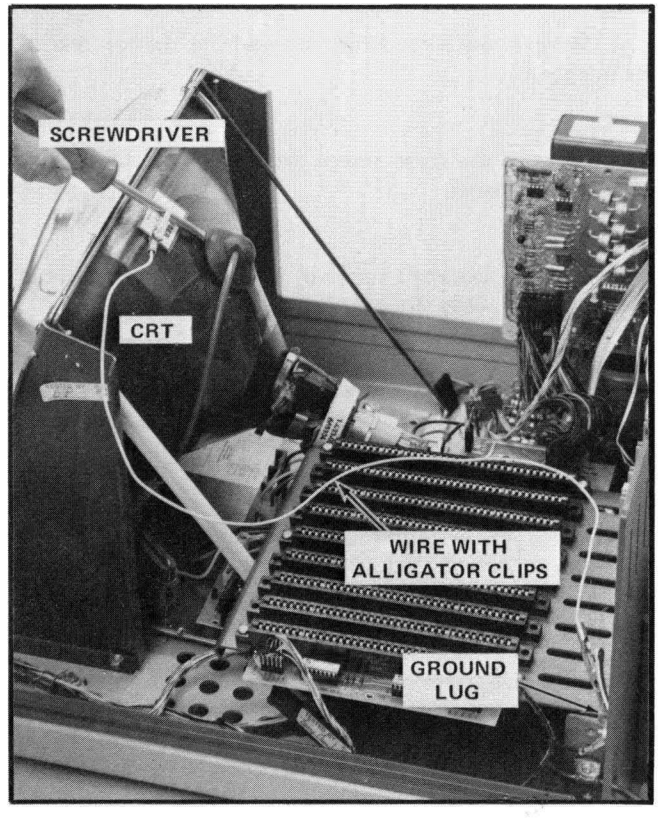


Fig. 3-3. Discharging the high voltage anode.

1. Remove the Terminal cover.

2. Remove the logic cards from the Motherboard.

3. Disconnect J112 from the Monitor Circuit board.

4. Remove the four 3/8-inch machine nuts that bolt the monitor to the mainframe.

5. Remove the machine screw near the left rear corner of the monitor circuit card.

6. Gently lift the monitor assembly out from the Terminal mainframe, and set the assembly on a foam rubber pad, being careful not to bump or scratch the crt.

CRT REMOVAL. The easiest and safest procedure for crt removal is to first remove the monitor assembly from the mainframe, then:

1. See WARNING under Monitor Assembly Removal.

2. Disconnect the plug from the rear of the neck by pulling gently and evenly on the plug.

3. Remove the ring magnets from the base of the crt neck by loosening the clamp screw and pulling the magnet assembly off the neck.

4. Remove the deflection coils in the same manner.

5. Remove the High Voltage anode lead by inserting a grounded screwdriver under the rubber grommet (see Fig. 3-3) and pushing when the screwdriver tip makes contact with the wire conductor. This allows one of the wire hooks to be removed from the anode connection. Twist the connector out and up to remove the other anode hook.

6. Remove the four machine screws that hold the monitor to the frame. HOLD THE MONITOR WITH ONE HAND TO PREVENT IT FROM FALLING WHEN THE LAST SCREW IS REMOVED.

MONITOR (CRT) INSTALLATION. Reverse the Monitor disassembly procedure.

DEFLECTION AMPLIFIER AND HIGH VOLTAGE BOARD. This board is best removed with the monitor assembly removed. Disconnect all the plugs and pull the board up from the plastic tabs, a corner at a time. For installation, plug identification is provided by an illustration beside the board.

HIGH VOLTAGE TRANSFORMER REMOVAL.

WARNING

Be sure to discharge the High Voltage anode lead; otherwise, personal injury may result.

1. Remove the monitor assembly from the mainframe.

2. Disconnect P104, P105, and the High Voltage anode.

3. Place the monitor assembly face down on a foam rubber pad.

4. Remove the two nuts that hold the transformer to the bottom of the monitor assembly and remove the transformer.

To install the High Voltage transformer, reverse the above procedure.

NOTE

After replacement or reassembly of any of the major afore-described Monitor assemblies, perform the display adjustments procedures provided in Section 4.

SILICON GREASE

Silicon grease is applied to both sides of the mica insulators used with the following components: Q1105, Q1110, Q1112, Q1118. In addition, silicon grease is applied to both sides of the mica insulators used with Q106 and CR103 on the Deflection and High Voltage board.

POWER TRANSFORMER INFORMATION

The power transformer can be wired for use with 115 V or 230 V nominal line voltage, and can be set for any of several ranges within the nominal setting.

Instructions for connecting the transformer are contained in the Installation Section. Note that the line fuse must also be changed when shifting between 115 and 230 volt operation.

PERFORMANCE CHECK/ADJUSTMENT

PERFORMANCE CHECK

GENERAL

This procedure (see Table 4-1) can be used under normal operating conditions with all circuit cards installed. Because some checks require that ON LINE be selected, check that the Terminal is not connected to a modem or computer. Checks are referenced to a circuit card 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 minibus to determine if the Terminal is at fault.

TABLE 4-1

Performance Check Procedure

Activity	Results	Check/Adjustment
Turn Terminal Power On.	Indicator on right of keyboard glows.	Power Supply (Adjustment 1).
Wait 30 seconds.	Cursor appears in upper-left hand corner of display—the home position.	Cursor, Timing, Monitor Circuitry, RAM. Check BRIGHTNESS and CONTRAST controls.
Adjust BRIGHTNESS and CONTRAST.	Optimum setting is to adjust BRIGHTNESS all the way up, then back down to the point where the field just becomes invisible; then adjust CONTRAST for best viewing.	Timing, Monitor Circuitry.
Set switches to LOCAL and BUFFER, then enter a few characters.	Characters are displayed; cursor moves one space after each key actuation.	Keyboard, Keyboard Interface, RAM, Timing, Cursor.
Enter a page full of "H" characters by pressing ERASE INPUT SHIFT and H keys. (Hold down H key and release other two keys to fill screen with H characters).	Screen fills with "H" characters (Readjust BRIGHTNESS and CONTRAST if necessary). Note that every character position contains an "H" character.	Keyboard, Timing, Cursor, RAM.
Check for 24 lines of characters (12 lines optional).		Cursor.
Check for 80 characters per line.		Cursor.
Press ERASE INPUT key.	Screen is erased, cursor positions to home.	Keyboard, Keyboard Interface, Cursor, RAM.
Check each written character on the keyboard; including shifted characters.	Characters displayed are same as indicated on top of keycaps.	Keyboard, RAM, Timing.
Press the TTY Lock key to place it in its locked position. Press each character key with the SHIFT key released.	All letter characters should be written as upper case.	Keyboard.

Table 4-1 (cont)

Activity	Results	Circuit/Adjustment
Press a character key and hold down.	Characters repeat after an approximate 1/2 second delay.	Keyboard, Keyboard Interface.
Key in 73 consecutive characters, then key in one more.	Bell rings when spacing past 73rd character.	Cursor, Keyboard Interface.
Check Wrap-around. Move the cursor to the 80th character position; Place DIRECT/BUFFER Switch to DIRECT, then type or space past the 80th character.	If Wrap-around has been enabled by Wrap-around strap, cursor positions down one line and is at the left margin. *NOTE* *Wrap-around capability may not be available on some earlier Terminal models.*	Cursor, Keyboard Interface.
Reselect BUFFER and check that Wrap-around does not work.		
Move the cursor away from the left margin and press the RETURN key.	With CR DOES LF strap option at IN, cursor spaces one line down and moves to left margin. With CR DOES LF strap option at OUT, cursor moves to left margin. With CR DOES LF strap option at BUFFER, cursor spaces one line down and moves to left margin (BUFFER position prevents computer originated RETURNS from generating a LINE feed).	Keyboard Interface, Cursor.
Press ^{C}M.	Same as RETURN key.	Keyboard Interface, Cursor.
Move cursor away from left margin, then press LF.	With LF DOES CR strap option at LF, cursor moves to next line. With LF DOES CR strap option at LF/CR, cursor moves to left margin of next line.	Keyboard, Keyboard Interface, Cursor.
Press ^{C}J.	Same as LF key.	Keyboard Interface, Cursor.
Press HOME key.	Cursor positions to home—the first character position on first line.	Keyboard, Keyboard Interface, Cursor.
Enter 23 LINE FEEDS (LF's).	Cursor moves to bottom-left corner of display.	
Enter 24th LINE FEED.	Cursor does not move. Display remains stable.	Edit, Cursor.

Table 4-1 (cont)

Activity	Results	Circuit/Adjustment
Set DIRECT-BUFFER switch to DIRECT. Check that rear panel ECHO switch is set to IN. Then enter another LINE FEED.	Displayed information rolls-up; The top line is deleted and a line of NUL's resides in the 24th line. The cursor does not move. With the Edit Card strapped for 4 line ROLL-UP, four LF's can be given before Terminal goes busy. Pressing RESET enables four more roll-ups. With the NO ROLL-UP strap cut, roll-up cannot occur when line feeding past the bottom line.	Edit, Cursor, RAM, Timing, Interface.
Press TAB key.	Cursor spaces one space to right.	Keyboard, Cursor.
Set ECHO Switch to OUT and enter a few characters from keyboard.	Keyboard entries cannot be displayed. Cursor does not space.	Interface.
Set DIRECT-BUFFER Switch back to BUFFER, and move cursor away from left margin. Press BACKSPACE.	Cursor moves to the left one character space. If held down Backspaces occur until the left margin is reached.	Keyboard Interface, Cursor.
Press ^{C}H (CTRL and H keys).	Cursor backspaces.	Keyboard Interface, Cursor.
Press ESC key then simultaneously press the ^{C}L keys (CTRL L is the FF control character).	With FF ERASE strap (cut strap) not cut, the display is cleared. With the FF ERASE strap cut, FF by itself will erase the display.	Keyboard, Keyboard Interface, Timing, Cursor, RAM.
Press ^{C}G.	Bell rings—repeats when keys are held down.	Keyboard Interface.
Press ESC followed by ^{C}G.	If hard copy unit is connected it is signaled to make a hard copy of the display. If connected, note that the cursor disappears as the copy is being made.	Keyboard Interface, Timing.
Press COPY Button.	Same as ESC ^{C}G.	Control, Timing.
Set Position Cursor Mode by pressing ^{CS}L followed by a 2 and then an asterisk (*).	The Cursor positions to the 19th character position on the 11th line. (18 and 10, respectively, if numbering from 0 instead of 1.)	Edit, Cursor.
Press RESET.	With CURSOR BLINK strap at RESET BLINK, cursor blinks only when RESET key is pressed. With CURSOR BLINK strap at BLINK, cursor blinks continously.	Keyboard, Timing.

Table 4-1 (cont)

Activity	Results	Circuit/Adjustment
Press the following keys →↑←↓	Cursor moves in direction indicated on key cap.	Keyboard, Keyboard Interface, Cursor.
Press NUM LOCK to detent then press each of the eleven remaining function controls.	Numeric characters are now displayed as indicated on the front of the keycaps. SEND-ENTER key displays a decimal point.	Keyboard, Keyboard Interface.
Press NUM LOCK again to re-establish normal function controls.	Normal Function Controls re-established.	
Obtain a page full of characters.		
Press INS C.	Character at cursor location and all characters to right of cursor move one space to right. 80th character is lost. A space resides at the cursor location and the cursor does not move. Hold key down to check repeatability.	Edit, Cursor, RAM, Timing, Keyboard.
Move cursor to a new line and press DEL C.	Character at cursor location is deleted and all characters to right of cursor move left one space. 80th character position contains a NUL character. Hold key down to check repeatibility.	Edit, Cursor, RAM, Timing, Keyboard.
Simultaneously press SHIFT and INS L.	Line where the cursor resides and all lines below the cursor move down one line. The 24th line (12th line optional) is lost. The cursor does not move and a line of SPACE characters is inserted at the cursor location. Hold keys down to check re-peatibility.	Edit, Cursor, RAM, Timing, Keyboard.
Simultaneously press SHIFT and DEL L.	The line where the cursor resides is deleted, and all lines below the cursor move up one line. A line of NUL characters reside in the 24th line (12th line optional). Hold keys down to check repeatibility.	Edit, Cursor, RAM, Timing, Keyboard.
Check buffer transmitting circuits. Switch to ON LINE and then switch the Baud Rate Selector to 300. Obtain a page full of caracters. Move the cursor to the middle of the second line and press ENTER.	A white block (ETX-Message Separator) is displayed at the cursor location; the KEYBOARD LOCK Indicator becomes lighted; the cursor moves to home and begins moving across line 1, transmitting the data until it reaches the end of the line. A CR and LF is performed and transmission continues on line 2. When cursor reaches stored ETX, transmission stops, a carriage return is performed and KEYBOARD LOCK indicator turns off.	Keyboard, Control; Interface, Cursor; RAM.

Table 4-1 (cont)

Activity	Results	Circuit/Adjustment
Press ENTER, then press RESET.	ENTER begins transmission; RESET terminates transmission, with cursor residing at last character transmitted.	Control, Interface.
Press ENTER, then press HOME.	ENTER sequence is terminated with the cursor positioning to HOME.	Control, Cursor, Interface.
Delete all lines except for line one. Simultaneously press SHIFT and SEND.	Line one is sent (as in ENTER above) except no ETX is stored at the cursor location. Note that NUL's contained on the remainder of the page are not transmitted. This is indicated by the cursor moving rapidly to the left margin of the last line.	Keyboard, Control, Interface, Cursor, RAM.
Move cursor five characters from left margin on Line 1, then simultaneously press RESET and RETURN.	A white block (CR-Message Separator) stores at the cursor location. Cursor spaces one space to right.	Control, Cursor, RAM.
Move cursor five characters from right margin on line 1. Then press ^{C}C.	A white block (ETX-Message Separator) stores at the cursor location. Cursor spaces one space to right.	Control, Cursor, RAM.
Move cursor inside data bracketed by Message Separators. Simultaneously press SHIFT and SEND.	No Message Separator stores. Cursor moves over data bracketed by Message Separator, after which a carriage return is performed and the cursor resides at the left margin.	Control, Cursor, RAM.
Key in a line full of characters. Position the cursor to home, then send the US Control Character by simultaneously pressing ^{CS}O. Press G.	Character at the home position is blanked. Remaining characters on line one are dimmed. Cursor spaces one space to right and KEYBOARD LOCK Indicator becomes lighted.	Control, Timing.
Press a character key.	Bell rings, character cannot be entered onto display. This is a dim, protected field.	Keyboard Interface, Control, Timing.
Simultaneously press RESET and a character key.	KEYBOARD LOCK Indicator goes out. Character can be entered into field.	Control, Timing.
Position cursor over the Field Attribute Code ("C" which was entered at home position), then press a character key.	Bell rings, FAC cannot be keyed over.	Control, Keyboard Interface.
Move cursor to mid-position on third line, then press ^{CS}O, followed by H.	Line becomes white to right margin. Cursor positions to first character space inside field. Note inversion of video; cursor appears dark.	Control, Timing.

Table 4-1 (cont)

Activity	Results	Circuit/Adjustment
Type both alpha and numeric characters into field.	Alpha and numeric data can be entered into the inverted, unprotected field.	Control, Timing.
Move Cursor to beginning of third line, then press ^{CS}O followed by Q.	Line blinks from cursor location to the FAC (Field Attribute Code) that defines the next field.	Control, Timing.
Try typing alpha-characters into field.	Cannot be done. Bell rings.	Control, Timing.
Enter Numeric characters.	Numeric characters can be entered into the blinking field. All characters in columns 2 and 3 of the ASCII code chart can be entered into this field.	Control, Timing.
Position cursor over second character in the blinking field, then press ERASE TO END.	Data in blinking field is erased from cursor position to end of blinking field. Cursor resides in first character position of inverted field.	Keyboard Interface, Timing, Cursor, RAM.
Press ERASE TO END key again.	Data in inverted field is erased from cursor position to end of line. Cursor resides at end of line.	Keyboard Interface, Timing, Cursor, RAM.
Move cursor down to fifth line, then position cursor away from left margin. Key in some characters on that line.		
Position cursor to left margin of fifth line, then press ^{CS}O followed by Z.	Data residing in fifth line becomes blanked.	Timing.
Position cursor back to beginning of fifth line, then press DEL C key.	Field Attribute code is deleted. Video in fifth line becomes visible once again.	Edit, Cursor, Timing.
Position cursor over the FAC that defines the blinking field, then simultaneously press RESET and a character key.	The FAC is replaced with the character represented by the key pressed. Data that was previously blinking returns to normal.	Timing, Keyboard Interface.
Enter a page full of characters. Then, using the FAC code chart (Table 2-8) enter a few protected and unprotected fields at different locations on the display. For field definition, set codes that cause protected fields to blink and unprotected fields to be inverted (Black on White).	Display becomes full of characters. Fields are set as defined by the FAC's.	

Table 4-1 (cont)

Activity	Results	Circuits/Adjustment
Press HOME, then TAB key.	Cursor goes home, then "tabs" to first character position of the first unprotected field.	Control, Cursor, RAM, Timing.
Send the HT control character (press ^{C}I).	Cursor tabs to next unprotected field.	Control, Cursor, RAM, Timing.
Send the VT control character (press ^{C}K).	Cursor backtabs to first character position of preceding unprotected field.	Control, Cursor, RAM, Timing.
Press the ERASE INPUT key.	Data defined by FAC's as unprotected is erased. Note also that all data not defined by a FAC is erased.	Keyboard Interface, Control, Timing, Cursor, RAM.
Type data back into the unprotected fields, then press and release ESC, then press the "O" letter key.	Again, all data residing in unprotected fields is erased.	Keyboard Interface, Control, Timing, Cursor, RAM.
Obtain a new page full of characters. Using the FAC code chart (Table 2-8), enter a few transmittable and non-transmittable fields at different locations on the display. As before, set different codes for field identification.	Display becomes full of characters. Fields are set as defined by the FAC's.	
Press ENTER.	No ETX (Message Separator) codes stores at the Cursor location. Cursor moves to HOME and begins sending transmittable data only; skipping the non-transmittable fields. Note that all data not defined by a FAC is transmitted.	Control, Interface.
Press ESC, then send SO control character (^{C}O).	Results are same as for ENTER above.	Control, Interface.
Simultaneously press SHIFT and SEND.	All information displayed is transmitted; even non-transmittable fields.	Control, Interface.
Press ESC, then send the SI control character (^{C}N).	Results are same as for SEND above.	Control, Interface.
ERASE the page.		
Optional ruling characters check. Press ^{C}N. Then press (in sequence) all characters found in columns 2 and 3 of the ASCII code chart.	32 different ruling characters are displayed.	Timing.
Check that ruling character provided by each key is same as shown in Fig. 2-1.		Timing.

Table 4-1 (cont)

Activity	Results	Circuit/Adjustment
Press ERASE INPUT key.	Ruling characters cannot be erased via an Erase Input Function (unless the ALTERNATE SET ERASE INPUT strap on Keyboard Interface is cut).	Keyboard Interface.
Press ENTER.	Ruling characters are not transmitted (unless ALT SET XMIT strap on Control Card is cut).	Control.
Send the SI control character (^{C}O). Type a few numeric characters.	Normal character set is re-established.	Timing.
Select ruling characters once again. Press a few numeric keys to ensure rulings set selection, then press RESET.	Normal character set is re-established by pressing RESET.	Timing.
Erase Screen, then press RESET, while entering the SOH control character (^{C}A).	A bright block stores at the Cursor location.	RAM, Timing.
Check out storage of rest of control characters (Refer to ASCII code chart).	Control characters with Bit 1 high should store (be displayed). Those with Bit 1 low, should not store.	RAM, Timing.
ERASE page.	Display erases; normal operation is re-established. Cursor goes home, PERFORMANCE CHECK COMPLETED.	

ADJUSTMENT

INTRODUCTION

Adjustment of the Terminal is required only when it ceases to properly perform its intended functions, or after circuit repairs have been made to the power supply or to the monitor circuitry. If an adjustment is to be performed on a routine schedule, an interval of one year is recommended. Adjustment should be preceded by a thorough cleaning and inspection as outlined in the Maintenance Section. Adjustment should be performed in a +20°C to +30°C environment and should be preceded by a twenty minute warm-up period.

EQUIPMENT REQUIRED

The following equipment is required in this precedure:

1. Variable voltage source that has an output capacity of at least 2 A at 100, 110, or 120 Vac, or at least 1.25 A at 200, 220, and 240 Vac. The instrument output should be variable to at least ±10% from the stated value.

2. Single trace Oscilloscope with 10 mV vertical sensitivity. Frequency response should include dc to at least 10 MHz.

3. Voltmeter with a range of at least −20 Vdc to +20 Vdc; accuracy within at least 1% on all voltage ranges.

4. Common Screwdriver. 1/8 inch tip, non-conductive, at least 10 inches in length, plus handle.

5. Screwdriver, Allen-Type, 3/32 inch tip—non conductive, at least 10 inches in length, plus handle.

ADJUSTMENT PROCEDURE

PRELIMINARY

Turn the Terminal power off and remove the line cord from the power source.

WARNING

Dangerous voltages exist within the Terminal. Normal electrical precautions need to be observed when working within the Terminal while the cover is removed.

REMOVE THE TERMINAL COVER

At the back-left corner, remove the shield that covers the transformer terminals. It is held in place by two screws. Determine what voltage the transformer is wired for, by comparing the connections against the diagram on the surfaces of the switch (S1001) cover. If a variable ac power supply is available, set it to the voltage for which the transformer is wired. If the indicated supply is not available, record the transformer wiring condition so it can be restored upon completion of the adjustment procedure. Then rewire the transformer connections to agree with the available power supply. See wiring diagram for instructions.

Check the slow blow fuse (2 A for 115 V or 1.25 A for 230 V).

WARNING

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

Check the +5 Vdc, 15 A fast blow fuse for proper size.

DETAILED PROCEDURE

Adjustments include Low Voltage Power Supply and Monitor Adjustments.

1. LOW VOLTAGE POWER SUPPLY CHECK/ADJUSTMENT

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

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

c. Connect the voltmeter reference lead to the ground Test point, TP 12. See Fig. 4-1.

d. Using a voltmeter that has 1.0% or better accuracy, adjust R258 to obtain +5.00 V at the +5 V test point. Adjustment and test point locations are shown in Fig. 4-1.

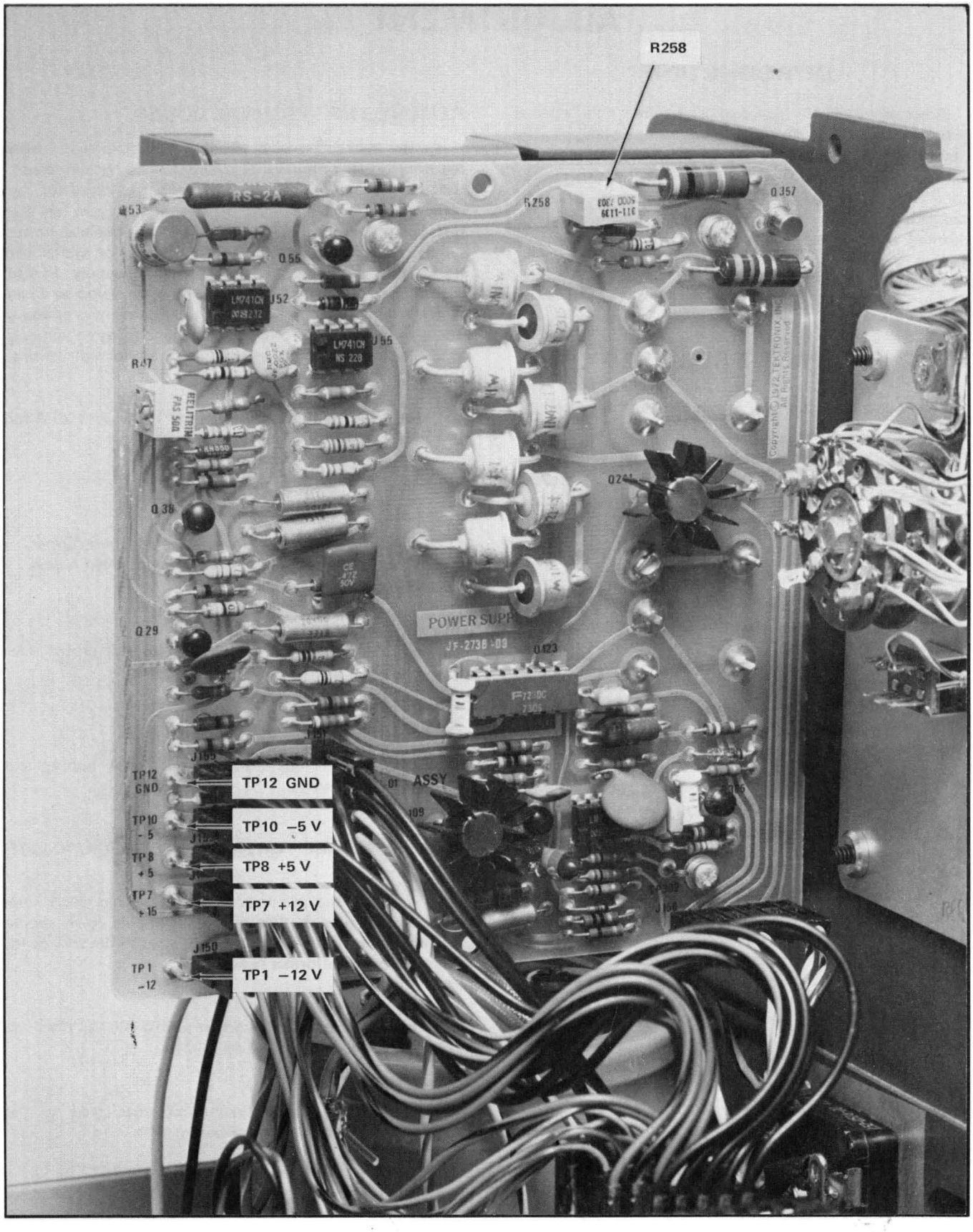


Fig. 4-1. Power Supply Adjustment and Test Point locations.

e. Measure the other power supply voltages as listed in Table 4-2. Test points are shown in Fig. 4-1. Record all voltages in Table 4-3. (Make duplicate copies of Table 4-3 for future use.)

f. Using the test oscilloscope, check that ripple voltages do not exceed those values given in Table 4-2.

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

h. Measure and record the supply voltages, again using Tables 4-2 and 4-3. Then check the ripple of each supply.

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

j. Again measure and record the supply voltages, again using Tables 4-2 and 4-3. Then check the ripple of each supply.

k. 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 larger than that specified in Table 4-3.

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

TABLE 4-2

Power Supply Voltage Limits

Supply	Test Point	Voltage Limits	Ripple (P-P)	Comments
+5 V	TP 8	+4.9 to +5.1	20 mV	Adjust R258 for +5 V; re-adjust to compromise so that +15 V and −12 V and −5 V supplies are within limits with line voltage at mid-position as well as at high and low limit.
+15 V	TP 7	+14.850 to +15.150	20 mV	NOT ADJUSTABLE
−5 V	TP 10	−4.9 to −5.1	20 mV	
−12 V	TP 1	−11.880 to −12.120	20 mV	

TABLE 4-3

Observed Voltages

Supply	(A) Center Line Voltage	(B) Low Line Voltage	(C) High Line Voltage	(D) Greater Deviation From (A)	% Observed Regulation $\frac{(D)}{(A)} \times 100$	Regulation Limit
+15 V						
+5 V						
−5 V						
−12 V						

2. TILT CORRECTION

a. Obtain a page full of characters by simultaneously pressing the ERASE INPUT SHIFT and H keys. Hold down on "H" while releasing the other two keys.

b. Check display for tilt. If tilted, loosen the yoke clamp screw and rotate the yoke to level the display. Fig. 4-2 shows component locations.

c. Tighten the clamp screw.

WARNING

Tightening the yoke clamp screws too tight may cause implosion. Tighten just enough to prevent yoke movement.

3. DISPLAY CENTERING

a. Check display for centering.

b. Center display by using ring magnets on yoke assembly. Fig. 4-2 shows component locations.

4. HORIZONTAL WIDTH ADJUSTMENT

Adjust L101 for a line length of 8.5 inches (22 cm).

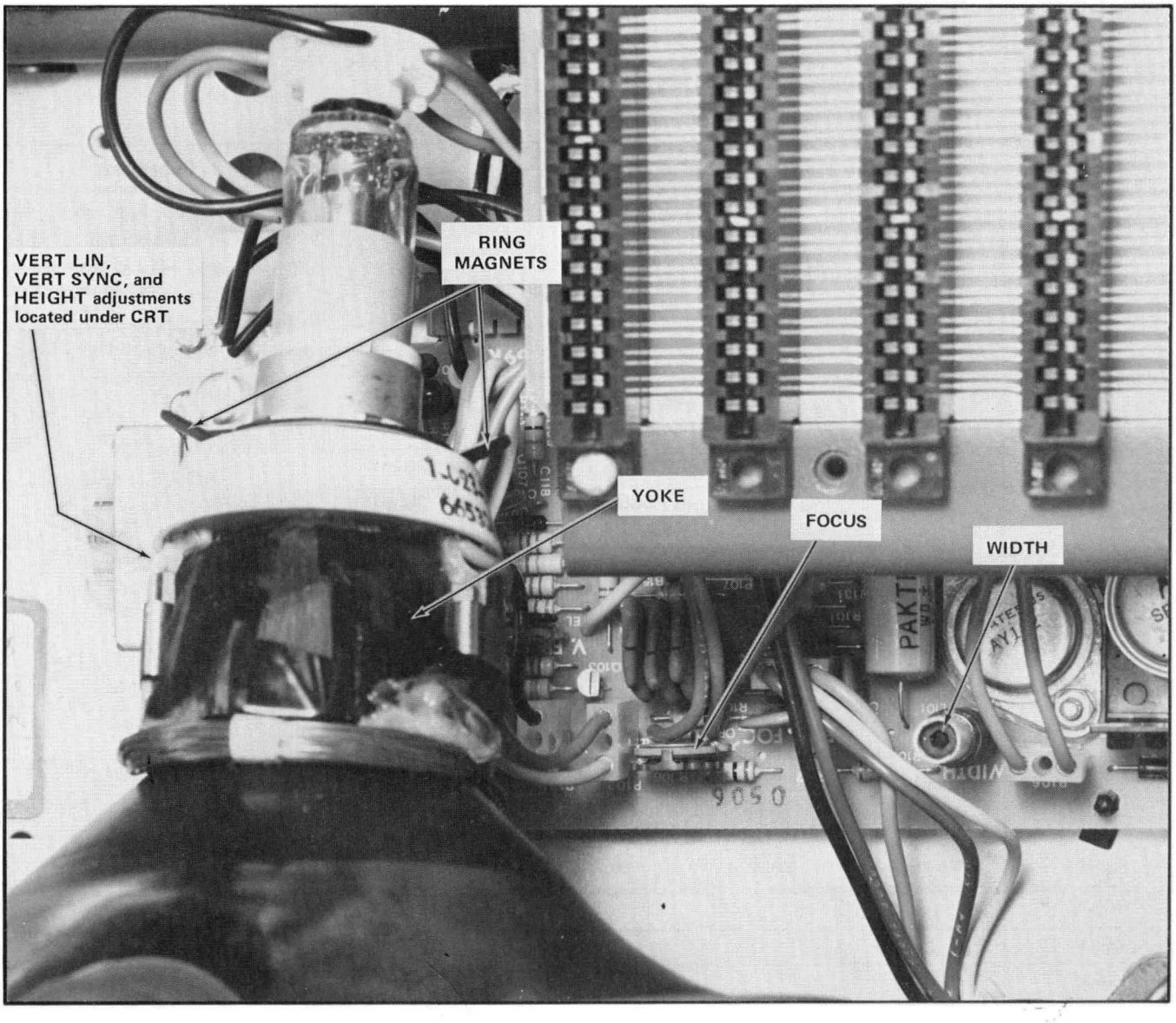


Fig. 4-2. Monitor Component locations.

5. FOCUS ADJUSTMENT

Adjust R107 for best over-all focus.

NOTE

FOCUS, BRIGHTNESS, and CONTRAST Adjustments all interact. Adjust BRIGHTNESS and CONTRAST for optimum viewing before adjusting FOCUS.

6. HEIGHT ADJUSTMENT

a. Adjust Height Control, R124, for a 24-line height of 4.5 inches (12 cm).

7. VERTICAL LINEARITY ADJUSTMENT

Adjust R121 for best vertical linearity. This can be done by checking that the characters in the top line are the same height as the same characters in the bottom line.

8. VERTICAL SYNC ADJUSTMENT

a. Turn Terminal Power OFF.

b. Remove P79 from J79, and bend Pin 1 so that P79 can be installed without pin 1; see Fig. 4-3 for illustration.

c. Turn Terminal power back ON.

d. Adjust R116 to the point where the cursor rolls up approximately three rolls every second.

e. Turn power OFF and reconnect pin 1 to J79.

f. Turn power back on and enter a page full of characters. Note Stable display.

g. Height, Linearity and Vertical Sync Adjustments interact. Repeat as necessary, in the order listed.

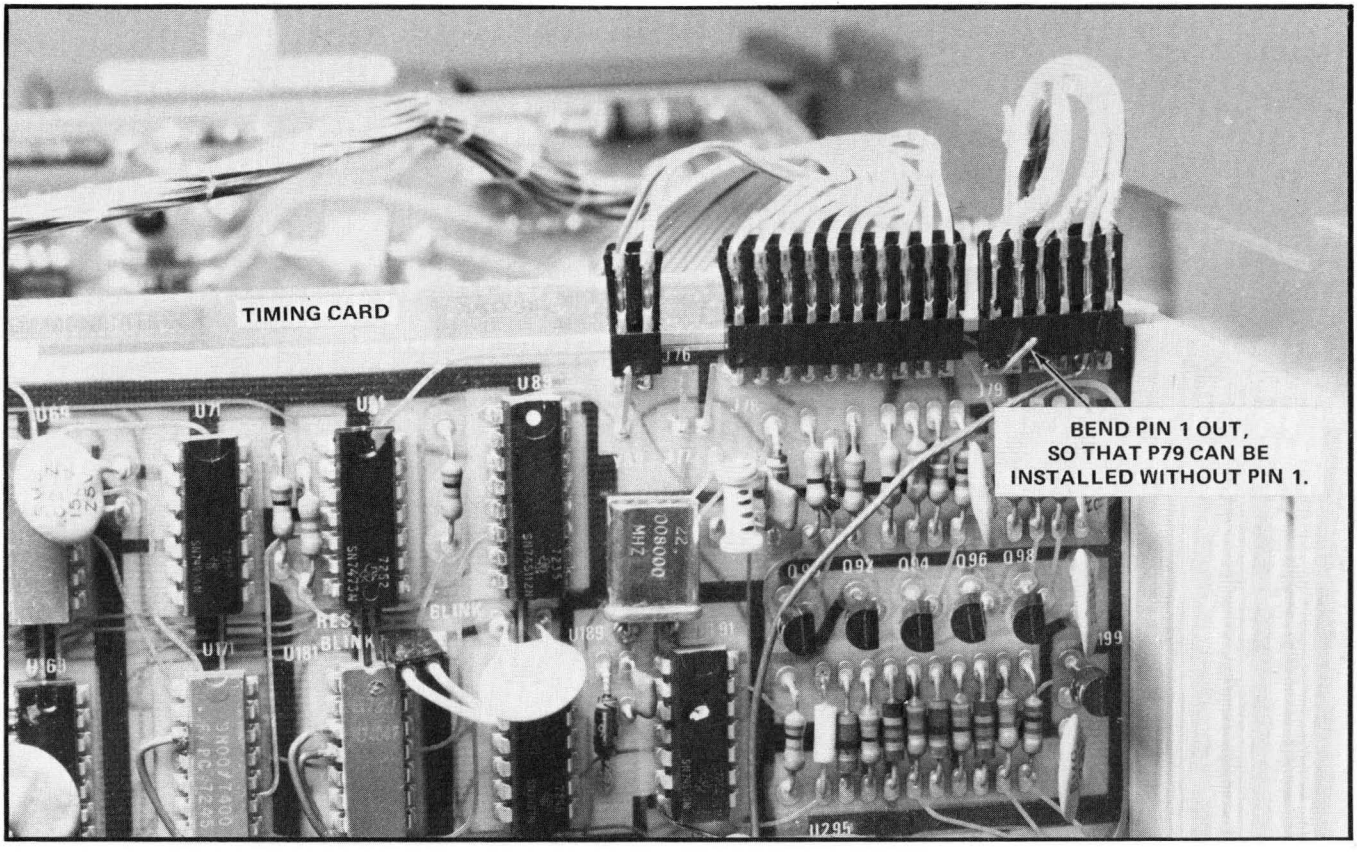


Fig. 4-3. Configuration of P/J79 for Vertical Sync Adjustment.

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
000FA	BALL ELECTRONICS DISPLAY DIVISION	P O BOX 43376	ST. PAUL, MN 55164
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
01963	CHERRY ELECTRICAL PRODUCTS CORPORATION	3600 SUNSET AVENUE	WAUKEGAN, IL 60085
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04009	ARROW-HART, INC.	103 HAWTHORNE STREET	HARTFORD, CT 06106
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07109	OAKTRON INDUSTRIES, INC.	704 30TH STREET	MONROE, WI 53566
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
10389	CHICAGO SWITCH, INC.	2035 WABANSIA AVE.	CHICAGO, IL 60647
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
13993	BALL BROTHERS RESEARCH CORPORATION	BOULDER INDUSTRIAL PARK	BOULDER, CO 80302
14433	ITT SEMICONDUCTORS	3301 ELECTRONICS WAY P O BOX 3049	WEST PALM BEACH, FL 33402
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
17954	MIRATEL, DIV. BALL BROS RESEARCH CORP.	1633 TERRACE DRIVE	ST. PAUL, MN 55113
18796	ERIE TECHNOLOGICAL PRODUCTS, INC. STATE COLLEGE DIVISION	1900 W. COLLEGE AVE.	STATE COLLEGE, PA 16801
22753	U. I. D. ELECTRONICS CORP.	4105 PEMBROKE RD.	HOLLYWOOD, FL 33021
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32159	WEST-CAP ARIZONA	2201 E. ELVIRA ROAD	TUCSON, AZ 85706
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
33096	COLORADO CRYSTAL CORPORATION	2303 W 8TH STREET	LOVELAND, CO 80537
50088	MOSTEK CORP.	1400 UPFIELD DR.	CARROLLTON, TX 75006
50522	MONSANTO CO., ELECTRONIC SPECIAL PRODUCTS	3400 HILLVIEW AVENUE	PALO ALTO, CA 94304
50558	ELECTRONIC CONCEPTS, INC.	526 INDUSTRIAL WAY WEST	EATONTOWN, NJ 07724
50579	LITRONIX INC.	19000 HOMESTEAD RD.	CUPERTINO, CA 95014
51284	MOS TECHNOLOGY, INC., VALLEY FORGE CORPORATE CENTER	950 RITTENHOUSE ROAD	NORRISTOWN, PA 19401
52833	KEYTRONIC CORP., OCR DIV.	SPOKANE INDUSTRIAL PK., P. O. BOX 14687	SPOKANE, WA 99214
55292	LEDCO DIV., WILBRECHT ELECTRONICS, INC.	240 EAST PLATO BLVD.	ST. PAUL, MN 55107
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
58756	CTS OF ELKHART INC.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	905 N. WEST BLVD	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
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
96733	SAN FERNANDO ELECTRIC MFG CO	1501 FIRST ST	SAN FERNANDO, CA 91341

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2197-01			CKT BOARD ASSY:RAM	80009	670-2197-01
A1	670-3197-01			CKT BOARD ASSY:RAM	80009	670-3197-01
A1	670-3197-02	B050000		CKT CARD ASSY:	80009	670-3197-02
A2	670-2198-01	B010100	B049999	CKT BOARD ASSY:CURSOR	80009	670-2198-01
A2	670-2198-02	B050000	B064267	CKT BOARD ASSY:	80009	670-2198-02
A2	670-2198-03	B064268		CKT BOARD ASSY:CURSOR	80009	670-2198-03
A4	670-2301-01			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-01
A4	670-2301-02			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-02
A4	670-2301-03			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-03
A4	670-2301-04			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-04
A4	670-2301-06	B050000		CKT CARD ASSY:	80009	670-2301-06
A4	670-3428-00			CKT BOARD ASSY:C.R.	80009	670-3428-00
A5	670-2200-03			CKT BOARD ASSY:EDIT	80009	670-2200-03
A5	670-2200-04			CKT BOARD ASSY:EDIT	80009	670-2200-04
A5	670-2200-06	B050000		CKT BOARD ASSY:	80009	670-2200-06
A6	670-2542-02			CKT BOARD ASSY:CONTROL	80009	670-2542-02
A6	670-2542-04	B050000		CKT CARD ASSY:	80009	670-2542-04
A7	670-2199-02			CKT BOARD ASSY:TIMING	80009	670-2199-02
A7	670-2199-03			CKT BOARD ASSY:TIMING	80009	670-2199-03
A7	670-2199-04			CKT BOARD ASSY:TIMING	80009	670-2199-04
A7	670-2199-05	B020545	B049999	CKT BOARD ASSY:TIMING	80009	670-2199-05
A7	670-2199-07	B050000		CKT BOARD ASSY:	80009	670-2199-07
A10	670-2195-01			CKT BOARD ASSY:MOTHER	80009	670-2195-01
A10	670-2195-02	B050000		CKT BOARD ASSY:	80009	670-2195-02
A11	119-0374-01	B010100	B063619	KEYBOARD,CMPTR:72 KEY,TTY,ASCII ENCODED	52833	65-0763-01
A11	119-0374-09	B063620		KEYBOARD ASSY:	80009	119-0374-09
A12	119-0363-00	B010100	B064505	MONITOR,TV:15 DEG TILT,15VDC,P4 PHOSPH	17954	TV-12C7-012-0124
A12	119-0363-01	B064506		MONITOR,TV:15 DEG TILE,15VDC,P4 PHOSPHOR	80009	119-0363-01
A13	670-2196-01			CKT BOARD ASSY:POWER SUPPLY	80009	670-2196-01
A13	670-2196-02			CKT BOARD ASSY:POWER SUPPLY	80009	670-2196-02
A13	670-2196-03	B050000		CKT BOARD ASSY:	80009	670-2196-03
.						
.						
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				A1 ASSEMBLY RAM		
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A1	670-2197-01			CKT BOARD ASSY:RAM	80009	670-2197-01
A1	670-3197-01			CKT BOARD ASSY:RAM	80009	670-3197-01
A1	670-3197-02	B050000		CKT CARD ASSY:	80009	670-3197-02
C1	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C21	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C41	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C55	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C65	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C92	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C181	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C202	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C221	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C223	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C224	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C231	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C232	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C245	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C261	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A1 RAM (CONT)		
C271	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C281	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C282	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C283	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C291	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C292	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C301	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	59660	301-000U2J0680K
C305	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C309	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301000 X 5P0102K
C311	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	59660	301-000U2J0680K
C345	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C361	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C371	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C396	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
L201	108-0317-00			COIL,RF:FIXED,15UH	32159	71501M
L211	108-0317-00			COIL,RF:FIXED,15UH	32159	71501M
R91	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R92	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R141	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R155	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R181	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R191	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R192	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R201	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R202	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R209	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R215	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R219	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R221	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R222	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R232	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R249	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R259	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R265	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R266	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R271	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R274	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R281	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R282	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R291	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R292	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R299	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R341	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R381	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R395	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R399	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
U1	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U11	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U21	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A1 RAM (CONT)		
U31	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U41	307-0347-00			RES.,FXD,FILM:13 RES NETWORK	73138	899-1-R220
U45	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U51	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U55	156-0150-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BUFFER,SCRN	01295	SN7437(NP3 OR JP
U61	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U65	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U71	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U81	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U91	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U101	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U111	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U121	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U131	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U141	156-0150-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BUFFER,SCRN	01295	SN7437(NP3 OR JP
U145	156-0269-00			MICROCIRCUIT,DI:DUAL CARRY SAVE FULL ADDER	80009	156-0269-00
U151	156-0269-00			MICROCIRCUIT,DI:DUAL CARRY SAVE FULL ADDER	80009	156-0269-00
U155	156-0036-02			MICROCIRCUIT,DI:DUAL 4-INPUT NAND BFR,SCRN	01295	SN7440(NP3 OR JP
U161	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U165	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U171	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U181	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U191	156-0179-00			MICROCIRCUIT,DI:1024 X 1 RANDOM ACCESS MEM	50088	MK400GP
U201	156-0177-02			MICROCIRCUIT,DI:DUAL LINE RCVR,SCRN	01295	SN75107A(NP3 OR
U221	156-0177-02			MICROCIRCUIT,DI:DUAL LINE RCVR,SCRN	01295	SN75107A(NP3 OR
U241	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U245	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U251	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U255	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U261	307-0366-00			RES.,FXD,FILM:220 OHM,2%,15 RES NETWORK	91637	MDP1601221G
U265	156-0177-02			MICROCIRCUIT,DI:DUAL LINE RCVR,SCRN	01295	SN75107A(NP3 OR
U281	156-0177-02			MICROCIRCUIT,DI:DUAL LINE RCVR,SCRN	01295	SN75107A(NP3 OR
U291	156-0177-02			MICROCIRCUIT,DI:DUAL LINE RCVR,SCRN	01295	SN75107A(NP3 OR
U301	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U309	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U311	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U315	156-0140-02			MICROCIRCUIT,DI:HEX BUFFERS W/OC HV OUT	01295	SN7417 (NP3)
U321	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U331	156-0321-02			MICROCIRCUIT,DI:TRIPLE 3 INP NAND GATE	01295	SN74S10
U341	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U345	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U347	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U351	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U355	156-0150-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BUFFER,SCRN	01295	SN7437(NP3 OR JP
U361	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U365	156-0140-02			MICROCIRCUIT,DI:HEX BUFFERS W/OC HV OUT	01295	SN7417 (NP3)
U371	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U381	156-0140-02			MICROCIRCUIT,DI:HEX BUFFERS W/OC HV OUT	01295	SN7417 (NP3)
U391	156-0094-00			MICROCIRCUIT,DI:DUAL PERIPHERAL DRIVER	01295	SN75451P
Y201	158-0072-00			XTAL UNIT,QTZ:4.9152 MHZ,0.05%	33096	ORD BY DESCR

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A2 ASSEMBLY CURSOR		
A2	670-2198-01	B010100	B049999	CKT BOARD ASSY:CURSOR	80009	670-2198-01
A2	670-2198-02	B050000	B064267	CKT BOARD ASSY:	80009	670-2198-02
A2	670-2198-03	B064268		CKT BOARD ASYY:CURSOR	80009	670-2198-03
C9	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C39	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C69	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C101	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C129	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C139	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C151	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C171	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C211	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C239	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C249	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C269	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C309	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C331	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C339	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C371	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
R101	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R119	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R120	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R151	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R271	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
U1	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U9	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U11	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U19	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U21	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U29	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U31	156-0042-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE,FF,SCRN	01295	SN7476(NP3 OR JP
U39	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U41	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U49	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U51	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U61	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U69	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U71	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U101	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U109	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U111	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U121	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U129	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U131	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U139	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U141	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U149	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U151	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U159	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U161	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A2 ASSEMBLY CURSOR (CONT)		
U169	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U201	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U209	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U211	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U219	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U221	156-0165-02			MICROCIRCUIT,DI:DUAL 4 INP NOR GATE	01295	SN7425
U229	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U231	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U239	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U241	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U249	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U251	156-0089-00			MICROCIRCUIT,DI:4-BIT UP/DOWN COUNTER	80009	156-0089-00
U259	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U261	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U269	156-0125-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
U271	156-0165-02			MICROCIRCUIT,DI:DUAL 4 INP NOR GATE	01295	SN7425
U309	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U311	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U319	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U321	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U331	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U339	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U341	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U349	156-0165-02			MICROCIRCUIT,DI:DUAL 4 INP NOR GATE	01295	SN7425
U351	156-0165-02			MICROCIRCUIT,DI:DUAL 4 INP NOR GATE	01295	SN7425
U359	156-0707-03			MICROCIRCUIT,DI:QUAD 2 INP EXCL OR GATE	07263	74S86
U361	156-0707-03			MICROCIRCUIT,DI:QUAD 2 INP EXCL OR GATE	07263	74S86
U369	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U371	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A4 ASSEMBLY KEYBOARD INTERFACE		
A4	670-2301-01			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-01
A4	670-2301-02			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-02
A4	670-2301-03			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-03
A4	670-2301-04			CKT BOARD ASSY:KEYBOARD INTERFACE	80009	670-2301-04 *
A4	670-2301-06	B050000		CKT CARD ASSY:	80009	670-2301-06
A4	670-3428-00			CKT BOARD ASSY:C.R.	80009	670-3428-00
C1	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C40	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C90	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C101	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C160	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C180	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C189	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C233	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C350	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C370	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C385	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C428	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C429	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
CR395	152-0075-00			SEMICOND DEVICE:GE,25V,40MA	14433	G866
CR395	----- -----			(CR395, -03 AND UP BOARDS ONLY)		
CR409	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q401	151-0254-00			TRANSISTOR:SILICON,NPN	03508	X38L3118
Q402	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q403	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
R71	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R75	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R91	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R159	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R190	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R335	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R391	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R394	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R394	----- -----			(R394, -03 AND UP BOARDS ONLY)		
R396	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R396	----- -----			(R396, -03 AND UP BOARDS ONLY)		
R401	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R411	315-0110-00			RES.,FXD,CMPSN:11 OHM,5%,0.25W	01121	CB1105
R412	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R413	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R414	315-0684-00			RES.,FXD,CMPSN:680K OHM,5%,0.25W	01121	CB6845
R415	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
S1-S75	260-1393-00			SWITCH,PUSH:SPST,NO KEYBOARD SWITCH	01963	M61-0100
S1-S75	----- -----			(S1-S75,260-1393-01(HEAVY DUTY),MAY BE USED		
U1	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U9	307-0349-00			RES.,FXD,FILM:13 RES. NTWK,1K OHM,2%,0.12	73138	899-1-R1K
U29	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U31	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A4 ASSEMBLY KEYBOARD INTERFACE (CONT)		
U39	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U41	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U49	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U51	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U61	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U69	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U79	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U81	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U89	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U91	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U101	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U109	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U129	156-0061-02			MICROCIRCUIT,DI:BCD TO DEC DCDR,BURN-IN	27014	DM8842
U131	156-0061-02			MICROCIRCUIT,DI:BCD TO DEC DCDR,BURN-IN	27014	DM8842
U139	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U141	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U149	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U161	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U169	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U171	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U179	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U181	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U189	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U191	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U201	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U209	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U229	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U231	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U239	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U241	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U249	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U251	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U261	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U269	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U271	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U279	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U281	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U289	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U291	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U301	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U309	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U329	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U331	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U339	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U341	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U349	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U351	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U361	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U369	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U371	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U379	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U381	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A4 ASSEMBLY KEYBOARD INTERFACE (CONT)		
U389	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U391	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U481	156-0094-00			MICROCIRCUIT,DI:DUAL PERIPHERAL DRIVER	01295	SN75451P
U481	----- -----			(U481, -03 AND UP BOARDS ONLY)		
U489	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U489	----- -----			(U489, -03 AND UP BOARDS ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A5 ASSEMBLY EDIT		
A5	670-2200-03			CKT BOARD ASSY:EDIT	80009	670-2200-03
A5	670-2200-04			CKT BOARD ASSY:EDIT	80009	670-2200-04
A5	670-2200-06	B050000		CKT BOARD ASSY:	80009	670-2200-06
C31	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C51	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C71	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C89	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C109	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C129	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C149	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C169	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C201	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C231	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C249	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C261	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C279	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C339	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C371	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C381	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C401	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C431	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C451	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
R90	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R90	----- -----			(R90, -04 AND UP BOARDS ONLY)		
R295	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R295	----- -----			(R295, -04 AND UP BOARDS ONLY)		
R489	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
U1	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U9	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U29	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U31	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U39	156-0036-02			MICROCIRCUIT,DI:DUAL 4-INPUT NAND BFR,SCRN	01295	SN7440(NP3 OR JP
U41	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U49	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U51	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U61	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U69	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U71	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U79	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U81	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U89	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U91	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U99	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U101	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U109	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U129	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U131	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U139	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U141	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U149	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A5 ASSEMBLY EDIT (CONT)		
U151	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U161	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U169	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U171	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U179	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U181	156-0165-02			MICROCIRCUIT,DI:DUAL 4 INP NOR GATE	01295	SN7425
U189	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U191	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U199	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U201	156-0079-02			MICROCIRCUIT,DI:DECADE COUNTER,SCREENED	01295	SN7490A(NP3 OR J
U209	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U229	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U231	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U239	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U241	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U249	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U251	156-0222-02			MICROCIRCUIT,DI:HEX D LATCH W/CLEAR,TTL	01295	SN74174(NP3 OR J
U261	156-0222-02			MICROCIRCUIT,DI:HEX D LATCH W/CLEAR,TTL	01295	SN74174(NP3 OR J
U269	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U271	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U279	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U281	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U289	156-0178-02			MICROCIRCUIT,DI:TRIPLE 3-INP NOR GATE,TTL	01295	SN7427(NP3 OR JP
U291	156-0042-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE,FF,SCRN	01295	SN7476(NP3 OR JP
U301	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U309	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U329	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U331	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U339	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U341	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U349	156-0144-00			MICROCIRCUIT,DI:3-INPUT POS NAND GATE	80009	156-0144-00
U351	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U361	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U369	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U371	156-0061-02			MICROCIRCUIT,DI:BCD TO DEC DCDR,BURN-IN	27014	DM8842
U379	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U381	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U389	156-0171-02			MICROCIRCUIT,DI:QUAD 2-INPUT 0R GATE,SCRN	01295	SN7432
U391	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U399	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U401	307-0349-00			RES.,FXD,FILM:13 RES. NTWK,1K OHM,2%,0.12	73138	899-1-R1K
U409	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U429	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U431	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U439	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U441	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U449	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U451	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U461	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U469	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U471	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U479	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U481	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U489	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U491	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U499	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A6 ASSEMBLY CONTROL		
A6	670-2542-02			CKT BOARD ASSY:CONTROL	80009	670-2542-02
A6	670-2542-04	B050000		CKT CARD ASSY:	80009	670-2542-04
C7	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C9	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C49	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C101	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C145	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C279	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C289	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C329	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C331	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C365	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C371	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C401	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C419	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C445	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C461	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C479	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C491	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
R7	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R95	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R101	307-0349-00			RES.,FXD,FILM:13 RES. NTWK,1K OHM,2%,0.12	73138	899-1-R1K
R195	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R395	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R495	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
U9	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U29	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U31	156-0072-02			MICROCIRCUIT,DI:MONOSTABLE MV,BURN-IN	01295	SN74121
U39	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U41	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U49	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U51	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U59	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U61	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U69	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U71	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U79	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U81	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U89	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U91	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U109	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U129	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U131	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U139	156-0178-02			MICROCIRCUIT,DI:TRIPLE 3-INP NOR GATE,TTL	01295	SN7427(NP3 OR JP
U141	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U149	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U151	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U159	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U161	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U169	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A6 ASSEMBLY CONTROL (CONT)		
U171	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U179	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U181	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U189	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U191	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U201	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U209	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U229	156-0041-05			MICROCIRCUIT,DI:DUAL D-FLIP FLOP	01295	SN7474
U231	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U239	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U241	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U249	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U251	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U259	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U261	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U269	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U271	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U279	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U281	156-0061-02			MICROCIRCUIT,DI:BCD TO DEC DCDR,BURN-IN	27014	DM8842
U289	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U291	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U301	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U309	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U339	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U341	156-0061-02			MICROCIRCUIT,DI:BCD TO DEC DCDR,BURN-IN	27014	DM8842
U359	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U361	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U369	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U371	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U379	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U381	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U389	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U391	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U401	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U409	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U429	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U431	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U439	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U449	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U451	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U459	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U461	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U469	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U471	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U479	156-0163-02			MICROCIRCUIT,DI:TPL 3-INP & GATE,SCRN	07263	7411(PCQR OR DCQ
U481	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U489	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U491	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A7 ASSEMBLY TIMING		
.						
A7	670-2199-02			CKT BOARD ASSY:TIMING	80009	670-2199-02
A7	670-2199-03			CKT BOARD ASSY:TIMING	80009	670-2199-03
A7	670-2199-04			CKT BOARD ASSY:TIMING	80009	670-2199-04
A7	670-2199-05	B020545	B049999	CKT BOARD ASSY:TIMING	80009	670-2199-05
A7	670-2199-07	B050000		CKT BOARD ASSY:	80009	670-2199-07
C11	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C69	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C87	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C90	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C91	283-0107-00			CAP.,FXD,CER DI:51PF,5%,200V	96733	R3017
C95	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C98	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C99	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C121	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C159	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C169	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C189	283-0107-00			CAP.,FXD,CER DI:51PF,5%,200V	96733	R3017
C199	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C221	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C251	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C269	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C289	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C291	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C296	283-0178-00	B020545		CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
C390	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C399	290-0530-00	B010100	B020544	CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C411	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C461	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C469	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C492	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C495	283-0203-00	B020545		CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
.						
CR91	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR397	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR399	152-0141-02	B010100	B020544	SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR496	152-0141-02	B020545		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR497	152-0141-02	B020545		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
.						
L90	108-0419-00			COIL,RF:FIXED,1.1UH	80009	108-0419-00
L189	108-0419-00			COIL,RF:FIXED,1.1UH	80009	108-0419-00
.						
Q90	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q92	151-0190-02			TRANSISTOR:SILICON,NPN	04713	SM7706
Q94	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q96	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q98	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q199	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q397	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q398	151-0190-02			TRANSISTOR:SILICON,NPN	04713	SM7706
Q399	151-0190-02	B020545		TRANSISTOR:SILICON,NPN	04713	SM7706
.						
R65	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A7 TIMING (CONT)		
R75	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R79	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R81	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R90	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R91	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R92	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R93	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R94	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R95	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R96	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
R97	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R98	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R99	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R111	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R190	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R191	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R192	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R193	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R194	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R195	315-0620-00			RES.,FXD,CMPSN:62 OHM,5%,0.25W	01121	CB6205
R196	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R197	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R198	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R199	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R231	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R251	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R252	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R253	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R291	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R292	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R293	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R294	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R294	----- -----			(-02, -03 BOARDS ONLY)		
R294	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R294	----- -----			(-04 AND UP BOARDS ONLY)		
R295	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R295	----- -----			(-02, -03 BOARDS ONLY)		
R295	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R295	----- -----			(-04 AND UP BOARDS ONLY)		
R296	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R297	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R298	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R300	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R301	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R321	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R371	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R389	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R390	315-0102-03			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R390	----- -----			(R390, -03, -04 BOARDS ONLY)		
R391	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R392	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R393	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A7 TIMING (CONT)		
R394	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R395	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R396	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R397	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R398	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R399	315-0103-03			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R399	----- -----			(-03, -04 BOARDS ONLY)		
R399	315-0101-03			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R399	----- -----			(-05 AND UP BOARDS ONLY)		
R400	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R400	----- -----			(-03, -04 BOARDS ONLY)		
R400	315-0221-03			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R400	----- -----			(-05 AND UP BOARDS ONLY)		
R401	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R489	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R496	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R496	----- -----			(R496, -05 AND UP BOARDS ONLY)		
U1	156-0117-00			MICROCIRCUIT,DI:SYNC 4-BIT BINARY COUNTER	80009	156-0117-00
U11	156-0117-00			MICROCIRCUIT,DI:SYNC 4-BIT BINARY COUNTER	80009	156-0117-00
U21	156-0117-00			MICROCIRCUIT,DI:SYNC 4-BIT BINARY COUNTER	80009	156-0117-00
U31	156-0117-00			MICROCIRCUIT,DI:SYNC 4-BIT BINARY COUNTER	80009	156-0117-00
U41	156-0117-00			MICROCIRCUIT,DI:SYNC 4-BIT BINARY COUNTER	80009	156-0117-00
U51	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U55	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U61	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U69	156-0030-00	B010100	B020544	MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U69	156-0150-02	B020545		MICROCIRCUIT,DI:QUAD 2-INP NAND BUFFER,SCRN	01295	SN7437(NP3 OR JP
U71	156-0032-03			MICROCIRCUIT,DI:4 BIT BINARY COUNTER,SCRN	07263	7493(PCQR)
U81	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U89	156-0118-03			MICROCIRCUIT,DI:1 DUAL J-K FF,BURN-IN	01295	SN74S112JP3
U101	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U111	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U121	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U131	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U141	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U151	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U161	156-0321-02			MICROCIRCUIT,DI:TRIPLE 3 INP NAND GATE	01295	SN74S10
U169	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U171	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U181	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U189	156-0150-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BUFFER,SCRN	01295	SN7437(NP3 OR JP
U191	156-0180-04			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00NP3
U201	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U211	156-0036-02			MICROCIRCUIT,DI:DUAL 4-INPUT NAND BFR,SCRN	01295	SN7440(NP3 OR JP
U221	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U231	156-0035-00			MICROCIRCUIT,DI:SGL 8-INPUT POS NAND GATE	80009	156-0035-00
U241	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U251	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U261	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U269	156-0034-02			MICROCIRCUIT,DI:DUAL 4 INP NAND GATE,SCRN	01295	SN7420(NP3 OR JP
U271	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A7 TIMING (CONT)		
U281	156-0180-04			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00NP3
U289	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U291	156-0093-02			MICROCIRCUIT,DI:HEX INV BUFFER,BURN-IN	01295	SN74LS00 (NP3)
U295	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U301	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U311	156-0036-02			MICROCIRCUIT,DI:DUAL 4-INPUT NAND BFR,SCRN	01295	SN7440(NP3 OR JP
U321	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U331	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U341	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U351	156-0079-02			MICROCIRCUIT,DI:DECADE COUNTER,SCREENED	01295	SN7490A(NP3 OR J
U359	156-0039-02			MICROCIRCUIT,DI:DUAL J-K MA-SLAVE FF,SCRN	01295	SN7473(NP3 OR JP
U361	156-0043-03			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE,SCRN	01295	SN7402
U369	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U371	156-0062-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN7486
U381	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
U389	156-0146-02			MICROCIRCUIT,DI:8 BIT PAR-IN SER OUT SR,SCR	01295	SN74165(NP3 OR J
U395	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U401	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U411	156-0180-04			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00NP3
U421	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
U431	156-0150-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BUFFER,SCRN	01295	SN7437(NP3 OR JP
U441	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U451	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U461	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U469	156-0030-00			MICROCIRCUIT,DI:UAD 2 INPUT NAND GATE		SN7400
U471	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
U481	156-0221-00			MICROCIRCUIT,DI:QUAD LATCH	01295	SN74175N
U489	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
U491	156-0147-00			MICROCIRCUIT,DI:ROM 64 X 5 X 7 CHAR GEN	80009	156-0147-00
U495	307-0349-00			RES.,FXD,FILM:13 RES. NTWK,1K OHM,2%,0.12	73138	899-1-R1K
U499	156-0401-00			MICROCIRCUIT,DI:ROM,5X7 LC ALPHA	80009	156-0401-00
Y89	158-0081-00			XTAL UNIT,QTZ:22.008MHZ,+/-0.01%	33096	PB3086

