Honeywell

SERIES 60 (LEVEL 6)

SYSTEM AND PERIPHERALS OPERATION

SUBJECT

> Operation and Maintenance Procedures for the Level 6 Peripheral Devices and System Control Panel Operation

SPECIAL INSTRUCTIONS

> This revision includes Addendum A, AT04A dated July 1976 as well as the addition of several new peripheral devices. Due to the extensive changes, change bars are omitted.

> Section 11 of this manual is superseded by the *CDU9114/9115/9116 Cartridge Disk Unit Operation* manual, CB65, Rev. 0 dated April 1978. Section 13 of this manual is superseded by the *PRU9103/9104/9105/9106/ 9108/9109 Line Printer Operation* manual, CB66, Rev. 0 dated May 1978.

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PREFACE

This manual describes Level 6 system and peripheral unit operating procedures and operational characteristics for the 6/30 and 6/40 models. The manual is divided into 14 sections and an appendix. Section 1 is an introduction to the system. Section 2 contains control panel operating procedures. Sections 3 through 14 discuss system components and peripherals, including controls and indicators, fault conditions, and operator maintenance. The appendix lists the various peripheral device ID numbers. Documents supporting this manual and suggested for operator reference are:

Series 60 (Level 6) Minicomputer Handbook, Order No. AS22
Series 60 (Level 6) GCOS/BES Operator's Guide, Order No. AS33
Series 60 (Level 6) GCOS 6/MDT Overview and User's Guide, Order No. AX11
Computer Supplies Catalog, Order No. BY62

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SECTION 1

INTRODUCTION

Honeywell's Level 6 minicomputer systems (see Figure 1-1) have been carefully engineered for simplicity and compactness of design combined with maximum reliability and performance. With its open-ended system architecture, its modular, highly functional software, and its low-cost peripherals, Level 6 satisfies the critical applications criteria of end users, system builders, and OEMs.

PERIPHERALS

Peripherals available for Level 6 system use are listed in Table 1-1. The devices are supported by Level 6 GCOS/BES and GCOS 6/MDT I/O drivers and executive routines.

Peripheral Device Connection

Most of the peripheral devices listed in the table are connected to the Level 6 Megabus via a single-board Multiple Device Controller (MDC9101) and appropriate device-pacs (i.e., adapters). The MDC is firmware driven and micro-programmed to provide four levels of simultaneity supporting up to four devices in any combination[1] with full capability of Direct Memory Access (DMA). Multiple controllers can be attached to the Megabus (see Figure 1-2).

Cartridge Disk Units connect to the Megabus via the Mass Storage Controller (MSC9101), which supports up to four disk units and requires only one Disk Device-Pac (CDM9101). The 7- and 9-track Magnetic Tape Units connect to the Megabus via the Magnetic Tape Controller (MTC9101), which supports up to four tape units *or* a combination of tape units and unit record devices (serial printers, line printers, and card readers). A maximum of two tape units and two unit record devices can be configured. The MTC requires only one Magnetic Tape Device-Pac (MTM9101 for 7-track NRZI or MTM9102 for 9-track NRZI) and other peripheral device-pacs as appropriate.

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[1] In a system, the diskette device is specifically allocated ports 0 and 1 or ports 2 and 3 or else ports 0, 1, 2 and 3. All other devices can be allocated ports in any combination.
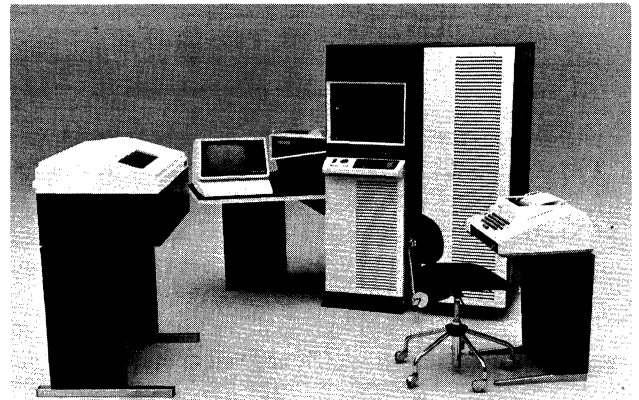
Figure 1-1. Typical Level 6 System

PERIPHERAL INTERFACES AND POWER SUPPLIES

Peripherals operate under the control of the software in a system environment. All action on a peripheral is initiated either through input/output commands or by operator entered data. If a requested device becomes unavailable to the system (device turned off, device busy, device malfunctioning, etc.) the software outputs an error code. The error message corresponding to the error code (described in the *Series 60 (Level 6) GCOS/BES Operator's Guide, GCOS/BES 2 Operator's Guide,* and *GCOS 6/MDT Overview and User's Guide*) tells the operator exactly what action is required to correct the situation. Section 2 of this text discusses the central processor, and Sections 3 through 13 discuss the available peripherals.
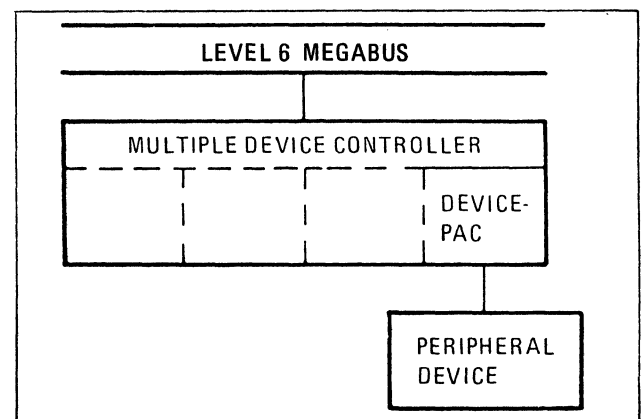
Figure 1-2. Peripheral Device Connection

TABLE 1-1. LEVEL 6 PERIPHERAL DEVICES

Device	Description
Card Readers	
CRU9101/9103	300/500 cpm punched card readers
CRU9102/9104	300/500 cpm punched card and mark sense readers
CRU9108/9111	300/500 cpm punched card readers
CRU9109/9112	300/500 cpm punched card and mark sense (IBM mode) readers
CRU9110/9113	300/500 cpm punched card and mark sense (Honeywell mode) readers
Consoles	
TTU9101/9102	10 cps, 72 characters per line, ASR-/KSR-33
TTU9103/9104	10 cps, 72 characters per line, ASR-/KSR-33 with autoshutdown
TWU9101	30 cps, 132 characters per line, 64-character ASCII set
TWU9104/9106	30 cps/120 cps, 132 characters per line, 96-character ASCII set
DKU9101/9102	960 character display (12 lines, 80 characters per line)
Disk Devices	
DIU9101/9102	Single/dual diskettes, 401,016 bytes/disk (unformatted), 256,256 bytes/disk (formatted)
CDU9101	Cartridge Disk Unit, low-density, 2.5/2.8M bytes, removable disk only
CDU9102	Cartridge Disk Unit, low-density, 5.0/5.6M bytes, fixed and removable disks
CDU9103	Cartridge Disk Unit, high-density, 5.0/5.6M bytes, removable disk only
CDU9104	Cartridge Disk Unit, high-density, 10.0/11.2M bytes, fixed and removable disks
CDU9114	Cartridge Disk Unit, low-density, 5.0/5.6M bytes, fixed and removable disks
CDU9116	Cartridge Disk Unit, high-density, 10.0/11.2M bytes, fixed and removable disks
Printers	
PRU9101/9102	Serial Printers, 60 lpm, 64-/96-ASCII character set
PRU9103/9104	Line Printers, 240/300 lpm, 96-/64-ASCII character set
PRU9105/9106	Line Printers, 440/600 lpm, 96-/64-ASCII character set
Magnetic Tape Units	
MTU9104/9105	9-track Magnetic Tape Unit, 45 ips/75 ips
MTU9112/9113	7-track Magnetic Tape Unit, 45 ips/75 ips

For the system to operate, all the power supplies must be turned on. Additionally, the Power Distribution Unit and the optional Memory Save and Autorestart must have power applied.

The order for application of power to the Level 6 system is as follows:

Power Distribution Unit

↓

Central Processor

↓

Memory Save and Autorestart

↓

Peripherals
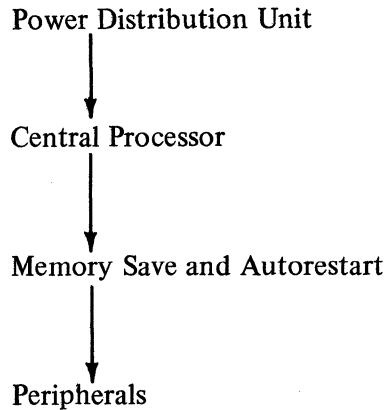
Power Distribution Unit

The Power Distribution Unit is located in the base of the cabinet (bottom of the rack; see Figure 1-3). The operator must set the Power Distribution Unit ON/OFF switch to the ON position. This action is taken before power is applied to the central processor.
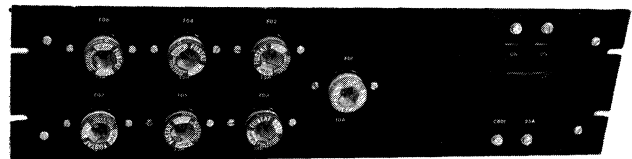
(Front)
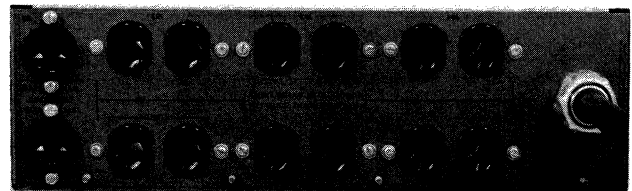
(Rear)

Figure 1-3. Power Distribution Unit

Memory Save and Autorestart

Memory Save and Autorestart (PSS9101/9102) is an optional device which provides for the retention of up to 131,072 bytes of memory for a two-hour period in the event of a power failure or fault (see Figure 1-4).

In the event of a normal system power down, the memory contents are automatically retained (with the ON/OFF switch positioned ON) until the system is manually powered up again.

Controls and Indicators

ON/OFF Switch

An ON/OFF switch enables the selection of one of two states. When it is placed in the OFF position, memory contents are not saved. When it is placed in the ON position, however, the central processor memory contents are saved for up to two hours by the battery backup unit.

MEMORY ON Indicator

The MEMORY ON indicator, when lit, indicates that the device is functioning properly. Loss of ac power for longer than two hours or a malfunction in the device (battery backup supply dead, etc.) causes the power supply to be turned off and the MEMORY ON indicator to be extinguished. Should total device failure occur, information retained is not available. Manual pressing of the Reset button is necessary to relight the indicator if the device itself lost power or the
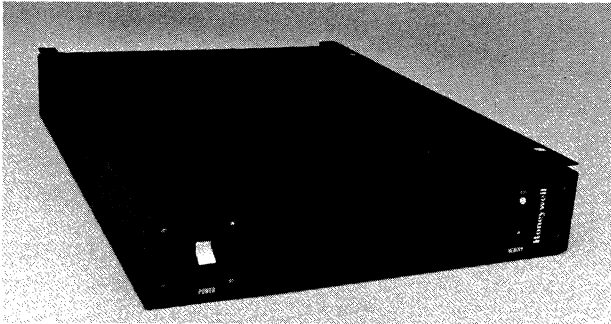
Figure 1-4. Memory Save and Autorestart Unit

two-hour time period was exceeded. In addition, ac power must be applied to the device and battery, if run down, to recharge them.

Reset Button

Pressing of the RESET button restores power to the device, thereby enabling a restart.

PROCESSOR INTERRUPTS

Conditions that cause a processor interrupt are:

o Interrupt level nonzero and previous operation complete
o Interrupt level nonzero and error on I/O command (see "Status Bits")
o Completion of a stop I/O command
o Termination of an IOLD command due to a device fault

If the interrupt level is zero (due either to initialize, master clear or explicitly set to that value), no interrupt will be issued for the cited conditions. Status will be set at the proper time and the NAK response from the MDC (when busy) may be used to test for completion of the previous operation.

SYSTEM SUPPLIES

Honeywell markets all the supplies required for the operation of the peripherals in a Level 6 system — printer ribbons, paper, card stock, cartridge disks, disk packs, etc. For details, see the *Computer Supplies Catalog*, Order No. BY62.

SECTION 2

CENTRAL PROCESSOR CONTROL PANELS

This section describes the two kinds of operator control panels – full and basic -- offered on Level 6 systems, panel options, controls and indicators, and the various functions that the operator can perform with these control panels.

PACKAGING

The physical configuration of the control panel is dependent upon the packaging of the central processor. Table-top models and systems in full (60-inch) cabinets will have protruding panels with the controls and indicators on an incline. Systems in the 30-inch "mini-rack" will have a flat control panel mounted vertically inside the front-door of the cabinet. Systems in the desk-style office packaging may have a flat control panel similar to the mini-rack, or a control panel mounted in the desk top behind the CRT keyboard. In the latter case, only a full control panel is allowed; the others may have either full or basic panels.

OEMs and system builders who wish to install a rack-mountable unit into their own cabinetry will get the protruding inclined panel unless they also order the vertical panel mounting option.

The 6/40 models have more logic and indicators on their control panels than do 6/30 models. An upgrade from a 6/30 to a 6/40 thus requires that the control panel be replaced.

FULL CONTROL PANEL

Systems being used for program development and testing should be equipped with the full control panel (or basic control panel with the portable plug-in panel option). Full panel functionality is also required for maintenance purposes in systems that do not have a system console (CRT, teleprinter, or keyboard printer).

The full panel allows certain CP registers and the entire memory contents to be entered and displayed. It controls, in a step-by-step fashion, the system initialization sequence by single-stepping a program and stopping and starting program execution.

Figure 2-1 shows the full control panel. Table 2-1 lists and describes the various controls and indicators.

Register Display

The registers – 21(6/30) and 26(6/40) – may be accessed from the control panel. A hexadecimal display located in the upper center portion of the control panel, in the area labeled REGISTER, accommodates this capability. The register display is divided into two sections: one labeled LOCATION, the other CONTENTS.

o LOCATION – A 2-digit hexadecimal display that indicates the coded location of the specific register selected. The selection codes assigned to access the visible registers are listed alphanumerically in Figure 2-2. A complete list of the selection codes is also stenciled on the control panel in the upper right-hand portion of the panel labeled REGISTERS.

o CONTENTS – A 4-digit (6/30)/5-digit (6/40) hexadecimal display that indicates the contents of the selected register. The specific visible register type/number associated with the assigned selection code is listed in the contents column of Figure 2-2.
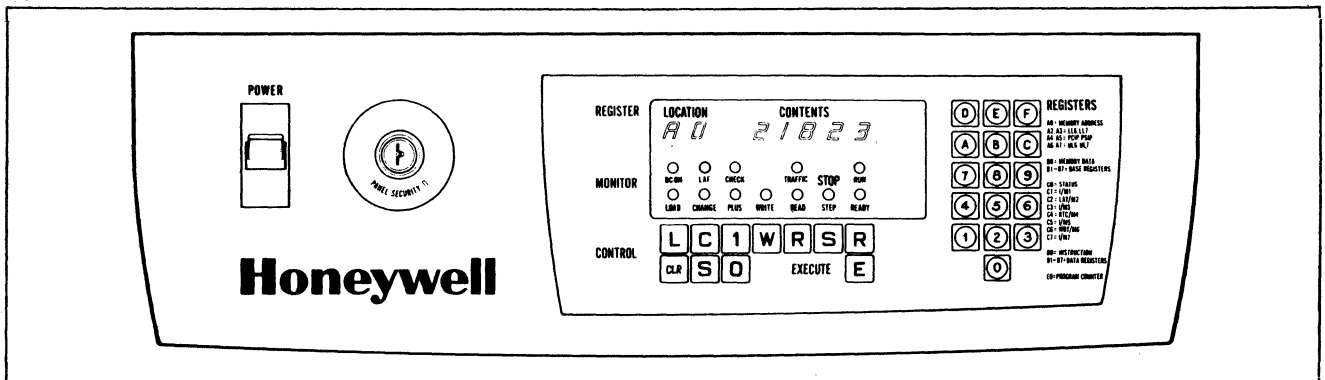
Figure 2-1. Full Control Panel (Shown with 6/40 Panel)

TABLE 2-1. FULL PANEL CONTROLS AND INDICATORS

Control/Indicator	Description
POWER (switch)	— Up for power on; down for power off.
PANEL SECURITY (switch)	— Left (locked) position disables panel switches and the register display (not lit) and push buttons except for POWER; right (unlocked) position enables panel switches/push buttons, and displays.
DC ON (indicator)	— Indicates dc power is applied to the CP.
CHECK (indicator)	— Indicates that one of the individual units (CP, controller, etc.) is executing QLTs or an error was encountered during QLT execution.
TRAFFIC (indicator)	— Indicates the CP is executing instructions other than a Halt.
RUN (indicator)	— Indicates the CP is executing any instruction, including a Halt. If TRAFFIC is off and RUN is on, the CP is continually executing a halt.
LOAD (indicator)	— Indicates the CP is in bootload mode.
CHANGE (indicator)	— Indicates control panel is in change mode, i.e., capable of modifying register contents.
PLUS (indicator)	— Indicates CP is in increment memory address mode. When off, memory address register is not modified during memory read or write mode.
WRITE (indicator)	— Indicates control panel is in memory write mode.
READ (indicator)	— Indicates control panel is in memory read mode.
STOP/STEP (indicator)	— Indicates CP is in single instruct mode.
READY (indicator)	— Indicates CP is in ready mode. Pressing the Execute key causes CP to go to run mode.
LAF (Long Address Form)[1] (indicator)	— Indicates CP is operating in the Long Address Form (i.e., 20-bit main memory addressing). It is also lit during system load independent of the setting of the LAF switch. If not lit, CP is operating in the SAF mode.
L (Load) (push button)	— Places the processor in load mode, lights Check indicator, activates QLT, and allows bootstrapping of the bootstrap record into memory. Used in conjunction with Execute so that when Execute is pressed next, the QLT should be executed. Upon subsequent pressing of the Execute key the bootstrapping is actually performed.
C (Change) (push button)	— Places the processor in change mode. In this mode the processor is ready to accept modifications to the contents of the selected register from the control panel. NOTE: Not all visible registers are modifiable.
1 (Plus One) (push button)	— Places the processor in plus 1 mode. In this mode the processor is ready to increment its address register before reading or writing successive memory locations from the control panel. This condition is initiated only after setting the processor to either the read or write mode. When in the plus 1 mode, each pressing of Execute causes the memory address register (A0) to be incremented by 1, prior to its being used.
W (Memory Write) (push button)	— First places the processor in a stop state (if not already in that state); resets the plus 1 mode (if in plus 1 mode); resets the load mode (if in load mode); and places the processor in write mode. In this mode the processor writes the contents of the selected register into the location addressed by the memory address register (A0), when Execute is pressed. (If A0 is selected, the contents of B0 are written.)

TABLE 2-1 (CONT). FULL PANEL CONTROLS AND INDICATORS

Control/Indicator	Description
R (Memory Read) (push button)	— First places the processor in a stop state (if not already in that state); resets the plus 1 mode (if in plus 1 mode); and places the processor in read mode. In this mode the processor reads the contents of the location addressed by the memory address register (A0) into the selected register when Execute is pressed. (If A0 is selected, the contents are read into B0).
S (Stop) (push button)	— Stops instruction execution and places the processor in a stop state. When it is in the stop state, a variety of operating procedures are possible from the control panel. Also, when in the stop state, the processor is automatically in the step mode. In this mode one instruction is executed each time Execute is pressed, thus permitting single stepping through a program.
R (Ready) (push button)	— Places the processor in the ready mode. In this mode the processor is ready to execute a series of instructions constituting a program. If Execute is pressed, the processor enters the run state and commences execution of the program.
CLR (Master Clear) (push button)	— Initiated by pressing Clear but is only effective while in the stop state. Pressing Clear invokes a number of clearing and initializing functions: 1. Clears and sets to 0 the P register, the M1 register (M2-M7), and the instruction register; does not clear to 0, but changes the SIP (P register) and SI register. Modifies the scientific accumulators. 2. Clears all pending interrupts. 3. Resets the real-time clock (RTC) and the watchdog timer (WDT). 4. Sets the ring number to zero and the interrupt priority level to 0. 5. Starts the Quality Logic Test (QLT) in each controller and SIP.
S (Select) (push button)	— Places the processor in select mode. In this mode the desired register that is to be displayed or operated on is selected by keying in the proper selection code from the hexadecimal-pad keys. The select mode may be initiated in any state.
0 (Plus Zero) (push button)	— Resets the plus 1 mode. In this mode the memory address register is not modified during a memory read or write operation.
E (Execute) (push button)	— Performs various execution functions depending on the mode that the processor is in prior to pressing Execute. In the *ready* mode, pressing Execute places the processor in a run state and it executes instructions starting with the instructions in the instruction register. If the instruction register contains a zero, execution begins at the address specified in the P register. Execution continues until a Halt instruction is encountered or Stop, Read, or Write is pressed. In the *step* mode, pressing Execute causes the execution of a single instruction. The processor returns to the stop mode after each single instruction execution. In the *read* or *write* mode, pressing Execute at the appropriate time causes the selected memory location to be displayed or changed. In a *load* mode, pressing Execute causes initiation of a bootstrap operation.
Configuration Switches[1]	— Four tiny rocker switches, located behind the full control panel on the control panel circuit board supply configuration information to the central processing unit. The switch on the extreme left is the volatile memory switch which should be set to "on" if the memory is volatile (i.e., not core and no Memory Save and Autorestart option) or the Memory Management Unit

TABLE 2-1 (CONT). FULL PANEL CONTROLS AND INDICATORS

Control/Indicator	Description
	option is present. In the "on" position an auto bootload will occur on powering up after a power failure. The switch should be set to "off" if core memory is present and no Memory Management Unit option is present *or* if this is a portable plug-in panel. In the "off" position an auto restart will occur on powering up after a power failure (if the Memory Save and Autorestart option is present). The second switch is not used. The third switch should be set to "on" if it is a standard control panel or to "off" if it is a portable plug-in panel. The switch on the extreme right is the LAF switch which should be set to "on" to put the CP in the LAF mode or to "off" for the SAF mode. The system must first be initialized by pressing the Clear key (this prevents the address from being changed while a program is running). After switching modes, the system must be cleared *twice*.

[1]6/40 full panel only

The positional format of the location and contents display is represented by key symbols H1 through H7 at the bottom of Figure 2-2.

Hexadecimal-Pad Keys

The set of 16 hexadecimal keys in the right part of the control panel marked REGISTERS is called the hex pad. These keys provide access to the user-visible registers. In the select mode, a hex pad key-in selects the register to be operated on, and the entered digits light up under LOCATION in the register display. In the change mode, a hex pad key-in changes the contents of the selected register, and the entered digits are displayed under CONTENTS in the register display. Each keystroke shifts and loads the selected hexadecimal digit into the least significant hexadecimal position of the selected register; all other digits are shifted to the left.

In the select mode, input from the hexadecimal-pad keys selects the register to be displayed/operated on. This input is simultaneously displayed in the LOCATION field on the display. Hexadecimal-pad keys 8 through F modify the leftmost location character (H1); hexadecimal-pad keys 0–7 modify the rightmost location character (H2).

In the change mode, input from the hexadecimal-pad keys changes the contents of the selected register. This input is simultaneously displayed in the CONTENTS field of the register display. Each key stroke shifts and loads the corresponding hexadecimal character into the least significant hexadecimal position of the selected register and the display. Specifically, each hexadecimal-pad key stroke enters the new character into the H6 (H7) position of the selected register and the CONTENT field of the register display. At the same time, the currently displayed characters (in all four/five positions) shift one

LOCATION SELECTION CODES — CONTENTS VISIBLE REGISTERS

	CODES	6/30 MODELS	6/40 MODELS
A	0	0 ——— 15	0 ——— 15/19
	0	MEMORY ADDRESS REGISTER	VIRTUAL MEMORY ADDRESS
	1		MAPPED MEMORY ADDRESS[a]
	2		RFU
	3	UNSPECIFIED	STACK ADDRESS REGISTER (T)
	4		RFU
	5		P REGISTER (SIP)
	6		UNSPECIFIED
	7		UNSPECIFIED
B		0 ——— 15	0 ——— 15/19
	0	MEMORY DATA REGISTER	MEMORY DATA REGISTER
	1	B1	B1
	2	B2	B2
	3	B3	B3
	4	B4	B4
	5	B5	B5
	6	B6	B6
	7	B7	B7
C		0 —— 8 —— 15	0 —— 8 —— 19 / 15
	0	UNSPECIFIED	S REGISTER
	1	M1 | I	I | M1
	2		RFU | M2 (RFU)
	3	UNSPECIFIED	UNSPECIFIED | M3 (RFU)
	4		RTC | M4 (SIP)
	5		UNSPECIFIED | M5 (SIP)
	6		WDT | M6 (RFU)
	7		UNSPECIFIED | M7 (RFU)
D		0 ——— 15	0 ——— 15
	0	INSTRUCTION REGISTER	INSTRUCTION REGISTER
	1	R1	R1
	2	R2	R2
	3	R3	R3
	4	R4	R4
	5	R5	R5
	6	R6	R6
	7	R7	R7
		0 ——— 15	0 ——— 19

Figure 2-2. Register Selection Codes

E	0	PROGRAM COUNTER	PROGRAM COUNTER
	1		
	2		
	3	UNSPECIFIED	UNSPECIFIED
	4		
	5		
	6		
	7	S REGISTER	

0   15

8	0	UNSPECIFIED	RFU
	1		SI REGISTER
	2		RFU
	3		SI REGISTER
	4		SA1-W0^c
	5		SA1-W1
	6		SA1-W2
	7		SA1-W3

0 .   15

9	0	UNSPECIFIED	SA2-W0
	1		SA2-W1
	2		SA2-W2
	3		SA2-W3
	4		SA3-W0
	5		SA3-W1
	6		SA3-W2
	7		SA3-W3

0	4	8	12	15
H3	H4	H5	H6	

0	4	8	12	15	19^b
H3	H4	H5	H6	H7	

H1	H2
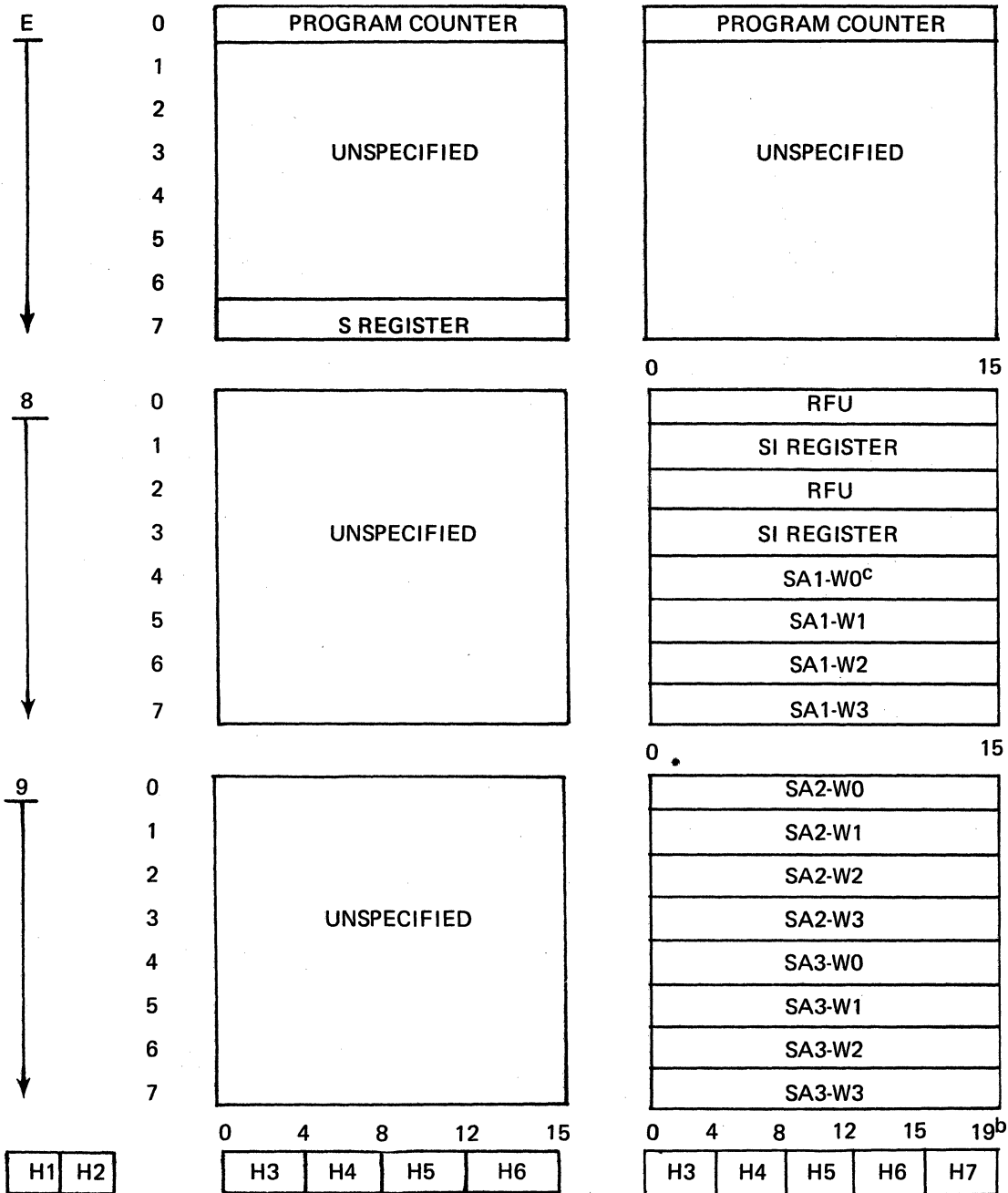
^{a}If memory management unit (MMU) present; otherwise unspecified.

^{b}In the SAF mode, the high-order digit of the 5-digit display must be zero.

^{c}Contains exponent, sign, and high-order 8 bits of mantissa.

RFU = Reserved for future use.

Figure 2-2 (Cont). Register Selection Codes

position to the left.

The activity resulting from key strokes is illustrated as follows:

out ← H3 ← H4 ← H5 ← H6 ← (H7) ← enter

You may take advantage of this shifting function and key in only a limited number of characters to arrive at the contents desired. For example, if the current CONTENTS display shows 4032 and you wish to change the contents to 3275, then key in only the characters 7,5.

Panel Display Interpretation

The CONTENTS field on the display panel is shown in hexadecimal notation. The 4-(5-) character hexadecimal display value represents the binary value of the 16-(20-) bit visible register. Each hexadecimal character is equivalent to a binary value of four bits. Thus if the display shows a value of (0)4CA2, this hexadecimal value represents the stored binary value of:

$$\left(\frac{0000}{0}\right) \frac{0100}{4} \frac{1100}{C} \frac{1010}{A} \frac{0010}{2}$$

For most registers, the display value is usable in hexadecimal form and does not need to be converted to binary. However, the exceptions are the M1, (and M2—M7 in 6/40), I, and S registers. These registers specify various status, security, and control indicators on a bit basis. Therefore, to properly interpret these registers, you must convert their hexadecimal displays to binary. Refer to Table 2-2 for a list of hexadecimal/binary/decimal conversions for the first 16 digit values.

TABLE 2-2. HEXADECIMAL/BINARY/
DECIMAL CONVERSION

Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

As an example, assume you wish to analyze the contents of the S register, e.g., on a 6/30 model. After you have selected and keyed in the proper selection code (E7), the display panel shows the following hexadecimal character display:

LOCATION   CONTENTS
E7   400D

For meaningful interpretation of its contents, you must first convert the hexadecimal value to binary:

$$\frac{\text{hexadecimal}}{400D} = \frac{\text{binary}}{0100\ 0000\ 0000\ 1101}$$

Next, you must overlay this binary value onto the bit fields structured for the S register:

S = 0 10   00000   00 001101
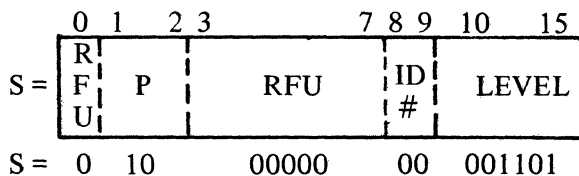
You can now analyze the system status and security indicators:

o P = Privilege State (Ring Number)
     For 6/30 and 6/40 (without MMU):
         00 = User State
         11 = Privilege State

     For 6/40 (with MMU):
         11 = Ring 0 (Privilege)
         10 = Ring 1 (Privilege)
         01 = Ring 2 (User)
         00 = Ring 3 (User)

     NOTE: Privileges and access rights accorded the various rings are in inverse order to the ring number (i.e., Ring 0 is the most privileged).

o RFU = reserved for future use.
o ID# (processor identity) = 00 indicates CP channel 0
o LEVEL (interrupt priority level) = 001101 when converted to decimal (binary 001101 = decimal 13) indicates the actual priority level.

BASIC CONTROL PANEL

The basic control panel is an important feature for customers who do not want their operators at remote locations to be able to modify the software. It is also less expensive than the full panel. As an option to the basic control panel, Honeywell offers a portable plug-in panel (see "Options"). By plugging this unit into the basic panel, full panel functionality is effected. A single portable plug-in panel can support a multitude of systems with basic control panels.

For security, the basic panel does not allow visibility to CP registers or main memory. Its only control capability is to initiate and control the system initialization procedure. This includes clearing the system, running quality logic tests (QLTs), and invoking either automatic restart (if memory contents are preserved) or bootload (if powering up the system initially or if the Memory Save and Autorestart option is not present). Displays indicate gross system status. The basic panel also provides a connector to facilitate interfacing the portable plug-in panel. Figure 2-3 shows the basic panel layout for 6/30 models and Figure 2-4 for 6/40 models. Table 2-3 describes its controls and indicators. Table 2-4 illustrates and interprets various LED indicator combinations.
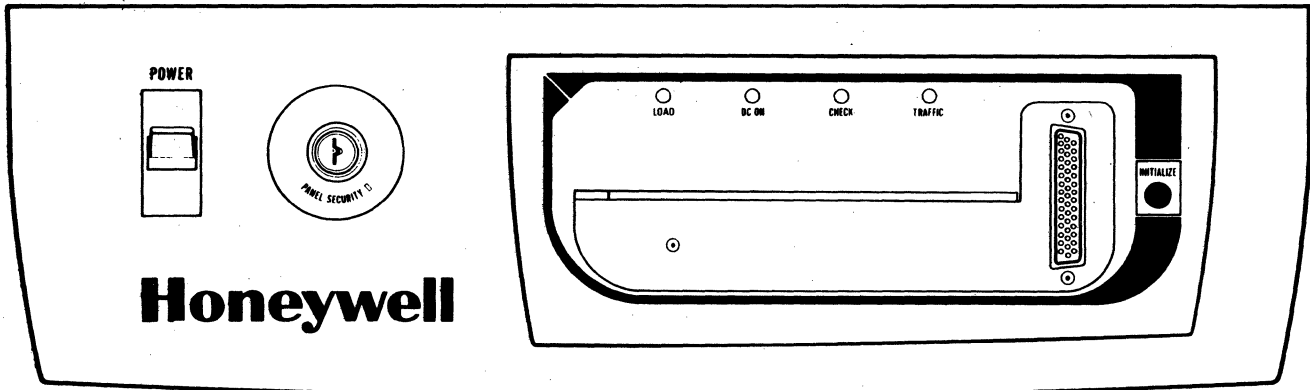
Figure 2-3. Basic Control Panel for 6/30 Models
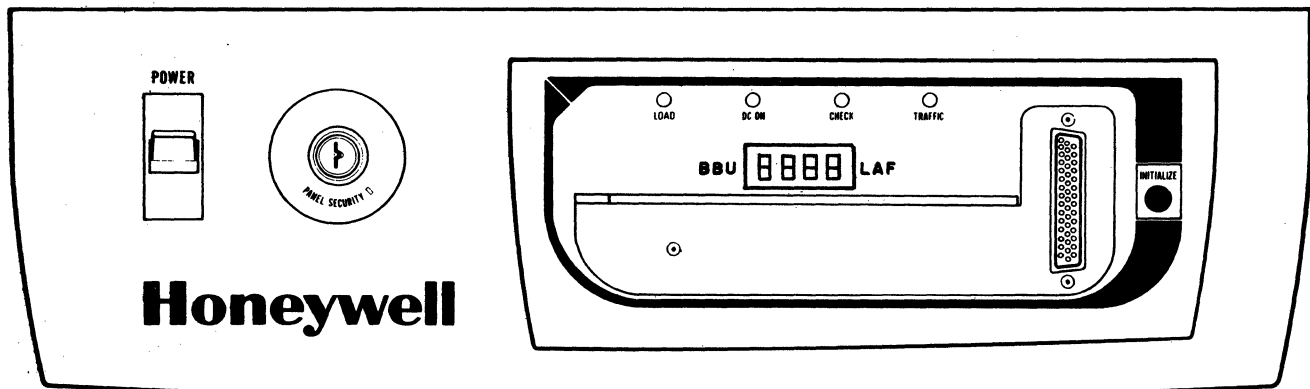
Figure 2-4. Basic Control Panel for 6/40 Models

TABLE 2-3. BASIC PANEL CONTROLS AND INDICATORS

Control/Indicator	Description
POWER (switch)	— Up for power on; down for power off.
PANEL SECURITY (switch)	— Left (locked) position disables panel except for POWER; right (unlocked) position enables panel.
LOAD (indicator)	— Indicates the CP is in bootload mode.
DC ON (indicator)	— Indicates DC power is applied to the system.
CHECK (indicator)	— Indicates the CP is executing QLTs or an error was encountered during QLT execution.
TRAFFIC (indicator)	— Indicates the CP is executing instructions other than a Halt.

INITIALIZE (push button)	— When pressed and the panel is unlocked, the following sequence occurs:
	
	  o DC clear of system
	  o QLTs are initiated and run
	  o Bootload is performed over channel 0400_{16} into location 0100_{16}
	  o CP begins instruction execution at location 0100_{16}

LAF[1] (indicator)	— Indicates CP is operating in the long address form.

TABLE 2-3 (Concl'd) BASIC PANEL CONTROLS AND INDICATORS

Control/Indicator	Description
CONFIGURATION SWITCHES[1]	— Four tiny rocker switches, located behind a sliding door on the front of the panel (see Figure 2-4), supply configuration information to the central processing unit.
	NOTE: If the portable plug-in panel is inserted, it must be removed to access these switches. The portable plug-in panel also has configuration switches which must be set (see Table 2-1).
	The switch on the extreme left is the volatile memory switch which should be set to "on" if the memory is volatile (i.e., not core and no Memory Save and Autorestart option) or the Memory Management Unit option is present. In the "on" position an auto bootload will occur on powering up after a power failure. The switch should be set to "off" if core memory is present and no Memory Management Unit option is present. In the "off" position an auto restart will occur on powering up after a power failure (if the Memory Save and Autorestart option is present).
	The two center switches are not used.
	The switch on the extreme right is the LAF switch which should be set to "on" to put the CP in the LAF mode or to "off" for the SAF mode. The system must first be initialized by pressing the Clear key (this prevents the address from being changed while a program is running). After switching modes, the system must be cleared *twice*.

[1]6/40 basic panel only.

TABLE 2-4. BASIC CONTROL PANEL INDICATOR INTERPRETATION

State/Occurrence	Indicators		
	Check	Load	Traffic
Normal Halt State	●	●	●
Normal Run State	●	●	○
Peripheral QLT Fault	○	●	◐
Load Fault	●[1]	○	●
Load in Process	●[1]	○	○
Memory Fault Detected	○	○	●
CP QLT Fault	○	○	○

LEGEND:
○ = ON ● = OFF ◐ = EITHER

[1]Could be ON if a particular peripheral controller QLT has a QLT fault condition stored in it.

OPTIONS

Portable Plug-in Panel

This is a self-contained, full control panel that can plug into any basic panel. It provides security, economy, and flexibility of operation in multi-system environments. See Figure 2-5.

Option No.	Model No.
CPF9408	6/34, 6/36
CPF9504	6/43

Prior to removing the portable panel, the basic panel and then the portable panel are locked (up position). The portable panel may then be removed. If this sequence is not properly followed, the insertion/removal of the portable plug-in panel can cause program disruption.

The portable plug-in panel also has a lock (toggle switch on right-hand side) that must be activated in the proper sequence in conjunction with the lock on the basic panel. Prior to inserting
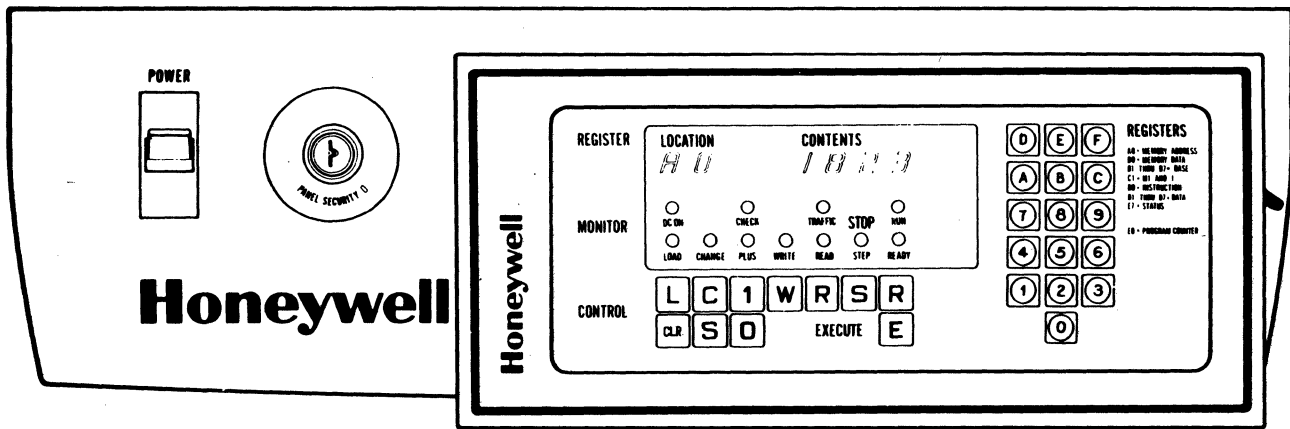
Figure 2-5. Portable Plug-In Panel Option (Shown with 6/30 Panel Plugged into Basic Panel)

the portable panel, the basic panel should be locked. The portable panel with the toggle switch in the "up" (locked) position can then be plugged in. If the "traffic" states between the two panels do not correspond, the portable panel is unlocked by setting the toggle switch to the "down" position and pressing the run or execute key (as appropriate) and relocking it. The basic panel is unlocked followed by the portable panel and then the desired operations are performed.

Vertical Panel Mounting

This is available for any rack-mountable system where physical space limitations exist and replaces the standard inclined panel mounting. It is designed for OEMs with their own cabinetry. See Figure 2-6.

Option No.	Model No.
CPF 9407	6/34, 6/36, 6/43

ORDERING INFORMATION

Systems are equipped with either basic or full control panels depending on the processor type number as follows:

Model No.	Processor Type No.	
	With Full Panel	With Basic Panel
6/34	CPS9451/9453	CPS9450/9452
6/36	CPS9460/9461	CPS9462/9463
6/43	CPS9550/9551	CPS9552/9553

CONTROL PANEL OPERATING PROCEDURES

The functions that can be performed from the full control panel are governed by the operation of the processor in its two major states. For example, in relation to program execution, when the processor is in the run state, only the limited actions of displaying registers and executing programs are possible from the control panel. When the processor is in the stop state, the actions possible are much more extensive; they consist of displaying/changing memory, displaying/changing registers, executing single instructions, restarting programs, and master clearing the processor.

Before you perform any operation from the panel (except for power on/off), you must first unlock the control panel using the panel security switch.
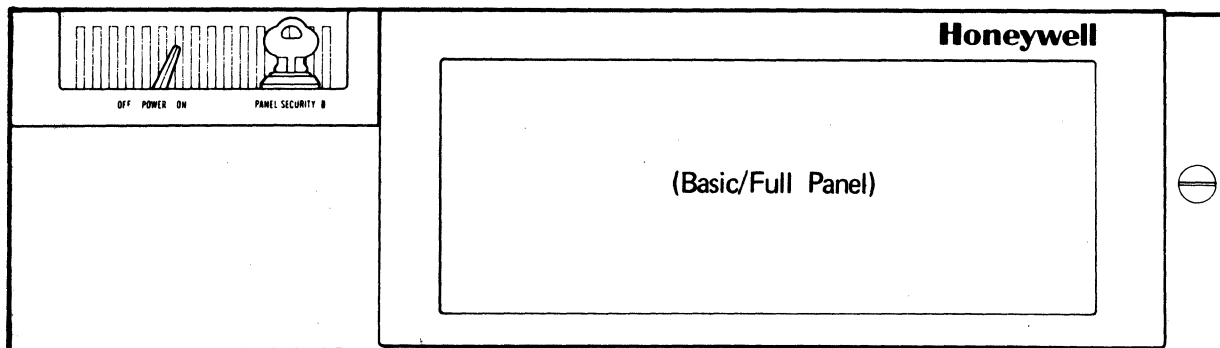
Figure 2-6. Vertical Panel Mounting Option

NOTE: In order for the Autorestart option to be initiated after a power failure, the control panel must be locked. For systems without this option, a reboot-strap will occur after a power failure if the control panel is locked or if the system has a basic control panel either locked or unlocked. In addition to automatically rebootstrapping from the device on channel 0400_{16}, the system will also start executing the program.