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A10 ASSEMBLY MOTHER		
A10	670-2195-01			CKT BOARD ASSY:MOTHER	80009	670-2195-01
A10	670-2195-02	B050000		CKT BOARD ASSY:	80009	670-2195-02
CR395	152-0066-01			SEMICOND DEVICE:SILICON,400V,1A	15238	LG4012
CR396	152-0066-01			SEMICOND DEVICE:SILICON,400V,1A	15238	LG4012
R211	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R212	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R213	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
U111	307-0366-00			RES.,FXD,FILM:220 OHM,2%,15 RES NETWORK	91637	MDP1601221G
U391	307-0365-00			RES.,FXD,FILM:1K OHM,2%,15 RES NETWORK	91637	LDP1602102GS7
U411	307-0366-00			RES.,FXD,FILM:220 OHM,2%,15 RES NETWORK	91637	MDP1601221G

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A11 ASSEMBLY KEYBOARD		
A11	119-0374-01	B010100	B063619	KEYBOARD,CMPTR:72 KEY,TTY,ASCII ENCODED	52833	65-0763-01
A11	119-0374-09	B063620		KEYBOARD ASSY:	80009	119-0374-09
C1	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C2	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C3	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C4	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C5	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C6	285-1134-00			CAP.,FXD,PLSTC:0.1UF,0.5%,100V	50558	MH12D104J
C7	283-0175-00			CAP.,FXD,CER DI:10PF,5%,200V	96733	TDR43BY100DP
C8	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C9	283-0077-00			CAP.,FXD,CER DI:330PF,5%,500V	59660	831-500B331J
C10	283-0092-00			CAP.,FXD,CER DI:0.03UF,+80-20%,200V	59660	845-534Z5U0303Z
C11	285-1134-00			CAP.,FXD,PLSTC:0.1UF,0.5%,100V	50558	MH12D104J
CR1	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2	152-0186-00			SEMICOND DEVICE:GERMANIUM,80V,10PA	18796	1N198
CR3	152-0186-00			SEMICOND DEVICE:GERMANIUM,80V,10PA	18796	1N198
CR4	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR7	152-0186-00			SEMICOND DEVICE:GERMANIUM,80V,10PA	18796	1N198
CR8	152-0186-00			SEMICOND DEVICE:GERMANIUM,80V,10PA	18796	1N198
CR9	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q1	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q2	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q3	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q4	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
R1	----- -----			SELECTED		
R2	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R4	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R5	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R6	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R7	----- -----			SELECTED		
R8	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R9	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R10	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R11	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R12	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R13	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R14	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R15	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R16	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R17	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R18	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R19	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R20	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R21	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R22	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R23	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A11 ASSEMBLY KEYBOARD (CONT)		
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R24	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R25	----- -----			SELECTED		
R26	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R27	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R28	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R30	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R31	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R32	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R33	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R34	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
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SW1	260-1507-00			SWITCH,REED:SPST	52833	60-0003-01
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Z1	156-0393-00			MICROCIRCUIT,DI:CLOCK GENERATOR/DRIVER	80009	156-0393-00
Z2	118-0001-00	B010100	B063619	MICROCIRCUIT,DI:KEYBOARD ENCODER MOS TECH	51284	MCS-1009-012
Z2	118-0430-00	B063620		MICROCIRCUIT,DI:KEYBOARD ENCODER	52833	20-3600-00
Z3	156-0129-02			MICROCIRCUIT,DI:QUAD 2-INP & GATE,BURN-IN	27014	DM8008
Z4	156-0061-02			MICROCIRCUIT,DI:BCD TO DEC DCDR,BURN-IN	27014	DM8842
Z5	156-0111-00			MICROCIRCUIT,DI:SGL BCD-TO-DEC DEC/DRIVER	80009	156-0111-00
Z6	156-0113-03			MICROCIRCUIT,DI:QUAD 2 INP NAND GATE,SCRN,	01295	SN74L00NP3
Z7	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
Z8	156-0047-02			MICROCIRCUIT,DI:TP1 3 INP,NAND GATE	27014	DM7410NA+ OR JA+
Z9	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
Z10	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
Z11	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404
Z12	156-0186-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7403(NP3 OR JP
Z13	156-0186-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7403(NP3 OR JP
Z14	156-0145-02			MICROCIRCUIT,DI:QUAD 2-INP NAND BFR	01295	SN7438
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VR1	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A12 ASSEMBLY TV MONITOR		
A12	119-0363-00	B010100	B064505	MONITOR,TV:15 DEG TILT,15VDC,P4 PHOSPH	17954	TV-12C7-012-0124
A12	119-0363-01	B064506		MONITOR,TV:15 DEG TILT,15VDC,P4 PHOSPHOR	80009	119-0363-01
C101	281-0751-00			CAP.,FXD,CER DI:0.01UF,1000V	17954	1-012-0112
C102	281-0751-00			CAP.,FXD,CER DI:0.01UF,1000V	17954	1-012-0112
C103	281-0751-00			CAP.,FXD,CER DI:0.01UF,1000V	17954	1-012-0112
C104	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
C105	285-0898-00			CAP.,FXD,PLSTC:0.47UF,10%,100V	56289	LP66A1B474K
C106	285-0898-00			CAP.,FXD,PLSTC:0.47UF,10%,100V	56289	LP66A1B474K
C107	290-0691-00			CAP.,FXD,ELCTLT:500UF,6V	13993	1-012-2158
C108	290-0692-00			CAP.,FXD,ELCTLT:100UF,50V	90201	MTV101N050E1AP
C109	285-0566-00			CAP.,FXD,PLSTC:0.022UF,10%,200V	56289	192P22392
C110	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	59660	0841545Z5V00203Z
C111	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	59660	0841545Z5V00203Z
C112	290-0693-00			CAP.,FXD,ELCTLT:50UF,50V	90201	MTV500N050C1FP
C113	285-1052-00			CAP.,FXD,PLSTC:10UF,1%,100V	14752	230B1B106F
C114	290-0694-00			CAP.,FXD,ELCTLT:200UF,25V	90201	MTV201N025E1AP
C115	290-0695-00			CAP.,FXD,ELCTLT:50UF,25V	90201	MTV500N050C0SP
C119	290-0696-00			CAP.,FXD,ELCTLT:25UF,50V	90201	MTV250N050C0PP
C120	281-0751-00			CAP.,FXD,CER DI:0.01UF,1000V	17954	1-012-0112
C120	----- -----			(C120, USED ONLY AS REQUIRED)		
CR2	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X-1
CR101	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR102	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR103	152-0613-00			SEMICOND DEVICE:RECT,SI,320V,7A	000FA	1-021-0360
CR104	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	15238	LG109
CR105	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	15238	LG109
CR106	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	15238	LG109
CR107	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	15238	LG109
CR108	----- -----			(USED ONLY AS REQUIRED)		
F101	159-0127-00			FUSE,CARTRIDGE:2A,125V	75915	256003
L1	108-0770-00			CHOKE,RF:	17954	6-003-0321
L2	108-0771-00			COIL,TUBE DEFL:	17954	6-004-0314
L101	114-0335-00			COIL,RF:VARIABLE,40-230MH	17954	1-016-0303
Q101	151-0347-00			TRANSISTOR:SILICON,NPN	56289	2N5551
Q102	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	X13T520
Q103	151-0254-00			TRANSISTOR:SILICON,NPN	03508	X38L3118
Q104	151-0349-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE280	04713	SJE924
Q105	151-0439-00			TRANSISTOR:SILICON,NPN	80009	151-0439-00
Q106	151-0483-00			TRANSISTOR:GERMANIUM,PNP	17954	B1182
Q107	----- -----			(USED ONLY AS REQUIRED)		
R101	301-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.50W	01121	EB2725
R103	301-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.50W	01121	EB8235
R104	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R106	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R107	311-1597-00			RES.,VAR,NONWIR:TRMR,2.5M OHM,20%,0.25W	58756	YR8878
R108	301-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.50W	01121	EB1505
R109	301-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.50W	01121	EB4705

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A12 ASSEMBLY TV MONITOR (CONT)		
R110	301-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.50W	01121	EB8215
R111	301-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.50W	01121	EB4705
R112	301-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.50W	01121	EB2215
R113	301-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.50W	01121	EB4715
R114	301-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.50W	01121	EB1515
R115	301-0823-00			RES.,FXD,CMPSN:82K OHM,5%,0.50W	01121	EB8235
R116	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R117	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R118	301-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.50W	01121	EB8225
R119	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R120	301-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.50W	01121	EB5615
R121	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R122	301-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.50W	01121	EB4725
R123	301-0151-00	B010100	B052916	RES.,FXD,CMPSN:150 OHM,5%,0.50W	01121	EB1515
R123	301-0560-00	B052917		RES.,FXD,CMPSN:56 OHM,5%,0.50W	01121	EB5605
R124	311-1328-00	B010100	B052916	RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5553
R124	311-1308-00	B052917		RES.,VAR,NONWIR:250 OHM,30%,0.25W	71450	201-YA5550
R125	308-0441-00	B010100	B052916	RES.,FXD,WW:3 OHM,5%,3W	91637	CW2B-3R00J
R125	308-0503-00	B052917		RES.,FXD,WW:6.8 OHM,5%,2.50W	91637	CW2B-D6R800J
R126	301-0391-00	B010100	B052916	RES.,FXD,CMPSN:390 OHM,5%,0.50W	01121	EB3915
R126	301-0681-00	B052917		RES.,FXD,CMPSN:680 OHM,5%,0.50W	01121	EB6815
R127	301-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.50W	01121	EB4715
R127A	315-0152-00	B020545		RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R128	301-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.50W	01121	EB2725
R129	307-0058-00			RES.,FXD,CMPSN:5.6 OHM,5%,0.5W	01121	EB56G5
R130	308-0459-00			RES.,FXD,WW:1.1 OHM,5%,3W	91637	CW2B-1R100J TR
R131	301-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.50W	01121	EB3325
R132	308-0239-00			RES.,FXD,WW:84 OHM,1%,3W	91637	RS2B-B84R00F
R133	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R133	----- -----			(R133, USED ONLY AS REQUIRED)		
R135	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R135	----- -----			(R135, USED ONLY AS REQUIRED)		
R136	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R136	----- -----			(R136, USED ONLY AS REQUIRED)		
R137	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R137	----- -----			(R137, USED ONLY AS REQUIRED)		
T2	120-0894-00			XFMR,POWER:HV	17954	6-003-0320
T101	120-0895-00			TRANSFORMER,PLS:	17954	1-017-5338
V1	154-0710-00			ELECTRON TUBE:CRT,P4	13993	1-014-0737
VR101	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A13 ASSEMBLY POWER		
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A13	670-2196-01			CKT BOARD ASSY:POWER SUPPLY	80009	670-2196-01
A13	670-2196-02			CKT BOARD ASSY:POWER SUPPLY	80009	670-2196-02
A13	670-2196-03	B050000		CKT BOARD ASSY:	80009	670-2196-03
C22	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C29	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C30	283-0134-00			CAP.,FXD,CER DI:0.47UF,+80-20%,50V	72982	8131N087Z5U0474Z
C43	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C45	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C52	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
C55	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
C101	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
C107	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C110	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C123	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C204	283-0142-00			CAP.,FXD,CER DI:0.0027UF,5%,200V	59660	875571YEE0272J
C209	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C305	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
C306	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C307	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
C322	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C351	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
.						
CR55	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR131	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR134	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR141	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR145	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR151	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR153	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR155	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR157	152-0198-00			SEMICOND DEVICE:SILICON,200V,3A	03508	1N5624
CR202	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
.						
Q29	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q38	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q53	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q55	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q109	151-0134-00			TRANSISTOR:SILICON,PNP	80009	151-0134-00
Q110	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q241	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q305	151-0342-00			TRANSISTOR:SILICON,PNP	07263	S035928
Q359	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
.						
R10	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R20	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R21	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R23	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R23	----- -----			(-01 BOARDS ONLY)		
R23	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R23	----- -----			(-02 AND UP BOARDS ONLY)		
R24	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R26	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A13 ASSEMBLY POWER (CONT)		
R27	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R28	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R29	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R30	321-0135-00			RES.,FXD,FILM:249 OHM,1%,0.125W	91637	MFF1816G249R0F
R31	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R32	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	91637	MFF1816G61900F
R33	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R34	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R40	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R41	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R42	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R43	321-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.125W	91637	MFF1816G18200F
R44	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R45	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C12001B
R45	----- -----			(-01 BOARDS ONLY)		
R45	321-0634-00			RES.,FXD,FILM:84.65K OHM,0.25%,0.125W	91637	CMF55-116D84651C
R45	----- -----			(-02 AND UP BOARDS ONLY)		
R46	321-0306-01			RES.,FXD,FILM:15K OHM,0.5%,0.125W	91637	MFF1816G15001D
R46	----- -----			(-01 BOARDS ONLY)		
R46	321-0680-00			RES.,FXD,FILM:35.3K OHM,0.5%,0.125W	91637	MFF1816D35301D
R46	----- -----			(-02 AND UP BOARDS ONLY)		
R47	311-1276-00			RES.,VAR,NONWIR:50 OHM,+/-10%,O.5W	32997	3329W-L58-500
R47	----- -----			(-01 BOARDS ONLY)		
R47	311-1277-00			RES.,VAR,NONWIR:100 OHM,10%,0.5W	32997	3329W-L58-101
R47	----- -----			(-02 AND UP BOARDS ONLY)		
R50	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R51	321-0306-01			RES.,FXD,FILM:15K OHM,0.5%,0.125W	91637	MFF1816G15001D
R51	----- -----			(-01 BOARDS ONLY)		
R51	321-0634-00			RES.,FXD,FILM:84.65K OHM,0.25%,0.125W	91637	CMF55-116D84651C
R51	----- -----			(-02 AND UP BOARDS ONLY)		
R52	321-0816-03			RES.,FXD,FILM:5K OHM,0.25%,0.125W	91637	MFF1816D50000C
R52	----- -----			(-01 BOARDS ONLY)		
R52	321-0634-00			RES.,FXD,FILM:84.65K OHM,0.25%,0.125W	91637	CMF55-116D84651C
R52	----- -----			(-02 AND UP BOARDS ONLY)		
R53	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R54	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R55	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R56	308-0402-00			RES.,FXD,WW:30 OHM,5%,5W	91637	CW2A-K30R00J
R57	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R58	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R59	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R101	301-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.50W	01121	EB7505
R106	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R110	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R111	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R112	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R201	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R202	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R203	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R204	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R205	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R206	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A13 ASSEMBLY POWER (CONT)		
.						
R207	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R208	308-0244-00			RES.,FXD,WW:0.3 OHM,10%,2W	91637	RS2B162ER3000K
R209	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R254	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R256	321-0181-00			RES.,FXD,FILM:750 OHM,1%,0.125W	91637	MFF1816G750R0F
R256	----- -----			(-01 BOARDS ONLY)		
R256	321-0183-00			RES.,FXD,FILM:787 OHM,1%,0.125W	91637	MFF1816G787R0F
R256	----- -----			(-02 AND UP BOARDS ONLY)		
R257	321-0226-00			RES.,FXD,FILM:2.21K OHM,1%,0.125W	91637	MFF1816G22100F
R258	311-1139-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	72-43-0
R304	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R305	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R306	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R307	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R307	----- -----			(-01 BOARDS ONLY)		
R307	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R307	----- -----			(-02 AND UP BOARDS ONLY)		
R341	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R356	308-0755-00			RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
R358	303-0301-00			RES.,FXD,CMPSN:300 OHM,5%,1W	01121	GB3015
.						
U52	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U55	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U123	156-0071-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC1723CL
U205	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
.						
VR306	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
C354	283-0358-00	B050000		CAP.,FXD,CER DI:0.01UF,+80-20%,1.4KV	59660	ORD BY DESCR
C356	283-0358-00	B050000		CAP.,FXD,CER DI:0.01UF,+80-20%,1.4KV	59660	ORD BY DESCR
C1006	290-0545-00			CAP.,FXD,ELCTLT:86,000UF,+75-10%,15V	56289	36D863G015DC2A
C1014	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	59821	2DDH66J103Z
C1144	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
CR1006	152-0518-00			SEMICOND DEVICE:RECT,SI,50V,27A	83003	K019
CR1120	150-1001-00	B010100	B064715	LT EMITTING DIO:RED,66ONM,100MA MAX	50522	MV5024
CR1120	150-1050-00	B064716		LT EMITTING DIO:RED	50579	RL-T1
CR1122	150-1001-00	B010100	B064715	LT EMITTING DIO:RED,66ONM,100MA MAX	50522	MV5024
CR1122	150-1050-00	B064716		LT EMITTING DIO:RED	50579	RL-T1
CR1124	150-1001-00	B010100	B064715	LT EMITTING DIO:RED,66ONM,100MA MAX	50522	MV5024
CR1124	150-1050-00	B064716		LT EMITTING DIO:RED	50579	RL-T1
DS1125	150-0134-00			LAMP,CARTRIDGE:6.3V,200MA	55292	72505-03
F1001	159-0023-00			FUSE,CARTRIDGE:3AG,2A,250V,5 SEC	71400	MDX2
F1007	159-0038-00			FUSE,CARTRIDGE:3AG,15A,32V,FAST-BLOW	71400	AGC15
J193	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
Q1014	151-0515-01			SCR:SILICON	04713	SCR1256K
Q1105	151-0337-00			TRANSISTOR:SILICON,NPN	02735	61443
Q1110	151-0337-00			TRANSISTOR:SILICON,NPN	02735	61443
Q1112	151-0433-00	B010100	B064784	TRANSISTOR:SILICON,NPN	80009	151-0433-00
Q1112	151-0470-00	B064785		TRANSISTOR:SILICON,NPN	80009	151-0470-00
Q1118	151-0337-00			TRANSISTOR:SILICON,NPN	02735	61443
R354	307-0413-00	B050000		RES,NTWK,FXD,FI:3.3M OHM,10%,1W	03888	FL1-3304K-10%
R1112	308-0570-00			RES.,FXD,WW:0.05 OHM,5%,5W	80009	308-0570-00
R1140	311-0095-00			RES.,VAR,NONWIR:500 OHM,10%	11237	41022
R1145	311-0467-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	11237	300SF-41334
S1001	260-1497-00			SWITCH,PUSH:DPDT,10A,250VAC	01963	E79-30A
S1002	260-1490-00	B010100	B052959	SWITCH,TOGGLE:1 SECT,3 POSN,30 DEG	10389	171-298-129
S1002	260-1902-00	B052960		SWITCH,ROCKER:DPST,16A,250VAC	04009	260011E
S1120	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
S1121	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
S1122	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
S1123	260-1334-00			SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
SP1144	119-0305-00			LOUDSPEAKER,PM:PERMANENT MAGNET,45 OHM,2W	07109	35A45C
T1000	120-0884-00			XFMR,PWR,STPDN: EM161700.DATA 4023	80009	120-0884-00

THEORY OF OPERATION

INTRODUCTION

This section of the manual is designed to aid the technician in understanding the operation of the Terminal. Not only is circuit operation discussed, but wire lists and diagrams are provided to aid in isolating malfunctions.

It is assumed that the person reading this section has a solid understanding of TTL and analog theory. For this reason, circuitry is not discussed on a component basis, except in those cases where, for clarity, specific components are mentioned.

This section is not intended to cover every detail of Terminal operation; however, it does provide sufficient information to enable the technician to isolate the majority of malfunctions to a block of circuitry on a specific card. Those with a good understanding of TTL and analog circuitry should then be able to further isolate the problem to a specific component.

Many Terminal functions encompass circuitry located on two or more cards. The use of a "minibus" makes this type of circuit design practical. For this reason, it is recommended that the material in this section be read in the order given. Information contained herein is intended to provide the first-time reader an over-view of Terminal operation.

Each circuit board or circuit card (circuit cards are those logic cards which are inserted into the minibus) is discussed in general terms. Here you will find the specific circuits and functions performed by each card. This information is followed by schematic descriptions of the circuits and functions previously mentioned. You can pull out and unfold the schematic as you read the schematic description.

The back portion of this section contains signal and wiring information. Signal information provides a description of each signal available to all cards that plug into the minibus. Here you will also find from which card (cards) each signal originates and on which card (cards) the signal is used. Wiring information provides a wiring list and diagram of wiring between major Terminal components.

Semiconductor information is provided in Fig. 6-16. This figure is located just preceding the schematics.

GENERAL DESCRIPTIONS

Figure 6-14, located at the end of the circuit descriptions, is an over-all block diagram of the Terminal system. Pull-out this illustration and refer to it when reading the following general descriptions.

KEYBOARD

Provides a data source for the computer and the Terminal. The operation of Keyboard circuitry is discussed first because this is the starting point of the majority of terminal data inputs to the computer. Refer to the Keyboard circuit description for more information.

TIMING CARD

A good understanding of Terminal timing is a prerequisite to understanding Terminal logic operation. The Timing Card provides master timing signals relevant to the operation of the Terminal. A 22.008 MHz crystal oscillator provides television timing compatibility. This frequency is divided to provide timing signals for making video, and for synchronizing the display and input/output functions to memory.

Minibus data is received and decoded to generate video for the Terminal display, the Hard Copy Unit, and for auxiliary monitors. Field Attribute Codes that contain "video appearance" information are decoded to display video as normal, dim, inverted, blinking, or blanked. Circuitry such as the character generator, cursor generator, cursor blink, horizontal and vertical drive signal generators, 50 Hz and 60 Hz timing, and others are contained on this card. Specific circuits are:

1. Master Oscillator.
2. Display and Input/Output Timing.
3. DMA Control.
4. Video Path.

5. Two Character Delay.
6. Cursor Generator.
7. Blanking Control.
8. FAC Storage.
9. Rulings Spread.
10. ROM ROW Decoders.
11. Unused Sweep Blanking.
12. Scan Next Line.
13. HCU Video.
14. Monitor Video.

The Circuit Description provides more detailed information on each of the afore-mentioned circuits.

KEYBOARD INTERFACE CARD

This card provides connection between the Keyboard and the minibus. Data from the Keyboard is detected and synchronized with Terminal memory timing before being entered to the memory or Computer Interface via the minibus. Appropriate incremental commands are generated to move the cursor when keying in data or when using the cursor movement keys. Erase Input, Clear Page, and bell ringing functions are controlled by this card.

The major circuits on this card are given below; they are discussed in the Circuit Description, in the order given:

1. Inputting Keyboard Data.
2. Control Character Decoders.
3. Keygate Generator With Repeat.
4. $\overline{\text{TSTROBE}}$ and $\overline{\text{CSTROBE}}$ Control.
5. Move Cursor Timing.
6. Move Cursor Gates.
7. Carriage Return and Line Feed Circuits.
8. Clear Page and Erase Input Circuits.
   a. Initiate.
   b. Clear Page Circuit.
   c. Erase Input Circuit.
   d. Rulings Erase Control.
9. Page Full.
10. Wrap-around.
11. Miscellaneous Circuits and Functions.
    a. Bell Circuit.
    b. Rubout Suppress.
    c. NUL and ETX.

CONTROL CARD

The majority of circuitry contained on this card is used to control transmission of memory contents. Coded hard-copy commands; erase-to-end functions; and detection of transmittable, numeric, and protected fields are performed by this card. In addition, ESC character decoding and prompt character decoding are performed here. The following circuits and functions are discussed in the circuit description of this card. Refer to the Circuit Description for more information.

1. Control Character Decoding for SI, BEL, CR, ENQ, VT, ETX, SO, ACK, and NUL.
2. ESC Decoder.
3. Prompt Character Decoder.
4. Make Copy Signal.
5. Conditional Transmit/Field Inhibit.
6. Erase to End Control.
7. EOL LF GEN Strap.
8. End Character Generation.
9. Protected Field and Non-Alpha Field Detection.
10. Miscellaneous Circuits and Operations.
    a. Send 8 Functions.
    b. Alternate Character Set Not Transmittable.
    c. $\overline{\text{CPUNT}}$.
    d. Cursor Blanking.

CURSOR CARD

The Cursor Card contains two sets of X and Y registers. One set remembers and controls the cursor location; the other set is used for display functions and is the source of the address for obtaining a character from memory for display. This card provides considerable steering of data between the minibus and the Cursor Register, as well as between the Cursor and Display Registers. Up, Down, Right, Left, and Clear Page functions are performed by this card. The circuits and functions discussed in the Cursor Card Description are given below. See the Circuit Description for information on each circuit.

1. Register Description.
2. Cursor Register Operation.
3. Display Register Operation.
   a. Register Counting.
   b. RAM Addressing.
   c. Presetting the Display Registers.
   d. RAM Address Multiplexers.
4. Edit Effects on the Registers.
   a. Insert Line.
   b. Delete Line.
   c. Insert Character.
   d. Delete Character.
5. Cursor Addressing and Reading.
   a. Cursor Positioning.
   b. Cursor Reading.
6. Miscellaneous Circuits.
7. Summary of Register Operations.
   a. General.
   b. Register Indicators.
   c. Examples of Register Counting.
   d. Purpose of Cursor Register.
   e. Direct Memory Access (DMA) Operation.

RAM CARD

The RAM Card contains MOS RAMs, which store data for screen display. Timing is provided by the Timing Card; data source is the minibus. Address inputs are BCD 0-79 for X and BCD 0-23 for Y. The RAM Card contains arithmetic logic, which converts each distinct X - Y code into the proper RAM address equivalent. Miscellaneous circuits not connected with the operation of the RAM Card are the Initialization Circuit and the 4.9 MHz Crystal Oscillator (used for input/output timing). Circuits and operations discussed in the RAM Card circuit description are given below. See the Circuit Descripiton for more information.

1. Operation of Major Circuits.
   a. Selecting the RAM Set.
   b. Read/Write Enabling.
   c. RAM Refreshing.
   d. Read to Minibus Enable.
   e. Address Decoding.
   f. Sense Amplifiers.
2. Miscellaneous Circuits.
   a. Initializing Circuit.
   b. 4.9 MHz Crystal Oscillator.

EDIT CARD

This Card contains control logic for the Edit, Roll-up Read Cursor, Position Cursor, Bit 8 and Bit 9 Set, and Cursor Tab Functions. As with the other circuit cards, no attempt is made to give a component-by-component description of circuit operations. The Edit Card circuits discussed are generalized, with only the functions of specific components that need explaining being discussed. Refer to the circuit description of this card for more information.

LOW VOLTAGE POWER SUPPLY

The discussion of this schematic explains the generation and regulation of the +15 Vdc, +5 Vdc, −12 Vdc, and −5 Vdc power supplies. Refer to the Power Supply circuit description.

DISPLAY CIRCUITS

This description is limited to those circuits necessary to operate the display monitor and include the following:

1. Video Amplifier.
2. Vertical Deflection.
3. Horizontal Deflection.
4. Power Supply.
5. Brightness.
6. Focus.
7. Troubleshooting Guide.

DETAILED DESCRIPTION

KEYBOARD DESCRIPTION

GENERAL

Refer to the Keyboard schematic. The keyboard is a source of data for the computer. It attaches to the Terminal which provides interfacing electronics as well as a display screen to display the man-computer interchange. Whether keyboard data is sent "directly" to the computer or is "buffered" (stored in Terminal memory) prior to sending, depends on the type of input/output operation.

CODED CHARACTER GENERATION. The keyboard contains an encoder array that consists primarily of Z2, Z1, and assoicated circuitry. Z2 is a MOS ROM-Type integrated circuit that provides encoding to and decoding from a 10X by 10Y keyboard matrix. Z1 provides proper timing inputs to Z2. Other inputs and outputs of Z2 will be covered in the following. The combined purpose of this circuitry is to generate a coded character output on 7 data line labeled KBIT 1 — KBIT 7 (KBIT 8 is pulled high to +5 V on the keyboard).

Z2 provides continuous scanning signals ($X_1 - X_{10}$) to the column inputs of the matrix. Row signals ($Y_1 - Y_{10}$) from the matrix are sampled one at a time by Z2. A full scan of the matrix comprises 90 clock times, with each clock time defining a specific Xn — Yn intersection of the matrix.

When a character key is depressed, a switch closure occurs at that Xn — Yn intersection. This switch closure is decoded by Z2, which enables output data on KBIT 1 — KBIT 7 that is representative of the bit combination of the character pressed. The STB output enables KSTROBE to accompany the character output.

Generating a character code also triggers repeat character timing within Z2. If the same key is held down for more than 0.3 seconds (the 0.3 seconds time delay is provided on pin 16 of Z2), STB is pulsed at a 10 Hz repetition rate, enabling KSTROBE ten times per second. This enables the Terminal to process the character bits at that rate.

The above-stated condition is maintained as long as the keyboard key is held down. Releasing the key ends the KBIT 1 — KBIT 7 and KSTROBE outputs.

Upper-case characters are generated by simultaneously pressing the SHIFT key and the desired character. Depressing SHIFT causes a switch closure at the $X_3 - Y_{10}$ junction. Because the SHIFT key causes a ground closure, transistors Q1 and Q2 provide the "switch" for this junction.

The $X_4 - Y_{10}$ junction of the keyboard matrix is reserved for the CTRL (control) key. Operation in the control mode occurs as long as the CTRL key is depressed, causing KBIT 5 — KBIT 7 to reflect control character information.

FUNCTION PAD OPERATION. The 12 key cluster at the right of the keyboard provides input codes for Z2. Like the normal character keys, Z2 decodes their input and sets the data output lines to reflect their specific input. However, pressing a Function Pad Key also sets the B9 output (pin 17). B9 prevents STB from enabling KSTROBE. This prevents the Terminal from responding to KBIT 1 — KBIT 7. However, B9 also provides an enabling voltage (via Z7E) to Z8A and Z8B. This allows B1 — B4 to control the output from decoders Z4 and Z5. The SHIFT signals, SH and $\overline{SH}$, provide steering for the shiftable outputs from Z4 and Z5.

Note that the low from Z6C also disables the repeat input frequency to Z2. Repeat capability for the special functions is provided by the Terminal logic.

Pressing the NUM LOCK Key enables the Special Function Keys to perform as a numeric pad. Pressing the function pad keys causes the keyboard to output numeric

characters on KBIT 1 – KBIT 7. NUM LOCK disables the Function Decoders Z4 and Z5. It also permits STB to enable KSTROBE from Z6B, and to enable repetition of STB from Z2, should any function key be held down more than 0.3 seconds. NUM LOCK must be depressed again to re-establish the normal function pad controls. Normally, the RESET key activates KRESET. With NUM LOCK pressed, pressing RESET enables the $X_{10} - Y_3$ junction (on the keyboard matrix) to be shorted by Q3 and Q4. Thus, with NUM LOCK pressed, RESET is able to activate the numeral "7".

MISCELLANEOUS FUNCTIONS

SHIFT, PAGE, TTY, AND RESET KEYS. SHIFT not only closes the $X_3 - Y_{10}$ junction on the matrix, but also provides steering for the Page, Insert, and Delete functions. PAGE is combined with outputs from the SHIFT key to determine the function it initiates. Pressing TTY permits only upper-case bit configurations to be structured. Pressing RESET either sets $\overline{\text{KRESET}}$ active or, if NUM LOCK is pressed, causes the bit configuration for the numeral "7" to be structured. Pressing BREAK causes the $\overline{\text{KBREAK}}$ signal to go active. This signal is used by the computer interface for computer signaling purposes.

TIMING CARD

TIMING

Refer to the Timing Card schematic. Component locations for the Timing Card are provided on the apron of the schematic. Terminal timing can be divided into specific time intervals. Let's look at the display to understand some basic timing principles.

First, we must know what is meant when we refer to a "field". A FIELD is that period of time required for the display beam to "sweep" (deflect from left to right) 262 times, starting at the top and ending at the bottom of the display. See Fig. 6-1. The standard Terminal generates 60 fields each second (a factory strap option enables the Terminal to be compatible with either 60 or 50 Hz line frequency). Thus, the standard Terminal generates a field every 16.67 ms. The $\overline{\text{VERTICAL DRIVE}}$ signal is the negative going pulse that triggers the vertical drive circuitry (on the monitor) 60 times per second. See Fig. 6-2.

As previously mentioned, a field consists of 262 horizontal sweeps of the crt writing beam. However, not all sweeps

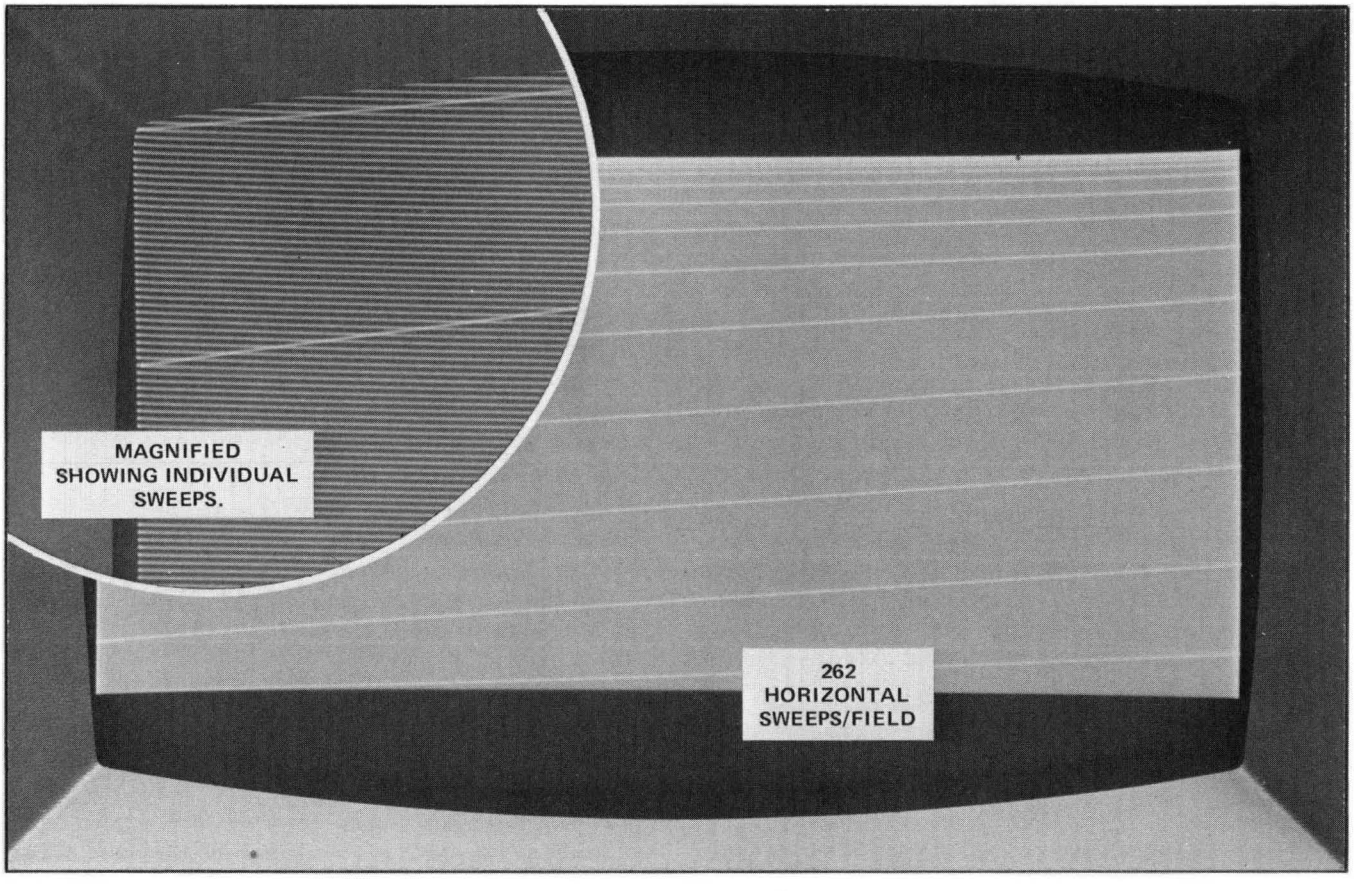


Fig. 6-1. Field definition. A video field contains 262 horizontal sweeps. The Standard Terminal is factory wired to generate 60 fields each second.

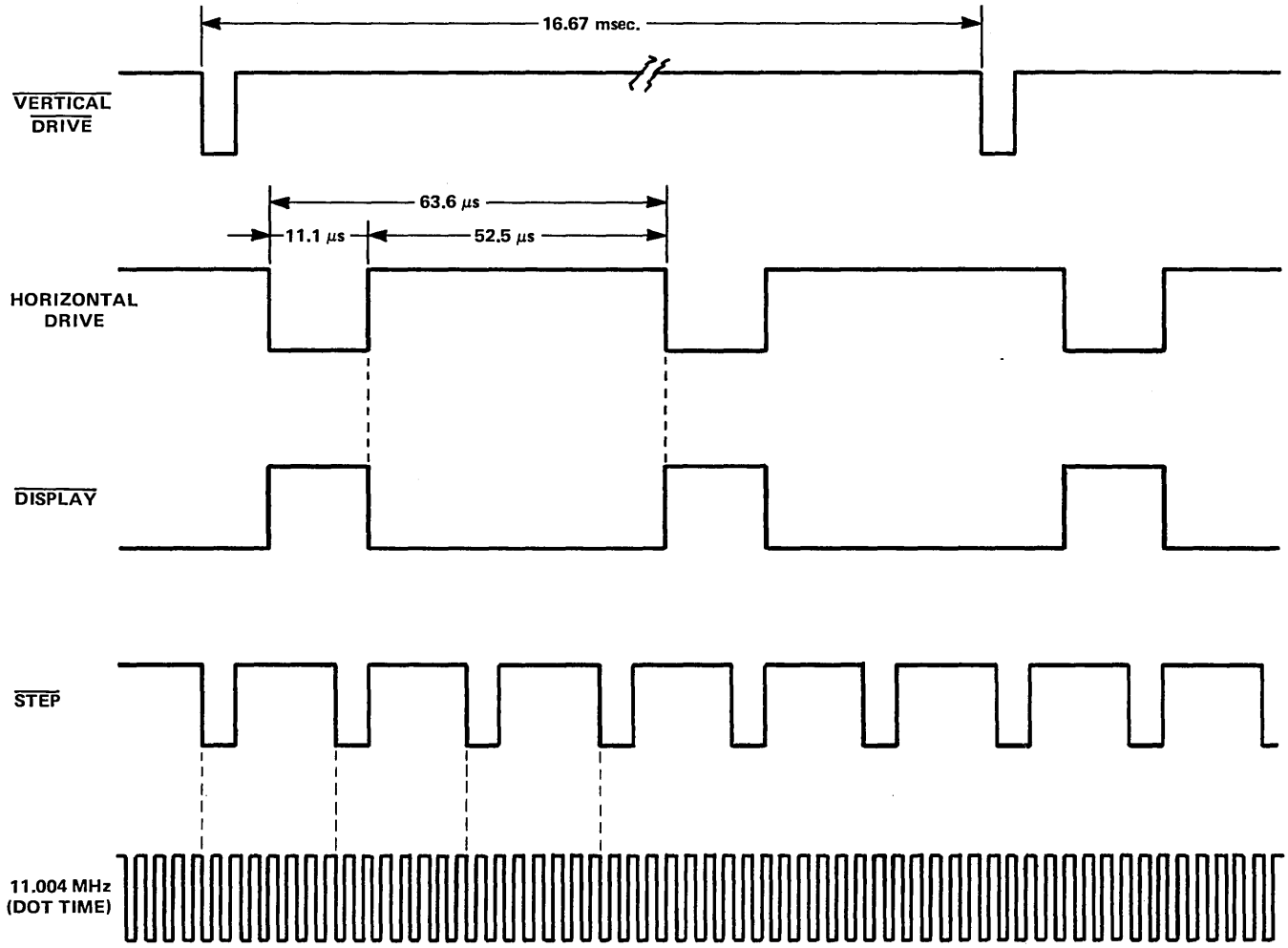


Fig. 6-2. Field Timing.

are used for displaying data. Twenty-two sweeps are blanked. Vertical retrace occurs during this time.

The HORIZONTAL DRIVE signal triggers the horizontal sweep every 63.6 μs (16.67 ms ÷ 262 = 63.6 μs). With 22 sweeps blanked, 240 are left for displaying information. This divides into 10 sweeps for each of the 24 lines of characters. Figure 6-2 shows the duration of HORIZONTAL DRIVE. The negative going pulse is the time alloted for sweep retrace, and is reserved for input/output functions (see Input/Output).

The on time of HORIZONTAL DRIVE (46.6 μs) also corresponds to $\overline{\text{DISPLAY}}$ time. During $\overline{\text{DISPLAY}}$ time data is read from the memory into the Character Generator to produce video. Video is produced a horizontal sweep at a time with each horizontal sweep divided into 100 character times. A character time corresponds to the repetition rate of the $\overline{\text{STEP}}$ signal - 636 ns (63.6 μs per sweep ÷ 100 = 636 ns per character). Eighty $\overline{\text{STEP}}$ times are reserved for character generation and 20 for input/output and sweep retrace (the sweep is blanked during horizontal retrace for approximately 10 character times).

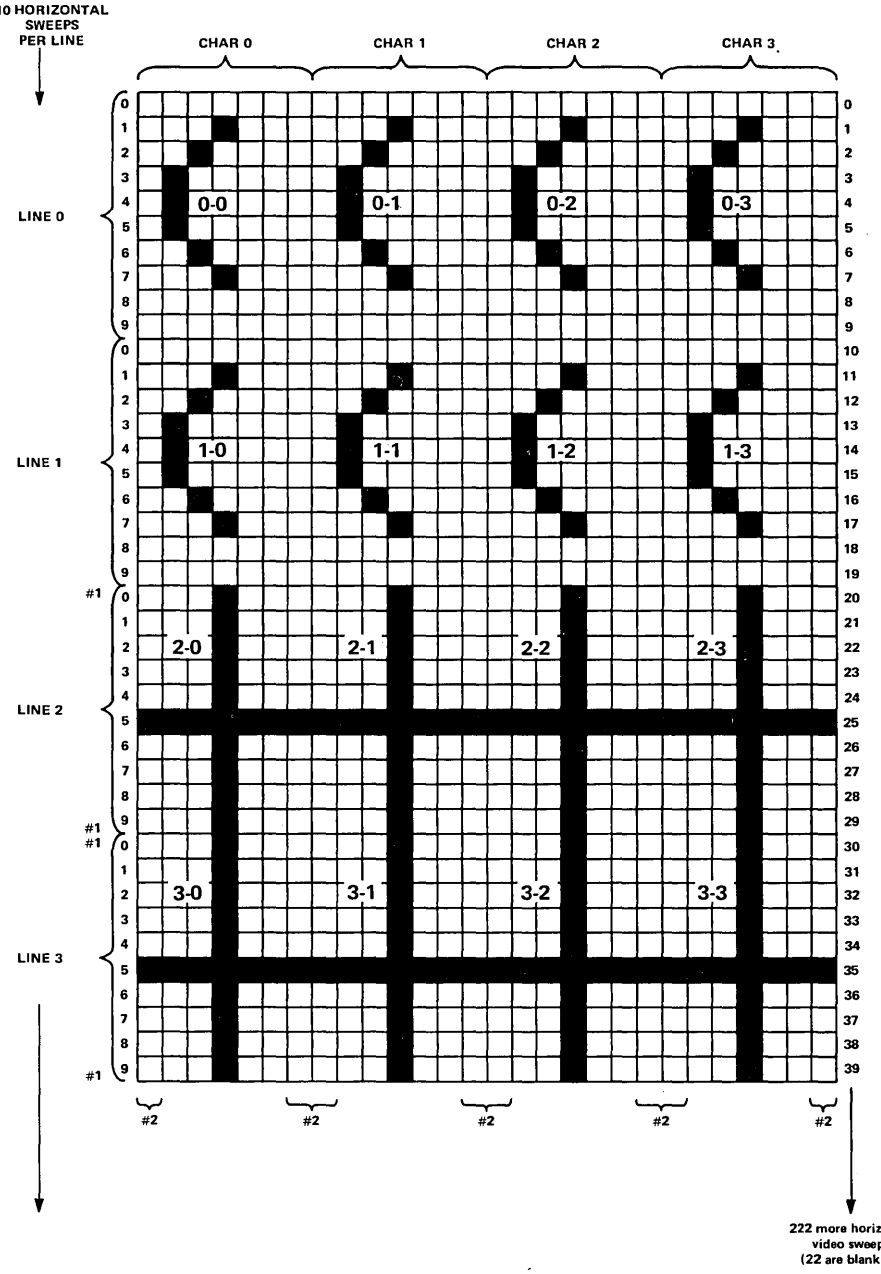
Each character time can be further divided into dot times. Dot times are the time during horizontal sweep movement when the display beam would be turned on or off in the process of character generation. An 11.004 MHz signal is used to establish a dot time of approximately 45 ns.

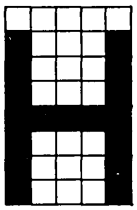
Review Fig. 6-2 and note the breakdown from simple to complex; these signals combine and interact on one another to generate video and control when input/output functions occur.

The TTL Video Logic Signal at the output of U269A is an excellent signal to monitor to show in detail what has been described above. This is discussed further in the following character generation description.

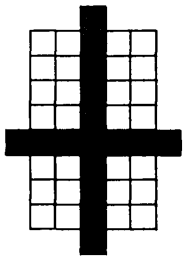
CHARACTER GENERATION

GENERAL. The circuitry in the upper portion of the schematic contains the Character Generator and video control circuits. Timing requirements are supplied by the timing circuits. Figure 6-3 shows a partial display illustration; Fig. 6-4 shows the TTL Video Logic Signal that generates the video shown on the display illustration. The following describes the relationship each component of the





Alpha ROM character. Note that the maximum dot area used by an alpha-numeric character is 5 X 7, this provides spacing between characters and lines.



Ruling character shown uses a 5 X 8 dot matrix. When write dot information appears on the perimeter of the matrix, Terminal logic causes the video circuits to repeat the dot, thus providing solid lines with no gaps (See notes #1 and #2).

#1 Ruling character shown causes Terminal to repeat video sweeps 0 and 9 of the character line.

#2 Ruling character shown causes Terminal to fill space between ruling characters with video.

Fig. 6-3. Partial Display illustration showing character generation in relation to horizontal sweep.

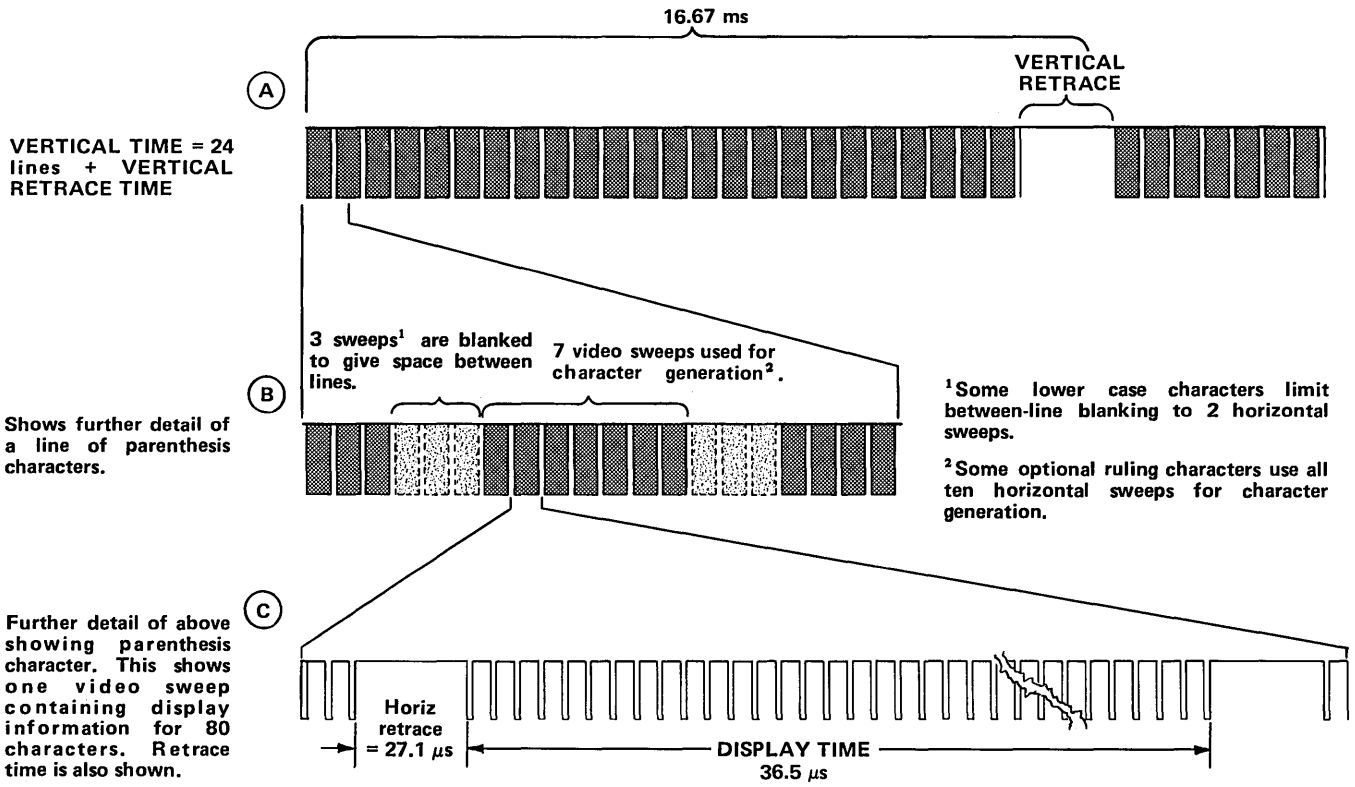


Fig. 6-4. TTL composite video signal.

TTL Video Logic Signal has to the information displayed in Fig. 6-3.

The TTL Video Logic Signal is monitored at the output of U269A. Assume that all 1920 character spaces have been filled with the opening parenthesis character "(".

TTL VIDEO SIGNAL DESCRIPTION. First review the display illustration, Fig. 6-3, then review Fig. 6-4.

Part A-D of Fig. 6-4 is the TTL Video Logic Signal before conversion to its analog counterpart. Oscilloscope sweep speed is 2 ms/div. Note that 24 separate groups are visible. Each group is representative of one line of characters. The small spacing between groups is representative of the 3 horizontal lines on which no data appears when generating standard characters. Some lower case characters (g, j, p, q, and y) are one sweep lower, thus allowing only 2 horizontal sweeps to separate them from the next line of characters. The vertical time (field time) is 16.67 ms and includes vertical retrace time.

Increasing the sweep speed to 50 μs/div shows more detail. Part B of Fig. 6-4 shows that each character line of "(" characters is composed of video information on 7 horizontal sweeps, with 3 sweeps for between-line spacing. Some optional ruling characters use all ten horizontal sweeps for character generation.

Part C of Fig. 6-4 shows the signal at a sweep speed of 5 μs/div. This shows one sweep that contains 80 negative-going spikes. These spikes command the writing beam to "turn-on" at the respective "dot position" to write the dot. Note the horizontal retrace time of 27 μs.

RETRACE TIMES

GENERAL. Data transmit and receive functions occur during horizontal retrace time. Keyboard inputs are keyed into memory during vertical retrace.

HORIZONTAL RETRACE. Transmitting and Receiving Functions occur during horizontal (sweep) retrace times. This is a period of 27 μs reserved for these functions.

Input/Output (I/O) is limited to one character per horizontal sweep. This allows a maximum local I/O rate of 15,720 characters per second (262 sweeps per field x 60 fields per second equals 15,720 characters per second).

The number 206 refers to the preset count on the outputs of the ÷ 50 counter (U1 and U21) in the timing circuitry. This count is preset every 50 $\overline{\text{STEP}}$ times. Each horizontal sweep contains two, 50-count cycles of the ÷ 50 counter. The first 17.5 $\overline{\text{STEP}}$ times every other 50-count cycle, are used for I/O timing. Figure 6-5, parts A and B, illustrates the timing signals that control transmit and receive functions.

For I/O functions, the timing circuits sequentially generate the $\overline{\text{READ}}$, STROBE, $\overline{\text{STORE}}$ and $\overline{\text{EXECUTE}}$ signals. These signals are acted upon by $\overline{\text{TSTROBE}}$, $\overline{\text{CSTROBE}}$, $\overline{\text{CPUNT}}$, and $\overline{\text{TBUSY}}$ to perform the I/O functions. Individual signal descriptions are given in the Dictionary of Line Titles, this section.

VERTICAL RETRACE. During vertical retrace, $\overline{\text{VSYNC}}$ goes active for 3 sweep times (190 μs) to enable Keyboard entries in to memory.

CIRCUIT FUNCTIONS

The majority of circuitry can be divided into function blocks that are described below.

22.008 MHz CRYSTAL OSCILLATOR. This is the master timing oscillator that provides timing for Terminal operation. Division by two provides 11.004 MHz pulses for video and field timing.

Display and Input/Output timing is provided by:

A. U11, a ÷ 16 counter that is preset to a count of 9 each time it is loaded. Seven 11.004 MHz clocks generate a load (STEP) signal from Carry Out, pin 15. STEP corresponds to a character time.

B. U1 and U21 provide timing control for the horizontal sweep and the input/output functions that occur during sweep retrace. This counter is preset to a count of 206. 50 clock (STEP) pulses enable a Carry Out signal from U21. This counter (U1 and U21) cycles twice to provide 100 counts before a clock pulse is generated from U141B for the Field Counter. 100 STEP pulses correspond to one horizontal sweep time.

C. U31 and U41 provide field timing. A field is composed of 262 horizontal sweeps. This counter is preset to a count of 125 (99 for 50 Hz line voltage) and must receive 131 clock pulses from U141 before the Carry Out line from U41 goes high. This counter also counts twice for each field. Two 131 count cycles enable a high going pulse from U61A. This equals the field rate of 16.67 μs.

DMA CONTROL. This circuitry slows down the $\overline{\text{STEP}}$ and STROBE signals during Direct Memory Access (DMA) and refresh operations. $\overline{\text{STEP}}$ changes duration to enable RAMs to be refreshed, or to perform functions such as clear screen, insert and delete line and character.

DMA functions vary in length of time. U359B assures that when a DMA function is completed, normal operation is re-established at the 50th character time of a sweep and not during an I/O cycle.

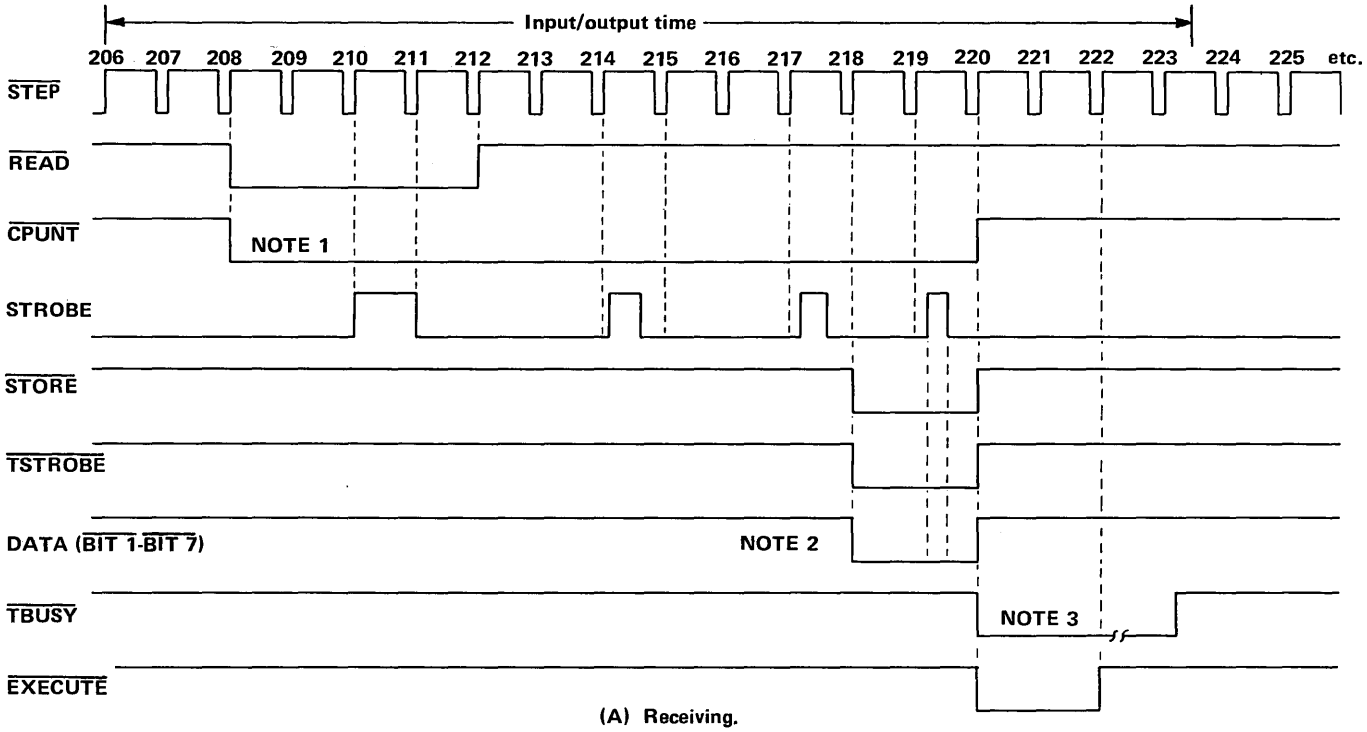
VIDEO PATH. Video Path includes Data Latches, two Read Only Memory (ROM) chips, Dot Multiplexer (U389), various gating, and the output drivers, Q397, and Q398.

TWO CHARACTER DELAY. The ASCII code for a character to be displayed is read during $\overline{\text{DISPLAY}}$ time. A character is written when the X EQUAL and Y EQUAL signals are true. This signifies that the Cursor Registers agree with the Display Registers. Normal operation is to generate a cursor at this time. However, because it takes two character times to display the character just read, the cursor must also be delayed two character times to assure proper position over the character.

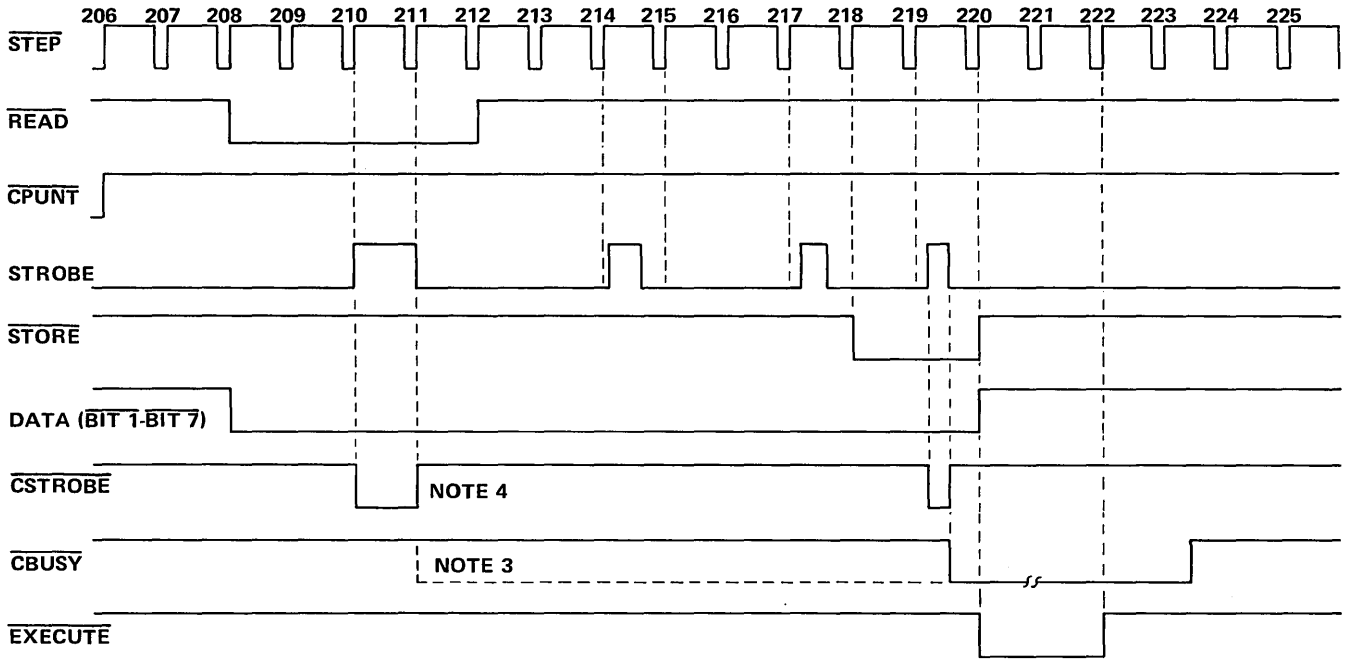
FIELD ATTRIBUTE CODE STORAGE. This circuitry decodes and stores the Field Attribute Code (FAC). The FAC is stored until another FAC, or the end of the line is detected. U381A and U141C are the gates which recognize a FAC. They supply the pulse that clocks the FAC into the Field Register, U401.

BLANKING CONTROL. This circuit inhibits video output during a clear page function and ensures that it is not re-enabled until $\overline{\text{VSYNC}}$ goes true. Data display continues from the top of the page; not from the middle.

CURSOR GENERATOR. When X EQUAL and Y EQUAL are true, the cursor is generated. U341 causes a delay which enables video inversion. The field rate is



(A) Receiving.



(B) Transmitting.

NOTE 1..CPUNT precedes data from the interface by 6.36 μs.

NOTE 2..Data is read from the minibus into memory during TSTROBE and STORE at STROBE time.

NOTE 3..TBUSY is asserted by the 4023 when the data is being processed by the 4023. CBUSY is asserted by the computer interface when data is sent to the computer. Both TBUSY and CBUSY are asserted when data is being executed by 4023 and is being sent to the computer.

NOTE 4..When reading the cursor position to the computer, CSTROBE goes active for the duration of STROBE during READ time. During Buffer Entry or keyboard entry (Direct), CSTROBE goes active for the duration of STROBE during STORE time. The computer interface sets CBUSY active until the entry is completed.

Fig. 6-5. Input and Output Timing.

divided by 16 to produce the 4 Hz blink. The Cursor Blink Strap controls when the cursor will blink; either continuously or only when the RESET key is pressed.

READ ONLY MEMORY ROW DECODERS. This group of circuitry provides logic for ROM row decoding. U351 is a BCD decade counter that is clocked at the sweep rate. It sequentially counts 10 sweeps to provide BCD outputs for U261, and row selection for ROM A. The ROM B Latch, U261, latches one count behind the ROM A count, thus causing the ROM B dot matrix to "fall" one dot position for some lower case characters. A comparison between ROM row selection is provided by Table 6-1.

Steering provided by gates located at the output of U261, select row codes for lower case or optional ruling characters.

VIDEO BLANKING OF UNUSED HORIZONTAL SWEEPS. The output of this group of gates controls video blanking on specific horizontal sweeps of a line of characters. Table 6-1 shows that when ROM A is selected sweeps 8 and 9 are blanked; when ROM B is selected, sweeps 0 and 9 are blanked; no sweeps are blanked when generating a ruling character.

RULINGS SPREAD. Cutting the Rulings strap enables the "spreading" of dots between ruling characters.

MISCELLANEOUS

The remaining circuitry on this card consists of auxiliary video generators for the Hard Copy Unit and external monitors, and various timing logic for control of display and input/output functions.

KEYBOARD INTERFACE CARD

INPUTTING KEYBOARD DATA

Refer to the Keyboard Interface schematic. A component locations illustration is provided on the apron of the schematic. Data keyed from the Keyboard is accompanied by KSTROBE. KSTROBE activates the Keygate Circuit, which generates a $\overline{\text{KEYGATE}}$ signal during the next vertical retrace interval. When $\overline{\text{KEYGATE}}$ is generated (during $\overline{\text{VSYNC}}$), data is latched through the Data Input Gates and onto the minibus. $\overline{\text{KEYGATE}}$ also activates $\overline{\text{TSTROBE}}$ and/or $\overline{\text{CSTROBE}}$ (as described in the description of that circuit) to cause the data to be processed by the Terminal and/or the Computer Interface.

TABLE 6-1

COMPARISON OF 10 HORIZONTAL SWEEPS TO ROM ROW SELECTION

Sweeps per line of chars	BCD Count From U351	Upper Case ROM A P/N 156-0147-00	ROM Row Selection	
			Lower Case ROM B P/N 156-0401-00	Optional Ruling ROM B P/N 156-0401-00
0	0000	0	Blanked	0 (repeat of ROM row #0)
1	0001	1	0	0
2	0010	2	1	1
3	0011	3	2	2
4	0100	4	3	3
5	0101	5	4	4
6	0110	6	5	5
7	0111	7	6	6
8	1000	Blanked	7	7
9	1001	Blanked	Blanked	7 (repeat of ROM row #7)

Note dropping of Lower-case characters one sweep. Lower-case characters, g, j, p, q, and y have tails written on 7th ROM row, thus extending one sweep lower than other alphanumeric characters.

The data placed onto the minibus is also latched through U109 and U209 during $\overline{\text{STORE}}$ and $\overline{\text{STEP}}$ time. With data on the outputs of these latches, it can be decoded by the Control Character Decoders and processed by applicable steering circuitry.

CONTROL CHARACTER DECODERS

Decoding for the NUL, ETX, BEL, BS, HT, LF, VT, FF, CR, and SI Control Characters is provided by U129 and U131. These characters cause register manipulation, bell ringing, page clearing, and erase input functions to be performed.

Information on the effects of individual control characters can be found in the following circuit descriptions.

NUL, BEL, and ETX—Miscellaneous Circuits and Functions

BS, HT, and VT—Register Control Enabling Circuit

CR and LF—Carriage Return and Line Feed Circuits

SI—Clear Page and Erase Input Circuits

KEYGATE GENERATOR WITH REPEAT

This circuit is activated by the KSTROBE signal. It generates the $\overline{\text{KEYGATE}}$ signal when keying data from the Keyboard and when using the Position Cursor Controls. It provides a one-time activation of $\overline{\text{KEYGATE}}$ for each KSTROBE.

$\overline{\text{KEYGATE}}$ goes active during vertical retrace time (it is during vertical retrace that $\overline{\text{VSYNC}}$ goes active), between 3 and 19 ms after $\overline{\text{BOUNCE}}$ becomes inactive. $\overline{\text{BOUNCE}}$ is generated when keys such as the edit, erase input, and cursor position keys are depressed. If $\overline{\text{BOUNCE}}$ remains active for more than 300 ms, $\overline{\text{KEYGATE}}$ has a 15 Hz repetition rate for edit and cursor movement functions.

The CONSOLE LOCK Strap prevents $\overline{\text{KEYGATE}}$ from being generated, and would be used when all keyboard inputs are to be inhibited. The $\overline{\text{KLOCK}}$ signal is activated when the cursor is positioned over a FAC (Field Attribute Code) or in a protected field. It prevents $\overline{\text{KEYGATE}}$ from being generated, thus inhibiting keyboard entry into a protected field.

$\overline{\text{TSTROBE}}$ AND $\overline{\text{CSTROBE}}$ CONTROL

Keyboard data is not acted upon by the Terminal and/or the computer until $\overline{\text{TSTROBE}}$ and/or $\overline{\text{CSTROBE}}$ are activated. When keying directly to the computer, the DIRECT signal is active (DIRECT-BUFFER switch is at DIRECT). Keyboard data is directed to the Interface Card when $\overline{\text{KEYGATE}}$ enables $\overline{\text{CSTROBE}}$. In Direct, the Terminal does not process keyboard inputs unless an "echo" condition is provided. This can be provided by either the computer, the modem, or the Interface Card. The $\overline{\text{ECHO}}$ signal is enabled by strap placement on the Interface Card, and enables $\overline{\text{TSTROBE}}$ to be generated when keying data from the Keyboard in Direct.

$\overline{\text{TSTROBE}}$ is controlled in the afore-described manner as long as $\overline{\text{KLOCK}}$ remains false. Whe $\overline{\text{KLOCK}}$ goes true, the only time $\overline{\text{TSTROBE}}$ goes true (when keying in data) is when one of the following is detected by U49A.

1. Keying data with the RESET Key depressed (this permits keying into a protected field and keying over a FAC).
2. VT Control Character.
3. HT Control Character.

MOVE CURSOR TIMING

This circuitry provides enabling signals at the proper times for the register control signals, $\overline{\text{CLRX}}$, $\overline{\text{CLRY}}$, $\overline{\text{UP}}$, $\overline{\text{DOWN}}$, $\overline{\text{LEFT}}$, and $\overline{\text{RIGHT}}$. The output of U191D is enabled at $\overline{\text{EXECUTE}}$ time when $\overline{\text{KEYGATE}}$ is active and remains active until the next $\overline{\text{STEP}}$ time. This is the time when the register controls activated by the $\overline{\text{KLEFT}}$, $\overline{\text{KRIGHT}}$, $\overline{\text{KUP}}$, and $\overline{\text{KDOWN}}$ inputs are enabled. Note also the $\overline{\text{STEP}}$ and $\overline{\text{EXECUTE}}$ time is also used to clear the X and Y Registers when the HOME key is pressed.

The output from U179A is used to enable other register control gates. The output of these gates go true when enabled by their respective decoded Control Character output from U131. These gates, their outputs, and the Control Character that activates the output are shown in Table 6-2.

TABLE 6-2

GATE	INPUT CONTROL CHARACTER	OUTPUT
U389B	HT	$\overline{\text{RIGHT}}$
U361C	BS	$\overline{\text{LEFT}}$
U351B	LF	$\overline{\text{DOWN}}$
U391B	LF	$\overline{\text{CLRX}}$ (LF does CR)
U391C	CR	$\overline{\text{CLRX}}$
U351C	CR	$\overline{\text{DOWN}}$ (CR does LF)

MOVE CURSOR GATES

The UP, DOWN, LEFT, RIGHT, and HOME keys are non-encoded keys that control cursor positioning by manipulating the count in the Cursor Registers located on the Cursor Card. Pressing the HOME key causes the X and Y Cursor Registers to clear. This positions the cursor to home. The $\overline{\text{KUP}}$, $\overline{\text{KDOWN}}$, $\overline{\text{KLEFT}}$, and $\overline{\text{KRIGHT}}$ signals increment or decrement the count in the Cursor Registers. The cursor position reflects the count from these registers.

CARRIAGE RETURN AND LINE FEED CIRCUITS

CARRIAGE RETURN. Decoding CR activates this circuit to enable $\overline{\text{CLRX}}$. $\overline{\text{CLRX}}$ clears the X Cursor Register, causing the cursor to position to the left margin. The CR DOES LF strap also enables line feeds to be performed when CR's are decoded. This is the standard Terminal configuration.

LINE FEED. Decoding the LF Control Character causes the $\overline{\text{DOWN}}$ signal to be activated. $\overline{\text{DOWN}}$ increments the count in the Y Cursor Register, thus moving the cursor down one line. This circuit can be strapped to also perform a carriage return with line feed if desired. The standard Terminal is strapped not to generate a carriage return with line feed.

CLEAR PAGE AND ERASE INPUT CIRCUITS

CLEAR DATA INITIATE CIRCUIT. This circuit detects when a decoded (or keyboard input) Clear Page or Erase Input function is commanded. U131 decodes the program commands, FF (Clear Page) and SI (Erase Input). These Control Characters must be preceded by ESC before their respective functions can be initiated (ESC is decoded by the Control Card, which sets $\overline{\text{LCE}}$ active.) Cutting the FF ERASE strap obviates the need to precede FF with ESC. Pressing the PAGE-ERASE INPUT key with SHIFT depressed initiates the Clear Page sequence from the keyboard; pressing PAGE-ERASE INPUT without SHIFT initiates Erase Input.

Whenever one of these functions is to be performed, the output of U261B goes high. The effect of this high-going signal can be found in the description of the Clear Page Control Circuit. Detecting an Erase Input function also enables the output of U51B. The effect of this low-going signal can be found in the description of the Erase Input Control Circuit.

CLEAR PAGE CONTROL. The purpose of this circuit is to enter a DMA (Direct Memory Access) cycle. All data in memory is read onto the minibus a character-at-a-time and, if it is a Clear Page function, it is not written back into memory but is deleted. If an Erase Input function is being performed, all protected data, if any, is written back into memory (more about Erase Input in the Erase Input Control Description).

A high-going signal from U261B enables this circuit. $\overline{\text{DMA}}$ is activated and the cursor positions to home by $\overline{\text{CLRX}}$ and $\overline{\text{CLRY}}$ signals that clear the Display Registers. $\overline{\text{RIGHT}}$ is activated and $\overline{\text{STEP}}$ signals increment the X Display Register from 0 to 79 (see circuit description of Cursor Card). When the last character of the line is reached (count 79), EOL DIS goes active. $\overline{\text{CLRX}}$ once again goes active as well as $\overline{\text{DOWN}}$, which causes the Y Display Register to increment the count to the next line of characters. The cycle repeats until the last line is reached, at which time LSTYDIS goes active. When the last character of the last line is read onto the minibus, EOL DIS causes $\overline{\text{CLRX}}$ and $\overline{\text{CLRY}}$ to position the cursor back to home. $\overline{\text{DMA}}$ goes inactive, and the Clear Page (or Erase Input) sequence is terminated.

ERASE INPUT CONTROL CIRCUIT. This circuit determines which data read from memory in an Erase Input sequence is deleted or read back into memory. Field Attribute Codes (FAC's) define this data as being protected or unprotected. Any character that has $\overline{\text{BIT 8}}$ true is defined as a FAC and is automatically protected. An Erase Input function does not erase FAC's. The Erase Input circuitry monitors $\overline{\text{BIT 8}}$ to determine if the character is a FAC, and if it is, it samples $\overline{\text{BIT 2}}$ of the FAC for protection status of the data that follows the FAC. Circuit operation is as follows.

Initiating Erase Input sets DMA active. See description of Clear Page and Erase Input Circuit. Also see Edit Card and Cursor Card descriptions for more information on DMA operation. The cursor begins scanning the memory a character at a time, a row at a time. An Erase Input function sets the output of U51B low. This one-sets U251A whose high-going output enables the Erase Input Control Circuit. As the cursor is moved to each character, it is read from memory and placed on the minibus. It is latched through U109 and U209, where it is sampled by the Erase Input Control Circuitry for $\overline{\text{BIT 2}}$ and $\overline{\text{BIT 8}}$ information, as described above. If the character is a FAC, the output of U241A goes high. This enables the Data Output Gates, placing the character back on the minibus. It is then read back into memory at the same location. If $\overline{\text{BIT 2}}$ of the

FAC defines, as protected, the data that follows, all data up to the next FAC or the end of the line, follows the same cyclical pattern: from memory, to minibus, through U109 and U209, through Data Output Gates, to the minibus, and back into memory. If $\overline{\text{BIT 2}}$ defines the data as being unprotected, the output of U241A remains low and the data, up to the next FAC, or the end of the line, becomes lost; it is not placed back into memory.

When another FAC is detected, the operation repeats. Again, whether the data the FAC defines is "erased" or not depends on the protection status defined by $\overline{\text{BIT 2}}$ of the FAC.

RULING ERASE CONTROL. An active $\overline{\text{BIT 9}}$ defines the character it is concurrent with as being a rulings character. During an Erase Input operation, it is desirous not to erase these characters. Therefore, when a rulings character is detected it is not erased, but written back into memory as described in the preceding description.

An ALTERNATE SET ERASE INPUT Strap can be cut to permit erasure of alternate character set characters (ruling characters).

PAGE FULL CIRCUIT

BREAK ON FULL. Note the BRK FUL Strap. The Standard Terminal does not enable a $\overline{\text{BREAK}}$ signal on page full. The strap must be cut to enable to circuit operation as follows:

When receiving information from the computer and the cursor positions to the last line, LSTYCRS goes true. Another line feed past the bottom line causes $\overline{\text{DOWN}}$ to go true. At $\overline{\text{EXECUTE}}$ time, $\overline{\text{BREAK}}$ is enabled. This inhibits further received data on some systems. The circuit is reset by clearing the page or by pressing the Home key.

BUSY ON FULL. The output from the Page Full Flip/Flop also inputs to the Busy On Full circuit. The Standard Terminal is set to enable $\overline{\text{TBUSY}}$ on page full. The BUSY FUL strap must be cut to prevent $\overline{\text{TBUSY}}$ from going active on page full.

WRAP-AROUND CIRCUIT

The wrap-around feature is enabled by the Wrap-around Strap. When in Direct mode, typing or moving the cursor past the 80th character position, causes $\overline{\text{CLRX}}$ and $\overline{\text{DOWN}}$ to become enabled. This moves the cursor down one line and to the left margin.

MISCELLANEOUS CIRCUITS AND FUNCTIONS

BELL CIRCUIT. This circuit is activated from one of three sources; when $\overline{\text{DING}}$ goes active, when attempting to enter keyboard data into a protected field, and when ESC BEL is decoded. Bell ringing occurs during $\overline{\text{VSYNC}}$ time (vertical retrace).

RUBOUT SUPPRESS. Detecting a rubout character (127_{10}) causes the output of U229 to enable $\overline{\text{TSUP}}$. This suppresses Terminal response to that character (as long as $\overline{\text{DMA}}$ is inactive and the RESET key is not depressed).

NUL AND ETX. Two control characters not previously discussed are NUL and ETX. Either of these characters activates $\overline{\text{TSUP}}$. However, ETX causes the cursor to space to the right via U341. All control characters cause cursor spacing to the right if RESET is held down. NUL prevents spacing and inhibits Terminal response to that character.

CONTROL CARD

GENERAL CIRCUITRY INFORMATION

Refer to the Control Card schematic. A component location illustration is provided on the apron of the schematic. The following descriptions provide basic information on circuitry contained on the Control Card.

CONTROL CHARACTER DECODER. This circuitry decodes the SI, BEL, CR, ENQ, VT, ETX, SO, ACK, and NUL Control Characters which are used as follows.

SI	Computer-initiated control command that initiates transmission of transmittable data only (SI must be preceded by ESC).
SO	Computer-initiated control command that initiates transmission of buffer contents, transmittable and non-transmittable data (SO must be preceded by ESC).
BEL	When preceded by ESC, a computer-controlled Make Copy request is initiated.
CR ETX	Stored CR and ETX codes are used in Buffer entry as Message Separators.

NUL	NUL's reside in memory where data is not entered. During Buffer transmission, NUL's are decoded for Null Suppression.
VT ACK	These are decoded but perform no useful function.

ESC DECODER. An ESC Decoder, U251, and associated circuitry, sets $\overline{\text{LCE}}$ active on receipt of the ESC Control Character. $\overline{\text{LCE}}$, plus the next $\overline{\text{TSTROBE}}$, triggers the CPU Delay Response Multi, U31, to enable $\overline{\text{CBUSY}}$. $\overline{\text{CBUSY}}$ prevents immediate transmission of cursor coordinates following receipt of the closing bracket (]) code that follows ESC.

PROMPT CHARACTER DECODER. Decodes the Prompt character selected by the Line Prompt Straps when transmitting line-by-line. Receipt of Prompt Character also triggers the CPU Delay Response Multi, U31. As with ESC, $\overline{\text{CBUSY}}$ goes active for duration of on time of U31. (0.5 second is standard). A lower value resistor can be strapped in to provide an on time of about 50 ms for shorter delay time requirements. Note that the 1 k resistor is already installed.

MAKE COPY SIGNAL. $\overline{\text{MAKE COPY}}$ is generated upon receipt of ESC followed by BEL. (Note $\overline{\text{LCE}}$ "arms" U339A.) When the Hard Copy Unit begins making a copy, $\overline{\text{HCU BUSY}}$ goes active.

CONDITIONAL TRANSMIT/FIELD INHIBIT. The $\overline{\text{ENTER}}$ signal is enabled as a result of a Send or Enter transmission sequence initiated from the keyboard or under program command from the computer (note that the $\overline{\text{KSEND}}$ and $\overline{\text{KENTER}}$ signals enable $\overline{\text{BOUNCE}}$). The enter sequence initiated from the keyboard causes an ETX code to store at the cursor location; send does not store an ETX. Also, if $\overline{\text{BIT 8}}$ is true, enter sequences will not cause an ETX code to be generated.

ERASE TO END CONTROL. This circuit initiates and stops the Erase to End Function. In BUFFER, Erase to End is inhibited at the end of a line (EOL CRS goes active) or if a FAC(s) is in the line, the function is terminated when the next FAC is detected. With Wrap-around Strap "IN", and DIRECT selected, Erase to End causes a carriage return/line feed to be executed at the end of the line.

EOL LF GEN STRAP. LF (line feed) generation and transmission are dependent on position of this strap. See Strappable Option.

END CHARACTER GENERATION. An End character is generated and transmitted as the last character of a buffer transmission or a Read Cursor operation. The specific End Character is dependent on the position of the End Character Straps. See Strappable Options.

PROTECTED FIELD AND NON-ALPHA FIELD DETECTION. This circuitry located on the lower portion of the schematic, is controlled by $\overline{\text{BIT 1}}$, $\overline{\text{BIT 2}}$, $\overline{\text{BIT 6}}$, $\overline{\text{BIT 7}}$, and the FA signal (from U201B). The following functions are performed:

1. Inhibits keyboard writing when cursor is located in a protected field ($\overline{\text{KLOCK}}$ goes active).
2. Allows only non-alpha characters to be written in non-alph fields.
3. Rings bell and prevents Terminal from writing data in a protected field and alpha data in a non-alpha field.

MISCELLANEOUS CIRCUITS AND OPERATIONS

CURSOR BLANKING. The cursor is blanked when performing an Erase to End function, making a hard copy, performing NUL suppression, when cursor is tabbing over optional ruling characters or through a non-transmittable field, or when seeking a preceding Message Separator after initiating a Buffer transmission sequence.

SEND 8 FUNCTIONS. $\overline{\text{SEND 8}}$ inhibits the following Cursor Card functions:

1. Control Character Decoding.
2. ESC Decoding.
3. FAC Detection. A buffer that contains FAC's will not have the FAC code preceded by the Field Segregator (US) when transmitting.

ALTERNATE CHARACTER SET NOT TRANSMITTABLE. $\overline{\text{BIT 9}}$ true signifies that the character concurrent with $\overline{\text{BIT 9}}$ is an optional ruling character. Normally, ruling characters are non-transmittable, regardless of Field Attribute Codes. Cutting the ALTERNATE SET XMIT strap allows transmission of alternate character set characters.

$\overline{\text{CPUNT}}$. $\overline{\text{CPUNT}}$ is placed on the minibus by the Interface Unit (full duplex operation) and is used to inhibit data outputs of the Control Card.

EXPLANATION OF TRANSMISSION CONTROL

GENERAL. The following is a basic description of the transmission sequences that occur as a result of initiating a Send or Enter sequence. The description covers most aspects of a buffer transmission. The circuitry being discussed is found at about the center of the schematic. Due to its complexity and interaction, the circuitry will be discussed by operation.

STATE DESCRIPTIONS. Ten logic states are provided by a State Circuit that consists of a State Register, U381, a BCD decoder (U281), and associated circuitry. Each state controls the outputs and also the state that is set next. These Control States are shown in the Transmission State Diagram, Fig. 6-6 and are explained in Table 6-3.

TABLE 6-3

State	BCD Output U381	Decimal Output U281	Description
Initial	1000	8 (Pin 10)	Initial is obtained by power-up, PAGE, HOME, RESET, and ESC. These conditions return circuitry to the Initial State regardless of preceding state.
Left One	1001	9 (Pin 11)	Obtained when transmission sequence (Enter or Send) is initiated. A $\overline{\text{LEFT}}$ signal goes active and is performed at $\overline{\text{EXECUTE}}$ time.
Left Seek	0000	0 (Pin 1)	$\overline{\text{LEFT}}$ remains active to be performed every $\overline{\text{EXECUTE}}$ until one of the conditions for change of state is obtained.
Stuff Right and Up	0001	1 (Pin 2)	If a Message Separator code (CR or ETX) or the Home Position have not been reached and the cursor is at the left margin, $\overline{\text{HIX}}$ and $\overline{\text{TSTROBE}}$ signals, as well as code for lower case "o", are set. These signals position the cursor to the right margin at $\overline{\text{STORE}}$ time. $\overline{\text{UP}}$ is set to position the cursor up one line at $\overline{\text{EXECUTE}}$ time.
Off ETX	0010	2 (Pin 3)	When cursor is moved back to a preceding ETX or CR code, cursor movement stops. This state sets circuit outputs to move the cursor off the Message Separator code before transmission begins. This is done by setting $\overline{\text{RIGHT}}$ active to be performed at $\overline{\text{EXECUTE}}$ time. Once the cursor is moved off the Message Separator, $\overline{\text{CSTROBE}}$ is set and transmission begins. If cursor moves back to the Home position without encountering a Message Separator, $\overline{\text{CSTROBE}}$ is set immediately. If the Message Separator is in the 80th character position $\overline{\text{CLRX}}$ and $\overline{\text{DOWN}}$ go active instead of $\overline{\text{RIGHT}}$.

TABLE 6-3 (cont)

State	BCD Output U381	Decimal Output U281	Description
Sending	0011	3 (Pin 4)	Circuit outputs are set to control data transmission. $\overline{\text{CSTROBE}}$ at $\overline{\text{READ}}$ time transmits the character. $\overline{\text{RIGHT}}$ at $\overline{\text{EXECUTE}}$ time moves the cursor to the next character.
Field Attribute	0100	4 (Pin 5)	When in transmitting process and a FAC is detected, cursor movement stops on the FAC. If the FAC defines a transmittable field, the circuit generates a US character which is sent via a $\overline{\text{CSTROBE}}$ at $\overline{\text{READ}}$ time. Transmission continues beginning with the FAC. Should the FAC define a non-transmittable field, no US character is transmitted and transmission of the FAC and all data in that field is suppressed.
EOL 1 (CR with LF)	0101	5 (Pin 6)	When the end of a line is detected, a carriage return/line feed is performed by enabling $\overline{\text{CLRX}}$ and $\overline{\text{DOWN}}$ to be acted upon at $\overline{\text{EXECUTE}}$ time. If data was transmitted in that line and the end of the line is reached, a CR character is transmitted via $\overline{\text{CSTROBE}}$ at $\overline{\text{STORE}}$ time.
EOL 2 (LF)	0110	6 (Pin 7)	When the cursor reaches the end of the line in which data was transmitted a LF character is generated and transmitted by $\overline{\text{CSTROBE}}$ at $\overline{\text{STORE}}$ time (see EOL LF GEN Strap).
END	0111	7 (Pin 9)	When the cursor reaches a stored Message Separator at the end of the message, or the last character position of the last line, the End code is transmitted (the specific End character depends on the character selected by the Message End Straps). Performing a $\overline{\text{CLRX}}$ at $\overline{\text{EXECUTE}}$ positions the cursor to the left margin, and the Initial State is set.

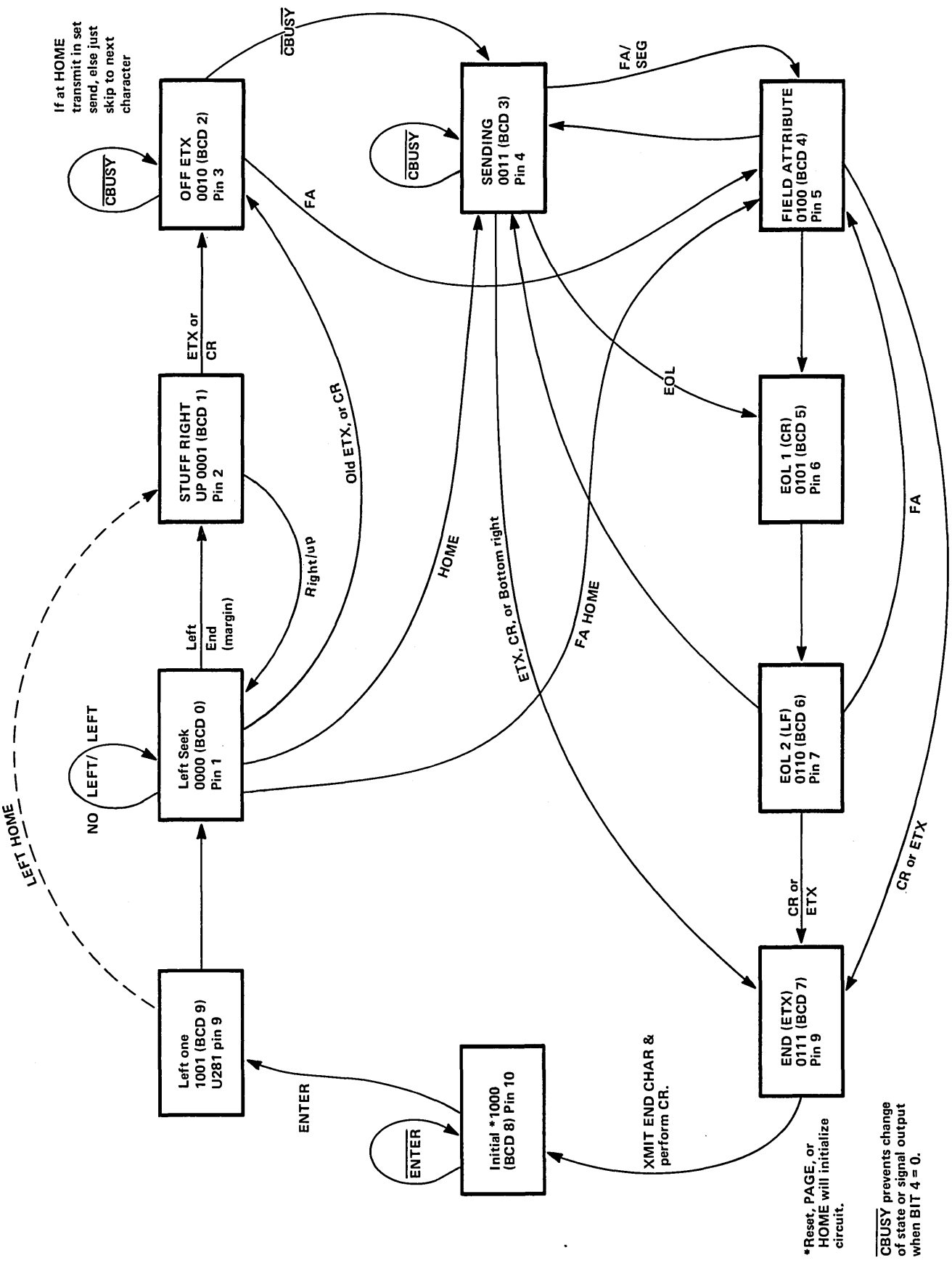


Fig. 6-6. Transmission State Diagram.

EXAMPLE OF TRANSMISSION CIRCUIT OPERATION. Assume that the information displayed in Fig. 6-7 is to be transmitted to the computer. It contains two lines of information, preceded and ended by Message Separator (CR or ETX) codes. Refer to the transmission state diagram when reading the following.

The Transmission Control Circuitry remains in the Initial State until a transmission sequence is initiated, either from the computer or by the operator at the keyboard. Assume that the cursor was at the end of the message and the operator presses the SEND-ENTER key. An ETX code stores at the cursor location and the cursor begins moving left via $\overline{\text{LEFT}}$ signals at $\overline{\text{EXECUTE}}$ time. When the left margin is encountered, Stuff Right and Up occurs, being brought about by generating a lower case "o" code and a $\overline{\text{TSTROBE}}$ at $\overline{\text{STORE}}$ time. An $\overline{\text{UP}}$ signal is generated and acted upon at $\overline{\text{EXECUTE}}$ time. Cursor movement continues once again to the left until the old ETX code is sensed, at which time cursor movement stops. The Off ETX state is set to move the cursor off the Message Separator code; transmission then begins with the character following the Message Separator. $\overline{\text{RIGHT}}$ signals at $\overline{\text{EXECUTE}}$ time increment the cursor to the right, with $\overline{\text{CSTROBE}}$'s occuring at $\overline{\text{READ}}$ time for each character transmitted. When the end of the line is detected, a carriage return/line feed is performed via a $\overline{\text{CLRX}}$ and $\overline{\text{DOWN}}$ at $\overline{\text{EXECUTE}}$ time, and a CR code is set to be transmitted via $\overline{\text{CSTROBE}}$ at $\overline{\text{STORE}}$ time. If an LF is also to be transmitted, it will be valid at $\overline{\text{CSTROBE}}$ in the next $\overline{\text{STORE}}$ time. Transmission of displayed information then continues until the ETX code is encountered, at which time the End code is transmitted. Setting $\overline{\text{CLRX}}$ active causes a carriage return to be performed at the next $\overline{\text{EXECUTE}}$ time. The Initial State is reset.

Further study of the Transmission State Diagram will show the variety of BUFFER transmission operations controlled by the Transmission Control Circuitry.

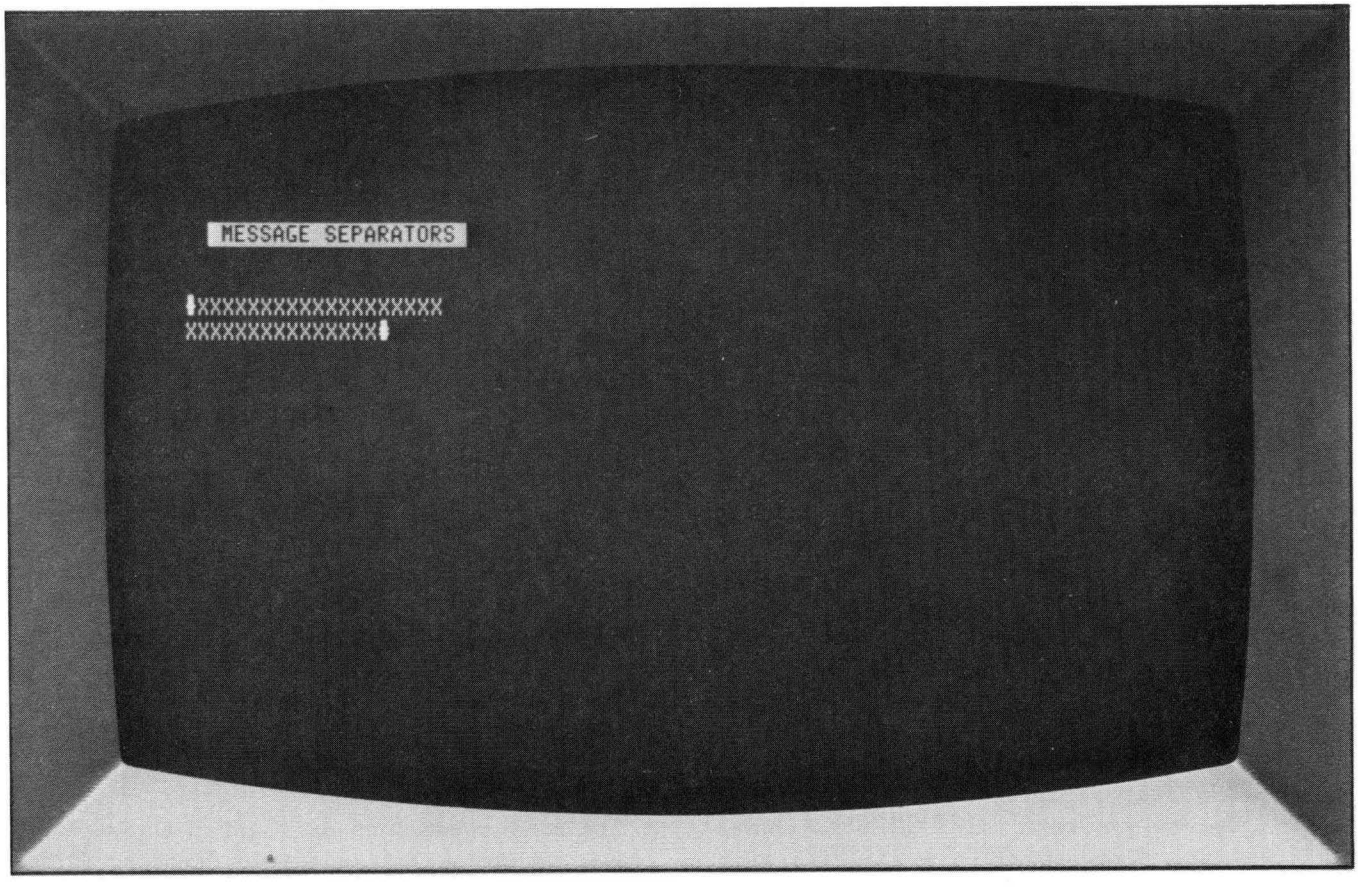


Fig. 6-7. Data Input described and "Example of Transmission Control Circuit operation."

CURSOR CARD

GENERAL

Refer to the Cursor Card schematic. A component location illustration is provided on the apron of the schematic.

REGISTER DESCRIPTION

The Register chips are 74193N synchronous 4-bit up/down counters. The outputs are triggered by a low-to-high-level transition of either count (clock) input. The direction of counting is determined by which count input is pulsed while the other count input is held high.

The outputs are programmable; that is, the outputs can be preset to any state by entering the desired data at the data inputs while the Load input is low. The register output changes to agree with the preset data inputs, independent of the up/down count pulses.

The Clear Input pin, which is independent of the Count and Load inputs, forces all outputs to the low level when a high level is applied. The registers are cascaded by using the Borrow and Carry outputs.

The Register Circuitry is divided into circuit blocks to help locate specific circuits that are being discussed. In most cases, individual block descriptions will not be given; circuit operation will be discussed by function.

CURSOR REGISTER OPERATION

GENERAL. The Cursor Register includes the Y Cursor Register chips, U39 and U31B and the X Cursor Register chips U41 and U49. The Y Register is incremented at $\overline{\text{EXECUTE}}$ time if $\overline{\text{DOWN}}$ is active. And the count is decremented at $\overline{\text{EXECUTE}}$ time when $\overline{\text{UP}}$ is active. Detection of the 24th (or 12th line, optional) inhibits further effects of $\overline{\text{DOWN}}$ signals (LSTY CRS goes active). Detection of top line inhibits further effects of $\overline{\text{UP}}$ signals (TOPCRS goes active) the X Register increments with $\overline{\text{RIGHT}}$ at $\overline{\text{EXECUTE}}$ time; detection of end of line prevents further X Register increments (EOLCRS goes active). The count from the X Register decrements with $\overline{\text{LEFT}}$ at $\overline{\text{EXECUTE}}$ time; detection of left margin prevents further X Register decrements ($\overline{\text{LEFT}}$ $\overline{\text{CURS}}$ goes active). The Y Register is cleared with $\overline{\text{CLRY}}$ at $\overline{\text{EXECUTE}}$; the X Register with $\overline{\text{CLRX}}$ at $\overline{\text{EXECUTE}}$.

DISPLAY REGISTER OPERATION

REGISTER COUNTING. The Display Register is incremented during $\overline{\text{DISPLAY}}$ time. Every horizontal sweep, at $\overline{\text{DISPLAY}}$ time, the X Display Register is incremented 80 times by the $\overline{\text{STEP}}$ signal. The Y Display Register increments once every 10 horizontal sweeps by the $\overline{\text{DOWN}}$ signal from the Timing Card.

RAM ADDRESSING. The outputs of the Display Register are used to address the RAM (memory) for display. During $\overline{\text{DISPLAY}}$ time, each $\overline{\text{STEP}}$ signal changes the X Display Register to a new character address. The character is read from the RAM, placed on the minibus, and processed by the video circuits on the Timing Card for display. The 80th character position (count 79) triggers the EOL DIS signal from U139B. EOL DIS is delayed one $\overline{\text{DMA}}$ $\overline{\text{STROBE}}$ time before being placed on the minibus. The X Display Register is cleared by $\overline{\text{CLRX}}$ and the count begins again. However, the X Display Register is not cleared for two character times after $\overline{\text{DISPLAY}}$ goes inactive. This allows time for $\overline{\text{CLRX}}$ and $\overline{\text{DOWN}}$ functions to be performed. This delay is of primary importance during DMA operation when Edit functions are being performed. (More information on the two-character delay can be found in the description of the "Edit Data Latches" in the Edit Card Circuit description.)

PRESETTING THE DISPLAY REGISTERS. The Display Registers can be preset to one of two preset inputs. Multiplexers U21, U149, and U151 select the preset input count for the Registers. One preset count is the output count from the Cursor Registers. The other set is a preset count established by straps to +5 Vdc and ground. The set selected depends on the state of the $\overline{\text{HIY}}$ and $\overline{\text{HIX}}$ signals.

Note that the Multiplexer enable pins are tied to ground. This permits the Multiplexers to be continually enabled, obviating the need for a load pulse.

Normally, the $\overline{\text{HIY}}$ and $\overline{\text{HIX}}$ signals are inactive. This enables the output from the Display Register Multiplexers to reflect the count set by the +5 Vdc and ground inputs. This provides the preset inputs of LSTYDIS and EOLDIS.

The preset counts from the X and Y Display Multiplexers are used to perform the edit functions and are summarized in the following:

During a Delete Line operation, simultaneously asserting $\overline{UP}$ and $\overline{DOWN}$ "presets" the Y Display Register to the 24th line (LSTYDIS). This occurs 80 times during the Delete Line operation.

During a Delete Character operation, simultaneously asserting $\overline{LEFT}$ and $\overline{RIGHT}$ "presets" the X Display Register to the 80th character position on the line (EOLDIS). This function occurs once during the Delete Character operation.

During an Insert Line operation, simultaneously asserting $\overline{UP}$, $\overline{DOWN}$, and $\overline{HIY}$ "jams" the Y Cursor Register count into the Y Display Register. This function occurs 80 times during the Insert Line operation.

During an Insert Character operation, simultaneously asserting $\overline{LEFT}$, $\overline{RIGHT}$, and $\overline{HIX}$ "jams" the X Cursor Register count into the X Display Register. This function occurs once during the Insert Character operation.

RAM ADDRESS MULTIPLEXERS. The output of Multiplexers U269, U261, and U259 are controlled by U101 in the Two Character Time Delay circuit. During $\overline{DISPLAY}$ (and for two $\overline{STEP}$ times following the trailing edge of $\overline{DISPLAY}$), and $\overline{DMA}$ time, these Multiplexer outputs reflect the address count from the Display Registers. During Input/Output time (horizontal retrace) they reflect the count from the Cursor Register. The Cursor Register count is transmitted as data during a Read Cursor operation.

EDIT EFFECTS ON THE REGISTERS

GENERAL. Edit functions set the DMA mode into operation. DMA operation is a very rapid manipulation of the memory that suspends the normal write/refresh cycles. Edit functions cause the following effects on the Registers, which in turn control the memory.

INSERT LINE. Refer to Fig. 6-8. Initiating this function sets $\overline{DMA}$ active from the Edit Card. The Edit Card also sets $\overline{UP}$, $\overline{DOWN}$, and $\overline{HIY}$ active, and at $\overline{STEP}$ time loads the Y Cursor Register count into the Y Display Register. $\overline{CLRX}$ clears the X Display Register causing the output count to reflect the left margin position. The output of the Display Register is now the address for the memory. If a character

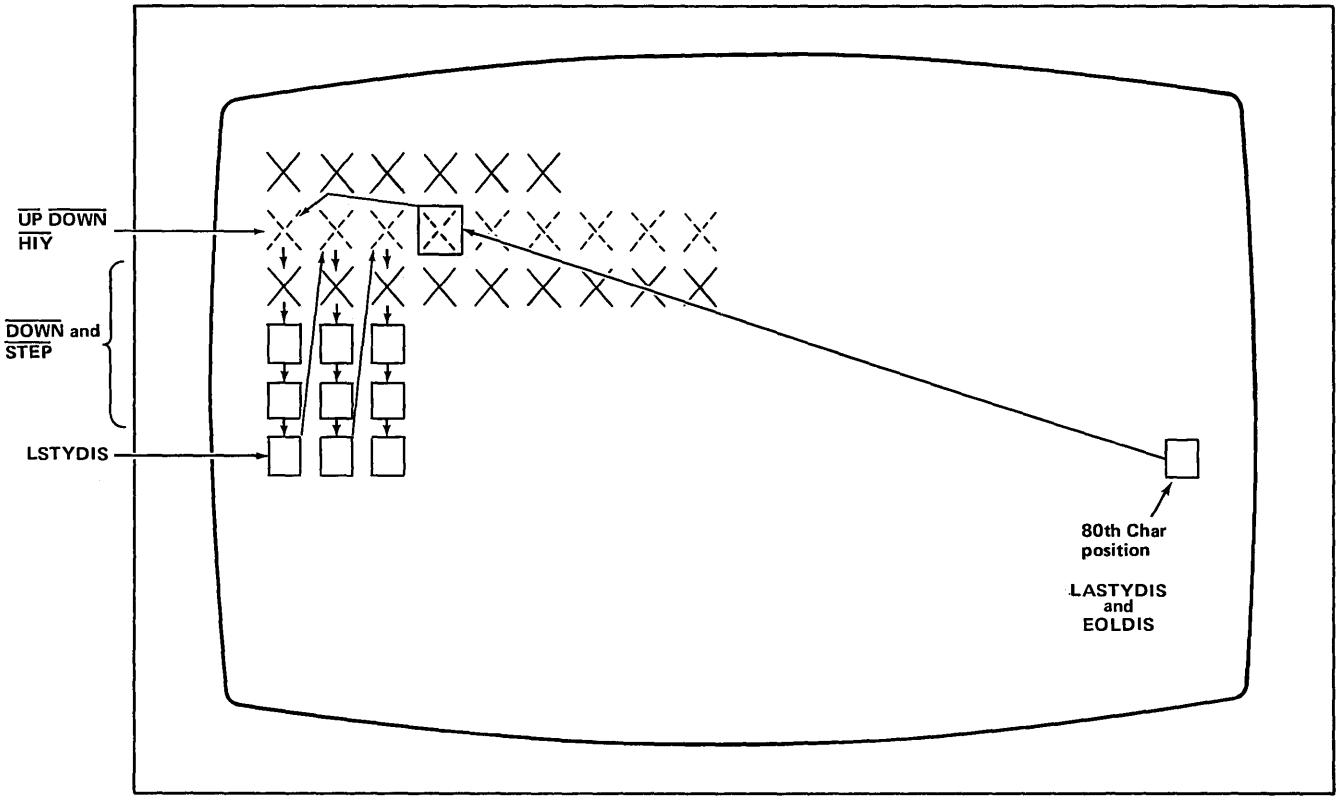


Fig. 6-8. Inserting a line (assume cursor is in 19th line).

resides in memory at this location, it is read from memory and latched into the Edit Card. $\overline{\text{DOWN}}$ remains true from the Edit Card causing $\overline{\text{STEP}}$ to increment the Y Display Register, addressing the character on the next line down. If a character resides at this position in memory, it is also read and latched into the Edit Card. A short time later (during the same $\overline{\text{STEP}}$ time) the first character that was latched into the Edit Card, is dumped back onto the minibus to be written back into the memory; but it is written down one line from its original position. The cycle repeats until LSTYDIS is sensed. Any characters in the last line are lost. LSTYDIS causes the Edit Card to simultaneously set $\overline{\text{UP}}$, $\overline{\text{DOWN}}$, and $\overline{\text{HIY}}$ to jam the Display Register count back to the Cursor Register count. $\overline{\text{RIGHT}}$ goes active for one $\overline{\text{STEP}}$ time to increment the X Display Register one character space to the right.

The above operations continue to repeat in the described sequence until LSTYDIS and EOLDIS are both active. This corresponds to the bottom line and the 80th character position. With the function completed, $\overline{\text{DMA}}$ goes false and the cursor address in the Cursor Register once again addresses the RAM. This is the position the cursor was in when the function was initiated. A line of SPACE (SP) characters now reside at the cursor location.

DELETE LINE. Refer to Fig. 6-9. Insert Line also sets $\overline{\text{DMA}}$ active. $\overline{\text{UP}}$ and $\overline{\text{DOWN}}$ are simultaneously asserted by the Edit Card to jam the Y Display Register to the bottom line (LSTYDIS). $\overline{\text{CLRX}}$ then causes the count from the Display Register to reflect the first character position on the bottom line; the character at that address is read from memory. If data resides in memory at that location, it is latched into the Edit Card. The Edit Card holds $\overline{\text{UP}}$ active so that the Y Display Register can be clocked by $\overline{\text{STEP}}$ signals. Each $\overline{\text{STEP}}$ time the display address moves up one line, latching a new character into the Edit Card latches and a short time later dumping the previous character back onto the minibus to be read back into the memory. However, it is read back into memory at a location that is one line above its old location. This cycle repeats until the Y Display Register count equals the count from the Y Cursor Register. At this time, YEQUAL goes true. $\overline{\text{UP}}$ and $\overline{\text{DOWN}}$ are again simultaneously asserted to jam the Y Display Register back to the bottom line (at $\overline{\text{STEP}}$ time). $\overline{\text{RIGHT}}$ is asserted and again at $\overline{\text{STEP}}$ time the X Display Register is increment to the next column of characters. Again, $\overline{\text{UP}}$ remains active so that the Y Display Register can be clocked by $\overline{\text{STEP}}$.

The afore-described process repeats until EOLDIS and YEQUAL go true. At this time $\overline{\text{DMA}}$ goes false and the

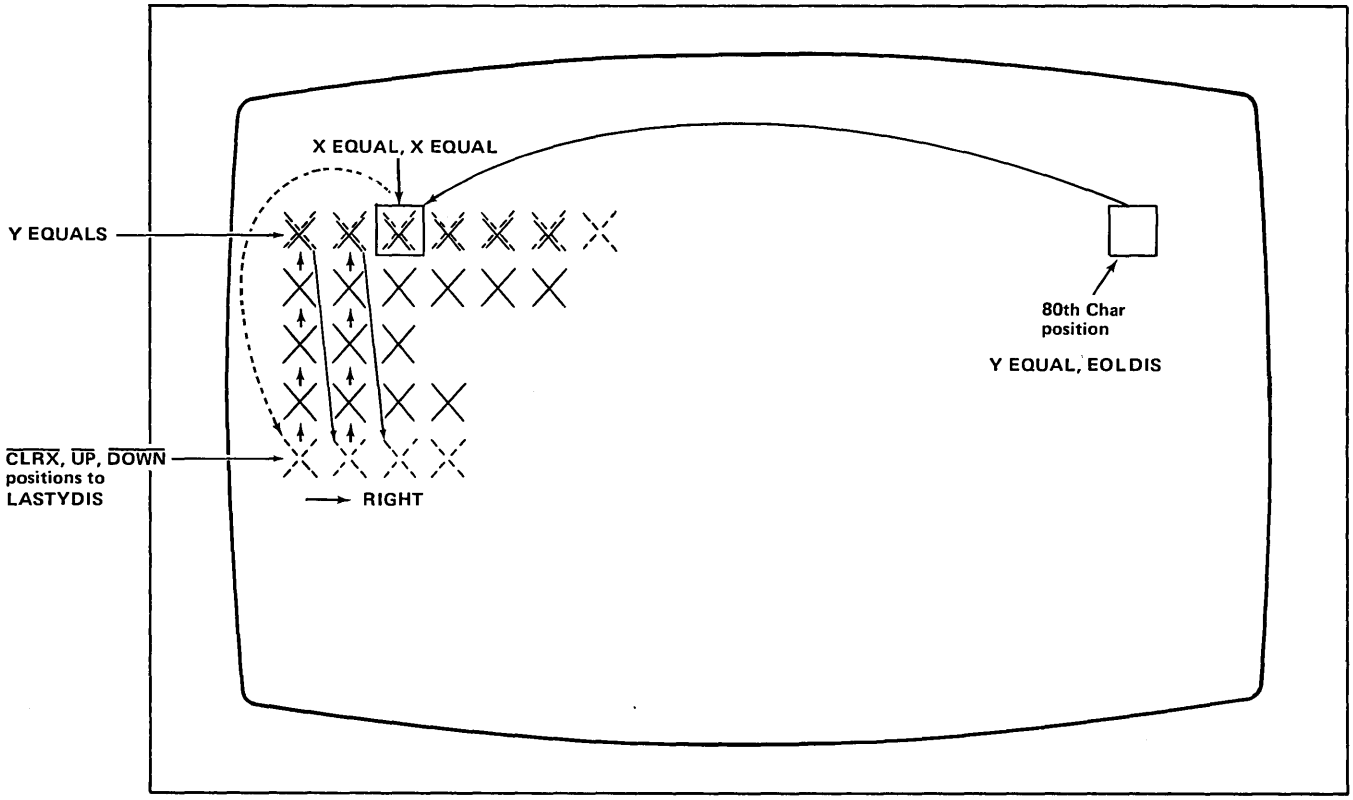


Fig. 6-9. Deleting a line.

RAM address reflects the count set by the Cursor Registers. A line of 80 NUL characters now reside on the bottom (last) line. The line of data at the cursor location (if any) is "deleted" and all lines below the cursor have moved up one line.

INSERT CHARACTER. Refer to Fig. 6-10A. Inserting a character places a SPACE character at the cursor location. Initiating this function activates $\overline{\text{DMA}}$ from the Edit Card. When the next XEQUAL occurs, $\overline{\text{LEFT}}$ at $\overline{\text{STEP}}$ time decrements the X Display Register one count. The count from the X Display Register reflects the address of the character preceding the cursor. This character is placed on the minibus and latched into the Edit Card. With $\overline{\text{RIGHT}}$ active, $\overline{\text{STEP}}$ increments the X Display Register to the next character position in that line. The character latched into the Edit Card is placed on the minibus, and written back into memory one space to the right. The character that previously resided in that position in memory has been latched into the Edit Card. The cycle repeats itself, moving all characters to the right one space, until EOLDIS is sensed (80th character position). $\overline{\text{DMA}}$ goes inactive and the cursor reappears. A space character has been entered at the cursor location. If a character has previously been stored in the 80th position, it is lost.

DELETE CHARACTER. Refer to Fig. 6-10B. $\overline{\text{DMA}}$ goes active from the Edit Card and $\overline{\text{LEFT}}$ and $\overline{\text{RIGHT}}$ simultaneously go active to jam the count in the X Display Register to reflect the end of the line. This occurs at $\overline{\text{STEP}}$ time, causing EOLDIS to go active. $\overline{\text{LEFT}}$ remains active and $\overline{\text{STEP}}$ decrements the X Display Register, alternately latching memory contents into and out of the Edit Card. When XEQUAL is sensed, $\overline{\text{DMA}}$ goes inactive. All data to the right of cursor is thus shifted left one space, the character at the cursor location is deleted. A NUL character resides in the character position at the end of the line.

CURSOR ADDRESSING AND READING

GENERAL. Steering of data and register contents is provided by the Cursor Register Card. When performing a Position Cursor or Read Cursor operation, the following occurs.