Display Memory

Any memory location may be accessed and displayed on the control panel. However, memory can be displayed only when the processor is in a stop state. The memory address register (A0) is the only visible register that can be used to access memory locations from the control panel. Any visible data register may be used for reading/displaying memory data, but by convention the memory data register (B0) is usually used for this purpose to preserve program integrity and will be so used in the procedure.

The following procedure describes a method for displaying the contents of one memory location and, as an option, displaying the contents of subsequent memory locations.

1. Press Read.
   Initially places the processor in a stop state, if the processor is not as yet in this state (the STOP/STEP indicator lights if not already lit). Then the processor is placed in read mode and instructed that the contents of the memory location addressed by the memory address register (A0) are to be displayed. The READ indicator lights when the Read control key is pressed.
2. Press Select.
   Places the processor in select mode as a necessary preliminary to selecting the memory address register.

   NOTE: This step is not necessary unless the CHANGE indicator is lit.

3. Press hexadecimal-pad keys A,0 to enter the 2-digit selection code for the memory address register.
   Digits A0 appear in the LOCATION field of the REGISTER display.
4. Press Change.
   Places the processor in change mode preparatory to keying in the address of the memory location to be displayed.

The CHANGE indicator lights when the Change control key is pressed.
5. Key in, via the hexadecimal-pad keys, the 4 or 5-digit hexadecimal value representing the address of the memory location to be read. (For 6/40 models, note that 5 digits must be used even in SAF mode, in which case the most significant digit must be set to zero.)
   This address appears in the CONTENTS field of the REGISTER display.
6. Press Select.
   Returns the processor to select mode as a necessary preliminary to selecting the memory data register. The CHANGE indicator turns off when the Select control key is pressed.
7. Press hexadecimal-pad key B to enter the first digit of the 2-digit selection code for the memory data register. The second digit need not be entered again at this point since the hexadecimal character 0 in position H2 is still actively engaged from step 3.
   Digits B0 appear in the LOCATION field of the REGISTER display.
8. Press Execute.
   The data contents of the selected memory location are loaded into the selected register (B0) and displayed in the CONTENTS field of the REGISTER display.
9. If successive memory locations are to be displayed using the current address of the memory address register as a base, press Plus 1.
   The PLUS indicator lights when the Plus 1 control key is pressed.
10. Press Execute.
    The memory address register is incremented by 1 before accessing memory and the memory data of the succeeding memory location appears in the CONTENTS field of the REGISTER display.
11. Repeat step 10 for each sequential memory location to be displayed.

Change Memory

Any memory location may be accessed and changed from the control panel. However, memory can be changed only when the processor is in a stop state. As mentioned previously, the memory address register (A0) is the only visible register than can be used to access memory locations from the control panel. Any visible data register may be used for writing/changing memory data, but by convention the memory data register (B0) is usually used for this purpose to preserve

program integrity and will be so used in this procedure.

The following procedure describes a method for changing the contents of one memory location and, as an option, changing the contents of subsequent memory locations.

1. Press Write.

   Initially places the processor in a stop state, if the processor is not already in this state. Then the processor is placed in write mode and instructed that the contents of the memory location addressed by the memory address register (A0) are to be changed. The WRITE indicator lights when the Write control key is pressed.

2. Press Select.

   Places the processor in select mode as a necessary preliminary to selecting the memory address register. This step is not necessary unless the CHANGE indicator is lit.

3. Press hexadecimal-pad keys A,0 to enter the 2-digit selection code for the memory address register. Digits A0 appear in the LOCATION field of the REGISTER display.

4. Press Change.

   Places the processor in change mode preparatory to keying in the address of the memory location to be changed. The CHANGE indicator lights when the Change control key is pressed.

5. Key in, via the hexadecimal-pad keys, the 4- or 5-digit hexadecimal value representing the address of the memory location to be changed.

   This address appears in the CONTENTS field of the REGISTER display.

6. Press Select.

   Returns the processor to select mode as a necessary preliminary to selecting the memory data register. The CHANGE indicator turns off when the Select control key is pressed.

7. Press hexadecimal-pad key B to enter the first digit of the 2-digit selection code for the memory data register. The second digit need not be entered again at this point since the hexadecimal character 0 in position H2 is still actively engaged from step 3.

   Digits B0 appear in the LOCATION field of the REGISTER display.

8. Press Change.

   Places the processor in change mode preparatory to keying in the data for the

memory location that is to be changed. The CHANGE indicator lights when the Change control key is pressed.

9. Key in, via the hexadecimal-pad keys, the 4- or 5-digit hexadecimal value representing the new data that is to be entered into the memory location to be changed.

   The data entered appears in the CONTENTS field of the REGISTER display.

10. Press Execute.

    When this action is initiated, the new data contents are loaded into the selected memory location.

11. If successive memory locations are to be changed using the current address of the memory address register as a base, press Plus 1.

    The PLUS indicator lights when the Plus 1 control key is pressed.

12. Repeat steps 9 and 10 for each sequential memory location to be changed.

    Note that while in the plus 1 mode (PLUS indicator lit), each pressing of the Execute key causes the memory address register to be incremented by 1 before the new data contents are loaded into the new incremented memory location.

Display Registers

The contents of any one of the 21 (6/30)/26 (6/40) visible registers may be displayed on the control panel. A register may be displayed when the processor is in any state.

The following procedure describes a method for displaying the contents of one register. The same procedure applies regardless of the processor state.

1. Press Select.

   Places the processor in select mode as a necessary preliminary to selecting the register to be displayed.

2. Key in, via the hexadecimal-pad keys, the 2-digit selection code (per Figure 2-2) for the desired register to be displayed.

   The selection code appears in the LOCATION field of the register display. When the desired selection code is keyed in, the data contents of the selected register is displayed in the CONTENTS field of the REGISTER display.

   NOTE: After a register in the run state is selected, its updated contents are displayed continuously (updated every 8 ms).

Change Registers

The contents of 18 of the 21 (6/30)/25 of the 26(6/40) visible registers may be changed from

the control panel (the M, I, S, and T registers can-not be modified from the control panel). A regis-ter may be changed only when the processor is in a stop state. The following procedure describes a method for changing the contents of one register.

1. Press Stop (or Read or Write) if the processor is in the run state.
   The STOP/STEP indicator lights when the Stop control key is pressed.
2. Press Select.
   Places the processor in the select mode as a necessary preliminary to selecting the register to be changed.
3. Key in, via the hexadecimal-pad keys, the 2-digit selection code (per Figure 2-2) for the desired register to be changed.
   The selection code appears in the LOCATION field of the REGISTER display. When the desired selection code is keyed in, the current data contents of the selected register are displayed in the CONTENTS field of the REGISTER display.
4. Press Change.
   Places the processor in change mode prepara-tory to keying in the data to the register that is to be changed. The CHANGE indicator lights when the Change control key is pressed.
5. Key in, via the hexadecimal-pad keys, the hexadecimal value representing the new data that is to be entered into the selected register.
   The data entered appears in the CONTENTS field of the REGISTER display and is shifted into the selected register.

Stop Program Execution

While a program is running, program execution can be stopped at any time by pressing Stop. The STOP/STEP indicator lights and the RUN, READY, and TRAFFIC indicators turn off. When this action is initiated, the processor completes the execution of the current instruction and enters the stop state. After this state is achieved, the following pertinent conditions exist.

1. The processor is automatically placed in a step mode; i.e., ready to execute one in-struction at a time.
2. The instruction register (D0) contains the instruction to be executed next.
3. The P register (E0) contains an address incremented by 1 from the location of the instruction to be executed next.

Note that when a program is running and a Halt instruction is encountered (RUN indicator remains lit, but TRAFFIC indicator turns off), the processor does *not* enter the stop state but rather enters idle condition. In this condition,

the Halt instruction is continuously re-executing and the processor is subject to external interrupts, etc. You must press the Stop control key in order to set the processor into a stop state.

Execute Single Instruction(s)

When running a program, you may wish to stop processing and step through the execution of one or more instructions. This procedure is accomplished from the control panel, as follows:

1. Press Stop.
   Refer to the previous procedure, "Stop Program Execution," for relevant informa-tion concerning processor/panel status after a stop state is attended.
2. Determine whether the processor has stopped at a point (address) from which you wish to begin executing single instructions. Display and view the contents of the P register (E0) using the procedure previously described for displaying registers.
   The P register (E0) contains an address incremented by 1 from the address of the instruction to be executed next. If this address is *one more* than the point at which you wish to start executing single instruc-tions, proceed to step 8. However, if a new starting point is desired, continue to the next step.
3. Press CLeaR.
   Sets the instruction register (D0), the P register (E0), privilege mode, and indicators, etc., to zero as a necessary preliminary to specifying a new starting address.

   NOTE: In an online environment, do not press CLeaR. Instead, select the instruction register (D0) and change its contents to 0000_{16} so as not to affect peripherals.

4. Press Select.
   Places the processor in select mode, as is required before the P register (E0) is selected.
5. Press hexadecimal-pad keys E,0 to enter the 2-digit selection code for the P register. Digits E0 appear in the LOCATION field of the REGISTER display.
6. Press Change.
   Places the processor in change mode prep-aratory to keying in the address of the instruction to be executed next. The CHANGE indicator lights when the Change control key is pressed.
7. Key in, via the hexadecimal-pad keys, the 4- or 5-digit hexadecimal value representing the address of the next instruction to be

executed.

This address is entered in the P register and appears in the CONTENTS field of the REGISTER display.

8. Press Execute.

An attempt is made first to execute the instruction contained in the instruction register (D0). If the instruction register contains an executable instruction, then this one instruction is executed. After it is executed, the next succeeding instruction is placed in the instruction register, the P register (E0) is incremented by 1, and the processor is returned to the step mode. If the instruction register (D0) contains the value zero, the one instruction addressed by the P register (E0) is fetched and executed. The contents of the P register are incremented by 1 and the instruction addressed by the P register is placed into the instruction register. Finally, the contents of the P register are incremented by 1 again (i.e., the address of the instruction residing in the instruction register, plus 1) and the processor is returned to the step mode.

9. Repeat step 8 for each successive instruction to be executed singly. At any time after executing a single instruction, you may return to the run state (see the next procedure on restarting programs).

Restart Program

A program may be restarted from the control panel at any time and at any point after it has been stopped during execution. However, when you are restarting a program, it is your responsibility to ensure that:

o No I/O was pending at the time the machine was halted.

o All registers are stored to the context the program requires.

The restart procedure is as follows:

1. Determine whether the current start address is the point at which you wish to restart the program. Display the contents of the P register (E0), using the procedure previously described for displaying registers. The P register contains an address incremented by 1 from the address of the instruction to be executed next. If this address is *one more* than the point at which you wish to restart the program, then proceed to step 7. However, if a new starting point is desired, continue to the next step.

2. Press CLeaR.

Sets the instruction register (D0) and the P register (E0) to the value zero as a necessary preliminary to specifying a new starting address.

NOTE: Privilege mode, indicators, etc., are all changed by CLeaR and must be re-instated by software.

3. Press Select.

Places the processor in select mode as is required before the P register (E0) is selected.

4. Press hexadecimal-pad keys E,0 to enter the 2-digit selection code for the P register. Digits E0 appear in the LOCATION field of the REGISTER display.

5. Press Change.

Places the processor in change mode preparatory to keying in the address of the instruction from which you wish to restart execution of the program. The CHANGE indicator lights when the Change control key is pressed.

6. Key in, via the hexadecimal-pad keys, the 4- or 5-digit hexadecimal value representing the restart address.

This address is entered into the P register and appears in the CONTENTS field of the REGISTER display.

7. Press Ready.

Places the processor in ready mode; i.e., instructs the processor that program execution is to begin when the Execute key is pressed. The READY indicator lights and the STOP indicator turns off when the Ready control key is pressed.

8. Press Execute.

The processor is placed in a run state and attempts to start executing the program beginning with the instruction contained in the instruction register (D0).

If the instruction register contains an executable instruction, program execution begins with the instruction specified by the instruction register. If the instruction register contains the value zero, program execution begins with the instruction addressed by the P register (E0).

The RUN and TRAFFIC indicators light when the Execute key is pressed. Program execution continues until a software Halt is encountered or the Stop, Read or Write key is pressed.

Master Clear

The master clear procedure is used to set or restore the processor to a standard initialized

state as a prelude to certain functions such as a bootstrap procedure. The following procedure indicates the master clearing operation:

1. Press Stop if the processor is not already in the stop state. Master clear is only operative when the processor is in the stop state. The STOP/STEP indicator lights when the Stop control key is pressed.

2. Press CLeaR.
   The specific functions that are activated by pressing CLeaR are listed in Table 2-1, under the description of the CLeaR control key.

BOARD CHECKING

Boards inside the central subsystem (boards that have microprogramming (firmware) capabilities) have built-in self-checking capabilities and LEDs (Light-Emitting Diodes) for problem indication. When the computer is powered up, the LEDs on the associated boards are illuminated, and after internal checking is finished, the lights are extinguished one after another. Any LED remaining lit indicates a malfunction on that board and the CHECK light on the operator's panel is lit to inform the operator. The operator thereby identifies the board which is malfunctioning. This allows the integrity of the configuration to be quickly checked, ensuring that all boards are inserted properly (filling every consecutive slot) and all terminators have been inserted.

Accessing and Checking Boards

The operator is required to check and identify malfunctioning boards inside the central subsystem. The accessing and checking procedures for both the freestanding (tabletop) and rack-mounted versions of the central subsystem are described below:

Freestanding (Tabletop) Central Subsystem

1. With the power ON, push the right and left cover release levers. (The release levers are located on the left and right side of the base chassis, 6 inches from the front.)

2. Lift the white cover upwards as far as possible. (The cover opens far enough to allow easy access to the boards for viewing and if necessary, removal.)

3. Check the boards in the cabinet for the one with the illuminated LED. (The LED is located in the right front section of the board and is easily viewed by the operator.)

4. Gently apply pressure to the front of the lighted board to ensure that it is positioned and seated properly.

5. Take the applicable action to correct any malfunctioning board (e.g., replace, notify Honeywell FED, etc.).

6. Once the light is extinguished, push the white cabinet cover down to its original position, ensuring that it is locked in place.

Rack-Mounted Central Subsystem

1. With the power ON, grasp the white face plate covering the operator's panel and remove. (The face plate is kept in place by a series of pressure fittings which are easily disengaged.)

2. Once the front of the operator's panel is exposed (black rectangle with the buttons and indicators), the next operation is to unlatch and swing away the operator's panel for access to the boards.

3. To remove the operator's panel:

   a. Unlock the operator's panel. (Turn the set screw, on the extreme lower right section of the operator's panel chassis, counter-clockwise.

   b. Swing the hinged operator's panel to the left. (Once it is opened the operator has easy access to the boards for viewing and if necessary removal.

4. Check the boards in the cabinet for the one with the illuminated LED. (The LED is located in the right front section of the board and is easily viewed by the operator.)

5. Gently apply pressure to the front of the lighted board to ensure that it is positioned and seated properly.

6. Take the applicable action to correct any malfunctioning boards (.e.g., replace, notify Honeywell FED, etc.).

7. Once the light is extinguished, swing the operator's panel closed (to the right) and turn the locking set screw clockwise.

8. Reposition the white face plate cover over the operator's panel and apply pressure to ensure proper positioning.

PHYSICAL CHARACTERISTICS

A variety of cabinet options is available for the central subsystem. All offer easy access and require only front-to-rear airflow for cooling:

o Drawer unit – 5.25 inches (13.33 cm) high for standard EIA rack mounting.

o Cabinet unit – 60 inch (152.4 cm) high for central subsystem, diskette, and other drawers.

o Tabletop configuration — completely enclosed, completely portable, 5.5 inches (13.97 cm) high, 19.5 inches (49.53 cm) wide, 29.7 inches (75.43 cm) deep.

o Office packaging, custom-shaped desk — 29.5 inches (74.9 cm) high; 49 inches (124 cm) wide; 33 inches (83.3 cm) deep; integrated keyboard (optional); concealed control panel; 29.5 inches (74.9 cm) high standard EIA rack space.

SECTION 3

CRU9101/9102/9103/9104 CARD READERS

The CRU9101/9102/9103/9104 Card Readers (Figure 3-1) are compact, self-contained, tabletop units providing economy and versatility of operation. The CRU9101/9102 and the CRU9103/9104 read 80-column Hollerith or binary punched cards at the rate of 300 and 500 cards per minute (cpm), respectively. In addition, the CRU9102/9104 can read 40- or 80-column mark sense cards. In the mark sense mode, cards marked in either the same or alternate row position as punched card rows can be easily and quickly read. With Option CRF9101, any of the card readers can have the capability of reading 51-column punched cards.

The card readers interface to the Level 6 Megabus by means of a single-board Multiple Device Controller (MDC9101)[1] and a Card Reader
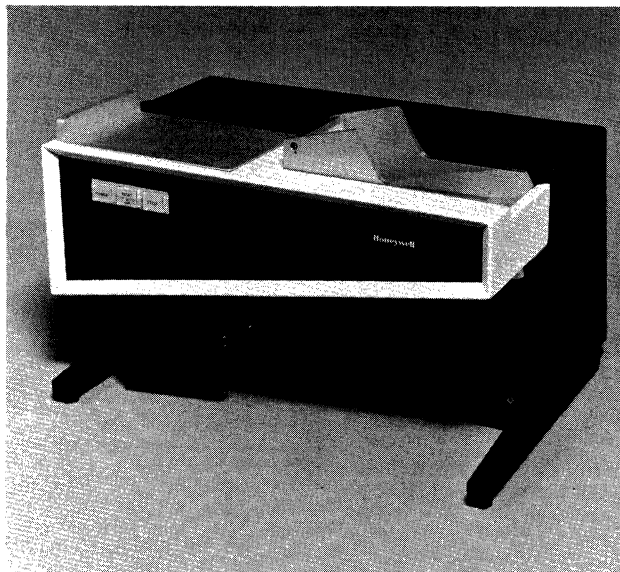
Figure 3-1. CRU9101/9103 Card Readers

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[1]Alternatively, the Magnetic Tape Controller (MTC9101), which supports up to four tape units or a combination of tape units and unit record devices (serial/line printers and card readers), can be used. A maximum of two tape units and two unit record devices can be configured.

Device-Pac (CRM9101). Each card reader includes a 50-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus.

Table 3-1 lists the specifications for the various card readers.

TABLE 3-1. CRU9101/9102/9103/9104 SPECIFICATIONS

Types:
CRU9101 — 300 cpm, 80-column punched cards
CRU9102 — 300 cpm, 80-column punched cards, 40- and 80-column mark sense cards
CRU9103 — 500 cpm, 80-column punched cards
CRU9104 — 500 cpm, 80-column punched cards, 40- and 80-column mark sense cards
Input Hopper Capacity: 500 cards
Output Stacker Capacity: 500 cards
Device Interface: Each card reader requires its own Device-Pac (CRM9101)
Data Transfer Mode: Automatic translation via device-pac of Hollerith or binary to ASCII
Reading Technique: Photoelectric, column-by-column serially
Card Specification: Standard punched or mark sense cards, 7.4 in. x 3.5 in. (18.6 cm x 8.9 cm), 0.0077 in. (0.0020 cm) thick; clean and free from excessive curl
Physical Dimensions:
Height -- 13.5 in. (34.2 cm)
Width -- 19.5 in. (49.5 cm)
Depth -- 15 in. (38.1 cm)
Weight -- 35 lb (15.8 kg)
Power: 120 Vac +10%, −15%
Power Consumption: 0.21 kVA
Heat Dissipation: 610 Btu/hr (154 kcal/hr)
Frequency: 60 Hz ±½ Hz
Environment:
Temperature -- 50°F to 100°F (10°C to 38°C)
Relative Humidity -- 30% to 70%
Cables (maximum):
ac -- 6 ft (1.8 m)
dc -- 50 ft (15.2 m)

FUNCTIONAL DESCRIPTION

As shown in Figure 3-2, cards are moved from the input hopper by the picker roller, which is a friction roller in close contact with the bottom card of the stack. This roller is rotated (by motor) on command by a magnetically operated clutch. This rotation feeds a card through the throat, which is gauged to permit only one card at a time to pass through. The picker roller continues to

drive the card until its leading edge is sensed, at which time the card is already captured by the first drive roller and the accompanying set of pinch rollers. An inertial damper on the picker roller shaft prevents over-travel of the picker roller after the captured card loses contact with it.

When the card enters the transport system, matched drive rollers maintain positive control during the entire reading operation. The read station, consisting of LED and an array of photo-sensors, is located between these two drive rollers. Timing is taken from the first drive roller by means of the strobe wheel, and is therefore in unison with the card being driven. The second drive roller also functions as a positive drive to deposit the card into the output hopper. The cards are ramped downward into the output hopper over a variable angle that is a function of the number of cards in the output hopper. A hinged follower in the output hopper guides the buildup of cards in the hopper and ensures positive stacking action. The input and output hoppers can both hold 500 cards.
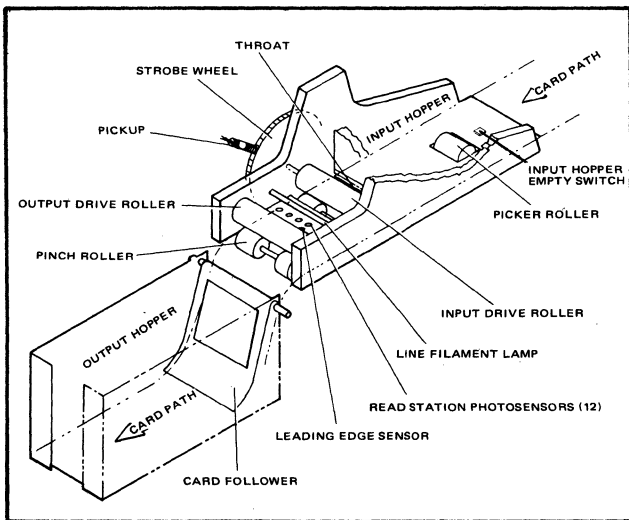
Figure 3-2. Card Reader Mechanical Assembly (Card Path)

CARD DATA FORMATS

Cards may be read in either of two formats: binary or ASCII. A card column has 12 rows for punched data, which if read in binary mode is 12 bits. These bits are placed directly into memory, right-justified as shown in Figure 3-3. One memory word is required for each card column read.
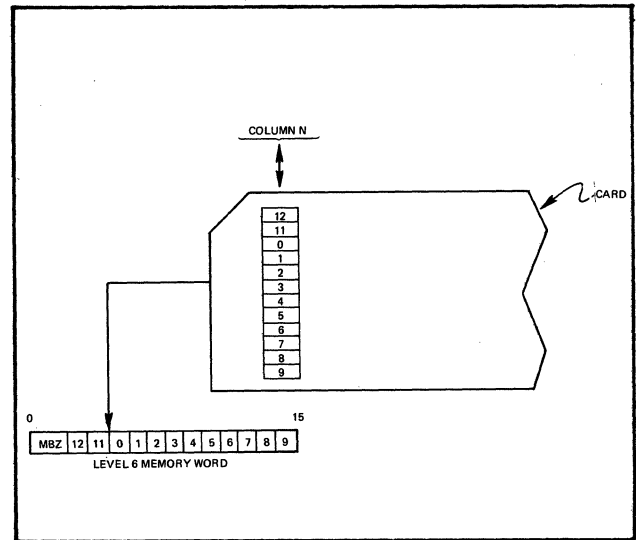
Figure 3-3. Binary Mode Format

In ASCII mode, the 12 bits designated by each card column are converted to a single 8-bit byte and transferred to the system memory — 2 bytes per word (see Figure 3-4). The conversion from Hollerith to ASCII is performed by the card reader adapter. Table 3-2 shows a comparison of the Hollerith and ASCII codes (bit designations are in ASCII and relate to the bits on the data bus as shown in Table 3-3).
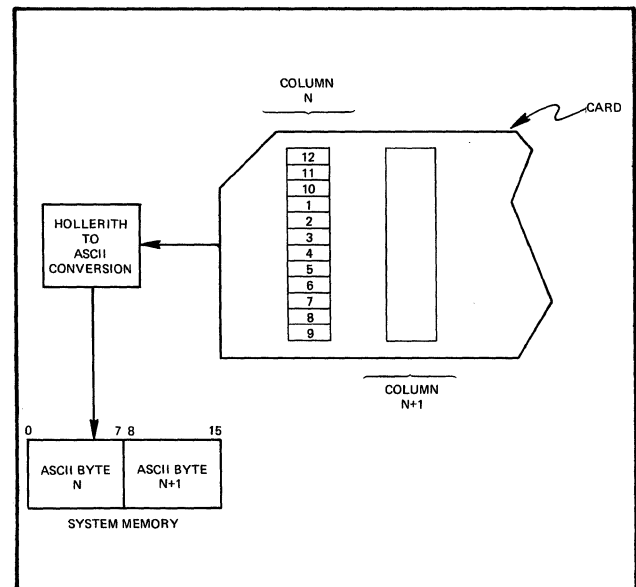
Figure 3-4. ASCII Mode Format

TABLE 3-2. HOLLERITH-ASCII CODE TABLE

b4b3b2b1 / Row		b8=0 b7=0 b6=0 b5=0 / Col 0	0 0 0 1 / 1	0 0 1 0 / 2	0 0 1 1 / 3	0 1 0 0 / 4	0 1 0 1 / 5	0 1 1 0 / 6	0 1 1 1 / 7	1 0 0 0 / 8	1 0 0 1 / 9	1 0 1 0 / 10	1 0 1 1 / 11	1 1 0 0 / 12	1 1 0 1 / 13	1 1 1 0 / 14	1 1 1 1 / 15	Col / Row
0000	0	NUL 12-0-9-8-1	DLE 12-11-9-8-1	SP No Pch 0	0 0	@ 8-4	P 11-7	\ 8-1	p 12-11-7	11-0-9 8-1	12-11-0-9-8-1	12-0-9-1	12-11-9-8	12-11-0-9-6	12-11-8-7	12-11-0-8	12-11-9-8-4	0
0001	1	SOH 12-9-1	DC1 11-9-1	! ① 12-8-7	1 1	A 12-1	Q 11-8	a 12-0-1	q 12-11-8	0-9-1	9-1	12-0-9-2	11-8-1	12-11-0-9-7	11-0-8-1	12-11-0-9	12-11-9-8-5	1
0010	2	STX 12-9-2	DC2 11-9-2	" 8-7	2 2	B 12-2	R 11-9	b 12-0-2	r 12-11-9	0-9-2	11-9-8-2	12-0-9-3	11-0-9-2	12-11-0-9-8	11-0-8-2	12-11-0-8-2	12-11-9-8-6	2
0011	3	ETX 12-9-3	DC3 11-9-3	# 8-3	3 3	C 12-3	S 0-2	c 12-0-3	s 11-0-2	0-9-3	9-3	12-0-9-4	11-0-9-3	12-0-8-1	11-0-8-3	12-11-0-8-3	12-11-9-8-7	3
0100	4	EOT 9-7	DC4 9-8-4	$ 11-8-3	4 4	D 12-4	T 0-3	d 12-0-4	t 11-0-3	0-9-4	9-4	12-0-9-5	11-0-9-4	12-0-8-2	11-0-8-4	12-11-0-8-4	11-0-9-8-2	4
0101	5	ENQ 0-9-8-5	NAK 9-8-5	% 0-8-4	5 5	E 12-5	U 0-4	e 12-0-5	u 11-0-4	11-9-5	9-5	12-0-9-6	11-0-9-5	12-0-8-3	11-0-8-5	12-11-0-8-5	11-0-9-8-3	5
0110	6	ACK 0-9-8-6	SYN 9-2	& 12	6 6	F 12-6	V 0-5	f 12-0-6	v 11-0-5	12-9-6	9-6	12-0-9-7	11-0-9-6	12-0-8-4	11-0-8-6	12-11-0-8-6	11-0-9-8-4	6
0111	7	BEL 0-9-8-7	ETB 0-9-6	' 8-5	7 7	G 12-7	W 0-6	g 12-0-7	w 11-0-6	11-9-7	12-9-8	12-0-9-8	11-0-9-7	12-0-8-5	11-0-8-7	12-11-0-8-7	11-0-9-8-5	7
1000	8	BS 11-9-6	CAN 11-9-8	(12-8-5	8 8	H 12-8	X 0-7	h 12-0-8	x 11-0-7	0-9-8	9-8	12-8-1	11-0-9-8	12-0-8-6	12-11-0-8-1	12-0-9-8-2	11-0-9-8-6	8
1001	9	HT 12-9-5	EM 11-9-8-1	) 11-8-5	9 9	I 12-9	Y 0-8	i 12-0-9	y 11-0-8	0-9-8-1	9-8-1	12-11-9-1	0-8-1	12-0-8-7	12-11-0-1	12-0-9-8-3	11-0-9-8-7	9
1010	10	IF 0-9-5	SUB 9-8-7	* 11-8-4	: 8-2	J 11-1	Z 0-9	j 12-11-1	z 11-0-9	0-9-8-2	9-8-2	12-11-9-2	12-11-0	12-11-8-1	12-11-0-2	12-0-9-8-4	12-11-0-9-8-2	10
1011	11	VT 12-9-8-3	ESC 0-9-7	+ 12-8-6	; 11-8-6	K 11-2	[12-8-2	k 12-11-2	{ 12-0	0-9-8-3	9-8-3	12-11-9-3	12-11-0-9-1	12-11-8-2	12-11-0-3	12-0-9-8-5	12-11-0-9-8-3	11
1100	12	FF 12-9-8-4	FS 11-9-8-4	, 0-8-3	< 12-8-4	L 11-3	\ 0-8-2	l 12-11-3	| 12-11	0-9-8-4	12-9-4	12-11-9-4	12-11-0-9-2	12-11-8-3	12-11-0-4	12-0-9-8-6	12-11-0-9-8-4	12
1101	13	CR 12-9-8-5	GS 11-9-8-5	- 11	= 8-6	M 11-4	] 11-8-2	m 12-11-4	} 11-0	12-9-8-1	11-9-4	12-11-9-5	12-11-0-9-3	12-11-8-4	12-11-0-5	12-0-9-8-7	12-11-0-9-8-5	13
1110	14	SO 12-9-8-6	RS 11-9-8-6	. 12-8-3	> 0-8-6	N 11-5	∧ ② 11-8-7	n 12-11-5	~ 11-0-1	12-9-8-2	9-8-6	12-11-9-6	12-11-0-9-4	12-11-8-5	12-11-0-6	12-11-9-8-2	12-11-0-9-8-6	14
1111	15	SI 12-9-8-7	US 11-9-8-7	/ 0-1	? 0-8-7	O 11-6	_ 0-8-5	o 12-11-6	DEL 12-9-7	11-9-8-3	11-0-9-1	12-11-9-7	12-11-0-9-5	12-11-8-6	12-11-0-7	12-11-9-8-3	EO 12-11-0-9-8-7	15

① may be "|"
② may be "¬"
③ The top line in each entry to the table represents an assigned character (columns 0 to 7). The bottom line in each entry is the corresponding card hole-pattern.
④ All bit designations are in ASCII.

TABLE 3-3. ASCII BIT RELATION TO BITS ON DATA BUS

ASCII Bit	Bus	
	Left Byte	Right Byte
8	0	8
7	1	9
6	2	10
5	3	11
4	4	12
3	5	13
2	6	14
1	7	15

CARD READER COMMANDS

Card reader operation is implemented by two sets of instructions: input and output commands (see Table 3-4). A discussion of these commands is found in the *Series 60 (Level 6) Minicomputer Handbook,* Order No. AS22.

STATUS BITS

One status word is defined for the card reader. Table 3-5 defines the status bits and the means by which each bit is reset. The MDC reacts to card reader errors as follows:

TABLE 3-4. CARD READER COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	09	Output Address and Range
	11	Output Configuration
Input	02	Input Interrupt Control
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	0C	Input Range
	10	Input Configuration
	18	Input Status
	26	Input Device ID (2008)

o Errors occurring during data transfer are indicated by a status report at the end of the card.

o Errors occurring on I/O commands from the central processor set the appropriate status bit and interrupt the processor immediately (that is if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action.

TABLE 3-5. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	Device is online; medium loaded; no further manual intervention is required to place it under program control. Note that a change of state of this bit will cause the Attention bit (bit 1) to be set resulting in an interrupt (if the interrupt level is nonzero).	A change in condition
Attention	1	Set whenever the Device Ready bit (bit 0 of the status word) changes state. Indicates to software any change of operational status of the device. When set, an interrupt is attempted (if the interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) serves as notification of both the end of the operation and the device state change.	Input status word 1[a]
Data Service Rate Error	2	Set during a Read/Write operation when the data transfer to/from main memory cannot be maintained at a high enough rate. Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device.	Next IOLD command[a]
Mark Sense Mode	3	The Mark Sense/STD switch on the card reader is in the mark sense mode.	A change in switch position
40-Column Mode	4	The 40/80 Column switch on the card reader is in the 40-Col. position.	A change in switch position
51-Column Mode	5	The 51/80 column switch on the card reader is in the 51-Col. position.	A change in switch position
External Clock Track	6	The Clock Track/Internal Clock switch on the card reader is in the Clock Track position.	A change in switch position
Read Check Error	7	The card reader failed to meet a light-dark check indicating possible device failure.	Next IOLD command[a]
ASCII Code Error	8	A pattern from card did not translate to ASCII (in ASCII mode only). Data in error forced to "ones."	Next IOLD command[a]
Corrected Memory Error	12	During execution of previous operation, main memory detected and corrected a memory read error. Data delivered to the MDC was assumed correct.	
Nonexistent Resource	13	Set whenever the MDC attempts a Write/Read request bus cycle and receives a NAK response. Indicates a possible programming error or illegal IOLD (direction bit 1).	Next IOLD command or input status word 1[a]
Bus Parity	14	Set whenever the MDC detects a parity error on either byte of the data bus during any output bus cycle (i.e., odd function code). during a second half memory read cycle, or when a parity error is detected in bits 0—7 of the address bus during an Output Address command.	Input status word 1[a]
Uncorrectable Memory Error	15	During execution of previous operation, main memory detected a read error which it could not correct. Data delivered to the MDC was incorrect. Will not cause termination of the operation in progress.	

[a]Initialize (Output Control Word) and Master Clear on the Bus also reset these status bits.

CONTROLS AND INDICATORS

Card reader controls and indicators are located on the front panel of the device as shown in Figure 3-5 and 3-6.

| POWER | RESET / LT CHK | STOP | 51 COL. |
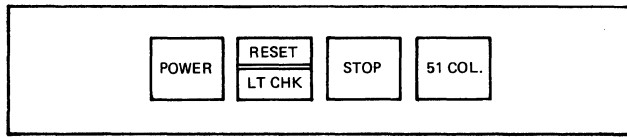
Figure 3-5. CRU9101/9103 Control Panel

| POWER | RESET / RD CHK | STOP | MARKS / STD | 40 COL / 80 COL | CLK TRK / INT CLK | 51 COL |
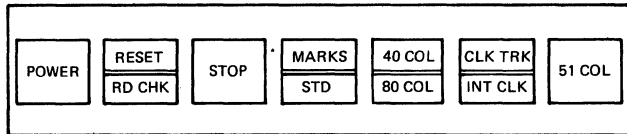
Figure 3-6. CRU9102/9104 Control Panel

POWER

Pressing this button applies or removes power. The indicator lights (white) when power is applied.

NOTE: Results are unspecified if pressed while the device is operating.

RESET/LT CHK

Pressing extinguishes RESET (yellow) after clearing one of the following conditions:

o Power-up completed
o Input hopper empty
o Output hopper full
o Mispick
o Card jam

LT CHK lights (white) to indicate that an LED or read sensor has failed. Notify FED.

NOTES: 1. A bulb check is performed whenever this button is pressed.

2. Applicable to CRU9101/9103 only.

RESET/RD CHK

RESET function same as above. If RD CHK lights (white) to indicate a read check failure, pressing RESET clears the condition.

NOTE: Applicable to CRU9102/9104 only.

STOP

Pressing this button stops the card reader (does not light).

MARKS/STD

Pressing selects reflective (mark) or transmissive (punch) mode of operation. The selected mode lights (white).

NOTE: Applicable to CRU9102/9104 only.

40 COL/80 COL

Pressing selects either the 40- or 80-column internal timing formats. The selected mode lights (white).

NOTE: Applicable to CRU9102/9104 only.

51 COL

Pressing selects 51-column hole reading format lights (white). Mixing of 80- and 51-column cards is not recommended, as the results are unspecified.

NOTE: Requires Option CRF9101.

CLK TRK/INT CLK

Pressing makes reader generate timing from a clock track printed on the cards, on internal timing in either of the two standard selectable formats. The selected mode lights (white).

NOTE: Applicable to CRU9102/9104 only.

OPERATION

Operating procedures for the card reader are described in the paragraphs that follow. For mark sense operation, see "Mark Sense Operation," and "Card Marking".

Standard Power-Up Procedures

Prior to powering-up the card reader, be sure that all electrical cables have been properly connected and secured, and that there are no cards in the hoppers.

1. Press the POWER button on the card reader panel. The POWER indicator will light indicating that power is available to the device. The RESET indicator will also light indicating, in this case, that the input hopper is empty.

2. Remove the card follower (weight) from the input hopper and load the input hopper with cards in accordance with the card loading procedures described in "Card Loading."

3. Select the desired column hole reading format by pressing the appropriate button on the card reader panel. The lighted half of the indicator displays the selected con-

dition. Mixing of 80- or 51-column cards is not recommended.

4. Press the RESET/LT CHK button. The RESET indicator will go out, indicating that the check condition (empty input hopper) has been removed and the card transport motor automatically starts. The card reader is online and ready to read cards.

Standard Power-Down Procedures

To power-down the card reader:

1. When the input hopper runs out of cards, the card transport motor automatically comes to a stop; the RESET indicator lights, indicating that the card reader is now in a standby (offline) state.

2. Remove cards from the output hopper, and if no more cards are to be run, first press STOP and then the POWER button on the card reader panel. The card reader is now completely powered-down.

Mark Sense Operation

Standard power-up/power-down procedures also apply to card readers having the added capability of reading mark sense cards. Mark sense operation is the same as normal operation except mark sense cards are used and the following controls must be set accordingly.

1. Press the MARKS/STD button on the card reader panel to MARKS (STD for standard operation). The lighted half of the indicator displays the selected condition.

2. Select the desired internal timing format by pressing the 40 COL/80 COL button on the card reader panel. The lighted half of the indicator displays the selected condition.

Data may be punched or marked, or may consist of both punches and marks, intermixed. To read both punches and marks on the same cards, mark sense cards should be used and all data must be entered in the same format (i.e., all 80-column format or all 40-column format cards are read in the MARKS mode).

Card Marking

Mark sense cards may be marked with any medium that is sufficiently nonreflective. The marks should be clear and legible. A standard number 2 lead pencil gives reflectance readings of about 3 percent and is ideal for marking the cards because of its general availability and the ease with which mistakes in marking can be cor-

rected. When marking the cards, it is not necessary to scrub back and forth over a mark to make it appear big and black. In fact, such a technique is likely to cause problems rather than prevent them. It is the clarity and positioning of the mark that is more important than the apparent intensity of the mark to the eye.

If a mark is placed outside of a marking area, it should be erased and placed in the proper area instead of being widened until it extends into the proper area.

Cards must be kept reasonably clean. If the desired marks are allowed to become smudgy, erroneous data may result.

Card Loading

Prior to input hopper loading, cards should be checked visually for appearance and condition. They must be in good condition (i.e., free of nicks and buckles). The use of abused cards can cause card jams. The proper handling and storage of cards will reduce this problem (see "Care And Handling Of Cards").

The input hopper is capable of holding up to 500 cards (approximately 3 inches). It is recommended when loading the input hopper to full capacity that the deck of cards be divided into two separate stacks of one and one-half inches each. This enables the operator to handle the cards more efficiently, thereby reducing the chances of a card jam during card reader operation.

1. When selecting a stack of cards for loading, fan or riffle the cards, looking for nicked, worn, or abused cards. Remove and replace defective cards in the stack. Now take the stack of cards and on a firm, flat surface such as a table or the top of the card reader, joggle them. Make sure that the edges on all the cards are even before they are loaded into the input hopper.

2. Remove the card follower from the input hopper and place, *not drop,* the cards into the hopper. Cards are placed with the 9-edge down and column 1 away from you.

3. Replace the card follower. The device is capable of reading a variety of cards but *only* one hole reading format at a time; mixing of 80-and 51-column cards is not recommended. In devices utilizing the mark sense option, data may be punched or marked or may consist of both punches and marks on the same card in one selected hole reading format.

4. Operate the device according to "Standard Power-Up Procedures."

Card Unloading

When the input hopper runs out of cards, the card transport motor automatically comes to a stop. Remove the cards from the output hopper and if no more cards are to be run, power-down the device.

Card Loading And Unloading On-The-Fly

Loading and unloading on-the-fly is permissable and should offer no problems provided that the following procedure is observed.

1. Lift the card follower when loading on-the-fly, as the level of the cards in the input hopper must not be allowed to get below 100 cards to ensure reliable picking. A convenient gauge for this is to keep the card stack in the input hopper at least 3/4 inch thick.
2. Use two hands to unload the output hopper. The procedure that works best is to hold up the cards coming into the output hopper with the index finger of the left hand while removing the stack of cards from beneath this index finger with the right hand. When removing cards from the output hopper in this manner, it is recommended that the stack of cards taken out at a time not be thicker than about 2 inches for ease of removal.

Card Mispicks

If the card reader has difficulty picking a card when reading a deck of cards, it will attempt to repick up to two additional times. If unsuccessful, the card reader will stop picking, the card transport motor will stop, and the RESET indicator will light. The bottom card of the stack in the input hopper will be the defective card. If not too damaged, the card edge may be flattened out enough to run by drawing the damaged edge of the card between the thumb and forefinger of one hand. After replacing the damaged card on the bottom of the remainder of the deck, and jogging the cards again, replace the deck in the input hopper with the card follower on top. Pressing the RESET button will restart the motor, reset the logic, and allow the device to complete the reading of the deck.

Card Jams

A card jam occurs whenever a card has not moved through the read station and into the output stacker. This condition may be caused by a damaged and defective card or a malfunction in the card reader. Most card jams occur because a card is mispicked and does not advance completely from the input hopper and into the read station and the output stacker.

Use the following procedure to remove card jams:

1. Power-down the card reader according to "Standard Power-Down Procedures."
2. Remove the front cover from the card reader as shown in Figure 3-7 to expose the mechanical assembly and card path.
3. Remove the damaged card by gently pulling it forward and through the read station (see Figure 3-8).
4. Should there be some difficulty in removing the card, it is suggested that the operator manually feed the card through the read station in the direction of the output hopper while turning, with the left hand, either pulley shown in Figure 3-8 to advance the card into the output hopper.

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning, done periodically on a scheduled routine, even though card reader operation may be satisfactory and seemingly not in need of attention. Preventive maintenance will keep the card reader and its components in the best operating condition at all times, reducing the chance of downtime and the need for further maintenance.

Care And Handling Of Cards

The proper storage and handling of cards will increase the life expectancy of the cards and eliminate the possibility of card jams. The following common sense rules are the prerequisites for proper card handling and storage.

o Prior to input hopper loading, cards should be checked visually for appearance and condition. The proper handling of cards during loading and unloading is important; see "Card Loading and Card Unloading."

o To avoid a card jam or possible mutilation of a card, observe the procedures described in "Card Loading and Unloading On-The-Fly" and "Card Mispicks."

o Avoid smears and smudges when marking mark sense cards.

o It's best not to smoke in the computer room or near the device, but if you must, be extremely careful. Smoke and ashes are dirt; hot ashes are destructive to cards. Food and drink should be prohibited.

o To prevent warping and buckling, cards should be stored flat and in a relatively dry area.

o The recommended storage environment is 50°F to 100°F (10°C to 37.8°C) with a relative humidity of 30% to 70%. Abrupt changes in relative humidity must be avoided to prevent card warping.

o To reduce the problem of nicked cards, never bundle them during storage. Cards should be neatly stacked and stored in a dust-free container, preferably a card filing drawer. Avoid the use of elastic bands.