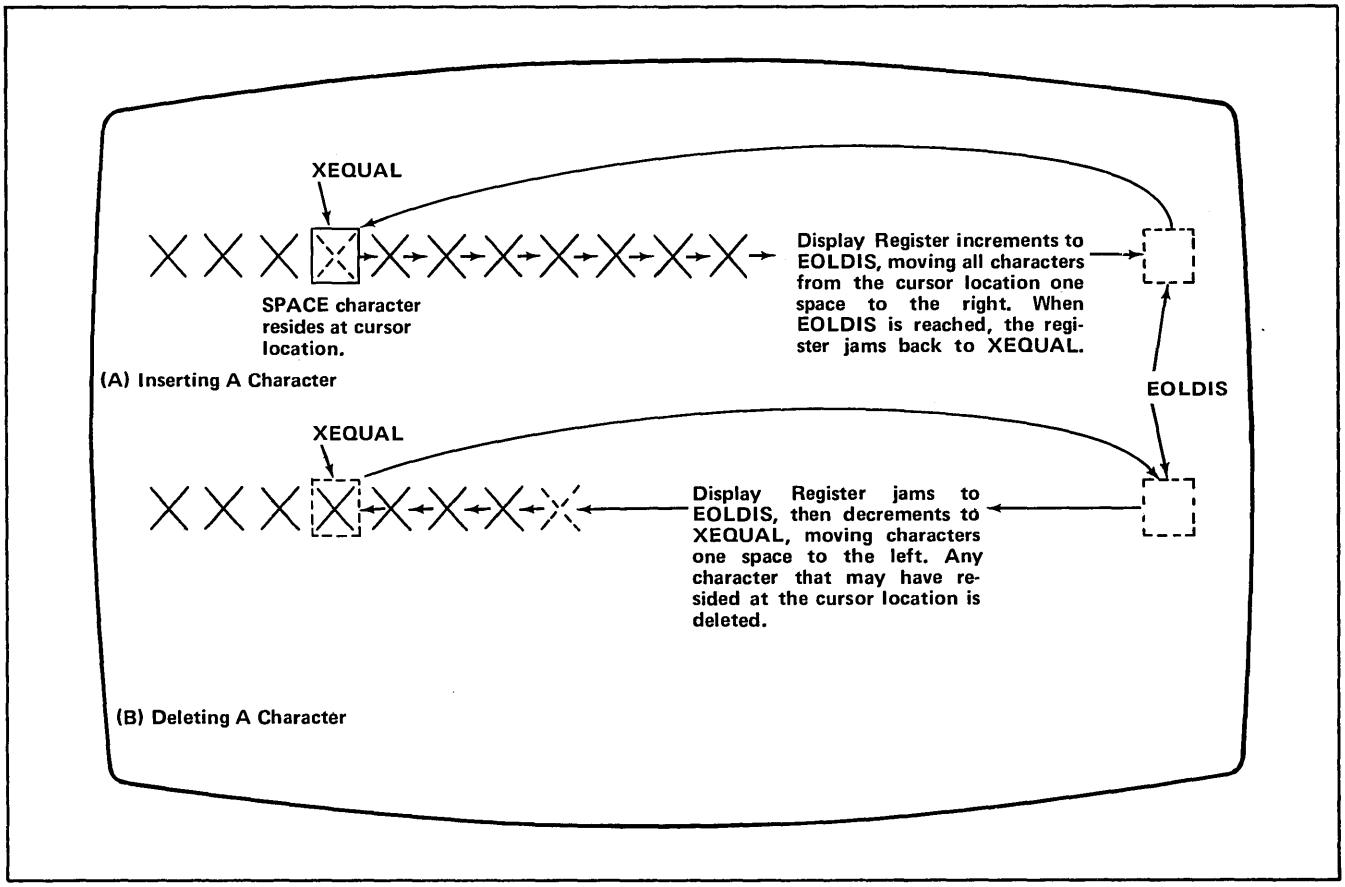


Fig. 6-10. Inserting and Deleting a character.

CURSOR POSITIONING. When the Cursor Registers are loaded with $\overline{BIT\ 1}$ – $\overline{BIT\ 7}$, the Register outputs reflect the state of the data inputs. This occurs when addressing the cursor to a specific character location. (Specific details on programming the cursor address can be found in the Programming Section of the User's Manual.)

Cursor addressing is initiated when Edit Card circuitry decodes the FS Control Character. Edit Card logic is then set to interpret the next two characters as "position cursor" data. The first character following FS sets $\overline{HIX}$ active from the Edit Card. This causes that character to be loaded into the X Cursor Register when $\overline{STORE}$ and STROBE are active. Gates, U111A, U319B, and U11C ensure that the character is a valid X address (not a Control Character). The next character is the Y address. It sets $\overline{HIY}$ active to load the character into the Y Cursor Register on the next con-current $\overline{STORE}$ and STROBE signals. Valid Y addresses are checked by U201D and U109B (not a control character or lower case). The count from the X and Y Cursor Register now reflects the new cursor location.

CURSOR READING. When the Edit Card circuitry decodes on ESC] sequence, it initiates the transmission of the GS Control Character. GS identifies the next two characters that follow as X and Y cursor position information, respectively. When the interface has completed transmission of GS, the trailing edge of $\overline{CSTROBE}$ enables $\overline{HIX}$ from the Edit Card. $\overline{HIX}$ at $\overline{READ}$ time causes Read Cursor Multiplexers U161 and U169 to sample the X cursor address. This address is placed on the minibus and transmitted. When this byte is transmitted, the trailing edge of $\overline{CSTROBE}$ enables $\overline{HIY}$ from the Edit Card. This time, the Y cursor address is placed on the minibus. Information on calculations performed by the program to arrive at the correct cursor address is provided in the Terminal User's Manual.

MISCELLANEOUS CIRCUITS

Circuitry not previously discussed is used for steering data and control signals, and for the effect of strappable options on the registers. This circuitry is fairly straightforward, so no further discussion on these circuits will be given.

SUMMARY OF REGISTER OPERATIONS

GENERAL. Logic on the Cursor Card uses $\overline{VSYNC}$, $\overline{DISPLAY}$ and $\overline{STEP}$ to clear the Y Display Register without a $\overline{CLRY}$ signal on the minibus. The X Display Register is cleared by a $\overline{CLRX}$ originating from the Timing Card.

The Cursor and Display Registers will not wrap-around by themselves. When either the high or low limit (0 and 79 respectively for X, and 0 and 23 or 11, respectively for Y) has been reached, the count stops, waiting for the End of line signals to enable a $\overline{CLRX}$ and $\overline{DOWN}$ from the keyboard Interface card. At this time the wrap-around occurs if enabled by the Wrap-around strap located on the Keyboard Interface card. "Register indicators" that control Register counting are:

EOLDIS — A high true signal that indicates the X Display Register has reached the 80th character position.

EOLCRS — Same as EOLDIS except this one corresponds to the Cursor Register.

LSTYDIS — A high true signal from the Y Display Register that corresponds to the bottom character line of the screen.

LSTYCRS — Same as LSTYDIS except this one corresponds to the Cursor Register.

$\overline{TOPCRS}$ — The Y Cursor Register outputs this signal when its count indicates the top character line.

$\overline{LEFTCRS}$ — The X Cursor Register outputs this signal when the count indicates the left-most character position.

Examples of Register counting are:

X Display Register — When $\overline{STEP}$ pulses at $\overline{RIGHT}$ time increment the count to 79, EOLDIS goes active to inhibit the effect of further $\overline{STEP}$ signals. $\overline{CLRX}$ must be sent to clear the Register and deactivate EOLDIS. When $\overline{STEP}$ pulses at $\overline{LEFT}$ time decrement the count to 0, $\overline{LEFTCRS}$ goes active to inhibit the Register's response to further $\overline{LEFT}$ counts. Incrementing the Register count deactivates $\overline{LEFTCRS}$.

X Cursor Register — Similar to X Display Register.

Y Display Register — When $\overline{STEP}$ pulses at $\overline{UP}$ time decrement the Register count to reflect the top character line, the Register stops counting. When $\overline{STEP}$ pulses at $\overline{DOWN}$ time increment the count to reflect the bottom character line (11 or 23 depending on 12 line option straps), LSTYDIS goes active to inhibit the Register's response to further increments. Sending $\overline{CLRY}$ deactivates LSTYDIS.

Y Cursor Register — Similar to Y Display Register except Y Cursor Register outputs $\overline{TOPCRS}$ to reflect the top line count.

PURPOSE OF CURSOR REGISTER. Writing data into the RAM at the address set by the Cursor Register is done when $\overline{HIX}$ and $\overline{HIY}$ are inactive This happens with a $\overline{TSTROBE}$ at $\overline{STROBE}$ and $\overline{STORE}$. However, if $\overline{HIX}$ is active at $\overline{STORE}$, minibus data will be preset into the X Cursor Register. The operation is the same for $\overline{HIY}$ and the character that addresses the Y Cursor Register. Table 6-4 summarizes data transfer on the minibus and its effects on the Registers.

TABLE 6-4

DATA EFFECT ON REGISTERS

$\overline{HIX}$	$\overline{HIY}$	$\overline{READ}$	$\overline{STORE}$
False	False	Data from RAM at cursor address	Data to RAM at cursor address
False	True	Y Cursor Coordinates to minibus	To Y Cursor Register from minibus
True	False	X Cursor Coordinates to minibus	To X Cursor Register from minibus

DIRECT MEMORY ACCESS (DMA) OPERATION. During DMA operation, the Cursor Register count does not change. Its output is used for comparison by the X Display Register. Depending on the Clear Page or Edit function being performed, the following signals perform their function on the Display Register at $\overline{STEP}$ time: $\overline{UP}$, $\overline{DOWN}$, $\overline{LEFT}$, $\overline{RIGHT}$, $\overline{CLRX}$, and $\overline{CLRY}$. The action performed by these register control signals occurs in the middle of $\overline{STEP}$ time. Summary of their operation during DMA time is given in Table 6-5.

TABLE 6-5

OPERATION OF REGISTER CONTROL COMMANDS IN DMA MODE (at $\overline{DISPLAY}$ and $\overline{STEP}$ time)

$\overline{HIX}$	$\overline{HIY}$	$\overline{UP}$ – $\overline{DOWN}$ SIGNALS			$\overline{LEFT}$ – $\overline{RIGHT}$ SIGNALS		
		$\overline{UP}$	$\overline{DOWN}$	$\overline{UP}$ AND $\overline{DOWN}$	$\overline{LEFT}$	$\overline{RIGHT}$	$\overline{LEFT}$ AND $\overline{RIGHT}$
False	False	Decrement Y Display Register	Increment Y Display Register	Preset Y Display Register to LSTYDIS (12th or 24th line)	Decrement X Display Register	Increment X Display Register	Preset X Display Register to EOLDIS
False	True			Transfer Y Cursor Coordinates to Y Display Register			
True	True or False						Transfer X Cursor Coordinates to X Display Register
		$\overline{DISPLAY}$		$\overline{DMA}$	$\overline{DISPLAY}$		$\overline{DMA}$

RANDOM ACCESS MEMORY (RAM) CARD

INTRODUCTION

Refer to the RAM Card schematic. A component location illustration is provided on the apron of the schematic. The RAM Card contains MOS RAMs which store data for screen display. Timing is provided by the Timing Card, data source is the minibus, and RAM address inputs come from the Cursor Card. Address inputs are BCD 0-79 for X and BCD 0-23 for Y. The RAM Card contains arithmetic logic that converts each distinct X – Y code into the proper RAM address equivalent. Miscellaneous circuits not connected with the operation of the RAM Card are the initialization circuit and the 4.9 MHz Crystal Oscillator.

OPERATION OF MAJOR CIRCUITS

INTRODUCTION. Data from the memory is placed on the minibus via a "read" operation. Data is placed in memory via a "write" operation.

The RAMs are shown at approximately the center of the schematic. Note the two sets. One set provides storage for the upper 12 lines (Set 2), the other set for the lower 12 lines (Set 1).

SELECTING THE RAM SET. The specific set is selected by the Set Selector and the Upper and Lower Set Enable Gates, U155B and U155A, respectively. When the cursor moves into the 13th line, the output of the U345C changes, disabling U155B and enabling U155A. Thus, the RAM address is "steered" to the applicable set of RAMs. When cut, the 12 LINE RAM strap (in the Read to Minibus Enable Circuit) disables the output amplifiers when moving the cursor past the 12th line.

READ/WRITE ENABLING. The Read/Write input (pin 3) of the RAM is dual purpose. A low at this input tells the RAM that data on pin 11 is to be written into memory at the address determined by the Row and Column Address Inputs. The Chip Enable Input (pin 13) must be low to write (store) into memory.

The Read/Write Input is controlled by the output of U141B. The operation of this gate and associated circuitry can be reviewed in conjuction with the timing diagram provided in Fig. 6-11.

U347 will not allow data to be written unless a $\overline{\text{TSTROBE}}$ occurs with $\overline{\text{STORE}}$ or $\overline{\text{DMA}}$. Reviewing the minibus signal descriptions of the remaining inputs to U347 will tell what conditions inhibit writing into memory.

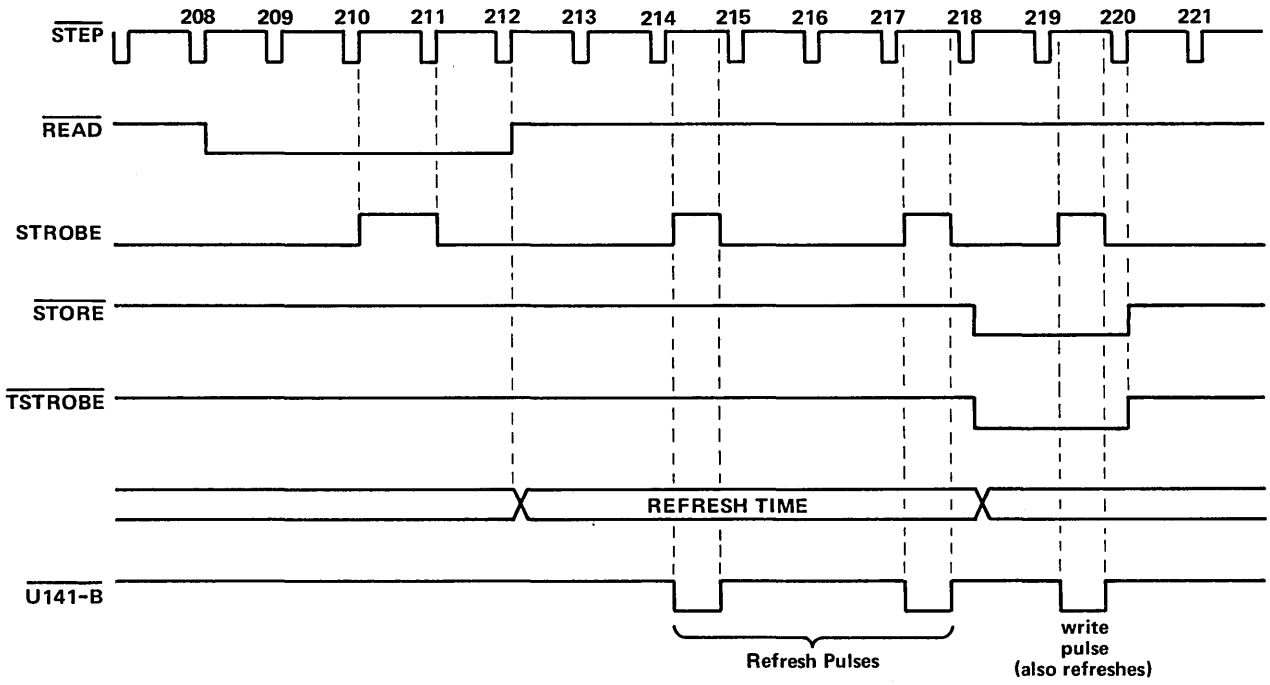


Fig. 6-11. RAM write timing.

Reading is accomplished with the Read/Write Input held high. Data output from the RAM directly follows the application of an address at the Row and Column Inputs.

RAM REFRESHING. The dynamic memory cell used in the RAM will not store data indefinitely. Stored data is "refreshed" in the RAM at the rate of 32 bit locations every 190.8 μs. Rewriting is accomplished internally without the need to re-apply external data.

Refreshing is accomplished during both the write cycle (previously discussed) and the Refresh Cycle. During a write cycle the state of the row address (R1-R5) not only determines which row the written character will be stored in, but also refreshes all 32 bits residing in that row. However, writing data into memory does not ensure that each of the 32 possible row addresses is refreshed in the time necessary to retain memory; therefore, Refresh Circuitry is provided.

The refresh cycle is identical to the write cycle except that the RAMs are disabled while the Read/Write Input is pulsed. Disabling the RAMs removes the data output and also prevents data at the Data Input from being written into memory. A refresh cycle consists of 32 address changes and associated write pulses.

The Refresh Circuitry consists of U341B, U321A, U45, U341A, and U321D. Refer to the timing diagram in Fig. 6-11. This is a partial illustration of the timing conditions that occur during horizontal retrace. The period of time between the trailing edge of $\overline{\text{READ}}$ and the leading edge of $\overline{\text{STORE}}$ is reserved for memory refreshing. During this time, a low $\overline{\text{REFRESH}}$ signal from U311F enables a high from U321C. This enables the STROBE signal to pulse the output of U141B twice during the low time of $\overline{\text{REFRESH}}$. Each low-going "write" pulse from U141B refreshes 32 bit locations.

The $\overline{\text{REFRESH}}$ signal is a result of the high from U341B that has been enabled by the trailing edge of $\overline{\text{READ}}$. The Q output of U341B is inverted by U311F to enable a high from U321C (as previously mentioned) and also disable the SET 1 and SET 2 outputs. Thus the RAMs are disabled for refreshing.

To ensure that each of the 32 RAM rows is refreshed, refresh memory is provided by U45, U341A, and U321D. The high output of U341B enables $\overline{\text{STEP}}$ to pulse the output of U321A twice during each sweep. This provides two clock pulses for the input of U45. U45 is a 4-bit binary counter with outputs to Row Multiplexer, U51. The outputs of U51 are controlled by the level on pin 1. If it is low, (not refresh time) the X1-X4 inputs from the Cursor Card affect the row address; if high (Refresh Time) the U45 outputs affect row address. Row 16 of the Refresh Row Address is provided by U341A and U321D.

In summary, the Refresh Circuitry provides 2 $\overline{\text{REFRESH}}$ pulses every horizontal sweep. Thus, the entire memory is refreshed every 16 sweeps. A refresh cycle takes approximately 100 μs (16 x 6.36 = 101.76 μs).

READ TO MINIBUS ENABLE. This circuitry controls whether or not data read from the RAM's is placed on the minibus. Data is read from the RAM's during a Normal Read operation, Read Cursor operation, and during a DMA operation.

ADDRESS DECODING. The position in which a character is to be written in the RAM or the position that is to be read from the RAM depends on the state of the 5 column and 5 row address inputs. In turn, these address inputs depend on the 7X and 5Y outputs from the Cursor Card.

The outputs from the Cursor Card are binary counts of 0-79 for X and 0-23 for Y. The position represented by these inputs must be arithmetically decoded into their RAM address equivalent. This is the purpose of the RAM Address Decoding (80Y + X) Circuitry.

SENSE AMPS

These amplifiers are used to amplify data from the RAMs before the data is placed onto the minibus.

MISCELLANEOUS CIRCUITS

INITIALIZING CIRCUIT. This circuit consists of U371 and associated circuitry. When power is initialized, a momentary low at pin 2 activates $\overline{\text{PAGE}}$ to trigger a Clear Page function. This ensures that the memory is cleared and the cursor is positioned at home. $\overline{\text{PAGE}}$ also trigger $\overline{\text{KEYGATE}}$ from the Keyboard Interface Card to reset U371A.

4.9 MHz CRYSTAL OSCILLATOR. This oscillator provides 4.9 MHz and 614 kHz (4.9 MHz ÷ 8) square waves for interface timing requirements.

EDIT CARD

INTRODUCTION

Refer to the Edit Card schematic. A component location illustration is provided on the apron of the schematic. Because the operation of this card and the Cursor and RAM cards are so inter-related, an over-view of Edit Card functional operation is provided. Fig. 6-12 is a Block Diagram of the Edit, Cursor, and RAM Cards.

Assume the operator initiates an edit function. The Edit Card recognizes the function to be performed and, in proper timing order, activates the required Register Control signals ($\overline{UP}$, $\overline{DOWN}$, $\overline{LEFT}$, $\overline{RIGHT}$, $\overline{HIY}$, $\overline{CLRX}$, etc.). These Register Control signals, together with timing inputs, increment or decrement the registers to obtain data addresses for the RAM card. The data is read from the RAM and latched into the Edit Card for a two-character time delay, before being placed back onto the minibus and read back into memory. The delay time allows time for the X and Y Display Register to increment or decrement (depending on the DMA function being performed) before the character previously read is written back into memory. This provides a new address for the character to be written into memory and is one character to the left, right, up, or down from its original position.

Register Indicators originate as outputs from the Registers on the Cursor Card, and they perform a dual function on the Edit Card. Not only do they tell the Edit Card when the function is complete, but they also control how the Registers are manipulated by the Register Control Signals to perform the Edit function.

The process of reading data from the RAM into the Edit Card before it is displayed is necessary to perform the edit functions. Normally, data in memory is "refreshed" by refresh circuitry on the RAM card at a rate that ensures memory is sustained. However, during Direct Memory Access (DMA), the normal refresh cycle is suspended. Instead, data is read from and written back into memory at a rate (determined by DMA timing) that ensures that memory is sustained. DMA operation occurs during edit, roll-up, clear page, and erase input functions.

EDIT CIRCUITS

The Edit circuits are DEL/INS and DMA Latches, Edit Control for Registers, Edit Data Latches, and the Edit Function Complete circuit. They will be discussed in that order.

DEL/INS AND DMA LATCHES. Initiating an Edit function causes $\overline{BOUNCE}$ to go active. $\overline{BOUNCE}$ enters the Keyboard Interface Card which generates $\overline{KEYGATE}$. $\overline{KEYGATE}$ clocks data into U229, the DEL/INS Latch, at $\overline{STEP}$ time. When XEQUAL and YEQUAL become true,

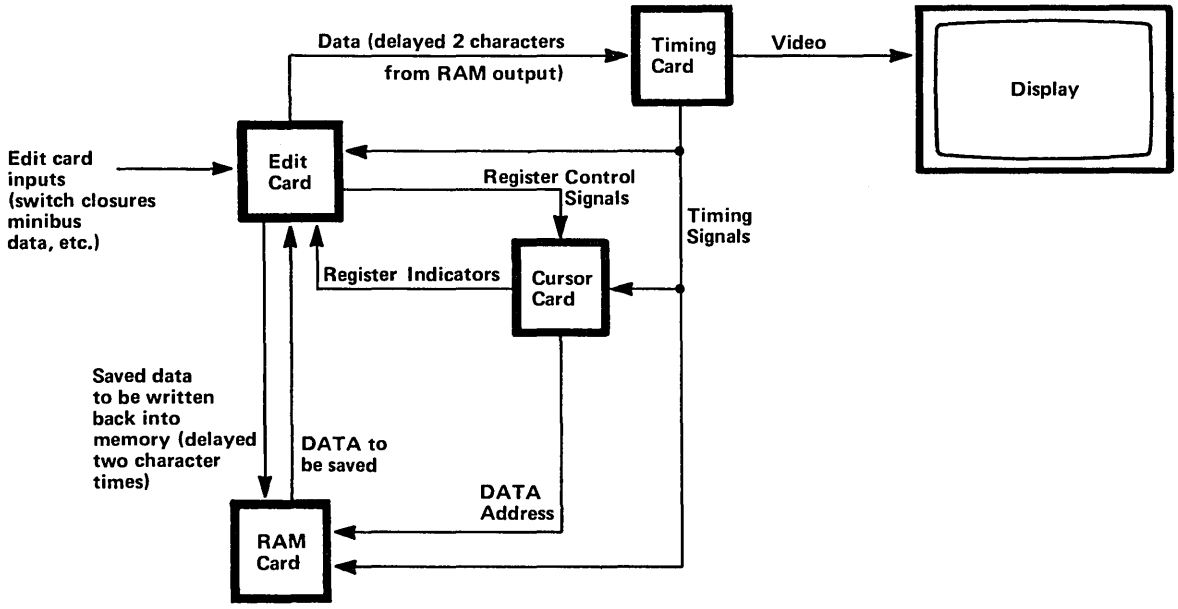


Fig. 6-12. Relation between Edit, Cursor, and RAM cards.

the output of U229 is clocked into DMA Latch U129, which is clocked by the high-going output of U241A. (The input to U241A that goes high to enable the high-going output, depends on the edit function being performed.) $\overline{DMA}$ becomes true, and the Register Control Signals ($\overline{UP}$, $\overline{DOWN}$, $\overline{LEFT}$, $\overline{RIGHT}$, $\overline{CLRX}$, $\overline{CLRY}$, and $\overline{HIY}$) are set in a combination that performs the commanded Edit function. More detailed information on how these outputs affect the Cursor and Display Registers can be found under "Edit Functions" in the Cursor Card Description.

EDIT DATA LATCHES (TWO CHARACTER DELAY). During Edit operations, two sets of data latches provide a means whereby data can be read from memory, stored in the latches, then re-written back into memory. The data is either deleted, or it is written back into memory one character space to the left, right, up, or down from the position it originally occupied in memory. This function is provided by D Latch 1 and D Latch 2.

DMA goes active for the duration of the Edit function, and causes the Edit Data Latches to be cleared. $\overline{STEP}$ also changes from a repetition rate of 636 ns to 1.9 μs. The 1.9 μs allows time for the following to occur:

1. The cursor address changes.

2. A character is read at that address and latched into D Latch 1.

3. A character is sent from D Latch 2 and read back into a different position in memory.

The next $\overline{STEP}$ signal addresses a new character to be read from memory and the cycle repeats until the Edit function is completed.

EDIT FUNCTION COMPLETE CIRCUIT. When the high level that clocks U129 ends, the Q output of U29A (Latch Clear and Pulser Flip/Flop) goes high. This high output is clocked into U29B on the trailing edge of $\overline{STEP}$. The low $\overline{Q}$ output then clears the INS/DEL Latch. The DMA Latch is cleared when the Edit function is completed, as indicated by the Register Indicator Signals, EOLDIS, LSTYDIS, XEQUAL, and YEQUAL.

ROLL-UP CIRCUITRY

GENERAL. Roll-up occurs in Direct mode when attempting to line feed past the 24th line (or 12th line if strapped for 12 line operation). Note that roll-up can be disabled by cutting the NO ROLL-UP strap, then strapping to ground. The roll-up sequence is to jam the cursor to the top of the screen, perform a Delete Line function, then jam the cursor back to the bottom line. Roll-up is controlled by the Roll-up Set circuit, Roll-up Complete Circuit, and the LSTY CRS Circuit.

ROLL-UP SET. The Roll-up circuitry is "armed" by the DIRECT signal. When LSTY CRS goes active, and $\overline{DOWN}$ is active, the next $\overline{EXECUTE}$ time enables $\overline{STEP}$ to clock a low from U239B through U499A. This enables $\overline{CLRY}$ from U439B and also triggers a Delete Line function, moving all lines on the display up one line.

ROLL-UP COMPLETE CIRCUIT. When the output of U499 returns high, a low-going signal from U431C clocks U1A in the Roll-up Complete circuit. A high is clocked to the Q output. High levels are now placed on two inputs of U109B. After the Delete Line function is completed, a low pulse from U131A is inverted by U431E to enable a low output from U109B. The Jam Count Flip/Flop, U9B, becomes zero-set, enabling the outputs from the Jam Count Set circuit. This jams the Y Cursor Register back to the bottom line.

LSTY CRS CIRCUIT. This circuit goes into operation at the end of the roll-up function. It inserts a bit content that is latched into the Y Cursor Register by $\overline{HIY}$. The 12-Line Roll strap is cut when only 12 lines are used.

ROLL-UP 4 ONLY. When strapped for 4-line roll-up DIRECT also arms U301C. When the low output from U499 ends, the high-going signal from U431A enables a low from U301C, which clocks the ÷4 counter. The fourth roll-up to occur enables a high level from pin 11 of U201 to inhibit further roll-ups. This circuit is reset by clearing the page or by pressing the RESET button.

READ CURSOR POSITION

This function is performed by the Read Cursor Position circuit. When ESC followed by] (closing bracket—93_{10}) is decoded, a SEND CURSOR ADDRESS signal from U379A triggers the Read Cursor circuitry. The Q output of U169A goes high to enable the GS character bit configuration to be transmitted at the next $\overline{STORE}$ and STROBE times. $\overline{STORE}$ enables the GS character; STROBE enables $\overline{CSTROBE}$. (See Timing illustration in Fig. 6-4, Part B.) When $\overline{CBUSY}$ ends and the next $\overline{READ}$ time occurs, STROBE enables $\overline{CSTROBE}$ and also clocks the high Q output from U169A to U149B. The high from U149B subsequently enables $\overline{HIX}$, causing the X Cursor Register

contents to be placed on the minibus and transmitted. Again, when $\overline{CBUSY}$ ends, STROBE at $\overline{READ}$ time enables $\overline{HIY}$, causing the Y Cursor Register contents to be transmitted.

CURSOR POSITIONING

Sending FS causes the next two characters received by the Terminal to be interpreted as Position Cursor information. When the FS Control Character is decoded by the Decoding Circuit, a low output from the FS Decoder, U379A, enables the Position Cursor circuit. The output of U71B is set to a high level and the next character received by the Terminal sets $\overline{TSTROBE}$, which subsequently enables $\overline{HIX}$ from U471D. $\overline{HIX}$ loads the character on the minibus into the X Cursor Register, whose output changes to reflect the new X Cursor location. The following character sets $\overline{HIY}$ active to strobe the Y address into the Y Cursor Register. The cursor position now reflects the new position.

CHARACTER DECODING CIRCUIT

This circuit provides decoding for the characters that control Cursor Positioning, Cursor Addressing, Rulings Set, FAC Set, Tab, and Backtab functions. This circuit is divided into three basic operating functions, the 3 MSB (Most Significant Bit) Decoder, the 4 LSB (Least Significant Bit) Decoder, and the Character Detect Gates.

The ESC] Gate, U279C, is only enabled when ESC precedes the] character. ($\overline{LCE}$ goes active from the Control Card when the ESC character is detected on the minibus.) The remainder of the circuitry provides decoding for the following Control Characters:

TABLE 6-6

CONTROL CHARACTER FUNCTIONS

CONTROL CHARACTER	FUNCTION
FS	Sets Position Cursor Operation
HT	Initiates Tab Function
VT	Initiates Backtab Function
SI	Sets $\overline{BIT\ 9}$ active to identify $\overline{BITS\ 1\text{-}7}$ as a ruling character. With $\overline{BIT\ 9}$ active, a ruling character is displayed instead of the normal ASCII character identified by the bit configuration.
SO	Deactivates $\overline{BIT\ 9}$
US	Sets $\overline{BIT\ 8}$ active to identify $\overline{BITS\ 1\text{-}7}$ as a Field Attribute Code.

BIT 8 AND BIT 9 SET

This circuit performs the functions as described under the SI, SO, and US Control Character descriptions above.

TAB/BACKTAB CIRCUITS

GENERAL. The Tab circuitry is located at the bottom of the schematic. The main purpose of this circuitry is to provide tabbing for the cursor from one unprotected field to the next in a form Fill-Out operation. Forward-tabbing or backtabbing is provided. These circuits provide no useful function when the DIRECT/BUFFER switch is at DIRECT. Forward tabbing in Direct causes the cursor to space once, then stop; backtabbing in Direct is prohibited.

TABBING. Sending the HT Control Character is one way of initiating the Tabbing function. When in Buffer, and HT is decoded, a low $\overline{TAB}$ signal from U379C one-sets U41B, setting the Q output high. The Terminal goes buys during the Tab function ($\overline{TBUSY}$ is active). Also, the cursor is blanked by $\overline{HCUBUSY}$ while the registers are being manipulated. The $\overline{RIGHT}$ signal goes active to increment the X Cursor Register one count each $\overline{EXECUTE}$ time. When the Register addresses a character from the RAM that is a FAC, the Protected/Unprotected circuitry checks to see if it is protected or not. If protected, the X Register continues to increment until either an unprotected field or the end of the line is reached. If the end of the line is reached before a FAC is detected, $\overline{CLRX}$ goes active to clear the X Register; $\overline{DOWN}$ increments the Y Register one count; $\overline{RIGHT}$ remains active and the X Register counts up once again. The cycle repeats until an unprotected FAC is detected, the X Register increments one more count, then stops. $\overline{TBUSY}$ and $\overline{HCUBUSY}$ end, and the cursor is displayed one character past the FAC that defines the unprotected field.

BACKTABBING. When the Terminal receives the VT Control Character, backtabbing occurs. As with Tab, backtabbing is used when Field Attribute Codes reside in memory. However, backtabbing positions the cursor back to the first character position in the preceding unprotected field. The FAC that defines the field that the cursor may reside in is ignored, whether the field is protected or unprotected.

Basically, the backtabbing function operates in reverse of the forward tabbing function. The cursor is blanked by $\overline{HCUBUSY}$ and $\overline{TBUSY}$ goes active. Register Control outputs are set to move the cursor to the left and up until an unprotected field is detected. At this time, cursor movement stops. The X Cursor Register is then incre-

mented one count to move the cursor one space to the right of the FAC.

DISPLAY CIRCUITS

GENERAL

Refer to the Monitor schematic. The Monitor consists of the following circuits: Vertical, Horizontal, Power Supply, Video, Brightness, and Focus. They will be discussed in that order. Waveforms associated with the circuit are shown in Fig. 6-13.

VERTICAL

The Vertical circuit provides a raster for the display. The ramp is generated by C105, C106, Q102, R115, and R116. C105 and C106 repeatedly charge up to a point that causes Q102 to conduct. C105 and C106 then discharge through R120 and Q102. Q102 ceases to conduct. The ramp developed by C105 and C106 is applied to the base of Q103. This ramp is felt at the emitter of Q103, where part of it is picked off by R124 and applied to Q104 to control the current through vertical yoke coils L1 and L2. A vertical drive signal (with a frequency slightly higher than the free-running frequency of C105-C106-Q102) is applied through R113 and C104. As the voltage at the anode of Q102 increases due to the C105-C106 charge, a negative-going V DRIVE pulse is applied to the gate of Q102 to cause Q102 to go into conduction. Therefore, the frequency of the circuit is slaved to the negative pulse received on the V DRIVE line.

R116 controls the free-running frequency of the circuit by controlling the charge rate of C105-C106, and is adjusted as necessary to permit the V DRIVE signal to control the circuit frequency. Feedback that controls linearity is adjustable by R121. Height can be controlled by R124.

HORIZONTAL

To obtain a signal appropriate for driving horizontal output transistor Q106, a driver stage consisting of Q105

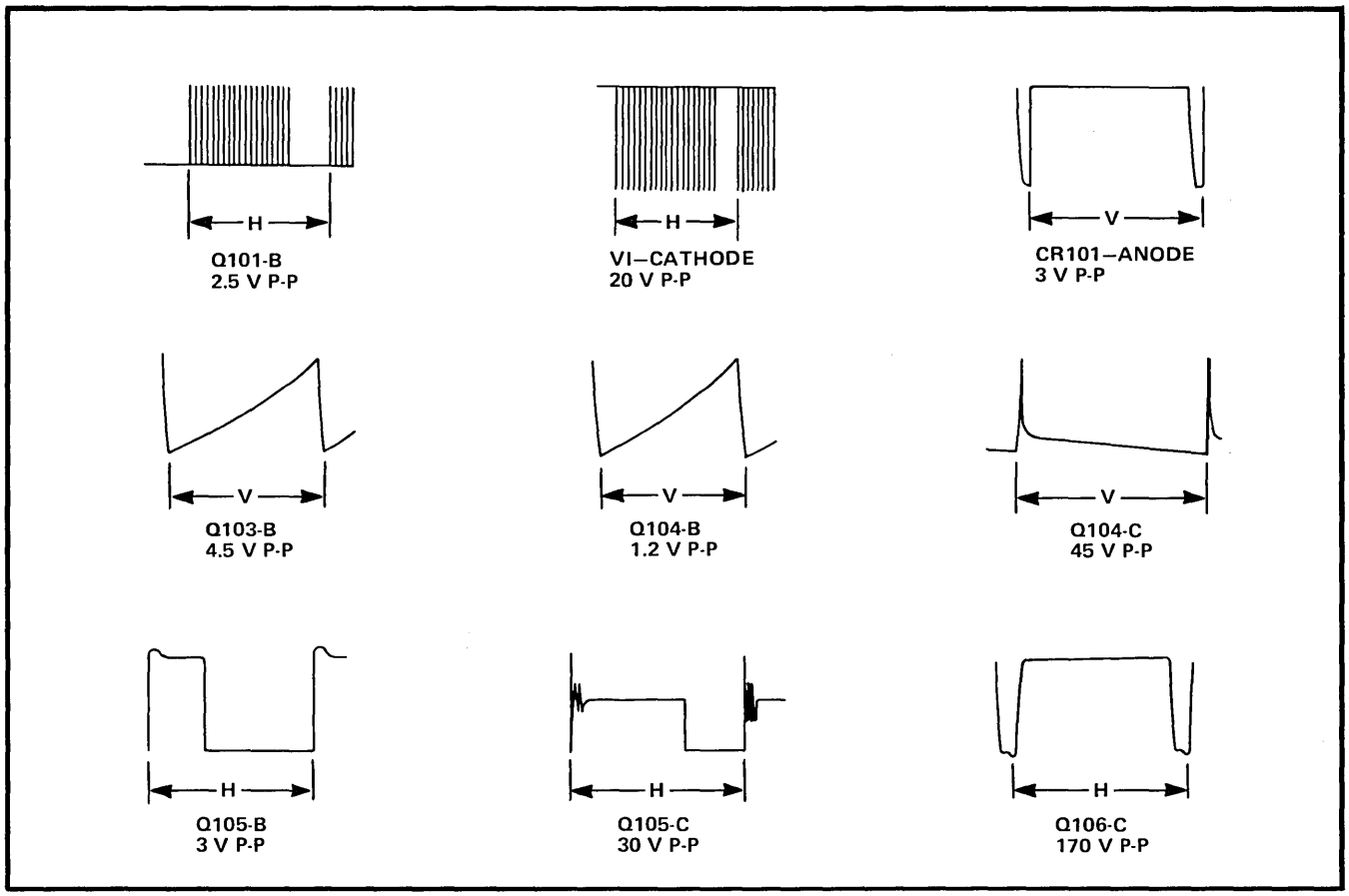


Fig. 6-13. Display waveforms.

and T101 is used. A positive-going pulse is coupled through R127 to the base of Q105. The driver stage is either cut off or driven into saturation by the base signal. The output signal appears as a rectangular waveform and is transformer-coupled to the base of the horizontal output stage. The polarity of the voltage at the secondary of the driver transformer is chosen such that Q106 is cut off when Q105 conducts and vice versa.

During conduction of the driver transistor, energy is stored in the coupling transformer. The voltage at the secondary is then positive at the base of Q106, keeping it cut off. As soon as the primary current of T101 is interrupted (due to the base signal driving Q105 into cut off), the secondary voltage changes polarity. Q106 starts conducting, and its base current flows. This gradually decreases at a rate determined by the transformer inductance and circuit resistance.

Q106 acts as a switch that is turned on or off by the rectangular waveform on the base. When Q106 is turned on, the supply voltage, plus the charge on C113, causes yoke current to increase in a linear manner and moves the beam from near the center of the screen to the right side. At this time, the transistor is turned off by a positive voltage on its base, which causes the output circuit to oscillate. A high reactive voltage in the form of a half-cycle, negative voltage pulse is developed by the yoke inductance and the primary of T2. The peak magnetic energy that was stored in the yoke during scan time is then transferred to C109 and the yoke's distributed capacity. During this cycle, the beam is returned to the center of the screen.

The distributed capacity now discharges into the yoke and induces a current in a direction opposite to the current of the previous part of the cycle. The magnetic field thus created around the yoke moves the scanning beam to the left of the screen.

After slightly more than half a cycle, the voltage across C109 biases the damper diode CR103 into conduction and prevents the flyback pulse from oscillating. The magnetic energy that was stored in the yoke from the discharge of the distributed capacity is released to provide sweep for the first half of scan and to charge C113 through the rectifying action of the damper diode. The beam is then at the center of the screen. The cycle will repeat as soon as the base voltage of Q106 becomes negative.

C113, in series with the yoke, serves to block dc currents through the yoke and to provide "S" shaping of the current waveform. "S" shaping compensates for stretching at the left and right sides of the picture tube. (Stretching would otherwise occur because the curvature of the crt face and the deflected beam do not describe the same arc.)

L101 is an adjustable width control placed in series with the horizontal deflection coils. The variable inductive reactance allows a greater or lesser amount of the deflection current to flow through the horizontal yoke and, therefore varies the width of the horizontal scan.

POWER SUPPLY. The negative flyback pulse developed during horizontal retrace time is rectified by CR104 and filtered by C110. This produces approximately −160 Vdc, which is coupled through the brightness control to the coaxial grid of the crt (V1).

This same negative flyback pulse is transformer-coupled to the secondary of transformer T2 where it is rectified by CR2, CR106, and CR105 to produce rectified voltages of approximately +12 kV, +400 V and +34 V, respectively. 12 kV is the anode voltage for the crt; +400 Vdc serves as the source voltage for grids No. 2 and 4 (focus grid) of the crt. The +34 Vdc potential is the supply voltage for the video output amplifier, Q101.

VIDEO

This circuit consists of a single stage amplifier (Q101) with a gain of about 17. The wiper of the CONTRAST control picks off a portion of the incoming video signal and applies it through R109 to the base of Q101. The resulting signal from the collector of Q101 is then applied to the cathode of the crt.

BRIGHTNESS

This passive circuit uses voltage-divider action to determine the control grid voltage, establishing cathode-to-grid bias. (Both the cathode and control grid are referenced to +34 V.) An arc suppression circuit prevents excessive voltage difference from developing between the control grid and other tube elements.

FOCUS

This is also a passive circuit, using voltage divider action, adjustable control, and arc suppression in a manner similar to the Brightness circuit. Since the circuit is dependent upon crt cathode current for the actual voltage being impressed on the crt elements, the FOCUS setting is highly

dependent upon the BRIGHTNESS and CONTRAST settings.

TABLE 6-7

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE REMEDY
1. Screen is dark	Check "A" bus Q106, Q105, CR2
2. Loss of video	CR105, Q101
3. Power consumption is too high	Check horizontal drive waveform; Check proper placement of horizontal linearity sleeve; Check Q105, Q106

POWER SUPPLY

Refer to the Power Supply schematic. Component locations are provided on the apron of the schematic. The power supply has regulated outputs of +15, +5, −12, and −5 volts. All of these supplies obtain their power from conventional, fullwave bridge rectifiers. The −12 and −5 volt supplies are connected in series aiding, with the current source for the −5 volt supply being the −12 volt supply.

All supplies are referenced to the adjustable +15 volt supply, and all supplies use remote sensing. Each supply contains "safety resistors" for supply protection in the event the supply load is disconnected. These resistors and the supply protected are:

R24	+15 Volts
R201	+5 Volts
R44	−12 Volts
R10	−5 Volts
R20	Ground
R21	

+15-VOLT SUPPLY

The +15 Volt supply uses an integrated-circuit regulator. Reference voltage is provided at the top of R256 and is input on pin 6 of U123. Supply adjustment is provided by R258, with the wiper also supplying the reference input for the +5-Volt supply. Q241 provides drive, while Q1105 is the Series-Pass transistor. R207 and R208 are the current-limiting resistors.

−12 AND −5 VOLT SUPPLIES

Regulation for these supplies is provided by U55 (−12) and U52 (−5). Reference voltage is supplied by the +15 Volt supply. −12 Volt sensing is applied to pin 3 of U55. Regulation occurs as follows: when the −12 sense line becomes more negative, the potential on pin 6 of U55 also lowers. The base of U357 subsequently becomes more negative, causing its emitter potential to lower. This in turn limits the drive voltage to the Series-Pass Transistor, Q1118, causing current flow through it to decrease. This decreases (makes more positive) the −12 Volt Supply. The opposite occurs when the −12 Volt Sense line goes more positive.

Current limiting for both the −12 and −5 Volt supplies is provided by Q55, R58, and R356. When the current through R58 and R356 increases to a point where 0.6 volts is felt at the base of Q55, Q55 turns on. This turns off the drive from Q357, shutting down the supply.

The −5 Volt supply has the sensing voltage applied to the negative input of U52. When the −5 Volt Sense line goes more negative, pin 6 of U252 becomes more positive. This decreases the bias on Q53, bringing the output back to −5 Volts.

+5 VOLT SUPPLY

The reference voltage for this supply is obtained from the wiper of R258 in the +15 Volt supply. R203 and C209 bring the +5 Volt supply up slowly when power is turned on. Regulation occurs as follows: when the +5 Volt Sensing line becomes more positive, the output of U205 also becomes more positive. This decreases the bias to Q109, which in turn causes the drive from Q1110 to decrease. This decreases the current through Q1112, which lowers the +5 Volt supply. A lowering of the voltage on the +5 Volt Sensing line has an opposite effect on the regulator circuitry.

CURRENT LIMITING. Foldback current limiting is provided by Q29, Q38, and associated circuitry. Resistors R40-R43 provide the foldback (decrease) in current as the voltage decreases. Operation is as follows: when the voltage drops to a level that is sufficient to bias Q38 off, Q29 turns on. R47 sets the point at which current limiting occurs. The decrease in collector voltage of Q29 biases Q110 into conduction. This limits the drive to Q1112, shutting down the supply.

OVER-VOLTAGE PROTECTION. Over-voltage protection is provided by a "crow-bar" circuit consisting of Q1114, VR306, and Q305. VR306 provides a 5.6-volt reference to the base of Q305. Should the voltage on the emitter increase to 6.2 volts, Q305 is biased into conduction. When the voltage at the gate of Q1114 increases to approximately 1.2 volts, Q1114 conducts and immediately lowers the +5 volt line to approximately 1 volt. The associated surge of current causes F1007 to open up, removing power from the circuit.

WIRING AND SIGNAL INFORMATION

WIRING

The following interconnecting references are provided to facilitate signal tracing:

Wire List—Provides a listing of signal path by cable number.

Wiring and Block Diagrams (Fig. 6-14 and 6-15)—Shows location and identity of connectors.

Motherboard Diagrams (Fig. 6-17 and 6-18)—Shows connector locations and lists interconnecting lines.

From/To Addresses (contained on the schematics)—Lists source or destination of subject signal. Signals that do not contain a To/From address will have a specific minibus pin number. The signal on that pin number is applicable to the same pins on all cards that can be inserted into the minibus connectors, J1-J9.

Minibus Signal Listing and Descriptions—An alphabetic signal listing of all signals common to the minibus that describes the signal function, also showing the card(s) from which it originates and the card(s) that uses (use) the signal. This information can be found immediately following the wiring information.

HOW TO USE THE WIRING INFORMATION

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 harmonica connector, go to that connector in the Wire List. If it is a card-edge connector (minibus signal) go to that connector on the Motherboard diagram. Opposite the connector and pin number is listed the interconnecting point or points.

Example 1. Follow $\overline{\text{HIY}}$ to its destination. Since $\overline{\text{HIY}}$ is a card that inserts into the minibus, its connector is common to pin J on all cards connected to the minibus. To determine if the signal goes elsewhere, look on the Motherboard diagram under minibus pin J. No other points are listed. For more information on $\overline{\text{HIY}}$ refer to the Minibus Signal Listing.

Example 2. Follow $\overline{\text{MAKE COPY}}$. Again, it is a connection on the minibus. Go to the Minibus Signal Listing and there you'll find that the Control Card and the Keyboard Interface Card generate this signal. Go to the Keyboard Interface schematic and find this signal. Note that the $\overline{\text{MAKE COPY}}$ command from the Keyboard Interface is a result of $\overline{\text{KMAKE COPY}}$ from J45 pin 4. Go to the Wire List and look up J45 pin 4. There you'll determine that $\overline{\text{KMAKE COPY}}$ is an output from the Keyboard plug, J111. Next look for the $\overline{\text{MAKE COPY}}$ signal on the Control Card. Note that here it is an output of a programmed make copy request. Refer back to the $\overline{\text{MAKE COPY}}$ signal description and you'll notice that the Timing Card uses this signal. Refer to the Timing Card schematic and find $\overline{\text{MAKE COPY}}$. Note that it outputs on J78 pin 7 which connects to J190 pin 13. J190 can be identified by referring to the Connectors and Wiring Diagram. There it is determined that J190 is the Hard Copy Connector on the back panel of the Terminal.

WIRE LISTS

The following wire lists provide a listing of wiring between separate assemblies. Each plug or jack is listed by individual pin numbers that show the destination or origination of the signals. The listing is in numeric order beginning with J45, J47, and J48 on the Keyboard Interface.

WIRE LIST FOR

KEYBOARD INTERFACE
J45, J47, & J48

Assembly Connectors		Signal	To or From				Wire
Jack	Pin	Name	Plug and/ or Jack	Pin	Minibus	Originating Assembly	Color Code
J45	1	$\overline{\text{KERASE INPUT}}$	J111	4			9-0
	2	$\overline{\text{KRESET}}$	J111	2			9-13
	3	$\overline{\text{KCLEAR}}$	J111	E			9-6
	4	$\overline{\text{KMAKE COPY}}$	J111	L			9-34
	5	$\overline{\text{KUP}}$	J111	M			9-8
	6	$\overline{\text{KRIGHT}}$	J111	C			9-4
	7	$\overline{\text{KHOME}}$	J111	D			9-3
	8	$\overline{\text{KLEFT}}$	J111	14			9-2
	9	$\overline{\text{KBREAK}}$	J111	A			9-7
	10	$\overline{\text{KDOWN}}$	J111	B			9-5
J47	1	KSTROBE	J111	5			9-02
	2	NO WIRE	Tied high on Motherboard				
	3	KBIT 7	J111	N			9-05
	4	KBIT 5	J111	P			9-07
	5	KBIT 6	J111	R			9-04
	6	KBIT 1	J111	F			9-12
	7	KBIT 2	J111	J			9-03
	8	KBIT 4	J111	H			9-08
	9	KBIT 3	J111	K			9-06
J48	1	+5 Vdc	To Speaker				2-0
	2	BELL	To Speaker				9-25

WIRE LIST FOR

EDIT
J52

Assembly Connectors		Signal	To or From				Wire
Jack	Pin	Name	Plug and/ or Jack	Pin	Minibus	Originating Assemby	Color Code
J52	1	$\overline{\text{KDEL LINE}}$	J111	W			9-16
	2	$\overline{\text{KINS CHAR}}$	J111	Y			9-14
	3	$\overline{\text{KDEL CHAR}}$	J111	Z			9-15
	4	$\overline{\text{KINS LINE}}$	J111	X			9-17

WIRE LIST FOR

CONTROL BOARD
J60

Assembly Connectors		Signal	To or From				Wire
Jack	Pin	Name	Plug and/ or Jack	Pin	Minibus	Originating Assembly	Color Code
J60	1	$\overline{\text{KERASE TO END}}$	J111	3			9-18
	2	$\overline{\text{KENTER}}$	J111	U			9-23
	3	$\overline{\text{KSEND}}$	J111	1			9-1

WIRE LIST FOR

TIMING CARD
J76, J78, & J79

Assembly Connectors		Signal	To or From				Wire
Jack	Pin	Name	Plug and/ or Jack	Pin	Minibus	Originating Assembly	Color Code
J76	1	COMPOSITE VIDEO	J191	Center	Conductor		9-1
	2	COMP VIDEO GND					9-2
J78	1	VIDEO CLOCK GND	J190	1			9-1
	2	VIDEO CLOCK	J190	2			9-2
	3	V DRIVE GND	J190	9			9-3
	4	H DRIVE GND	J190	3			9-4
	5	HCU COMP VIDEO	J190	11			9-5
	6	HCU COMP VIDEO GND	J190	12			9-6
	7	$\overline{\text{MAKE COPY}}$	J190	13			9-7
	8	$\overline{\text{MAKE COPY GND}}$	J190	14			9-8
	9	$\overline{\text{HCU BUSY}}$	J190	7			9-N
	10	$\overline{\text{HCU BUSY GND}}$	J190	8			9-0
J79	1	VERTICAL DRIVE	J112	9			9-1
	2	VERTICAL DR. GND	J112	10			(shield) 9-1
	3	INTERNAL VIDEO	To Contrast Pot.				9-2
	4	INTERN. VID. GND	To Contrast Pot.				(shield) 9-2
	5	MONITOR H DRIVE	J112	6			9-3
	6	VERT. DR. GND	J112	1			(shield) 9-3

WIRE LIST FOR

KEYBOARD

J111

Assembly Connectors		Signal Name	To or From				Wire Color Code
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	
J111	1	$\overline{\text{KSEND}}$	J60	3			9-1
	2	$\overline{\text{KRESET}}$	J45	2			9-13
	3	$\overline{\text{KERASE TO END}}$	J60	1			9-18
	E	$\overline{\text{KCLEAR}}$	J45	3			9-6
	5	KSTROBE	J47	1			9-02
	8	$\overline{\text{KNUM LOCK}}$	NO WIRE				
	14	$\overline{\text{KLEFT}}$	J45	8			9-2
	15	GROUND	J205	1	(Strapped to Pin S also)		0-N
	16	+5 V	J205	2	(Strapped to Pin T also)		2-0
	17	−12 V	J205	4			7-1
	A	$\overline{\text{KBREAK}}$	J45	9			9-7
	B	$\overline{\text{KDOWN}}$	J45	10			9-5
	C	$\overline{\text{KRIGHT}}$	J45	6			9-4
	D	$\overline{\text{KHOME}}$	J45	7			9-3
	4	$\overline{\text{KERASE INPUT}}$	J45	1			9-0
	F	KBIT 1	J47	6			9-12
	H	KBIT 4	J47	8			9-08
	J	KBIT 2	J47	7			9-03
	K	KBIT 3	J47	9			9-06
	L	$\overline{\text{KMAKE COPY}}$	J45	4			9-34
	M	$\overline{\text{KUP}}$	J45	5			9-8
	N	KBIT 7	J47	3			9-05
	P	KBIT 5	J47	4			9-07
	R	KBIT 6	J47	5			9-04
	S	GROUND	J205	1	(Strapped to Pin 15 also)		
	T	+5 Vdc	J205	2	(Strapped to Pin 16 also)		
	U	$\overline{\text{KENTER}}$	J60	2			9-23
	V	KBIT 8	NO WIRE (pulled high on Motherboard)				
	W	$\overline{\text{KDEL LINE}}$	J52	1			9-16
	X	$\overline{\text{KINS LINE}}$	J52	4			9-17
	Y	$\overline{\text{KINS CHAR}}$	J52	2			9-14
	Z	$\overline{\text{KDEL CHAR}}$	J52	3			9-15

WIRE LIST FOR

HIGH VOLTAGE BOARD
J112

Assembly Connectors		Signal Name	To or From				Wire Color Code
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	
J112	1	MONITOR H DRIVE GND	J79	6			(shield) 9-3
	2	+34 V	Brightness Pot				8-03
	3	−160 V	Brightness Pot				8-02
	4	BRIGHTNESS VOLT	Brightness Pot Wiper				8-04
	5	GROUND	J210	2			0-N
	6	MONITOR H DRIVE	J79	5			9-3
	7	+15 V	J210	1			2-1
	8	CONTRAST VOLTAGE	Contrast Pot Wiper				9-05
	9	VERTICAL DRIVE	J79	1			9-1
	10	VERT DRIVE GND	J79	2			(shield) 9-1

WIRE LIST FOR

LV POWER SUPPLY
J150, J151, J152, J153, J154

Assembly Connectors		Signal Name	To or From				Wire Color Code
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	
J150	1	−12 V SENSE	J203	1			7-1
	2	−12 V	J203	2			7-1
	3	−12 V	J203	3			7-1
	4	−12 V	J203	4			7-1
	5	−12 V	J203	5			7-1
J151	1	See LV Power Supply Schematic for distribution					0-N
	2						0-N
	3						9-2-6
	4						2-0
	5						2-0
	6						9-0-2
	7						9-1-6
	8						9-0-3
J152	1	+15 V SENSE	J201	1			2-1
	2	+15 V	J201	2			2-1
	3	+15 V	J201	3			2-1
	4	+15 V	J201	4			2-1
J153	1	+5 V SENSE	J202	1			2-0
	2	+5 V	J202	2			2-0
	3	+5 V	J202	3			2-0
	4	+5 V	J202	4			2-0
	5	+5 V	J202	5			2-0
J154	1	−5 V SENSE	J204	1			7-0
	2	−5 V	J204	2			7-0
	3	−5 V	J204	3			7-0

WIRE LIST FOR

HIGH VOLTAGE BOARD
J155 and J156

Assembly Connectors		Signal Name	To or From				
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	Wire Color Code
J155	1	GND	J200	1			0-N
	2	GND	J200	2			0-N
	2	GND	J200	3			0-N
	4	GND	J200	4			0-N
	5	GND	J200	5			0-N
J156	1	To Transistor Heat Sink (See LV Power Supply Schematic for distribution)					9-0-4
	2						9-0-6
	3						9-0-5
	4						0-N
	5						9-0-8
	6						9-0-7

WIRE LIST FOR

CHASSIS WIRING
J190, J191, and DISPLAY CONTROLS

Assembly Connectors		Signal Name	To or From				
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	Wire Color Code
J190	1	VIDEO CLOCK GND	J78	1			9-1
	2	VIDEO CLOCK	J78	2			9-2
	3	H DRIVE GND	J78	4			9-4
	7	$\overline{\text{HCU BUSY}}$	J78	9			9-N
	8	$\overline{\text{HCU BUSY GND}}$	J78	10			9-0
	9	V DRIVE GND	J78	3			9-3
	11	HCU COMP VIDEO	J78	5			9-5
	12	HCU COMP VID GND	J78	6			9-6
	13	$\overline{\text{MAKE COPY}}$	J78	7			9-7
	14	$\overline{\text{MAKE COPY GND}}$	J78	8			9-8
J191	1	COMPOSITE VIDEO	J76	1			9-1
	2	COMP VID GND	J76	2			9-2
ON/OFF Switch	1	See LV Power Supply Schematic for distribution					8-01
	2						9-18
	5						9-8
	6						8-02
BRIGHT-NESS							
		+34 V	J112	B			8-03
		−160 V	J112	C			8-02
		BRIGHTNESS VOLTAGE	J112	D			8-04
CON-TRAST		INTERNAL VIDEO	J79	3			9-2
		INTERN VID GND	J79	4			(shield) 9-2
		CONTRAST VOLTAGE	J112	J			9-05
SPEAK-ER		+5 Vdc	J48	1			2-0
		BELL	J48	2			9-25

WIRE LIST FOR

MOTHERBOARD
J200, J201, J202, J203, J204

Assembly Connectors		Signal Name	To or From				
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	Wire Color Code
J200	1	GND	J155	1			0-N
	2	GND	J155	2			0-N
	3	GND	J155	3			0-N
	4	GND	J155	4			0-N
	5	GND	J155	5			0-N
J201	1	+15 V SENSE	J152	1			2-1
	2	+15 V	J152	2			2-1
	3	+15 V	J152	3			2-1
	4	+15 V	J152	4			2-1
J202	1	+5 V SENSE	J153	1			2-0
	2	+5 V	J153	2			2-0
	3	+5 V	J153	3			2-0
	4	+5 V	J153	4			2-0
	5	+5 V	J153	5			2-0
J203	1	–12 V SENSE	J150	1			7-1
	2	–12 V	J150	2			7-1
	3	–12 V	J150	3			7-1
	4	–12 V	J150	4			7-1
	5	–12 V	J150	5			7-1
J204	1	–5 V SENSE	J154	1			7-0
	2	–5 V	J154	2			7-0
	3	–5 V	J154	3			7-0

WIRE LIST FOR

MOTHERBOARD
J205, J207, J208, J210, J213

Assembly Connectors		Signal Name	To or From				
Jack	Pin		Plug and/ or Jack	Pin	Minibus	Originating Assembly	Wire Color Code
J205	1	GND	J111	15			0-N
	2	+5 V	J111	16			2-0
	3	+15 V					No Wire
	4	−12 V	J111	17			7-1
	5	−5 V					No Wire
J207	1	+5 V	To F-P switches and LEDS				2-0
	2	KEYBOARD LOCK	KEYBOARD LOCK INDICATOR				9-7
	3	WAIT LED	J207	3			9-8
	4	LED #1	(SPARE LED)				9-0-3
J208	1	GND					0-N
	2	LOCAL/LINE SW.					9-6
	3	DIRECT/BUFFER SWITCH					9-3
	4	SW #2	(SPARE SWITCH)				9-2
	5	SW #1	(SPARE SWITCH)				9-5
J210	1	+15 V	J112	H			2-1
	2	GND	J112	E			0-N
J213	1	+15 V					No Wire
	2	+5 V					No Wire
	3	GND					No Wire
	4	−12 V					No Wire

MINIBUS SIGNAL LISTING AND DESCRIPTIONS

The following table lists in alphabetic order all signals common to the minibus. The table provides the following information about each signal.

1. The minibus connector.
2. The card or cards that originate the signal.
3. The card or cards that use the signal.
4. A description of the function performed by the signal.

The following acronyms are used in the table to identify the circuit cards:

KBI C—Keyboard Interface Card

RAM C—RAM Card

CURS C—Cursor Card

TIM C—Timing Card

CONT C—Control Card

ED C—Edit Card

INTF C—Interface Card

NOTE

Signals are designated low true by placing a horizontal bar over them. Reading the signals can be enhanced by reading them as in the following example:

The signal designated $\overline{BREAK}$ can be read "break not."

TABLE 6-8

SIGNAL DEFINITIONS

Signal	Minibus Pin	Source	Used By	Description
$\overline{AUXSENSE}$	20			Status bit line that is reserved for auxiliary devices. The $\overline{HCU\ BUSY}$ signal may also be used by auxiliary devices if no Hard Copy Unit is connected with its power on.
$\overline{BIT\ 1}$	10	KBI C	CONT C	Data to and from the Terminal, peripherals, and the Computer.
$\overline{BIT\ 2}$	T	RAM C	CURS C	
$\overline{BIT\ 3}$	11	CURS C		
$\overline{BIT\ 4}$	12	ED C	T C	
$\overline{BIT\ 5}$	U	CONT C	INT C	
$\overline{BIT\ 6}$	F	INT C		
$\overline{BIT\ 7}$	6			
$\overline{BIT\ 8}$	26	RAM C ED C INT C	ED C CONT C T C INTF C	When true, $\overline{BIT\ 1}$-$\overline{BIT\ 7}$ are designated as a Field Attribute Code. $\overline{BIT\ 8}$ is not transmittable.
$\overline{BIT\ 9}$	30	KBI C ED C	ED C CONT C T C	When true, $\overline{BIT\ 1}$-$\overline{BIT\ 7}$ are designated as an alternate ROM character such as a ruling character. $\overline{BIT\ 9}$ is not transmittable.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
$\overline{\text{BOUNCE}}$	9	ED C CONT B	KBI C	$\overline{\text{BOUNCE}}$ is produced by ERASE TO END, SEND, ENTER, INS CHAR, DEL CHAR, INS LINE, and DEL LINE. $\overline{\text{KEYGATE}}$ is produced as a response to $\overline{\text{BOUNCE}}$.
$\overline{\text{BREAK}}$	$\overline{\text{L}}$	KBI C	INTF C	Set active from the Keyboard Interface Card as a result of pressing the BREAK key. Can also go active as a result of a Break on page full. This signal is used to signal the computer. NOTE: In some interfaces, $\overline{\text{BREAK}}$ may be pulled up to +15 Vdc Data signals may also be present on $\overline{\text{BREAK}}$.
$\overline{\text{CBUSY}}$	1	CONT C	ED C INTF C	Means the computer interface cannot accept a character. Controls the timing of data transmitted to the computer.
$\overline{\text{CLRX}}$	35	KBI C ED C CONT C T C	KBI C CURS C CONT C	Used to clear to zero either the X Cursor or X Display Register. Can go active independent of $\overline{\text{CLRY}}$.
$\overline{\text{CLRY}}$	29	KBI C ED C	KBI C CURS C	Used to clear to zero either the Y Cursor or the Y Display Register. Can go active independent of $\overline{\text{CLRX}}$.
$\overline{\text{CPUNT}}$	C	INTF C	KBI C CURS C CONT C	$\overline{\text{CPUNT}}$ means that data is about to be asserted by the computer interface during the next $\overline{\text{STORE}}$ time. (See Fig. 6-5). It is asserted 0 to 100 ns after the leading edge of $\overline{\text{READ}}$ and is removed just after the end of $\overline{\text{STORE}}$. Other devices armed to use the $\overline{\text{STORE}}$ interval must hold their data off the minibus until the next $\overline{\text{STORE}}$ time when $\overline{\text{CPUNT}}$ is not true.
$\overline{\text{CSTROBE}}$	3	KBI C CONT C	ED C INTF C	Strobes data to the Interface for transmission to the computer. If the origin of the data is the Terminal memory, as in an Enter operation, $\overline{\text{CSTROBE}}$ is a 636 ns pulse coincident with STROBE and either $\overline{\text{READ}}$ or $\overline{\text{STORE}}$. (See Fig. 6-5.) If the origin of data is the keyboard, a peripheral, or another Interface, $\overline{\text{CSTROBE}}$ is generated coincident with $\overline{\text{STORE}}$ and STROBE and is 250 ns wide.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
$\overline{\text{CSUP}}$	K	CONT C	INTF C	Inhibits the computer or peripheral interface from accepting a $\overline{\text{CSTROBE}}$. $\overline{\text{CSUP}}$ asserted at $\overline{\text{READ}}$ time inhibits sending of memory contents, as would be done with non-transmittable fields and null suppression.
$\overline{\text{DING}}$	R	CURS C CONT C	KBI C	Causes the bell to ring, and is asserted when the X Cursor Register senses the count of 72 when the operator is keying. Also asserted when attempting to key into a protected field or over a Field Attribute Code.
DIRECT	19	J208-3	KBI C ED C	Originates from the DIRECT/BUFFER switch When DIRECT is selected, this signal is high Keying of data causes $\overline{\text{CSTROBE}}$ to accompany the keyed data. When low (BUFFER selected), keying causes $\overline{\text{TSTROBE}}$ to accompany the keyed data. $\overline{\text{TSTROBE}}$ occurs because the Buffer Mode is selected. Direct with an echo causes both $\overline{\text{CSTROBE}}$ and $\overline{\text{TSTROBE}}$ to accompany the keyed data. Also, when DIRECT is selected, roll-up can occur (if strapped), as can an auto CR/LF function.
$\overline{\text{DISPLAY}}$	D	TIM C	CURS C ED C CONT C	During the time that this signal is active, data on the bus is being read from the RAM into the Character Generator and used to produce video. It roughly corresponds to "not blanking". Control logic can read data on the bus at this time for several purposes (data is valid on the trailing edge of $\overline{\text{STEP}}$.) Logic can read Field Attribute Codes and detect cursor location to determine whether the cursor is in a protected field.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
$\overline{\text{DMA}}$	K	KBI C ED C	KBI C CURS C CONT C TIM C INTF C	$\overline{\text{DMA}}$ goes active during Edit, Clear Page and Erase Input functions. During Direct Memory Access (DMA), normal timing is suspended to enable the logic that asserts $\overline{\text{DMA}}$ to have full control of the memory. $\overline{\text{READ}}$, $\overline{\text{STORE}}$, $\overline{\text{EXECUTE}}$, $\overline{\text{RIGHT}}$ and $\overline{\text{DOWN}}$ commands cease to come from the Timing Card. $\overline{\text{STROBE}}$ and $\overline{\text{STEP}}$ change repetition rate. $\overline{\text{CLRX}}$, $\overline{\text{CLRY}}$, $\overline{\text{UP}}$, $\overline{\text{DOWN}}$, $\overline{\text{LEFT}}$, and $\overline{\text{RIGHT}}$ control the Display Register, which in turn addresses the memory. The screen is blanked and the RAM refresh cycle is suspended. The logic that asserts $\overline{\text{DMA}}$ then manipulates data in a write/read pattern at a speed that ensures data is not lost.
$\overline{\text{DMA STROBE}}$	33	TIM C	KBI C CURS C ED C	During $\overline{\text{DMA}}$, this 90 ns pulse switches to a 1.9 μs period, whose leading edge is used to strobe data from the RAM to the registers. The period before and including the leading edge is DMA Read. The trailing edge of $\overline{\text{DMA STROBE}}$ indicates that a DMA Store period has begun and registers wishing to enter into the RAM should place data on the minibus, until the trailing edge of $\overline{\text{STEP}}$.
$\overline{\text{DOWN}}$	N	KBI C ED C CONT C TIM C	KBI C CURS C ED C	The down counting pulse for the Cursor and Display Registers. Example: a low pulse on $\overline{\text{DOWN}}$ at $\overline{\text{EXECUTE}}$ time will move the cursor down one character line.
$\overline{\text{ECHO}}$	7	INTF C	KBI C	Directs the input source (such as the Keyboard via the Keyboard Interface Card) to assert $\overline{\text{TSTROBE}}$ with each $\overline{\text{CSTROBE}}$ to provide a local copy to the Terminal screen of data entered to the computer. $\overline{\text{ECHO}}$ is asserted by the Interface and, depending on the Interface, selected by strap option or rear panel control.
$\overline{\text{ENTER}}$	Y	CONT C	KBI C	Goes active when the Enter of Send sequence of transmission from Terminal memory is in progress.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
EOLCRS	R	CURS C	ED C CONT C	Indicates that the X Cursor Register has reached the end of the line (79th count). When transmitting memory contents to the computer, EOLCRS is sensed to automatically transmit CR's (LF's optional) into the data stream to compensate for their not being stored in memory. CR's (and LF's) are transmitted only at the ends of those lines that contain data.
EOLDIS	$\overline{D}$	CURS C	KBI C ED C	This signal goes true when the X Display Register has sensed the End of a line (80th character position). It is used primarily in Direct Memory Access (DMA) operations.
$\overline{EXECUTE}$	18	TIM C	KBI C CURS C ED C CONT C INTF C	This is a master timing signal which occurs during horizontal retrace at counts of 220 and 221 in the ÷50 counter on the Timing Card. See Fig. 6-5. During $\overline{EXECUTE}$ time, the Cursor Registers are mainpulated for LF, CR, UP, DOWN, HOME, etc. If a command has been issued resulting in $\overline{DMA}$ $\overline{TBUSY}$ is set immediately at $\overline{EXECUTE}$ time.
$\overline{HCU\ BUSY}$	$\overline{J}$	CONT C	ED C TIM C	This signal indicates that the Hard Copy Unit is busy making a copy of the memory. This signal also blanks the cursor when tabbing during non-transmittable periods of the buffer transmission sequence, and when making a hard copy.
$\overline{HIX}$, $\overline{HIY}$	13 J	ED C CONT C	KBI C RAM C CURS C ED C CONT C	These signals are used along with data to preset (respectively) the X and Y Cursor and Display Registers, or to read them at $\overline{READ}$ time.
$\overline{HOME}$	$\overline{F}$	KBI C	CONT C	This signal goes active as a result of pressing the $\overline{HOME}$ key. It causes the X and Y Cursor Registers to be cleared, thus homing the cursor.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
KEYGATE	M	KBI C	RAM C CURS C ED C CONT C INTF C	KEYGATE goes true as a result of keying data from the keyboard or by pressing one of the Function Control keys (INS C, INS L, →, ↓, etc.) It normally goes true for one STORE time, 3 to 19 milliseconds after BOUNCE has become inactive. If BOUNCE stays true for greater than 300 milliseconds, KEYGATE has a repetition rate of 15 Hz to repeat cursor movements.
KLOCK	N	CONT C	KBI C	Indicator 2 on the console is controlled by this signal. It is used to indicate Keyboard lock conditions, and inhibits TSTROBE. This is how data and Field Attribute Codes are protected from keyboard replacement.
LCE	B	CONT C	KBI C ED C	LCE goes active when the ESC Control Character is detected on the minibus. It indicates the following character (concurrent with LCE) is to be interpreted as a command and is not to perform its normal function.
LED 3 (Indicator 3)	2			Spare Indicator.
LEFT	W	KBI C ED C CONT C	CURS C	Counting signal that decrements the count in the X Cursor Register. Example: A low on LEFT at EXECUTE time moves the cursor left one space.
LEFT CRS	L	CURS C	ED C CONT C	When true, it signifies that the cursor is at the left-most position of the display.
LOCAL	H	J208-2	CONT C INTF C	Originates from the LOCAL/ON LINE switch and indicates that the Terminal is logically disconnected from the computer. The associated peripheral devices (if any are connected) can interact with each other in Local Mode.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
LSTY CRS	32	CURS C	KBI C ED C CONT C	Indicates that the Cursor Register on the Cursor Card has reached the last character line. The Cursor Card may be strapped to enable this signal to go active with either 12 or 24 line displays.
LSTY DIS	16	CURS C	KBI C ED C	Indicates that the Y Display Register on the Cursor Card has reached the last character line. It may also be strapped for either 12 or 24 line displays.
$\overline{\text{MAKE COPY}}$	$\overline{\text{C}}$	KBI C CONT C	TIM C	Directs the Hard Copy Unit to make a copy.
$\overline{\text{PAGE}}$	$\overline{\text{E}}$	KBI C RAM C	KBI C ED C CONT C TIM C INTF C	This signal is asserted by simultaneously pressing the PAGE-ERASE INPUT and SHIFT keys. The signal also goes active when power is turned on. Its function is to erase the memory (protected data as well), and home the cursor.
$\overline{\text{READ}}$	4	TIM C	Used on all cards	A synchronizing signal that occurs in the horizontal retrace interval, in counts 208, 209, 210, and 211 of the ÷50 counter on the Timing Card. See Fig. 6-5. During this time, the contents of the RAM at the cursor location, are placed on the minibus, regardless of whether the Terminal is On Line, in Local, or Sending. Decoding of data by Terminal logic is done in count 208 when $\overline{\text{STEP}}$ is active. If necessary, this allows $\overline{\text{CSUP}}$ to be asserted in counts 209, 210, and 211. For example, the above would be done to accomplish null suppression. Reading cursor coordinates is also done at this time.
$\overline{\text{RESET}}$	28	CONT C	KBI C ED C TIM C	Goes active as a result of the operator pressing the Keyboard RESET key. It is a multi-purpose key that performs the functions listed in the Characteristics Section.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
$\overline{\text{RIGHT}}$	V	KBI C ED C CONT C TIM C	CURS C	Increment signal for the X Cursor and Display Registers. Example: $\overline{\text{RIGHT}}$ at $\overline{\text{EXECUTE}}$ time increments the X Cursor Register. $\overline{\text{RIGHT}}$ at $\overline{\text{STEP}}$ time during $\overline{\text{DMA}}$ or $\overline{\text{DISPLAY}}$, increments the X Display Register.
$\overline{\text{SEND 8}}$	27	INTF C	KBI C ED C CONT C	Indicates that data is being sent as an 8-bit byte (do not add parity). Inhibits Terminal from storing or executing characters while allowing peripherals to use the minibus.
SP1 (FAST I/O)	23	TIM C	KBI C INTF C	Spare minibus line that can be used by interfaces or peripherals. SP1 can be used for Fast I/O. Fast I/O can be strapped on the Timing Card to cause the Input/Output (I/O) sequence to occur not only in the horizontal retrace period of time, but five more times where display usually occurs. During Fast I/O, the screen is blanked. The logical operation of the Terminal is unchanged; however, Fast I/O = 94,320 characters per second, whereas regular I/O = 15,720 characters per second.
$\overline{\text{SP2}}$ ($\overline{\text{TAPEFETCH}}$)	P	(TTY PORT INTF C)	CONT C	Signal generated by some TTY Port Interface Cards that provides transmission control. Normally a prompt for the transmission of one character.
$\overline{\text{STEP}}$	22	TIM C	KBI C ED C CONT C	A 1.572 MHz signal that provides timing intervals for the horizontal sweep. One horizontal sweep is 63.6 μs. $\overline{\text{STEP}}$ divides the sweep into 100 timing intervals of 636 ns. See Fig. 6-5.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

<table>
<tr><th>Signal</th><th>Minibus Pin</th><th>Source</th><th>Used By</th><th>Description</th></tr>
<tr><td>$\overline{\text{STORE}}$</td><td>E</td><td>TIM C</td><td>KBI C
CURS C
CONT C
ED C
INTF C</td><td>$\overline{\text{STORE}}$ goes active during counts 218 and 219 of the ÷50 counter on the Timing Card. See Fig. 6-5. $\overline{\text{STORE}}$ occurs once every horizontal sweep (every 63.6 μs) during the horizontal retrace interval. Data to be entered into the RAM from the Keyboard Interface or peripheral, should be on the bus at counts 216 and 217 of the ÷50 Counter. At $\overline{\text{STEP}}$ time and count 216, logic determines whether a $\overline{\text{TSUP}}$ should be asserted in count 217. If $\overline{\text{TSUP}}$ is not asserted, at count 217, the bus data is written into memory at the cursor address at count 217. If a $\overline{\text{CSTROBE}}$ has previously been asserted at count 210, the bus data goes to the Interface. Valid on-line combinations of $\overline{\text{CSTROBE}}$ and $\overline{\text{TSTROBE}}$ at $\overline{\text{STEP}}$ time include:
<table>
<tr><th>$\overline{\text{TSTROBE}}$</th><th>$\overline{\text{CSTROBE}}$</th><th>INPUT/OUTPUT</th></tr>
<tr><td>Lo</td><td>Lo</td><td>To Terminal and Computer</td></tr>
<tr><td>Lo</td><td>Hi</td><td>To Terminal</td></tr>
<tr><td>Hi</td><td>Lo</td><td>To Computer</td></tr>
<tr><td>Hi</td><td>Hi</td><td>Input/Output inhibited</td></tr>
</table>
</td></tr>
<tr><td>STROBE</td><td>21</td><td>TIM C</td><td>KBI C
CURS C
ED C
CONT C</td><td>A 250 ns master timing signal that is usually timed according to the display memory read/write pulse requirements. At $\overline{\text{READ}}$ time, it is 636 ns. See Fig. 6-5. It is pulsed in counts 214 and 217 of the ÷50 Counter for memory refresh, and count 219 for writing data from the minibus into memory. It is also pulsed continuously at a 1.9 μs rate during the time $\overline{\text{DMA}}$ is active.</td></tr>
<tr><td>SW1 and
SW2</td><td>Z
X</td><td>J208-5
J208-4</td><td></td><td>Spare console rocker switches reserved for use with interfaces and peripherals.</td></tr>
</table>

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
$\overline{\text{TBUSY}}$	8	KBI C ED C	TIM C	With flagged interfaces, $\overline{\text{TBUSY}}$ controls the timing of data being transmitted to the Terminal. See Fig. 6-5. For operations like Line Feed, Carriage Return, Home, Address Cursor, and transmission of buffer contents, the Terminal does not go busy. A peripheral can also pull down on $\overline{\text{TBUSY}}$.
$\overline{\text{TOP CRS}}$	$\overline{\text{M}}$	CURS C	ED C CONT C	When true, it signifies that the Cursor Register is at a count that corresponds to the top character line of the display.
$\overline{\text{TSTROBE}}$	5	KBI C ED C CONT C INTF C	CURS C ED C CONT C KBI C	When active, $\overline{\text{TSTROBE}}$ enables STROBE to strobe data into the Terminal to be displayed on the screen. It goes true the same time as $\overline{\text{STORE}}$. See Fig. 6-5. Thus, for data to be decoded, stored, or to address the cursor, $\overline{\text{TSTROBE}}$ must be anded with STROBE at $\overline{\text{STORE}}$ time.
$\overline{\text{TSUP}}$	17	KBI C CONT C	KBI C	When active, the Terminal memory response to $\overline{\text{TSTROBE}}$ is suppressed. $\overline{\text{TSUP}}$ is used to prevent entry into memory of incoming data such as CR and LF. If entry is to be suppressed, Terminal logic asserts $\overline{\text{TSUP}}$ during the second character portion of the window (count 217 of the ÷50 Counter on the Timing Card) before STROBE becomes true.
$\overline{\text{UP}}$	$\overline{\text{H}}$	KBI C ED C CONT C	CURS C ED C	A counting signal that, when true, allows the count in the Y Cursor Register to be decremented at $\overline{\text{EXECUTE}}$ time. Logic also allows the Y Display Register to be decremented at $\overline{\text{STEP}}$ when $\overline{\text{UP}}$ is true.
$\overline{\text{VSYNC}}$	34	TIM C	KBI C CURS C CONT C	A low 190.8 μs signal that correponds to 3 horizontal times during vertical retrace. Its leading edge is 3 horizontal sweeps after the last visible line on the bottom and 18 sweeps before the next visible sweep at the top.

TABLE 6-8 (cont)

SIGNAL DEFINITIONS (cont)

Signal	Minibus Pin	Source	Used By	Description
$\overline{\text{WAIT}}$	25	INTF C		An output of the Optional Data Communications Interface that signifies a computer transmission is pending or in progress, or a half duplex line is turned with the Terminal in the receive mode.
X EQUAL	$\overline{\text{A}}$	CURS C	EDC TIM C CONT C	When true, it signifies that the X Cursor Register count is equal to the X Display Register count. This signal, along with Y EQUAL is used to generate the cursor. The cursor address is the location in memory where data will either be read from or written to at $\overline{\text{READ}}$ or $\overline{\text{STORE}}$ time, respectively. X EQUAL is valid at the leading edge of $\overline{\text{STEP}}$.
Y EQUAL	31	CURS C	ED C CONT C TIM C	Signifies that the Y Cursor Register count is equal to the Y Display Register count. This signal along with X EQUAL is used to generate the Cursor. Y EQUAL is valid on the leading edge of $\overline{\text{STEP}}$.
614 kHz	B	RAM C	INTF C	Square wave used by the Interface.
4.9152 MHz	24	RAM C	INTF C	Square wave used by the Interface.
+15 Vdc	15		INTF C	Low voltage power supplies.
+5 Vdc	S		All cards	
−5 Vdc	$\overline{\text{P}}$		RAM C TIM C	
−12 Vdc	14		INTF C RAM C TIM C	

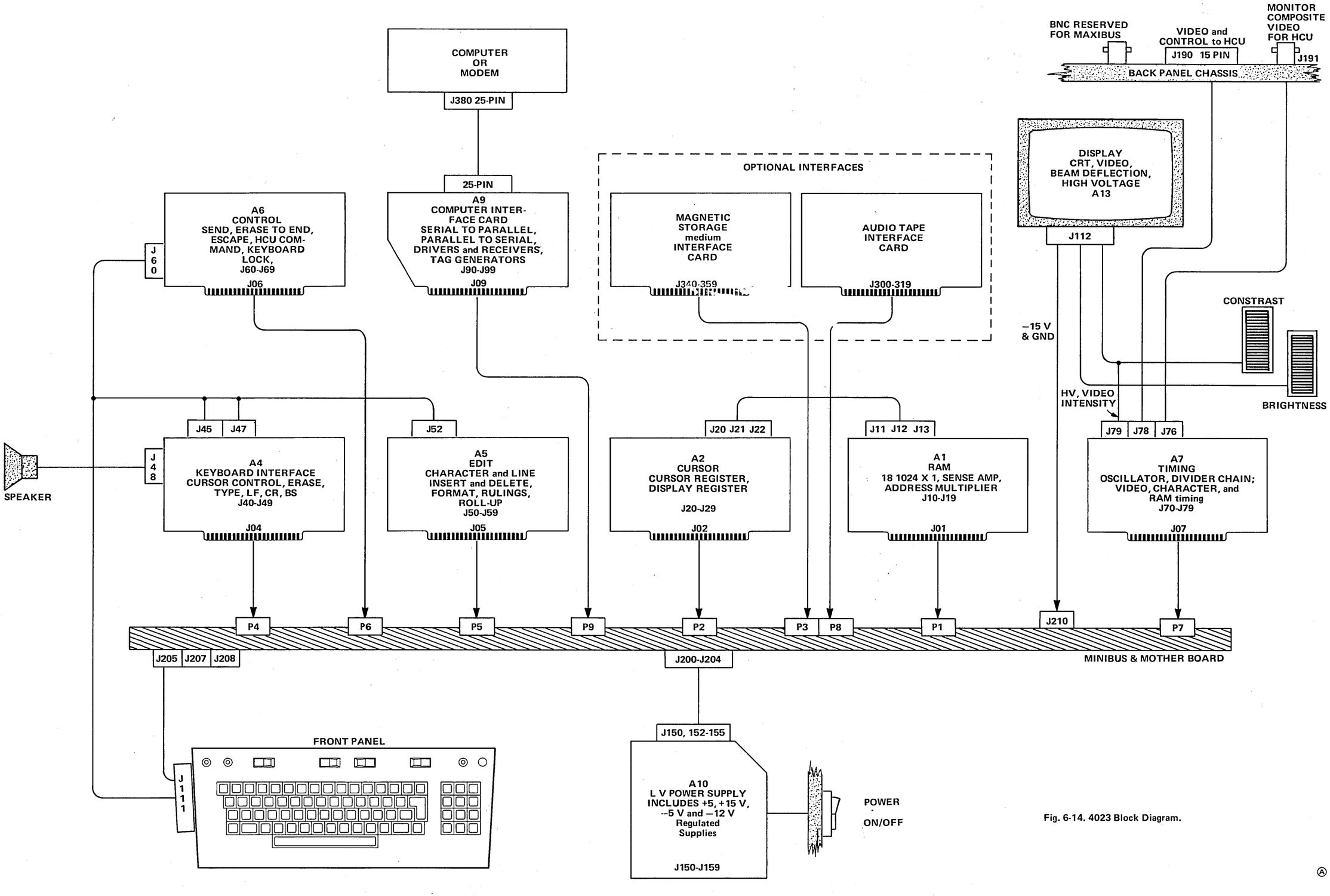


Fig. 6-14. 4023 Block Diagram.

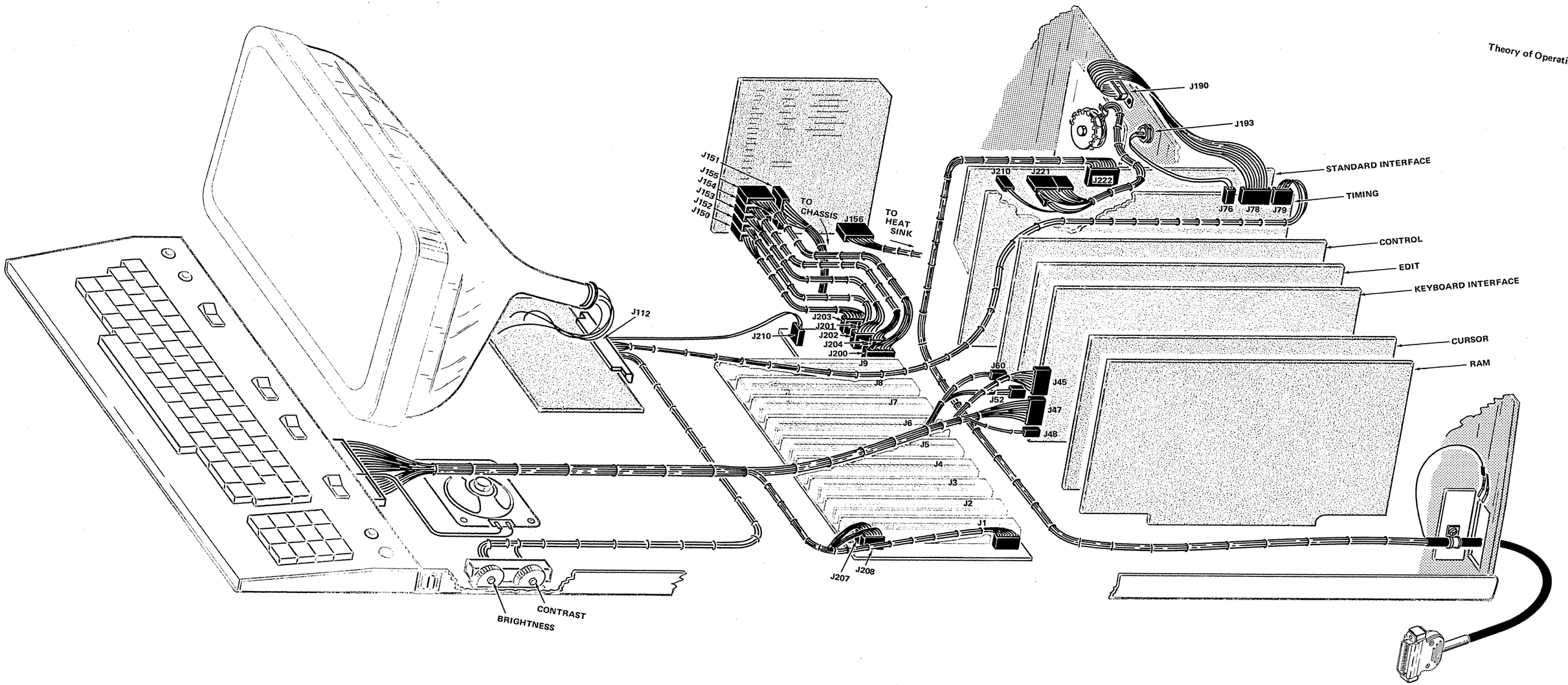
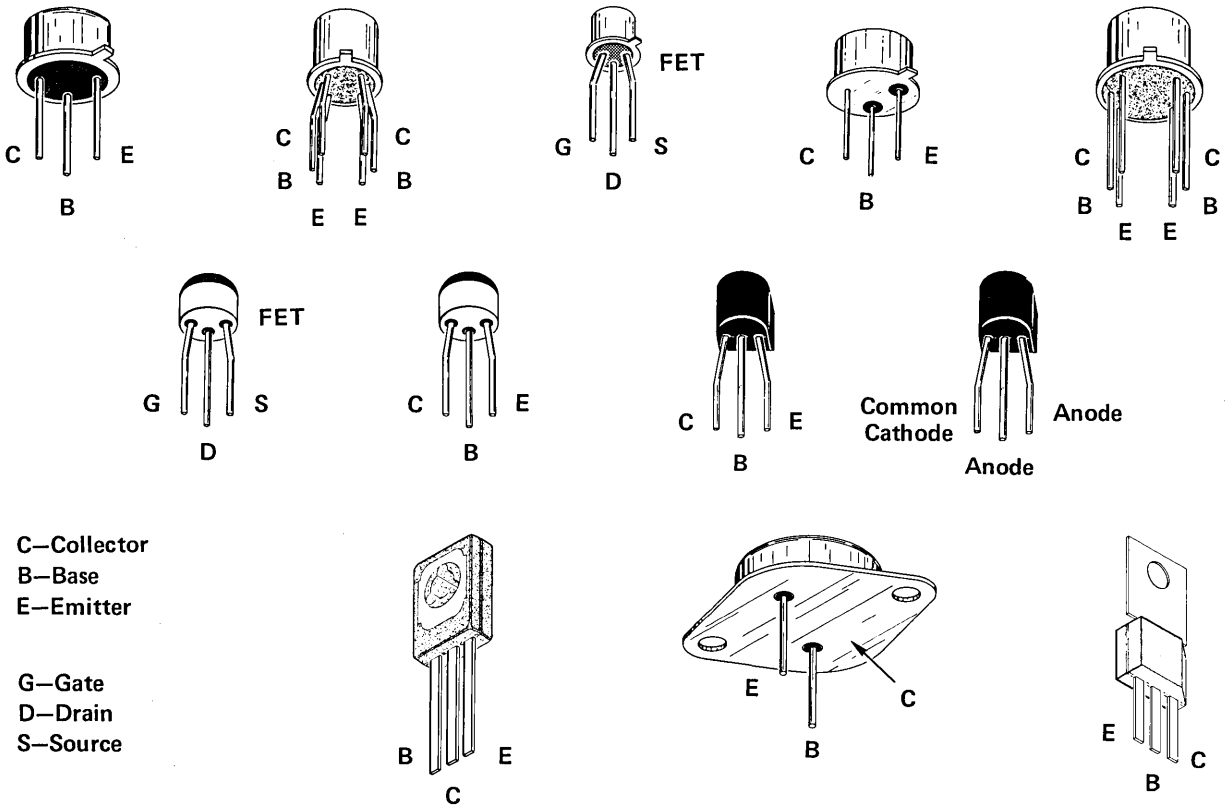


Fig. 6-15. 4023 Wiring Diagram.

SEMICONDUCTOR DEVICES



INTEGRATED CIRCUITS

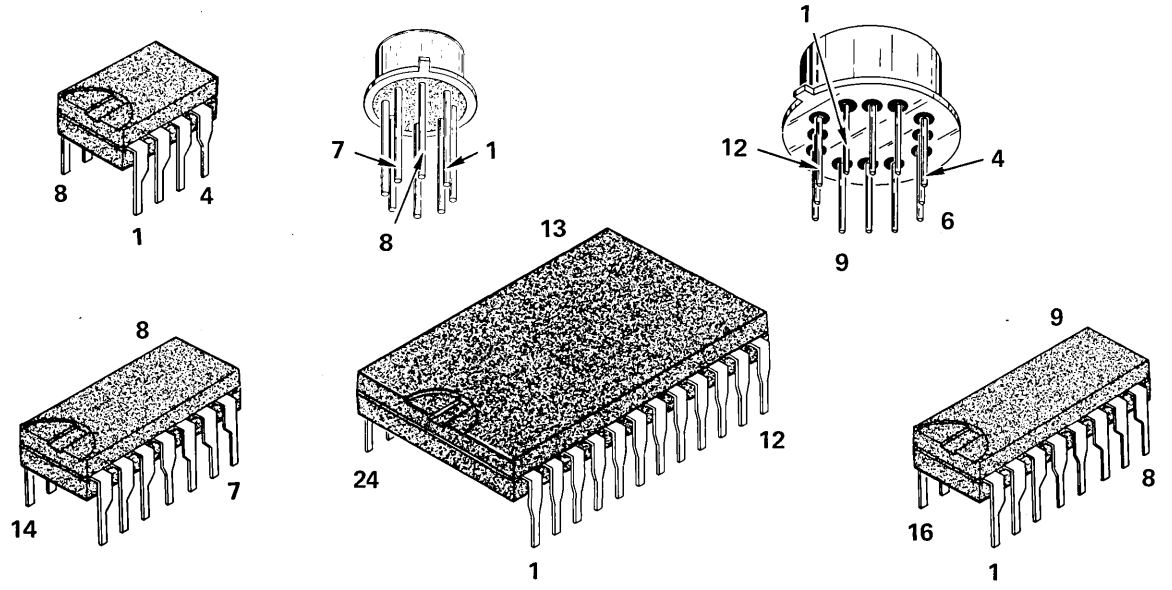


Fig. 6-16. Semiconductor Information.

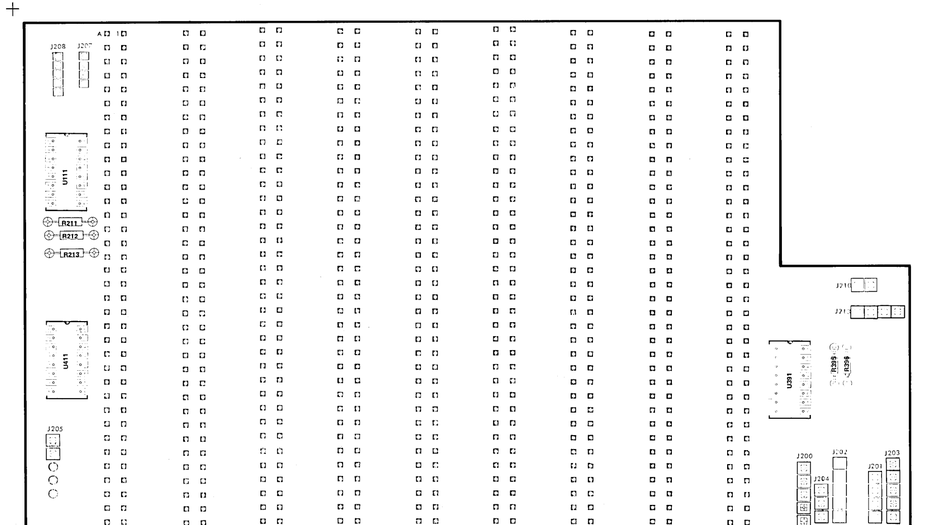


Fig. 6-17. Motherboard Component Locations.

CKT # GRID LOC

DIODE

CR395 F4
CR396 F4
CR1128 D1
CR1122 E3
CR1124 A1

JACK

J1 F2
J2 F2
J3 F2
J4 F2
J5 F2
J6 F2
J7 F3
J8 F3
J9 F3
J208 B4
F3
J201 A4
F3
J202 B4
F3
J203 C4
F3
J204 D4
F3
J205 E4
F2
J207 A1
D1
E2
E4
J208 A3
C1
C3
D4
E2
J210 F3
F4
J213 D4
F3

RESISTOR

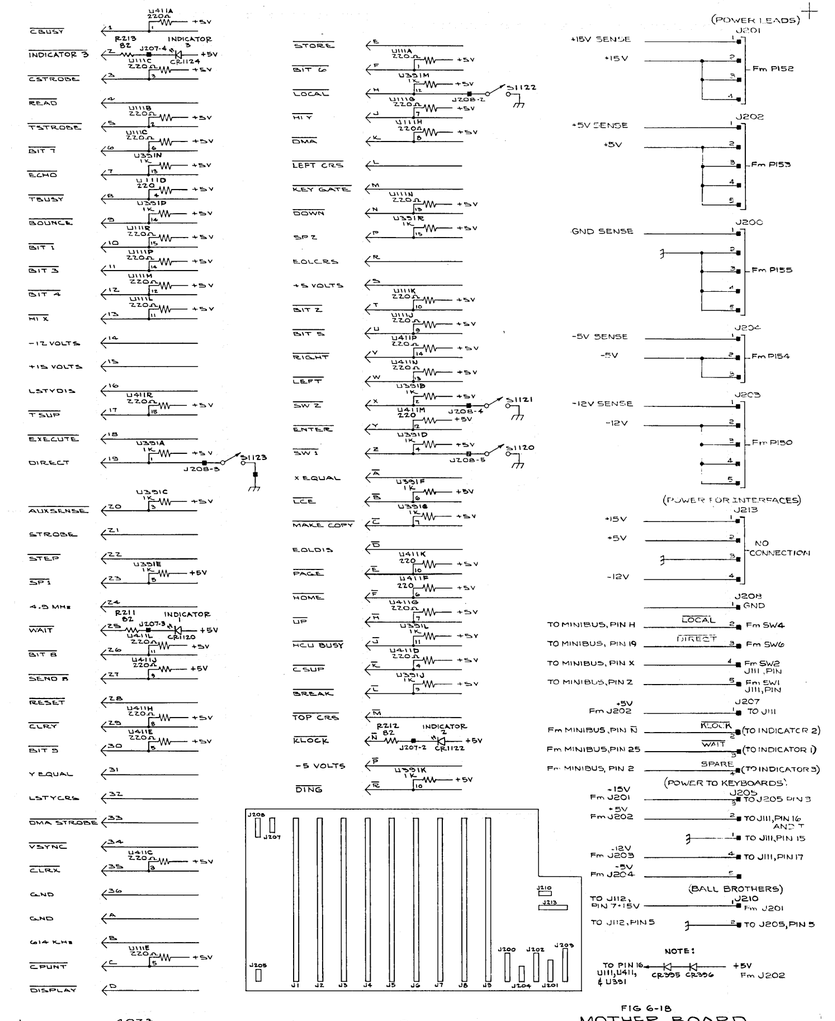
R211 D1
R212 E2
R213 A1

SWITCH

S1120 C3
S1121 C3
S1122 A3
S1123 C2

INTEGRATED CIRCUIT

U11 F4
U111A A2
U111B B1
U111C A1
U111D B1
U111E F1
U111F B1
U111G A2
U111H B2
U111J C2
U111K B2
U111L C1
U111M B1
U111N B2
U111P B1
U111R B1
U391 A2
U391A C1
U391B C2
U391C D1
U391D C2
U391E D1
U391F C2
U391G B2
U391J D2
U391K E2
U391L D2
U391N B1
U391P B1
U391R B2
U411 F4
U411A A1
U411C E1
U411D D2
U411E E1
U411F D2
U411G D2
U411H E1
U411J D1
U411K D2
U411L D1
U411M C2
U411N C2
U411P C2
U411R C1



4023

FIG 6-18
MOTHER BOARD

KEYBOARD
119-0374-01

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
74L00	14	7	HIGH
7403	14	7	HIGH
7404	14	7	
7410	14	7	HIGH
7438	14	7	HIGH
7442	16	8	
74145	16	8	

TYPICAL MATRIX CONNECTION EACH USED INTERSECTION

TYPICAL CONNECTION FOR CTRL, V & M

TO KEYBOARD SWITCHES

FM KEYBOARD SWITCHES
'X' INDICATES CLOSURE OF ASSOCIATED CHARACTER SWITCH WHEN KEY IS DEPRESSED

* SELECTED VALUE (3.3 NOMINAL)

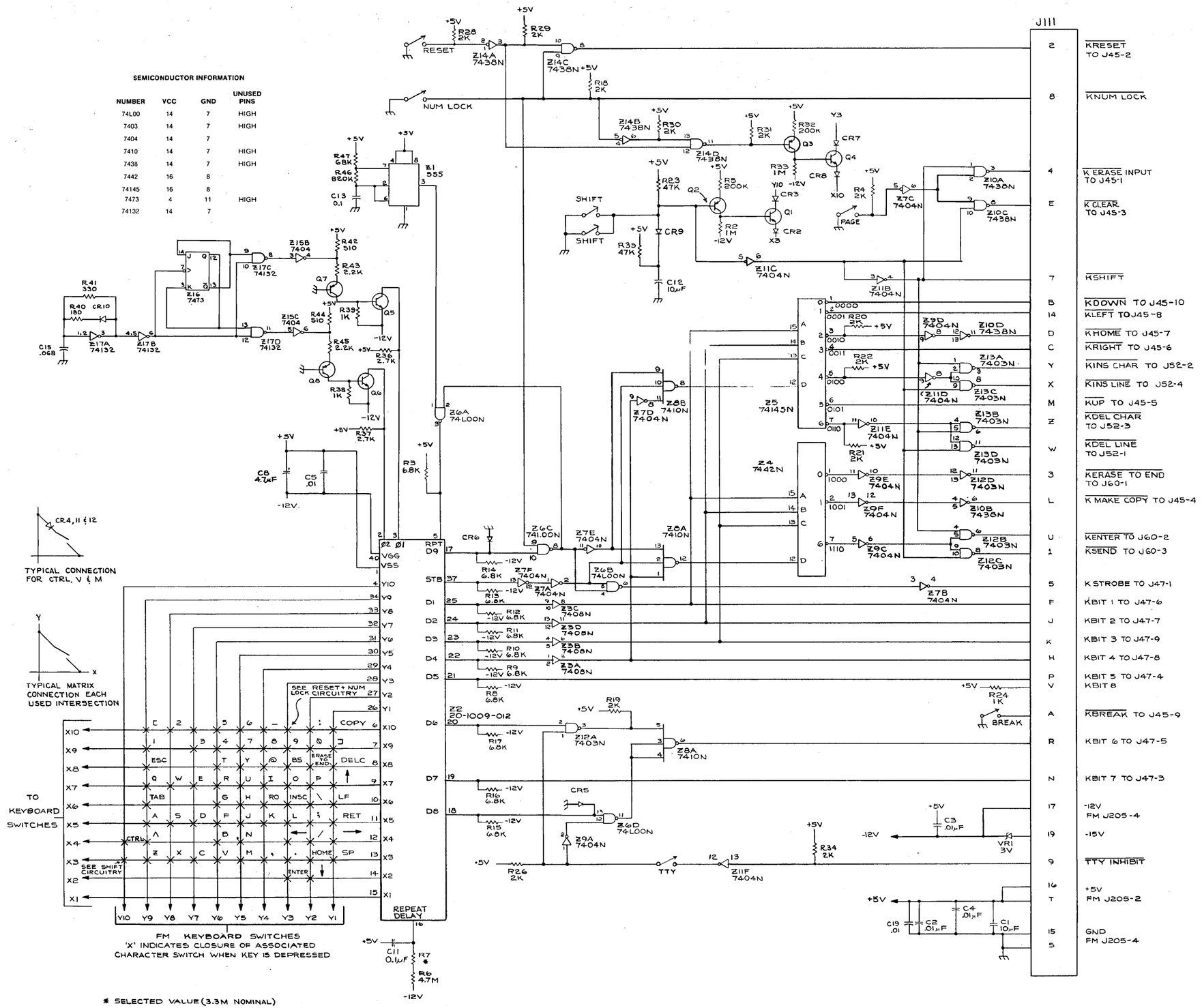
J111	
2	$\overline{\text{KRESET}}$ TO J45-2
8	$\overline{\text{KNUM LOCK}}$
4	$\overline{\text{KERASE INPUT}}$ TO J45-1
E	$\overline{\text{K CLEAR}}$ TO J45-3
7	$\overline{\text{KSHIFT}}$
B	$\overline{\text{KDOWN}}$ TO J45-10
14	$\overline{\text{KLEFT}}$ TO J45-8
D	$\overline{\text{KHOME}}$ TO J45-7
C	$\overline{\text{KRIGHT}}$ TO J45-6
Y	$\overline{\text{KINS CHAR}}$ TO J52-2
X	$\overline{\text{KINS LINE}}$ TO J52-4
M	$\overline{\text{KUP}}$ TO J45-5
Z	$\overline{\text{KDEL CHAR}}$ TO J52-3
W	$\overline{\text{KDEL LINE}}$ TO J52-1
3	$\overline{\text{KERASE TO END}}$ TO J60-1
L	$\overline{\text{K MAKE COPY}}$ TO J45-4
U	$\overline{\text{KENTER}}$ TO J60-2
1	$\overline{\text{KSEND}}$ TO J60-3
5	K STROBE TO J47-1
F	KBIT 1 TO J47-6
J	KBIT 2 TO J47-7
K	KBIT 3 TO J47-9
H	KBIT 4 TO J47-8
P	KBIT 5 TO J47-4
V	KBIT 8
A	$\overline{\text{KBREAK}}$ TO J45-9
R	KBIT 6 TO J47-5
N	KBIT 7 TO J47-3
17	-12V FM J205-4
19	-15V
9	$\overline{\text{TTY INHIBIT}}$
16	+5V
T	+5V FM J205-2
15	GND
5	GND FM J205-4

REV. C, OCT. 1976

(119-0374-01)
FIG. 6-19A. KEYBOARD

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
74L00	14	7	HIGH
7403	14	7	HIGH
7404	14	7	
7410	14	7	HIGH
7438	14	7	HIGH
7442	16	8	
74145	16	8	
7473	4	11	HIGH
74132	14	7	



4023

@

(119-0374-02)
FIG. 6-19B. KEYBOARD

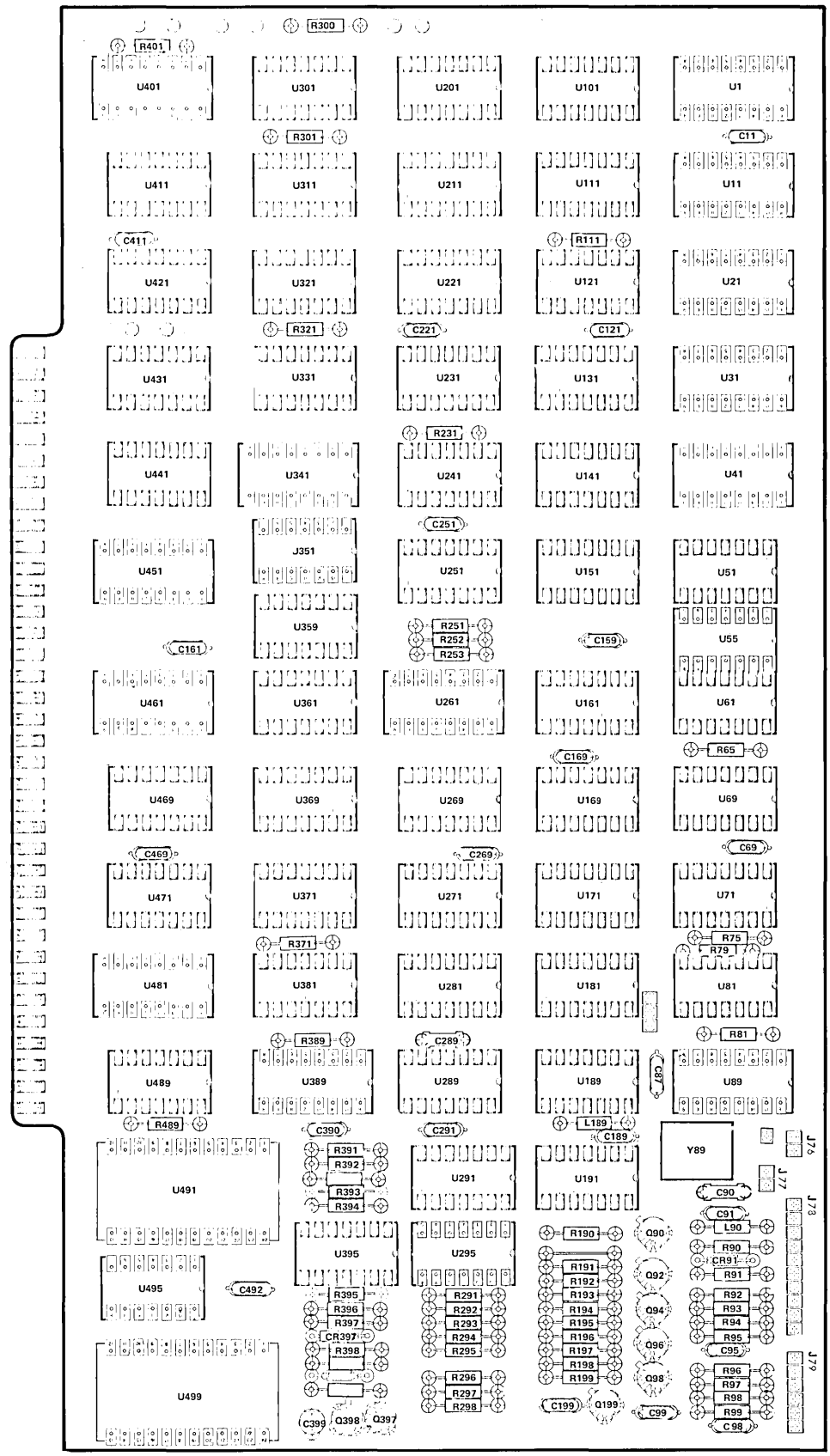


Fig. 6-20A. Timing Card Component Locations (670-2199-02).

REV. C, JAN. 1975

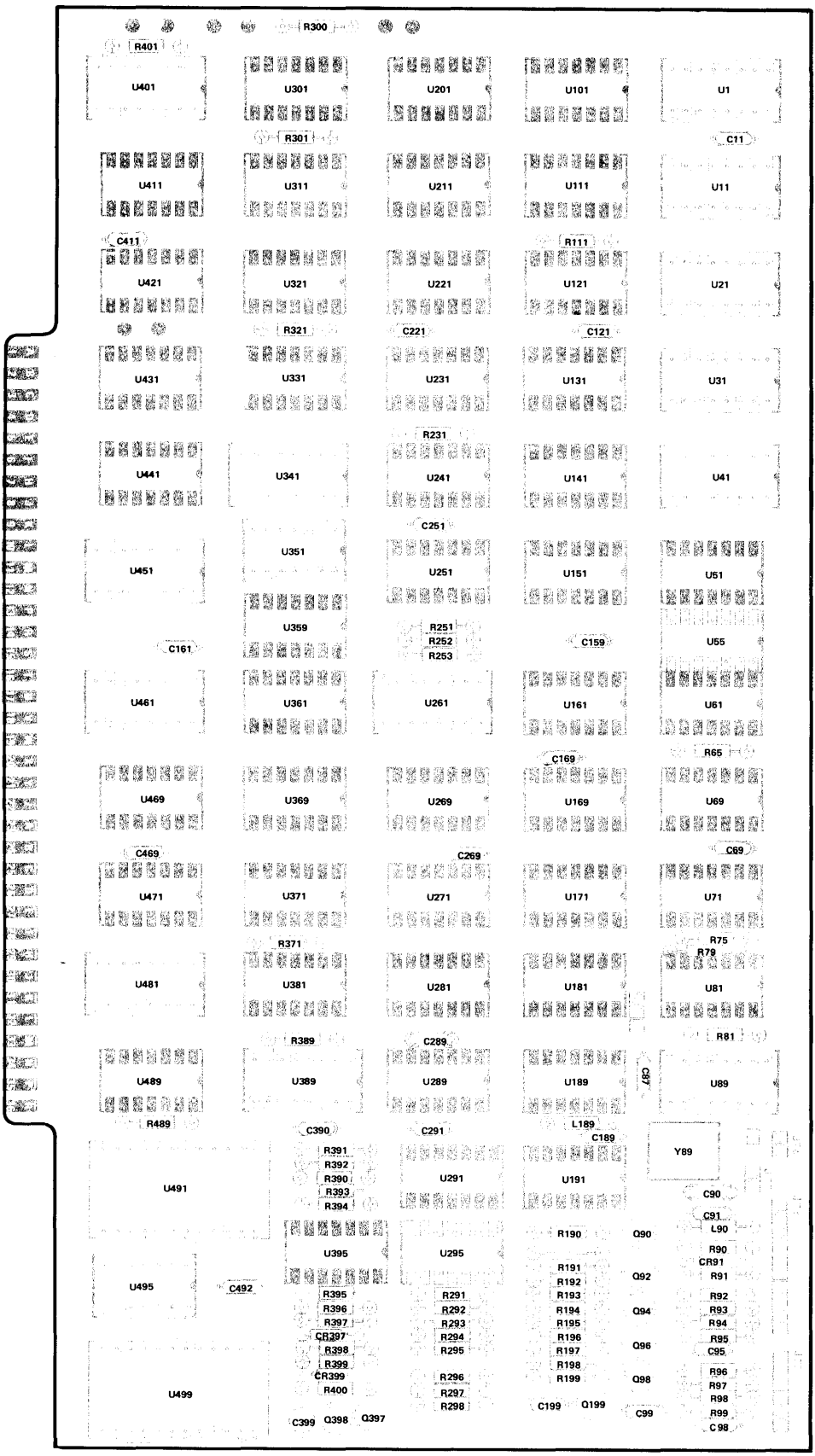


Fig. 6-20B. Timing Card Component Locations (670-2199-03).

REV. B, JAN. 1975

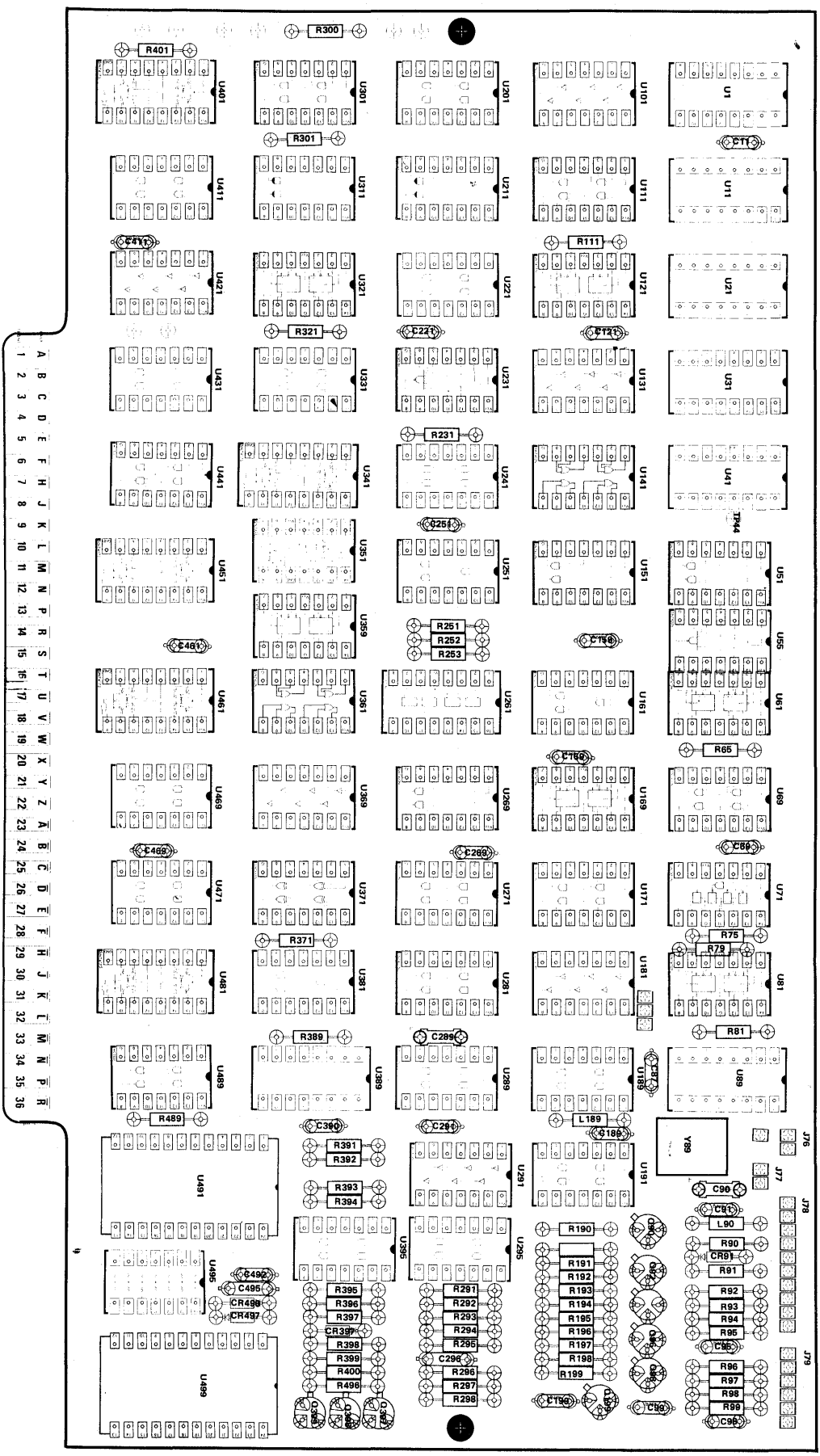


Fig. 6-20C. Timing Card Component Locations (670-2199-04).