Cleaning And Checking The Card Reader

The following procedures should be scheduled by the operator and performed daily and monthly, or more often as usage dictates.

Daily Maintenance

The card contacting surfaces of the input hopper, including the opening under the throat gauge (see Figure 3-7) should be cleaned once a day by the operator. To perform this function:

1. Power-down the card reader according to "Standard Power-Down Procedures."
2. Remove the front cover from the card reader (see Figure 3-7).
3. With a dry lint-free cloth, remove dust or
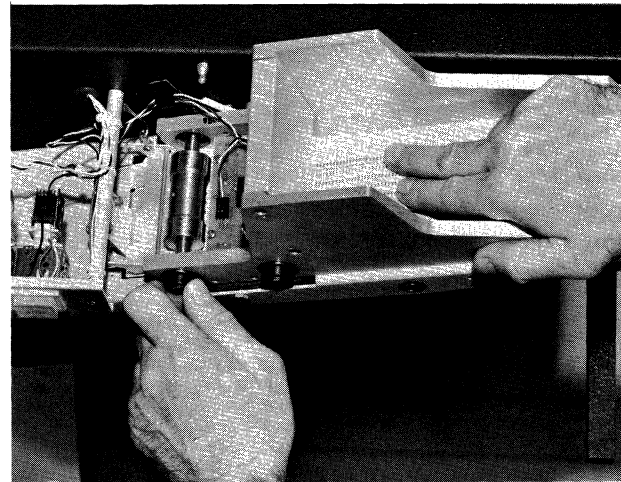
Figure 3-8. Clearing a Card Jam

card stock material that may have accumulated in the input hopper or in the opening under the throat gauge.

4. Observe the condition of the platen (knife edge) in the throat gauge for dirt build-up. If dirty, wipe the platen edge to remove the accumulated dirt.
5. Replace the card reader cover and power-up the device according to "Standard Power-Up Procedures."

Monthly Maintenance

A periodic cleaning of the picker roller and read station (see Figures 3-7 and 3-8) should be made by the operator on a monthly basis, or more often as usage dictates. To perform this function:

1. Power-down the device according to "Standard Power-Down Procedures."
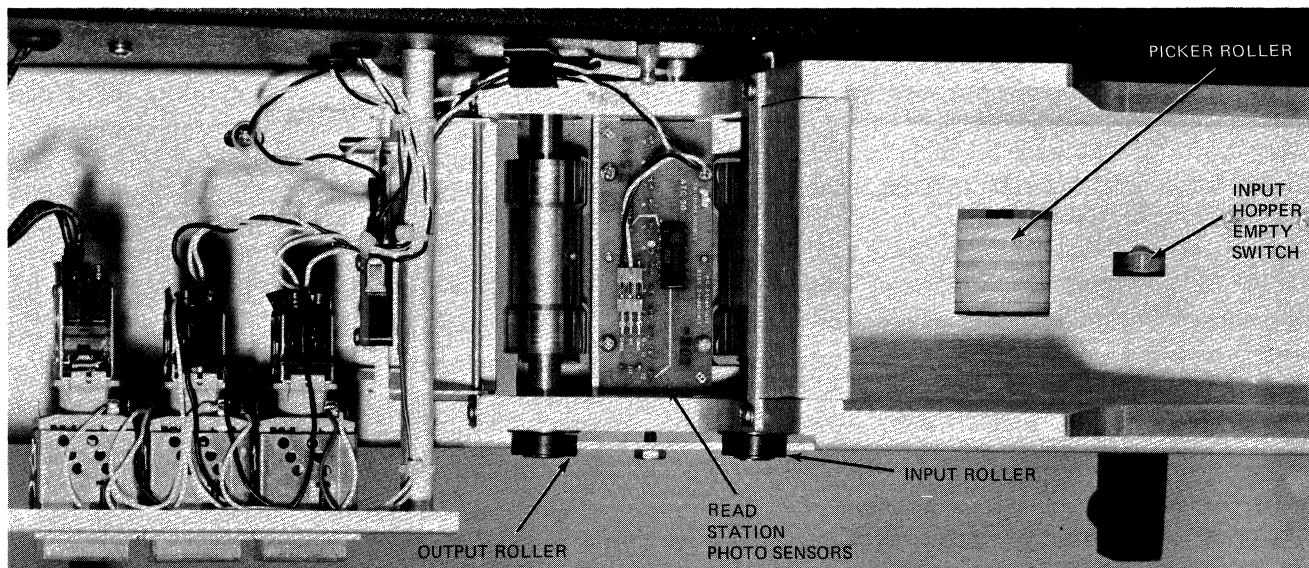
Figure 3-7. Card Reader with Housing Removed

2. Remove the front cover from the card reader (see Figure 3-7).

3. Moisten a clean lint-free cloth with alcohol. Place the moistened cloth over a finger and hold the finger against the top surface of the picker roller as exposed in the input hopper. With the other hand, reach under the input hopper and manually rotate the picker roller while holding the moistened cloth against the top of the roller. Continue rotating the picker roller until all dirt is removed.

4. Inspect for lint build-up around the read station. Excessive lint should be removed by gently blowing and/or vacuum cleaning the area.

5. Replace the device cover and power-up according to "Standard Power-Up Procedures."

SECTION 4

CRU9108/9109/9110/9111 9112/9113 CARD READERS

The CRU9108/9109/9110 and CRU9111/ 9112/9113 Card Readers are compact, self-contained units (Figure 4-1). The CRU9108/ 9109/9110 process 80-column (Hollerith) punched cards at the rate of 300 cards per minute (cpm). The CRU9111/9112/9113 process 80-column punched cards at the rate of 500 cpm. A mark sensing capability, which allows reading of marks or punches during a single pass, is incorporated in the following readers: the CRU9110/9113 read mark sense cards in the Honeywell mode;[1] the CRU9109/9112 read mark sense cards in the IBM mode.[2]

The card readers interface to the Level 6 Megabus by means of a single-board Multiple Device
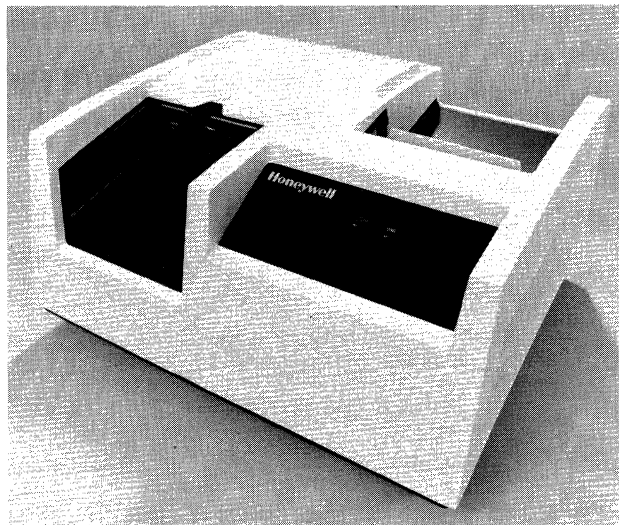
Figure 4-1. CRU9108/9109/9111/9112 Card Readers

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[1]In Honeywell mode, marks are arranged on 12 rows in even-numbered columns. The preprinting of marks must be on the rear face of the card.

[2]In IBM mode, marks are arranged on 12 rows in even- or odd-numbered columns. The preprinting of marks must be on the front face of the card.

[3]Alternatively, the Magnetic Tape Controller (MTC9101), which supports up to four tape units or a combination of tape units and unit record devices (serial/line printers and card readers), can be used. A maximum of two tape units and two unit record devices can be configured.

Controller (MDC9101)[3] and a Card Reader Device-Pac (CRM9101). Each card reader includes a 50-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus.

Table 4-1 lists the specifications of the various card readers.

TABLE 4-1. CRU9108/9109/9110/9111/9112/9113 SPECIFICATIONS

Types:
CRU9108 – 300 cpm
CRU9109 – 300 cpm with mark sense (IBM mode)
CRU9110 – 300 cpm with mark sense (Honewell mode)
CRU9111 – 500 cpm
CRU9112 – 500 cpm with mark sense (IBM mode)
CRU9113 – 500 cpm with mark sense (Honeywell mode)
Input Hopper Capacity: 1000 cards
Output Stacker Capacity: 1000 cards
Device Interface: Each card reader requires its own device-pac (CRM9101)
Data Transfer Mode: Automatic translation via device-pac of Hollerith to binary or ASCII
Reading Technique: Photoelectric, column-by-column, serially
Card Specification: Standard punched or mark sense cards, 7-3/8 in. x 3-1/2 in. (18.6 cm x 8.9 cm), 0.0077 in. (0.01956 cm) thick; clean and free from excessive curl
Physical Dimensions:
Height – 11.75 in. (29.8 cm)
Width – 23.25 in. (59.1 cm)
Depth – 20 in. (50.8 cm)
Weight – 90 lb (40.8 kg)
Power: 120 Vac +10%, –15%
Power Consumption: 0.20 kVA
Heat Dissipation: 800 Btu/hr (202 kcal/hr)
Frequency: 60 Hz ±½ Hz
ENVIRONMENT:
Temperature – 68°F to 78°F (20°C to 26°C)
Relative Humidity – 40% to 60% (no condensation)
Cables:
ac -- 6 ft (1.8 m)
dc -- 50 ft (15.2 m)

FUNCTIONAL DESCRIPTION

Card reading is initiated by the software after the device is readied by the operator. Cards are read column by column, from left to right. Each column is read twice (double strobing) and the results are compared to ensure accurate input.

Cards must be loaded in the input hopper with row 9 down and the printed face of the card

toward the operator for normal processing (except for mark sensing in Honeywell mode). The output stacker can be unloaded while the device is operating as long as approximately 300 cards remain in the stacker.

The design of the card readers has been optimized for functional simplicity. The number of individual parts in the mechanism has been kept to a minimum for long life and low maintenance (downtime). Only nine moving parts are associated with the device, which significantly reduces the possibility of error.

Card passage from the input hopper to the output stacker is relatively short, thereby reducing card wear and minimizing the possibility of card jams.

Cards are maintained under constant pressure in the input hopper and the output stacker by tension springs. Feeding operations are controlled by precision rollers driven by a stepping motor. This feeding feature permits practically noiseless operation.

The input hopper and the output stacker have a maximum capacity of 1000 cards each. This large card capacity frees the operator from constant device monitoring.

The card transport mechanism shown in Figure 4-2 performs the following functions:

o. Card feeding from the input hopper
o Card transportation through the read station
o Card stacking

The cards contained in the input hopper are pulled by a constant force spring. When activated, the stepping motor drives the feeding roller which pushes the next card to be read into the read station.

The read station is located between two rollers which allow precise card feeding during a read operation.

The stacker rollers ensure positive card stacking. The stacker pusher uses the same guidance principle as the hopper pusher.

The transport rollers are driven by a high-inertia asynchronous motor by means of mini-pitch belt.

CARD DATA FORMATS

Cards may be read in either of two formats: binary or ASCII. A card column has 12 rows for punched data, which if read in binary mode is 12 bits. These bits are placed directly into memory, right-justified as shown in Figure 4-3. One memory word is required for each card column read.

In ASCII mode, the 12 bits designated by each card column are converted to a single 8-bit byte and transferred to the system memory – 2 bytes per word (see Figure 4-4). The conversion from Hollerith to ASCII is performed by the card reader adapter. Table 4-2 shows a comparison of the Hollerith and ASCII codes (bit designations are in ASCII and relate to the bits on the data bus as shown in Table 4-3).
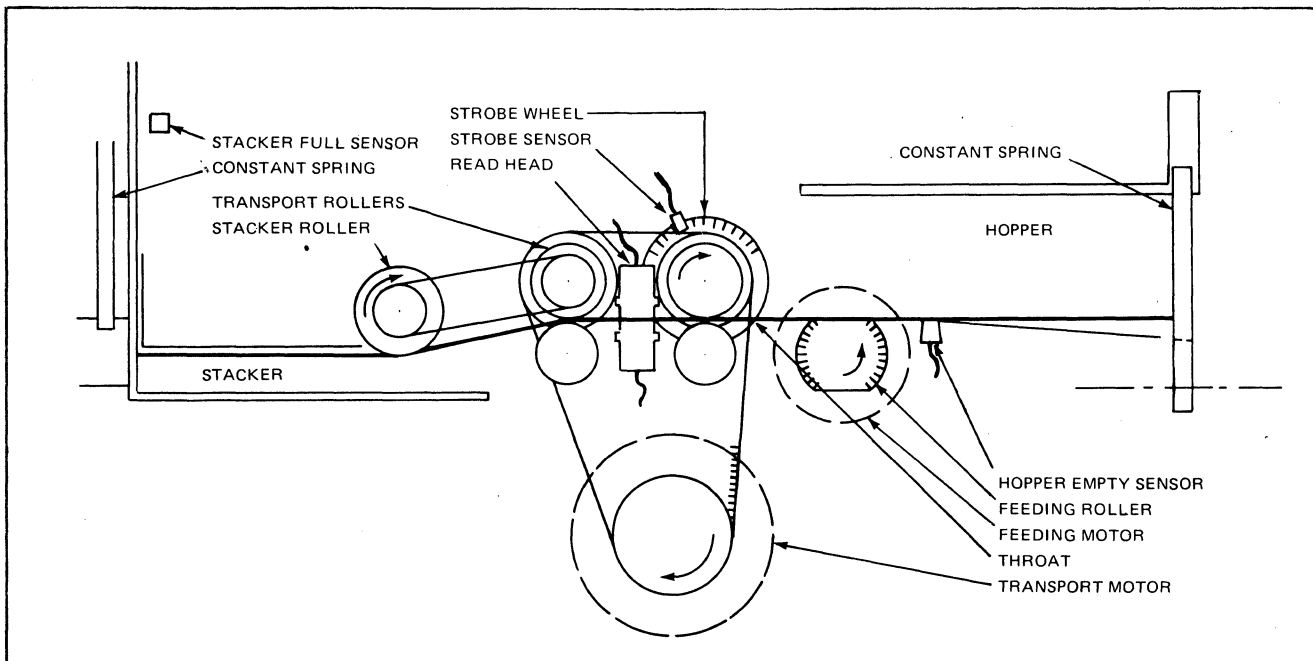
Figure 4-2. Card Reader Mechanism
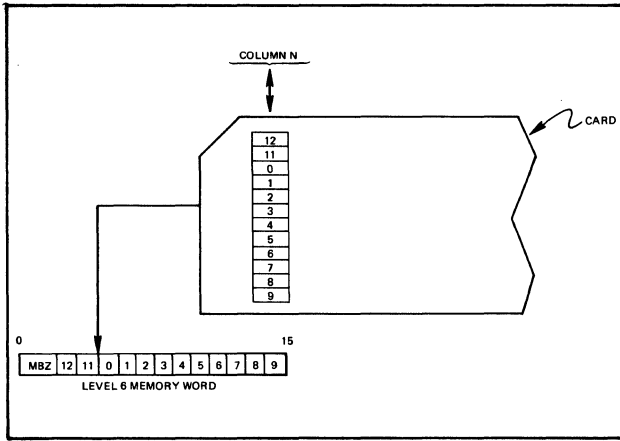
Figure 4-3. Binary Mode Format
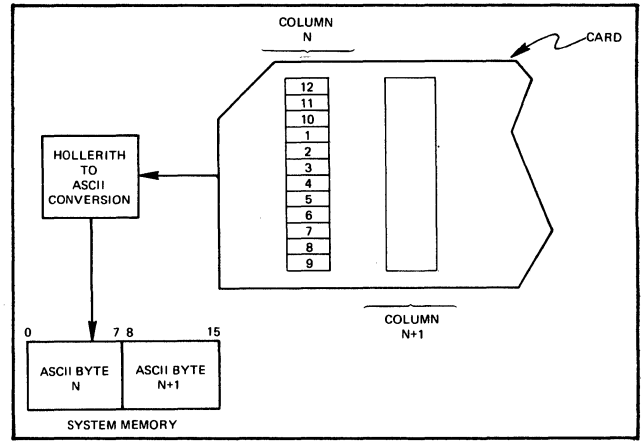
Figure 4-4. ASCII Mode Format

TABLE 4-2. HOLLERITH – ASCII CODE TABLE

b4b3b2b1 \ Row	Col \ Row	b8 0 b7 0 b6 0 b5 0 — 0	0 0 0 1 — 1	0 0 1 0 — 2	0 0 1 1 — 3	0 1 0 0 — 4	0 1 0 1 — 5	0 1 1 0 — 6	0 1 1 1 — 7	1 0 0 0 — 8	1 0 0 1 — 9	1 0 1 0 — 10	1 0 1 1 — 11	1 1 0 0 — 12	1 1 0 1 — 13	1 1 1 0 — 14	1 1 1 1 — 15	Col \ Row
0000	0	NUL 12-0-9-8-1	DLE 12-11-9-8-1	SP No Pch	0 0	@ 8-4	P 11-7	\ 8-1	p 12-11-7	11-0-9 8-1	12-11-0-9-8-1	12-0-9-1	12-11-9-8	12-11-0-9-6	12-11-8-7	12-11-0-8	12-11-9-8-4	0
0001	1	SOH 12-9-1	DC1 11-9-1	! ① 12-8-7	1 1	A 12-1	Q 11-8	a 12-0-1	q 12-11-8	0-9-1	9-1	12-0-9-2	11-8-1	12-11-0-9-7	11-0-8-1	12-11-0-9	12-11-9-8-5	1
0010	2	STX 12-9-2	DC2 11-9-2	" 8-7	2 2	B 12-2	R 11-9	b 12-0-2	r 12-11-9	0-9-2	11-9-8-2	12-0-9-3	11-0-9-2	12-11-0-9-8	11-0-8-2	12-11-0-8-2	12-11-9-8-6	2
0011	3	ETX 12-9-3	DC3 11-9-3	# 8-3	3 3	C 12-3	S 0-2	c 12-0-3	s 11-0-2	0-9-3	9-3	12-0-9-4	11-0-9-3	12-0-8-1	11-0-8-3	12-11-0-8-3	12-11-9-8-7	3
0100	4	EOT 9-7	DC4 9-8-4	$ 11-8-3	4 4	D 12-4	T 0-3	d 12-0-4	t 11-0-3	0-9-4	9-4	12-0-9-5	11-0-9-4	12-0-8-2	11-0-8-4	12-11-0-8-4	11-0-9-8-2	4
0101	5	ENQ 0-9-8-5	NAK 9-8-5	% 0-8-4	5 5	E 12-5	U 0-4	e 12-0-5	u 11-0-4	11-9-5	9-5	12-0-9-6	11-0-9-5	12-0-8-3	11-0-8-5	12-11-0-8-5	11-0-9-8-3	5
0110	6	ACK 0-9-8-6	SYN 9-2	& 12	6 6	F 12-6	V 0-5	f 12-0-6	v 11-0-5	12-9-6	9-6	12-0-9-7	11-0-9-6	12-0-8-4	11-0-8-6	12-11-0-8-6	11-0-9-8-4	6
0111	7	BEL 0-9-8-7	ETB 0-9-6	' 8-5	7 7	G 12-7	W 0-6	g 12-0-7	w 11-0-6	11-9-7	12-9-8	12-0-9-8	11-0-9-7	12-0-8-5	11-0-8-7	12-11-0-8-7	11-0-9-8-5	7
1000	8	BS 11-9-6	CAN 11-9-8	(12-8-5	8 8	H 12-8	X 0-7	h 12-0-8	x 11-0-7	0-9-8	9-8	12-8-1	11-0-9-8	12-0-8-6	12-11-0-8-1	12-0-9-8-2	11-0-9-8-6	8
1001	9	HT 12-9-5	EM 11-9-8-1	) 11-8-5	9 9	I 12-9	Y 0-8	i 12-0-9	y 11-0-8	0-9-8-1	9-8-1	12-11-9-1	0-8-1	12-0-8-7	12-11-0-1	12-0-9-8-3	11-0-9-8-7	9
1010	10	IF 0-9-5	SUB 9-8-7	* 11-8-4	: 8-2	J 11-1	Z 0-9	j 12-11-1	z 11-0-9	0-9-8-2	9-8-2	12-11 9-2	12-11-0	12-11-8-1	12-11-0-2	12-0-9-8-4	12-11-0-9-8-2	10
1011	11	VT 12-9-8-3	ESC 0-9-7	+ 12-8-6	; 11-8-6	K 11-2	[12-8-2	k 12-11-2	{ 12-0	0-9-8-3	9-8-3	12-11-9-3	12-11-0-9-1	12-11-8-2	12-11-0-3	12-0-9-8-5	12-11-0-9-8-3	11
1100	12	FF 12-9-8-4	FS 11-9-8-4	, 0-8-3	< 12-8-4	L 11-3	\ 0-8-2	l 12-11-3	¦ 12-11	0-9-8-4	12-9-4	12-11-9-4	12-11-0-9-2	12-11-8-3	12-11-0-4	12-0-9-8-6	12-11-0-9-8-4	12
1101	13	CR 12-9-8-5	GS 11-9-8-5	- 11	= 8-6	M 11-4	] 11-8-2	m 12-11-4	} 11-0	12-9-8-1	11-9-4	12-11-9-5	12-11-0-9-3	12-11-8-4	12-11-0-5	12-0-9-8-7	12-11-0-9-8-5	13
1110	14	SO 12-9-8-6	RS 11-9-8-6	. 12-8-3	> 0-8-6	N 11-5	∧ ② 11-8-7	n 12-11-5	~ 11-0-1	12-9-8-2	9-8-6	12-11-9-6	12-11-0-9-4	12-11-8-5	12-11-0-6	12-11-9-8-2	12-11-0-9-8-6	14
1111	15	SI 12-9-8-7	US 11-9-8-7	/ 0-1	? 0-8-7	O 11-6	— 0-8-5	o 12-11-6	DEL 12-9-7	11-9-8-3	11-0-9-1	12-11-9-7	12-11-0-9-5	12-11-8-6	12-11-0-7	12-11-9-8-3	EO 12-11-0-9-8-7	15

① may be "|"
② may be "⌐"
③ The top line in each entry to the table represents an assigned character (columns 0 to 7). The bottom line in each entry is the corresponding card hole-pattern.
④ All bit designations are in ASCII.

TABLE 4-3. ASCII BIT RELATION TO BITS ON DATA BUS

ASCII Bit	Bus	
	Left Byte	Right Byte
8	0	8
7	1	9
6	2	10
5	3	11
4	4	12
3	5	13
2	6	14
1	7	15

CARD READER COMMANDS

Card reader operation is implemented by two sets of instructions: input and output commands (see Table 4-4). A description of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, Order No. AS22.

STATUS BITS

One status word is defined for the card reader. Table 4-5 defines the status bits and the means by which each bit is reset. The MDC reacts to card reader errors as follows:

TABLE 4-4. CARD READER COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	09	Output Address and Range
	11	Output Configuration
Input	02	Input Interrupt Control
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	0C	Input Range
	10	Input Configuration
	18	Input Status
	26	Input Device ID (2008)

o Errors occurring during data transfer are indicated by a status report at the end of the card.

o Errors occurring on I/O commands from the central processor set the appropriate status bit and interrupt the processor immediately (that is if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action.

CONTROLS AND INDICATORS

Card reader controls and indicators are located on the front panel of the device (with the excep-

TABLE 4-5. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	Device is online; medium loaded; no further manual intervention is required to place it under program control. Note that a change of state of this bit will cause the Attention bit (bit 1) to be set resulting in an interrupt (if the interrupt level is nonzero).	A change in condition
Attention	1	Set whenever the Device Ready bit (bit 0 of the status word) changes state. Indicates to software any change of operational status of the device. When set, an interrupt is attempted (if the interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) serves as notification of both the end of the operation and the device state change.	Input status word 1[a]
Data Service Rate Error	2	Set during a Read/Write operation when the data transfer to/from main memory cannot be maintained at a high enough rate. Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device.	Next IOLD command[a]
Mark Sense Mode	3	The Standard/Mark Mode switch on the Card Reader is in the Mark Sense mode.	A change in switch position
40-Column Mode	4	The 40/80 Column switch on the Card Reader is in the 40-Col. position.	A change in switch position
Read Check Error	7	The Card Reader failed to meet a light-dark check indicating possible device failure.	Next IOLD command[a]
ASCII Code Error	8	A pattern from card did not translate to ASCII (in ASCII mode only). Data in error forced to all Ones.	Next IOLD command[a]
Corrected Memory Error	12	During execution of previous operation, Main Memory detected and corrected a memory read error. Data delivered to the MDC was assumed correct.	
Nonexistent Resource	13	Set whenever the MDC attempts a Write/Read request bus cycle and receives a NAK response. Indicates a possible programming error or illegal IOLD (direction bit 1).	Next IOLD command or input status word 1[a]

TABLE 4-5 (CONT). STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Bus Parity	14	Set whenever the MDC detects a parity error on either byte of the data bus during any Output bus cycle (i.e., odd function code), during a second half memory read cycle, or when a parity error is detected in bits 0–7 of the address bus during an Output Address command.	Input status word 1[a]
Uncorrectable Memory Error	15	During execution of previous operation, Main Memory detected a read error which it could not correct. Data delivered to the MDC was incorrect. Will not cause termination of the operation in progress.	

[a]Initialize (Output Control Word) and Master Clear on the Bus also reset these status bits.

tion of the main power switch) as shown in Figure 4-5.

POWER ON/OFF

The main power switch, located on the rear of the device, applies and removes power to and from the device. If the operator positions the switch OFF when the device READY indicator is lit, data could be lost. Any attempt to open the cabinet by raising the cover results in the device being automatically switched off.

START

Pressing the START push button causes the READY indicator to light. The device remains in standby state (READY indicator off) if the hopper is empty or the stacker is full.

Pressing the START button also resets any outstanding error conditions.

STOP

Pressing the STOP push button stops the device. Pressing STOP transfers the device from ready state to standby state.

STANDARD/MARK MODE

Pressing selects the reading mode on card readers with the Mark Sense Option.

o Mark Mode — Marks and/or holes
o Standard — Holes only

40 Col./80 Col.

Pressing selects 40-column reading mode for card readers with the Mark Sense Option. When in 40-col. mode, the 80-COL. indicator is unlit.

80 COL.

The 80 COL. indicator is lit when in the 80-column card reading mode and unlit for card readers with the Mark Sense Option when the 40 col./80 col. button is pressed to select the 40 col. mode.
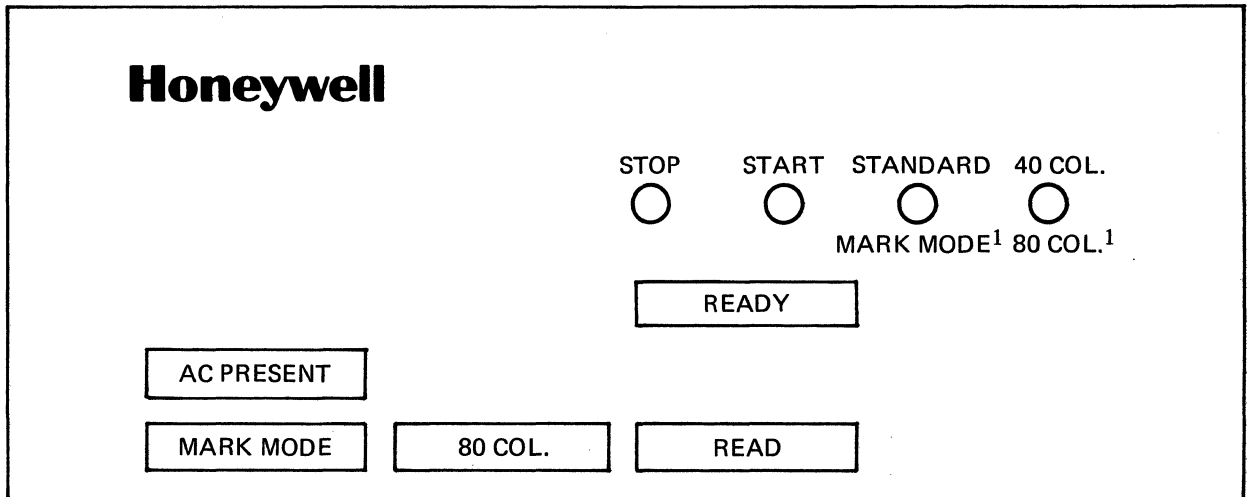
[1]Not applicable to CRU9108/9111 readers.

Figure 4-5. CRU9108/9109/9110/9111/9112/9113 Control Panel

AC PRESENT

The AC PRESENT indicator lights if ac power is present. It remains lit as long as the main power switch is in the ON position.

READY

The READY indicator is lit when the device is in ready state. Ready state will be reflected to the system by means of an attention message.

The READY indicator is not lit when the device is in standby state.

READ

The READ indicator lights if at least one of the following conditions occurs:

o Read Compare Error
o Card Speed Shift
o Clock Transport Error
o All Dark Check

MARK MODE

The MARK MODE indicator, applicable only on devices with the Mark Sense Option, is lit when the MARK MODE is selected.

OPERATION

Operating procedures for the card readers are described below.

Applying Power

Power-up is the transition from an unpowered state to a fully operational state. To apply power,

1. Set the main power switch to the ON position.

Removing Power

1. Press the STOP push button.
2. Set the main power switch to the OFF position.

Normal Operation

Once the power has been applied and the AC PRESENT light is lit, the device is ready for normal operation. Simply press the START button (the READY light is lit) and card reading occurs.

Mark Sense Operation

Standard power-up/power-down procedures also apply to card readers having the added capability of reading mark sense cards. Mark sense operation is the same as normal operation except

that mark sense cards are used and the following controls must be set accordingly.

1. Press the STANDARD/MARKS MODE button on the card reader panel for MARKS MODE operation. The MARK MODE indicator displays the selected condition.
2. Press the 40 Col./80 Col. button on the card reader panel. The 80 COL. indicator should extinguish.

Data may be punched or marked, or may consist of both punches and marks, intermixed. To read both punches and marks on the same cards, mark sense cards should be used and all data must be entered in the same format (i.e., all 80-column format or all 40-column format cards are read in the MARKS mode).

Card Marking

Mark sense cards may be marked with any medium that is sufficiently nonreflective. The marks should be clear and legible. A standard number 2 lead pencil gives reflectance readings of about 3 percent and is ideal for marking the cards because of its general availability and the ease with which mistakes in marking can be corrected. When marking the cards, it is not necessary to scrub back and forth over a mark to make it appear big and black. In fact, such a technique is likely to cause problems rather than prevent them. It is the clarity and positioning of the mark that is more important than the apparent intensity of the mark to the eye.

If a mark is placed outside of a marking area, it should be erased and placed in the proper area instead of being widened until it extends into the proper area.

Cards must be kept reasonably clean. If the desired marks are allowed to become smudgy or smeared, erroneous data may result.

Card Loading

The input hopper can hold up to 1000 cards. Cards must be loaded in the hopper with row 9 down and the printed face toward the operator. The hopper can be loaded during operation if there are still at least 300 cards in it (about 2 inches).

When loading the input hopper to full capacity, divide the deck of cards into stacks of 1½ inches. You can handle the cards more efficiently, reducing the chances of a card jam during card reader operation.

1. When selecting a stack of cards for loading, fan or riffle the cards looking for nicked,

worn, or abused cards. Remove defective cards from the stack, duplicate them, and return them to their same position. Now take the stack of cards and on a firm, flat surface such as a table or the top of the card reader, joggle them. Make sure that the edges on all the cards are even before they are loaded into the input hopper.

2. Place, do not drop, the stacked cards into the input hopper and do not, under any condition, overload the hopper with cards.

Card Unloading

The stacker can be unloaded during normal operation if a minimum of 300 cards (2 inches) remain in the stacker. Unload the output stacker each time the input hopper is filled.

Error Conditions

Error conditions set the device in standby state.

o A Read incident extinguishes READY and lights READ.

o A throat jam or misfeed extinguishes READY. Clear the throat jam or misfeed and restart.

o Stacker Full and Hopper Empty conditions extinguish READY. The device cannot be put in ready state by pressing START as long as Stacker Full and/or Hopper Empty condition(s) have not been cleared.

Stop Conditions

STOP conditions are:

o Pressing of STOP push button
o Stacker full
o Hopper empty
o Throat jam error
o Read compare error
o Clock alert
o Card speed shift .
o All dark error

Card Jams

A card jam occurs whenever a card has not moved through the read station and into the output stacker. This condition may be caused by a damaged and defective card or a malfunction in the card reader. Most card jams occur because a card is mispicked and does not advance completely from the input hopper and into the read station and the output stacker.

Use the following procedure to remove card jams:

1. Press the STOP push button.
2. Remove main power.
3. Remove any cards from the input hopper and stacker.
4. Raise the top access cover to gain access to the read station.

   NOTE: Raise the cover by positioning the left and right hands on the left and right sides of the cover near the front and raise the cover upwards and to the rear (see Figure 4-6).
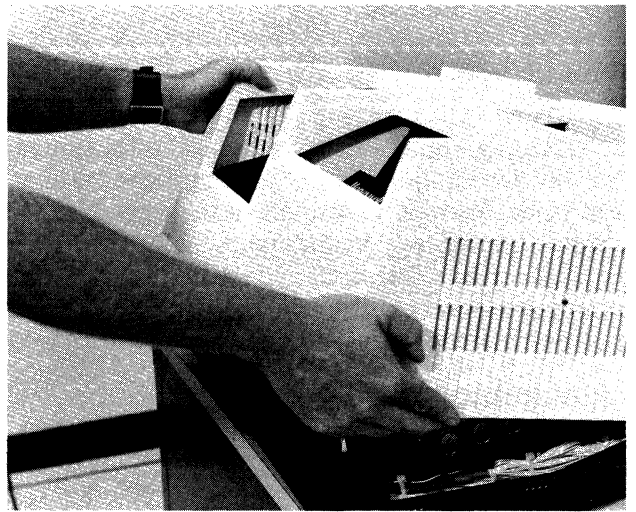
Figure 4-6.   Raising the Access Cover

5. Remove the parts of the card(s) that are accessible from the hopper and stacker.
6. Position one hand on the right-hand read wheel and manually advance the card through the reader (see Figure 4-7). The operator must ensure that all particles of the jammed cards have been removed before closing the cover. A subsequent card should be manually fed through the device to ensure that the path is clear.

To restart the card reader following a successful removal of a card jam, the operator should:

1. Close the access cover.
2. Reapply power.
3. Load cards into input hopper.
4. Press the START push button.
5. Ensure that the device is in READY state.
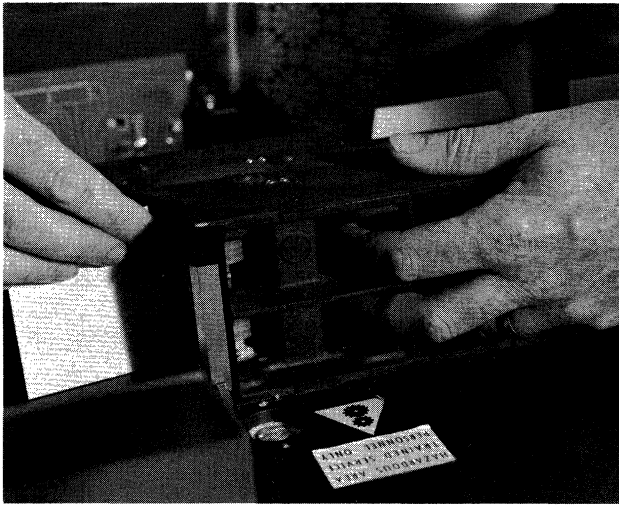
Figure 4-7. Manually Advancing A Card Through the Reader

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning, done periodically on a scheduled routine, even though card reader operation may be satisfactory and seemingly not in need of attention. Preventive maintenance will keep the card reader and its components in the best operating condition at all times, reducing the chance of downtime and the need for further maintenance.

Care And Handling Of Cards

The proper storage and handling of cards will increase the life expectancy of the cards and eliminate the possibility of card jams. The follow-common sense rules are the prerequisites for proper card handling and storage:

o Prior to input hopper loading, cards should be checked visually for appearance and condition. The proper handling of cards during loading and unloading is important; see "Card Loading and Card Unloading."

o Avoid smears and smudges when marking mark sense cards.

o It's best not to smoke in the computer room or near the device, but if you must,

be extremely careful. Smoke and ashes are dirt; hot ashes are destructive to cards. Food and drink should be prohibited.

o To prevent warping and buckling, cards should be stored flat and in a relatively dry area.

o The recommended storage environment is 50°F to 100°F (10°C to 37.8°C) with a relative humidity of 30% to 70%. Abrupt changes in relative humidity must be avoided to prevent card warping.

o To reduce the problem of nicked cards, never bundle them during storage. Cards should be neatly stacked and stored in a dust-free container, preferably a card filing drawer. Avoid the use of elastic bands.

Cleaning and Checking the Card Reader

The following procedure should be scheduled and performed at least once a week or more often depending upon degree of use:

1. Remove power from the card reader ensuring that primary power is removed.
2. Open the cabinet cover.

   NOTE: Raise the cover by positioning the left and right hands on the left and right sides of the cover near the front and raise the cover upwards and to the rear (see Figure 4-6).

3. Visually inspect the inside of the cabinet for any evidence of physical damage. Parts that overheat during operation with the resulting danger of failure or breakdown can often be detected by the smell of overheated insulation or paint.
4. With a vacuum hose or a low pressure air hose, remove accumulated dust from the inside of the cabinet and from around each device component — the input hopper and output stacker.
5. Close the cabinet cover; reapply power.

SECTION 5

TTU9101/9102/9103/9104 TELEPRINTER CONSOLES

Figure 5-1. TTU9101/9103 Teleprinter Consoles

Four teleprinter console devices, Types TTU9101/9103 (ASR-33) and TTU9102/9104 (KSR-33) (Figure 5-1), are available for Level 6 system console and I/O use. The TTU9101/9102 differ, respectively, from the TTU9103/9104 in that the latter are equipped with an autoshutdown feature that can extend console life and reduce maintenance costs. The teleprinter consoles print data from or transmit data to the central processor at the rate of 10 characters per second. The TTU9101/9103 can also read and punch paper tape at the same rate.

All functions of the teleprinters are initiated by the receipt of certain codes. Some of these, such as carriage return and line feed, have their own keys. Other codes may be generated by simultaneously pressing the CTRL (control) key and one of the alphabetic keys.

Horizontal spacing is 10 characters per inch. Vertical spacing is 6 lines per inch with single spacing, and the line length is up to 72 characters. A local carriage return (generating no code) occurs after all 72 characters in the line have been printed and an attempt is made to print another character.

The teleprinter consoles interface to the Level 6 Megabus by means of a single-board Multiple Device Controller (MDC9101) and a Console Device-Pac (KCM9101). Each teleprinter includes a 26-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus.

Table 5-1 lists the specifications on the various teleprinters. Table 5-2 lists the teleprinter character set.

AUTOSHUTDOWN

The TTU9103/9104 teleprinters are equipped with an automatic shutdown option which turns the device off in the absence of activity from the central processor for a 1 minute period (when operating with the control switch set to the LINE position).

The central processor activates the teleprinter whenever activity is awaiting transmittal. The
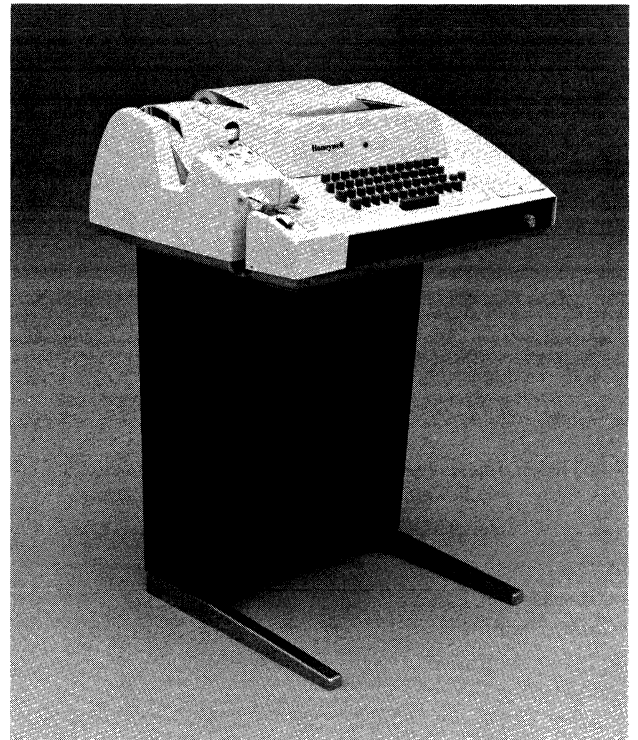
TABLE 5-1. TTU9101/9102/9103/9104 SPECIFICATIONS

Types:
TTU9101 (ASR-33)
TTU9102 (KSR-33)
TTU9103 (ASR-33) with autoshutdown
TTU9104 (KSR-33) with autoshutdown

Printer:
Feed — friction
Capacity — paper roll 8½ in. (21.6 cm) wide, 5 in. (12.7 cm) diameter
Speed — 10 characters per second
Density — horizontal — 10 characters per inch, 72 characters per line; vertical — 3 or 6 lines per inch.

Reader/Punch (TTU9101/9103):
Tape — 8-level, paper or mylar-paper combination, 1 in. (2.54 cm) wide
Capacity — 855-ft (260-m) tape roll
Speed — 10 characters per second (includes feed for punch)
Density — 10 characters per inch

Interfaces:
EIA — Asynchronous data transfer with one or two stop bits; 110 baud operation
Device — Each teleprinter console requires its own Console Device-Pac (KCM9101)

TABLE 5-1 (CONT). TTU9101/9102/9103/9104
SPECIFICATIONS

Field Upgradability:
Option TTK9101 enables TTU9101/9102 to be upgraded
   to TTU9103/9104

Physical Dimensions:
(including pedestal)
Height — 33 in. (83.82 cm)
Width — 22 in. (55.8 cm)
Depth — 18.5 in. (46.9 cm)
Weight — 87 lb. (39.15 kg)
Power: 120 Vac +10%, −15%
Power Consumption: 0.26 kVA (TTU9101/9103)
                   0.23 kVA (TTU9102/9104)
Heat Dissipation: 375 Btu/hr (TTU9101/9103)
                  325 Btu/hr (TTU9102/9104)
Frequency: 60 Hz ±½ Hz
Environment:
Temperature — 50°F to 100°F (10°C to 38°C)
Relative Humidity — 30% to 70% (no condensation)
Cables (maximum):
ac — 6 ft (1.8 m)
dc — 25 ft (7.6 m)

TABLE 5-2. TELEPRINTER CHARACTER SET

H2\H1	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	≠	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	−	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

All characters in these two rows + SP (space) and DEL (delete) are non-printing.

"Fold-over Printing" means that lower case characters received by model 33's are actually printed as their upper case equivalent. Codes shown in Columns 6 & 7 of the chart "fold-over" into Columns 4 & 5 respectively, (except for "DEL").

For ASCII to hexadecimal conversion: Each ASCII character = 2 hexadecimal digits (8 bits): H1 H2. For example: T = 54.

operator can also activate the device by pressing the BREAK key, which is located above the control switch on the front panel of the device.

The TTU9101/9102 can be field-upgraded to the TTU9103/9104, respectively, via the Auto-shutdown Add-on Kit, Option TTK9101. (The autoshutdown feature is not currently supported by software.)

DATA FORMAT

The range of the data buffer in memory is expressed in bytes and is even or odd. The starting address may be on any byte boundary. Data read or written by the MDC is packed 2 bytes per word. In the case of an odd byte (which may be at the start or end of block), only the designated byte may be transferred. The console is set (by software) to operate in either of two modes:

o 8-bit direct transcription
o 7-bit with even parity

In case 7-bit mode is selected, the MDC generates the parity on input transfers. Bit designations relative to the holes in the paper tape are shown in Figure 5-2.

Figure 5-2. Bit Designations on Paper Tape

TELEPRINTER COMMANDS

Teleprinter operation is implemented by two sets of instructions: input and output commands (see Table 5-3). Descriptions of these commands

are found in the *Series 60 (Level 6) Minicomputer Handbook*, Order No. AS22.

TABLE 5-3. TELEPRINTER COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	09	Output Address and Range
		NOTE: The low order bit of the channel no. of this command specifies the direction of data transfer.
	11	Output Configuration Word A
	13	Output Configuration Word B
	07	Output Task
Input	02	Input Interrupt Control
	0C	Input Range (Residual)
	10	Input Configuration Word A
	12	Input Configuration Word B
	18	Input Status Word
	26	Input Device ID TTU9101/9103–2018 TTU9102/9104–2019
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	06	Input Task Word
	1A	Input Attention Character

STATUS BITS

One status word is defined for the teleprinter. Table 5-4 defines the status bits and the means by which each bit is reset. The MDC reacts to teleprinter read or punch errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action.