REV. B, JAN 1975

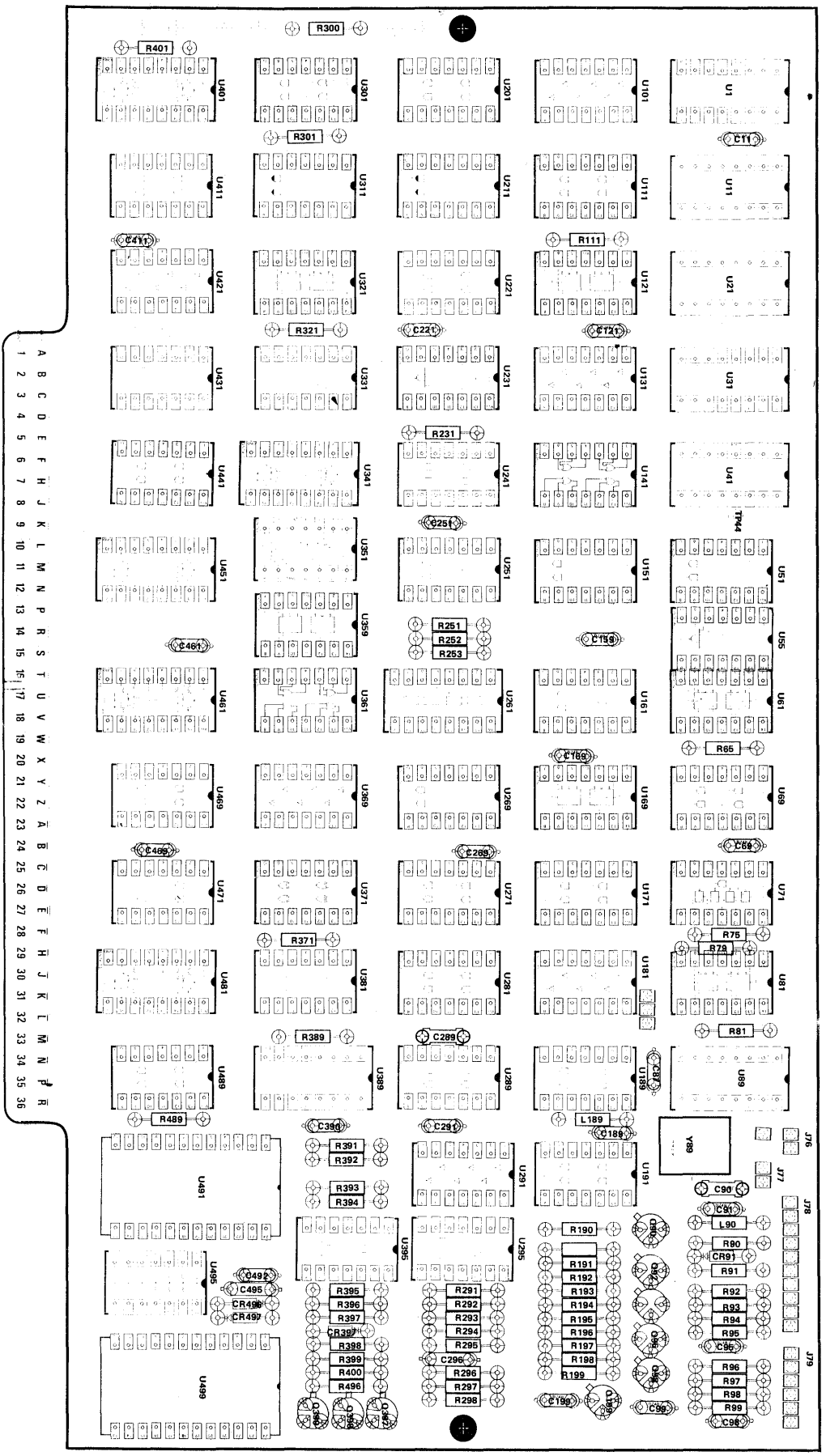


Fig. 6-20D. Timing Card Component Locations (670-2199-05).

REV. B, JAN 1975

CKT #	GRID LOC
CAPACITOR	
C11	H4
C69	H4
C87	H5
C90	H1
C91	H1
C95	B6
C98	B5
C99	A5
C121	H4
C159	H5
C169	H2
C189	H1
C199	B6
C221	H5
C251	H5
C269	H5
C289	D5
C291	H5
C390	H5
C399	E5
C411	H5
C461	H5
C469	H5
C492	H6
DIODE	
CR91	G2
CR397	C5
CR399	E5
JACK	
J76	B6
J78	B6
	E1
	F1
	G1
J79	D6
	E6
	F6
CHOKE, COIL	
L90	H2
L189	H2
TRANSISTOR	
Q90	G2
Q92	G2
Q94	B5
Q96	B5
Q98	A5
Q199	B4
Q397	C5
Q398	C5
RESISTOR	
R65	H2
R75	G5
R79	F6
R81	D2
R90	G2
R91	G2
R92	B5
R93	B5
R94	B6
R95	B6
R96	B5
R97	B5
R98	A5
R99	B5
R111	H4
R190	H3
R191	B5
R192	B5
R193	B5
R194	B5
R195	A5
R196	A4
R197	B4
R198	A4
R199	C5
R231	I4
R251	B2
R252	B2
R253	B2
R291	B4
R292	B5
R293	B5
R294	B4
R295	B4
R296	B5
R297	B5
R298	B5
R300	B2
R301	F5
R321	G5
R371	H5
R389	C5
R390	E5
R391	C5
R392	C5
R393	B4
R394	B4
R395	C5
R396	C5
R397	C5
R398	C5
R399	E5
R400	E5
R401	C1
R489	H5

CKT #	GRID LOC
INTEGRATED CIRCUIT	
U1	H3
U11	H2
U21	H3
U31	H4
U41	G5
U51A	F5
U51B	B3
U55	G5
U61	H4
U61A	G4
U69A	G5
U69B	F5
U69C	H4
U69D	F4
U71	D4
U81A	F5
U81B	D5
U89	H1
U89A	H1
U89B	F2
U101A	G2
U101B	G3
U101C	G3
U101D	E2
U101E	G3
U101F	G3
U111A	G5
U111B	G3
U111C	C2
U111D	F4
U121B	E4
U131A	F4
U131B	G3
U131C	G2
U131D	H4
U131E	G3
U131F	G4
U141A	H3
U141B	H4
U141C	D4
U141D	F5
U151A	F4
U151B	F4
U161A	G2
U161B	G3
U161C	G1
U169A	G5
U169B	G5
U171A	E4
U171B	B2
U171C	E4
U171D	E5
U181A	D3
U181B	B4
U181C	D4
U181D	F5
U181E	H1
U181F	A3
U189A	D4
U189B	H1
U189C	G2
U189D	C4
U191A	H1
U191B	H1
U191C	C4
U191D	H1
U201A	G4
U201B	G4
U201C	F2
U201D	G2
U211A	F4
U211B	E3
U221A	E4
U221B	E4
U221C	F2
U221D	E3
U231A	E3
U241A	E4
U241B	E4
U241C	F2
U241D	G4
U251A	F4
U251B	F4
U251C	A2
U261	B2
U269A	D5
U269B	D4
U271A	B3
U271B	B3
U271C	G2
U271D	C5
U281A	F5
U281B	C5
U281C	C4
U281D	D5
U289A	B3
U289B	B2
U289C	B3
U289D	C4
U291A	B5
U291B	B5
U291C	B5
U291E	B5
U291F	B5
U295C	B4
U295D	B4
U301A	F4
U301B	D5
U301C	D2

CKT #	GRID LOC
U301D	F5
U311A	G3
U321A	D2
U321B	E2
U331A	F2
U331B	F2
U331C	F4
U331D	F4
U341	D5
U351	B1
U395A	G2
U359A	G2
U359B	H4
U361B	C4
U361C	C3
U361D	D5
U369	C4
U369A	G2
U369B	B2
U369D	B3
U369F	C5
U371A	D4
U371B	E5
U371C	D5
U371D	C5
U381A	D4
U381B	C5
U381C	C4
U389	C3
U395A	B4
U395B	B4
U395C	C5
U395D	C5
U401	C4
U411A	B2
U411B	D4
U411C	G4
U411D	C2
U421B	C2
U421C	F4
U421D	C2
U421E	H5
U421F	D2
U431A	H3
U431B	E4
U431C	F4
U431D	G2
U441A	C3
U441B	D4
U441C	D4
U441D	D4
U451	D2
U461	D2
U465A	A3
U465D	B4
U469B	D2
U469C	B3
U471A	C6
U471B	E5
U471C	C6
U471D	F5
U481	C4
U489A	C3
U489B	B3
U489C	C3
U489D	C3
U491	C3
U495A	B3
U495B	C3
U495D	C3
U495E	B3
U495F	B3
U495H	C3
U495J	B2
U495K	I2
U495L	I3
U495M	D3
U495N	C2
U495R	C2
U499	C3

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7437	14	7	HIGH
7438	14	7	HIGH
7440	14	7	HIGH
7473	4	11	HIGH
7486	14	7	LOW
7490	5	10	LOW
7493	5	10	LOW
74161	16	8	HIGH
74165	16	8	HIGH
74175	16	8	HIGH
74S00	14	7	HIGH
74S112	16	8	HIGH

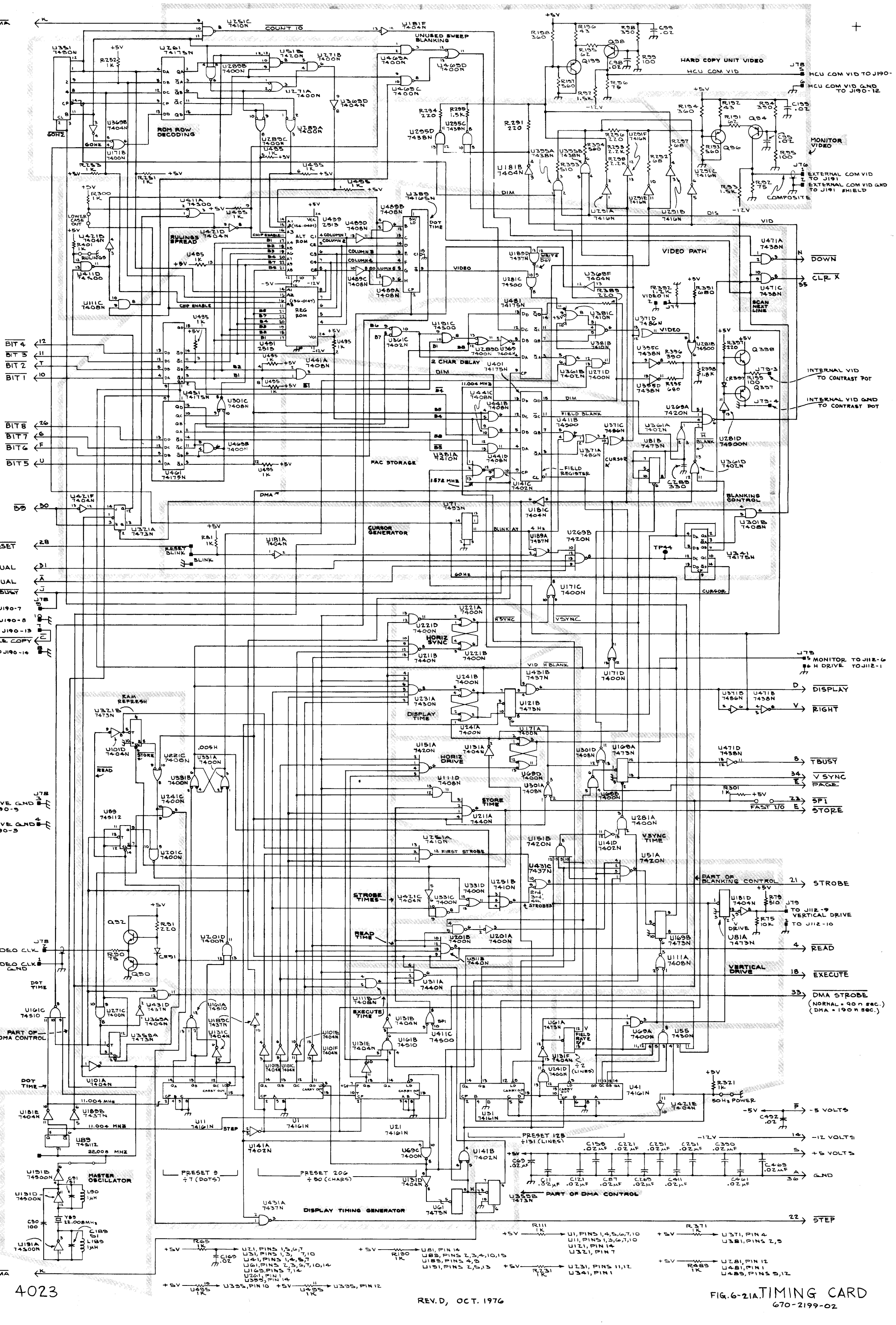


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FIG. 6-21A. TIMING CARD
670-2199-02

CKT #	GRID LOC
CAPACITOR	
C11	H4
C69	H4
C87	H5
C90	H1
C91	H1
C95	B6
C98	B5
C99	A5
C121	H4
C159	H5
C169	H2
C189	H1
C199	B6
C221	H5
C251	H5
C269	H5
C289	D5
C291	H5
C390	H5
C411	H5
C461	H5
C469	H5
C492	H6
DIODE	
CR91	G2
CR397	C5
JACK	
J76	B6
J78	B6
	E1
	F1
	G1
J79	D6
	E6
	F6
CHOKE, COIL	
L90	H2
L189	H2
TRANSISTOR	
Q90	G2
Q92	G2
Q94	B5
Q96	B5
Q98	A5
Q199	B4
Q397	C5
Q398	C5
RESISTOR	
R65	H2
R75	G5
R79	F6
R81	D2
R90	G2
R91	G2
R92	B5
R93	B5
R94	B6
R95	B6
R96	B5
R97	B5
R98	A5
R99	B5
R111	H4
R190	H3
R191	B5
R192	B5
R193	B5
R194	B5
R195	A5
R196	A4
R197	B4
R198	A4
R199	C5
R231	I4
R251	B2
R252	B2
R253	B2
R291	B4
R292	B5
R293	B5
R294	B4
R295	B4
R296	B5
R297	B5
R298	B5
R300	B2
R301	F5
R321	G5
R371	H5
R389	C5
R391	C5
R392	C5
R393	B4
R394	B4
R395	C5
R396	C5
R397	C5
R398	C5
R401	C1
R489	H5

CKT #	GRID LOC
INTEGRATED CIRCUIT	
U1	H3
U11	H2
U21	H3
U31	H4
U41	G5
U51A	F5
U51B	B3
U55	G5
U61	H4
U61A	G4
U69A	G5
U69B	F5
U69C	H4
U69D	F4
U71	D4
U81A	F5
U81B	D5
U89	H1
U89A	H1
U89B	F2
U101A	G2
U101B	G3
U101C	G3
U101D	E2
U101E	G3
U101F	G3
U111A	G5
U111B	G3
U111C	C2
U111D	F4
U121B	E4
U131A	F4
U131B	G3
U131C	G2
U131D	H4
U131E	G3
U131F	G4
U141A	H3
U141B	H4
U141C	D4
U141D	F5
U151A	F4
U151B	F4
U161A	G2
U161B	G3
U161C	G1
U169A	F5
U169B	G5
U171A	E4
U171B	B2
U171C	E4
U171D	E5
U181A	D3
U181B	B4
U181C	D4
U181D	F5
U181E	H1
U181F	A3
U189A	D4
U189B	H1
U189C	G2
U189D	C4
U191A	H1
U191B	H1
U191C	C4
U191D	H1
U201A	G4
U201B	G4
U201C	F2
U201D	G2
U211A	F4
U211B	E3
U221A	E4
U221B	E4
U221C	F2
U221D	E3
U231A	E3
U241A	E4
U241B	E4
U241C	F2
U241D	G4
U251A	F4
U251B	F4
U251C	A2
U261	B2
U269A	D5
U269B	D4
U271A	B3
U271B	B3
U271C	G2
U271D	C5
U281A	F5
U281B	C5
U281C	C4
U281D	D5
U289A	B3
U289B	B2
U289C	B3
U289D	C4
U291A	B5
U291B	B5
U291C	B5
U291E	B5
U291F	B5
U295C	B4
U295D	B4
U301A	F4
U301B	D5
U301C	D2

CKT #	GRID LOC
U301D	F5
U311A	G3
U311B	G4
U321A	D2
U321B	E2
U331A	F2
U331B	F2
U331C	F4
U331D	F4
U341	D5
U351	B1
U359A	G2
U359B	H4
U361A	D5
U361B	C4
U361C	C3
U361D	D5
U369	C4
U369A	G2
U369B	B2
U369D	B3
U369F	C5
U371A	D4
U371B	E5
U371C	D5
U371D	C5
U381A	D4
U381B	C5
U381C	C4
U389	C3
U395A	B4
U395B	B4
U395C	C5
U395D	C5
U401	C4
U411A	B2
U411B	D4
U411C	G4
U411D	C2
U421B	C2
U421C	F4
U421D	C2
U421E	H5
U421F	D2
U431A	H3
U431B	E4
U431C	F4
U431D	G2
U441A	C3
U441B	D4
U441C	D4
U441D	D4
U451	D2
U461	D2
U465A	A3
U465D	B4
U469B	D2
U469C	B3
U471A	C6
U471B	E5
U471C	C6
U471D	F5
U481	C4
U489A	C3
U489B	B3
U489C	C3
U489D	C3
U491	C3
U495A	B3
U495B	C3
U495D	C3
U495E	B3
U495F	B3
U495H	C3
U495J	B2
U495K	I2
U495L	I3
U495M	D3
U495N	C2
U495R	C2
U499	C3

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7437	14	7	HIGH
7438	14	7	HIGH
7440	14	7	HIGH
7473	4	1	HIGH
7486	14	7	LOW
7490	5	10	LOW
7493	5	10	LOW
74161	16	8	HIGH
74165	16	8	HIGH
74175	16	8	HIGH
74S00	14	7	HIGH
74S112	16	8	HIGH

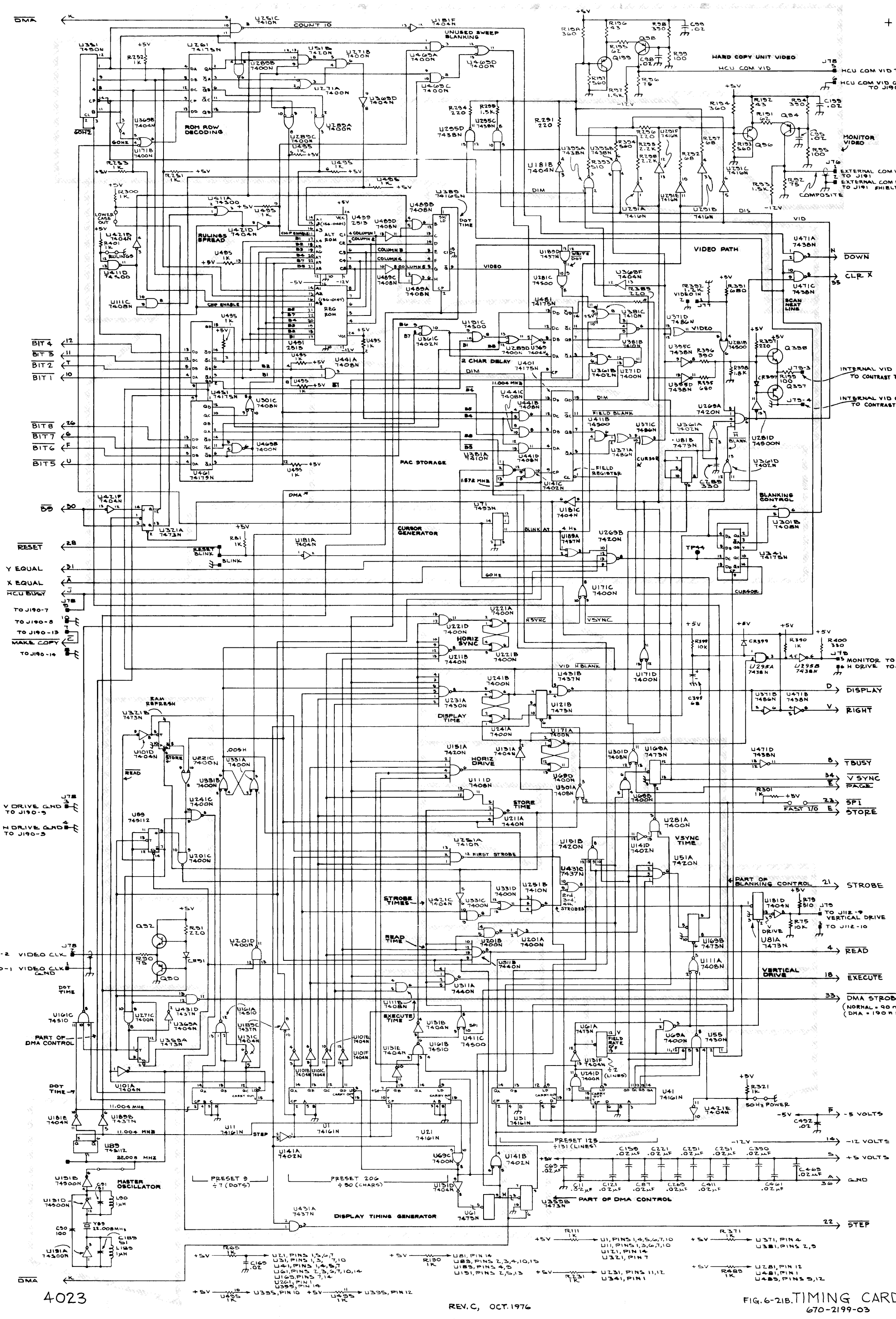

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FIG. 6-21B. TIMING CARD
670-2199-03

CKT #	GRID LOC
CAPACITOR	
C11	H4
C69	H4
C87	H5
C90	H1
C91	H1
C95	B6
C98	B5
C99	A5
C121	H4
C159	H5
C169	H2
C189	H1
C199	B6
C221	H5
C251	H5
C269	H5
C289	D5
C291	H5
C390	H5
C399	E5
C411	H5
C461	H5
C469	H5
C492	H6
DIODE	
CR91	G2
CR397	C5
CR399	E5
JACK	
J76	B6
J78	B6
	E1
	F1
	G1
J79	D6
	E6
	F6
CHOKE, COIL	
L90	H2
L189	H2
TRANSISTOR	
Q90	G2
Q92	G2
Q94	B5
Q96	B5
Q98	A5
Q199	B4
Q397	C5
Q398	C5
RESISTOR	
R65	H2
R75	G5
R79	F6
R81	D2
R90	G2
R91	G2
R92	B5
R93	B5
R94	B6
R95	B6
R96	B5
R97	B5
R98	A5
R99	B5
R111	H4
R190	H3
R191	B5
R192	B5
R193	B5
R194	B5
R195	A5
R196	A4
R197	B4
R198	A4
R199	C5
R231	I4
R251	B2
R252	B2
R253	B2
R291	B4
R292	B5
R293	B5
R294	B4
R295	B4
R296	B5
R297	B5
R298	B5
R300	B2
R301	F5
R321	G5
R371	H5
R389	C5
R390	E5
R391	C5
R392	C5
R393	B4
R394	B4
R395	C5
R396	C5
R397	C5
R398	C5
R399	E5
R400	E5
R401	C1
R489	H5

CKT #	GRID LOC
INTEGRATED CIRCUIT	
U1	H3
U11	H2
U21	H3
U31	H4
U41	G5
U51A	F5
U51B	B3
U55	G5
U61	H4
U61A	G4
U69A	G5
U69B	F5
U69C	H4
U69D	F4
U71	D4
U81A	F5
U81B	D5
U89	H1
U89A	H1
U89B	F2
U101A	G2
U101B	G3
U101C	G3
U101D	E2
U101E	G3
U101F	G3
U111A	G5
U111B	G3
U111C	C2
U111D	F4
U121B	E4
U131A	F4
U131B	G3
U131C	G2
U131D	H4
U131E	G3
U131F	G4
U141A	H3
U141B	H4
U141C	D4
U141D	F5
U151A	F4
U151B	F4
U161A	G2
U161B	G3
U161C	G1
U169A	G5
U169B	G5
U171A	E4
U171B	B2
U171C	E4
U171D	E5
U181A	D3
U181B	B4
U181C	D4
U181D	F5
U181E	H1
U181F	A3
U189A	D4
U189B	H1
U189C	G2
U189D	C4
U191A	H1
U191B	H1
U191C	C4
U191D	H1
U201A	G4
U201B	G4
U201C	F2
U201D	G2
U211A	F4
U211B	E3
U221A	E4
U221B	E4
U221C	F2
U221D	E3
U231A	E3
U241A	E4
U241B	E4
U241C	F2
U241D	G4
U251A	F4
U251B	F4
U251C	A2
U261	B2
U269A	D5
U269B	D4
U271A	B3
U271B	B3
U271C	G2
U271D	C5
U281A	F5
U281B	C5
U281C	C4
U281D	D5
U289A	B3
U289B	B2
U289C	B3
U289D	C4
U291A	B5
U291B	B5
U291C	B5
U291E	B5
U291F	B5
U295C	B4
U295D	B4
U301A	F4
U301B	D5
U301C	D2

CKT #	GRID LOC
U301D	F5
U311A	G3
U321A	D2
U321B	E2
U331A	F2
U331B	F2
U331C	F4
U331D	F4
U341	D5
U351	B1
U395A	G2
U359A	G2
U359B	H4
U361B	C4
U361C	C3
U361D	D5
U369	C4
U369A	G2
U369B	B2
U369D	B3
U369F	C5
U371A	D4
U371B	E5
U371C	D5
U371D	C5
U381A	D4
U381B	C5
U381C	C4
U389	C3
U395A	B4
U395B	B4
U395C	C5
U395D	C5
U401	C4
U411A	B2
U411B	D4
U411C	G4
U411D	C2
U421B	C2
U421C	F4
U421D	C2
U421E	H5
U421F	D2
U431A	H3
U431B	E4
U431C	F4
U431D	G2
U441A	C3
U441B	D4
U441C	D4
U441D	D4
U451	D2
U461	D2
U465A	A3
U465D	B4
U469B	D2
U469C	B3
U471A	C6
U471B	E5
U471C	C6
U471D	F5
U481	C4
U489A	C3
U489B	B3
U489C	C3
U489D	C3
U491	C3
U495A	B3
U495B	C3
U495D	C3
U495E	B3
U495F	B3
U495H	C3
U495J	B2
U495K	I2
U495L	I3
U495M	D3
U495N	C2
U495R	C2
U499	C3

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7437	14	7	HIGH
7438	14	7	HIGH
7440	14	7	HIGH
7473	4	11	HIGH
7486	14	7	LOW
7490	5	10	LOW
7493	5	10	LOW
74161	16	8	HIGH
74165	16	8	HIGH
74175	16	8	HIGH
74S00	14	7	HIGH
74S112	16	8	HIGH

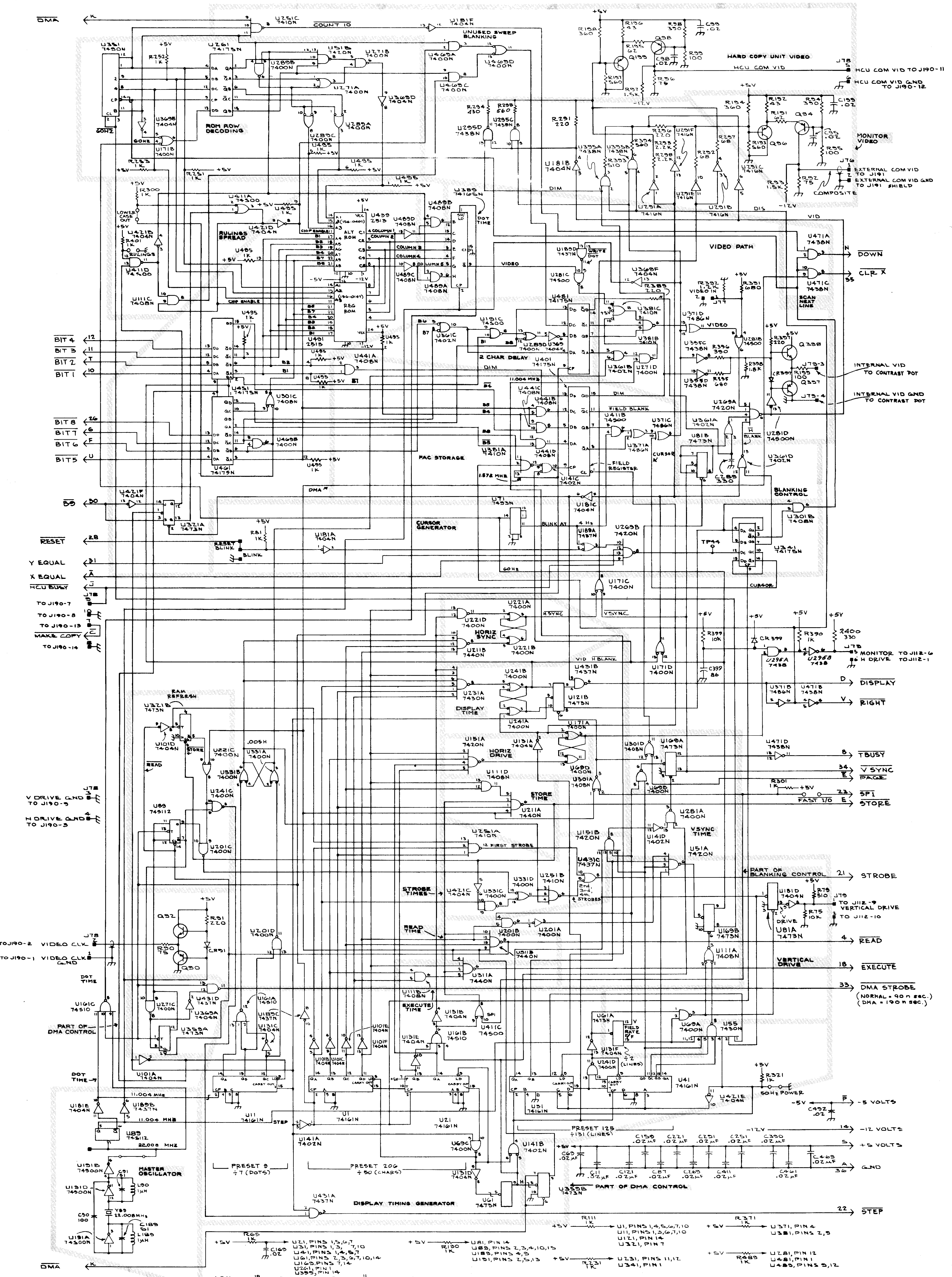

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FIG. 6-21C. TIMING CARD

670-2199-04

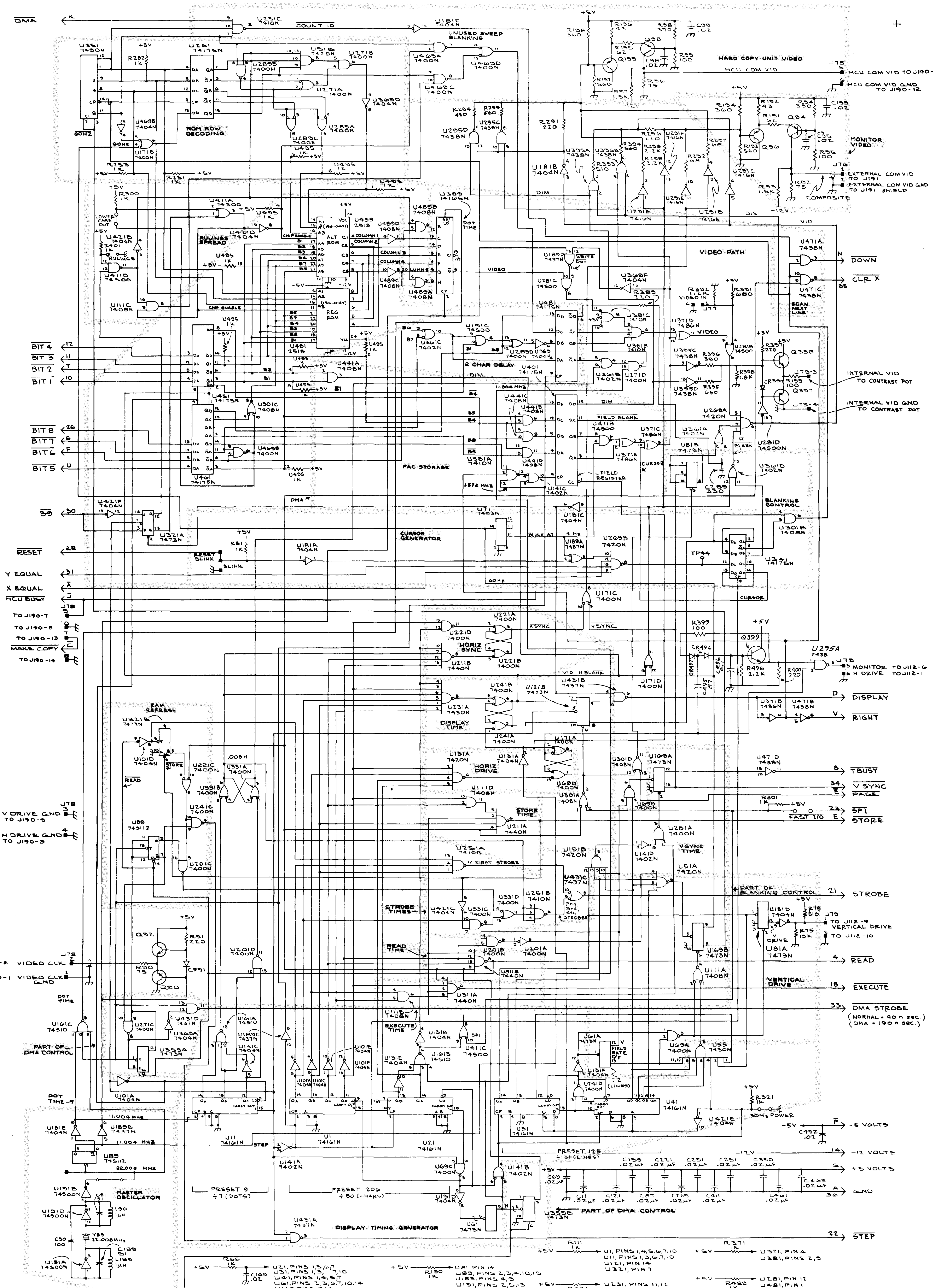

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FIG. 6-21D. TIMING CARD

670-2199-05

CKT #	GRID LOC
CAPACITOR	
C11	H4
C69	H4
C87	H5
C90	H1
C91	H1
C95	B6
C98	B5
C99	A5
C121	H4
C159	H5
C169	H2
C189	H1
C199	B6
C221	H5
C241	H5
C269	H5
C289	D5
C291	H5
C296	E5
C390	H5
C411	H5
C461	H5
C469	H5
C492	H6
C495	E5
DIODE	
CR91	G2
CR397	C5
CR496	E5
CR497	E5
JACK	
J76	B6
J78	B6
	E1
	F1
	G1
J79	D6
	E6
	F6
CHOKE, COIL	
L90	H2
L189	H2
TRANSISTOR	
Q90	G2
Q92	G2
Q94	B5
Q96	B5
Q98	A5
Q199	B4
Q397	C5
Q398	C5
Q399	E5
RESISTOR	
R65	H2
R75	G5
R79	F6
R81	D2
R90	G2
R91	G2
R92	B5
R93	B5
R94	B6
R95	B6
R96	B5
R97	B5
R98	A5
R99	B5
R111	H4
R190	H3
R191	B5
R192	B5
R193	B5
R194	B5
R195	A5
R196	A4
R197	B4
R198	A4
R199	C5
R231	I4
R251	B2
R252	B2
R253	B2
R291	B4
R292	B5
R293	B5
R294	B4
R295	B4
R296	B5
R297	B5
R298	B5
R300	B2
R301	F5
R321	G5
R371	H5
R389	C5
R391	C5
R392	C5
R393	B4
R394	B4
R395	C5
R396	C5
R397	C5
R398	C5

CKT #	GRID LOC
R399	E5
R400	E5
R401	C1
R489	H5
R496	E5
INTEGRATED CIRCUIT	
U1	H3
U11	H2
U21	H3
U31	H4
U41	G5
U51A	F5
U51B	B3
U55	G5
U61	H4
U61A	G4
U69A	G5
U69B	F5
U69C	H4
U69D	F4
U71	D4
U81A	F5
U81B	D5
U89	H1
U89A	H1
U89B	F2
U101A	G2
U101B	G3
U101C	G3
U101D	E2
U101E	G3
U101F	G3
U111A	G5
U111B	G3
U111C	C2
U111D	F4
U121B	E4
U131A	F4
U131B	G3
U131C	G2
U131D	H4
U131E	G3
U131F	G4
U141A	H3
U141B	H4
U141C	D4
U141D	F5
U151A	F4
U151B	F4
U161A	G2
U161B	G3
U161C	G1
U169A	G5
U169B	G5
U171A	E4
U171B	B2
U171C	E4
U171D	E5
U181A	D3
U181B	B4
U181C	D4
U181D	F5
U181E	H1
U181F	A3
U189A	D4
U189B	H1
U189C	G2
U189D	C4
U191A	H1
U191B	H1
U191C	C4
U191D	H1
U201A	G4
U201B	G4
U201C	F2
U201D	G2
U211A	F4
U211B	E3
U221A	E4
U221B	E4
U221C	F2
U221D	E3
U231A	E3
U241A	E4
U241B	E4
U241C	F2
U241D	G4
U251A	F4
U251B	F4
U251C	A2
U261	B2
U269A	D5
U269B	D4
U271A	B3
U271B	B3
U271C	G2
U271D	C5
U281A	F5
U281B	C5
U281C	C4
U281D	D5
U289A	B3
U289B	B2
U289C	B3
U289D	C4
U291A	B5
U291B	B5
U291C	B5
U291E	B5

CKT #	GRID LOC
U291F	B5
U295A	E6
U295C	B4
U295D	B4
U301A	F4
U301B	D5
U301C	D2
U301D	F5
U311A	G3
U321A	D2
U321B	E2
U331A	F2
U331B	F2
U331C	F4
U331D	F4
U341	D5
U351	B1
U395A	G2
U395B	H4
U361A	D5
U361B	C4
U361C	C3
U361D	D5
U369	C4
U369A	G2
U369B	B2
U396D	B3
U369F	C5
U371A	D4
U371B	E5
U371C	D5
U371D	C5
U381A	D4
U381B	C5
U381C	C4
U389	C3
U359A	G2
U359B	H4
U395C	C5
U395D	C5
U401	C4
U411A	B2
U411B	D4
U411C	G4
U411D	C2
U421B	C2
U421C	F4
U421D	C2
U421E	H5
U421F	D2
U431A	H3
U431B	E4
U431C	F4
U431D	G2
U441A	C3
U441B	D4
U441C	D4
U441D	D4
U451	D2
U461	D2
U465A	A3
U465D	B4
U469B	D2
U469C	B3
U471A	C6
U471B	E5
U471C	C6
U471D	F5
U481	C4
U489A	C3
U489B	B3
U489C	C3
U489D	C3
U491	C3
U495A	B3
U495B	C3
U495D	C3
U495E	B3
U495F	B3
U495H	C3
U495J	B2
U495K	I2
U495L	I3
U495M	D3
U495N	C2
U495R	C2
U499	C3

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7437	14	7	HIGH
7438	14	7	HIGH
7440	14	7	HIGH
7473	4	11	HIGH
7486	14	7	LOW
7490	5	10	LOW
7493	5	10	LOW
74161	16	8	HIGH
74165	16	8	HIGH
74175	16	8	HIGH
74S00	14	7	HIGH
74S112	16	8	HIGH

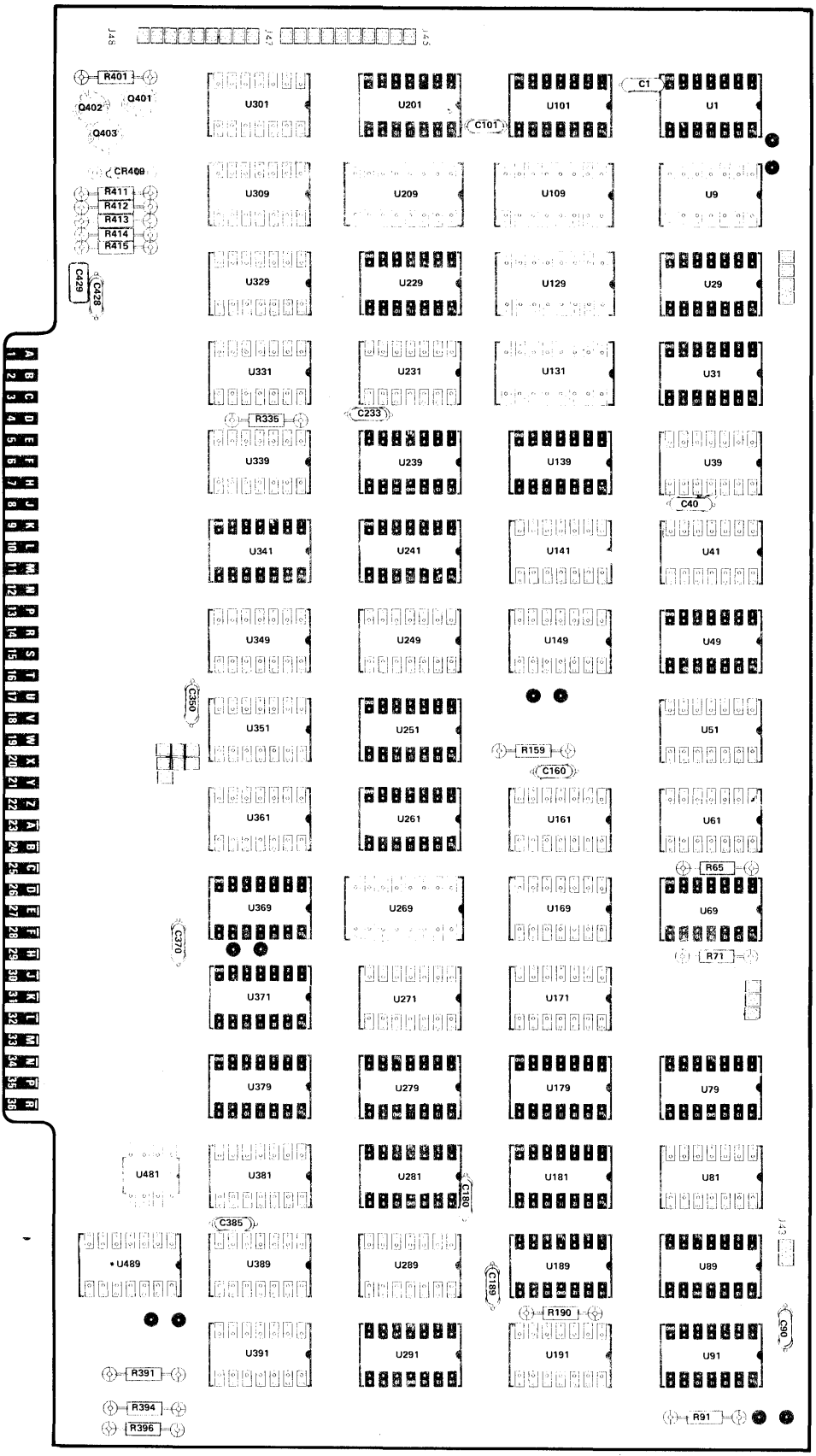

Fig. 6-22. Keyboard interface Card Component Locations 670-2301-04 and below.

***U489 added on 670-2301-04 board.**

CKT #	GRID LOC
CAPACITOR	
C1	A1
C40	A1
C90	A2
C101	A2
C160	A2
C180	A2
C189	A2
C233	A2
C350	A2
C370	A3
C385	A3
C428	A3
C429	D5
DIODE	
CR409	D5
JACK	
J43	F6
J45	D1
	E1
	F1
J47	G1
	H1
J48	D6
TRANSISTOR	
Q401	D5
Q402	D5
Q403	D5
RESISTOR	
R71	A5
R75	C2
R91	G5
R159	A4
R190	A5
R335	A6
R391	C3
R401	D5
R411	D5
R412	C5
R413	C4
R414	D5
R415	D5
INTEGARTED CIRCUIT	
U1	D2
U9A	G2
U9B	D2
U9D	D1
U9E	D2
U9G	D2
U9H	D1
U9J	H1
U9K	F5
U9L	F2
U9M	F4
U9N	F5
U29A	F5
U29B	H2
U29C	C3
U29D	E3
U31A	D5
U31B	D5
U31C	B1
U31D	I5
U31E	H5
U31F	H5
U39A	B5
U39B	E5
U39C	F2
U39D	D3
U41A	C4
U41B	F3
U41C	E4
U41D	F4
U49A	D3
U49D	E4
U51A	B2
U51B	F5
U51C	G5
U51D	D4
U61A	H2
U61B	G6
U61C	E5
U61D	E4
U69A	G5
U69C	G4
U79	A4
U81A	B4
U81B	B4
U81C	B4
U81D	B4
U89	B2
U91A	C2
U91B	B4
U91C	G5
U101A	E4
U101B	D5
U101C	D5
U101D	G1
U101E	D5
U101F	D4
U109	H3
U129	E3
U131	E3
U139A	G3
U139B	F1
U139C	F3
U139D	G6
U139E	F3
U139F	G4
U141A	F4
U141B	F3
U141C	E4
U141D	G4
U149A	G4
U149B	F4
U149C	E4
U149D	D3
U161A	D4
U161B	D4
U161C	E4
U161D	F4
U169A	F4
U169B	E5
U169C	E5
U169D	E5
U171A	F4
U171B	B2
U171C	C3
U171D	C5
U179A	A5
U179B	C3
U181A	C3
U181B	C1
U181C	B2
U181D	B3
U181E	B4
U181F	E4
U189A	B4
U191A	B4
U191B	B4
U191C	C3
U191D	B4
U201A	B5
U201B	D4
U201C	D3
U201D	F5
U201E	F5
U201F	F5
U209	H3
U229	G4
U231A	G2
U231B	G3
U231C	I5
U231D	H4
U239A	H5
U239B	G2
U241A	G5
U241B	G3
U241C	G4
U249A	C3
U249B	G2
U249C	B3
U249D	D3
U251A	F5
U251B	E4
U261B	F4
U261C	E4
U269	E5
U271A	C2
U271B	E5
U271C	C2
U271D	C2
U279	B3
U281A	B2
U281B	B2
U289A	B2
U289B	B3
U289C	B3
U289D	B3
U291A	B3
U291B	B3
U301A	H2
U301B	H2
U301C	H2
U301D	H2
U309A	H2
U309B	H2
U309C	H4
U309D	H2
U329A	H4
U329B	C6
U329C	H4
U329D	H4
U331A	G3
U331C	G3
U331D	G3
U339A	G3
U339B	F6
U339C	C4
U339D	F5
U341A	F4
U341B	C4
U349A	H4
U349B	H4
U349C	H4
U349D	H4
U351A	G5
U351B	F6
U351C	F6
U351D	G5
U361A	F5
U361B	D6
U361C	E6
U361D	D6
U369A	E6
U369B	D5
U369C	B3
U369D	E5
U369E	C2
U369F	C1
U371A	E6
U371B	E6
U371C	E6
U371D	F5
U371E	E6
U371F	E6
U379A	C6
U379C	E6
U379D	E5
U379E	E6
U381A	D6
U381B	D6
U381C	D6
U381D	D6
U389A	C3
U389B	C6
U389C	H4
U389D	D6
U391A	C3
U391C	F6
U391D	B5
U391E	F6
U481A	F4
U481B	F4

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7411	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7432	14	7	LOW
7438	14	7	HIGH
7442	16	8	
7473	4	11	HIGH
7474	14	7	HIGH
7493	5	10	LOW
74175	16	8	HIGH

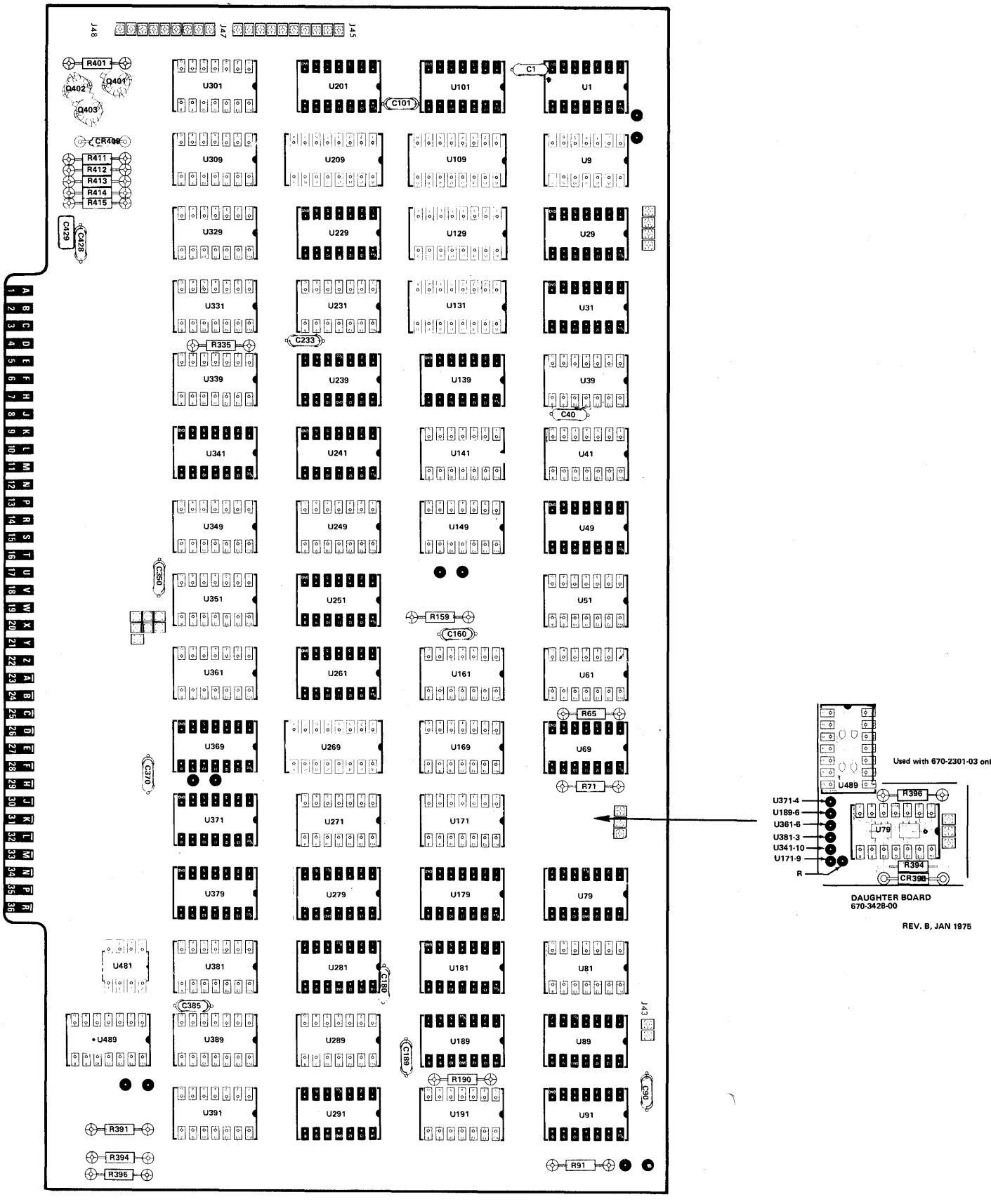

Fig. 6-22. Keyboard interface Card Component Locations 670-2301-04 and below.

***U489 added on 670-2301-04 board.**

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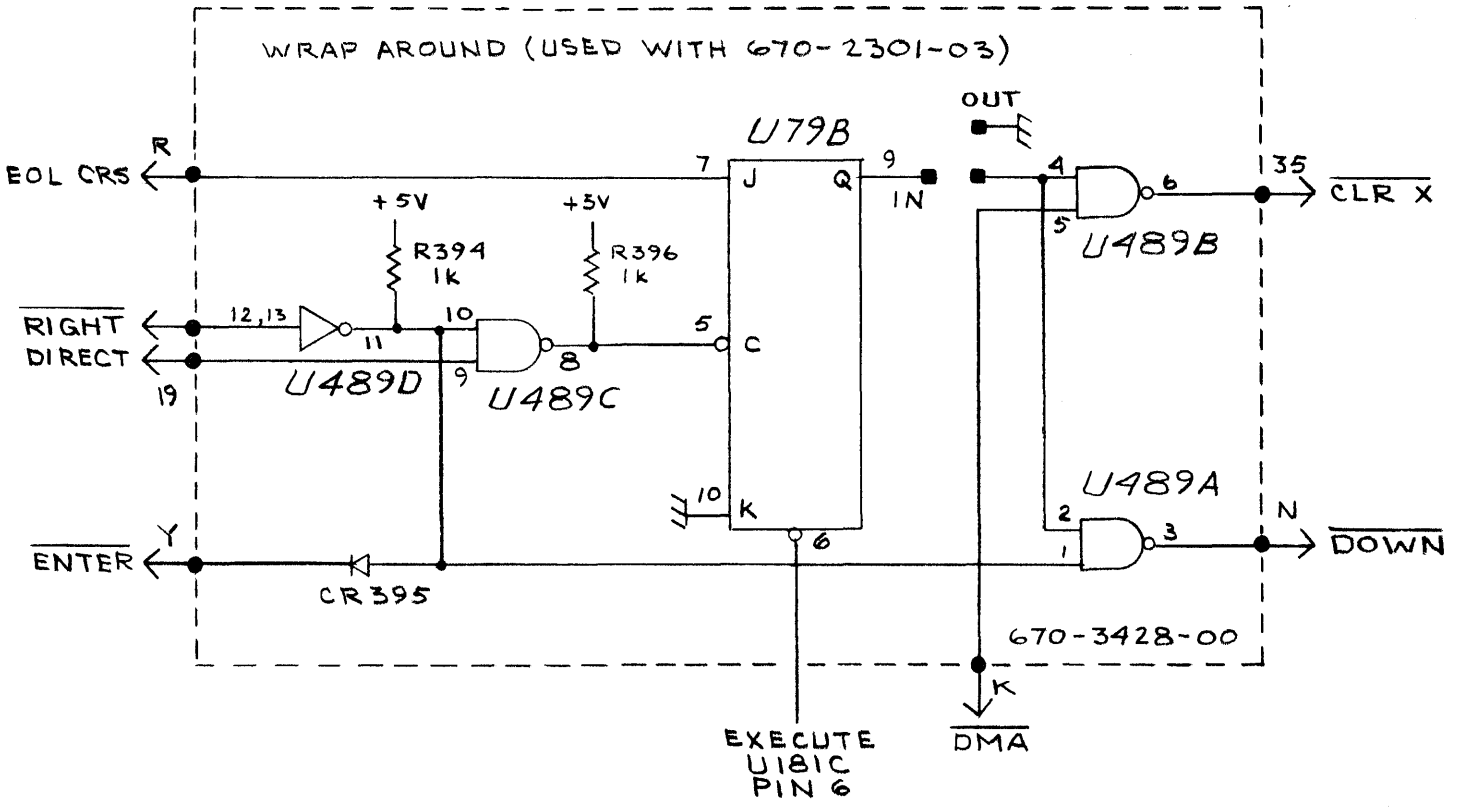
WRAP AROUND (USED WITH 670-2301-03)
OUT
U79B
R
EOL CRS
7
J
Q
9
IN
4
6
35
CLR X
+5V
+5V
R394
1k
R396
1k
5
U489B
RIGHT
DIRECT
12,13
10
11
9
8
19
U489D
U489C
C
5
U489A
10
K
2
1
3
N
DOWN
Y
ENTER
6
CR395
670-3428-00
K
EXECUTE
U18IC
PIN 6
DMA

CKT #	GRID LOC
CAPACITOR	
C1	A1
C40	A1
C90	A2
C101	A2
C160	A2
C180	A2
C189	A2
C233	A2
C350	A2
C370	A3
C385	A3
C428	A3
C429	D5
DIODE	
CR409	D5
JACK	
J43	F6
J45	D1
	E1
	F1
J47	G1
	H1
J48	D6
TRANSISTOR	
Q401	D5
Q402	D5
Q403	D5
RESISTOR	
R71	A5
R75	C2
R91	G5
R159	A4
R190	A5
R335	A6
R391	C3
R401	D5
R411	D5
R412	C5
R413	C4
R414	D5
R415	D5
INTEGRATED CIRCUIT	
U1	D2
U9A	G2
U9B	D2
U9D	D1
U9E	D2
U9G	D2
U9H	D1
U9J	H1
U9K	F5
U9L	F2
U9M	F4
U9N	F5
U29A	F5
U29B	H2
U29C	C3
U29D	E3
U31A	D5
U31B	D5
U31C	B1
U31D	I5
U31E	H5
U31F	H5
U39A	B5
U39B	E5
U39C	F2
U39D	D3
U41A	C4
U41B	F3
U41C	E4
U41D	F4
U49A	D3
U49D	E4
U51A	B2
U51B	F5
U51C	G5
U51D	D4
U61A	H2
U61B	G6
U61C	E5
U61D	E4
U69A	G5
U69C	G4
U79	A4
U81A	B4
U81B	B4
U81C	B4
U81D	B4
U89	B2
U91A	C2
U91B	B4
U91C	G5
U101A	E4
U101B	D5
U101C	D5
U101D	G1
U101E	D5
U101F	D4
U109	H3
U129	E3
U131	E3
U139A	G3
U139B	F1
U139C	F3
U139D	G6
U139E	F3
U139F	G4
U141A	F4
U141B	F3
U141C	E4
U141D	G4
U149A	G4
U149B	F4
U149C	E4
U149D	D3
U161A	D4
U161B	D4
U161C	E4
U161D	F4
U169A	F4
U169B	E5
U169C	E5
U169D	E5
U171A	F4
U171B	B2
U171C	C3
U171D	C5
U179A	A5
U179B	C3
U181A	C3
U181B	C1
U181C	B2
U181D	B3
U181E	B4
U181F	E4
U189A	B4
U191A	B4
U191B	B4
U191C	C3
U191D	B4
U201A	B5
U201B	D4
U201C	D3
U201D	F5
U201E	F5
U201F	F5
U209	H3
U229	G4
U231A	G2
U231B	G3
U231C	I5
U231D	H4
U239A	H5
U239B	G2
U241A	G5
U241B	G3
U241C	G4
U249A	C3
U249B	G2
U249C	B3
U249D	D3
U251A	F5
U251B	E4
U261B	F4
U261C	E4
U269	E5
U271A	C2
U271B	E5
U271C	C2
U271D	C2
U279	B3
U281A	B2
U281B	B2
U289A	B2
U289B	B3
U289C	B3
U289D	B3
U291A	B3
U291B	B3
U301A	H2
U301B	H2
U301C	H2
U301D	H2
U309A	H2
U309B	H2
U309C	H4
U309D	H2
U329A	H4
U329B	C6
U329C	H4
U329D	H4
U331A	G3
U331B	F3
U331C	G3
U331D	G3
U339A	G3
U339B	F6
U339C	C4
U339D	F5
U341A	F4
U341B	C4
U349A	H4
U349B	H4
U349C	H4
U349D	H4
U351A	G5
U351B	F6
U351C	F6
U351D	G5
U361A	F5
U361B	D6
U361C	E6
U361D	D6
U369A	E6
U369B	D5
U369C	B3
U369D	E5
U369E	C2
U369F	C1
U371A	E6
U371B	E6
U371C	E6
U371D	F5
U371E	E6
U371F	E6
U379A	C6
U379C	E6
U379D	E5
U379E	E6
U381A	D6
U381B	D6
U381C	D6
U381D	D6
U389A	C3
U389B	C6
U389C	H4
U389D	D6
U391A	C3
U391C	F6
U391D	B5
U391E	F6
U481A	F4
U481B	F4

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7411	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7432	14	7	LOW
7438	14	7	HIGH
7442	16	8	
7473	4	11	HIGH
7474	14	7	HIGH
7493	5	10	LOW
74175	16	8	HIGH

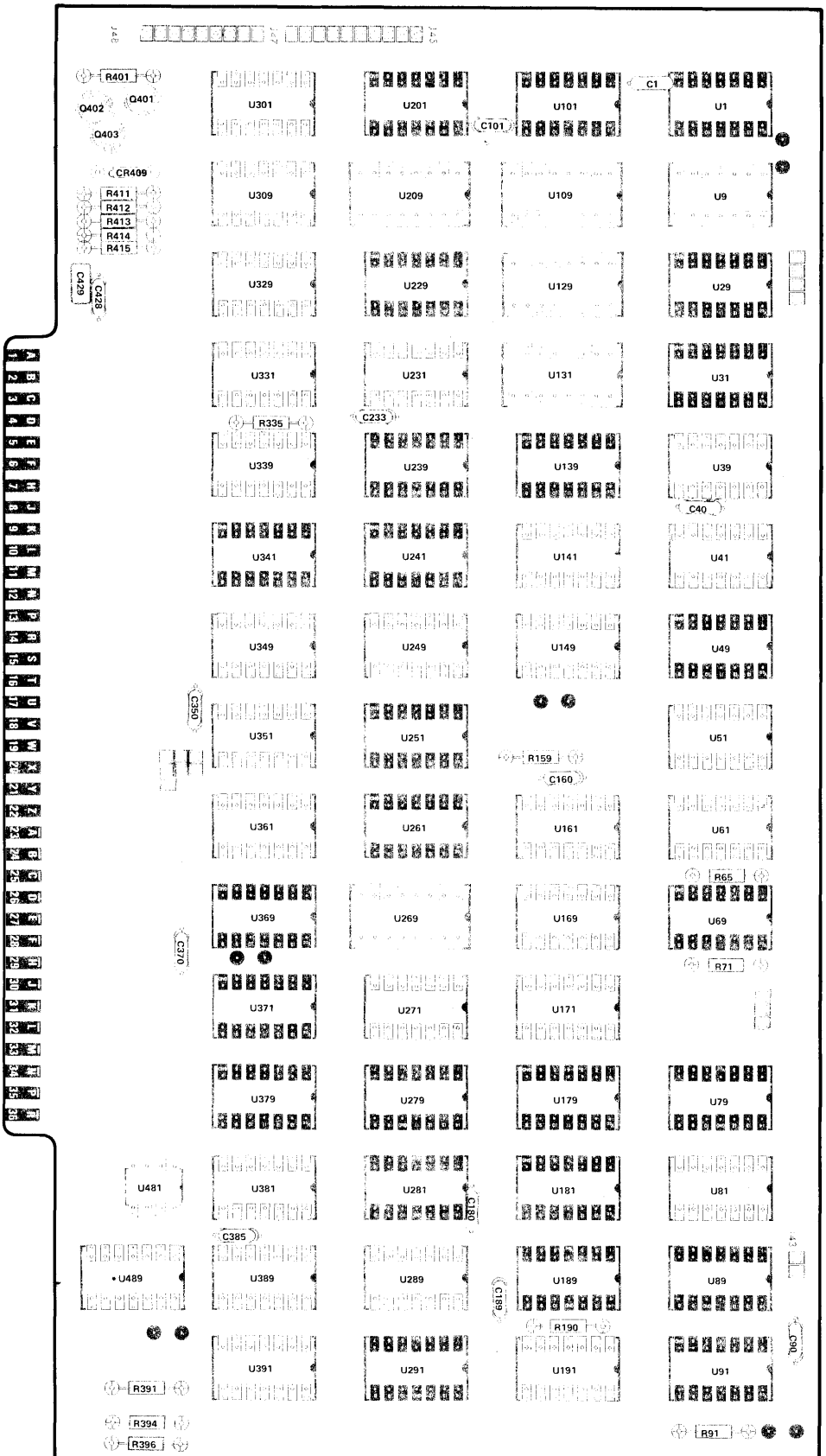

Fig. 6-22. Keyboard interface Card Component Locations 670-2301-04 and below.

***U489 added on 670-2301-04 board.**

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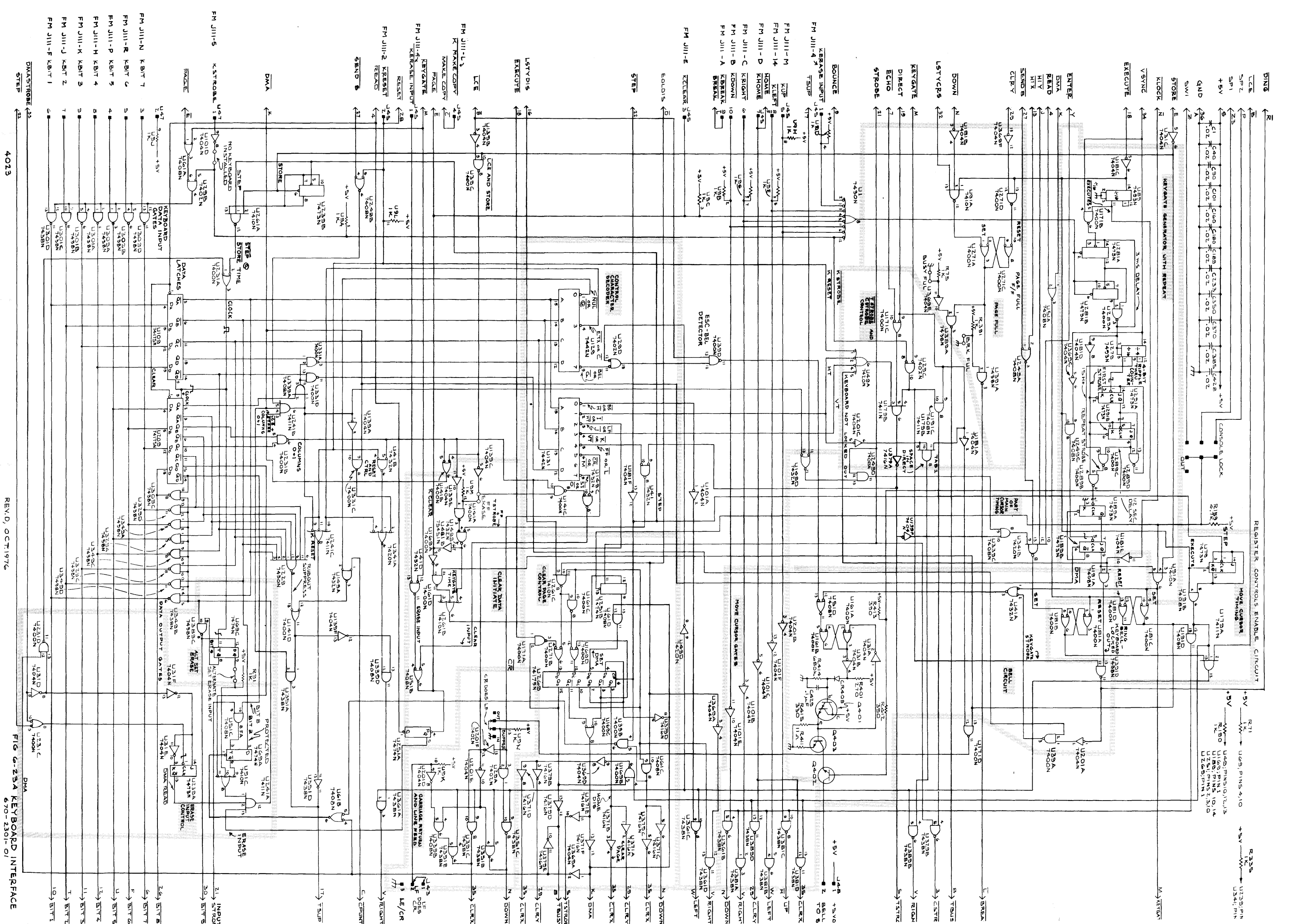
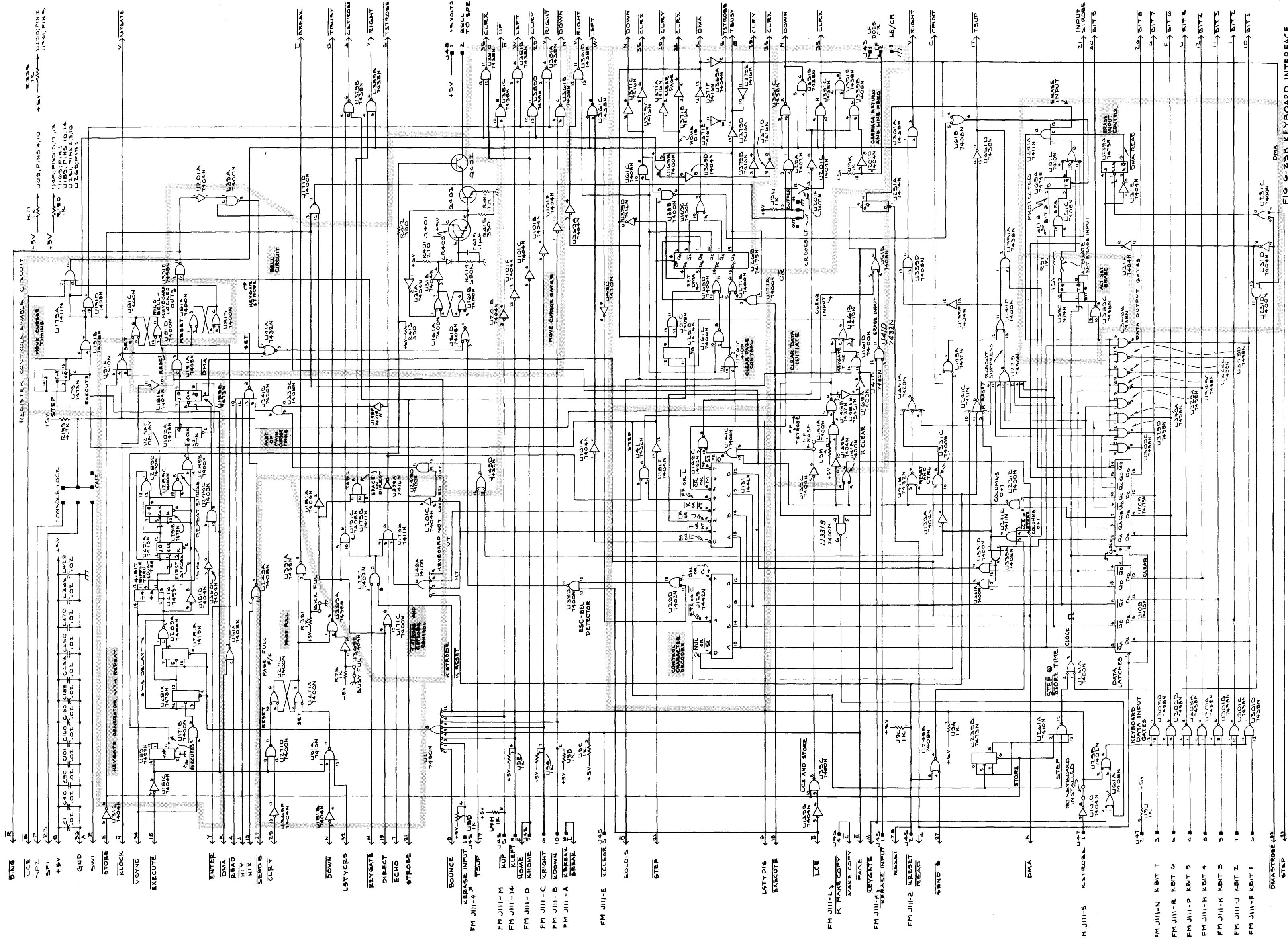

KEYGATE GENERATOR WITH REPEAT
REGISTER CONTROLS ENABLE CIRCUIT
KEYBOARD DATA INPUT GATES
DATA LATCHES
DATA OUTPUT GATES
CONTROL CHARACTER DECODER
ESC-BEL DETECTOR
CLEAR DATA INITIATE
MOVE CURSOR GATES
GARBAGE RETURN AND LINE FEED
BELL CIRCUIT
KEYBOARD NOT LOCKED OUT
PAGE FULL
BUSY FULL
CONSOLE LOCK
DMA
STEP
EXECUTE
ENTER
DMA
READ
HIT
HTX
SEND B
CLRY
DOWN
LSTYCPS
KEYGATE
DIRECT
ECHO
STROBE
BOUNCE
KERASE INPUT
TSUP
KUP
KLEFT
HOME
KHOME
KRIGHT
KDOWN
KBREAK
BREAK
KSTROBE
KCLEAR
LSTYDIS
EXECUTE
LCE
K MAKE COPY
PAGE
KEYGATE
KERASE INPUT
KRESET
RESET
SEND B
KSTROBE
VSYNC
KLOCK
STORE
SWI
GND
+5V
SPI
SPZ
LCE
DING
FM J111-N KBIT 7
FM J111-R KBIT 6
FM J111-P KBIT 5
FM J111-H KBIT 4
FM J111-K KBIT 3
FM J111-J KBIT 2
FM J111-F KBIT 1
DMASTROBE
STEP
DMA
4023
REV.D, OCT.1976
FIG 6-23A KEYBOARD INTERFACE
670-2301-01


REGISTER CONTROLS ENABLE CIRCUIT
KEYGATE GENERATOR WITH REPEAT
BELL CIRCUIT
MOVE CURSOR GATES
CLEAR DATA INITIATE
CLEAR PAGE CONTROL
CONTROL CHARACTER DECODER
ESC-BEL DETECTOR
KEYBOARD NOT LOCKED OUT
PAGE FULL F/F
DATA OUTPUT GATES
ALT SET ERASE
ERASE INPUT
DMA READ CONTROL
PROTECTED BIT 8
DATA LATCHES
KEYBOARD INPUT GATES
STEP @ STORE TIME
CONSOLE LOCK
DMA
FIG 6-23B KEYBOARD INTERFACE

EOL CRS → TO U79 PIN 7
DING
LCE
SPZ
SPI
+5V
GND
SWI
STORE
KLOCK
VSYNC
EXECUTE
ENTER
DMA
READ
HIY
HIX
SEND B
CLRY
DOWN
LSTYCRS
KEYGATE
DIRECT
ECHO
STROBE
BOUNCE
KERASE INPUT
FM J111-4 TSUP
FM J111-M KUP
FM J111-14 KLEFT
FM J111-D KHOME
FM J111-C KRIGHT
FM J111-B KDOWN
FM J111-A KBREAK
BREAK
FM J111-E KCLEAR
EOLDIS
STEP
LSTYDIS
EXECUTE
LCE
FM J111-L K MAKE COPY
MAKE COPY
PAGE
KEYGATE
FM J111-4 KERASE INPUT
RESET
FM J111-2 KRESET
READ
SEND B
DMA
FM J111-5 KSTROBE
FM J111-N KBIT 7
FM J111-R KBIT 6
FM J111-P KBIT 5
FM J111-H KBIT 4
FM J111-K KBIT 3
FM J111-J KBIT 2
FM J111-F KBIT 1
DMASTROBE
STEP

REGISTER CONTROLS ENABLE CIRCUIT
CONSOLE LOCK
OUT
KEYGATE GENERATOR WITH REPEAT
3 ms DELAY
4-BIT RIPPLE THRU COUNTER
FIRST STROBE
REPEAT STROBE
15Hz
½ SEC DELAY
DMA to U489C PIN 9
EXECUTE TO U79 PIN 6
ENTER TO U48IA PINS 1&2
PAGE FULL F/F
PAGE FULL
DIRECT TO U489A PIN 1
BRK FUL
BUSY FUL
TAB 1
SPACE IN DIRECT
T STROBE AND C STROBE CONTROL
K STROBE
K RESET
KEYBOARD NOT LOCKED OUT
VT
HT
ESC-BEL DETECTOR
CONTROL CHARACTER DECODER
STEP
STORE TIME
CLOCK
NO KEYBOARD INSTALLED
KEYBOARD DATA INPUT GATES
DATA LATCHES
CLEAR
DATA OUTPUT GATES
MOVE CURSOR TIMING
PART OF MAIN CURSOR TIMING
MOVE CURSOR GATES
BELL CIRCUIT
RING BELL - KEYBOARD LOCKED OUT
KEYGATE STROBE
CLEAR DATA INITIATE
CLEAR INPUT
CR
CR DOES LF
LF DOES CR
CARRIAGE RETURN AND LINE FEED
CLEAR PAGE CONTROL
SET DMA
HOME DIS
CLEAR PAGE
KEYGATE TIME
R-CLEAR
ERASE INPUT
FF ERASE
FF TSTROBE
RESET AND CTRL
COLUMNS 0+1
RUBOUT SUPPRESS
PROTECTED BIT 8
BIT 7
ALTERNATE SET ERASE INPUT
ALT SET ERASE
ERASE INPUT CONTROL
DMA READ
DMA
R71 1K → U69, PINS 4,10
R180 1K → U49; PIN 10,12,13; U169; PIN 1; U185; PINS 10,14; U261; PINS 2,3,10; U269; PIN 1
R335 1K → U139; PIN 2; U341; PIN 5
R413 390
R412 390
R401 270 Q401
Q402
Q403
CR409
R414 680K
CA29 .1μF
R415 330
R411 11Ω
R391 1K
R394 1K
R396 1K
R91 1K
U9H 1K
U9E 1K
U9B 1K
U9C 1K
U9N 1K
U9M 1K
U9L 1K
U9K 1K
U9J 1K
U9A 1K
U45 U8D 1K
U45 U8E 1K
U45 U8C 1K
U47 U9J 1K
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U9289 7438N
U9299 7400N
U9309 7410N
U9319 7408N
U9329 7408N
U9339 7408N
U9349 7432N
U9359 7432N
U9369 7408N
U9379 7411N
U9389 7438N
U9399 7400N
U9409 7410N
U9419 7408N
U9429 7408N
U9439 7408N
U9449 7432N
U9459 7432N
U9469 7408N
U9479 7411N
U9489 7438N
U9499 7400N
U9509 7410N
U9519 7408N
U9529 7408N
U9539 7408N
U9549 7432N
U9559 7432N
U9569 7408N
U9579 7411N
U9589 7438N
U9599 7400N
U9609 7410N
U9619 7408N
U9629 7408N
U9639 7408N
U9649 7432N
U9659 7432N
U9669 7408N
U9679 7411N
U9689 7438N
U9699 7400N
U9709 7410N
U9719 7408N
U9729 7408N
U9739 7408N
U9749 7432N
U9759 7432N
U9769 7408N
U9779 7411N
U9789 7438N
U9799 7400N
U9809 7410N
U9819 7408N
U9829 7408N
U9839 7408N
U9849 7432N
U9859 7432N
U9869 7408N
U9879 7411N
U9889 7438N
U9899 7400N
U9909 7410N
U9919 7408N
U9929 7408N
U9939 7408N
U9949 7432N
U9959 7432N
U9969 7408N
U9979 7411N
U9989 7438N
U9999 7400N

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FIG 6-23C KEYBOARD INTERFACE

670-2301-04 & UP

CKT #	GRID LOC
CAPACITOR	
C1	A1
C40	A1
C90	A2
C101	A2
C160	A2
C180	A2
C189	A2
C233	A2
C350	A2
C370	A3
C385	A3
C428	A3
C429	D5
DIODE	
CR409	D5
JACK	
J43	F6
J45	D1
	E1
	F1
J47	G1
	H1
J48	D6
TRANSISTOR	
Q401	D5
Q402	D5
Q403	D5
RESISTOR	
R71	A5
R75	C2
R91	G5
R159	A4
R190	A5
R335	A6
R391	C3
R401	D5
R411	D5
R412	C5
R413	C4
R414	D5
R415	D5
INTEGRATED CIRCUIT	
U1	D2
U9A	G2
U9B	D2
U9D	D1
U9E	D2
U9G	D2
U9H	D1
U9J	H1
U9K	F5
U9L	F2
U9M	F4
U9N	F5
U29A	F5
U29B	H2
U29C	C3
U29D	E3
U31A	D5
U31B	D5
U31C	B1
U31D	I5
U31E	H5
U31F	H5
U39A	B5
U39B	E5
U39C	F2
U39D	D3
U41A	C4
U41B	F3
U41C	E4
U41D	F4
U49A	D3
U49D	E4
U51A	B2
U51B	F5
U51C	G5
U51D	D4
U61A	H2
U61B	G6
U61C	E5
U61D	E4
U69A	G5
U69C	G4
U79A	A4
U79B	B6
U81A	B4
U81B	B4
U81C	B4
U81D	B4
U89	B2
U91A	C2
U91B	B4
U91C	G5
U101A	E4
U101B	D5
U101C	D5
U101D	G1
U101E	D5
U101F	D4
U109	H3
U129	E3
U131	E3
U139A	G3
U139B	F1
U139C	F3
U139D	G6
U139E	F3
U139F	G4
U141A	F4
U141B	F3
U141C	E4
U141D	G4
U149A	G4
U149B	F4
U149C	E4
U149D	D3
U161A	D4
U161B	D4
U161C	E4
U161D	F4
U169A	F4
U169B	E5
U169C	E5
U169D	E5
U171A	F4
U171B	B2
U171C	C3
U171D	C5
U179A	A5
U179B	C3
U181A	C3
U181B	C1
U181C	B2
U181D	B3
U181E	B4
U181F	E4
U189A	B4
U191A	B4
U191B	B4
U191C	C3
U191D	B4
U201A	B5
U201B	D4
U201C	D3
U201D	F5
U201E	F5
U201F	F5
U209	H3
U229	G4
U231A	G2
U231B	G3
U231C	I5
U231D	H4
U239A	H5
U239B	G2
U241A	G5
U241B	G3
U241C	G4
U249A	C3
U249B	G2
U249C	B3
U249D	D3
U251A	F5
U251B	E4
U261B	F4
U261C	E4
U269	E5
U271A	C2
U271B	E5
U271C	C2
U271D	C2
U279	B3
U281A	B2
U281B	B2
U289A	B2
U289B	B3
U289C	B3
U289D	B3
U291A	B3
U291B	B3
U301A	H2
U301B	H2
U301C	H2
U301D	H2
U309A	H2
U309B	H2
U309C	H4
U309D	H2
U329A	H4
[illegible]	
U329B	C6
U329C	H4
U329D	H4
U331A	G3
U331B	F3
U331C	G3
U331D	G3
U339A	G3
U339B	F6
U339C	C4
U339D	F5
U341A	F4
U341B	C4
U349A	H4
U349B	H4
U349C	H4
U349D	H4
U351A	G5
U351B	F6
U351C	F6
U351D	G5
U361A	F5
U361B	D6
U361C	E6
U361D	D6
U369A	E6
U369B	D5
U369C	B3
U369D	E5
U369E	C2
U369F	C1
U371A	E6
U371B	E6
U371C	E6
U371D	F5
U371E	E6
U371F	E6
U379A	C6
U379C	E6
U379D	E5
U379E	E6
U381A	D6
U381B	D6
U381C	D6
U381D	D6
U389A	C3
U389B	C6
U389C	H4
U389D	D6
U391A	C3
U391C	F6
U391D	B5
U391E	F6
U481A	F4
U481B	F4
U489A	B5
U489B	B6
U489C	B6
U489D	B5

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7411	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7432	14	7	LOW
7438	14	7	HIGH
7442	16	8	
7473	4	11	HIGH
7474	14	7	HIGH
7493	5	10	LOW
74175	16	8	HIGH

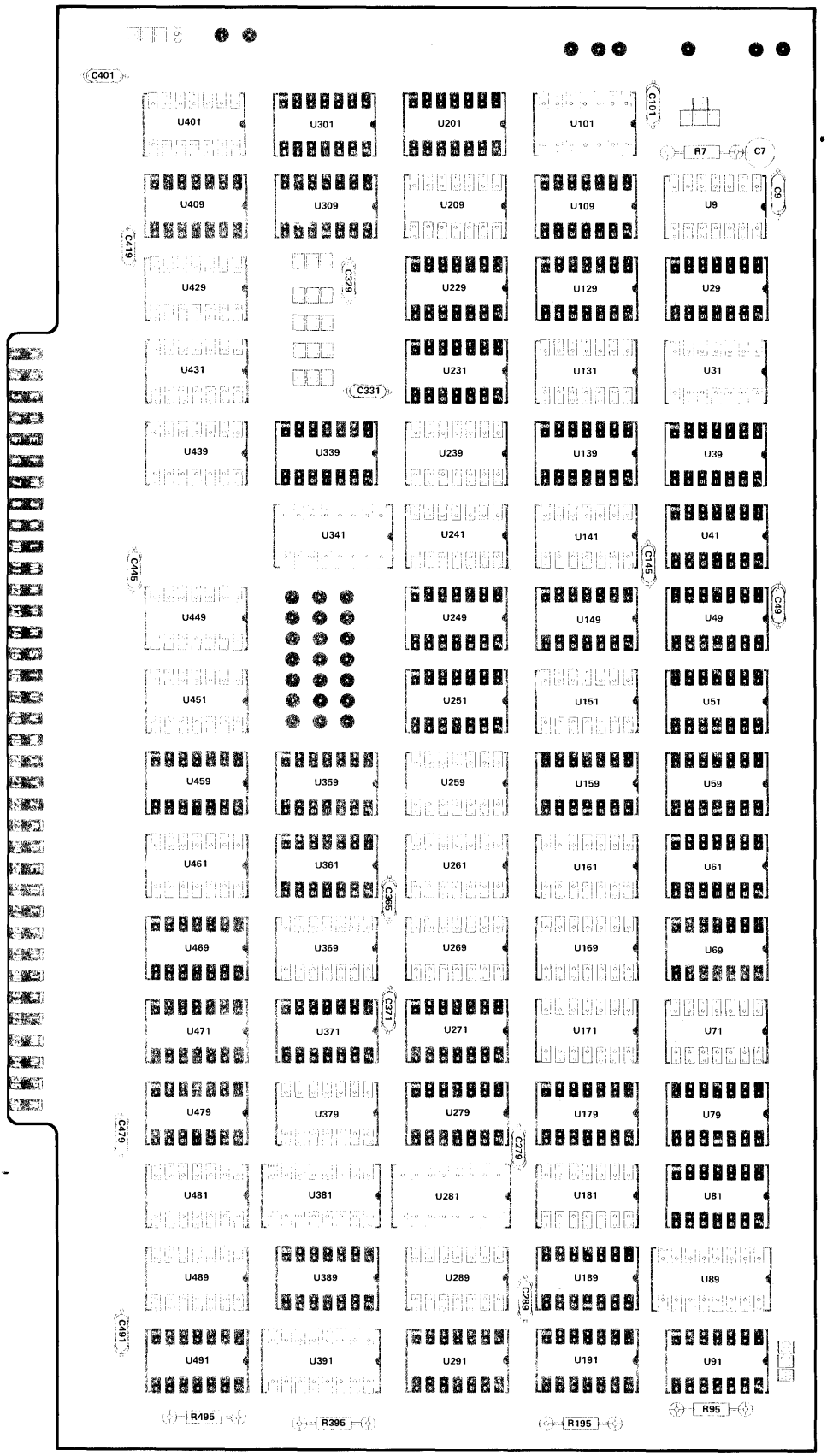

Fig. 6-24. Control Card Component Locations.

REV.B, JAN 1975

CKT #	GRID LOC
CAPACITOR	
C7	B4
C9	B6
C49	B6
C101	B6
C145	B6
C279	B6
C289	B6
C329	B6
C331	B6
C365	B6
C371	B6
C401	B6
C419	B6
C445	B6
C461	B6
C479	B6
C491	B6
JACK	
J60	C5
RESISTOR	
R7	B5
R95	J4
R195	G4
R395	H4
R495	H5
INTEGRATED CIRCUIT	
U9A	J3
U9B	C4
U9C	D4
U9D	F5
U29A	D3
U29B	D4
U29C	C2
U31	B4
U39B	C4
	D3
U41A	B5
U41B	D2
U41C	H4
U41D	B4
U49A	D3
U49B	C5
U51A	H5
U51B	F5
U59A	I4
U59B	I4
U61A	F2
U61B	E2
U61C	D4
U61D	C5
U69A	F2
U69B	D3
U71A	F4
	G3
U71B	H3
U79A	C5
U79B	G5
U81A	G2
U81B	F2
U81C	H4
U81D	H4
U89	I3
U91A	G4
U91B	H4
U91C	J3
U91D	H6
U101	C5
	H6
U101B	D3
U101D	H6
U101E	C4
U101F	G5
U101G	A4
U101J	C5
U101K	C4
U101L	B5
U101M	A5
U101N	D4
U109	D3
U109A	C5
U109B	D5
U109C	B4
U129A	C4
U129B	C4
U131A	D4
U131B	C2
U131C	C1
U131D	C2
U131E	B4
U139A	C4
U139B	C3
U139C	C3
U141A	D4
U141B	E3
U141C	D3
U141D	E1
U149A	I4
U149B	F5
U149C	F3
U149D	D2
U151B	E3
U151C	D1
U151D	F3
U151E	F3
U151F	I4
U159A	E3
U159B	H5
U161A	H4
U161B	G4
U161C	G4
U161D	G3
U169A	F3
U169B	H3
U169C	G4
U169D	F3
U171A	F3
U171B	G3
U171C	G5
U171D	G3
U179	G4
U181A	G4
U181B	G4
U181C	F5
U181D	G5
U181E	I2
U181F	G3
U189A	I4
U189B	G1
U191A	I4
U191B	I4
U201A	C4
U201B	D2
U201C	I5
U201D	B4
	C4
U209A	C2
	F4
U209C	D4
U229A	B4
U229B	B4
U231A	H4
U231B	B4
U231C	E4
U239A	C4
U239B	B3
U239C	C3
U239D	C3
U241A	C2
U241B	C2
U241C	C4
U241D	A2
U241F	B2
U249	B4
U251	B4
U259A	E5
U259B	F5
U259C	E3
U259D	F3
U261A	F5
U261B	F3
U261D	F3
U261E	H5
U261F	E3
U269A	F3
U269B	G3
U269C	G4
U269D	G4
U271A	G5
U271B	G3
U271C	H3
U279	G4
U281	H3
U289A	I3
U289B	G3
U289C	H2
U289D	H2
U291	C2
U291A	I4
U291B	I2
U291D	G2
U301A	C5
U301B	J4
U301D	C3
U309A	B4
U339A	B3
U339B	C2
U341	C2
U359A	H5
U359B	F5
U359C	H4
U359D	E3
U361A	D3
U361B	E3
U361C	F5
U361D	F4
U369A	F3
U369B	F3
U369C	F5
U369D	F3
U371A	G5
U371B	F5
U371C	B5
U371D	D5
U379A	D6
U379B	J5
U379C	C6
U379D	D6
U379E	D6
U379F	D6
U381	G2
U389A	G2
	J3
U389C	I4
U391	I3
U401A	B5
U401B	F6
U401C	D4
U401D	C6
U401E	D6
U401F	C6
U409A	H6
U409B	I5
U409C	C4
	C5
U429A	G6
U429B	F6
U429C	F6
U429D	G6
U429E	G6
U429F	G6
U431A	I6
U431B	G6
U431C	I5
U431D	G6
U431E	I6
U431F	I5
U439A	G6
U439B	I6
U439C	D4
U439D	B6
U439E	G6
U439F	G6
U449A	B2
U449B	B2
U449C	D2
U449E	A1
	B1
U449F	B1
U451A	B2
U451B	B2
U451C	B2
U451D	A2
U451E	B2
U451F	B1
U459A	D4
U459B	E6
U459C	E6
U459D	E6
U461A	E6
U461B	D4
U461C	F6
U461D	B5
U461E	D6
U461F	C5
U469A	E6
U469B	H5
U469C	F3
U469D	C6
U471A	C5
U471B	C4
U471C	B5
U471D	D5
U479A	H1
U479B	F6
	I2
U481A	G3
U481B	E5
U481C	I1
U481D	D2
U481E	G2
U481F	E2
U489A	J5
U489B	G6
U489C	J5
U489D	F6
U489E	I5
U489F	I5
U491A	E6
U491B	E6
U491C	I5
U491D	F6

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7410	14	7	HIGH
7411	14	7	HIGH
7416	14	7	
7420	14	7	HIGH
7427	14	7	LOW
7430	14	7	HIGH
7438	14	7	HIGH
7442	16	8	
7473	4	11	HIGH
7474	14	7	HIGH
74121	14	7	HIGH
74175	16	8	HIGH

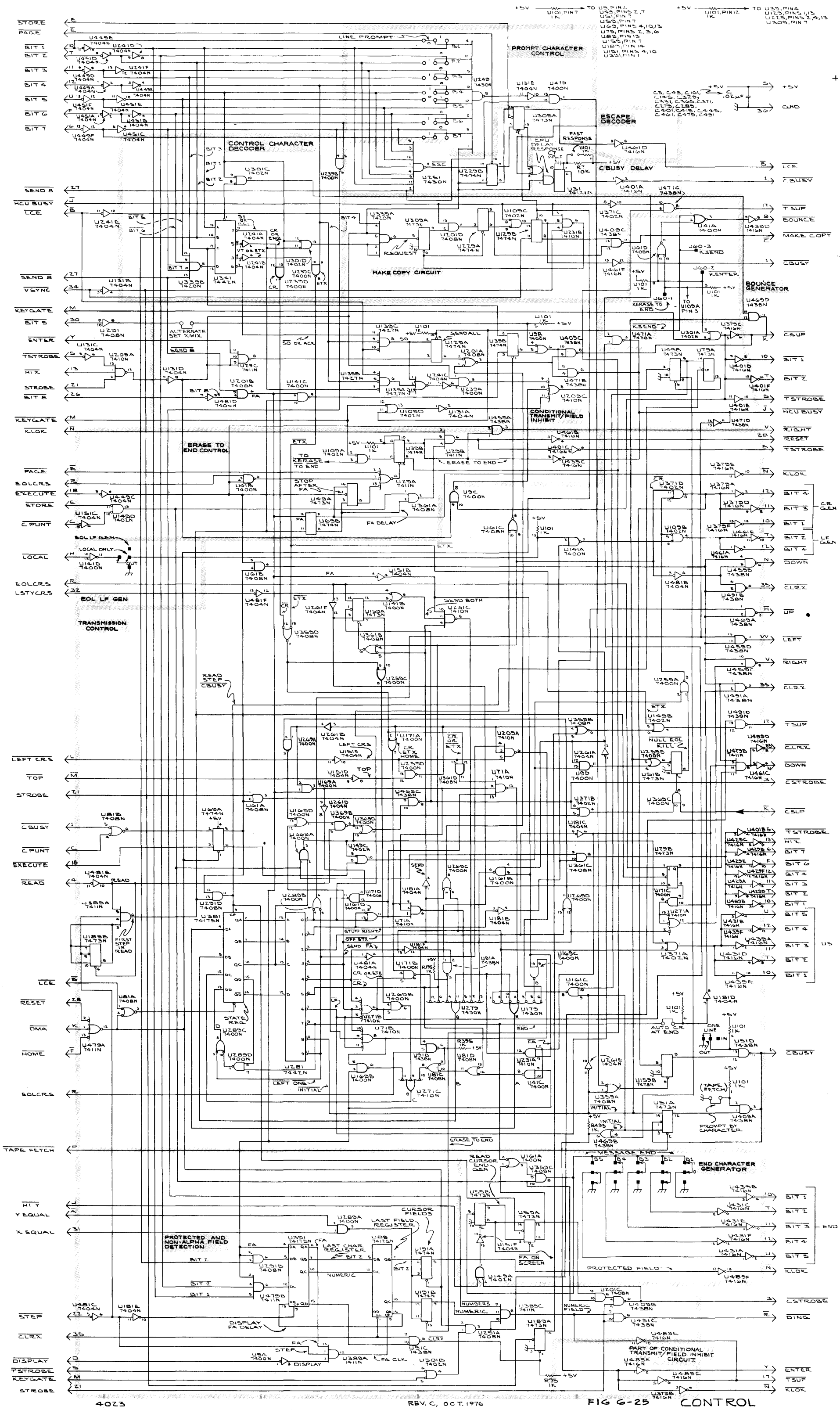

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FIG 6-25 CONTROL

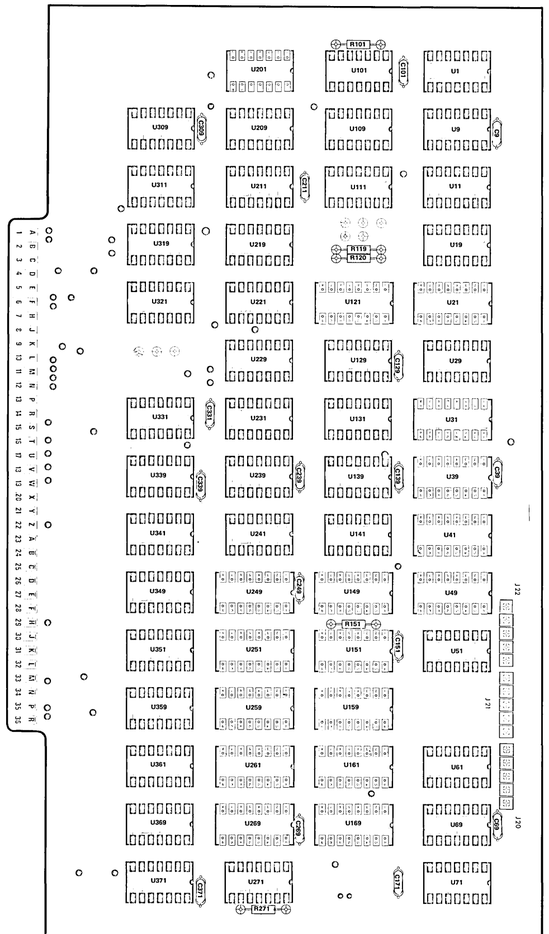
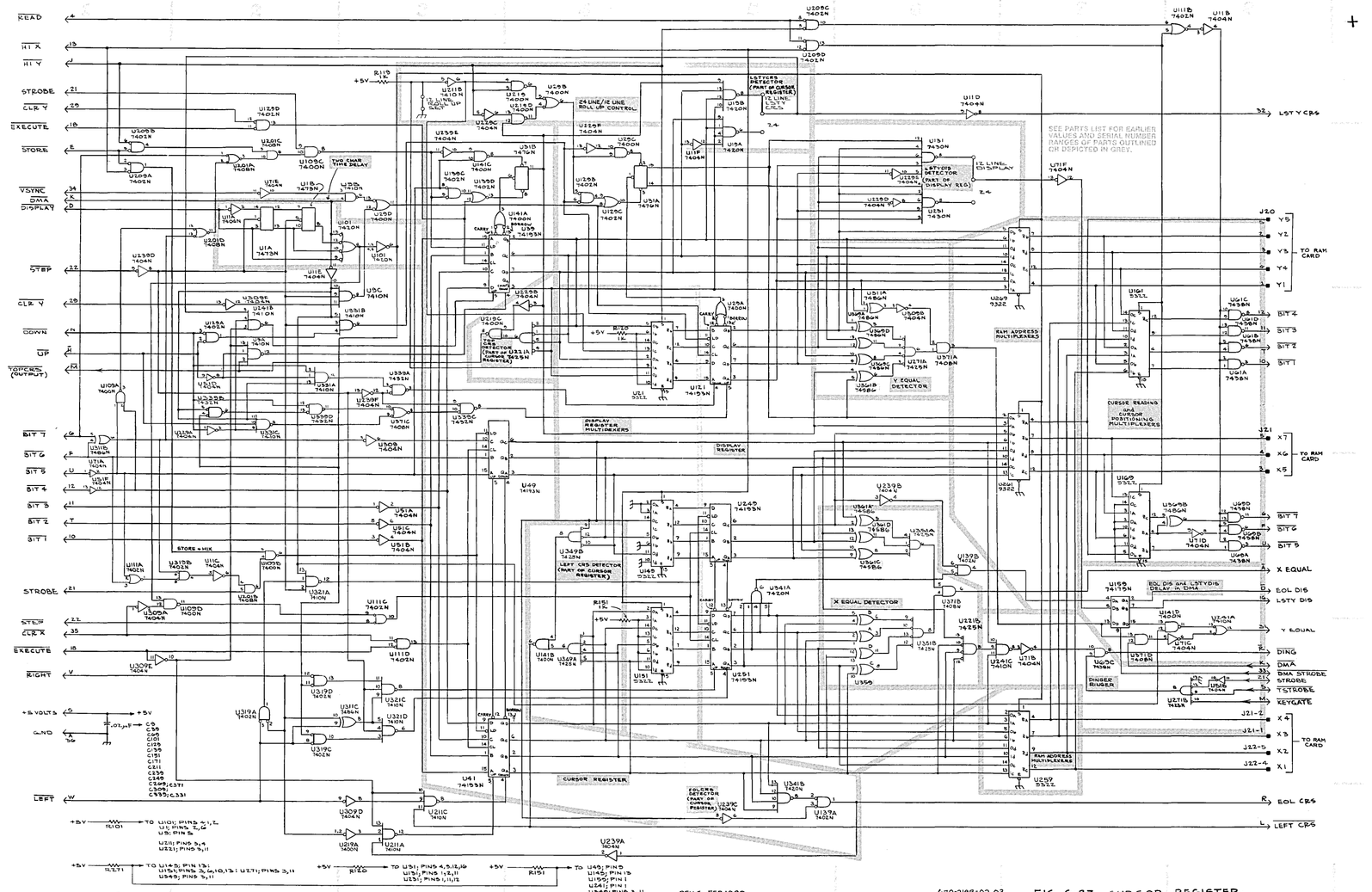


Fig. 6-26. Cursor Card Component Locations.

CKT #	GRID LOC
CAPACITOR	
C9	E1
C39	E1
C69	E1
C101	E1
C129	E1
C139	E1
C151	E1
C171	E1
C211	E1
C239	E1
C249	E1
C269	E1
C289	E1
C311	E1
C339	E1
C371	E1
JACK	
J21	C8
	E8
J22	E8
RESISTOR	
R101	F1
R119	A3
R128	F3
R151	F4
R271	F1
TRANSFORMER	
T28	B8
INTEGRATED CIRCUIT	
U1A	B2
U1B	B2
U9A	G2
U90	B3
U11A	B2
U11B	A8
U11C	G2
U11D	A6
U11E	B2
U11F	B5
U19A	B5
U19B	A5
U21	C4
U29A	C5
U29B	A4
U29C	B4
U29D	B3
U31A	B4
U31B	B4
U34A	D5
U39	B4
U41	E3
U49	C3
U51A	D3
U51B	D3
U51C	D3
U51E	E8
U51F	D1
U61A	C8
U61B	C8
U61C	C8
U61D	C8
U69A	D8
U69B	D8
U69C	E7
U69D	D8
U71A	D1
U71B	E7
U71C	E8
U71D	D8
U71E	B2
U71F	B7
U101	B3
U109A	G1
U109B	B2
U109C	B2
U109D	D1
U111A	D1
U111B	A8
U111C	D3
U111D	E3
U121	C5
U129A	G2
U129B	B4
U129C	B4
U129D	B2
U131	B6
U139A	F5
U139B	D6
U139C	B3
U139D	B3
U141A	B3
U141B	E4
U141C	B3
U141D	E8
U149	D4
U151	E4
U159	D7
U161	C7
U169	D7
U201A	B2
U201B	D2
U201C	B2
U201D	B2
U209A	B1
U209B	B1
U209C	A5
U209D	A5
U211A	F3
U211B	A3
U211C	F3
U219A	F3
U219B	A4
U219C	C3
U219D	A4
U221A	C4
U221B	E6
U229A	C2
U229B	C4
U229C	A3
U229D	B6
U229E	B6
U229F	B4
U231	B6
U239A	F4
U239B	D6
U239C	F3
U239D	B1
U239E	B3
U239F	C3
U241B	C2
U241C	E7
U249	D5
U251	E5
U259	E7
U261	C7
U269	B7
U271A	D6
U271B	E8
U3B9	C3
U309A	D1
U309B	D6
U309D	F3
U309E	E1
U309F	B4
U311A	D6
U311B	D1
U311C	E3
U316A	D6
U319A	E2
U319B	D2
U319C	E2
U319D	E2
U321A	D2
U321C	E3
U321D	E3
U331A	C2
U331B	C3
U331C	C2
U339A	C3
U339B	C2
U339C	C3
U339D	C3
U341B	F5
U349A	E4
U349B	D4
U351A	D6
U351B	E6
U359A	E6
U359B	E6
U359C	E6
U359D	E6
U361B	D6
U361C	D6
U361D	D6
U369A	D6
U369B	D8
U369C	D6
U369D	D6
U371A	D6
U371B	D6
U371C	C3
U371D	E7
U518	C2
U741A	E8

SEMICONDUCTOR INFORMATION

NUMBER	VCC	GND	UNUSED PINS
7400	14	7	HIGH
7402	14	7	HIGH
7404	14	7	
7408	14	7	LOW
7410	14	7	HIGH
7420	14	7	HIGH
7425	16	8	LOW
7430	14	7	HIGH
7432	14	7	LOW
7438	14	7	HIGH
7473	4	11	HIGH
7476	5	13	HIGH
7486	14	7	LOW
74175	16	8	HIGH
74193	16	8	LOW
9322	16	8	LOW



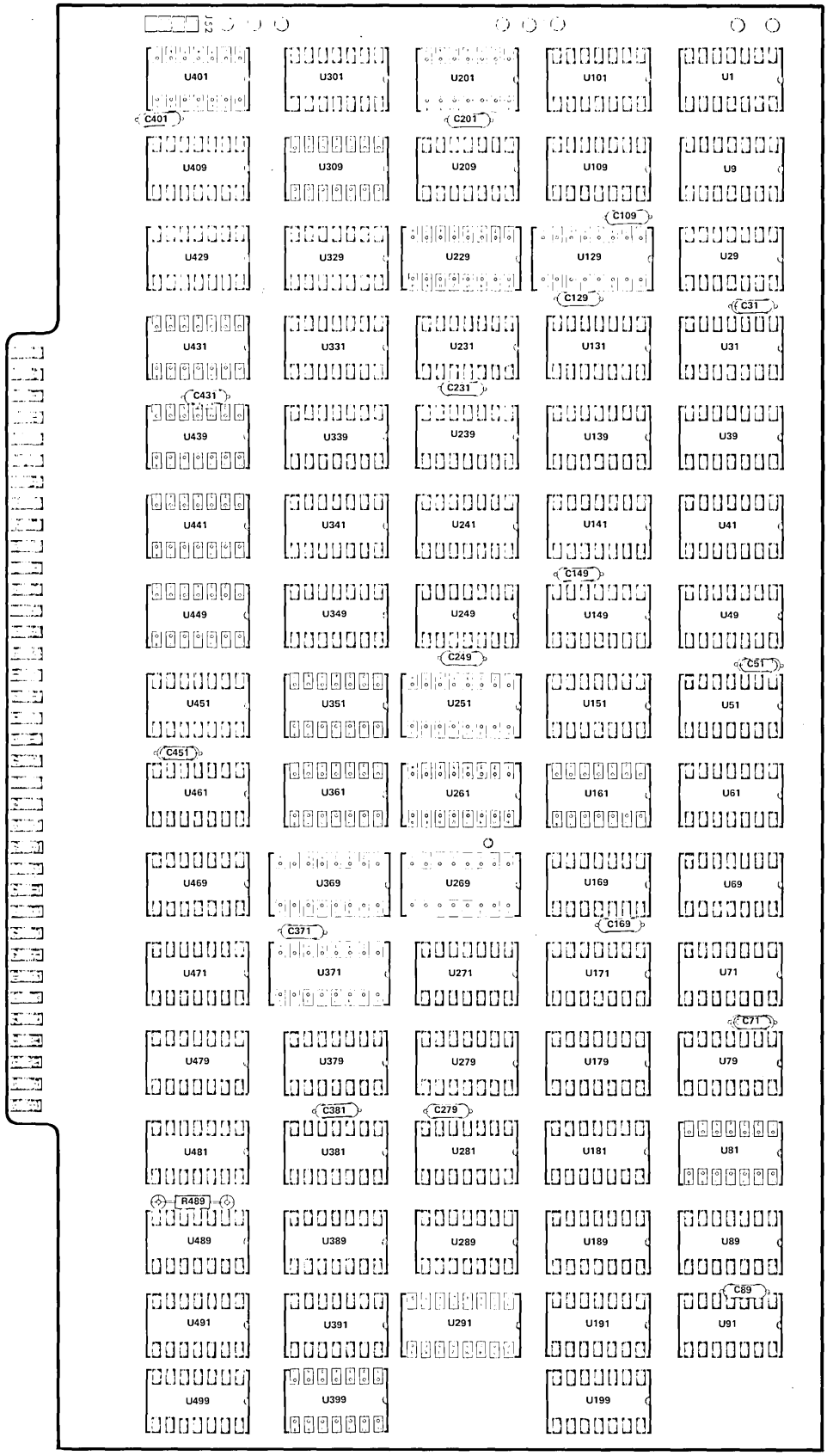


Fig. 6-30. Edit Card Component Locations.

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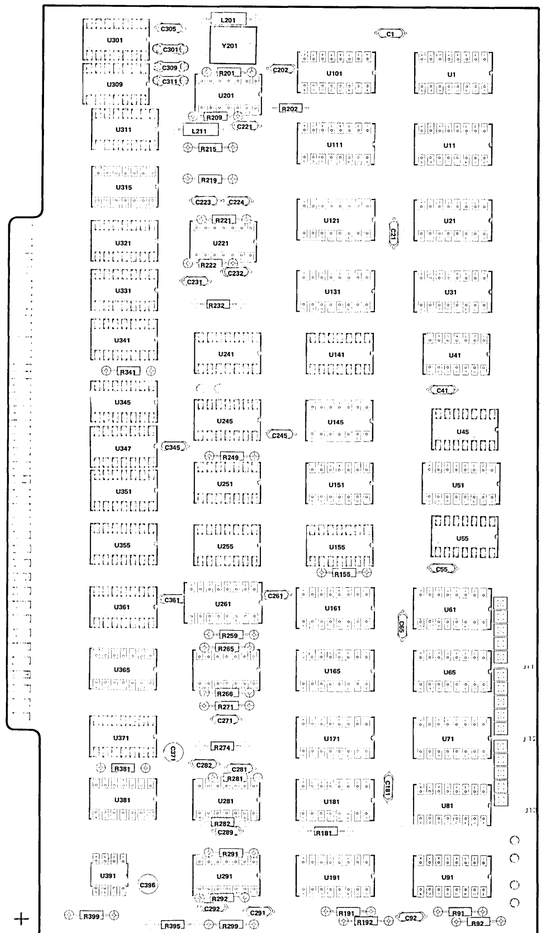

Fig. 6-28. RAM Card Component Locations.

CKT # GRID LOC

CAPACITOR

C1	F3
C21	F4
C41	F3
C55	F3
C65	F4
C92	F4
C181	F4
C282	F1
C221	F1
C223	F2
C224	F2
C231	F2
C232	F2
C245	F2
C261	F2
C271	F2
C281	F2
C282	F1
C289	F2
C291	F3
C292	F1
C301	A7
C305	F3
C309	F3
C311	A7
C345	F2
C361	F2
C371	F3
C396	A7

JACK

J11	E1
J12	C1
	D1
	E1
J13	C1
	D1

CHOKE, COIL

L201	A7
L211	A7

RESISTOR

R91	E6
R92	E6
R141	B2
R155	F5
R191	F6
R192	F6
R281	B6
R282	B7
R289	D6
R215	C7
R219	C7
R221	D6
R222	D6
R232	D7
R249	A2
R359	D7
R265	D6
R266	E6
R271	E7
R274	E7
R281	E6
R282	E6
R291	F6
R292	F7
R299	F7
R341	F5
R381	F5
R395	F7
R399	A7

INTEGRATED CIRCUIT

U1	B5
U11	B5
U21	C5
U31	C5
U41	A6
U45	E2
U51	E3
U55A	E3
U55B	E3
U55C	E3
U55D	E3
U61	D5
U65	D5
U71	E5
U81	E5
U91	F5
U101	B6
U111	B6
U121	C6
U131	C6
U141A	C4
U141B	A4
U141C	C4
U141D	C4
U145A	C3
U145B	C2
U151A	B2
U151B	B2
U155A	B4
U155B	B4
U171	E6
U181	E6
U191	E6
U201A	B7
U201B	B7
U221A	C7
U221B	C7
U241A	C3
U241C	C3
U241D	C2
U245A	B2
U245B	B2
U245C	B2
U251A	D2
U251B	D2
U255A	D2
U255B	D2
U261	E7
U261A	D7
U261B	D7
U261C	E7
U261D	E7
U261K	F7
U261L	C7
U261M	D7
U261N	C7
U261R	B7
U265A	D7
U265B	D7
U281A	E7
U281B	E7
U291A	F7
U291B	F7
U301	A7
U309A	A8
U309D	B8
U309C	B7
U311A	A5
U311B	A7
U311C	A1
U311D	D2
U311E	B3
U311F	D3
U315A	C7
U315B	B7
U315C	B7
U315D	C7
U315E	B7
U321A	E2
U321B	A2
U321C	A4
U321D	D3
U331B	B3
U331C	B3
U341A	D3
U341B	D2
U345A	B3
U345B	B2
U345C	B2
U347	A2
U351A	B3
U351B	D3
U355A	B3
U355B	D3
U355C	D4
U355D	C4
U361	B4
U361A	D3
U361C	C1
U361F	B2
U365	C7
U365A	D7
U365B	C7
U365D	D7
U365E	D7
U365F	D7
U371A	A7
U371B	B3
U381A	E7
U381B	E7
U381C	E7
U381D	F7
U381E	F7
U381F	E7
U391B	A7

SEMICONDUCTOR INFORMATION

			UNUSED PINS
7400	14	7	HIGH
7402	14	7	LOW
7404	14	7	
7408	14	7	HIGH
7417	14	7	
7420	14	7	HIGH
7430	14	7	HIGH
7437	14	7	HIGH
7440	14	7	HIGH
7473	4	11	HIGH
7486	14	7	LOW
7493	5	11	LOW
74H183	14	7	
74S10	14	7	HIGH
75107	14	7	
75451	8	4	
-0125	16	8	LOW
4006	9 and 10		

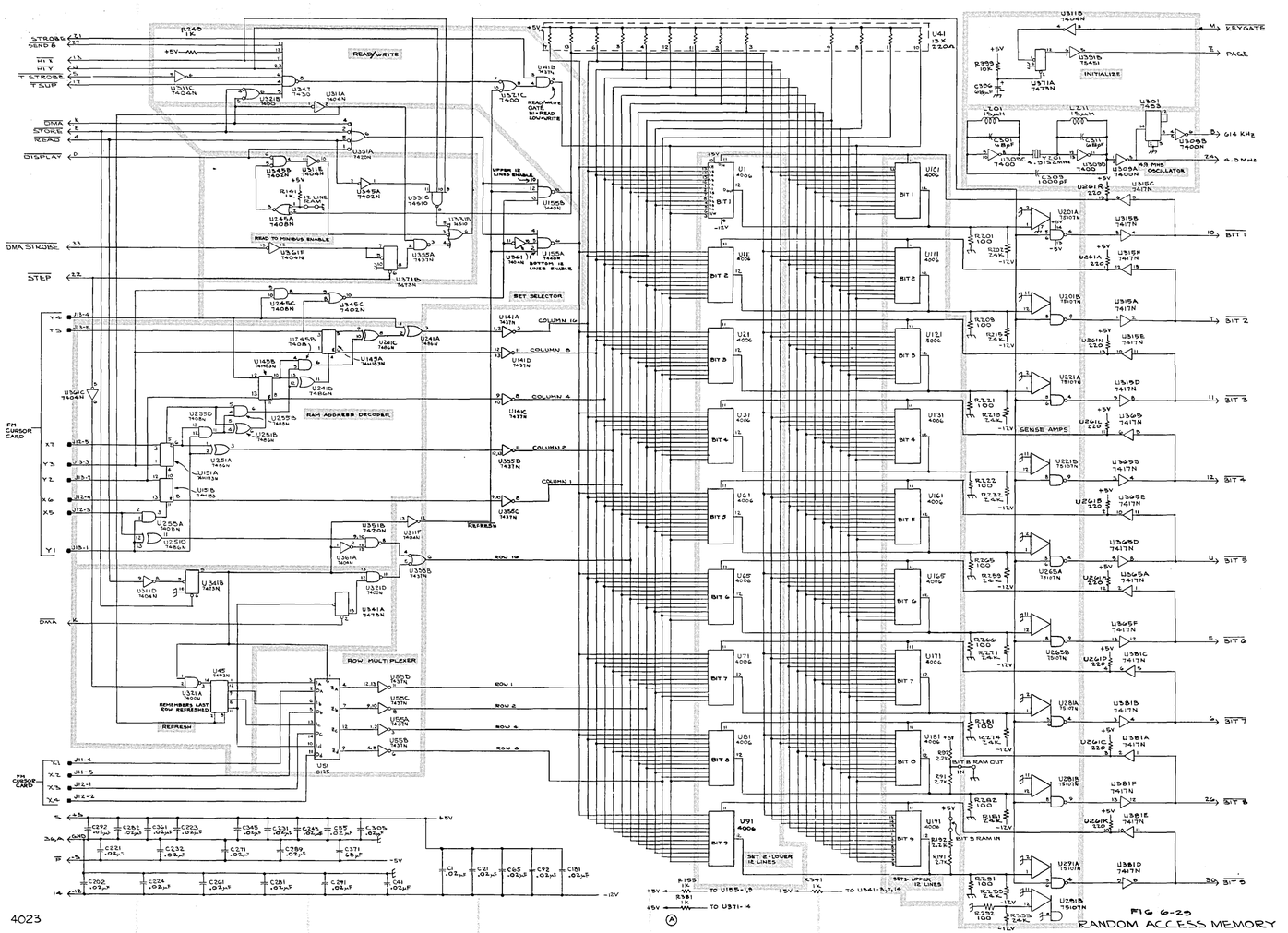

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FIG 6-29
RANDOM ACCESS MEMORY

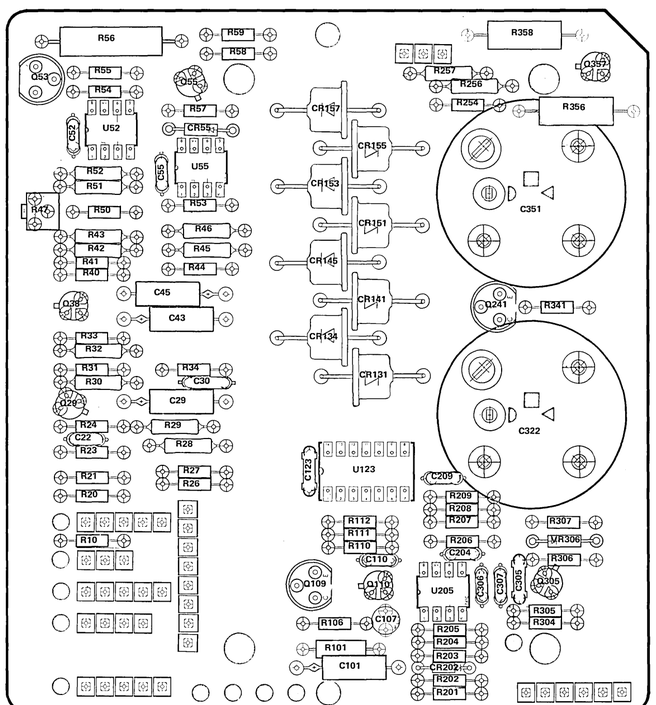
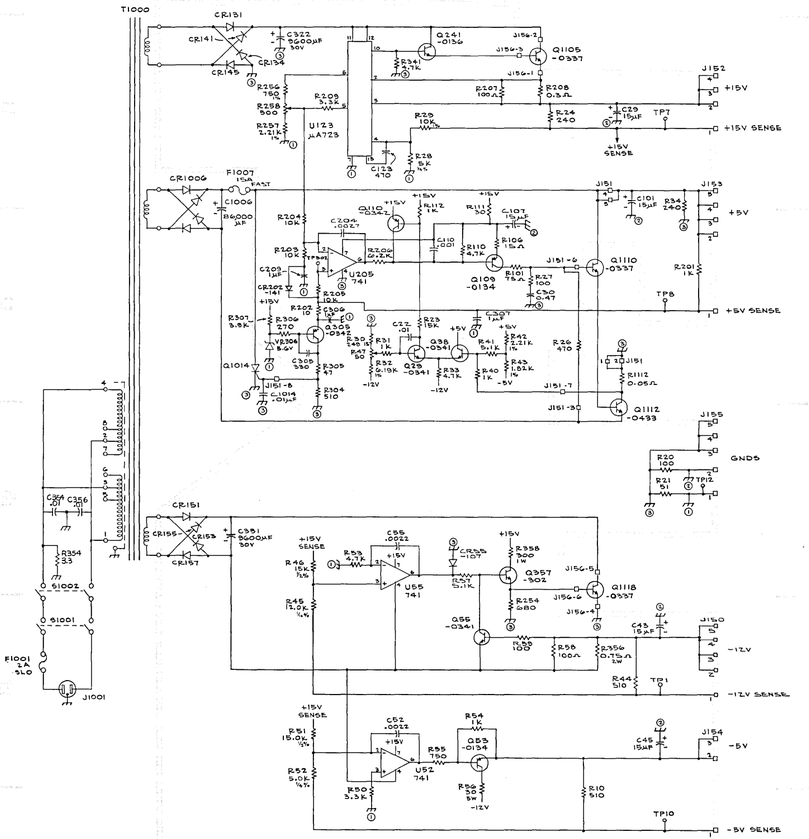


Fig. 6-32. Power Supply Board Component Locations.