CONTROLS

Teleprinter controls among the various types differ only by the presence (TTU9101/9103) or absence (TTU9102/9104) of the paper tape reader/punch. See Figure 5-3.
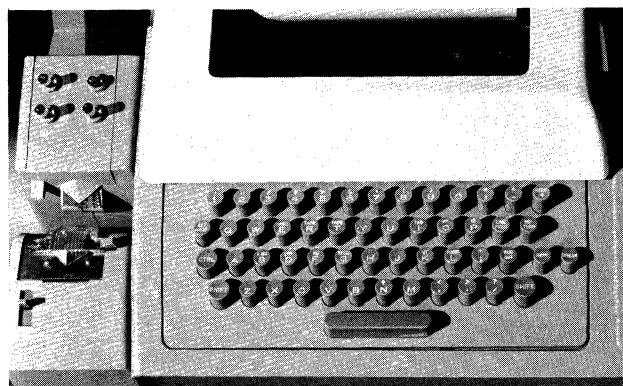
Figure 5-3. Teleprinter Controls

TABLE 5-4. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	In current loop connections, the console is connected by the presence of the output current when the Device-Pac is not busy (i.e., not sending data to the console). In EIA connections, Data Terminal Ready for direct connections or Carrier Detect for data set connection.	Change of condition
Attention	1	Operator pressed a key on the console for software attention.	Input status word command[b]
Data Service Rate Error[a]	2	The MDC/bus/CP have failed to meet the teleprinter speed and data has been lost.	Next IOLD command[b]
Data Parity Error (Even)[a]	3	Device-Pac detected a data parity error. Only applicable if the task word was set to specify 7-bit mode (Bit 10 = 0).	Next IOLD command[b]
No Stop Bit Error[a]	5	A character was received from the console without a stop bit.	Next IOLD command[b]
Termination by Control Character 2	8	Control Character 2 was detected in the input stream and caused a termination.	Next IOLD command[b]
Termination by Control Character 3	9	Control Character 3 was detected in the input stream and caused a termination.	Next IOLD command[b]

TABLE 5-4 (CONT). STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Corrected Memory Error	12	The data read from memory was accompanied by a signal indicating an error was corrected.	Next IOLD command[b]
Nonexistent Resource	13	Set whenever the MDC attempts a Write or Read request bus cycle and receives a NAK response.	Next IOLD command[b]
Bus Parity Error	14	Set whenever the MDC detects a parity error on either byte of the Data Bus during any Output bus cycle (i.e., odd function code), during a second-half memory read cycle or when a parity error is detected in bits 0—7 of the Address Bus during an Output Address command.	Input status word command[b]
Uncorrectable Memory Error	15	The data read from memory was accompanied by a signal indicating an error existed that the memory could not correct.	Next IOLD command[b]

[a]These bits relate to the state of the last character received on input and will remain set until the next character is received without these conditions.

[b]Initialize (Output Control Word) and Master Clear also reset these status bits.
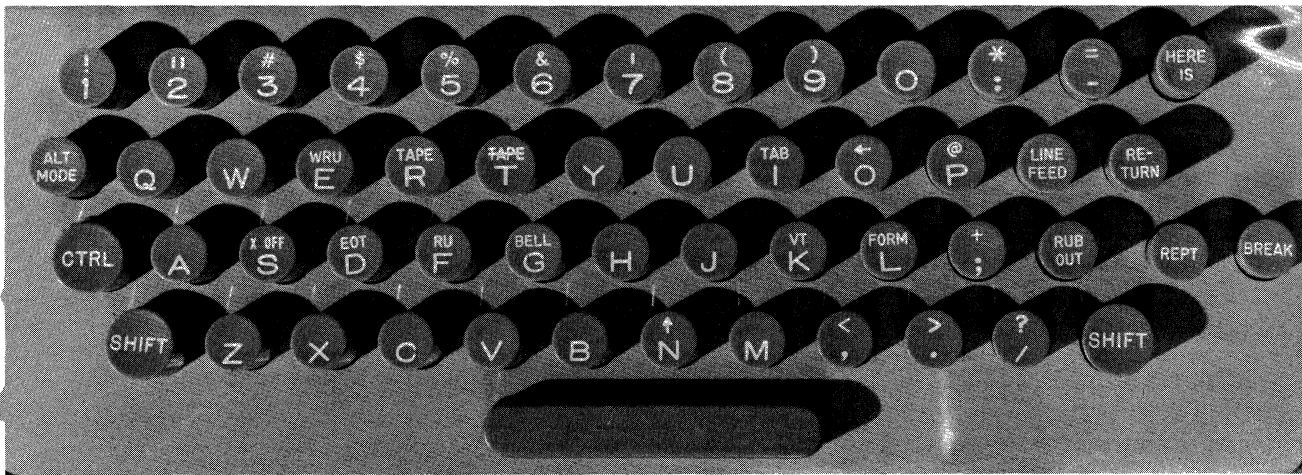
Figure 5-4. Teleprinter Keyboard

Keyboard

The teleprinter keyboard is similar to a standard typewriter keyboard (see Figure 5-4). The keys are interlocked so that only correct combinations may be pressed simultaneously. Some of the ASCII keys are inscribed with words such as FORM and EOT for control functions. When a key is pressed, it generates a printable ASCII character.

Control Keys

The control keys used for normal teleprinter operation are described in the following paragraphs.

LINE/OFF/LOCAL

This switch, located on the right side of the front panel, is the main power switch for the device (Figure 5-3).

NOTES
1. A DASHED LINE INDICATES A LOCAL CIRCUIT
2. A BROKEN LINE INDICATES CODE RECOGNITION
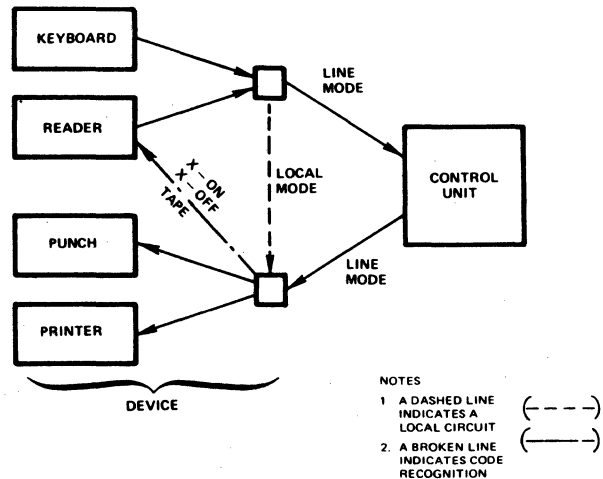
Figure 5-5. Teleprinter Interconnections in Local and Line Modes

o In the OFF position, the device is disabled.
o In the LINE position, the device is enabled to send to or receive from the central processor in the full-duplex mode.
o In the LOCAL position, the device is offline, in the half-duplex mode (offline tape generation and duplication). Figure 5-5 indicates the interconnection of the various components during LOCAL and LINE operations.

CRTL (Control) Key

Pressing the control key does not generate any code, but allows some of the keys to generate nonprintable function characters. When CTRL is pressed, inappropriate keys (mostly those having uppercase characters) are locked out.

SHIFT Key

Pressing the SHIFT key causes all the ASCII keys to generate their associated uppercase characters.

LINE FEED Key

Pressing the LINE FEED key causes the paper to advance vertically. The carriage does not return to the left margin (see RETURN).

RETURN Key

Pressing the RETURN key generates a carriage return character. The type unit returns to the left margin but the paper does not advance vertically. The RETURN key should be used with the LINE FEED key to advance the paper vertically.

RUB OUT Key

Pressing the RUB OUT key generates an octal code 377 each time. For example, by backspacing a paper tape and punching RUB OUT over an error, the error is converted to octal code 377 and is ignored upon subsequent reading.

REPT (Repeat) Key

Pressing the repeat key simultaneously with another key, causes the normal action of the other key to be repeated as long as the two keys are pressed.

ALT MODE Key

Pressing the ALT MODE key produces an octal code of 375. When ALT MODE is pressed simultaneously with the CTRL key, an octal code of 275 is produced.

Paper Tape Punch Control

The paper tape punch can be activated manually or automatically.

Manual Operation

Four push buttons on the punch give the operator complete control over punch operation (Figure 5-6).

ON—The ON push button activates the punch. It permits characters received by the printer to be punched in tape.
OFF—The OFF push button deactivates the punch. It prohibits punching.
B.SP.—The backspace push button is used primarily for tape correction. Each time it is pressed, tape moves in the reverse direction one character space.
REL—The tape release push button allows tape to be pulled manually through the punch unit. This button can be used in either the ON or OFF condition.
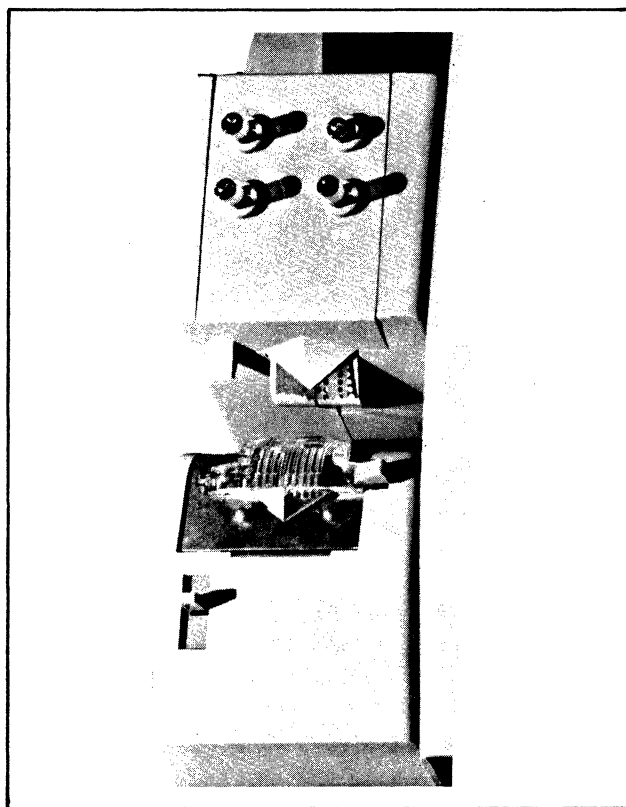
Figure 5-6. Paper Tape Reader/Punch Controls

Automatic Operation

Automatic operation refers to an enabled option which allows the software to start or stop the punch by sending it specific commands.

Paper Tape Reader Control

The paper tape reader can be activated manually or automatically.

Manual Operation

A three-position switch gives the operator complete control over read operation (Figure 5-6).

START—Positioning the lever to START activates the reader.
STOP—Positioning the lever to STOP stops the reader.
FREE—Positioning the lever to FREE allows tape to be moved manually through the reader.

Automatic Operation

Assuming this lever is in the AUTO position, the reader will respond to specific software commands to control the starting, reading, and stopping of tape.

OPERATION

Operating procedures for the teleprinters are described below.

Applying Power

Set LINE/OFF/LOCAL switch to LINE or LOCAL Position.

Removing Power

Set LINE/OFF/LOCAL switch to OFF position.

Paper Loading

To install a new paper roll, follow these directions. Figure 5-7 illustrates the components discussed in the text.

1. Set LINE/OFF/LOCAL switch to OFF position.
2. Install a new paper roll in the unit by inserting the spindle into the new paper roll.
3. Place the roll in the recess provided at the rear of the cover.
4. The end of the spindle extending from both ends of the roll should rest in the associated slots (see Figure 5-7 for paper feed direction).
5. Raise the clear plastic lid over the typing unit.
6. Fold and crease the leading edge of the paper to present a smooth threading edge for feeding.
7. Release the tension of the typing unit platen by moving the pressure lever unit.
8. Push the paper under the platen roller as far as possible and move the pressure lever backwards to reapply roller tension.
9. Push the platen knob to feed the paper forward until it can be passed under the unit paper guide.
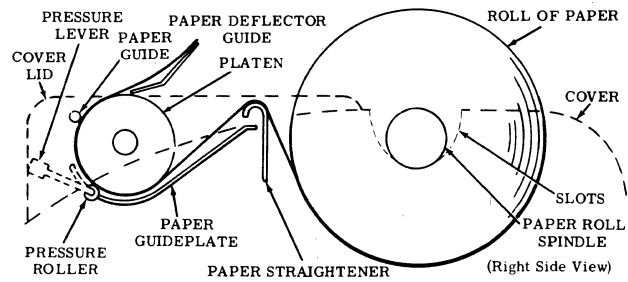
This illustration from Technical Manual Models 32 and 33 Teletypewriter Sets Keyboard Send-Receive (KSR) Receive-Only (RO) Automatic Send-Receive (ASR), Copyrighted by Teletype Corporation; used with permission.

Figure 5-7. Installation of Paper Roll

10. If necessary, again release the tension on the pressure rollers and straighten the paper.
11. Reapply roller tension.
12. Close the cover.
13. Set LINE/OFF/LOCAL switch to ON.

Ribbon Replacement

To install a new ribbon, follow these directions. Figure 5-8 illustrates the components discussed in the procedures.

1. Set LINE/OFF/LOCAL switch to OFF.
2. Raise the cover lid.
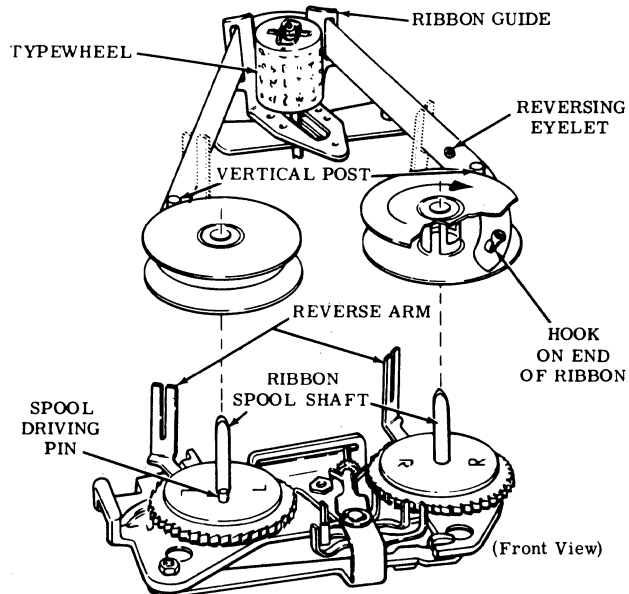
This illustration from Technical Manual Models 32 and 33 Teletypewriter Sets Keyboard Send-Receive (KSR) Receive-Only (RO) Automatic Send-Receive (ASR), Copyrighted by Teletype Corporation; used with permission.

Figure 5-8 Ribbon Installation

3. Pull both spools off the friction spindles.
4. Wind the ribbon onto one of the spools.
5. Discard the old ribbon.
6. Unwrap a new ribbon and engage the hook at the end of the ribbon in the hub of the empty spool.
7. Wind a few turns of ribbon onto the empty spool in the direction indicated by the arrow in the hub.
8. Ensure that the reversing eyelet has been wound onto the empty spool.
9. Place the spools on the shafts so that the ribbon feeds to the rear from the right side of the spool and from the left side of the left spool.
10. Turn each spool slightly until the spool driving pin engages the hole in the spool.
11. Guide the ribbon around the right vertical post and through the slot in the reverse arm.
12. Place the ribbon in the ribbon guide behind the typewheel.
13. Guide the ribbon through the left side of the reverse arm and around the vertical post.
14. Rotate the spool to take up any slack.
15. Set LINE/OFF/LOCAL switch to LINE.

Loading the Paper Tape Reader

The paper tape reader reads data punched on 8-channel, rolled-oiled or fan-folded perforated tape at a maximum rate of 10 characters per second. To load the paper tape, follow these procedures:

1. Raise the tape retainer cover by pushing the tape retainer release button below the FREE/STOP/START switch.
2. Set the reader control to FREE.
3. Position the tape so that the arrow (printed or cut) on the tape faces up and points to the left.
4. Position the leader portion of the tape over the read pins with the sprocket feed holes over the sprocket (feed) wheel.
5. Close the tape retainer cover.

6. Ensure that the tape moves freely.
7. Set the reader control to START.

Loading the Paper Tape Punch

The paper tape punch perforates 8-channel, rolled-oiled or fan-folded paper tape at a maximum rate of 10 characters per second. The following procedures are required to load the paper tape; follow these directions:

1. Press the REL push button on the face of the punch unit.
2. Place the tape in the tape holder to the rear of the punch unit.
3. Pull the tape so that the arrow (printed or cut) faces up and is pointing towards you.
4. Snip the end of the tape into the shape of an arrow head.
5. Guide the tape through the punch assembly.
6. Feed a length of tape through the reader.
7. Press the ON push button.

OPERATOR MAINTENANCE

Operator maintenance includes such preventive maintenance as normal checking and cleaning performed periodically on a routine scheduled basis. This maintenance will keep the teleprinter in the best operating condition.

The following list is a general guide to operator maintenance:

o Always plug the device into a 3-wire grounded outlet.
o Ensure that all covers are secured and closed during operation.
o Never operate the teleprinter without paper.
o Avoid leaning on or placing objects on any part of the teleprinter.
o Turn the power OFF before replacing paper or ribbons.
o Never put food or beverages on or near the device.
o Keep the outside covers clean and free of debris.
o Clean and dust the inside areas of the print, punch, and reader mechanisms.

SECTION 6

TWU9101
KEYBOARD TYPEWRITER CONSOLE
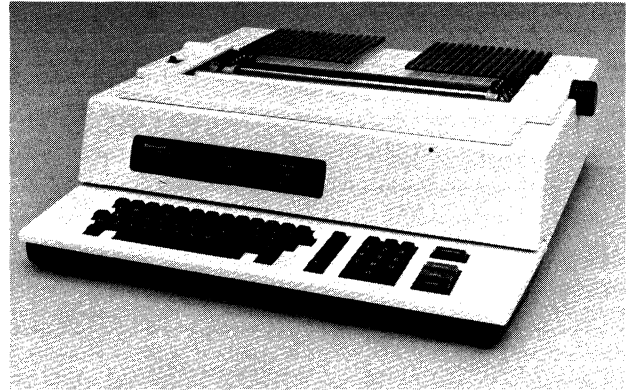
Figure 6-1. TWU9101 Keyboard Typewriter Console

The TWU9101 Keyboard Typewriter Console is available for console and low-speed printer use. The TWU9101 (Figure 6-1) has a 64-character ASCII code set and prints at 30 characters per second. It also has 132 print positions.

The console interfaces to the Level 6 Megabus by means of a single-board Multiple Device Controller (MDC9101) and a Console Device-Pac (KCM9101). Each console includes a 26-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus.

Table 6-1 lists the 64-character ASCII code set. Table 6-2 list the console specifications.

TABLE 6-1. KEYBOARD TYPEWRITER CONSOLE CHARACTER SET

H2 \ H1	0	1	2	3	4	5
0	NUL	DLE	SP	0	@	P
1	SOH	DC1	!	1	A	Q
2	STX	DC2	"	2	B	R
3	ETX	DC3	#	3	C	S
4	EOT	DC4	$	4	D	T
5	ENQ	NAK	%	5	E	U
6	ACK	SYN	&	6	F	V
7	BEL	ETB	'	7	G	W
8	BS	CAN	(	8	H	X
9	HT	EM	)	9	I	Y
A	LF	SUB	*	:	J	Z
B	VT	ESC	+	;	K	[
C	FF	FS	,	<	L	\
D	CR	GS	–	=	M	]
E	SO	RS	.	>	N	∧
F	SI	US	/	?	O	_

For ASCII to hexadecimal conversion:
Each ASCII character = 2 hexadecimal digits (8 bits): H1 H2,
for example: T = 54

TABLE 6-2. TWU9101 SPECIFICATIONS

Print speed: 30 cps
Print format: 10 cpi, horizontal; 6 cpi, vertical
Character set: 64-character ASCII
Print ribbon: Cartridge-type, replaceable by operator
Paper slew speed: 7 ips
Carriage return speed: Nominal for 132 columns, 380 ms; nominal for 80 columns, 280 ms
Paper stock: Standard continuous fanfold paper forms with feed holes on each edge with or without margin perforations
Forms length – 3.0 in. to 17 in. (7.62 cm to 43.2 cm)
Forms width – 4.0 in. to 15 in. (10.16 cm to 38.1 cm)
Device interface: Each keyboard typewriter console requires its own device-pac (KCM9101)
Matrix font: 7 x 9 dot; equal to 10-point type
Cartridge type: M3918

Physical Dimensions:
Height – 13.1 in. (19.05 cm)
Width – 22.5 in. (57.15 cm)
Depth – 26.5 in. (52.07 cm)
Weight – 70 lb (31.7 kg)
Power: 120 Vac +10%, –15%
Power Consumption: 0.23 kVA
Heat Dissipation: 500 Btu/hr (126 kcal/hr)
Frequency: 60 Hz ±½ Hz

Environment:
Temperature – 50°F to 100°F (10°C to 38°C)
Relative Humidity – 30% to 70% (no condensation)

Cables (maximum):
ac – 6 ft (1.8 m)
dc – 50 ft (15.2 m)

KEYBOARD TYPEWRITER CONSOLE COMMANDS

Typewriter console operation is implemented by two sets of instructions: input and output commands (see Table 6-3). Descriptions of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook,* Order No. AS22.

TABLE 6-3. TYPEWRITER CONSOLE COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	09	Output Address and Range
		NOTE: The low order bit of this command specifies the direction of data transfer.
	11	Output Configuration Word A
	13	Output Configuration Word B
	07	Output Task
Input	02	Input Interrupt Control
	0C	Input Range (Residual)
	10	Input Configuration Word A
	12	Input Configuration Word B
	18	Input Status Word
	26	Input Device ID (2018)
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	06	Input Task Word
	1A	Input Attention Character

STATUS BITS

One status word is defined for the typewriter console. Table 6-4 defines the status bits and the means by which each bit is reset. The MDC reacts to typewriter console errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action. If interrupts are blocked (Level = 0), the command in error is used as if there were no error.

CONTROLS AND INDICATORS

Keyboard typewriter console controls and indicators are described below. See Figures 6-2 and 6-3.

MAIN POWER SWITCH

Pressing this switch (located on the rear of the console) applies or removes ac power to the device. When set to the ON position, AC PRESENT lights.

LOCAL SWITCH

Pressing this switch (located under the rectangular cover of the print mechanism) logically disconnects the console from the system.

TABLE 6-4. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	In current loop connections, the console is connected by the presence of the output current when the device-pac is not busy (i.e., not sending data to the console). In EIA connections, Data Terminal Ready for direct connections or Carrier Detect for data set connection.	Change of condition
Attention	1	Operator pressed a key on the console for software attention.	Input status word command[b]
Data Service Rate Error[a]	2	The MDC/Bus/CP have failed to meet the teleprinter speed and data has been lost.	Next IOLD command[b]
Data Parity Error (Even)[a]	3	Device-pac detected a data parity error. Only applicable if the task word was set to specify 7-bit mode (Bit 10 = 0).	Next IOLD command[b]
No Stop Bit Error[a]	5	A character was received from the console without a stop bit.	Next IOLD command[b]
Termination by Control Character 2	8	Control Character 2 was detected in the input stream and caused a termination.	Next IOLD command[b]

TABLE 6-4. (CONT.) STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Termination by Control Character 3	9	Control Character 3 was detected in the input stream and caused a termination.	Next IOLD command[b]
Corrected Memory Error	12	The data read from memory was accompanied by a signal indicating an error was corrected.	Next IOLD command[b]
Nonexistent Resource	13	Set whenever the MDC attempts a Write or Read request bus cycle and receives a NAK response.	Next IOLD command[b]
Bus Parity Error	14	Set whenever the MDC detects a parity error on either byte of the Data Bus during any Output bus cycle (i.e., odd function code), during a second-half memory read cycle or when a parity error is detected in bits 0–7 of the Address Bus during an Output Address command.	Input status word command[b]
Uncorrectable Memory Error	15	The data read from memory was accompanied by a signal indicating an error existed that the memory could not correct.	Next IOLD command[b]

[a]These bits relate to the state of the last character received on input and remain set until the next character is received without these conditions.

[b]Initialize (Output Control Word) and Master Clear also reset these status bits.

Figure 6-2. TWU9101 Control Panel

POWER ON/OFF

Pressing the POWER ON button applies dc power to the console. STANDBY lights to indicate that the device is powered up and physically connected to the system. Pressing POWER OFF removes dc power to the console (STANDBY extinguishes).

START

Pressing the START button causes a transition from standby state to ready state and enables communication with the system.

STOP

Pressing the STOP button causes a transition from ready state to standby state.

READY

Indicates the device is in the Ready state, logically connected to the system, and ready to communicate with the system.

STANDBY

Indicates the device is powered up, physically connected to the system, but not ready to communicate with the system.

AC PRESENT

Indicates ac power is applied to the device via the power switch (located on the rear of the console).

OFF LINE

Indicates the device is powered up, but not physically connected to the system.

OPERATOR ACTION

Indicates that an out-of-paper situation has been sensed.

SHIFT

Pressing the SHIFT key with an applicable key generates its associated uppercase character.
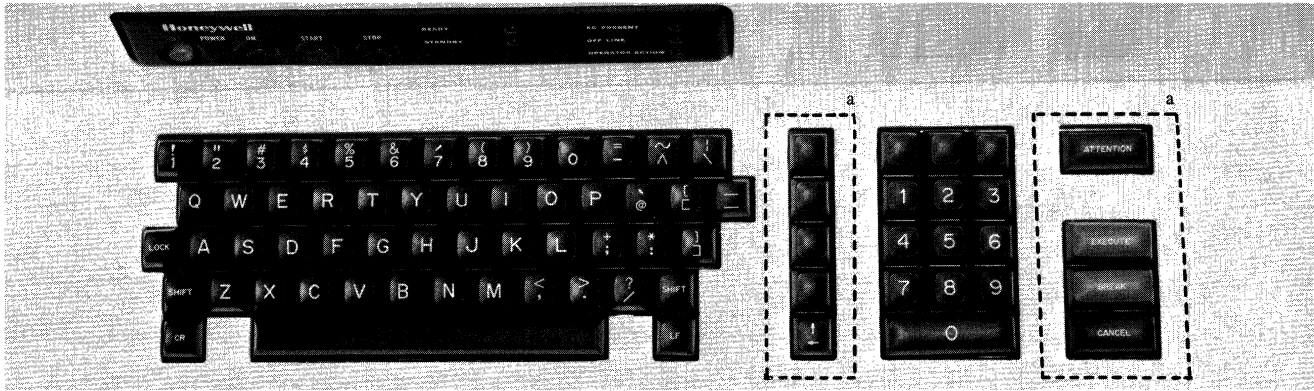
Figure 6-3. TWU9101 Keyboard Configuration [a]Not used

LF

Pressing the LF (line feed) key advances the last line upwards one line position.

CR

Pressing the CR (carriage return) key causes the carriage to return to the first character position of the same line that it is positioned on.

LOCK

Pressing the LOCK key locks the keyboard in an uppercase-only operating mode.

Paper-Out Sensor

A sensor, placed on the left tractor, detects when the forms supply is depleted. Upon detection of a paper-out condition, printing is stopped and STANDBY lights.

MECHANICAL ADJUSTMENTS

There are several mechanical adjustments located in the printer mechanism (Figure 6-4) for the control of printing and paper feeding.

Paper Width

Adjusted via the left/right tractor assemblies. Simply unlock the tractor assemblies and slide them into the proper position.

Paper Advance Knob

Used to manually advance paper one or more lines.

Multicopy Adjustment Lever

Used for manual adjustment of the platen in relationship to the print head. The lever is designed with 5 individual settings (1 through 5)
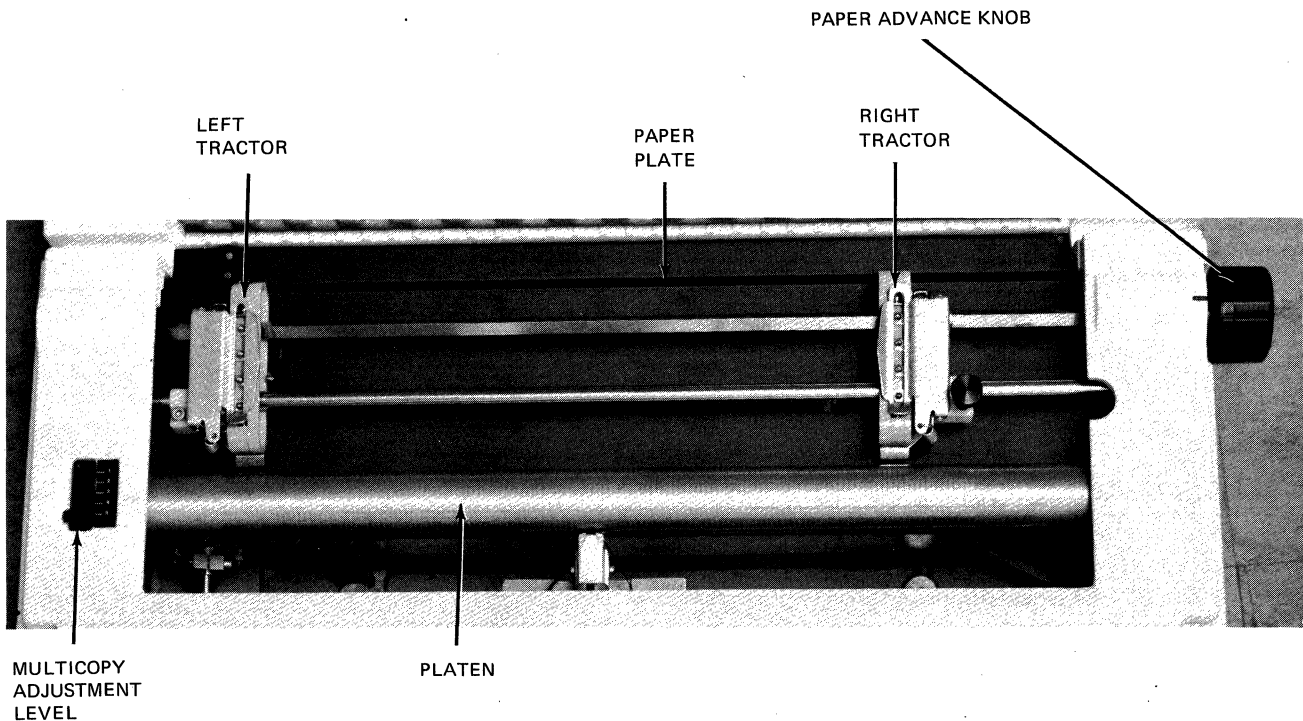
Figure 6-4. Paper Positioning Controls

which correspond to the thickness of the applicable form (single through 4-ply). The lever should be checked whenever forms are changed or when the device is turned on to ensure the proper setting. See Table 6-5.

TABLE 6-5. MULTICOPY ADJUSTMENT LEVEL

Media Thickness	Lever Position
0.07 to 0.11 mm (0.003 in. to 0.0043 in.)	1
0.12 to 0.22 mm (0.0051 in. to 0.0087 in.)	2
0.23 to 0.32 mm (0.0091 in. to 0.0126 in.)	3
0.33 to 0.42 mm (0.0130 in. to 0.0165 in.)	4
0.43 to 0.52 mm (0.0169 in. to 0.0205 in.)	5

OPERATION

Operating procedures for the TWU9101 are described below.

Applying Power
1. Set the ac power switch on rear of console to ON (AC PRESENT lights).
2. Press the POWER ON button (STANDBY lights).
3. Refer to "Forms Loading" procedures; otherwise press START button.

Removing Power
1. Press the STOP button.
2. Press the POWER OFF button (STANDBY extinguishes).
3. Set the ac power switch on rear of console to OFF (AC PRESENT extinguishes).

Forms Loading
1. Press the STOP button (if not already stopped).
2. Remove the paper slide.
3. Adjust the Multicopy Lever to 5.
4. Slide the print mechanism to the extreme left or right so that it will not interfere with the loading of forms.

> NOTE: The print mechanism is locked and cannot be freely moved until the console is stopped and in STANDBY.

5. Open the left and right tractor face plates.

6. Adjust the right tractor as necessary to accommodate the form being used.

> NOTE: Steps 7 through 12 require that the operator be positioned at the rear of the printer since the paper loading procedures must be performed from this position.

7. Position the edge of form under the lower portion of the tractors and slowly turn the paper advance knob.
8. Once the form is started, manually feed a segment of the form under the tractors using the paper advance knob.
9. Position the form to be fed under the platen.
10. Using the paper advance knob, feed the form under the platen.

> NOTE: Enough of the form should be fed through so that it can be attached to the upper position of the tractors.

11. Position the form on the upper tractors and close the tractor face plates to secure the form.
12. Replace the paper slide to its original position.
13. Adjust the Multicopy Lever to a setting that corresponds to the form just loaded.
14. Press the START button.

> NOTE: If the paper is not properly positioned, the initial loading under the lower tractors may be difficult. If the form does not catch under the tractor properly, begin form loading again with the paper repositioned under the tractors. It may be necessary to apply some pressure to multipart forms as they have a tendency to separate while being introduced.

Ribbon Cartridge Replacement
Ribbons are supplied as cartridges. The cartridge is positioned on the print mechanism (see Figure 6-5) by the operator, on a reference pin which ensures proper positioning and plastic clips to ensure locking.
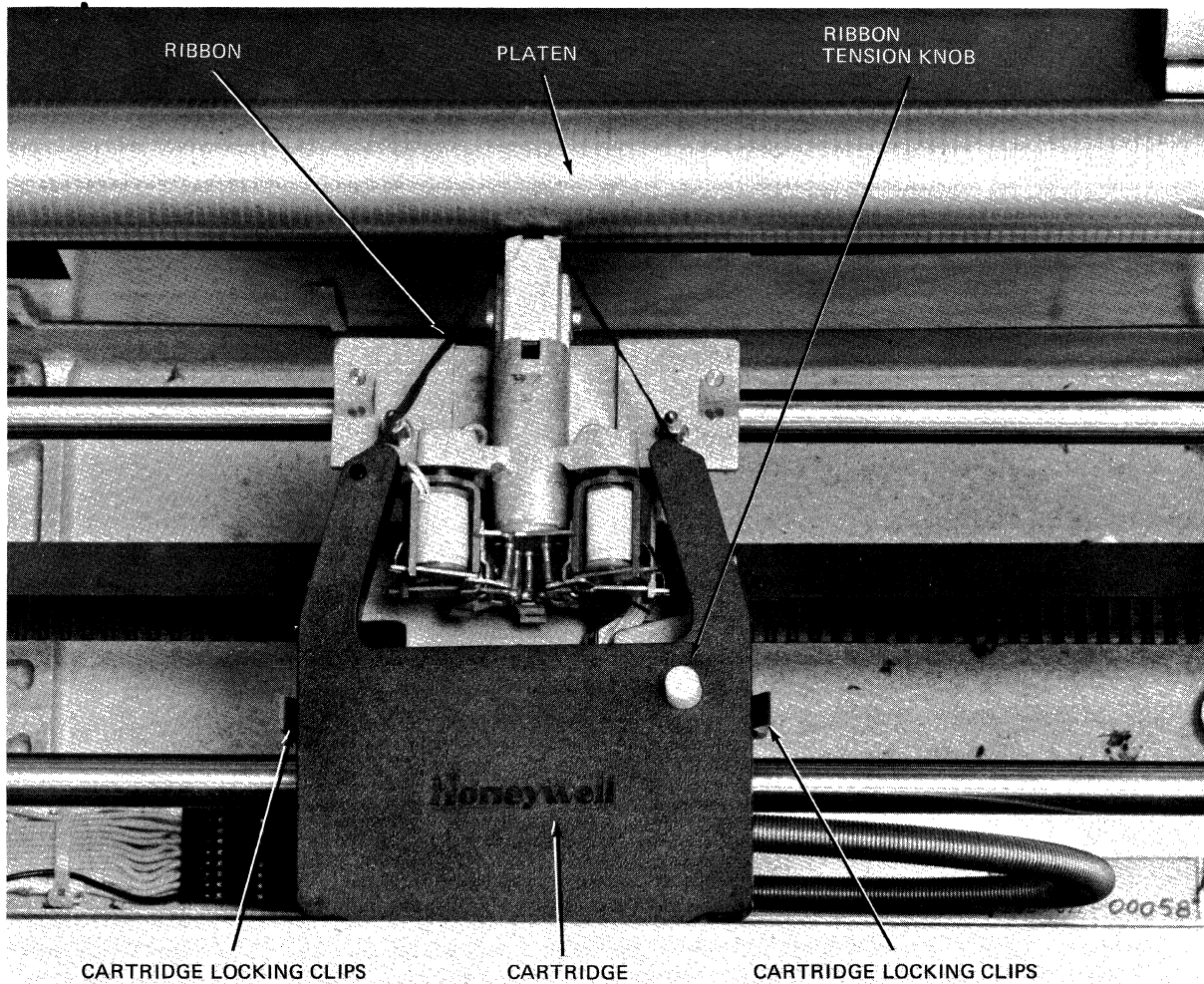
Figure 6-5. Ribbon Cartridge Replacement

The operator replaces the cartridge as necessary to ensure high quality printing. Cartridge loading includes the following steps:

1. Remove power from the console.
2. Lift off the cover over the print mechanism.
3. Slacken ribbon tension via the ribbon tension knob.
4. Remove worn ribbon cartridge.
5. Slacken ribbon tension on new ribbon cartridge.
6. Position the ribbon between the platen and the print head mechanism.
7. Gently draw the cartridge away from the print mechanism.
8. Carefully position the cartridge on the reference pin and the plastic locking clips.
9. Adjust ribbon tension.
10. Replace cover.
11. Apply power to the console.

OPERATOR MAINTENANCE

Operator maintenance includes such preventive maintenance as normal checking and cleaning, performed periodically on a routine scheduled basis. This maintenance will keep the console in the best operating condition thereby reducing the possibility of downtime.

The following list is a general guide to operator maintenance:

o Always plug the console into a 3-wire grounded outlet.
o Ensure that all covers are closed and secured during operation.
o Never operate the console without paper.
o Avoid leaning on or placing objects on any part of the console.
o Turn power OFF before replacing paper or ribbon cartridge.
o Never put food or beverage on or near the console.
o Keep outside covers clean and free of debris.
o Clean and dust the inside areas of the print mechanism.

SECTION 7

TWU9104/9106 KEYBOARD TYPEWRITER CONSOLES

Figure 7-1. TWU9104/9106 Keyboard Typewriter Console

The TWU9104/9106 Keyboard Typewriter Consoles are available for console and low-speed printer use. The TWU9104/9106 (Figure 7-1) have a 96-character ASCII code set and print at 30 and 120 characters per second, respectively. Both have 132 print positions.

The consoles interface to the Level 6 Megabus by means of a single-board Multiple Device Controller (MDC9101) and a Console Device-Pac (KCM9101). Each console includes a 26-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus.

Table 7-1 lists the 96-character ASCII code set. Table 7-2 lists the console specifications.

TABLE 7-1. KEYBOARD TYPEWRITER CONSOLE CHARACTER SET

H2 \ H1	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	¦
D	CR	GS	−	=	M	]	m	}
E	SO	RS	.	>	N	∧	n	~
F	SI	US	/	?	O	_	o	◊

For ASCII to hexadecimal conversion: Each ASCII character = 2 hexadecimal digits (8 bits): H1 H2. For example: T = 54.

TABLE 7-2. TWU9104/9106 SPECIFICATIONS

Print speed: 30 cps (TWU9104); 120 cps (TWU9106)
Print format: 10 cpi, horizontal; 6 cpi, vertical
Character set: 96-character ASCII
Print ribbon: Cartridge-type, replaceable by operator
Line feed time: 60 ms (nominal)
Carriage return speed: Nominal for 132 columns, 380 ms; nominal for 80 columns, 280 ms
Paper Stock: Standard continuous fanfold paper forms with feed holes on each edge with or without margin perforations
Forms Length − 3.0 in. to 17 in. (7.62 cm to 43.2 cm)
Forms Width − 4.0 in. to 15 in. (10.16 cm to 38.1 cm)
Device interface: Each keyboard typewriter console requires its own device-pac (KCM9101)
Matrix font: 7 x 9 dot; equal to 10-point type
Cartridge Type: M3918

Physical Dimensions:
Height − 13.1 in. (19.05 cm)
Width − 22.5 in. (57.15 cm)
Depth − 26.5 in. (52.07 cm)
Weight − 70 lb (31.7 kg)
Power: 120 Vac +10%, −15%
Power Consumption: 0.23 kVA
Heat Dissipation: 500 Btu/hr (126 kcal/hr)
Frequency: 60 Hz ±½ Hz

Environment:
Temperature − 50°F to 100°F (10°C to 38°C)
Relative Humidity − 30% to 70% (no condensation)

Cables (maximum):
ac − 6 ft (1.8 m)
dc − 50 ft (15.2 m)

KEYBOARD TYPEWRITER CONSOLE COMMANDS

Typewriter console operation is implemented by two sets of instructions: input and output commands (see Table 7-3). Descriptions of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook,* Order No. AS22.

TABLE 7-3. TYPEWRITER CONSOLE COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	09	Output Address and Range
		NOTE: The low order bit of this command specifies the direction of data transfer.
	11	Output Configuration Word A
	13	Output Configuration Word B
	07	Output Task
Input	02	Input Interrupt Control
	0C	Input Range (Residual)
	10	Input Configuration Word A
	12	Input Configuration Word B
	18	Input Status Word
	26	Input Device ID (201C)
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	06	Input Task Word
	1A	Input Attention Character

STATUS BITS

One status word is defined for the typewriter console. Table 7-4 defines the status bits and the means by which each bit is reset. The MDC reacts to typewriter console errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action. If interrupts are blocked (Level = 0), the command in error is used as if there were no error.

CONTROLS AND INDICATORS

Keyboard typewriter console controls and indicators are described below. See Figures 7-2 and 7-3.

MAIN POWER SWITCH

Pressing this switch (located on the rear of the console) applies or removes power to the device.

START

Pressing the START button causes a transition from the standby state to ready state and enables communication with the system.

TABLE 7-4. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	In current loop connections, the console is connected by the presence of the output current when the device-pac is not busy (i.e., not sending data to the console). In EIA connections, Data Terminal Ready for direct connections or Carrier Detect for data set connection.	Change of condition
Attention	1	Operator pressed a key on the console for software attention.	Input status word command[b]
Data Service Rate Error[a]	2	The MDC/Bus/CP have failed to meet the teleprinter speed and data has been lost.	Next IOLD command[b]
Data Parity Error (Even)[a]	3	Device-pac detected a data parity error. Only applicable if the task word was set to specify 7-bit mode (Bit 10 = 0).	Next IOLD command[b]
No Stop Bit Error[a]	5	A character was received from the console without a stop bit.	Next IOLD command[b]
Termination by Control Character 2	8	Control Character 2 was detected in the input stream and caused a termination.	Next IOLD command[b]

TABLE 7-4. (CONT.) STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Termination by Control Character 3	9	Control Character 3 was detected in the input stream and caused a termination.	Next IOLD command[b]
Corrected Memory Error	12	The data read from memory was accompanied by a signal indicating an error was corrected.	Next IOLD command[b]
Nonexistent Resource	13	Set whenever the MDC attempts a Write or Read request bus cycle and receives a NAK response.	Next IOLD command[b]
Bus Parity Error	14	Set whenever the MDC detects a parity error on either byte of the Data Bus during any Output bus cycle (i.e., odd function code), during a second-half memory read cycle or when a parity error is detected in bits 0–7 of the Address Bus during an Output Address command.	Input status word command[b]
Uncorrectable Memory Error	15	The data read from memory was accompanied by a signal indicating an error existed that the memory could not correct.	Next IOLD command[b]

[a]These bits relate to the state of the last character received on input and remain set until the next character is received without these conditions.

[b]Initialize (Output Control Word) and Master Clear also reset these status bits.

Figure 7-2. TWU9104/9106 Control Panel

STOP

Pressing the STOP button causes a transition from ready state to standby state. It is also used to reset to local condition.

LOCAL

Pressing the LOCAL button allows the console to be used independently from the system (STANDBY lights).

TEST

Pressing the TEST button (preceded by LOCAL) causes a printout of the complete (uppercase and lowercase) character set. Refer to PRINT TEST procedures.

READY

Indicates the console is in ready state, logically connected to the system, and ready to communicate with the system.

STANDBY

Indicates the device is powered up, physically connected to the system, but not ready to communicate with the system.

LOCAL

Indicates the console is in the local mode and can be operated independently of the system.

OFF LINE

Indicates the console is powered up, but not physically connected to the system.

SHIFT

Pressing the SHIFT key with an applicable key generates its associated uppercase character.

Figure 7-3. TWU9104/9106 Keyboard Configuration

CTL
Pressing the CTL (control) key generates the control function codes of the ASCII code set.

RPT
Pressing the RPT (repeat) key simultaneously with another key, causes repeated generation of the other key as long as both are pressed.

LF
Pressing the LF (line feed) key advances the last line upwards one line position.

BRK
Pressing the BRK (break) key allows the operator to generate an interrupt to the system.

RETURN
Pressing the RETURN key causes the carriage to return to the first character position of the same line that it is positioned on.

DEL
Pressing the DEL (delete) key together with the SHIFT key generates and sends to the MDC an ASCII hex code of 1F.

CLR
Pressing the CLR (clear) key generates and sends to the MDC an ASCII hex code of 0C. The same code can also be generated by pressing the CTL key together with the L key.

HERE IS
This key is not used.

ESC
Pressing the ESC (escape code) key generates and sends to the MDC an ASCII hex code of 1B. The same code can also be generated by simultaneously pressing the CTL, SHIFT, and [(left bracket) keys.

CAP LOCK
Pressing the CAP LOCK locks the keyboard in an uppercase-only operating mode.

Paper-Out Sensor
A sensor, placed on the left tractor, is provided to detect depletion of the forms supply. Upon detection of a paper-out condition, printing is stopped and STANDBY lights.

MECHANICAL ADJUSTMENTS

There are several mechanical adjustments located in the printer mechanism (Figure 7-4) for the control of printing and paper feeding.

Paper Width
Adjusted via the left/right tractor assemblies. Simply unlock the tractor assemblies and slide them into the proper position.

Paper Advance Knob
Used to manually advance paper one or more lines.
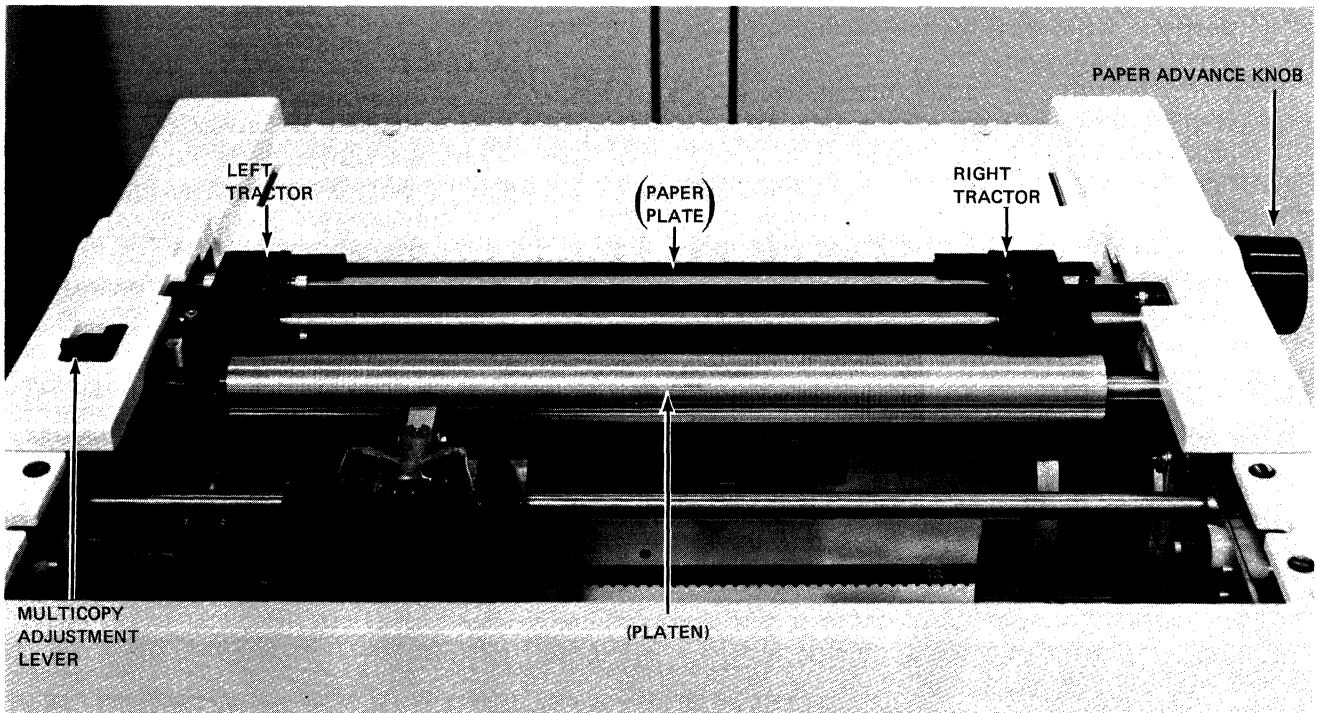
Figure 7-4. Paper Positioning Controls

Multicopy Adjustment Lever

Used for manual adjustment of the platen in relationship to the print head. The lever is designed with 5 individual settings (1 through 5) which correspond to the thickness of the applicable form (single through 4-ply). The lever should be checked whenever forms are changed or when the device is turned on to ensure the proper setting. See Table 7-5.

TABLE 7-5. MULTICOPY ADJUSTMENT LEVEL

Media Thickness	Lever Position
0.07 to 0.11 mm (0.003 in. to 0.0043 in.)	1
0.12 to 0.22 mm (0.0051 in. to 0.0087 in.)	2
0.23 to 0.32 mm (0.0091 in. to 0.0126 in.)	3
0.33 to 0.42 mm (0.0130 in. to 0.0165 in.)	4
0.43 to 0.52 mm (0.0169 in. to 0.0205 in.)	5

OPERATION

Operating procedures for the TWU9104/9106 are described next.

Applying Power
1. Set power switch on rear of console to ON (STANDBY lights).
2. Refer to "Forms Loading" procedure; otherwise press START button.

Removing Power
1. Press the STOP button.
2. Set power switch on rear of console to OFF (STANDBY extinguishes).

Forms Loading
1. Press the STOP push button (if not already stopped).
2. Remove the paper slide.
3. Adjust the Multicopy Lever to 5.
4. Slide the print mechanism to the extreme left or right so that it will not interfere with the loading of forms.
   NOTE: The print mechanism is locked and cannot be freely moved until the console is stopped and in STANDBY.
5. Flip up the left and right tractor face plates.
6. Adjust the right tractor as necessary to accommodate the form being used.
   NOTE: Steps 7 through 12 require that the operator be positioned at the rear of the printer since the paper loading procedures must be performed from this position.

7. Position the edge of form under the lower portion of the tractors and slowly turn the paper advance knob.
8. Once the form is started, manually feed a segment of the form under the tractors using the paper advance knob.
9. Position the form to be fed under the platen.
10. Using the paper advance knob, feed the form under the platen.

> NOTE: Enough of the form should be fed through so that it can be attached to the upper position of the tractors.

11. Position the form on the upper tractors and flip-down the left and right tractor face plates to secure the form.
12. Replace the paper slide to its original position.
13. Adjust the Multicopy Lever to a setting that corresponds to the form just loaded.

14. Press the START button.

> NOTE: If the paper is not properly positioned, the initial loading under the lower tractors may be difficult. If the form does not catch under the tractor properly, begin form loading again with the paper repositioned under the tractors. It may be necessary to apply some pressure to multipart forms as they have a tendency to separate while being introduced.

Ribbon Cartridge Replacement

Ribbons are supplied as cartridges. The cartridge is positioned on the print mechanism (see Figure 7-5) by the operator, on a reference pin which ensures proper positioning and plastic clips to ensure locking.
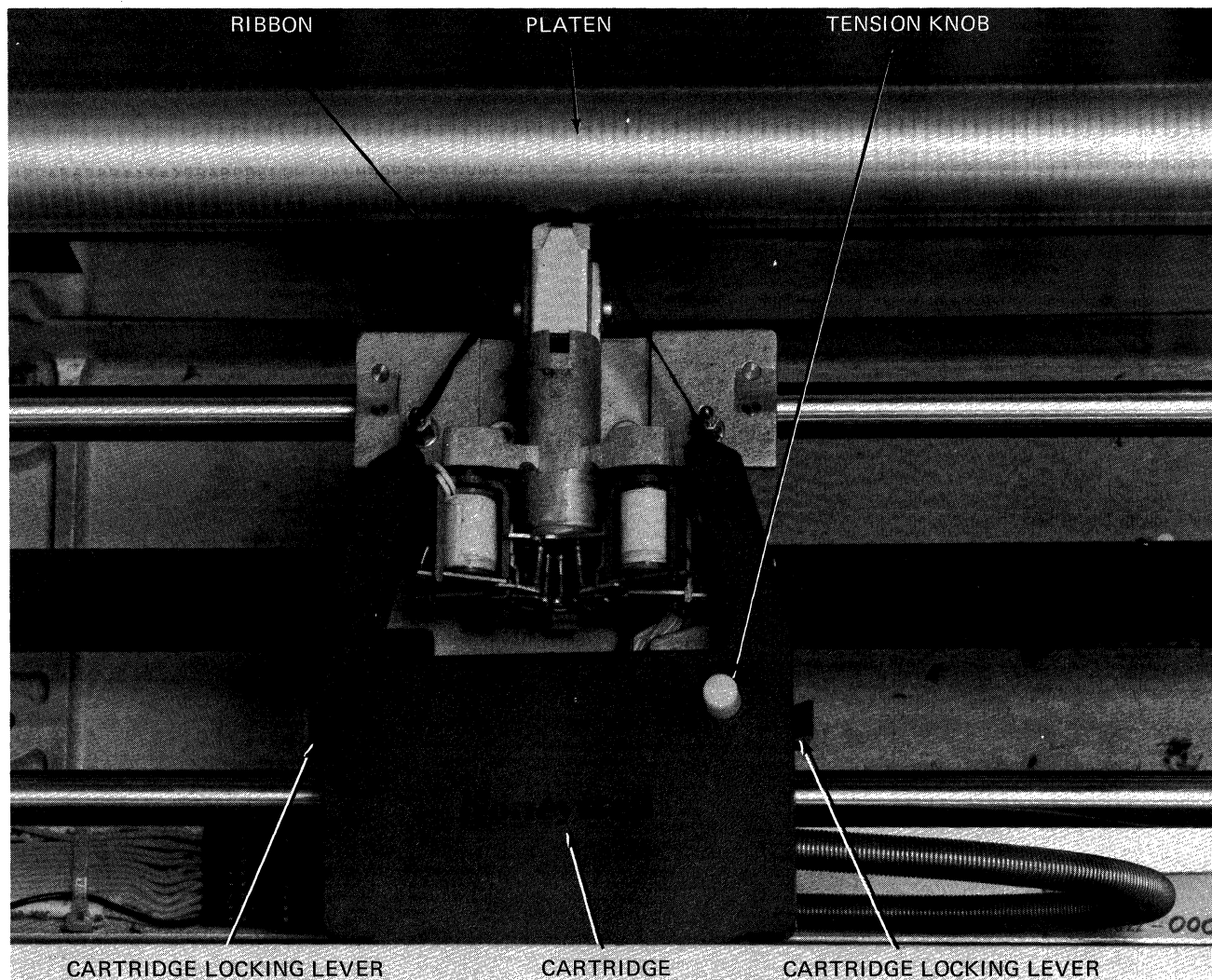
Figure 7-5. Ribbon Cartridge Replacement

The operator replaces the cartridge as necessary to ensure high quality printing. Cartridge loading includes the following steps:

1. Remove power from the console.
2. Lift off the cover over the print mechanism.
3. Slacken ribbon tension via the ribbon tension knob.
4. Remove worn ribbon cartridge.
5. Slacken ribbon tension on new ribbon cartridge.
6. Position the ribbon between the platen and the print head mechanism.
7. Gently draw the cartridge away from the print mechanism.
8. Carefully position the cartridge on the reference pin and the plastic locking clips.
9. Adjust ribbon tension.
10. Replace cover.
11. Apply power to the console.

Print Test

To check print quality and print the entire character set do the following:

1. Press the STOP button.
2. Press the LOCAL button.
3. Press the TEST button.
4. Press the START button (printing begins).
5. Press the STOP button to terminate the print test.

OPERATOR MAINTENANCE

Operator maintenance includes such preventive maintenance as normal checking and cleaning performed periodically on a routine scheduled basis. This maintenance will keep the console in the best operating condition thereby reducing the possibility of downtime.

The following list is a general guide to operator maintenance:

o Always plug the console into a 3-wire grounded outlet.

o Ensure that all covers are closed and secured during operation.

o Never operate the console without paper.

o Avoid leaning on or placing objects on any part of the console.

o Turn power OFF before replacing paper or ribbon cartridge.

o Never put food or beverage on or near the console.

o Keep outside covers clean and free of debris.

o Clean and dust the inside areas of the print mechanism.

SECTION 8

DKU9101/9102
CRT KEYBOARD CONSOLES

The DKU9101/9102 CRT Keyboard Consoles enable conversational message transfer, status display, and operator control of any Level 6 system. The CRT units (Figure 8-1) display 64 uppercase ASCII characters and 95 uppercase and lowercase ASCII characters, including space, respectively.

The CRT units interface to the Level 6 megabus by means of a single board Multiple Device Controller (MDC9101) and a CRT Device-Pac (KCM9101). Each CRT consoles includes a 25-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the megabus. Table 8-1 lists the specifications.

FUNCTIONAL DESCRIPTION

The DKU9101/9102 consists of a CRT display unit with a detachable keyboard unit permitting flexibility of operation and placement.

Keyboard

The console keyboard utilizes solid-state, high-reliability switches as keys. The keyboard permits the entry of variable data and program parameters. The 60 keys can generate 128 characters of the ASCII code set. The characters include 26 alphabetic, 10 numeric, and 32 special symbols. Also included are 10 control keys. See Figure 8-2.

A special entry marker (cursor) appears on the console display screen to indicate the location of the next character to be displayed. The DKU9101/9102 uses the "bottom line entry" approach for the display. The cursor moves only on the bottom line of the display. The bottom line display operates just like the print line of a journal roll, i.e., a line feed causes the entire display page (including the bottom line) to move up one line, leaving the new bottom line blank, or clear. A line return causes the cursor to move to the left margin first display position.

Display Screen

Manually entered data and processor-generated inquiries and responses are displayed on a 12-inch
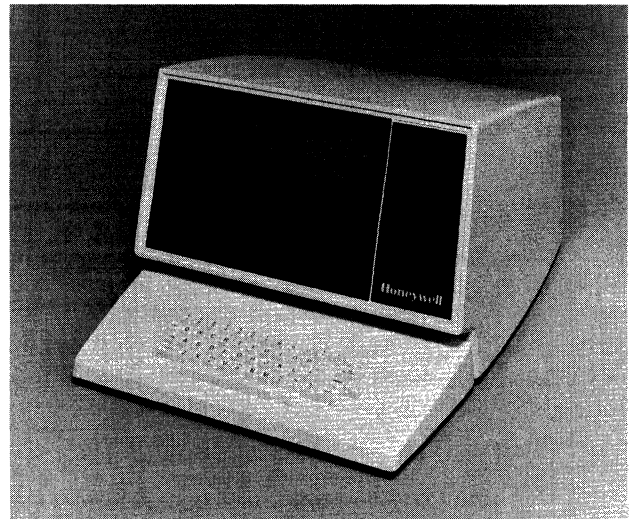
Figure 8-1. DKU9101/9102 CRT Keyboard Consoles

TABLE 8-1. DKU9101/9102 SPECIFICATIONS

Keyboard: TTY layout; 60 keys/128 character ASCII code set; n-key roll-over

KEYBOARD DIMENSIONS:
Width – 17.9 in. (45.4 cm)
Depth – 8 in. (20.3 cm)
Height – 3 in. (7.6 cm)

Character Set:
DKU9101 – 64 uppercase ASCII characters
DKU9102 – 95 uppercase and lowercase ASCII characters, including space
Character Matrix: 5 x 7 characters
Display: 960-character screen; 80-character line; 12 lines
Displayable Screen Area – 54 square inches (348.4 sq. cm)
Character Size – 0.08 in. x 0.16 in. (.2 cm x .406 cm)
Interface: 60 mA or 20 mA current loop; Bell 103A modem compatibility
Device Interface: Each CRT Keyboard Console requires its own device-pac (KCM9101)

Physical Dimensions:
Height – 13 in. (33 cm)
Width – 18 in. (20.3 cm)
Depth – 24 in. (60.9 cm)
Weight – 40 lb (18.1 kg)
Power: 120 Vac +10%, -15%
Power: 120 Vac +10%, −15%
Heat Dissipation: 1000 Btu/hr (252 kcal/hr)
Frequency: 60 Hz ±½ Hz

Environment:
Temperature – 50°F to 100°F (10°C to 38°C)
Relative Humidity – 10% to 90% (no condensation)

Cables (maximum):
ac – 6 ft (1.8 m)
dc – 50 ft (15.2 m)
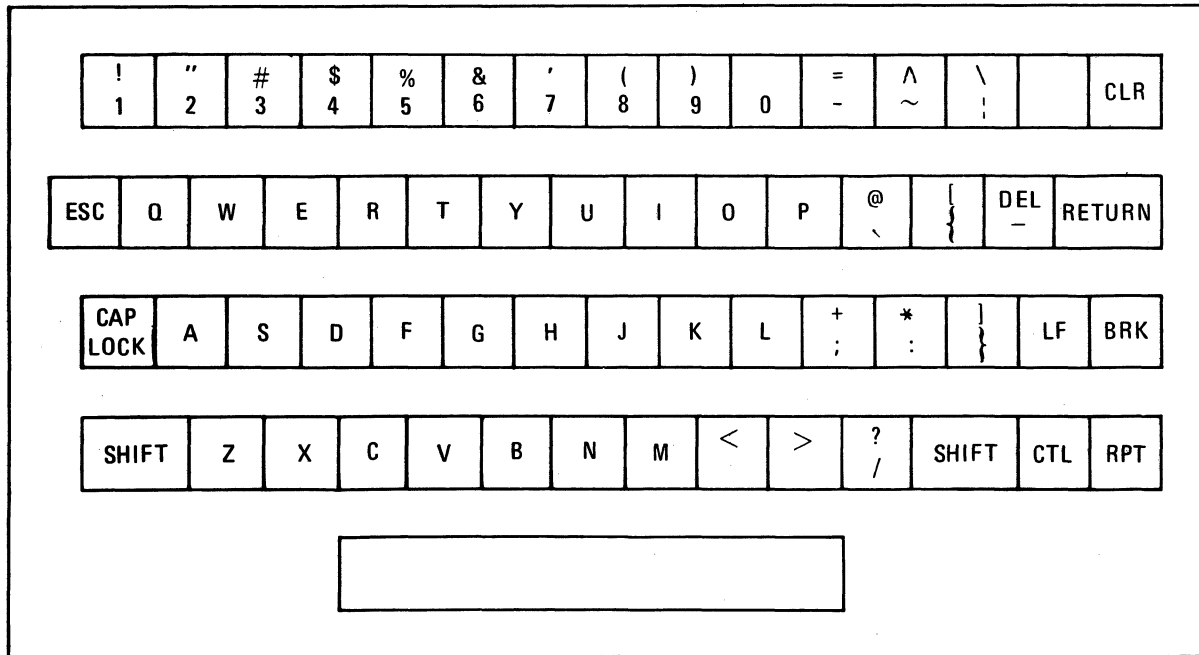
Figure 8-2. DKU9101/9102 Keyboard

CRT. With a display of up to 960 characters (12 lines, 80 characters per line) and a 60-frames per second refresh rate, the display projects clear, bright, easily read information. The operator has access to all character positions within the bottom line.

CRT CONSOLE COMMANDS

CRT console operation is implemented by two sets of instructions: input and output commands (see Table 8-2). Descriptions of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, Order No. AS22.

STATUS BITS

One status word is defined for the CRT console. Table 8-3 defines the status bits and the means by which each bit is reset. The MDC reacts to CRT console data transfer errors as follows:

o Errors detected during the data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O commands are acknowledged normally and stored in MDC memory but cause no further action. If interrupts are blocked (Level = 0), the command in error is used as if there were no error.

TABLE 8-2. CRT CONSOLE COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	09	Output Address and Range
		NOTE: The low-order bit of the channel no. of this command specifies the direction of data transfer.
	11	Output Configuration Word A
	13	Output Configuration Word B
	07	Output Task
Input	02	Input Interrupt Control
	0C	Input Range (Residual)
	10	Input Configuration Word A
	12	Input Configuration Word B
	18	Input Status Word
	26	Input Device ID (201A)
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	06	Input Task Word
	1A	Input Attention Character

CONTROLS

CRT console controls consist of control keys located on the keyboard and switches located on the back panel of the CRT cabinet.

TABLE 8-3. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	In current loop connections, the console is connected by the presence of the output current when the device-pac is not busy (i.e., not sending data to the console). In EIA connections, Data Terminal Ready for direct connections or Carrier Detect for data set connection.	Change of condition
Attention	1	Operator pressed a key on the console for software attention.	Input status word command[b]
Data Service Rate Error[a]	2	The MDC/Bus/CP have failed to meet the teleprinter speed and data has been lost.	Next IOLD command[b]
Data Parity Error (Even)[a]	3	Device-pac detected a data parity error. Only Only applicable if the task word was set to specify 7-bit mode (Bit 10 = 0).	Next IOLD command[b]
No Stop Bit Error[a]	5	A character was received from the console without a stop bit.	Next IOLD command[b]
Termination by Control Character 2	8	Control Character 2 was detected in the input stream and caused a termination.	Next IOLD command[b]
Termination by Control Character 3	9	Control Character 3 was detected in the input stream and caused a termination.	Next IOLD command[b]
Corrected Memory Error	12	The data read from memory was accompanied by a signal indicating an error was corrected.	Next IOLD command[b]
Nonexistent Resource	13	Set whenever the MDC attempts a Write or Read request bus cycle and receives a NAK response.	Next IOLD command[b]
Bus Parity Error	14	Set whenever the MDC detects a parity error on either byte of the Data Bus during any Output bus cycle (i.e., odd function code), during a second-half memory read cycle or when a parity error is detected in bits 0–7 of the Address Bus during an Output Address command.	Input status word command[b]
Uncorrectable Memory Error	15	The data read from memory was accompanied by a signal indicating an error existed that the memory could not correct.	Next IOLD command[b]

[a]These bits relate to the state of the last character received on input and remain set until the next character is received without these conditions.

[b]Initialize (Output Control Word) and Master Clear also reset these status bits.

POWER ON/OFF

Setting the switch to the ON position applies power to the device (the appearance of the cursor on the screen indicates that the power is on.) Setting the switch to the OFF position removes power.

BRIGHTNESS

This switch varies the intensity of data images on the CRT screen. Rotating the knob clockwise intensifies the brightness; rotating the knob counterclockwise diminishes the brightness.

REMOTE/LOCAL

This switch is set to REMOTE for normal usage or to LOCAL for testing purposes.

BAUD RATE

This thumbwheel switch is used to set the desired baud rate. The numbers 2, 3, 5, 7, 8, 10, 11, 12, 13 and 15 correspond to baud rates of 75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, and 9600 bps respectively.

STOP BIT 1/2

This switch is set to either 1 or 2 for the desired number of stop bits.

SHIFT KEY

The SHIFT key is used with any applicable key to generate its associated uppercase character.

CTL (Control) Key

The Control key generates the control function codes of the ASCII code set, but must always be used with another key to produce the desired code which will not be displayed.

RPT (Repeat) Key

The repeat key, when pressed along with another key, causes repeated generation of the other key. The repeat key must be pressed first and held down during the repeat operation. The character being repeated need not be held down during the entire operation, but can be released after the operation has started.

BRK (Break) Key

The break key allows the operator to generate an interrupt to the central processor which may be used to suspend processing.

CLR (Clear) Key

The clear key produces a form feed character which clears the display screen and returns the cursor to its home position.

CAP LOCK Key

The CAP LOCK key locks the keyboard in an uppercase-only operating mode.

Cursor Control

The cursor is designed for bottom line data entry. As lines are entered by the operator, the previously entered line is advanced upwards on the screen while the cursor moves to the first column position on the bottom line. This motion is triggered by the operator entering valid line terminating characters (carriage return/line feed).

The cursor automatically advances to the next character position in a line of data whenever a character is entered by the operator. The follow-ing are the available cursor controls:

RETURN Key

Pressing the RETURN key (or reception of a carriage return character from the central processor) returns the cursor to the first character position of the line (last line). The line does not advance upwards with this command; the line feed character is required to cause upward motion of the line.

LF (Line Feed) Key

Pressing the Line Feed key (or reception of a line feed character from the central processor) causes the last line to move upwards one line position. Any line currently at the top of the screen is also moved upwards one line and there-fore is lost.

Additional cursor controls are also available if enabled by the setting of internal switches per Honeywell FED.

o Pressing CTL and L together produce a form feed character which clears the display screen and returns the cursor to its home position.
o Pressing CTL and G together produce a BEL character which causes an audible alarm.
o Pressing CTL and H together produce a backspace character which moves the cursor back one space.
o Pressing CTL and R together produce a DC2 character which advances the cursor one column without destroying the present screen display.

Alarm Bell

A keyboard alarm bell sounds whenever the CRT receives a BEL code from the software or when a character is entered by the operator in character position 75 of the line. The bell is intended as a warning that the end of the line is near. Any data entered by the operator that exceeds the line character limit (80 characters) is overwritten in column 80 and is lost.

SECTION 9

DIU9101/9102
DISKETTES UNITS

Figure 9-1. Tabletop Dual Diskette Unit

The DIU9101 Single Diskette Unit and the DIU9102 Dual Diskette Unit (Figure 9-1) are random access storage devices with an unformatted data capacity of 3,108,128 bits per disk (401,016 bytes per disk).

Data is recorded on the magnetic oxide coated surface of an 8-inch flexible Mylar disk (or diskette) used with the device. The diskette may be removed and changed as application permits. Data representation is in ASCII code.

Diskette units are available singly, or in a dual configuration and interface to the Level 6 Megabus by means of single-board Multiple Device Controller (MDC9101), and a Diskette Device-Pac (DIM9101). A power supply is also included.

Each Diskette Device-Pac can attach two Single Diskette Units or one Dual Diskette Unit. Up to two Diskette Device-Pacs can be connected to an MDC, which in turn connects to the Megabus.

Table 9-1 lists the specifications for the diskette devices.

MEDIA

The flexible disk is packaged in an 8-inch square protective nonremovable jacket. Both diskette and jacket contain a center hole with an access slit that extends from the center to the respective outer edge. When loaded and operative, the magnetic heads on the diskette unit come into physical contact with the recording surface of the diskette. The jacket becomes immobile and is held stationary while the diskette unit spindle automatically engages the diskette and rotates it at a speed of 360 rpm.

BASIC TRACK FORMAT

Each track on the diskette contains up to 26 equal length sectors of 128 bytes each. There are 77 tracks numbered from 0 through 76 yielding a total formatted capacity of 256,256 bytes. The data encoding scheme is double frequency recording and each field is preceded by an AM (Address Mark) and followed by a 2-byte EDC (Error Detection Code). The basic track format is shown in Figure 9-2.
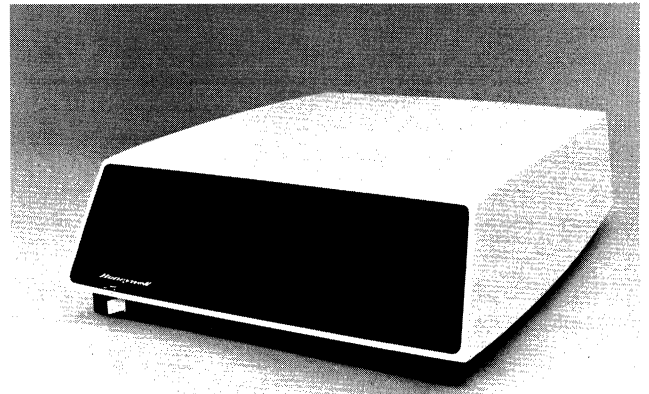
TABLE 9-1. DIU9101/9102 SPECIFICATIONS

Seek Time: 20 ms minimum (track-to-track including head settling time); 260 ms average; 770 ms maximum.

Latency Time: 83.33 ms average rotational latency

Transfer Rate: (device-pac to diskette) 249,984 bits/second; 31,248 bytes/second; 15,624 words/second

Data Capacity: 256,256 bytes/disk (formatted), 3328 data bytes/track (formatted)

Diskette Speed: 360 rpm

Tracks Per Disk Surface: 77

Recording Density: 3200 bpi

Device Interface: Diskette Device-Pac (DIM9101) for each DIU9102 or for up to two DIU9101s.

Media: Honeywell Type M4101 (or equivalent)

Physical Dimensions:

Height — 14.6 in. (37 cm)

Width — 20.5 in. (52.07 cm)

Depth — 26.9 in. (68.9 cm)

Weight — 60 lb (27.2 kg) single diskette
120 lb (54.4 kg) dual diskette

Power: 120 Vac +10%, −15%

Power Consumption: 0.42 kVA single diskette
0.84 kVA dual diskette

Heat Dissipation: 340 Btu/hr single (85.7 kcal/hr)
680 Btu/hr dual (171.4 kcal/hr)

Frequency: 60 Hz ±½ Hz

Environment:

Temperature — 50°F to 100°F (10°C to 38°C)

Relative Humidity — 10% to 90% (no condensation)

Cables (maximum):

ac — 6 ft (1.8 m)

dc — 20 ft (6 m)

Figure 9-2. Basic Track Format

DISKETTE UNIT COMMANDS

Diskette unit operation is implemented by two sets of instructions: input and output commands (see Table 9-2). Descriptions of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, Order No. AS22.

TABLE 9-2. DISKETTE COMMANDS

Type	Function Code	Command
Output	09[a]	Output Address
	0D	Output Range
	11	Output Configuration Word A
	13	Output Configuration Word B
	03	Output Interrupt Control
	07	Output Task Word
	01	Output Control Word
Input	0C	Input Range
	10	Input Configuration Word A
	12	Input Configuration Word B
	02	Input Interrupt Control
	26	Input Device ID (2010)
	06	Input Task Word
	18	Input Status Word

[a]Function Code 09 as executed by the CP results in execution of functions 09 and 0D.

STATUS BITS

One status word is defined for the diskette unit. Table 9-3 defines the status bits and the means by which each bit is reset. The MDC reacts to diskette unit read or write errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.
o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action. If interrupts are blocked (Level = 0), the command in error is used as if there were no error.

CONTROLS

Diskette unit controls are as follows:

POWER ON/OFF

This two-position switch is used to either apply or remove power. In non-tabletop configurations power is applied from the control panel of the central processor.

TABLE 9-3. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	The device is online with the medium loaded and no further manual intervention is required to place it under program control. Note that a change of state of this bit causes the Attention bit (bit 1) to be set resulting in an interrupt (if the interrupt level is nonzero).	A change in condition
Attention	1	Set whenever the Device Ready bit (bit 0 of the status word) changes state. Indicates to software any change of operational status of the device (e.g., load/unload of media). Whenever set, an interrupt is attempted (if the Interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) serves as notification of both the end of the operation and the device state change.	Input Status Word or Output Task Word[a]
Overrun/ Underrun	2	Set during a Read or Write operation when the data transfer to/from main memory cannot be maintained at a high enough rate (15.6K words per second during field transfers in word mode). Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device.	Output Task Word[a]
Deleted Field	3	Set if a Deleted Data Field Address Mark is encountered during a Format Read command or if a data field which would normally be read during a Read Data command is skipped because of a Deleted Data Field Address Mark. Also set if the Deleted Data Field encoding of the Task Word (1XXXX101) is received on a Read channel and a normal data field is skipped during the resulting read operation. Posting of this indication does not cause the operation in progress to be terminated.	Output Task Word[a]
Read Error	4	Set during any Read operation if the EDC Word at the end of a field disagrees with the EDC Word calculated while reading the field.	Output Task Word[a]
Device Fault	5	Set whenever a Fault indication is received from the device.	Recalibrate[a]
Missed Data Sync	6	Set if, after a Sector ID has been detected during a Read operation, the corresponding data field is not detected, or if during a Format Read two consecutive data fields (or two consecutive ID fields) Address Marks are detected (indicating that a field was missed).	Output Task Word[a]

TABLE 9-3 (cont). STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Unsuccessful Search	7	Set during a non-format Read or Write operation for which the Sector ID specified in Configuration Words A and B cannot be located on the Track.	Output Task Word[a]
Seek Error	10	Set during a Seek operation if the device indicates that it is on track zero when not expected, if a cylinder number greater than 76 is specified in Configuration Word A, or if the device cannot be positioned at Track zero (as indicated by the Track Zero line) during a Recalibrate command.	Recalibrate[a]
Corrected Memory Error	12	During execution of the previous operation Main Memory detected and corrected a memory read error. The data that was delivered to the MDC was assumed to be correct.	Output Task Word[a]
Non-Existent Resource	13	Set whenever the MDC attempts a Write or Read request bus cycle and receives a NAK response.	Output Task Word or Input Status Word[a]
Bus Parity Error	14	Set whenever the MDC detects a parity error on either byte of the data bus during any output bus cycle (i.e., odd function code), during a Second Half Memory Read cycle or when a parity error is detected in bits 0–7 of the address bus during an Output Address command.	Input Status Word[a]
Uncorrected Memory Error	15	During execution of the previous operation Main Memory detected a read error which the EDAC algorithm could not correct. The data that was delivered to the MDC was incorrect. Will not cause termination of the operation in progress (may result in bad data written on the medium).	Output Task Word[a]

[a]Initialize (Output control word) and Master Clear on the Bus also resets these status bits.

Access Cover Button

Pressing this button opens the diskette unit access cover to enable either the insertion or removal of the diskette. The access cover is closed manually.

OPERATION

Operating procedures for the diskette units are described as follows:

Applying Power
Set POWER switch to ON position.

Removing Power
Set POWER switch to OFF position.

Diskette Unit Loading

Prior to loading, visually check the condition of the flexible disk. It should not be torn, folded, or creased. Do not use a damaged diskette.

1. Remove the diskette from its protective envelope (Figure 9-3).

   NOTE: Diskette remains inside its non-removable jacket.

2. Press the access cover button on the diskette unit.

3. Carefully inset the diskette squarely and completely into the diskette unit.

4. Close the access cover. (The diskette unit spindle automatically engages the diskette and the device is ready for operation.)
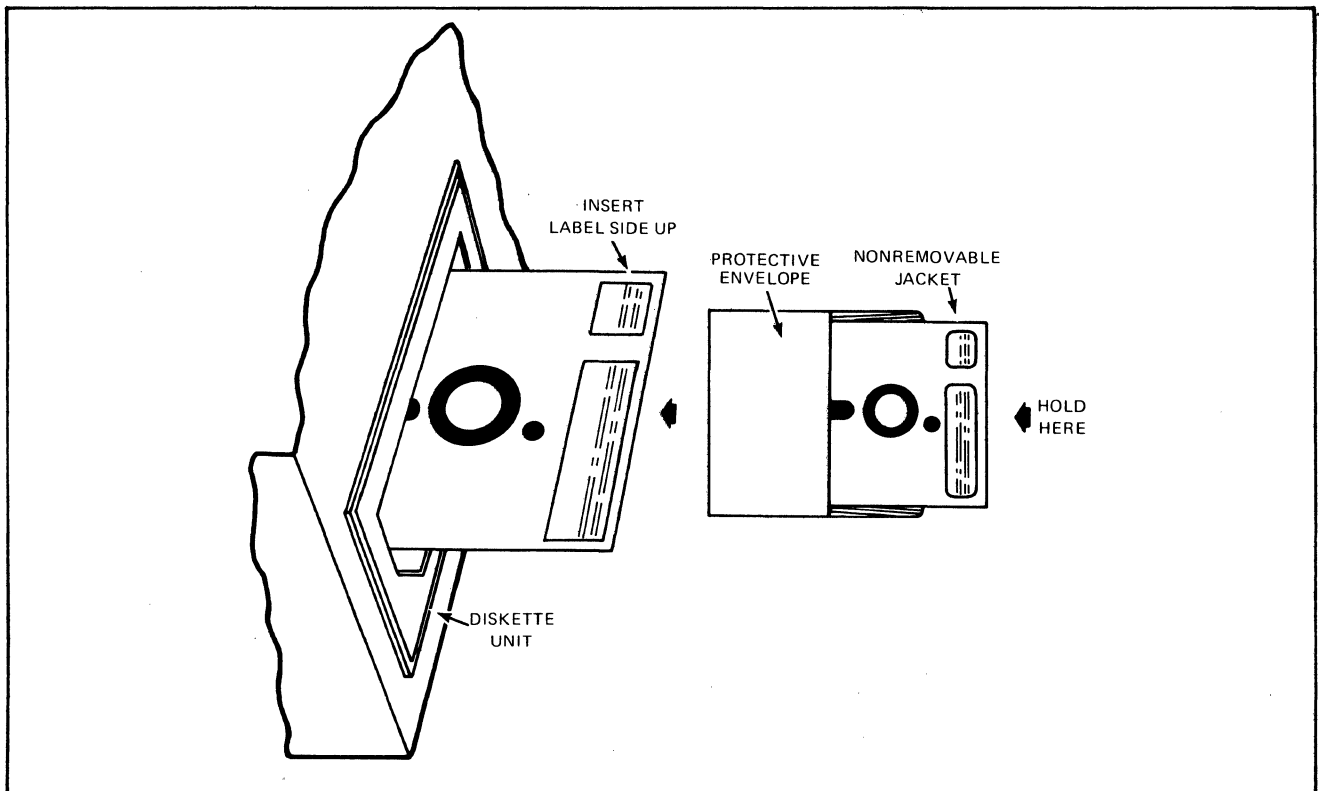
Figure 9-3. Diskette Media Handling

Diskette Unit Unloading

1. Press the access cover button on the diskette unit.
2. Grasp the diskette jacket and remove it from the diskette unit.
3. Close the access cover if no other diskette is to be inserted.
4. Return the diskette back into its envelope.

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning done periodically on a scheduled basis, even though diskette unit operation may be satisfactory and not in need of attention.

Care And Handling of Diskette

Proper handling storage of a diskette will increase its life expectancy and reduce the possibility of errors. The following rules are the prerequisites for proper media handling and storage.

o Prior to inserting the diskette, visually examine its condition. The nonremovable jacket should not be torn, folded, or creased. Do not use a damaged diskette.

o Keep diskette clean. Handle with care since dust and dirt smudges, especially on the

recording surfaces, can reduce the intensity and accuracy of reading or recording signals.

o Labels must be written upon before adhering them to the nonremovable jacket as writing pressure from a pencil or pen on the jacket may damage the diskette. Preferably, felt tipped pens should be used to minimize contamination.

o Labels should be placed so that their location does not obstruct the index sensing hole or adhere the diskette to its jacket.

o It is best not to smoke in the computer room or near the device, but if you must, be extremely careful as smoke and ashes are dirt. Hot ashes are destructive to disks. Food and drink should not be placed on or near the device.

o To reduce the problem of damaged or defective diskettes, never bundle them during storage. Avoid the use of elastic bands or paper clips and store each in its envelope when not in use. Do not stack diskettes on top of other packages.

o The diskette should be stored in an environment that is the same as the diskette unit operating environment. The recommended environment is from 50°F to 115°F (10°C to 46°C) with a relative humidity of 5% to

90%. Abrupt changes in relative humidity must be avoided.

o Diskettes must not be exposed to direct sunlight or intense heat.

Handling of Defective Diskette/Track

Although new diskettes are shipped free of defects, spots on which records cannot be successfully written can develop. If media errors begin to occur, a decision will have to be made by the operator regarding replacement of it. If the media is physically damaged or should the recording surface become contaminated or smudged with dirt, then the diskette must be replaced.

If however, a bad spot develops on the media due to excessive wear on a particular track, then it may be desirable to flag the affected track as being defective in order to keep the remainder of the diskette in use. When a track becomes defective, allocation of space must be made around the bad track. For example, if track 4 on a particular diskette is bad, no files will be allocated space on any track referenced as "track 4."

SECTION 10

CDU 9101/9102/9103/9104 CARTRIDGE DISK UNITS

The CDU9101/9102/9103/9104 Cartridge Disk Units (Figure 10-1) are random access storage devices with a data storage capacity of 2.5 to 10 million bytes per disk for the 256-byte sector format or 2.8 to 11.2 million bytes for the 576-byte sector format. The units are available in low- or high-density units with data recorded at 100 or 200 tracks per inch, respectively, and with either a removable cartridge, or with both a removable and a fixed disk on the same spindle.

The units interface to the Level 6 Megabus by means of a single-board Mass Storage Controller (MSC9101) and a Cartridge Disk Device-Pac (CDM9101). Each unit includes a cable that attaches to a single common device-pac connected to the MSC, which in turn connects to the Megabus.

Table 10-1 list the specifications for the units.
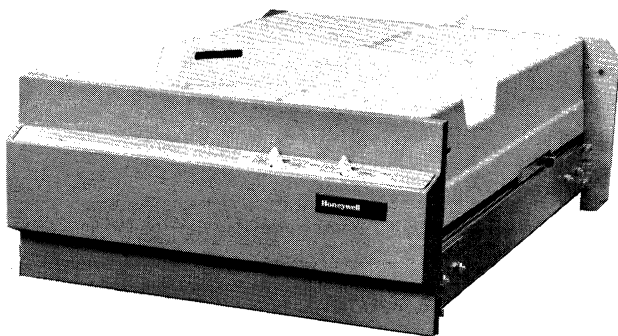
**Figure 10-1. CDU9101/9102/9103/9104
Cartridge Disk Units**

**TABLE 10-1. CDU9101/9102/9103/9104
SPECIFICATIONS**

Density:
CDU9101/9102 – Low
CDU9103/9104 – High

Media:
CDU9101/9103 – Removable
CDU9102/9104 – Removable and Fixed
Capacity:
Bytes/Sector – 256/576
Sectors/Track – 24/12
Bytes/Track – 6144/6912

**TABLE 10-1. (cont). CDU9101/9102/9103/9104
SPECIFICATIONS**

Tracks/Cylinder:
CDU9101/9103 – 2
CDU9102/9104 – 4[a]

Bytes/Cylinder:
CDU9101/9103 – 12,288/13,824
CDU9102/9104 – 24,576/27,648

Cylinders/Unit:
CDU9101/9102 – 204
CDU9103/9104 – 408

Bytes/Unit:
CDU9101 – 2.5/2.8M bytes
CDU9102/9103 – 5.0/5.6M bytes
CDU9104 – 10.0/11.2M bytes
Units/Controller: 4

Bytes/Controller:
CDU9101 – 10.0/11.2M bytes
CDU9102/9103 – 20.0/22.5M bytes
CDU9104 – 40.1/45.1M bytes
Simultaneity: During data transfer on one unit, simultaneous seek operations can be performed on all other units attached to the same controller.

Latency: 12.5 ms (average rotational)

Seek Times:
Same Cylinder – 0
Cylinder to Cylinder – 9 ms
Average Random – 35 ms
Maximum (408 tracks) – 65 ms
Transfer Rate:[b] 2.5M bits/second; 312K bytes/second; 156K words/second
Controller: MSC9101 controls up to 4 disk units of the same density
Device Interface: Single Device-Pac (CDM9101) interfaces up to 4 disk units
Disk Pack: Honeywell M4024 cartridge disk (or equivalent) for either the high- or low-density units
Physical Dimensions:
Height – 8.75 in. (24 cm)
Width – 19 in. (48.2 cm)
Depth – 30 in. (76.2 cm)
Weight – 85 lb (38.6 kg)
Power: 120 Vac +10%, –15%
Power Consumption: 0.80 kVA
Heat Dissipation: 1150 Btu/hr (290 kcal/hr)
Frequency: 60 Hz ±½ Hz

Environment:
Temperature – 50°F to 100°F (10°C to 38°C)
Relative Humidity – 10% to 90% (no condensation)

Cables (maximum):
ac – 8 ft (2.4 m)
dc – 11 ft (3.3 m)

[a]Multitracking between platters is not allowed.

[b]A 7 ms seek delay occurs when switching platters on the 200 tpi units.

MEDIA

Data is recorded on the magnetic oxide coated surface of a double-sided 14-inch aluminum disk. The removable cartridge disk may be changed as application permits. Data representation is in ASCII.

BASIC TRACK FORMAT

Each track on the drive contains 12 or 24 equal length sectors of 576 or 256 bytes respectively. There are 204 or 408 cylinders per surface and 2 or 4 tracks per cylinder yielding a total formatted capacity of 2,506,752 and 11,280,384 bytes, respectively. The data encoding scheme is double frequency recording and each field is preceded by a SYNC word and followed by an EDC (Error Detection Code) word and postamble. The basic track format is shown in Figure 10-2.

CARTRIDGE DISK COMMANDS

Cartridge disk operation is implemented by two sets of instructions: input and output commands (see Table 10-2). Description of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, Order No. AS22.