CKT #	GRID LOC
CAPACITOR	
C22	C2
C29	B4
C38	C3
C43	E4
C45	E4
C52	E2
C55	D2
C101	B4
C107	C3
C110	C3
C123	B2
C204	C2
C209	C2
C305	C2
C306	C2
C307	C3
C322	B2
C351	B2
C1014	C2
DIODE	
CR55	D3
CR131	B2
CR134	B2
CR141	B2
CR145	B2
CR151	D1
CR153	D1
CR155	D1
CR157	D1
CR202	C2
CR1006	B1
FUSE	
F1001	E1
JACK	
J150	E4
J151	B4
	C2
	C3
	C4
	D3
J152	B4
J153	B4
J154	E4
J155	B4
J156	B3
	D3
	E3
J1001	E1
TRANSISTOR	
Q29	C3
Q38	C3
Q53	E3
Q55	E3
Q109	C3
Q110	C2
Q241	B3
Q305	C2
Q357	D3
Q1014	C2
Q1105	B3
Q1110	C3
Q1112	D4
Q1118	D3

CKT #	GRID LOC
RESISTOR	
R10	F3
R20	D4
R21	D4
R23	C3
R24	B3
R26	C3
R27	C3
R28	B2
R29	B3
R30	C2
R31	C2
R32	C2
R33	C3
R34	B4
R40	C3
R41	C3
R42	C3
R43	C3
R44	E4
R45	E2
R46	B2
R47	C2
R50	F2
R51	E2
R52	E2
R53	D2
R54	E3
R55	E3
R56	F3
R57	D3
R58	E3
R59	E3
R101	C3
R106	C3
R110	C3
R111	C3
R112	C3
R201	C4
R202	C2
R203	C2
R204	C2
R205	C2
R206	C2
R207	B3
R209	B2
R254	E3
R256	B2
R257	B2
R258	B2
R304	C2
R305	C2
R306	C2
R307	C2
R341	B2
R358	D3
R1112	C4
SWITCH	
S1001	E1
S1002	D1
TRANSFORMER	
T1000	B1
INTEGRATED CIRCUIT	
U52	E2
U53	D2
U123	B2
U205	C2
VOLTAGE REGULATOR	
VR306	C2



REV E, APR 1979

FIG 6-33A
POWER SUPPLY 670-2196-01

CKT #	GRID LOC
CAPACITOR	
C22	C2
C29	B4
C30	C3
C43	E4
C45	E4
C52	E2
C55	D2
C101	B4
C107	C3
C110	C3
C123	B2
C204	C2
C209	C2
C305	C2
C306	C2
C307	C2
C322	B2
C351	D2
C1014	C2
DIODE	
CR55	D3
CR131	B2
CR134	B2
CR141	B2
CR145	B2
CR151	D1
CR153	D1
CR155	D1
CR157	D1
CR202	C2
CR1006	B1
FUSE	
F1001	E1
JACK	
J150	E4
J151	B4
	C2
	C3
	C4
	D3
J152	B4
J153	B4
J154	E4
J155	D4
J156	B3
	D3
	E3
J1001	E1
TRANSISTOR	
Q29	C3
Q38	C3
Q53	E3
Q55	E3
Q109	C3
Q110	C2
Q241	B3
Q305	C2
Q357	D3
Q1014	C2
Q1105	B3
Q1110	C3
Q1112	D4
Q1118	D3

CKT #	GRID LOC
RESISTOR	
R10	F3
R20	D4
R21	D4
R23	C3
R24	C3
R26	C3
R27	C3
R28	B2
R29	B3
R30	C2
R31	C2
R32	C2
R33	C3
R34	B4
R40	C3
R41	C3
R42	C3
R43	C3
R44	E4
R45	E2
R46	D2
R47	C2
R50	F2
R51	E2
R52	E2
R53	D2
R54	E3
R55	E3
R59	E3
R101	C3
R106	C3
R110	C3
R111	C3
R112	C3
R201	C4
R202	C2
R203	C2
R204	C2
R205	C2
R206	C2
R207	B3
R208	B3
R209	B2
R254	E3
R256	B2
R257	B2
R258	B2
R304	C2
R305	C2
R306	C2
R307	C2
R341	B2
R358	D3
R1112	C4
SWITCH	
S1001	E1
S1002	D1
TRANSFORMER	
T1000	B1
INTEGRATED CIRCUIT	
U52	E2
U55	D2
U123	B2
U205	C2
VOLTAGE REGULATOR	
VR306	C2

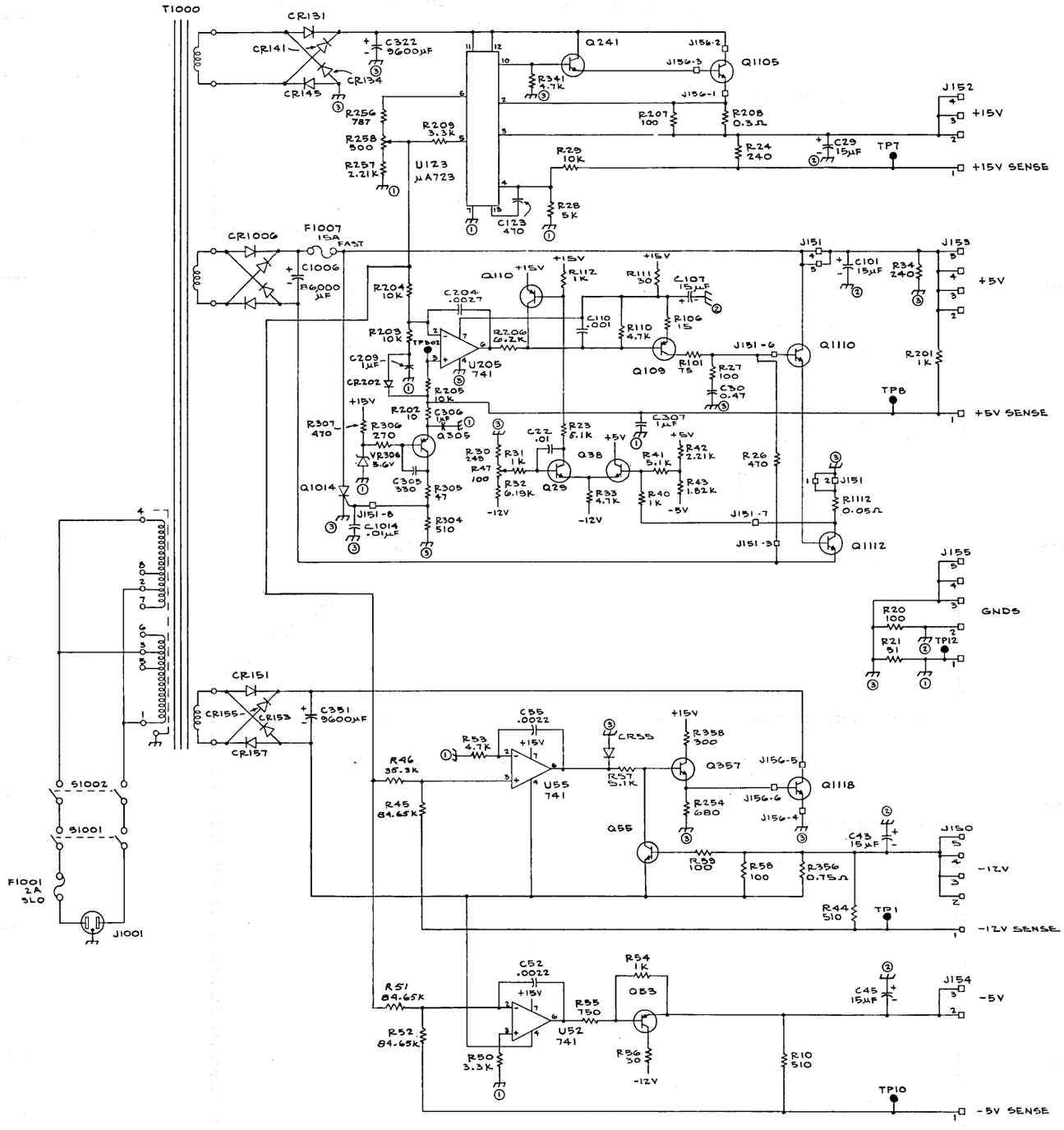


FIG 6-33B

POWER SUPPLY 670-2196-02

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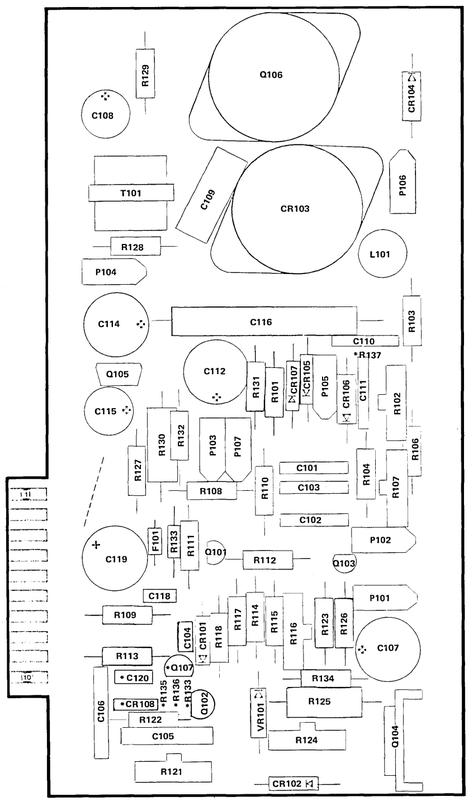
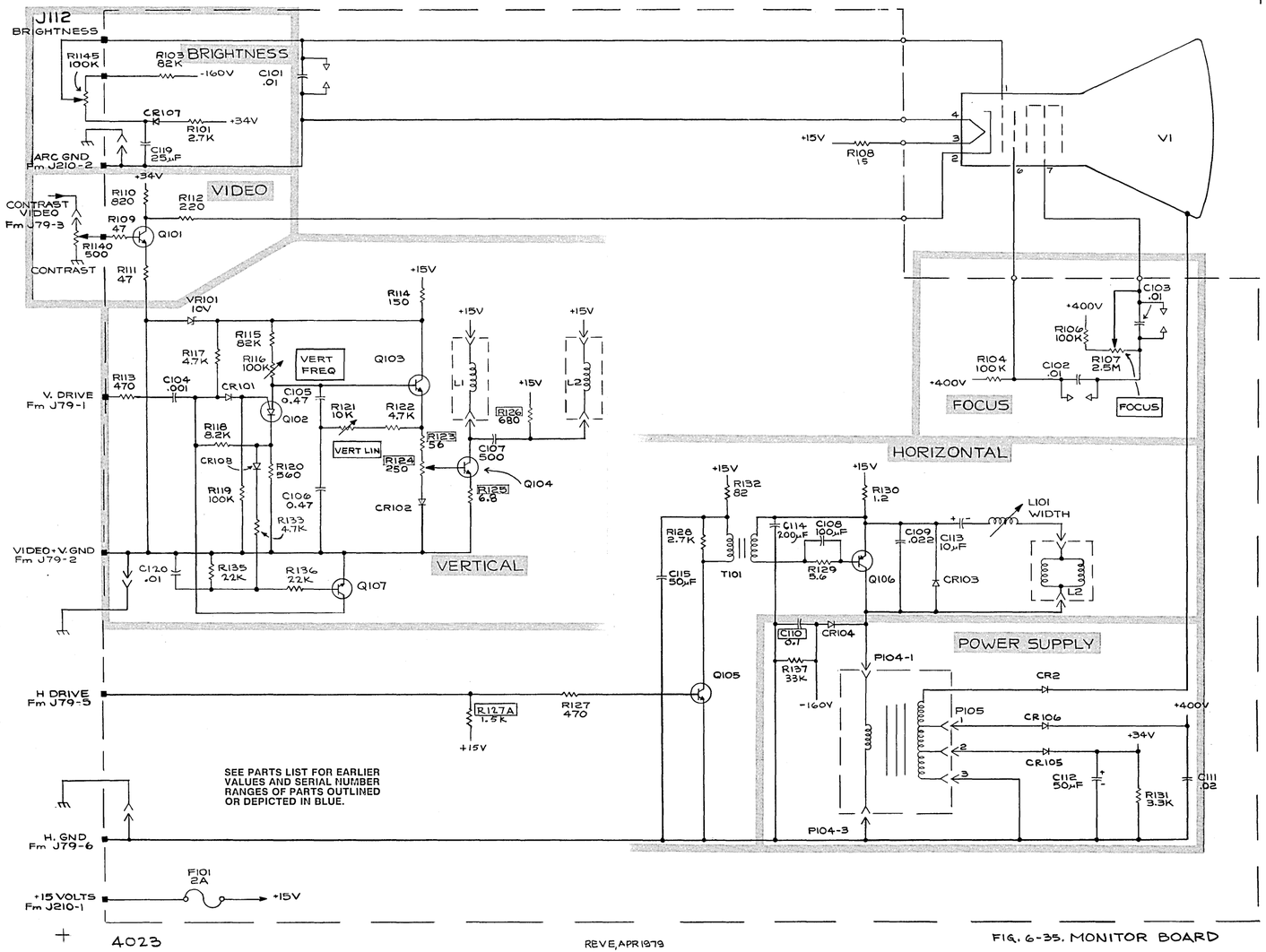


*These components are included only when required to compensate for circuit performance variations. Otherwise, the components are not included.

Fig. 6-34. Monitor Board Component Locations.



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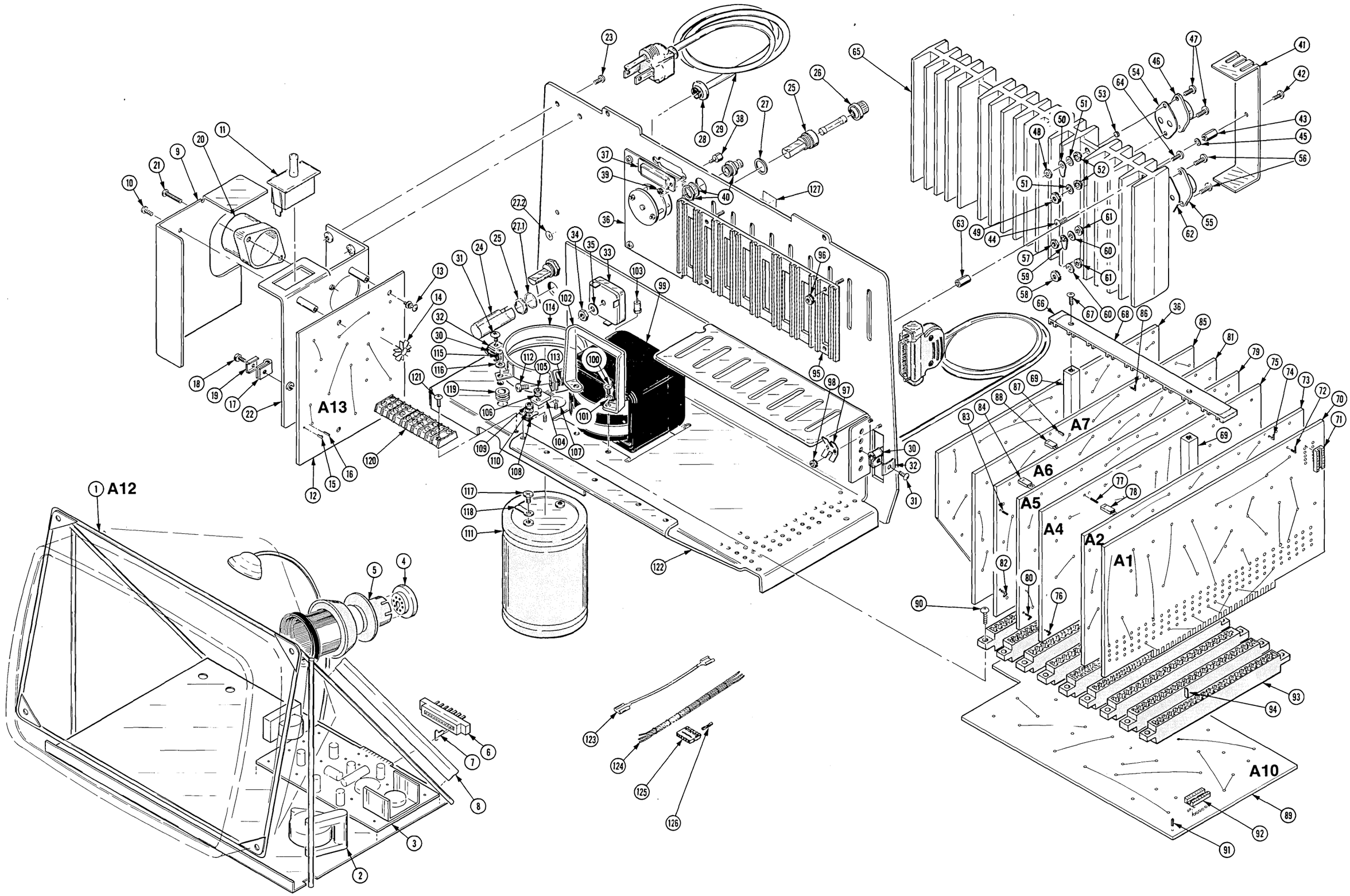
REVE, APR 1979

FIG. 6-35. MONITOR BOARD


A13
A12
A7
A6
A5
A4
A2
A1
A10

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
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CL	TWENTIETH CENTURY PLASTICS	3628 CRENCHAW BLVD.	LOS ANGELES, CA 90016
000GG	BALL ELEC DISPLAY DIV.	1610 P. DELL AVE.	CAMPBELL, CA 95008
00779	AMP, INC.	P.O. BOX 3608	HARRISBURG, PA 17105
01963	CHERRY ELECTRICAL PRODUCTS CORPORATION	3600 SUNSET AVENUE	WAUKEGAN, IL 60085
02107	SPARTA MANUFACTURING COMPANY	ROUTE NO. 2, BOX 128	DOVER, OH 44622
03614	BUSSMAN MFG., DIV. OF MCGRAW EDISON CO.	502 EARTH CITY PLAZA	EARTH CITY, MO 63045
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
05820	WAKEFIELD ENGINEERING, INC.	AUDUBON ROAD	WAKEFIELD, MA 01880
06383	PANDUIT CORPORATION	17301 RIDGELAND	TINLEY PARK, IL 60477
06915	RICHCO PLASTIC CO.	5825 N. TRIPP AVE.	CHICAGO, IL 60646
07109	OAKTRON INDUSTRIES, INC.	704 30TH STREET	MONROE, WI 53566
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
10389	CHICAGO SWITCH, INC.	2035 WABANSIA AVE.	CHICAGO, IL 60647
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12881	METEX CORPORATION	970 NEW DURHAM ROAD	EDISON, NJ 08817
13150	VERNITRON ELECTRICAL COMPONENTS, BEAU PRODUCTS DIVISION	P O BOX 10	LACONIA, NH 03246
13993	BALL BROTHERS RESEARCH CORPORATION	BOULDER INDUSTRIAL PARK	BOULDER, CO 80302
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22753	U. I. D. ELECTRONICS CORP.	4105 PEMBROKE RD.	HOLLYWOOD, FL 33021
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
28520	HEYMAN MFG. CO.	147 N. MICHIGAN AVE.	KENILWORTH, NJ 07033
31781	EDAC INC.	20 RAILSIDE RD.	DON MILLS, ONT, CANADA M3A 1
52833	KEYTRONIC CORP., OCR DIV.	SPOKANE INDUSTRIAL PK., P. O. BOX 14687	SPOKANE, WA 99214
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
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
79963	ZIERICK MFG. CO.	RADIO CIRCLE	MT. KISCO, NY 10549
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98278	MALCO A MICRODOT COMPANY, INC. CONNECTOR AND CABLE DIVISION	220 PASADENA AVE.	SOUTH PASADENA, CA 91030
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170

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	390-0340-01	B010100	B049999	1	COVER,TERMINAL:TOP	80009	390-0340-01
	390-0340-06	B050000		1	COVER,SCOPE:TAN	80009	390-0340-06
					**********(ATTACHING PARTS)**********		
-2	212-0111-00			4	SCREW,MACHINE:8-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-3	426-0928-01			1	FRAME,TRIM:GRAY PLASTIC	80009	426-0928-01
					**********(ATTACHING PARTS)**********		
-4	213-0088-00			1	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-5	334-1555-00			4	PLATE,IDENT:TRADEMARK	80009	334-1555-00
-6	331-0326-01			1	MASK,CRT SCALE:	80009	331-0326-01
					**********(ATTACHING PARTS)**********		
-7	211-0581-00			4	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-8	334-2033-00			1	PLATE,IDENT:	80009	334-2033-00
-9	386-2707-01	B010100	B049999	1	PANEL,KEYBOARD:	80009	386-2707-01
	386-2707-02	B050000		1	PANEL,KEYBOARD:	80009	386-2707-02
					**********(ATTACHING PARTS)**********		
-10	212-0001-00			3	SCREW,MACHINE:8-32 X 0.250 INCH,PNH STL	77250	ORD BY DESCR
-11	211-0537-00			3	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
-12	211-0517-00			8	SCREW,MACHINE:6-32 X 1 INCH,PNH,STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-13	337-1882-00			1	SHIELD,ELEC:POWER SWITCH	80009	337-1882-00
					**********(ATTACHING PARTS)**********		
-14	211-0504-00			1	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)**********		
-15	260-1334-00			4	SWITCH,ROCKER:SPDT,0.5A,125VAC	22753	RSW-412
					**********(ATTACHING PARTS)**********		
-16	210-0406-00			8	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-17	210-0004-00			8	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	ORD BY DESCR
-18	166-0024-00			8	SPACER,SLEEVE:0.133 ID X 0.125 INCH L,BRS	76854	3-5116-314
					**********(END ATTACHING PARTS)**********		
-19	----- -----			1	LAMP,CARTRIDGE:(SEE DS1125 REPL)		
-20	----- -----			3	LAMP,LED:(SEE CR1120,CR1122,CR1124 REPL)		
-21	131-0775-00			1	CONTACT,ELEC:HEX,0.25 INCH W/6-32 1 END	88245	1601-A
-22	----- -----			1	KEYBOARD ASSY:(SEE A11 REPL)		
-23	366-1555-00			1	.PUSH BUTTON SET:GRAY,KEYBOARD	52833	ORD BY DESCR
	366-1555-01			1	..PUSH BUTTON SET:A THRU Z	52833	GLWW010199000101
	366-1555-02			1	...PUSH BUTTON:MARKED "A"	52833	GLWW0101A0010101
	366-1555-03			1	...PUSH BUTTON:MARKED "B"	52833	GLWW0101B0010101
	366-1555-04			1	...PUSH BUTTON:MARKED "C"	52833	GLWW0101C0010101
	366-1555-05			1	...PUSH BUTTON:MARKED "D"	52833	GLWW0101D0010101
	366-1555-06			1	...PUSH BUTTON:MARKED "E"	52833	GLWW0101E0010101
	366-1555-07			1	...PUSH BUTTON:MARKED "F"	52833	GLWW0101F0010101
	366-1555-08			1	...PUSH BUTTON:MARKED "G"	52833	GLWW0101G0010101
	366-1555-09			1	...PUSH BUTTON:MARKED "H"	52833	GLWW0101H0010101
	366-1555-10			1	...PUSH BUTTON:MARKED "I"	52833	GLWW0101I0010101
	366-1555-11			1	...PUSH BUTTON:MARKED "J"	52833	GLWW0101J0010101
	366-1555-12			1	...PUSH BUTTON:MARKED "K"	52833	GLWW0101K0010101
	366-1555-13			1	...PUSH BUTTON:MARKED "L"	52833	GLWW0101L0010101
	366-1555-14			1	...PUSH BUTTON:MARKED "M"	52833	GLWW0101M0010101
	366-1555-15			1	...PUSH BUTTON:MARKED "N"	52833	GLWW0101N0010101
	366-1555-16			1	...PUSH BUTTON:MARKED "O"	52833	GLWW0101O0010101
	366-1555-17			1	...PUSH BUTTON:MARKED "P"	52833	GLWW0101P0010101
	366-1555-18			1	...PUSH BUTTON:MARKED "Q"	52833	GLWW0101Q0010101
	366-1555-19			1	...PUSH BUTTON:MARKED "R"	52833	GLWW0101R0010101
	366-1555-20			1	...PUSH BUTTON:MARKED "S"	52833	GLWW0101S0010101
	366-1555-21			1	...PUSH BUTTON:MARKED "T"	52833	GLWW0101T0010101
	366-1555-22			1	...PUSH BUTTON:MARKED "U"	52833	GLWW0101U0010101
	366-1555-23			1	...PUSH BUTTON:MARKED "V"	52833	GLWW01010000V001
	366-1555-24			1	...PUSH BUTTON:MARKED "W"	52833	GLWW0101W0010101
	366-1555-25			1	...PUSH BUTTON:MARKED "X"	52833	GLWW0101X0010101
	366-1555-26			1	...PUSH BUTTON:MARKED "Y"	52833	GLWW0101Y0010101
	366-1555-27			1	...PUSH BUTTON:MARKED "Z"	52833	GLWW0101Z0010101

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-	366-1555-28			1	..PUSH BUTTON SET:1 THRU 9	52833	GLWW010199020801
	366-1555-29			1	..PUSH BUTTON:MARKED ZERO	52833	GLWW010110100101
	366-1555-30			1	..PUSH BUTTON:GRAY,*/:	52833	GLWW010117720802
	366-1555-31			1	..PUSH BUTTON:MARKED EQUAL OVER MINUS	52833	GLWW010110380802
	366-1555-32			1	..PUSH BUTTON:MARKED + OVER SEMI-COLON	52833	GLWW010110370802
	366-1555-33			1	..PUSH BUTTON:MARKED LESS THAN OVER COMMA	52833	GLWW010110340802
	366-1555-34			1	..PUSH BUTTON:MKD GREATER THAN OVER PERIO	52833	GLWW010110350802
	366-1555-35			1	..PUSH BUTTON:MKD ? OVER /	52833	GLWW010110140802
	366-1555-36			1	..PUSH BUTTON:GRAY,PAGE/ERASE/INPUT	52833	GGW0101P3621201
	366-1555-37			1	..PUSH BUTTON:MKD L BRACE OVER L BRACKET	52833	GGWW010110850802
	366-1555-38			1	..PUSH BUTTON:MARKED ESC	52833	GGWW0101E3890701
	366-1555-39			1	..PUSH BUTTON:MARKED TILDE OVER CARET	52833	GGWW010110640802
	366-1555-40			1	..PUSH BUTTON:MARKED TAB	52833	GGWW0101T5990701
	366-1555-41			1	..PUSH BUTTON:MARKED CTRL	52833	GGWW0101C3560701
	366-1555-42			1	..PUSH BUTTON:MARKED TTY LOCK	52833	GGWW0101T4931101
	366-1555-43			1	..PUSH BUTTON:MARKED SHIFT	52833	GGWW0203S5770701
	366-1555-44			1	..PUSH BUTTON:MKD R BRACE OVER R BRACKET	52833	GGWW010110860802
	366-1555-45			1	..PUSH BUTTON:MARKED BACK SPACE	52833	GGWW0101B3211101
	366-1555-46			1	..PUSH BUTTON:MARKED GRAVE ACCENT OVER AT	52833	GGWW010110790802
	366-1555-47			1	..PUSH BUTTON:MARKED LF	52833	GGWW0101L4780701
	366-1555-48			1	..PUSH BUTTON:MKD VERT DSH OV BACK SLASH	52833	GGWW010110870802
	366-1555-49			1	..PUSH BUTTON:MARKED RUB OUT	52833	GGWW2502R4431101
	366-1555-50			1	..PUSH BUTTON:MARKED BREAK	52833	GGWW0101B3310701
	366-1555-51			1	..PUSH BUTTON:GRAY RETURN	52833	GGWW0905R4450701
	366-1555-52			1	..PUSH BUTTON:MARKED SHIFT	52833	BBWW020255770701
	366-1555-53			1	..PUSH BUTTON:GRAY,SPACE BAR	52833	GGWW120110900000
	366-1555-54			1	..PUSH BUTTON:GRAY,ERASE TO END/8	52833	GGW0101E2051205
	366-1555-55			1	..PUSH BUTTON:GRAY,COPY/9	52833	GGWW0101R3770704
	366-1555-56			1	..PUSH BUTTON:GRAY,RESET/7	52833	GGWW0101C0930704
	366-1555-57			1	..PUSH BUTTON:	52833	GGWW010113771108
	366-1555-58			1	..PUSH BUTTON:GRAY,ARROW UP/5	52833	GGWW010139050107
	366-1555-59			1	..PUSH BUTTON:GRAY,DEL L/DEL C/6	52833	GGWW0101D2531108
	366-1555-60			1	..PUSH BUTTON:GRAY,ARROW LEFT/1	52833	GLWW010139210107
	366-1555-61			1	..PUSH BUTTON:GRAY,HOME/2	52833	GGWW0101H4690704
	366-1555-62			1	..PUSH BUTTON:GRAY,SEND ENTER/.	52833	GGWW0101S3541108
	366-1555-63			1	..PUSH BUTTON:GRAY,ARROW DOWN/0	52833	GLWW010139000107
	366-1555-64			1	..PUSH BUTTON:GRAY,NUM LOCK	52833	GGWW0101N5101101
	366-1555-65			1	..PUSH BUTTON:GRAY,ARROW RIGHT/3	52833	GLWW010139030107
-24	118-0031-00			2	.ACTUATOR ASSY:90Z SGL UNIT,W/MECH ALT ACT	52833	61-0261-09
-25	118-0043-00			2	.ACTUATOR ASSY:SINGLE UNIT	52833	61-0021-03
	260-1507-00			72	.SWITCH,REED:SPST	52833	60-0003-01
-26	136-0156-01			1	CONNECTOR,RCPT,:22/44 PIN,CHASSIS MOUNT	05574	2VH22-1AN5
-27	214-0702-00			2	KEY,CONN PLZN:CKT BD CONN,T SHAPED	80009	214-0702-00
-28	200-1476-01	B010100	B049999	1	COVER,KEYBOARD:LOWER,PAINTED	80009	200-1476-01
	200-1476-02	B050000		1	COVER,KEYBOARD:	80009	200-1476-02
					**********(ATTACHING PARTS)**********		
-29	211-0504-00			3	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)*********		
	348-0507-00	B050000		FT	SHLD GSKT,ELEK:MESH TYPE,0.25 X 0.14	12881	01-604-1756
	407-1865-00	B050000		1	BRACKET,GASKET:RIGHT,ALUMINUM	80009	407-1865-00
	407-1864-00			1	BRACKET,GASKET:LEFT,ALUMINUM	80009	407-1864-00
					**********(ATTACHING PARTS)**********		
	210-0586-00	B050000		2	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)*********		
-30	381-0338-00			1	BAR MOUNTING:VARIABLE RESISTOR,ALUMINUM	80009	381-0338-00
					**********(ATTACHING PARTS)**********		
-31	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-32	366-0128-01			2	KNOB:THUMBWHEEL	80009	366-0128-01
	213-0140-00			2	.SETSCREW:2-56 X 0.94 INCH,HEX SOC ST	70276	ORD BY DESCR
-33	----- -----			2	RES.,VAR:(SEE R1140,R1145 REPL)		
					**********(ATTACHING PARTS)**********		
-34	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-35	210-0046-00			2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					**********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-36	343-0006-00			1		CLAMP,LOOP:0.50 INCH DIAMETER,PLSTC	95987	1-2-6B
						**********(ATTACHING PARTS)**********		
-37	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-38	210-0863-00			1		WSHR,LOOP CLAMP:0.187 ID U/W 0.5 W CLP,STL	95987	C191
						**********(END ATTACHING PARTS)**********		
-39	407-1446-00			1		BRACKET MONITOR:RIGHT,ALUMINUM	80009	407-1446-00
						**********(ATTACHING PARTS)**********		
-40	210-0458-00			2		NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-41	407-1445-00			1		BRACKET MONITOR:LEFT,ALUMINUM	80009	407-1445-00
						**********(ATTACHING PARTS)**********		
-42	210-0458-00			2		NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-43	119-0305-00			1		LOUDSPEAKER,PM:PERMANENT MAGNET,45 OHM,2W	07109	35A45C
						**********(ATTACHING PARTS)**********		
-44	210-0457-00			4		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-45	385-0115-00			3		SPACER,POST:1.687 L W/8-32 THD EA END	80009	385-0115-00
-46	260-1490-00			1		SWITCH,TOGGLE:1 SECT,3 POSN,30 DEG	10389	171-298-129
-47	348-0128-00			4		BUMPER,PLASTIC:CABINET MTG,2.022 INCH LONG	80009	348-0128-00
						**********(ATTACHING PARTS)**********		
-48	211-0513-00			4		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-49	337-1968-00	B010100	B049999	1		SHIELD,ELEC:LINE SELECTOR	80009	337-1968-00
	337-1968-01	B050000		1		SHIELD,ELEC:LINE SELECTOR	80009	337-1968-01
						**********(ATTACHING PARTS)**********		
-50	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-51	390-0341-01	B010100	B049999	1		CABINET,TERM:BOTTOM	80009	390-0341-01
	390-0341-03	B050000		1		CABINET,TERM.:BOTTOM	80009	390-0341-03
-52	131-0861-00			2		TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-53	179-1943-00			1		WIRING HARNESS:SWITCH	80009	179-1943-00
-54	131-0707-00			15		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-55	352-0169-00			3		.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-56	352-0162-00			1		.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-57	352-0163-00			1		.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0163-00

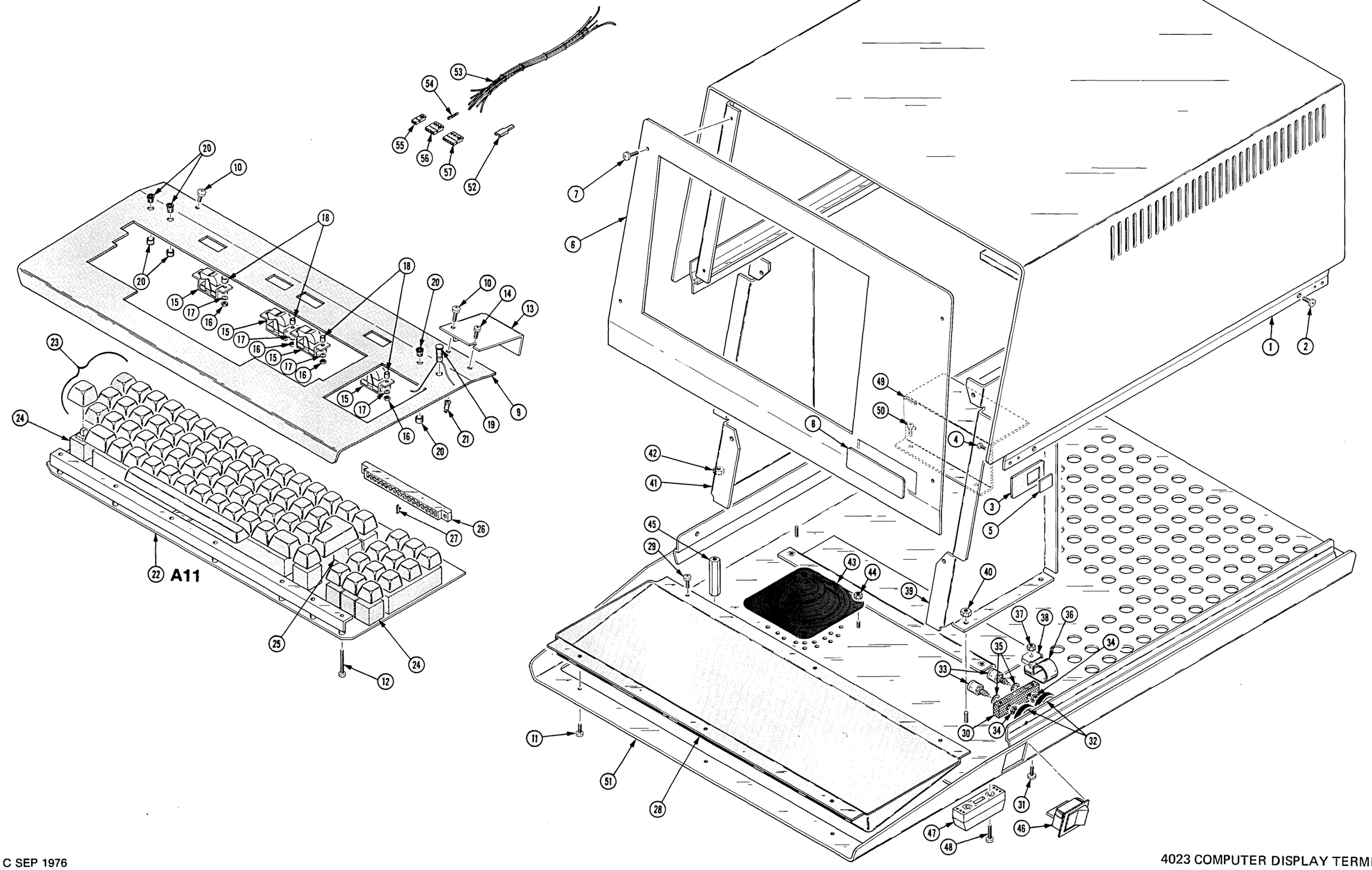
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-1	----- -----			1		MONITOR,TV:(SEE A12 REPL)		
						**********(ATTACHING PARTS)**********		
	212-0045-00			4		SCREW,MACHINE:8-32 X 0.500 INCH,TRH,STL	83385	ORD BY DESCR
	210-0008-00			4		WASHER,LOCK:INTL,0.172 ID X 0.331"OD,S	78189	1208-00-00-0541C
	212-0067-00			2		SCREW,MACHINE:8-32 X 0.375,TRH,STL,CR PL	93907	ORD BY DESCR
						**********(END ATTACHING PARTS)*********		
	----- -----			-		.MONITOR ASSY INCLUDES:		
-2	----- -----			1		..TRANSFORMER:HIGH VOLTAGE(SEE T2 REPL)		
-3	119-0585-00			1		..CKT BOARD ASSY:MAIN CHASSIS	000GG	6-002-0506
	----- -----			1		..TRANSFORMER:PULSE(SEE T101 REPL)		
	361-0801-00			4		..SPACER,CKT BD:0.975 L,NYLON	06915	CBS-6M
-4	136-0584-00			1		..SKT,PL-IN ELEK:ELECTRON TUBE,CRT	13993	1-022-0427
-5	----- -----			1		..COIL,TUBE DEFLE:(SEE L2 REPL)		
-6	131-1028-00			1		CONN,RCPT,ELEC:CKT BD,10/20 CONTACT	05574	000201-5436
-7	214-0702-00			1		KEY,CONN PLZN:CKT BD CONN,T SHAPED	80009	214-0702-00
-8	000-9421-00			2		BINDING EDGE:OPAQUE,0.125 X 11.0	000CL	ORD BY DESCR
-9	337-1860-00			1		SHIELD,ELEC:INTERLOCK SWITCH	80009	337-1860-00
						**********(ATTACHING PARTS)**********		
-10	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)*********		
-11	260-1497-00			1		SWITCH,PUSH:DPDT,10A,250VAC	01963	E79-30A
-12	----- -----			1		CKT BOARD ASSY:POWER SUPPLY(SEE A13 REPL)		
						**********(ATTACHING PARTS)**********		
-13	211-0207-00	B010100	B064495	4		SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	ORD BY DESCR
	211-0244-00	B064496		4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	ORD BY DESCR
						**********(END ATTACHING PARTS)*********		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-14	214-1291-00			2		.HEAT SINK,ELEC:XSTR,0.72 OD X 0.375"H	05820	207SB
-15	214-0579-00			6		.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-16	131-0589-00			36		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-17	343-0003-00			1		CLAMP,LOOP:0.25 ID,PLASTIC	95987	1-4-6B
						**********(ATTACHING PARTS)**********		
-18	211-0507-00			1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-19	210-0863-00			1		WSHR,LOOP CLAMP:0.187 ID U/W 0.5 W CLP,STL	95987	C191
						**********(END ATTACHING PARTS)*********		
-20	432-0048-00	B010100	B064257	2		BASE,CAP.MTG:GENERAL	80009	432-0048-00
	432-0048-02	B064258		2		BASE,CAP. MTG:1.365 H,PLASTIC	80009	432-0048-02
						**********(ATTACHING PARTS)**********		
-21	211-0017-00			4		SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)*********		
-22	407-1226-00			1		BRACKET,ANGLE:CAPACITOR,ALUMINUM	80009	407-1226-00
						**********(ATTACHING PARTS)**********		
-23	211-0581-00			4		SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)*********		
-24	200-0237-01	B010100	B032468	1		COVER,FUSE HLDR:BLACK PLASTIC	80009	200-0237-01
	200-0237-03	B032469	B064420	1		COVER,FUSE HLDR:	80009	200-0237-03
	200-0237-04	B064421		1		COVER,FUSE HLDR:PLASTIC,SAFETY CONTROLLED	80009	200-0237-04
-25	352-0362-00	B010100	B032059	2		FUSEHOLDER: W/MOUNTING HARDWARE	75915	345603
	352-0002-00	B032060	B064187	2		FUSEHOLDER:ASSEMBLY	80009	352-0002-00
	----- -----			-		.EACH ASSEMBLY INCLUDES:		
	352-0010-00	B010100	B064187	1		..FUSEHOLDER:WITH HARDWARE	03614	HKP-L
	204-0832-00	B064188		1		BODY,FUSEHOLDER:3AG,5 X 20MM FUSES	S3629	031.1673(MDLFEU)
-26	200-0582-00	B010100	B064187	1		.CAP,ELECTRICAL:FUSE HOLDER	71400	9435 1/2
	200-2264-00	B064188		1		CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-27	210-0873-00			1		.WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NP	70485	ORD BY DESCR
-27.1	210-1039-00	B064188		1		WASHER,LOCK:INT,0.521 ID X 0.625 INCH O	24931	ORD BY DESCR
-27.2	334-3379-02	B064188		1		MARKER,IDENT:MARKED GROUND SYMBOL	80009	334-3379-02
-28	358-0161-00			1		BSHG,STRAIN RLF:FOR 0.50 INCH HOLE,PLASTI	28520	1147 SR-5P-4
-29	161-0033-00			1		CABLE ASSY,PWR: POWER	80009	161-0033-00
-29.1	131-0861-00			1		TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-30	343-0001-00			2		CLAMP,LOOP:0.15 INCH DIA,PLASTIC	95987	1-8-6B
						**********(ATTACHING PARTS)**********		
-31	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-32	210-0863-00			2		WSHR,LOOP CLAMP:0.187 ID U/W 0.5 W CLP,STL	95987	C191
						**********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-33	----- -----			1		SEMICOND DE:(SEE CR1006 REPL)		
						**********(ATTACHING PARTS)**********		
-34	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-35	210-0949-00			1		WASHER,FLAT:0.141 ID X 0.50 INCH OD,BRS	12327	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-36	----- -----			1		INTERFACE:		
	198-2490-00	B010100	B064429	1		WIRE SET,ELEC:	80009	198-2490-00
	198-2490-01	B064430		1		WIRE SET,ELEC:	80009	198-2490-01
	131-0458-00	B010100	B052846	1		.CONNECTOR,RCPT,:15 PIN,FEMALE	71468	DA15S
	175-0833-00	B010100	B052846	FT		.WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
	131-0707-00	B010100	B052846	56		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	131-0707-00	B052847		26		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	352-0168-00	B010100	B052846	1		.CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
	175-0828-00	B010100	B052929	FT		.WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
	131-0621-00	B010100	B052929	12		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
	352-0201-00	B010100	B052929	8		.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
	352-0201-00	B052930		2		.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
	131-2065-00	B064430		1		.TERM,QIK DISC:18-22 AWG,BRASS TIN PLATED	00779	2-520181-2
	175-2026-00	B052847		1		CA ASSY,SP ELEC:10,26 AWG,7.0 L	80009	175-2026-00
	131-2011-00			1		.CONN,RCPT,ELEC:D SERIES,15 FEMALE CONTACT	00779	205205-1
	131-1279-01			10		.CONTACT,ELEC:FEMALE	00779	66505-4
	175-0833-00			FT		.WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
	131-0707-00			10		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	352-0168-00			1		.CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-37	131-0458-00			1		CONNECTOR,RCPT,:15 PIN,FEMALE	71468	DA15S
						**********(ATTACHING PARTS)**********		
-38	129-0260-00			2		POST,ELEC-MECH:0.255 HEX X 0.500 INCH L	80009	129-0260-00
-39	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
	198-3470-00	B052930		3		WIRE SET,ELEC:	80009	198-3470-00
	----- -----			-		.EACH WIRE KIT INCLUDES:		
	131-0621-00			10		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
	175-0828-00			FT		.WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
	352-0201-00			2		.CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00
-40	131-0274-00			1		CONNECTOR,RCPT,:BNC	91836	KC79-67
	134-0067-00			1		BUTTON,PLUG:GRAY PLASTIC	80009	134-0067-00
-41	200-1506-00			2		COVER,XSTR:	80009	200-1506-00
						**********(ATTACHING PARTS)**********		
-42	211-0581-00			2		SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-43	384-0519-00			2		SPACER,POST:0.562 L,W/6-32 THD THRU	80009	384-0519-00
						**********(ATTACHING PARTS)**********		
-44	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-45	210-0006-00			2		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
						**********(END ATTACHING PARTS)**********		
-46	----- -----			3		TRANSISTOR:(SEE Q1105,Q1110,Q1118 REPL)		
						**********(ATTACHING PARTS)**********		
-47	211-0513-00			6		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-48	210-0407-00			3		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-49	210-0457-00			3		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-50	210-0202-00			3		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-51	210-0803-00			6		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
-52	210-0967-00			6		WASHER,SHLDR:0.156 ID X 0.094D X 0.375 O	86928	5607-82
-53	210-0910-00			6		WASHER,NONMETAL:0.188 ID X 0.313" OD,TEFLO	02107	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
	198-3613-00	B010100	B064429	1		WIRE SET,ELEC:	80009	198-3613-00
	198-3613-01	B064430		1		WIRE SET,ELEC:	80009	198-3613-01
	131-0861-00	B010100	B064429	2		.TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
	131-1159-00	B064430		4		.TERM,QIK DISC.:14-18 AWG,U/W 0.25 X 0.032	00779	42660-2
	131-2065-00	B064430		2		.TERM,QIK DISC:18-22 AWG,BRASS TIN PLATED	00779	2-520181-2
	175-1577-00			FT		.CABLE,SP,ELEC:4,18 AWG,TWISTED	80009	175-1577-00
-54	386-0978-00			3		INSULATOR,PLATE:TRANSISTOR,MICA	80009	386-0978-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-55	----- -----			1		TRANSISTOR:(SEE Q1112 REPL)		
						**********(ATTACHING PARTS)**********		
-56	211-0513-00			2		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-57	210-0407-00			1		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-58	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-59	210-0202-00			1		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-60	210-0803-00			2		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
-61	210-0967-00			2		WASHER,SHLDR:0.156 ID X 0.094D X 0.375 O	86928	5607-82
	210-0910-00			2		WASHER,NONMETAL:0.188 ID X 0.313" OD,TEFLO	02107	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-62	386-0978-00			1		INSULATOR,PLATE:TRANSISTOR,MICA	80009	386-0978-00
-63	129-0089-01			6		SPACER POST:0.830 L X 0.250,6-32 THD,AL	80009	129-0089-01
						**********(ATTACHING PARTS)**********		
-64	211-0581-00			6		SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-65	214-1781-00			1		HEAT SINK,XSTR:(4) TO-3,AL	80009	214-1781-00
-66	343-0469-00			1		RETAINER,CKT BD:POLYCARBONATE	80009	343-0469-00
						**********(ATTACHING PARTS)**********		
-67	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-68	386-2792-00			1		PLATE,ALIGNMENT:	80009	386-2792-00
						**********(END ATTACHING PARTS)**********		
-69	386-2866-00			2		SPRT,CKT BD RET:	80009	386-2866-00
						**********(ATTACHING PARTS)**********		
	211-0513-00			4		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-70	----- -----			1		CKT BOARD ASSY:RAM(SEE A1 REPL)		
-71	136-0260-01			2		.SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-72	131-0787-00			15		.CONTACT,ELEC:0.64 INCH LONG	22526	47359
-73	----- -----			1		CKT BOARD ASSY:CURSOR(SEE A2 REPL)		
-74	131-0787-00			15		.CONTACT,ELEC:0.64 INCH LONG	22526	47359
-75	----- -----			1		CKT BOARD ASSY:KEYBOARD INTFCE(SEE A4 REPL		
-76	131-0589-00			21		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-77	131-0608-00			14		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-78	131-0993-00			3		.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-79	----- -----			1		CKT BOARD ASSY:EDIT(SEE A5 REPL)		
-80	131-0589-00			4		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-81	----- -----			1		CKT BOARD ASSY:CONTROL(SEE A6 REPL)		
-82	131-0589-00			3		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-83	131-0608-00			22		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-84	131-0993-00			7		.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-85	----- -----			1		CKT BOARD ASSY:TIMING(SEE A7 REPL)		
-86	131-0589-00			21		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-87	131-0608-00			3		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-88	131-0993-00			1		.BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-89	----- -----			1		CKT BOARD ASSY:MOTHER(SEE A10 REPL)		
						**********(ATTACHING PARTS)**********		
-90	211-0511-00			6		SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
	----- -----			-		.CKT BOARD ASSY INCLUDES:		
-91	131-0589-00			33		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
	131-0608-00			9		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-92	136-0260-01			2		.SOCKET,PLUG-IN:16 CONTACT,RECT SHAPE	71785	133-51-02-075
-93	131-1147-00			9		.CONNECTOR,RCPT,:72 PIN	31781	336-072-520-309
-94	131-1148-00			19		.KEY,CONN PLZN:PLASTIC	00779	67611-6
-95	351-0239-00			1		GUIDE,CKT BD:MAIN,LEFT & RIGHT,GRAY PC	80009	351-0239-00
						**********(ATTACHING PARTS)**********		
-96	210-0457-00			6		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-97	131-1249-00			2		CONTACT,ELEC:QUICK DISCONNECT	00779	41478
						**********(ATTACHING PARTS)**********		
-98	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-99	----- -----			1		TRANSFORMER:POWER(SEE T1000 REPL)		
						**********(ATTACHING PARTS)**********		
-100	211-0507-00			4		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-101	210-0006-00			4		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
-102	407-1174-00			2		BRACKET,XFMR:ALUMINUM	80009	407-1174-00
						**********(END ATTACHING PARTS)**********		
-103	131-0775-00			2		CONTACT,ELEC:HEX,0.25 INCH W/6-32 1 END	88245	1601-A
-104	----- -----			1		TRANSISTOR:(SEE Q1114 REPL)		
						**********(ATTACHING PARTS)**********		
-105	210-0407-00			1		NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-106	210-0071-00			1		WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
						**********(END ATTACHING PARTS)**********		
-107	342-0136-00			1		INSULATOR,WSHR:0.812 OD X 0.0025 INCH THK	04713	ORD BY DESCR
-108	210-0202-00			2		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						**********(ATTACHING PARTS)**********		
-109	210-0586-00			1		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
-110	210-0851-00			1		WASHER,FLAT:0.119 ID X 0.375 INCH OD,ST	12327	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-111	----- -----			1		CAPACITOR:(SEE C1006 REPL)		
						**********(ATTACHING PARTS)**********		
-112	211-0511-00			1		SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	ORD BY DESCR
-113	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-114	343-0067-01			1		CLAMP,LOOP:CAPACITOR MTG	80009	343-0067-01
						**********(ATTACHING PARTS)**********		
-115	211-0016-00	B010100	B064026	3		SCREW,MACHINE:4-40 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
	211-0099-00	B064027		3		SCREW,MACHINE:0.312 FLH,100 DEG	83385	ORD BY DESCR
-116	210-0851-00			3		WASHER,FLAT:0.119 ID X 0.375 INCH OD,ST	12327	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-117	212-0518-00			2		SCREW,MACHINE:10-32 X 0.312,PNH,STL,CD PL	83385	ORD BY DESCR
-118	210-0273-00			2		TERMINAL,LUG:0.781 INCH LONG	79963	547
-119	348-0004-00	B010100	B049999	1		GROMMET,RUBBER:0.281 ID X 0.563 INCH OD	70485	763
	348-0063-00	B050000		1		GROMMET,PLASTIC:0.50 INCH DIA	80009	348-0063-00
-120	124-0282-00			1		TERMINAL STRIP,:GROUND	13150	7605-0803-000B
	210-0203-00	B050000		1		TERMINAL,LUG:SE #6	78189	2103-06-00-2520N
						**********(ATTACHING PARTS)**********		
	211-0507-00	B050000		1		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
	210-0435-00	B050000		1		NUT,PRESSMOUNT:6-32 X 0.344 OD	80009	210-0435-00
						**********(END ATTACHING PARTS)**********		
-121	211-0511-00			2		SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	ORD BY DESCR
-122	386-2420-01	B010100	B049999	1		PANEL,REAR:	80009	386-2420-01
	386-2420-03	B050000		1		PANEL,REAR:W/CHASSIS	80009	386-2420-03
-123	131-1480-00	B010100	B064400	2		LEAD,ELECTRICAL:STRD,22 AWG,3.75 L	80009	131-1480-00
	131-1480-01	B064401	B064429	2		LEAD,ELECTRICAL:STRD,22 AWG,3.75 L	80009	131-1480-01
	131-1480-02	B064430		2		LEAD,ELECTRICAL:STRD,22 AWG,3.75 L	80009	131-1480-02
-124	179-1091-00			1		WIRING HARNESS:READOUT	80009	179-1091-00
	131-0371-00			12		.CONTACT,ELEC:FOR NO.26 AWG WIRE	98278	122-0182-019
	179-1947-00	B010100	B019999	1		WIRING HARNESS:MONITOR	80009	179-1947-00
	179-1947-01	B020000	B064429	1		WIRING HARNESS:MONITOR	80009	179-1947-01
	179-1947-02	B064430		1		WIRING HARNESS:MONITOR	80009	179-1947-02
	179-1944-00			1		WIRING HARNESS:HEAT SINK NO 1	80009	179-1944-00
-125	131-0621-00			5		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
	131-0792-00			1		.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-126	352-0202-00			1		.HLDR,TERM CONN:6 WIRE BLACK	80009	352-0202-00
	343-0549-00			11		.STRAP,TIEDOWN:0.091 W X 3.62 INCH LONG	06383	PLT1M
	179-1945-00			1		WIRING HARNESS:HEAT SINK NO 2	80009	179-1945-00
	131-0621-00			1		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
	131-0792-00			2		.CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
	334-2192-01			1		MARKER,IDENT:MKD INT SET FOR 110V	80009	334-2192-01
	334-2193-01			1		MARKER,IDENT:MKD INT SET FOR 120V	80009	334-2193-01
	334-2194-01			1		MARKER,IDENT:MKD INT SET FOR 200V	80009	334-2194-01
	334-2195-01			1		MARKER,IDENT:MKD INT SET FOR 220V	80009	334-2195-01
	334-2196-01			1		MARKER,IDENT:MKD INT SET FOR 240V	80009	334-2196-01
	334-2558-01			1		MARKER,IDENT:MARKED 104V,50HZ	80009	334-2558-01

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-	334-2560-01			1		MARKER,IDENT:MARKED 110V,50HZ	80009	334-2560-01
-127	334-2192-01			1		MARKER,IDENT:MKD INT SET FOR 110V	80009	334-2192-01
	334-2193-01			1		MARKER,IDENT:MKD INT SET FOR 120V	80009	334-2193-01
	334-2194-01			1		MARKER,IDENT:MKD INT SET FOR 200V	80009	334-2194-01
	334-2195-01			1		MARKER,IDENT:MKD INT SET FOR 220V	80009	334-2195-01
	334-2196-01			1		MARKER,IDENT:MKD INT SET FOR 240V	80009	334-2196-01
	334-2558-01			1		MARKER,IDENT:MARKED 104V,50HZ	80009	334-2558-01
	334-2560-01			1		MARKER,IDENT:MARKED 110V,50HZ	80009	334-2560-01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ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	021-0111-00			1	INTERFACE:BASIC DATA	80009	021-0111-00
	070-1613-00			1	MANUAL,TECH:SERVICE	80009	070-1613-00
	070-1621-00			1	MANUAL,TECH: USER'S	80009	070-1621-00