TABLE 10-2. CARTRIDGE DISK COMMANDS

Type	Function Code	Command
Output	09 [a]	Output Address
	0D	Output Range
	0F	Offset Range
	11	Output Configuration Word A
	13	Output Configuration Word B
	03	Output Interrupt Control
	07	Output Task Word
	01	Output Control Word
Input	0C	Input Range
	0E	Input Offset Range
	10	Input Configuration Word A
	12	Input Configuration Word B
	02	Input Interrupt Control
	26	Input Device ID $\begin{pmatrix} CDU9101 - 2330 \\ CDU9102 - 2331 \\ CDU9103 - 2332 \\ CDU9104 - 2333 \end{pmatrix}$
	06	Input Task Work
	18	Input Status Word

[a]Function Code 09 as executed by the CP results in execution of functions 09 and 0D.
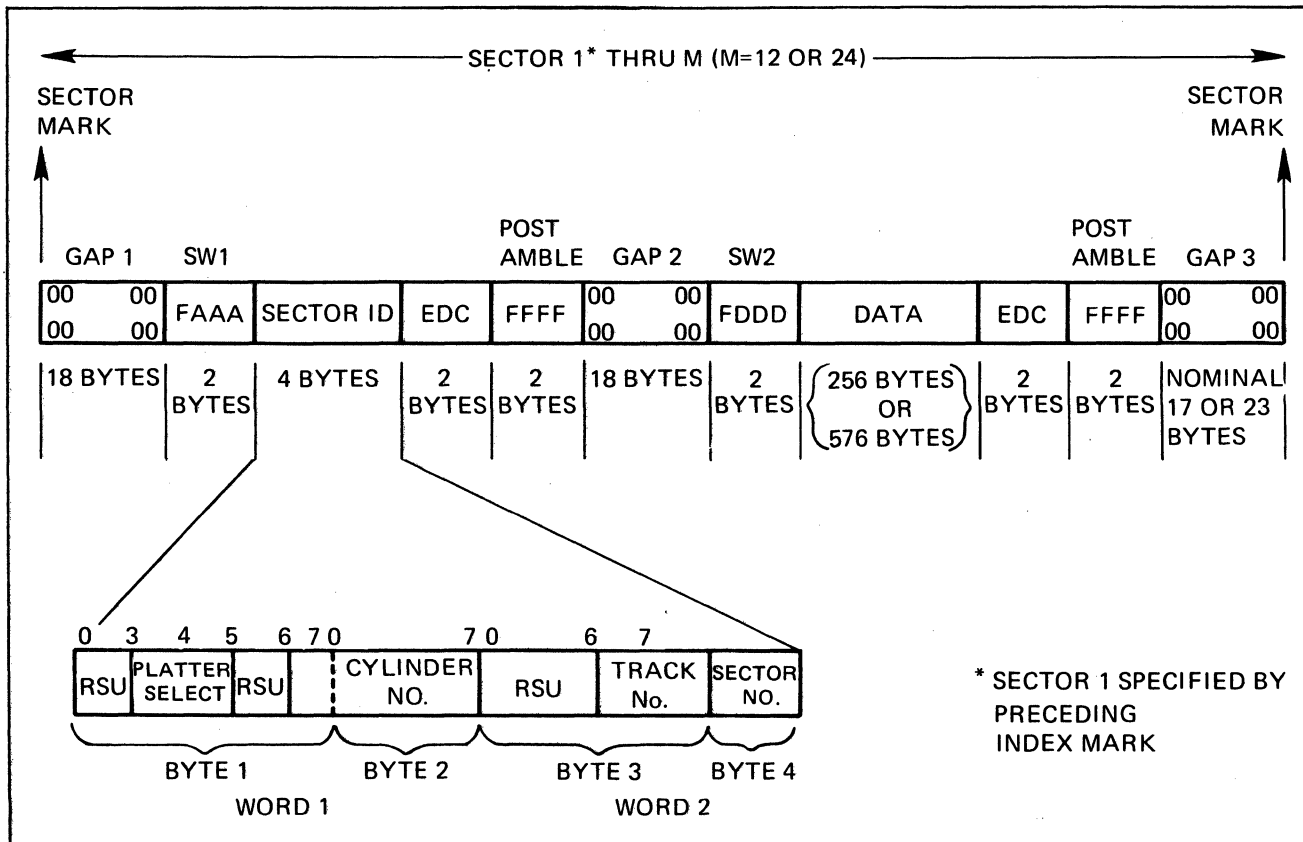
Figure 10-2. Basic Track Format

STATUS BITS

One status word is defined for the Cartridge Disk Unit. Table 10-3 defines the status bits and the means by which each bit is reset. The MSC reacts to disk read or write errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O command is acknowledged normally and stored in MSC memory but causes no further action. If interrupts are blocked (Level = 0), the command in error is used as if there were no error.

TABLE 10-3. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	The device is online with the medium loaded and no further manual intervention is required to place it under program control. Note that a change of state of this bit will cause the Attention bit (bit 1) to be set resulting in an Interrupt (if the interrupt level is nonzero).	A change in condition
Attention	1	Set whenever the Device Ready bit (bit 0 of the status word) changed state. Indicates to software any change of operational status of the device (e.g., load/unload of media). Whenever set, an interrupt is attempted (if the interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) serves as notification of both the end of the operation and the device state change.	Input Status Word or Output Task Word[a]
Overrun/ Underrun	2	Set during a Read or Write operation when the data transfer to/from Main Memory cannot be maintained at a high enough rate (156K) words per second during field transfers in word mode). Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device.	Output Task Word[a]
Write Protection Error	3	Set if an attempt is made to perform any Write operation on a protected surface (i.e., Write Protect is set on the device). Operator intervention is required to reset the Write Protect condition of the device.	Output Task Word[a]
Read Error	4	Set during any Read operation if the EDC word at the end of a field disagrees with the EDC word calculated while reading the field.	Output Task Word[a]
Illegal Seek (100 tpi device only)	5	Set if bit 7 of Configuration Word A is equal to a one during execution of a Seek command.	Output Task Word[a]
Missed Data Sync	6	Set if, after a Sector ID has been detected during any Read operation, the corresponding data field is not detected.	Output Task Word[a]

TABLE 10-3. (cont). STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Unsuccessful Search	7	Set during a nonformat Read or Write operation for which the Sector ID specified in Configuration Words A and B cannot be located on the track. Also set during a Format Write operation if the track has been formatted.	Output Task Word[a]
Missing Clock Pulse	8	Set if the controller detects a missing clock pulse during Write operations. Note that a missing clock pulse during a Read operation results in a Read Error.	Output Task Word[a]
Missing Sector Pulse	9	Set if the controller detects no sector pulse for a period of 1.5 ms. Normally indicates that one of the fixed surfaces (tracks 2 or 3) has been selected on a device which has no fixed platter.	Output Task Word[a]
Seek Error	10	Set during a Seek operation if the MSC receives a seek error indication from the device. Occurs if the device does not successfully complete a Seek operation, or if an attempt is made to Seek beyond the cylinder limits.	Recalibrate[a]
Corrected Memory Error	12	Indicates that during execution of the previous operation Main Memory detected and corrected a memory read error. Data delivered to the MSC was assumed to be correct.	Output Task Word[a]
Nonexistent Resource	13	Set whenever the MSC attempts a Write or Read Request bus cycle and receives a NAK response.	Output Task Word[a]
Bus Parity Error	14	Always zero (not supported by the MSC).	–
Uncorrected Memory Error	15	Indicates that during execution of the previous operation Main Memory detected a memory read error which the EDAC algorithm could not correct. Data delivered to the MSC was incorrect. Will not cause termination of the operation in progress (may result in bad data written on the medium).	Output Task Word[a]

CONTROLS AND INDICATORS

Cartridge disk controls and indicators are shown in Figure 10-3.

POWER

Setting this two-position switch applies or removes power. When set to the right-hand position power is applied and the POWER indicator lights.

START/STOP

Setting this two-position switch starts or stops the unit. When set to the START position the spindle is set in motion, automatically locking the cartridge latches and initiating the cycle-up of the unit (READY lights). When set to the STOP position the spindle is slowed to a stop (approximately 30 seconds), automatically unlocking the cartridge latch and completing the cycle-down of the unit (STOP lights).

READY

This indicator lights when the unit is completely cycled up and ready for operation. Cartridge disk loading or unloading is inhibited (cartridge latches locked) when READY is lit.

WRITE INHIBIT FIXED/RMVBL

One or two (depending on unit) write protect toggle switches are provided on each unit for individual protection of the disks. To protect a fixed and/or removable disk, the appropriate toggle switch(es) are set towards WRITE INHIBIT (the opposite direction to enable writing on disk).

Cartridge Latch Arm

This lever is used to manually lock or unlock the removable cartridge disk pack. In the unlocked position, the two cartridge latches are retracted into the sides of the cartridge disk unit. In the locked position, the two cartridge latches are extended and lock the disk pack in place (Figure 10-3). The cartridge latch arm is inoperable while READY is lit.

> NOTE: The cartridge latch arm should never be forced in either direction.
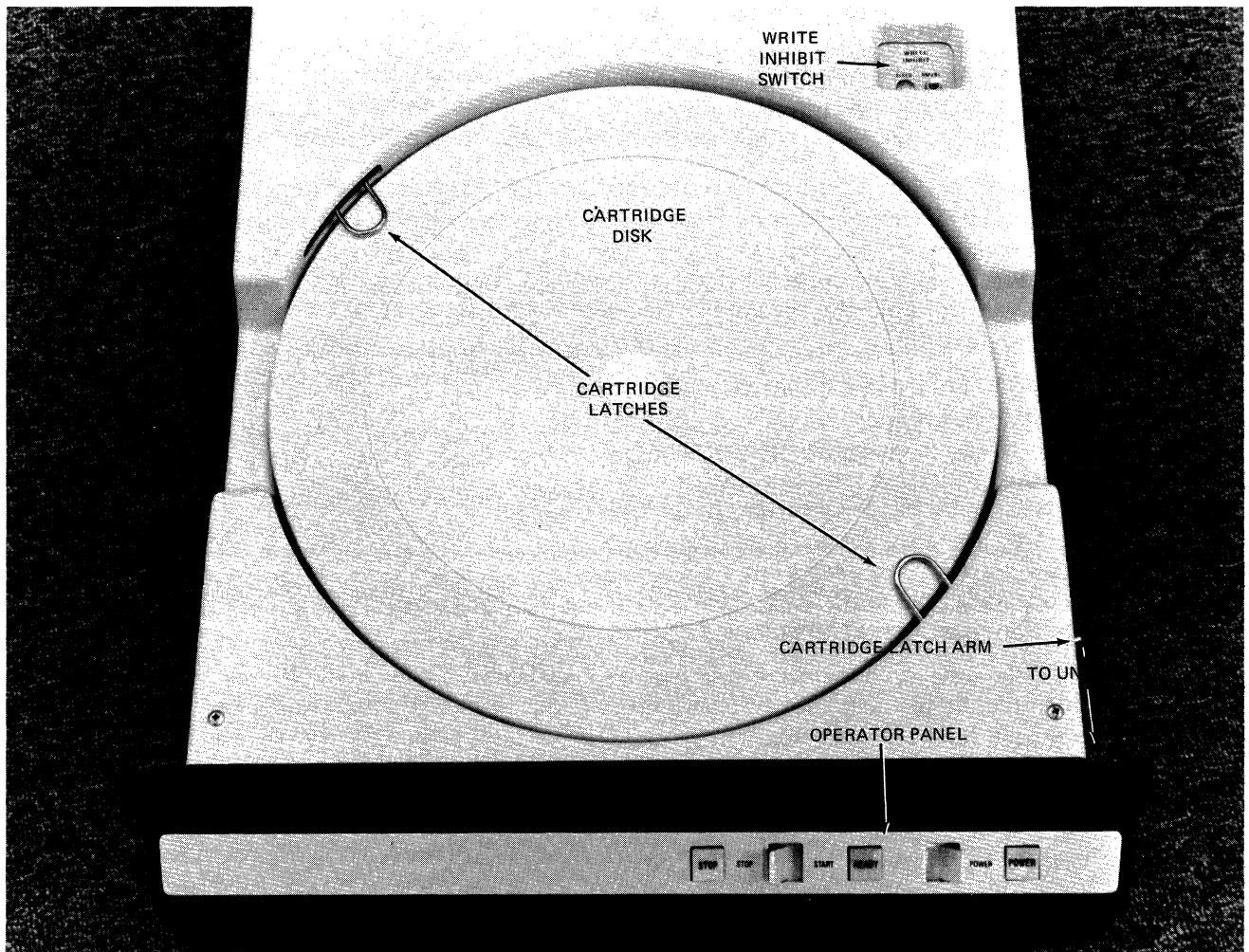

Figure 10-3. CDU9101/9102/9103/9104 Controls and Indicators

OPERATION

Operating procedures for the disk units are described below.

Applying Power

1. Set the POWER switch to POWER. POWER lights indicating that ac power is applied and STOP lights approximately 30 seconds later indicating that the cartridge latch mechanism is automatically unlocked.

Removing Power

1. Set the STOP/START switch to STOP. STOP lights as READY extinguishes.
2. Set the POWER switch to the left-hand position. POWER extinguishes.

Cartridge Disk Loading

NOTE: These instructions pertain to the use of the removable disk.

1. Power-up the disk drive. The cartridge latch mechanism must be unlocked in order to load the drive.
2. If located in the system cabinet, pull the cartridge disk drive forward, extending it as far as it can possibly go out of the cabinet.

WARNING

The base outrigger (located at the base of the cabinet) must be in place before pulling the cartridge disk drive forward.

3. Set the WRITE INHIBIT switch to the desired disk position.
4. Prior to loading, visually observe and check the condition of the cartridge disk. It should be free of dents and nicks. Do not use damaged cartridge.
5. The disk cartridge is sealed in a dust-free container and must be opened for loading. To open the cartridge:

   a. Slide the release button on the cartridge handle to the unlocked position to release the bottom cover.
   b. Lift the cartridge handle to the upright carrying position while holding the release button in the unlocked position. This will release the bottom cover on the cartridge exposing the disk.
   c. In removing the bottom cover, gently lift the cartridge clear of the cover while holding the bottom cover securely with the other hand; having removed the cover, set aside.

6. With the latch mechanism unlocked, retract the latches on the drive to accept the cartridge disk via the cartridge latch arm.

WARNING

When operating cartridge latch arm, it should move freely and never be forced in either direction.

7. With the name on the cartridge facing towards the front of the drive, gently lower and place the cartridge disk onto the drive spindle.
8. Once the cartridge is set firmly in place, lower the handle, allowing the cartridge hub to make contact with the drive spindle. The cartridge is keyed so that it cannot be incorrectly installed.
9. Take the removed bottom cover; invert and place it directly on top of the top-cover of the installed cartridge disk. If the bottom cover is not installed, interlocks will prevent the drive from functioning.
10. Move the cartridge latch arm (Figure 10-3) into the locked position which extends latches over the top of the cartridge securing the cartridge to the drive. If the latches do not close over the cover, the cartridge is not installed properly.
11. Set the STOP/START switch to START. The disk drive spindle is set into motion; the cartridge latch mechanism automatically locks and the STOP indicator extinguishes. The READY indicator lights when the drive is completely cycled up and ready for operation.

Cartridge Disk Unloading

NOTE: These instructions pertain to the use of the removable disk.

1. Power-down the disk drive.
2. When STOP lights (the latch mechanism is unlocked), retract the latches via the cartridge latch arm.
3. Remove the inverted bottom cover from the top of the cartridge disk and set it aside.
4. Slide the release button on the cartridge handle to the unlocked position and lift

the handle to the upright carrying position while holding the release button in the unlocked position. This releases the cartridge from the drive spindle.

5. Gently lift the cartridge disk clear of the spindle housing and replace the bottom cover on the cartridge to protect the disk from contamination.

6. Lower the handle on the cartridge, locking the bottom cover and securing it to the rest of the cartridge.

7. Raise the cartridge handle to the carrying position for removal and storage of the cartridge disk.

> NOTE: When a drive is not being operated, it is recommended that an empty closed cartridge be installed on the drive to protect the fixed disk from contamination.

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning done periodically on a scheduled basis, even though disk unit operation may be satisfactory and not in need of attention.

Care and Handling Of Cartridge Disks

The following routine rules are the prerequisites for proper cartridge disk handling and storage.

o Prior to installation, visually check the physical condition of the cartridge disk. It should be free of dents and nicks. Do not use a damaged disk.

o Keep disks clean. Handle with extreme care as dust and dirt, especially on the recording surfaces, can reduce the intensity and accuracy of reading or recording signals.

o It is best not to smoke in the computer room or near the device, but if you must, be extremely careful as smoke and ashes are dirt. Hot ashes are destructive to disks. Food and drink should not be placed on or near cartridge disks.

o A cartridge disk should be stored in an environment that is the same as the drive operating environment. The recommended storage environment is between 30°F to 149°F (-1°C to 65°C) with a relative humidity of 5% to 98%. Abrupt changes in relative humidity must be avoided to prevent warping or disk buckling.

o Cartridge disks must not be exposed to direct sunlight, intense heat, or magnetic fields.

o Cartridge disks should be neatly stacked flat and stored in a dust-free storage cabinet made of fire-resistant material and not stacked on top of other packages.

Handling Of Defective Cartridge Disk/Track

Although new cartridge disk packages are shipped free of defects, spots on the disk itself on which records cannot be successfully written can develop. If disk errors begin to occur, a decision will have to be made by the operator regarding replacement of the cartridge disk. If the cartridge disk is physically damaged or should the recording surface of the disk become contaminated or smudged with dirt, then the cartridge disk must be replaced.

If, however, a bad spot develops on the disk due to excessive wear on a particular track, then it may be desirable to flag the affected track via software as being defective in order to keep the remainder of the cartridge disk in use. When a track becomes defective, allocation of space on the disk must be made around the bad track.

SECTION 11

CDU 9114/9116 CARTRIDGE DISK UNITS

The CDU9114/9116 Cartridge Disk Units (Figure 11-1) are random access storage devices with a data storage capacity of 5 to 10 million bytes per disk for the 256-byte sector format or 5.6 to 11.2 million bytes for the 576-byte sector format. The units are available in low- or high-density units with data recorded at 100 or 200 tracks per inch, respectively, and with both a removable and a fixed disk on the same spindle.

The units interface to the Level 6 Megabus by means of a single-board Mass Storage Controller (MSC9101) and a Cartridge Disk Device-Pac (CDM9101). Each unit includes a cable that attaches to a single, common device-pac connected to the MSC, which in turn connects to the Megabus.

Table 11-1 list the specifications for the units.
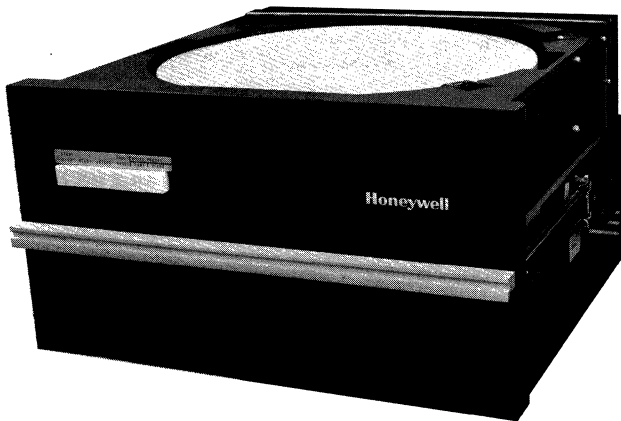
Figure 11-1. CDU9114/9116 Cartridge Disk Units

TABLE 11-1. CDU9114/9116 SPECIFICATIONS

Density:
CDU9114 – Low
CDU9116 – High
Media: Removable and Fixed
Capacity:
Bytes/Sector – 256/576

TABLE 11-1. (cont). CDU9114/9116 SPECIFICATIONS

Sectors/Track – 24/12
Bytes/Track – 6144/6912
Tracks/Cylinder[a] – 4
Bytes/Cylinder – 24,576/27,648

Cylinders/Unit:
CDU9114 – 204
CDU9116 – 408

Bytes/Unit:
CDU9114 – 5.0/5.6M bytes
CDU9116 – 10.0/11.2M bytes
Units/Controller: 4

Bytes/Controller:
CDU9114 – 20.0/22.5M bytes
CDU9116 – 40.1/45.1M bytes
Simultaneity: During data transfer on one unit, simultaneous seek operations can be performed on all other units attached to the same controller
Latency: 12.5 ms (average rotational)

Seek Time:
Same cylinder[b] – 0
Track to track – 9 ms
Average random – 35 ms
Maximum (408 tracks) – 65 ms
Transfer Rate: 2.5M bits/second: 312K bytes/second
Controller: MSC9101 controls up to 4 disk units of the same density
Device Interface: A single device-pac (CDM9101) interfaces up to 4 disk units
Disk Pack: Honeywell M4024 cartridge disk (or equivalent) is used for either the high- or low-density units.
Physical Dimensions:
Height – 8.75 in. (24 cm)
Width – 19 in. (48.2 cm)
Depth – 30 in. (76.2 cm)
Weight – 85 lb. (38.6 kg)
Power: 120 Vac +10%, -15%
Power Consumption: 0.80 kVA
Heat Dissipation: 1150 Btu/hr (290 kilocalories/hr)
Frequency: 60 Hz ± ½ Hz

Environment:
Temperature – 50°F to 100°F (10°C to 38°C)
Relative Humidity – 10% to 90% (no condensation)

Cables (maximum):
ac – 8 ft (2.4 m)
dc – 11 ft (3.3m)

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[a] Fixed and removable tracks on the same cylinder will not be linked by multiple sector data transfers – they are considered logically different media.

[b] Cartridge disk (fixed and removable) cannot be crossed without initiation of a seek operation.

MEDIA

Data is recorded on the magnetic oxide coated surface of a double-sided 14-inch aluminum disk. The removable cartridge disk may be changed as application permits. Data representation is in ASCII.

BASIC TRACK FORMAT

Each track on the drive contains 12 or 24 equal length sectors of 576 or 256 bytes respectively. There are 204 or 408 cylinders per surface and 4 tracks per cylinder yielding a total formatted capacity of 5,640,192 and 11,280,384 bytes, respectively. The data encoding scheme is double frequency recording and each field is preceded by a SYNC word and followed by an EDC (Error Detection Code) word and postamble. The basic track format is shown in Figure 11-2.

CARTRIDGE DISK COMMANDS

Cartridge disk operation is implemented by two sets of instructions: input and output commands (see Table 11-2). Descriptions of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, Order No. AS22.

TABLE 11-2. CARTRIDGE DISK COMMANDS

Type	Function Code	Command
Output	09[a]	Output Address
	0D	Output Range
	0F	Offset Range
	11	Output Configuration Word A
	13	Output Configuration Word B
	03	Output Interrupt Control
	07	Output Task Word
	01	Output Control Word
Input	0C	Input Range
	0E	Input Offset Range
	10	Input Configuration Word A
	12	Input Configuration Word B
	02	Input Interrupt Control
	26	Input Device ID
		CDU9114—2331
		CDU9116—2333
	06	Input Task Word
	18	Input Status Word

[a]Function Code 09 as executed by the CP results in execution of functions 09 and 0D.
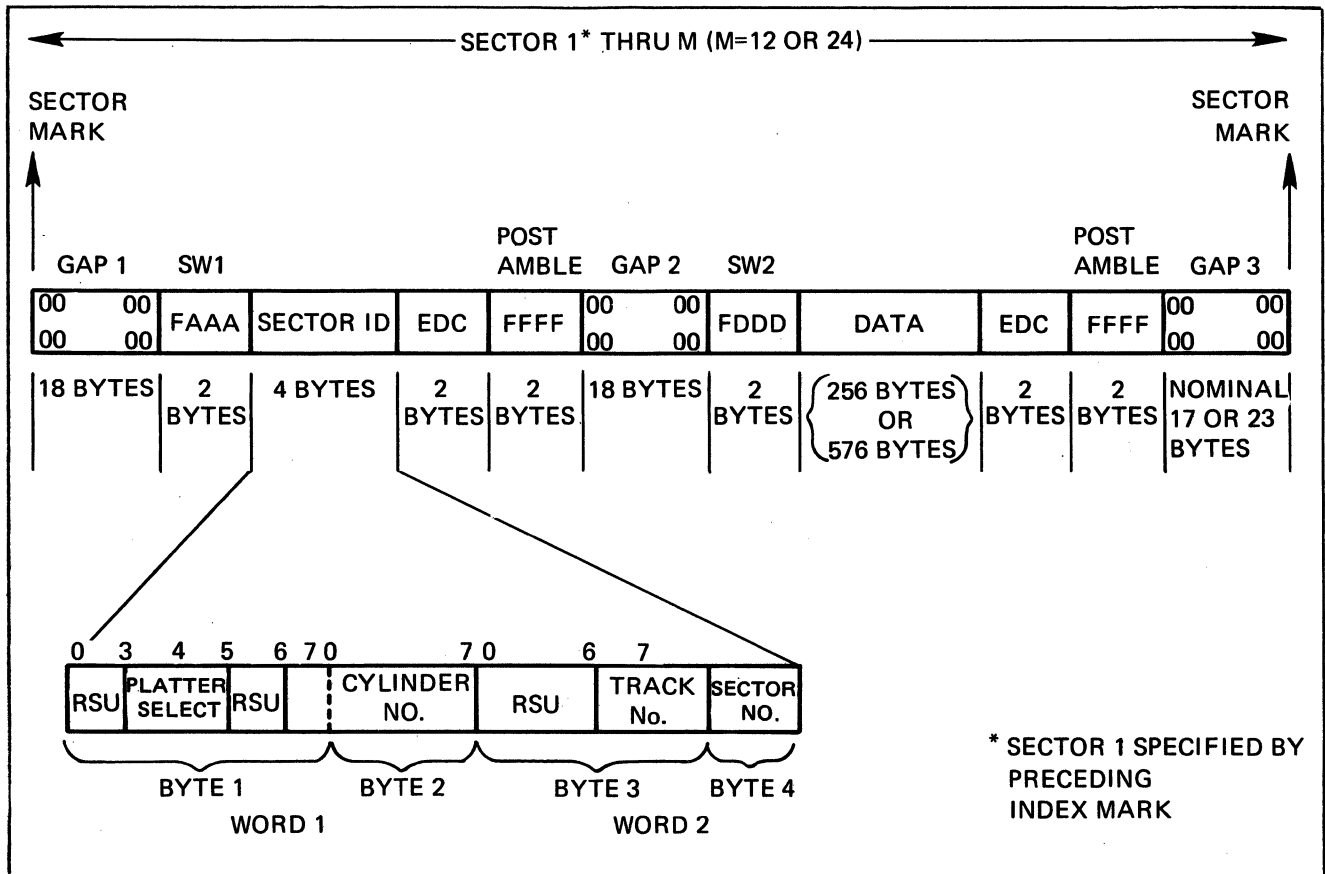
Figure 11-2. Basic Track Format

STATUS BITS

One status word is defined for the Cartridge Disk Unit. Table 11-3 defines the status bits and the means by which each bit is reset. The MSC reacts to disk read or write errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bits and interrupt the central processor (if interrupts are allowed). The I/O command is acknowledged normally and stored in MSC memory but causes no further action. If interrupts are blocked (Level = 0), the command in error is used as if there were no error.

TABLE 11-3. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	The device is online with the medium loaded and no further manual intervention is required to place it under program control. Note that a change of state of this bit will cause the Attention bit (bit 1) to be set resulting in an Interrupt (if the interrupt level is nonzero).	A change in condition
Attention	1	Set whenever the Device Ready bit (bit 0 of the status word) changed state. Indicates to software any change of operational status of the device (e.g., load/unload of media). Whenever set, an interrupt is attempted (if the interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) serves as notification of both the end of the operation and the device state change.	Input Status Word or Output Task Word[a]
Overrun/ Underrun	2	Set during a Read or Write operation when the data transfer to/from Main Memory cannot be maintained at a high enough rate (156K) words per second during field transfers in word mode). Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device.	Output Task Word[a]
Write Protection Error	3	Set if an attempt is made to perform any Write operation on a protected surface (i.e., Write Protect is set on the device). Operator intervention is required to reset the Write Protect condition of the device.	Output Task Word[a]
Read Error	4	Set during any Read operation if the EDC word at the end of a field disagrees with the EDC word calculated while reading the field.	Output Task Word[a]
Illegal Seek (100 tpi device only)	5	Set if bit 7 of Configuration Word A is equal to a one during execution of a Seek command.	Output Task Word[a]
Missed Data Sync	6	Set if, after a Sector ID has been detected during any Read operation, the corresponding data field is not detected.	Output Task Word[a]

TABLE 11-3 (cont). STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Unsuccessful Search	7	Set during a nonformat Read or Write operation for which the Sector ID specified in Configuration Words A and B cannot be located on the track. Also set during a Format Write operation if the track has been formatted.	Output Task Word[a]
Missing Clock Pulse	8	Set if the controller detects a missing clock pulse during Write operations. Note that a missing clock pulse during a Read operation results in a Read Error.	Output Task Word[a]
Missing Sector Pulse	9	Set if the controller detects no sector pulse for a period of 1.5 ms. Normally indicates that one of the fixed surfaces (tracks 2 or 3) has been selected on a device which has no fixed platter.	Output Task Word[a]
Seek Error	10	Set during a Seek operation if the MSC receives a seek error indication from the device. Occurs if the device does not successfully complete a Seek operation, or if an attempt is made to Seek beyond the cylinder limits.	Recalibrate[a]
Corrected Memory Error	12	Indicates that during execution of the previous operation Main Memory detected and corrected a memory read error. Data delivered to the MSC was assumed to be correct.	Output Task Word[a]
Nonexistent Resource	13	Set whenever the MSC attempts a Write or Read Request bus cycle and receives a NAK response.	Output Task Word[a]
Bus Parity Error	14	Always zero (not supported by the MSC).	–
Uncorrected Memory Error	15	Indicates that during execution of the previous operation Main Memory detected a memory read error which the EDAC algorithm could not correct. Data delivered to the MSC was incorrect. Will not cause termination of the operation in progress (may result in bad data written on the medium).	Output Task Word[a]

[a]Initialize (output control word) and Master Clear on the Bus also resets these status bits.

CONTROLS AND INDICATORS

Cartridge disk controls and indicators are shown in Figure 11-3.

START/STOP

Pressing this button starts or stops the unit. When the button is extinguished, the unit is stopped and READY and ACTIVE are also extinguished. The cartridge latch mechanism is unlocked at this time permitting a cartridge disk to be loaded or unloaded. When the button is lit, the spindle is in motion, automatically locking the cartridge latch and initiating cycle-up. READY lights when the cycle-up is completed.

READY

Lights when the unit is properly cycled-up and ready for operation. Cartridge disk loading or unloading is inhibited at this time.

ACTIVE

Lights when the unit is in operation (i.e., a seek, read or write operation is taking place).

FAULT/RESET

Lights when a fault has been detected. After the fault is corrected, pressing this button clears the fault condition.

WRITE PROTECT CART/FIXED

Pressing one or both buttons protects the disk(s) from inadvertent writing. The button lights if write protect is enabled.

Cartridge Latches

Two individually operated latches are used to manually lock or unlock the removable cartridge disk pack. In the unlocked position, the two cartridge latches are retracted from the top cover. In the locked position, the two cartridge latches clasp the top cover.

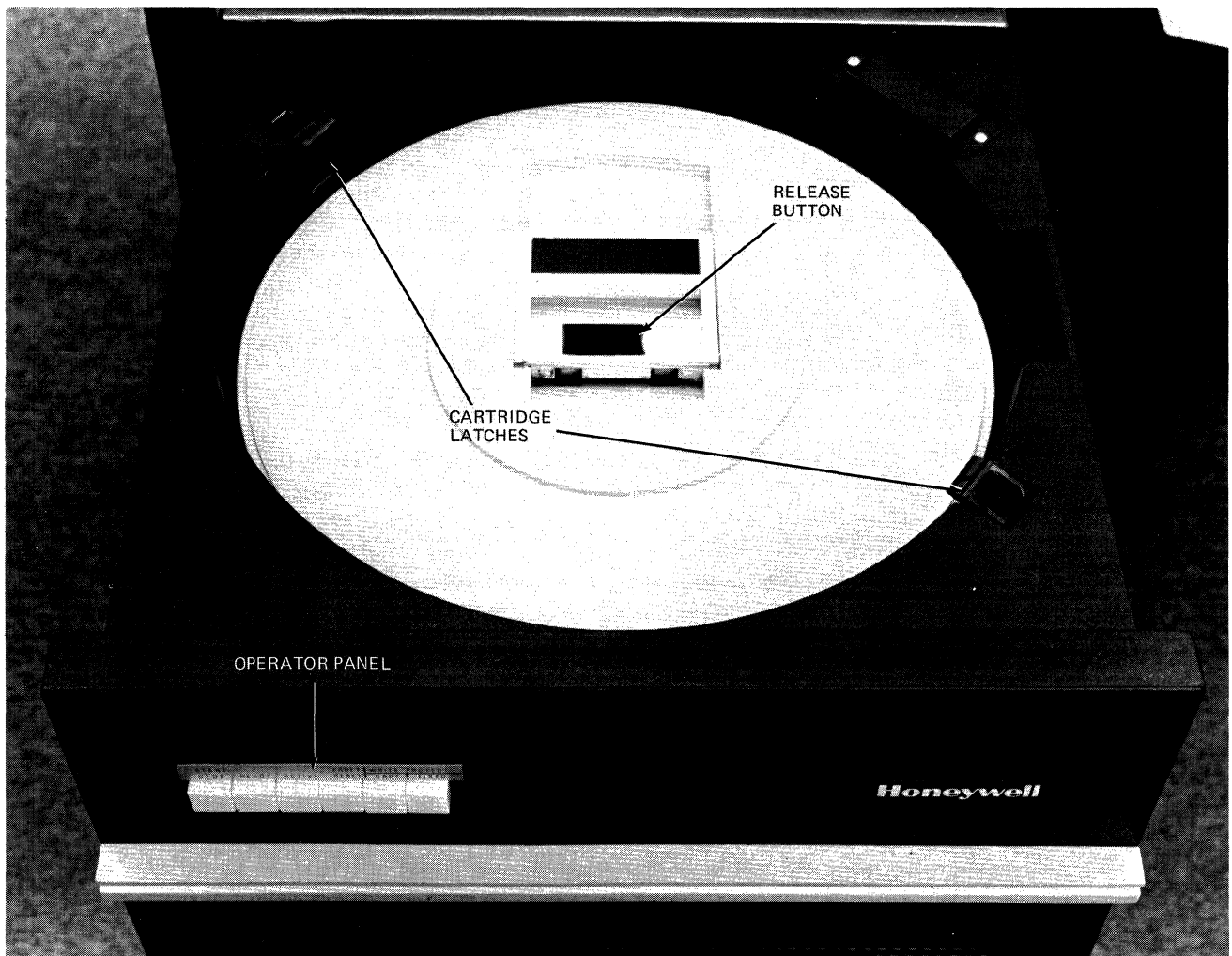> NOTE: The cartridge latches are inoperable while READY is lit.

Figure 11-3. CDU9114/9116 Controls and Indicators

OPERATION

Operating procedures for the disk units are described below.

Applying and Removing Power

Power to the Cartridge Disk Units is applied or removed by the POWER switch on the system control panel.

Cartridge Disk Loading

NOTE: These instructions pertain to the use of the removable disk.

1. Power-up the disk drive. The cartridge latch mechanism must be unlocked in order to load the drive.
2. If located in the system cabinet, pull the cartridge disk drive forward, extending it as far as it can possibly go out of the cabinet.

WARNING

The base outrigger (located at the base of the cabinet) must be in place before pulling the cartridge disk drive forward.

3. Press the write protect buttons as appropriate for the disks.
4. Prior to loading, visually observe and check the condition of the cartridge disk. It should be free of dents and nicks. Do not use a damaged cartridge.
5. The disk cartridge is sealed in a dust-free container and must be opened for loading. To open the cartridge:
   a. Slide the release button on the cartridge handle to the unlocked position to release the bottom cover.
   b. Lift the cartridge handle to the upright carrying position while holding the release button in the unlocked position. This will release the bottom cover on the cartridge exposing the disk.
   c. In removing the bottom cover, gently lift the cartridge clear of the cover while holding the bottom cover securely with the other hand; having removed the cover, set it aside.
6. With the name on the cartridge facing towards the front of the drive, gently lower and place the cartridge disk onto the drive spindle.
7. Once the cartridge is set firmly in place, lower the handle, allowing the cartridge hub to make contact with the drive spindle. The cartridge is keyed so that it cannot be incorrectly installed.

8. Take the removed bottom cover; invert and place it directly on top of the topcover of the installed cartridge disk. If the bottom cover is not installed, interlocks will prevent the drive from functioning.
9. Move the cartridge latches (Figure 11-3) into the locked position which has them clasping the top cover of the cartridge. If the latches do not close over the cover, the cartridge is not installed properly.
10. Press STOP/START button. The disk drive spindle is set into motion; the cartridge latch mechanism automatically locks, the STOP light extinguishes and START lights. READY lights when the drive is completely cycled up and ready for operation.

Cartridge Disk Unloading

NOTE: These instructions pertain to the removable cartridge disk.

1. Press the START/STOP button.
2. Wait for READY to extinguish (cartridge latch mechanism automatically unlocks), then retract the cartridge latches.
3. Remove the inverted bottom cover from the top of the cartridge disk and set it aside.
4. Slide the release button on the cartridge handle to the unlocked position and lift the handle to the upright carrying position while holding the release button in the unlocked position. This releases the cartridge from the drive spindle.
5. Gently lift the cartridge disk clear of the spindle housing and replace the bottom cover on the cartridge to protect the disk from contamination.
6. Lower the handle on the cartridge, locking the bottom cover and securing it to the rest of the cartridge.
7. Raise the cartridge handle to the carrying position for removal and storage of the cartridge disk.

   NOTE: When a drive is not being operated, it is recommended that an empty closed cartridge be installed on the drive to protect the fixed disk from contamination.

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning done periodically on a scheduled basis, even though disk unit operation may be satisfactory and not in need of attention.

Care And Handling Of Cartridge Disks

The following routine rules are the prerequisites for proper cartridge disk handling and storage.

o Prior to installation, visually check the physical condition of the cartridge disk. It should be free of dents and nicks. Do not use a damaged disk.

o Keep disks clean. Handle with extreme care as dust and dirt, especially on the recording surfaces, can reduce the intensity and accuracy of reading or recording signals.

o It is best not to smoke in the computer room or near the device, but if you must, be extremely careful as smoke and ashes are dirt. Hot ashes are destructive to disks. Food and drink should not be placed on or near cartridge disks.

o A cartridge disk should be stored in an environment that is the same as the drive operating environment. The recommended storage environment is between 30°F to 149° (-1°C to 65°C) with a relative humidity of 5% to 98%. Abrupt changes in relative humidity must be avoided to prevent warping or disk buckling.

o Cartridge disks must not be exposed to direct sunlight, intense heat, or magnetic fields.

o Cartridge disks should be neatly stacked flat and stored in a dust-free storage cabinet made of fire-resistant material and not stacked on top of other packages.

Handling of Defective Cartridge Disk/Track

Although new cartridge disk packages are shipped free of defects, spots on the disk itself on which records cannot be successively written can develop. If disk errors begin to occur, a decision will have to be made by the operator regarding replacement of the cartridge disk. If the cartridge disk is physically damaged or should the recording surface of the disk become contaminated or smudged with dirt, then the cartridge disk must be replaced.

If, however, a bad spot develops on the disk due to excessive wear on a particular track, then it may be desirable to flag the affected track via software as being defective in order to keep the remainder of the cartridge disk in use. When a track becomes defective, allocation of space on the disk must be made around the bad track.

SECTION 12

PRU9101/9102 SERIAL PRINTERS

The PRU9101/9102 Serial Printers (Figure 12-1) are self-contained, tabletop-sized printers designed for low-cost printing requirements. The printers have 64- and 96-ASCII code character sets, respectively. Both operate at 165 characters per second and print at line speeds of 60 lpm for 132 characters per line and 200 lpm for 20–30 characters per line.

The printers interface to the Level 6 Megabus by means of a single-board Multiple Device Controller (MDC9101)[1] and a Printer Device-Pac (PRM9101). Each printer includes a 50-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus. The printers can be made self-standing via a serial printer pedestal (Option PRF9101).

Table 12-1 lists the serial printer character set and Table 12-2 lists the printer specifications.

Figure 12-1. PRU9101/9102 Serial Printers

TABLE 12-1. SERIAL PRINTER CHARACTER SET

H2 \ H1	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l		
D	CR	GS	–	=	M	]	m	}
E	SO	RS	.	>	N	^	n	^
F	SI	US	/	?	O	_	o	SP

For ASCII to hexadecimal conversion: Each ASCII character = 2 hexadecimal digits (8 bits): H1 H2. For example: T = 54.

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[1] Alternatively, the Magnetic Tape Controller (MTC9101), which supports up to 4 tape units or a combination of tape units and unit record devices (serial/line printers and card readers), can be used. A maximum of 2 tape units and 2 unit record devices can be configured.

TABLE 12-2. PRU9101/9102 SPECIFICATIONS

Printable Characters:
PRU9101 — 64-character set (10 numeric, 26 alphabetic, 28 special symbols)
PRU9102 — 96-character set (10 numeric, 52 alphabetic, 34 special symbols)
Print Format: 132 print positions per line, 10 characters per inch
Vertical Spacing: 6 lines per inch
Print Speed: 60 lpm at 132 characters per line
Matrix Font: 9 x 7 dot (equivalent to 10-point type)
Programmed Operations: Print only; space only; space and print
Device Interface: Each serial printer requires its own Printer Device-Pac (PRM9101)
Ribbon: M3918

Paper Stock:
Width — 4.4 in. to 14.8 in. (11.4 cm to 37.8 cm)
Weight — (Standard fan-folded and edge-punched) — 15 lb (6.82 kg) minimum; (multicopy) — 12 lb (5.45 kg) maximum; (with carbon-5 parts) — 6 lb (2.73 kg)

Physical Dimensions:
Height — 13.5 in. (34.2 cm)
Width — 28 in. (71.1 cm)
Depth — 22 in. (55.8 cm)
Weight — 120 lb. (54.4 kg)

TABLE 12-2 (CONT). PRU9101/9102 SPECIFICATIONS

Power: 120 Vac +10%, −15%
Power Consumption: 0.45 kVA
Heat Dissipation: 1350 Btu/hr (340 kcal/hr)
Frequency: 60 Hz ±½ Hz

Environment:
Temperature − 50°F to 100°F (10°C to 38°C)
Relative Humidity − 30% to 70% (no condensation)

Cables (maximum):
ac − 8 ft (2.4 m)
dc − 50 ft (15.2 m)

SERIAL PRINTER COMMANDS

Serial printer operation is implemented by two sets of instructions: input and output commands (see Table 12-3). Description of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, AS22.

STATUS BITS

One status word is defined for the serial printer. Table 12-4 defines the status bits and the means by which each bit is reset. The MDC reacts to card reader errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring on I/O commands from the central processor set the appropriate status bit and interrupt the processor immediately (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action.

TABLE 12-3. SERIAL PRINTER COMMANDS

Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	07	Output Task Word
	09	Output Address and Range
Input	02	Input Interrupt Control
	06	Input Task Word
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	0C	Input Range
	18	Input Status Word
	26	Input Device ID $\{$ 2004-PRU9101 $\}$ $\{$ 2006-PRU9102 $\}$

TABLE 12-4. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	Printer power on. No faults. Paper loaded. No open interlocks. Switches in correct positions.	A change in conditions
Attention	1	Device ready condition has changed.	Input Status word clears this bit[a]
End of Form	3	Printer has detected end-of-form either by VFU, if equipped, or otherwise by preconfigured line count.	Next IOLD Command[a]
Corrected Memory Error	12	Memory read response was accompanied by a signal indicating the error was corrected.	Next IOLD Command[a]
Nonexistent Resource	13	A NAK was received from memory. Indicates possible programming error (nonexistent memory).	Next IOLD Command[a]
Parity	14	Parity was incorrect on a bus transfer toward the MDC.	Next IOLD Command[a]
Uncorrectable Memory	15	Memory read response was accompanied by a signal indicating an error existed that could not be corrected.	Next IOLD Command[a]

[a]Initialize (output control word) and Master Clear on the Bus also reset these status bits.

CONTROLS AND INDICATORS

Serial printer controls and indicators are located on a panel on the right-hand side of the printer cabinet (see Figure 12-2).
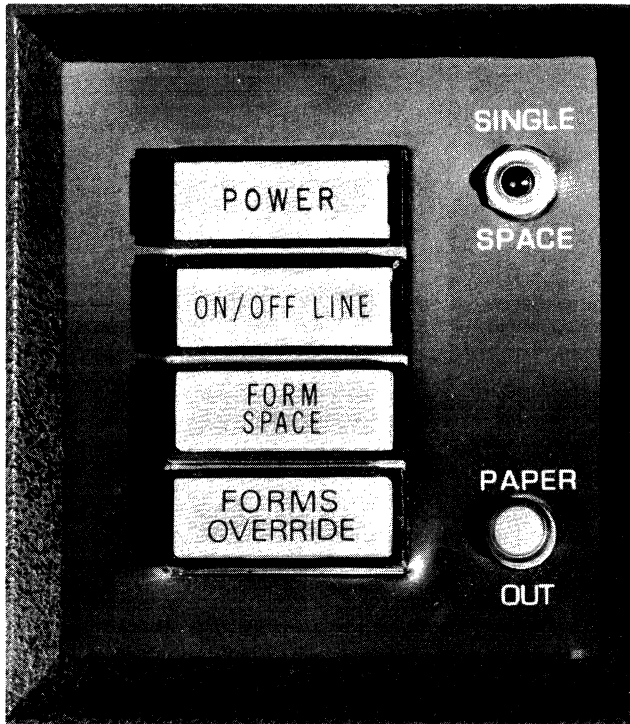

Figure 12-2. PRU9101/9102 Control Panel

POWER

Pressing the POWER push button applies power to the printer (the push button lights, indicating that the device is on). Subsequent pressing of the POWER push button removes power from the device (the light is extinguished).

ON/OFF LINE

Pressing this button selects the online/offline mode. In the online mode with ON/OFF LINE push button lit, the printer is logically connected to the central processor and is available for printing. In the offline mode with the button not lit, the printer is not logically connected to the central processor.

FORM SPACE

Pressing manually advances the paper to the top-of-form (the first selected print line following the paper perforation). This push button is also used to reposition the paper tape controller to the first printing position (printer reacts to the punches in the paper tape to control all print formatting). The top-of-form is determined when the paper tape is made (punched).

Before the FORM SPACE button is used, the operator should ensure that the ON/OFF LINE

button is not lit (in the OFF LINE position). The FORM SPACE button is not operational when the printer is online to the central processor.

FORMS OVERRIDE

Pressing overrides the PAPER OUT indicator, thereby allowing the current form to be completed before changing the paper. This prevents the form currently being printed from being split onto two separate forms.

SINGLE SPACE

Pressing this button allows for manual single-line feeds, but it is not operational when the printer is online to the central processor.

PAPER OUT

Indicates an out-of-paper situation. Pressing FORMS OVERRIDE overrides the condition (completing the current form) or allows change of paper.

MECHANICAL ADJUSTMENTS

These controls are adjusted to allow the paper to move freely and accurately through the print mechanism.

Horizontal Forms Tension Adjustment

This adjustment is used if the paper has been loaded, but the horizontal forms tension is too tight or too loose:

1. Loosen the lock screw on the right tractor assembly.
2. Slide the right tractor assembly along its rails to the left or right until the correct tension is reached.
3. Tighten the lock screw on the right tractor assembly.

Horizontal Forms Position Adjustment

This adjustment is used if the paper has been loaded, but the forms are not positioned properly:

1. Loosen the lock screws on the left and right tractor assemblies.
2. Grasp both tractor assemblies and slide them in unison to the desired position.
3. Tighten the lock screws on both tractor assemblies.

Top of Form Adjustment

See Figure 12-3 for identification of the controls used.

1. With the printer turned on, press the FORMS SPACE button. This aligns the top-of-form hole in the vertical format tape, directly over the light source in the paper tape reader.
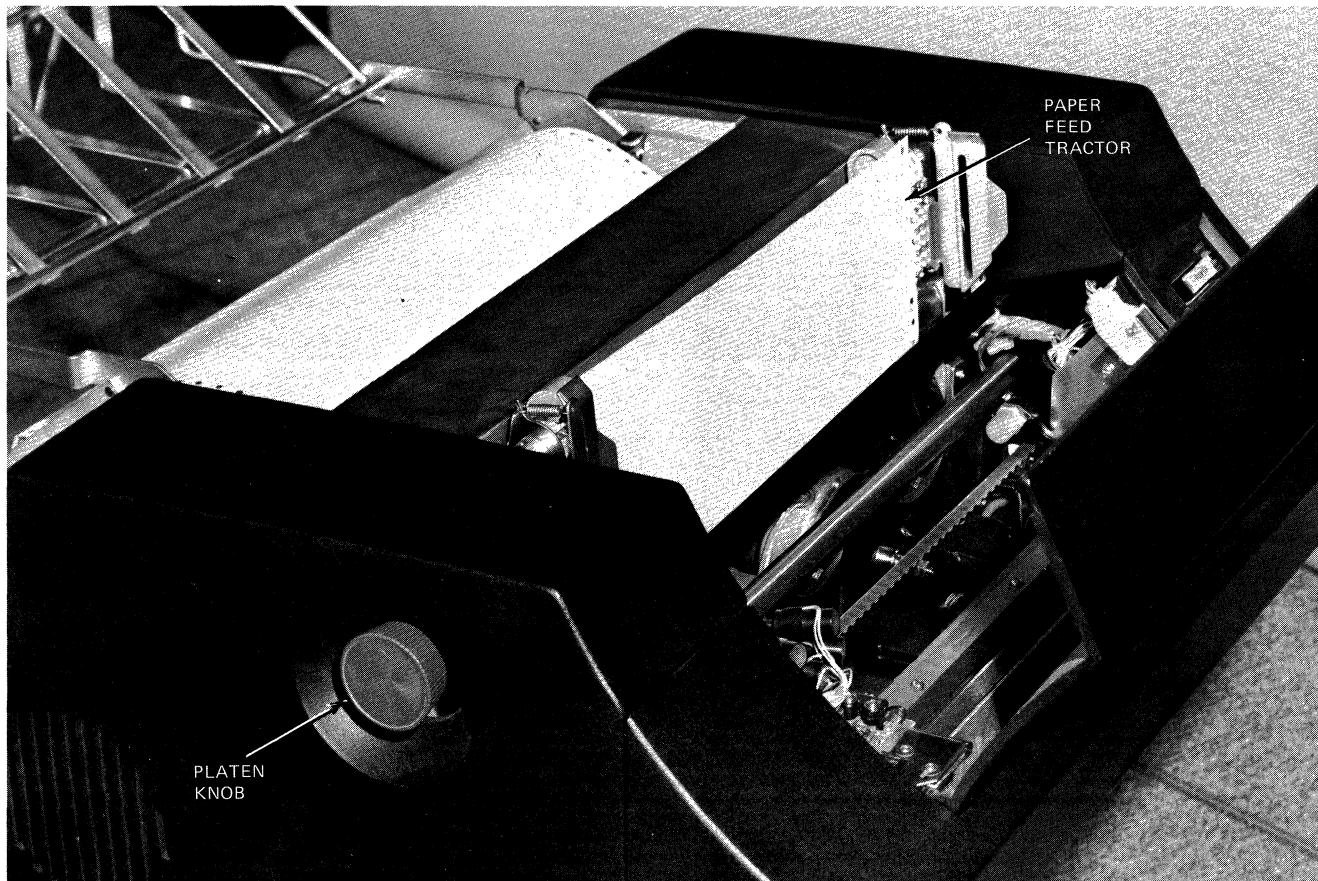
Figure 12-3. Paper Loading and Form Alignment Controls

PAPER FEED TRACTOR
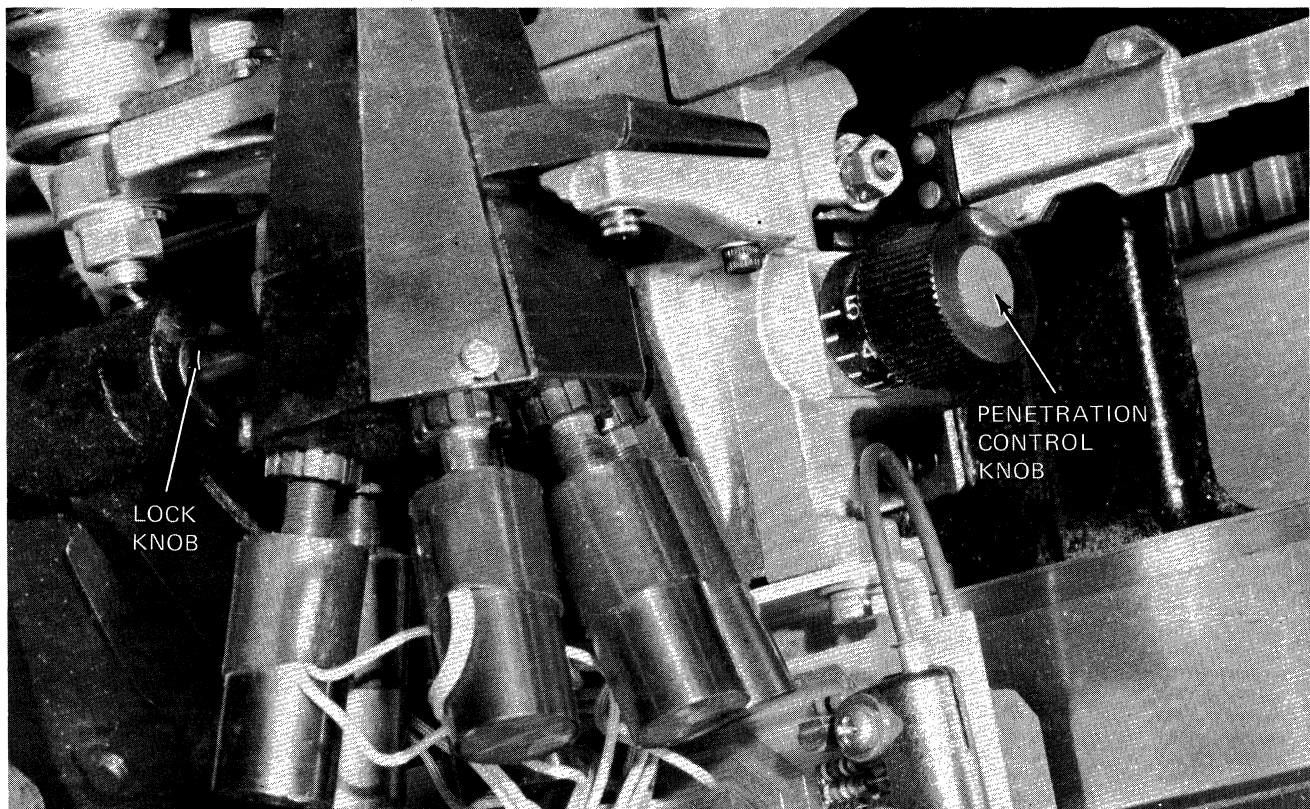
PLATEN KNOB

Figure 12-4. Forms Thickness Control

PENETRATION CONTROL KNOB

LOCK KNOB

2. Use the platen knob to adjust the paper so that the desired top line on the form is aligned vertically with the print head. This adjustment is performed by pulling out the platen knob and rotating it in either direction. Once aligned, each time a Form Feed code is received or the FORMS SPACE button is pressed, the paper slews to this same line at the top of the next form.

Forms Thickness Adjustment

Two adjustment knobs, on either side of the print head carriage, control the clearance between the platen and the face of the print head (see Figure 12-4). This clearance must be adjusted according to the thickness of the forms being used.

To adjust the print head for optimum print quality do the following:

1. Open the front cabinet cover.
2. Loosen the Lock Knob on the left side of the print head.
3. Increase the penetration of the print wires on the ribbon by slightly turning the Penetration Control Knob.
4. Manually move the print head across the paper. Keep increasing the penetration until smudging occurs.
5. Back off the Penetration Control Knob just to the point of no smudging.
6. Tighten the Lock Knob to secure the print head in position.

NOTE: Numbers on the Penetration Control Knob do not correspond to the number of copies used.

7. Close front cabinet cover.

Figure 12-5. Vertical Format Unit

VERTICAL FORMAT UNIT
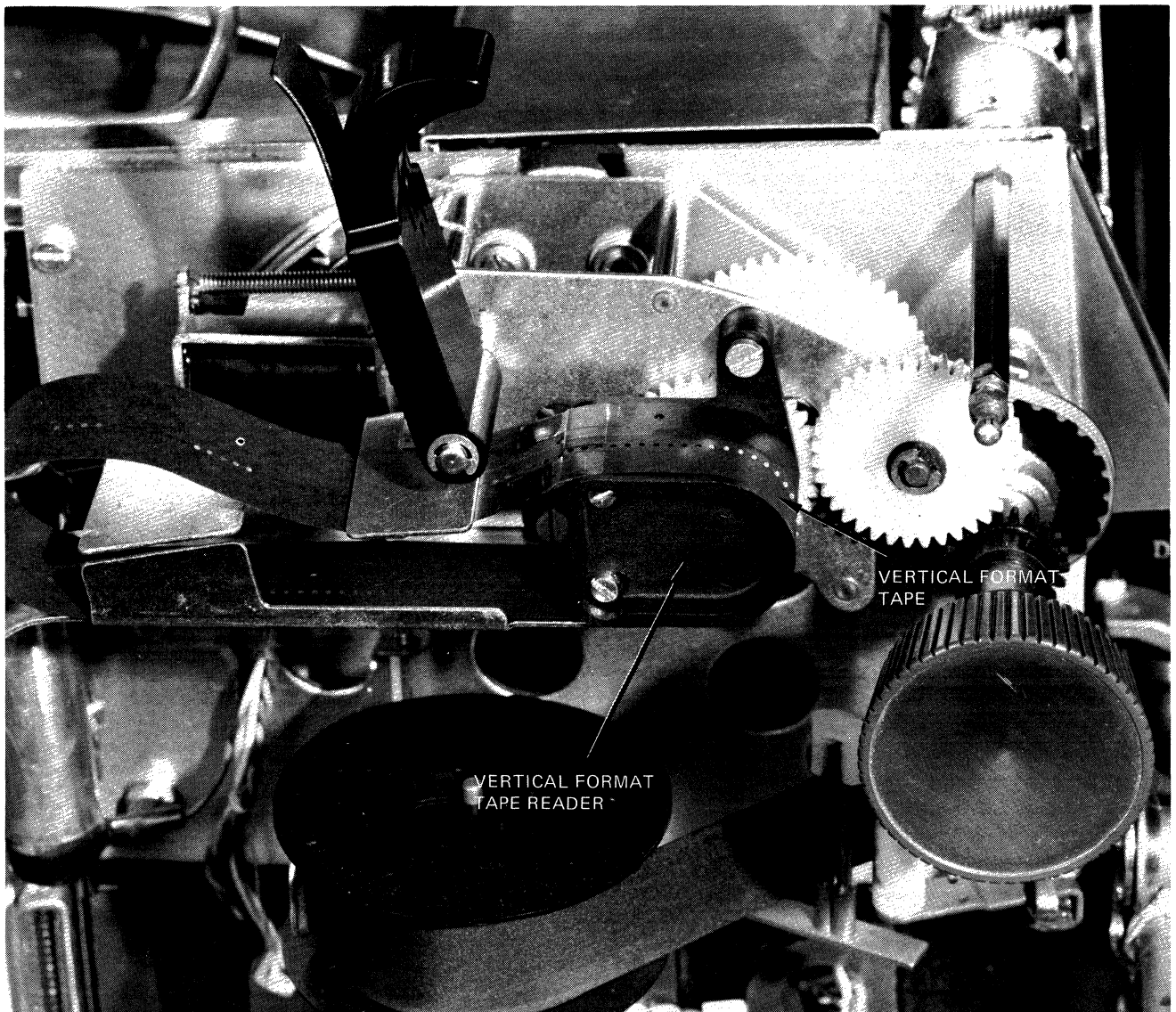
Vertical formatting is controlled by a paper tape in the Vertical Format Unit (see Figure 12-5). This unit is located on the upper left side of the printer, just under the left cover.

The tape is a standard 1-inch wide, 8-channel, black opaque paper tape (see Figure 12-6). The sprocket holes, located between channels 3 and 4, have a 1/10-inch pitch between holes. Channel 5 defines the Vertical Tab format and Channel 7 the Top-of-Form format. The tape reader and the paper feed mechanism are mechanically linked so that each line feed advances both the paper by one line and the paper tape by one sprocket hole.

Reception of a Vertical Tab code advances the paper (and tape) to the next hole in Channel 5. For example, if the holes in Channel 5 are spaced 6 sprocket holes apart, each Vertical Tab advances the paper 6 lines (1 inch).

Similarly, reception of a Form Feed code or pressing FORMS SPACE advances the paper (and tape) to the next hole in Channel 7.

On the standard paper tape shipped with the printer, Vertical Tab holes are spaced 6 sprocket holes apart in Channel 5, (corresponding to a 1-inch tab) and Top of Form holes are spaced 66 sprocket holes apart in Channel 7 (corresponding to an 11-inch form).
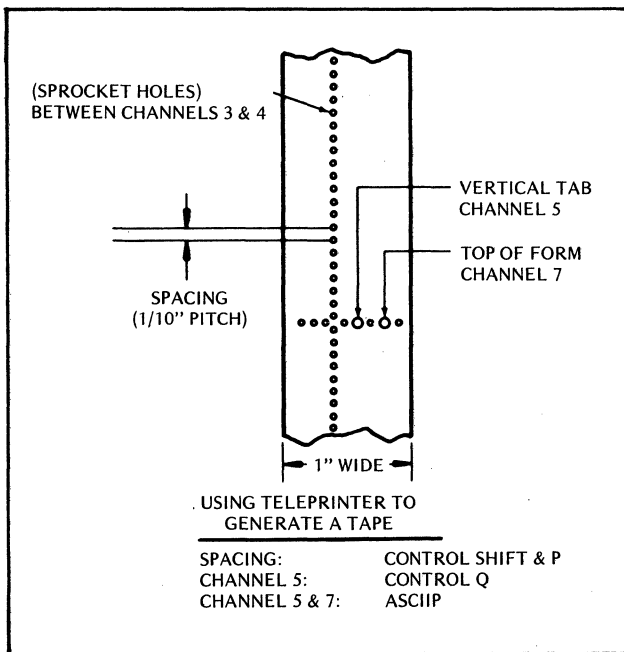

Figure 12-6. Vertical Format Tape

OPERATION

Operating procedures for the serial printers are described as follows:

Applying Power

Press the POWER button on the operator control panel. The device is powered up when the POWER button lights.

Removing Power

Press the POWER button on the operator control panel. The device is powered down when the POWER button is extinguished.

Paper Loading

1. Open the front cabinet cover.
2. Open the paper feed tractors for the left and right pin feed units. Make sure the left pin feed unit is locked in place at the extreme left margin.
3. Feed the paper down through the slanted opening in the top of the printer. The paper will follow the forward paper pan and come up to the pin feed tractors.
4. Place the top sheet in the paper feed tractors. Make sure the holes are aligned so that the top of the sheet is parallel with the top of the printer. If necessary, loosen the fixing knob on the top of the right pin feed unit and move the unit to accommodate the width of the paper. When properly adjusted, tighten the fixing knob.
5. Close the paper feed tractors.
6. Close the front cabinet cover.

Start/Run Sequence

Once the printer has been powered up and loaded with paper, it is ready to be placed online to accept data from the system.

1. Ensure that all controls on the control panel and all mechanical adjustments have been properly made.
2. Press the ON/OFF LINE button. It will light in the online position.

Ribbon Replacement

To replace a ribbon follow this procedure (see Figure 12-7):

1. Press the POWER button to remove power.
2. Open the front cabinet cover and loosen the Lock Knob on the left side of the print head.
3. Note the setting on the Penetration Control Knob, then set the knob to No. 5.
4. Open the side cabinet covers.
5. Remove the caps from the ribbon reversing guides.

6. Swing the ribbon tension arms clear of the spools.
7. Lift the spools clear of the axles.
8. Place the empty spools (partially wound) on the right-hand axle.
9. Insert the ribbon through the right-hand reversing guide and thread through idlers and ribbon guides.
10. Place a full spool on the left-hand axle (ensuring that the ribbon is inserted in the left-hand ribbon reversing guide).
11. Replace the ribbon reversing guide caps.
12. Close the side cabinet covers.
13. Re-adjust the Penetration Control Knob to its original setting and lock.
14. Close the front cabinet cover.
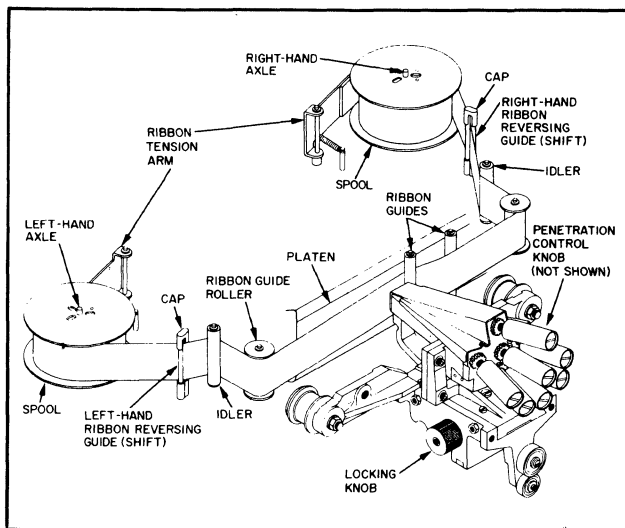15. Press the POWER button to apply power.

P. One sprocket hole will be generated each time the P key is pressed.
7. After the tape has been fully generated, press the HERE IS key to generate a rear trailer of sprocket holes. Remove the tape from the reader.

Splicing the VFU Tape

1. As shown in Figure 12-8, overlap the two ends of the tape (A and B) and place the sprocket holes over one another to properly align the two ends. Arrange the splice so that the distance between consecutive Form Feed holes is the same all around the tape.
2. Use perforated splicing tape to hold both ends of the tape together.

Figure 12-7. Ribbon Replacement Diagram
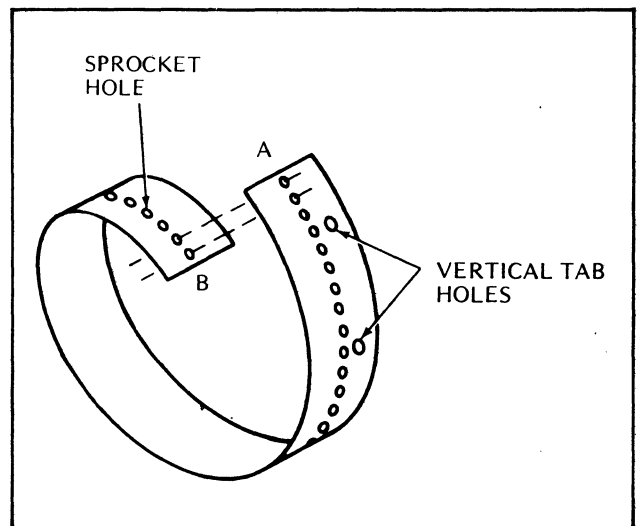
Figure 12-8. Splicing a VFU Tape

Generating a Master VFU Tape

To generate a master VFU tape on a teleprinter unit, follow these procedures:

1. Turn the LOCAL Switch on teleprinter unit to extreme clockwise position.
2. Turn the punch switch to ON (use black opaque tape only).
3. To generate a tape leader, press HERE IS key several times.
4. To generate a Vertical Tab hole in Channel 5, press and hold the control key and then press Q.
5. To generate a hole in both Channels 5 and 7 (Vertical Tab and Top of Form), press the P key alone.
6. To space the tape between holes, press and hold the control and SHIFT keys, then press

Duplicating the VFU Tape

Insert the master VFU tape in a teleprinter tape reader and lock it in. Turn the switch to START and a duplicate tape will be punched automatically.

Ribbon Specification

The printer uses a 1-inch nylon ribbon mounted on 3-inch diameter spools. The following four colors are available:

Black	Part No. 63002293-01
Red	Part No. 63002293-02
Green	Part No. 63002293-03
Blue	Part No. 63002293-04

TABLE 12-5. OPERATOR TROUBLE-SHOOTING

Symptom	Action
The printer will not print and ON/OFF indicator is OFF.	Try the ON/OFF switch; check the power cord; check fuses.
Printer will not print, ON/OFF indicator is ON, but ON/OFF LINE light is OFF.	Press ON/LINE.
Printer will not print, but ON/OFF LINE indicator is ON.	Ensure that front cover is closed; check fuses; ensure that interface cable at rear of printer is secure.
Paper skewing.	Position the paper feed tractors and tighten the fixing knob.
Ink ribbon tracking problems.	Make sure that ribbon is installed properly.
Poor print quality (e.g., smudging or light print).	Adjust head penetration.
Missing dots in printed character.	Open front cover and carefully wipe timing fence with damp cloth. Caution: USE ONLY WATER AND MILD DETERGENTS.
Form feed or vertical tab problem.	Check vertical format unit.

Operator Trouble-Shooting

If the printer is not operating properly, see Table 12-5 for possible sources of the error. If the printer still fails to operate properly after performing the indicated action, then call for service.

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning performed periodically on a routine scheduled basis. This maintenance will keep the printer in the best operating conditions thereby reducing the possibility of downtime.

The following list is a general guide to operator maintenance.

o Always plug the printer into a 3-wire grounded outlet.
o Ensure that all covers are closed and secured during operation.
o Never operate the printer without paper.
o Avoid leaning on or placing objects on any part of the printer.
o Turn power OFF before adjusting print head or replacing ribbon.
o Never put beverages or food on or near the printer.
o Keep outside covers clean and free of debris.
o Clean and dust the inside areas of the print mechanism.

SECTION 13

PRU9103/9104/9105/9106 LINE PRINTERS

The PRU9103/9104/9105/9106 Line Printers (Figure 13-1) produce high-quality printed output at medium- to high-printing speeds of 240 to 600 lines per minute. The printers have 64- and 96-ASCII character code sets and offer 136-column printing with vertical spacing of 6 or 8 lines per inch. With Option PRF9101 installed, the printers can increase their format flexibility with paper spacing controlled by a 12-channel paper tape.

The printers interface to the Level 6 Megabus by means of a single-board Multiple Device Controller (MDC9101)[1] and a Printer Device-Pac (PRM9101). Each printer includes a 50-foot cable that attaches to its device-pac; up to four device-pacs can be connected to an MDC, which in turn connects to the Megabus.
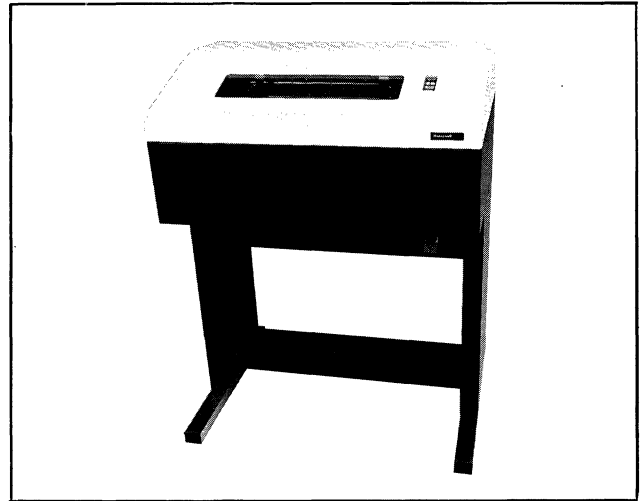
Table 13-1 lists the 96-character ASCII code set. Table 13-2 lists the printer specifications.

TABLE 13-1. LINE PRINTER CHARACTER SET

H2 \ H1	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	¦
D	CR	GS	−	=	M	]	m	}
E	SO	RS	.	>	N	∧	n	∧
F	SI	US	/	?	O	_	o	■

For ASCII to hexadecimal conversion: Each ASCII character = 2 hexadecimal digits (8 bits): H1 H2 For example: T = 54

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[1] Alternatively, the Magnetic Tape Controller (MTC9101), which supports up to 4 tape units or a combination of tape units and unit record devices (serial/line printers and card readers), can be used. A maximum of 2 tape units and 2 unit record devices can be configured.

Figure 13-1. PRU9103/9104/9105/9106 Line Printers

TABLE 13-2. PRU9103/9104/9105/9106 SPECIFICATIONS

Print Speed:
PRU9103 − 240 lpm
PRU9104 − 300 lpm
PRU9105 − 440 lpm
PRU9106 − 600 lpm
Columns/line: 136

Line Advance Speed (one line):
PRU9103/9104 − 50 ms (max.)
PRU9105/9106 − 25 ms (max.)

Paper Slew Speed:
PRU9103/9104 − 20 ips (min.)
PRU9105/9106 − 25 ips (min.)
Vertical Spacing: 6 or 8 lines per inch

Character Set:
PRU9103/9105 − 96-character uppercase and lowercase ASCII set
PRU9104/9106 − 64-character standard ASCII set
Paper Stock: Standard fanfolded and edge-punched; 4 in. to 16.75 in. wide (10.1 cm to 50.4 cm) with 4 in. to 24 in. (10.1 cm to 60.9 cm) between folds; With PRF9101 option, distance between paper folds may be varied from 4 in. to 24 in. (10.1 cm to 60.9 cm) at 6 or 8 lines per inch
Forms Thickness: 0.02 in. (0.508 mm) (max.)

Paper Weight:
For single copy − 15 lb (6.72 kg) bond (min.)
For up to 6 copies − 12 lb (5.5 kg) bond (min.)
Ribbon: M3910 or M3916
Format Tape: M3018
Format Tape Punch: M3014

Physical Dimensions:
Height − 45 in. (114.3 cm)

TABLE 13-2. (cont). PRU9103/9104/9105/9106
SPECIFICATIONS

Width – 33 in. (83.8 cm)
Depth – 22 in. (55.8 cm)
Weight – 340 lb (154.2 kg)
Power: 120 Vac +10%, –15%
Power Consumption: 0.58 kVA
Heat Dissipation: 1800 Btu/hr (454 kcal/hr)
Frequency: 60 Hz ±½ Hz

Environment:
Temperature – 50°F to 100°F (10°C to 38°C)
Relative Humidity – 30% to 70%

Cables (maximum):
ac – 6 ft (1.8 m)
dc – 50 ft (15.2 m)

LINE PRINTER COMMANDS

Line printer operation is implemented by two sets of instructions: input and output commands (see Table 13-3). Description of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, AS22.

TABLE 13-3. LINE PRINTER COMMANDS

| Type	Function Code	Command
Output	03	Output Interrupt Control
	01	Output Control
	07	Output Task Word
	09	Output Address and Range
Input	02	Input Interrupt Control
	06	Input Task Word
	08	Input Memory Byte Address
	0A	Input Memory Module Address
	0C	Input Range
	18	Input Status Word 1
	26	Input Device ID
		PRU9104/9106 – 2000
		PRU9103/9105 – 2002
		PRU9104/9106 with
		PRF9102 – 2001
		PRU9103/9105 with
		PRF9102 – 2003

STATUS BITS

One status word is defined for the line printer. Table 13-4 defines the status bits and the means

by which each bit is reset. The MDC reacts to printer errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.
o Errors occurring on I/O commands from the central processor set the appropriate status bit and interrupt the processor immediately (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action.

CONTROLS AND INDICATORS

Line printer controls and indicators necessary for normal printer operation with the exception of the MAIN POWER switch and Print Inhibit switch are located at the front of the printer, as shown in Figure 13-2. The printer hood, however, must be raised (as shown in Figure 13-3) for access to the FORMS RESET and 6LPI/8LPI controls, as they are concealed from view with the hood closed.
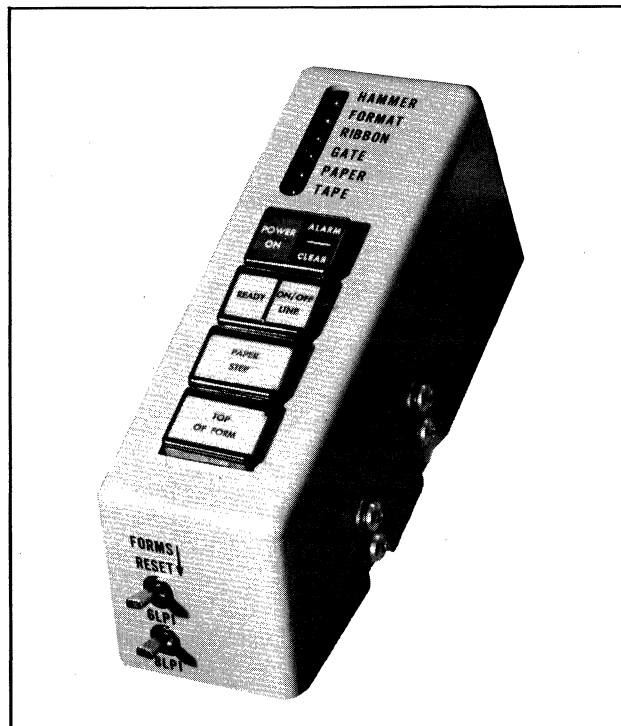
Figure 13-2. PRU9103/9104/9105/9106 Operator Panel

The MAIN POWER switch is located at the front of the printer directly below the control panel as shown in Figure 13-4). The Print Inhibit

TABLE 13-4. STATUS BIT DEFINITIONS

Status Condition	Bit	Definition	Reset By
Device Ready	0	Printer power on. No faults. Paper loaded. No open interlocks. Switches in correct positions.	A change in conditions
Attention	1	Device ready condition has changed.	Input Status word clears this bit[a]
End of Form	3	Printer has detected end-of-form either by VFU, if equipped, or otherwise by pre-configured line count.	Next IOLD Command[a]
Corrected Memory Error	12	Memory read response was accompanied by a signal indicating the error was corrected.	Next IOLD Command[a]
Nonexistent Resource	13	A NAK was received from memory. Indicates possible programming error (non-existent memory).	Next IOLD Command[a] or Input Status Word
Parity	14	Parity was incorrect on a bus transfer toward the MDC.	Input Status Word[a]
Uncorrectable Memory	15	Memory read response was accompanied by a signal indicating an error existed that could not be corrected.	Next IOLD Command[a]

[a]Initialize (output control word) and Master Clear on the Bus also reset these status bits.

switch is mounted on a logic card that is located on the left side of the printer on the inside door of the logic box (see Figure 13-4). This logic card is not handled by the operator; it is intended for Honeywell field service use only. The operator should check the card only to ensure that the switch is set in the up position (inadvertently setting to the down position will result in a printer fault condition).

In addition to the main controls, there are mechanical controls and mechanical adjustments directly related to the control of printing and paper feeding located on the printer mechanism that are described below (see Figures 13-3 and 13-4).

POWER ON
Indicates that dc voltages and ac power have been applied to the printer.

ALARM/CLEAR
This is both a push button and an indicator.

The ALARM indicator lights to indicatate that a fault condition exists. If the specific fault condition has an associated fault indicator, that indicator will be lit in conjunction with the ALARM indicator.

The ALARM indicator will also light in conjunction with the READY indicator if the Print Inhibit switch (on the logic card) has inad-vertently been moved from its normal (up) position or if the print drum is not revolving at its proper speed or if a "paper runaway" condition occurs (i.e., paper won't stop moving) or if the paper feed mechanism jams or if the belt breaks.

Press the ALARM push button after correcting the fault condition to reset the indicator.

A clear state exists when no fault conditions exist and ALARM is not lit (CLEAR is always unlit).

READY
Indicates that the printer is ready for online operation.

ON/OFF LINE
This push button/indicator lights when the printer is in the online mode and under system control. Pressing the push button alternately places the printer in the offline mode and is not lit.

Following initial power-up, the printer will be offline and the indicator will not be lit.

PAPER STEP
This push button causes paper to advance to the next line. The button is disabled when the printer is in the online mode (i.e., when the ON/OFF LINE indicator is lit).

TOP OF FORM

This push button causes paper to move to the top of the next form (page). This control is disabled when the printer is in the online mode (i.e., when the ON/OFF LINE indicator is lit).

FORMS RESET

This momentary toggle switch controls the positioning of paper while power is on. It is used in conjunction with the PAPER ADVANCE COARSE and PAPER ADVANCE FINE adjustments.

6LPI/8LPI

This two-position toggle switch selects either 6- or 8-lines per inch spacing.

> NOTE: The following are LED fault indicators.

HAMMER

Indicates a failure in the electrical circuits which control the printing of characters. This indicator lights in conjunction with the ALARM indicator, and causes the printer to enter the offline mode (with the ON/OFF LINE indicator not lit).

FORMAT

Indicates that the paper forms are not moving in proper synchronization. This fault condition may occur as a result of failure in the printer logic, or because paper was adjusted vertically without the proper actuation of the FORMS RESET switch. This indicator lights in conjunction with the ALARM indicator.

The FORMAT indicator is extinguished by pressing the FORMS RESET switch.

> NOTE: If the FORMAT indicator remains lit, recheck forms loading procedure. If this does not correct the condition, call Honeywell Field Engineering.

RIBBON

Indicates one of the following: A ribbon snag has occurred *or* a ribbon has failed to reverse its direction at one end of the spool *or* one of the ribbon motors is not operating properly.

This indicator lights in conjunction with the ALARM indicator, and causes the printer to enter the offline mode (with the ON/OFF LINE indicator not lit).

GATE

This indicator lights in conjunction with the ALARM indicator, and indicates the drum gate is unlatched.

PAPER

This indicator lights in conjunction with the ALARM indicator, and indicates the printer has run out of paper forms, or the forms are torn. The occurrence of a paper fault condition causes the printer to enter the offline mode (with the ON/OFF LINE indicator not lit).

The PAPER fault indicator is extinguished when the condition is corrected.

TAPE

The TAPE indicator is present only on those printers having the VFU option (PRF9101) installed.

The TAPE indicator lights to indicate a fault in the VFU option. Such a fault may be caused by a failure in the VFU circuitry, an incorrectly punched VFU tape, the wrong VFU tape being installed for the operation being performed, or by a torn or damaged VFU tape.

The TAPE indicator lights in conjunction with the ALARM indicator, and causes the printer to enter the offline mode (with the ON/OFF LINE indicator extinguished).

MAIN POWER ON/OFF

This circuit breaker switch is used to apply or remove ac power.

MECHANICAL ADJUSTMENTS

There are several mechanical adjustments which are located in the printer mechanism for the control of printing and paper feeding as shown in Figures 13-3 and 13-4.

Paper Width

Enables the left/right tractor assemblies to be adjusted to the proper paper width by simply unlocking the tractor assemblies and sliding them into proper width. Fine thumb-wheel adjustments are also provided for each tractor assembly.

Paper Advance Coarse

Used to vertically position the paper at predetermined increments. FORMS RESET switch must be held down when making a coarse paper advance adjustment.

Paper Advance Fine

Provides a fine vertical positioning of paper between the predetermined increment range of the coarse paper advance adjustment. The FORMS RESET switch must be in the up position when making fine paper advance adjustment.

Paper Horizontal Positioning

Allows for fine horizontal paper adjustment by moving both tractors in unison in a horizontal direction.

Forms Thickness

Enables minor adjustments to accommodate forms of different thickness (e.g., when the number of carbons being used is changed).

Phasing Control

Used for adjusting and maintaining equal printing density at top and bottom of a character.

VFU Positioning Switch

This momentary rocker switch is used to check for proper VFU tape formatting. Pressing the switch causes the VFU tape to move to the punched Top-Of-Form location.

VERTICAL FORMAT UNIT

Printers that contain Option PRF9101 can have paper spacing controlled by a 12-channel paper tape. The unit consists of a vertical format tape and tape reader that are located on the right-hand side of the printer under the printer cover (see Figure 13-4).

The vertical format tape must be punched with the same spacing (6 or 8 lines per inch) as the printing it will control. Additional tape and punches for either 6 or 8 lines per inch are available from Honeywell. The tape should be glued into a loop exactly as long as the form (or an integral multiple of the length, with identical punches for each page controlled).

Paper Tape Format

Whatever distance the paper form is fed through the printer during a given period of time, the format tape is fed an equal distance through the photoelectric reading station. The format tape is thus a gauge of the longitudinal dimension of the form. Generally, the length of the tape equals the height of a single form; when the ends of the tape are joined, there are exactly as many exposed frames on the tape as there are single-spaced lines (printed and blank) on the form. The printer uses a 6- or 8-lines per inch format tape, depending on the setting of the FORMS RESET toggle switch on the control panel of the printer.

A format tape is supplied imprinted with 6 or 8 frames per inch to facilitate location of the punches. Generally a new tape must be mounted if (1) the height of the form is changed or (2) a change is made in the number of lines per inch printed, with one exception. If, and only if, all formatting holes are punched opposite the sprocket holes, the tape can be used for either six or eight lines per inch printing.
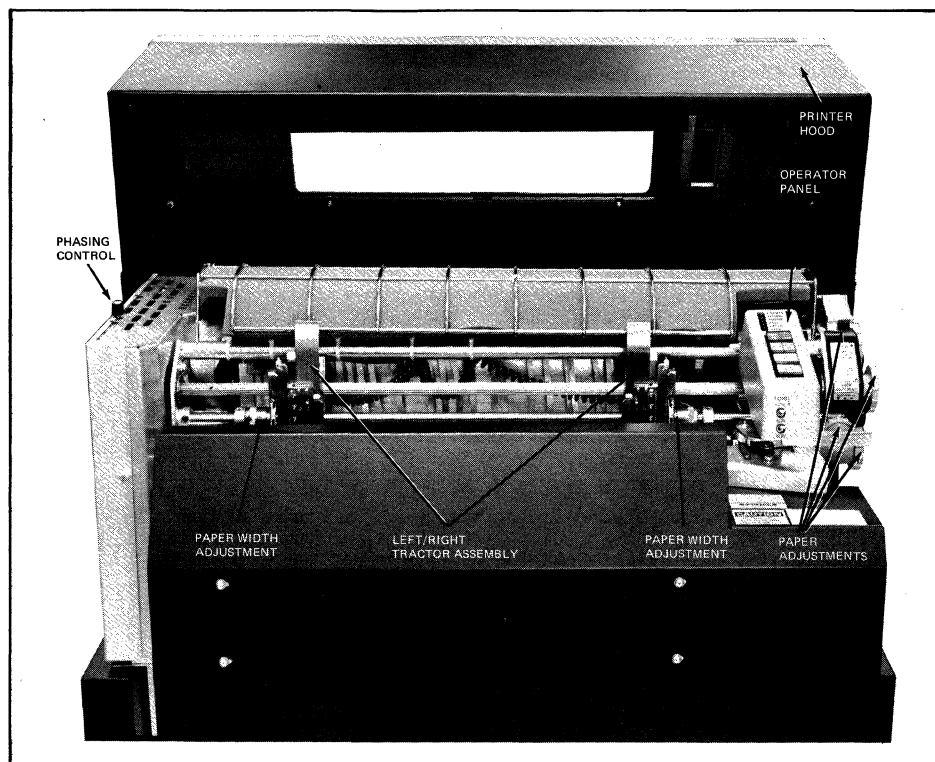

Figure 13-3. Mechanical Adjustments

OPERATION

Operating procedures for the line printers are described below.

Standard Power-Up Procedure

Prior to powering-up the printer, check that all electrical cables have been properly connected and secured and that ac power is available.

1. Set MAIN POWER switch to ON. The switch is located at the lower front of the printer (see Figure 13-4). Both the POWER ON and READY indicators on the operator control panel will light.
2. Raise the printer hood.
3. Open the logic box door on the left side of the printer to check that the Print Inhibit switch is set to the up position.
4. Load the paper in accordance with the procedures described in "Paper Loading."
5. Press ON/OFF LINE button, the indicator will light, indicating that the printer is online and in full operation.
6. Observe printer operation and make fine paper advance adjustment if required to obtain the desired print line positioning.
7. Adjust PHASING control, if necessary, to obtain uniform ink density of characters.

Standard Power-Down Procedure

1. Press the ON/OFF LINE button. The indicator will extinguish after printing of the current line has been completed, setting the printer in the offline mode.
2. Set MAIN POWER switch to OFF; both POWER ON and READY indicators will extinguish.

Paper Loading

1. Raise the printer hood and pull the drum gate latch forward, swinging the drum gate to its fully opened position as shown in Figure 13-4.
2. Press the TOP OF FORM button on the operator control panel.
3. Open both spring loaded tractor pressure plates (see Figure 13-3).
4. Place paper in tractors and close the pressure plates.
5. Loosen both paper width adjustment controls and move both tractors laterally to adjust for correct paper width. Once adjustment is made, tighten both paper width adjustment controls. Adjust horizontal tension, if necessary, via thumbwheel switches on each tractor assembly.
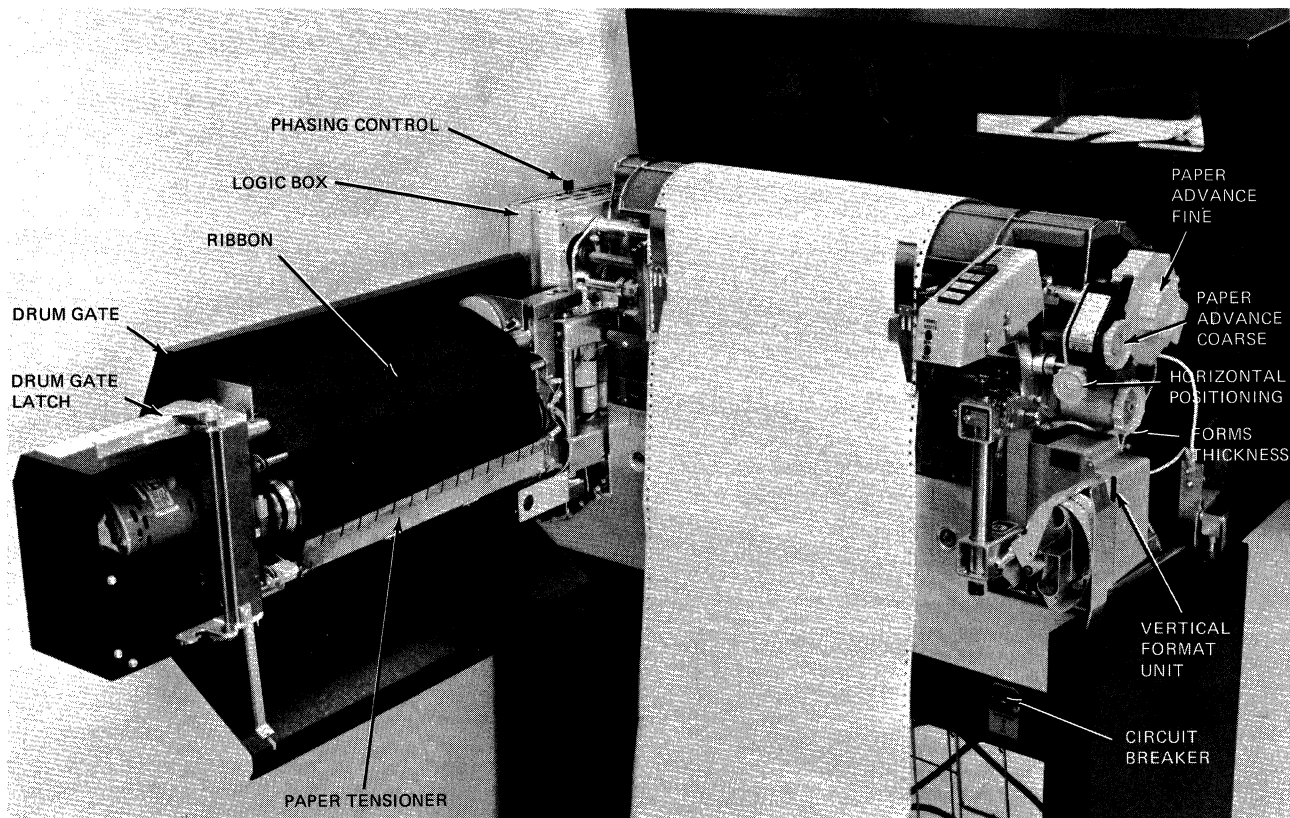

Figure 13-4. Printer Assembly

6. Align the perforation between forms (i.e., top-of-form to one of the top-of-form indexes).

¼-inch Top Of Form Index: the first line of print occurs ¼-inch from the top of the form.
*½-inch Top Of Form Index:* the first line of print occurs ½-inch from the top of the form.

Perform alignment as follows:
a. Press and hold the FORMS RESET button on the operator control panel while rotating the PAPER ADVANCE COARSE knob (see Figure 13-4) until perforation is lined up with the desired index.
b. Once alignment has been made, release the FORMS RESET button.

7. Use PAPER HORIZONTAL POSITIONING control (see Figure 13-4) to position paper horizontally for location of the first column of print. Use this control to move paper to the desired location on the horizontal position index. The position index is graduated to allow a first character indentation of up to 2 inches.

8. Close and latch the drum gate, and close the printer hood.

> NOTE: Use PAPER ADVANCE FINE control to correct any small remaining misalignment during printout. Fine adjustment is made with FORMS RESET switch in the up position, drum gate closed, and printer hood raised.
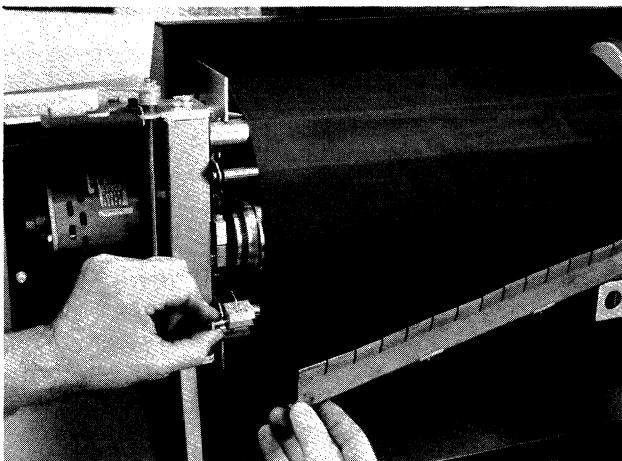
Figure 13-5. Removing Paper Tensioner from Drum Gate
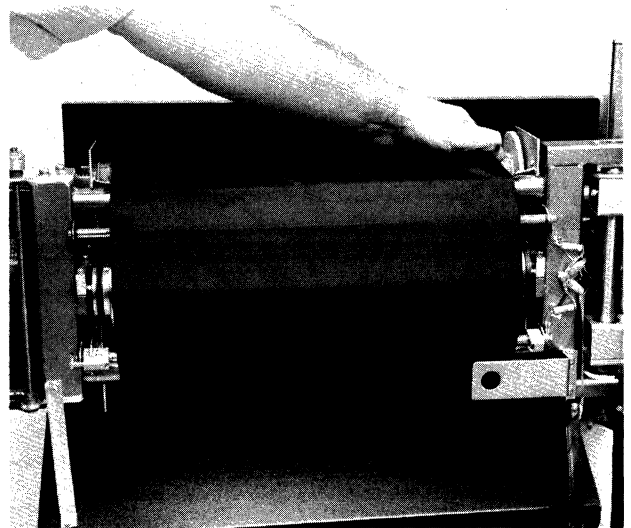
Figure 13-6. Removing Printer Ribbon

Ribbon Replacement
1. Set MAIN POWER switch to OFF.

2. Raise the printer hood and pull drum gate latch forward, swinging the drum gate to its fully opened position as shown in Figure 13-4.

3. Holding the paper tensioner with one hand (see Figure 13-5), pull the tensioner plunger knob with the other hand and remove the paper tensioner from the drum gate and set aside.

> NOTE: Be careful of sharp edges.

4. To remove the ribbon; grasp the right end of the top and bottom ribbon cores (see Figure 13-6). Push both cores to the left and swing the right ends forward and out of the drum gate.

5. Hold the ribbon cores together and remove the ribbon from the compartment.

6. When loading a new ribbon, it must be installed so that it unwinds from top of the ribbon core. Place the new fully wound ribbon core against the top left floating ribbon holder.

7. Push the core against the floating ribbon holder spring and swing the right end of the ribbon core into position against the fixed right-hand ribbon holder, making certain that the guide pin slips into the slot on the core.

8. The upper portion is now installed. To load the lower portion, ensure that it unwound from top of the ribbon core and fed down over the print drum and lower ribbon guide bars.

9. Once the lower portion of the ribbon is positioned, install the ribbon core on the bottom ribbon holder following the procedure described in steps 6 and 7.

10. With ribbon installed, replace the paper tensioner. Insert the paper tensioner block into position (see Figure 13-7).

11. Push in the paper tensioner against the tensioner plunger knob indexing slot while with the other hand pulling the tensioner plunger knob out to allow slot engagement. Once engaged, release the knob. Figure 13-7 shows ribbon and tensioner completely installed.

12. Close and latch the drum gate, and close the printer hood.

13. Set the MAIN POWER switch to ON.

VFU Tape Punching

The printer may use either a 6- or an 8-lines per inch tape, depending on the format desired. However, the vertical format tape must be punched with the same spacing as the printing that the printer will control.
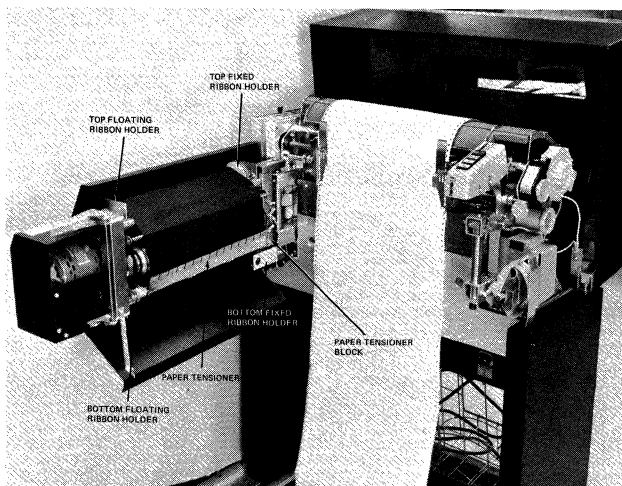

Figure 13-7. Printer with Ribbon and Paper
Tensioner Installed

To prepare a vertical format control tape:

1. Place the tape in the punch so that each of the two indexing posts on the punch mate with a sprocket hole in the tape.

2. Punch the desired Top-Of-Form (TOF) location in channel 1 of the tape. Channel 1 is the outboard tape channel corresponding to the extreme left-hand cell as the operator faces the printer from the front.

3. Move the tape through the punch, punching any holes specified by the programmers' pencil marks on the tape.

4. Punch the desired End-Of-Form (EOF) location in channel 12 of the tape.

5. To form the tape loop, grasp the ends of the tape (as it rests in the punch) and loop them downward to make the joint.

6. Spread a thin coat of glue on each surface to be joined and press firmly together to form the joint. The tape is now ready for installation in the printer.

> NOTE: If, and only if, all holes are punched opposite sprocket holes, the tape may be used for either 6- or 8-lines per inch vertical formatting. However, TOF and EOF should not be punched simultaneously opposite any given sprocket hole.

VFU Tape Loading

The Vertical Format Unit (VFU) is located on the right-hand side of the printer under the machine cover (see Figure 13-4). The tape is mounted on the upper sprocket rollers as shown in Figure 13-8.

To mount a vertical format control tape:

1. Set MAIN POWER switch to OFF.

2. Raise the printer hood and pull drum gate latch forward, swinging the drum gate to its fully opened position.

3. Open the VFU cover and insert the tape over the upper sprocket roller with channel 1 (containing TOF punch) farthest away from the body of the printer. The sprocket holes in the tape must mate with the cogs on the roller.

4. Feed and thread the tape through the read station.

5. Close the VFU cover and latch the drum gate.
6. Set MAIN POWER switch to ON (tape will load automatically after power stabilizes).
7. Press the VFU positioning switch once to ensure proper tape formatting.
8. With the VFU tape loaded, both POWER ON and READY indicators on the operator control panel will light.
9. Lower the printer hood.

Operator Trouble-Shooting

If the printer is not operating properly, see Table 13-5 for possible sources of the error. If the printer still fails to operate properly after performing the indicated action, then call for service.

OPERATOR MAINTENANCE

Preventive maintenance includes the checks and cleaning done periodically on a scheduled routine basis, even though printer operation may be satisfactory and not in need of attention.

Cleaning And Checking The Printer

It is recommended that the printer be scheduled for cleaning monthly or more often as usage dictates.

1. Power-down the printer according to the procedures described in "Standard Power-Down Procedure."
2. Raise the printer hood, pull the drum gate latch forward, swinging the drum gate open, and open the VFU compartment (if present).
3. Remove all paper in the printer.
4. With the aid of a lint free cloth, clean the paper chamber of dirt and any accumulated paper dust.
5. Using a vacuum cleaner or a low pressure hose, remove all dust and paper chaff from the inside and outside of the printer.
6. Close the VFU cover, latch the drum gate, and lower the printer hood.
7. Using a lint free cloth clean the outside of the printer.
8. Power-up the printer.

TABLE 13-5. OPERATOR TROUBLE-SHOOTING

| Indicator Conditions	Probable Cause	Corrective Action
POWER ON indicator does not light	MAIN POWER circuit breaker is in OFF position. Internal voltage requirements not satisfied. Initial delay circuit inoperative.	Set MAIN POWER circuit breaker to ON.
READY indicator does not light	Fault condition exists, as defined by ALARM indicator lit.	Press and release ALARM switch/ indicator. If fault condition remains, lift printer cover and observe fault indicators.
GATE fault indicator is lit	Character drum gate unlatched.	Latch character drum gate.
PAPER and RIBBON fault indicators are lit	Paper is torn; printer is out of paper, ribbon is stalled.	Repair torn paper; install paper; check for foil on ribbon. Press and release ALARM switch/indicator.
ALARM and READY fault indicators are lit	PRINT INHIBIT switch ON.	Set PRINT INHIBIT switch to OFF. Set power circuit breaker on.
ON/OFF LINE switch/ indicator does not light, or will not go out	Hammer bank is not moving, or logic format is not initializing.	Press and release ALARM switch/ indicator. Observe that ribbon and hammer bank are moving, then press and release ON/OFF LINE switch/ indicator.
TOP OF FORM switch does not function	Printer is in online mode. ON/OFF LINE switch/indicator is lit.	Press and release ON/OFF LINE switch/indicator.
FORMAT error indication	Paper was adjusted vertically without activation of the FORMS RESET switch.	Active FORMS RESET switch.
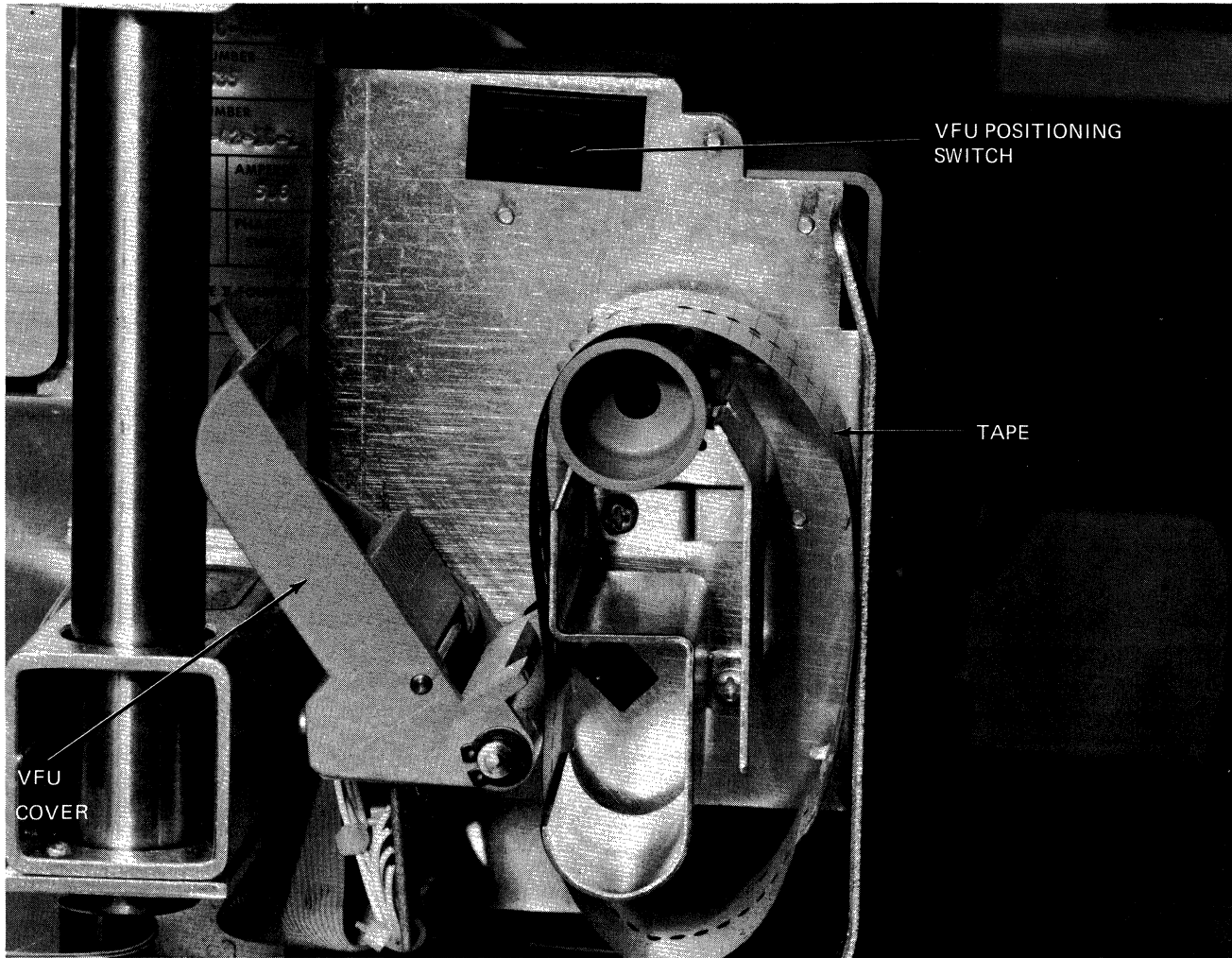
Figure 13-8. Printer VFU

SECTION 14

MTU9104/9105/9112/9113 MAGNETIC TAPE UNITS

The MTU9104/9105 and MTU9112/9113 Magnetic Tape Units are compact, self-contained, rackmountable tape units (Figure 14-1). The MTU9104/9105 are 9-track, 800-bits per inch (bpi) units with transport speeds of 45 and 75 inches per second (ips), respectively. The MTU9112/9113 are 7-track, 556-/800-bpi units with transport speeds of 45 and 75 ips, respectively. The recording technique used is NRZI (nonreturn-to-zero-inverted).

The Magnetic Tape Units interface with the Level 6 Megabus by means of a Magnetic Tape Controller (MTC9101) and a single 7-track NRZI Magnetic Tape Device-Pac (MTM9101) or a single 9-track NRZI Magnetic Tape Device-Pac (MTM9102). In combination, the Controller and Device-Pac can connect and control up to four 7- or 9-track tape units.

Table 14-1 lists the specifications for the various tape units.

DATA INTEGRITY

The tape units offer built-in protection against destruction caused by an accidental write operation; before recording is permitted a write-enable ring must be in place. All information written on tape is immediately read and checked.

In the 7-track NRZI mode at 556/800 bpi, Longitudinal Redundancy Check (LRC) characters are generated during writing and checked during reading to detect errors.

In the 9-track NRZI mode at 800 bpi, LRC and Cyclic Redundancy Check (CRC) characters are generated during writing and checked during reading to detect errors.

Tape de-skewing in the write mode is electronically adjustable. In addition, an automatic vacuum tape cleaner reduces the incidence of data errors caused by foreign matter on the tape.

_____
[1]Alternatively, the Magnetic Tape Controller (MTC9101), which supports up to 4 tape units or a combination of tape units and unit record devices (serial/line printers and card readers), can be used. A maximum of 2 tape units and 2 unit record devices can be configured.
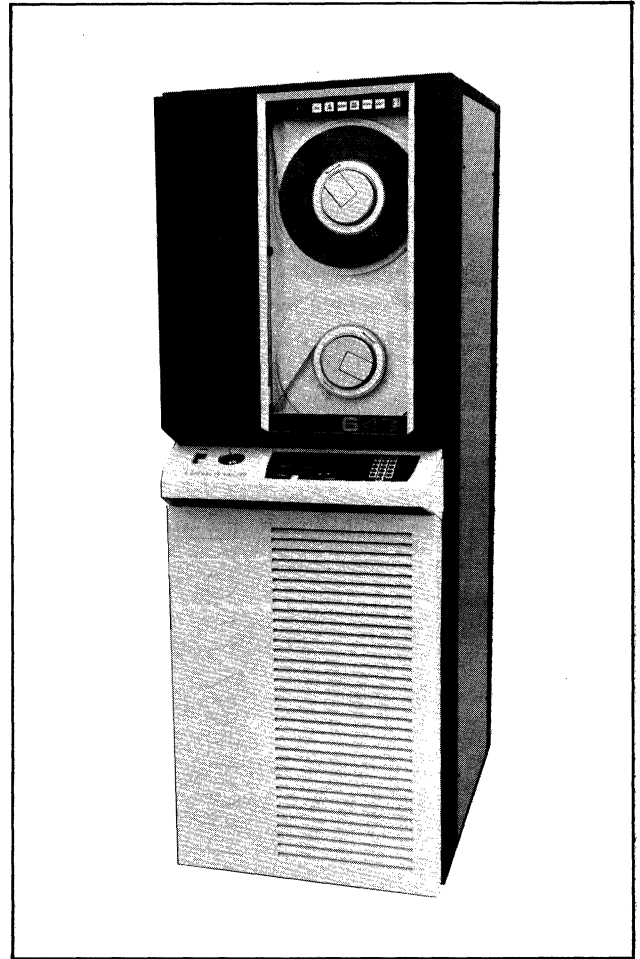

Figure 14-1. MTU9104/9105/9112/9113 Magnetic Tape Units

TABLE 14-1. MTU9104/9105/9112/9113 SPECIFICATIONS

No. of Tracks:
MTU9112/9113 – 7
MTU9104/9105 – 9

Tape Density:
MTU9112/9113 – 556/800 bpi
MTU9104/9105 – 800 bpi

Read/Write Speed:
MTU9112/9104 – 45 ips (114 cm/s)
MTU9113/9105 – 75 ips (190.5 cm/s)

Rewind Speed:
MTU9112/9104 – 200 ips (508 cm/s)
MTU9113/9105 – 250 ips (762 cm/s)

Transfer Rate:
MTU9112 – 25/36K characters/second
MTU9113 – 41.7/60K characters/second
MTU9104 – 36K bytes/second
MTU9105 – 60K bytes/second

Interrecord Gap:
MTU9112/9113 – 0.75 in. (1.9 cm)
MTU9104/9105 – 0.60 in. (1.5 cm)

TABLE 14-1. (cont). MTU9104/9105/9112/9113 SPECIFICATIONS

Vacuum Column:
MTU9112/9104 — Single
MTU9113/9105 — Dual
Device-Pac:
MTU9112/9113 — Only 1 MTM9101 7-track, NRZI Magnetic Tape Device-Pac required for up to 4 tape units
MTU9104/9105 — Only 1 MTM9102 9-track, NRZI Magnetic Tape Device-Pac required for up to 4 tape units
Controller: MTC9101
Tape: 2400-foot (731.5-m) reels of ½-inch Mylar-base certified for 800 bpi; reel diameter of 10½ in.; IBM-compatible reel hubs
Physical Dimensions:
Height — 24 in. (60.9 cm)
Width — 19 in. (48.2 cm)
Depth — 15.4 in. (39.1 cm)
Weight:
MTU9112/9104 — 110 lb (49.5 kg)
MTU9113/9105 — 120 lb (54 kg)
Power: 120 Vac +10%, −15%
Power Consumption:
MTU9112/9104 — 0.78 kVA
MTU9113/9105 — 0.82 kVA
Heat Dissipation:
MTU9112/9104 — 2000 Btu/hr (504 kcal/hr)
MTU9113/9105 — 2360 Btu/hr (595 kcal/hr)
Frequency: 60 Hz ±½ Hz
Environment:
Temperature — 50°F to 100°F (10°C to 38°C)
Relative Humidity — 10% to 90% (no condensation)
Cables (maximum):):
ac — 7.5 ft (3.65 m)
dc — 25 ft (7.71 m)

MAGNETIC TAPE

The physical layout of ½-inch magnetic tape is illustrated in Figure 14-2. A full reel of tape has a nominal recording length of 2400 feet (732 m); the entire length of the tape is oxide coated. Beginning and end-of-tape sensing is controlled by reflective markers affixed to the Mylar base side of the tape. The beginning-of-tape (BOT) spot is attached approximately 16 feet (4.88 m) from the physical beginning of the tape, and the end-of-tape (EOT) spot is attached approximately 25 feet (7.62 m) from the physical end of the tape.

MEDIA INTERCHANGEABILITY

Tapes generated by these units are compatible with tapes generated by other units if the other tape units comply with American National Standards Institute recording standards.

DATA ORGANIZATION

7-Track
Six data tracks and one parity track are used to record data.

A record can contain any number of 6-bit characters, with 1 character per frame. Track 7 of each frame is used for parity. Odd or even parity is available.

Information can be written and read in two modes: byte mode and pack mode.

o Byte Mode — Transfers 12 (of 16) bits (2 characters) of a data word to or from the tape. The other 4 bits (0, 1, 8, and 9 of each memory word) will be ignored on writes and zero-filled on reads from tape.
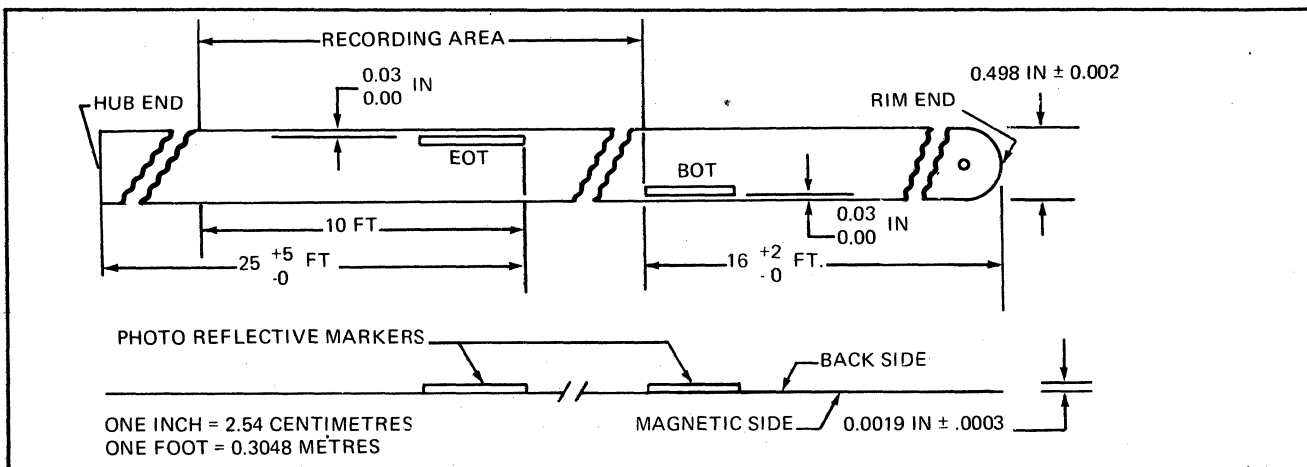
Figure 14-2. Magnetic Tape Layout

o Pack Mode — Transfers all 16 bits of each data word to or from the tape; 3 tape frames are required for each data word written on tape. Note that the device-pac generates two additional bits (zeros) for every third data word to be written on tape and strips these bits off when reading them from tape.

The correspondence between a word and the frames recorded on tape for each mode is shown in Figure 14-3. Even parity is used in the BCD mode and odd parity is used in the binary modes. In either mode, longitudinal even parity is indicated for each track at the end of a record. Since the file mark (17_8) is a single frame record, the file mark longitudinal parity frame is identical to the file mark itself.
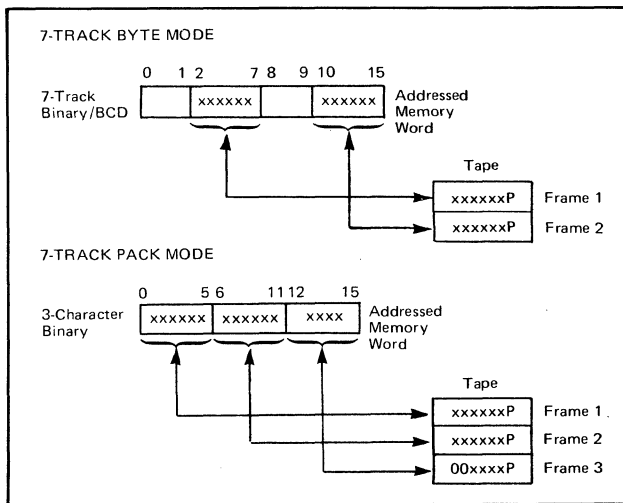

Figure 14-3. 7-Track Data Format

9-Track

Eight data tracks and one parity track are used to record data. A record can contain any number of 8-bit characters, with 1 character per frame. Odd parity will be written on tape and checked when read.

Information is written on or read from tape in the byte mode, which transfers all 16 bits of a data word to or from tape as shown in Figure 14-4.

TAPE UNIT COMMANDS

Magnetic Tape Unit operation is implemented by two sets of instructions: input and output commands (see Table 14-2). Description of these commands are found in the *Series 60 (Level 6) Minicomputer Handbook*, AS22.
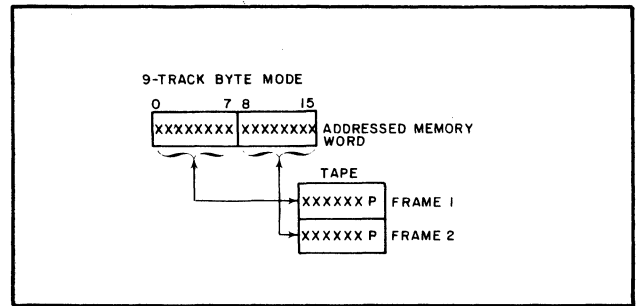

Figure 14-4. 9-Track Data Format

TABLE 14-2. TAPE UNIT COMMANDS

Type	Function Code	Command
Output	09[a]	Output Address
	0D	Output Range
	11	Output Configuration Word
	03	Output Interrupt Control
	07	Output Task Word
	01	Output Control Word
Input	0C	Input Range
	10	Input Configuration Word
	02	Input Interrupt Control
	26	Input Device ID
		MTU9112 — 2169 (@ 556 cpi)/2171 (@ 800 cpi)
		MTU9113 — 216A (@ 556 cpi)/2172 (@ 800 cpi)
		MTU9104 — 2145
		MTU9105 — 2146
	06	Input Task Word
	18	Input Status Word 1
	1A	Input Status Word 2

[a]Function Code 09 as executed by the CP will result in execution of functions 09 and 0D.

STATUS BITS

Two status words are defined for the magnetic tape unit. Tables 14-3 and 14-4 defines the status bits and the means by which each bit is reset. The MTC reacts to tape errors as follows:

o Errors detected during data transfer are stored in a status word for interrogation by a subsequently issued order.

o Errors occurring in I/O commands from the central processor set the appropriate status bit and interrupt the processor immediately (if interrupts are allowed). The I/O command is acknowledged normally and stored in MDC memory but causes no further action.

TABLE 14-3. STATUS BIT DEFINITIONS -- WORD 1

Status Condition	Bit	Definition	Reset By
Device Ready	0	Unit is online with tape loaded, is not rewinding, and no further manual intervention is required to place it under program control. This bit will be zero, if either Status Word 2, bit 0 is a zero or Status Word 2, bit 1 is a one.	A change in condition
Attention	1	Indicates an event has occurred at the unit which requires software action. This event, moreover, was not related to a current task, but rather was unsolicited. This bit will be set whenever the device changes its ready condition as a result of a non-software initiated command (i.e., enter or leave the online state, rewinding state, or media loaded state). Attention status may occur following a software initiated Stop I/O or initialize command if the device was performing a Rewind or Rewind and Unload Instruction. Whenever the Attention bit is set, an interrupt is attempted (if the interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) will serve as notification of both the end of the operation and the device state change.	Initialize, Input Status Word 1, or Output Task Word command.
Retryable Media Error	2	Indicates a data error has occurred and will be set whenever Status Word 2 bit 4, 5, 6 or 7 is active.	Initialize or Output Task Word command
Reserved for Future Use	3	Must be zero.	—
Corrected Media Error	4	Indicates an error condition was detected on tape; however, the data read is not lost. For this subsystem, the detected condition is a noise area within an interblock or BOT gap. A noise area may comprise 1 to 11 detectable frames of magnetic transitions on the media when the subsystem is functioning in the minimum data block mode. In the non-minimum data block mode, all detected frames of magnetic transitions are processed as a block.	Initialize or Output Task Word command
Tape Mark	5	Indicates a Tape Mark has been detected during the execution of a Write Tape Mark, Forward Space Tape Mark, or a Backspace Tape Mark order. This status bit will also be active if the block encountered during execution of a Forward/Backspace/Read block instruction is a Tape Mark.	Initialize or Output Task Word command

TABLE 14-3 (cont). STATUS BIT DEFINITIONS -- WORD 1

Status Condition	Bit	Definition	Reset By
BOT (Beginning of Tape)	6	Indicates the BOT marker is positioned at the BOT sensor. A backspace or rewind order issued to a unit with tape at BOT will result in no tape motion initiated and a normal termination of the order.	—
EOT (End of Tape)	7	Indicates the EOT marker is positioned at, or has passed beyond, the EOT sensor. This status bit will remain active until the EOT marker passes back over the sensor as a result of a Tape Backward Motion command (e.g., backspace, rewind). The state of this status bit has no effect on forward motion commands, except the Forward Space to Tape Mark in which forward motion is terminated in the next interblock gap.	—
Unequal Length Check	8	Indicates that for the previous Read operation, the physical block was either greater or less than the value in the range register at the beginning of the Read operation. This bit, a 1, and a residue in the range register indicates that a short block was transferred. This bit active and a range register contents of zero indicates that a long block was transferred.	Initialize or Output Task Word command
Non-Retryable Error	9	Indicates that the position of media under the tape read/write and erase heads is unknown. This bit will be set when a write order RAW[1] failure occurs (i.e., the detection of magnetic transitions on tape before the start or following the completion of a recorded data block or the failure to detect magnetic transitions in the area where a data block is being written or the failure to detect an NRZI density identification area on tape when writing an NRZI tape). This bit will also be set when an erase order raw failure occurs (i.e., the detection of magnetic transitions in the area on tape being erased) or when, during a read order, a split block is detected. A split block is a data block in which its beginning and end positions cannot be guaranteed detectable because of a detected unrecorded area within the block. This status bit also becomes active when Status Word 2 bit 10 (Time Out Check) is set.	Initialize or Output Task Word command
Reserved for Future Use	10	Must be zero.	—

[1]Read After Write

TABLE 14-3 (cont). STATUS BIT DEFINITIONS -- WORD 1

Status Condition	Bit	Definition	Reset By
Operation Check	11	Indicates a write type order (Write, Write Tape Mark, Erase) was issued to a tape drive in Write Protect (see state of Status Word 2 bit 2); that upon acceptance of an Output Task Word data transfer command, the direction of data transfer is not the same as that specified by the direction bit of the channel number issued by the previous Output Address command; that upon acceptance of an Output Task Word data transfer command, the contents of the range register is zero (for Read or Write) or less than 18 (for write) when the subsystem is in the ANSI configuration mode; or that a command (other than No Operation) was issued to a channel on which the device is in the offline or Not Ready state.	Initialize or Output Task Word command
Corrected Memory Error	12	Indicates that during execution of the previous operation, main memory detected and corrected a memory read error. The data that was delivered to the MTC was assumed to be correct.	Initialize or Output Task Word command
Nonexistent Resource Error	13	Indicates the MTC attempted a Write or Read request bus cycle and received a NAK response. Occurrence of this condition does not cause a termination of the operation in progress; however, it can result in bad data being written on the tape.	Initialize, Input Status Word 1, or Output Task Word command
Bus Parity Error	14	Indicates the MTC detected a parity error on either byte of the Data Bus during any output bus cycle(i.e., odd function code), during a second-half memory read cycle or when a parity error is detected in bits 0—7 of the Address Bus during an Output Address command. Occurrence of this condition does not cause a termination of the operation in process; however, it can result in bad data being written on tape.	Initialize, or (error free) Input Status Word 1 command
Non-correctable Memory Error	15	Indicates that during execution of the previous operation, the main memory detected a memory read error which the EDAC algorithm could not correct. The data that was delivered to the MTC was incorrect. Occurrence of this condition does not cause a termination of the operation in progress; however, it can result in bad data being written on tape.	Initialize or Output Task Word command

TABLE 14-4. STATUS BIT DEFINITIONS -- WORD 2

Status Condition	Bit	Definition	Reset By
Online	0	Indicates the unit is online to the subsystem via the ONLINE/OFFLINE switch on the unit. The unit can also be put into offline status via the Rewind and Unload instruction.	—
Rewinding	1	Indicates the unit is processing a rewind operation either via a command issued by the subsystem or the REWIND switch on the unit.	—
File in Protect	2	Indicates the unit is in write protect (i.e., the write permit ring is not in position on the mounted file reel).	—
High Density Selected	3	Indicates that the device high/low density selector switch is set to the high position. For example, a 556/800 cpi 7-track NRZI tape device set to high density will set this indicator and read and write tape at 800 cpi. A 9-track NRZI tape device which processes tape at 800 cpi (only) will set this indicator to zero.	—
Data Service Rate Error	4	Indicates that during a Read or Write operation, data transfer to/from main memory and the unit via the MTC could not maintain the rate in demand. Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device. The detection of this error condition does not effect the execution of the data transfer operation in process.	Initialize or Output Task Word command
Uncorrectable Character Error	5	Indicates that during a Read or Write operation either a Vertical Redundancy Check (VRC) error and/or a dropped character error was detected. In a VRC error, one or more data characters were detected with incorrect vertical parity. Data character parity is odd unless bit 3 in the stored configuration word is set. In a dropped character error, one or more data characters following the first contiguous segment of data characters in the block were not read.	Initialize or Output Task Word command
CRC (Cyclic Redundancy Check) Error	6	Indicates that during a Read or Write operation (9-track NRZI only), the tape CRC character failed to compare with the reconstructed value.	Initialize or Output Task Word command
LRC (Longitudinal Redundancy Check) Error	7	Indicates that during a Read or Write operation, an incorrect longitudinal parity was detected for any track read. The LRC character written at the end of each block will result in even track parity.	Initialize or Output Task Word command

TABLE 14-4 (cont). STATUS BIT DEFINITIONS -- WORD 2

| Status Condition	Bit	Definition	Reset By
Reserved for Future Use	8	Must be zero.	—
Reserved for Future Use	9	Must be zero.	—
Time Out Check	10	Indicates that during a Read or Space operation, an excessive delay prior to detecting a block has occurred and has resulted in a termination of the order. This delay is equivalent to passing over approximately 25 feet of tape. This bit is also set during a Rewind or Rewind and Unload operation following an excessive delay without the device entering a Rewind sequence or at BOT. Positioning of the tape under the read/write and erase heads is unknown. Activation of this bit during a Rewind and Unload operation indicates that an excessive delay has been detected without the device entering the offline state.	Initialize or Output Task Word command
Functionality Not Available	11	Indicates for the subsystem specified herein that the Output Task Word — Read Backwards order is not available. A termination of the order without tape motion takes place.	Initialize or Output Task Word command
Beginning of Block (BOB) Early	12	Indicates that the block written on tape was detected by the RAW circuitry to have begun earlier than that specified for the selected device.	—
Beginning of Block (BOB) Late	13	Indicates that the block written on tape was detected by the RAW circuitry to have begun later than that specified for the selected device.	—
End of Block (EOB) Early	14	Indicates that the block written on tape was detected by the RAW circuitry to have terminated earlier than that specified for the selected device.	—
End of Block (EOB) Late	15	Indicates that the block written on tape was detected by the RAW circuitry to have terminated later than that specified for the selected device.	—
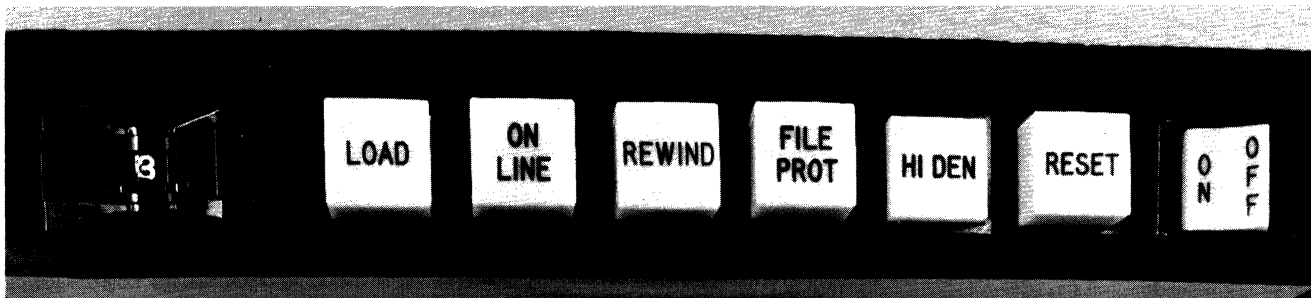
Figure 14-5. MTU9104/9105/9112/9113 Control Panel

CONTROLS AND INDICATORS

Magnetic tape unit controls and indicators are shown in Figure 14-5.

UNIT SELECT SWITCH

This thumbwheel switch is used to assign the desired logical unit number (0, 1, 2, or 3). The unit number should only be changed when the tape unit is offline.

LOAD

Pressing LOAD applies vacuum to the loop chamber (after the tape is threaded) and cycles-up the unit. LOAD lights when the unit is fully cycled-up and the tape is positioned at BOT. LOAD is extinguished whenever the tape moves off of BOT.

ONLINE

Pressing ONLINE places the tape unit online if it is offline, or offline if it is online. ONLINE lights whenever the tape unit is online.

REWIND

Pressing REWIND rewinds the unit to BOT. REWIND lights until BOT is sensed. The button is operative only when the unit is offline. The tape rewinds past the BOT tab, then reverses and advances to the BOT tab and stops. If the tape is at BOT when REWIND is pressed, the tape rewinds slowly off of the take-up reel.

FILE PROT

Lights to indicate that the tape mounted and cycled-up is protected from being written on (write-enable ring not installed).

HI DEN

Pressing selects the higher density in those tape units with dual density. HI DEN lights when the higher density is in effect. (This button is inoperative on single density units.)

RESET

Pressing stops tape motion if the tape unit is in the forward, reverse, or rewind mode, and places the unit offline, if it is online. RESET lights whenever the tape unit is selected.

ON/OFF

Pressing the ON side of the button applies power to the tape unit and the button lights. Pressing the OFF side of the button removes power from the unit.

OPERATION

Operating procedures for the magnetic tape units are described below.

Applying Power
Press the ON/OFF switch to ON. ON/OFF lights.

Removing Power
Press the ON/OFF switch to OFF. ON/OFF extinguishes.

Tape Mounting
To mount a tape, follow this procedure.

1. Open the front glass door on the tape unit.
2. Prior to mounting the supply reel, visually examine the condition of the tape. It should be free of kinks and creases. Check condition of the reel as well. It must not be warped or damaged in any way.

   NOTE: If tape is to be written on, install a write-enable ring in back of the tape reel.

3. Open the supply reel hub loading latch and place the supply reel on the hub. Handle the reel by its hub and not by the flanges. Since the flange is the weakest part of the reel it is more susceptible to damage.
4. Gently press the supply reel onto the supply reel hub and close the loading latch.
5. In the same manner, install an empty reel (take-up reel) on the remaining hub.
6. Refer to "Tape Threading".

Tape Threading

1. Using a clockwise direction of rotation, unwind approximately 3 feet of tape from the supply reel.

2. Thread and feed the tape over the upper roller guides, through the tape head area, and under the capstan and lower roller guide directly over to the take-in reel; see the tape threading diagram located on the inside cover of the handler door and Figure 14-6.

3. Loop the free end of tape up over the take-up reel in a clockwise direction, making sure that the tape is not twisted or creased in the process. Secure tape end to the reel by holding the tape end with a finger through one of the holes in the reel flange and rotate the take-up reel clockwise, until at least one complete turn of tape is firmly seated on the reel.

4. Remove finger and continue to manually turn the take-up reel clockwise until there is sufficient tape on the take-up reel to tension the tape.

    NOTE: Do not manually rotate the file reel while turning the take-up reel, since friction provides the necessary windup tension required on the take-up reel.

5. Make sure the tape is properly aligned on the roller guides and turn the file reel slightly to take up any remaining slack.

6. Close the front door and press LOAD. Vacuum chamber(s) will activate and tape will be tensioned and advanced to the BOT marker.

7. Select the proper recording density, if applicable, via the HI DEN button.

8. Set unit select switch to desired unit address.

9. Check FILE PROT indicator. If tape is to be written on, the indicator should be unlit.

10. Press ONLINE. Handler is powered and cycled; ready for online operation.

11. Close front glass door on the tape unit.

Tape Rewinding

The tape unit can unwind tape in either the online or offline mode. During online operation, the handler rewinds tape to the BOT marker under program control.

Offline the handler automatically rewinds tape to the BOT marker. However to perform such a function, the handler must be in the offline mode.

MTU9112/9104 Tape Units   MTU9113/9105 Tape Units

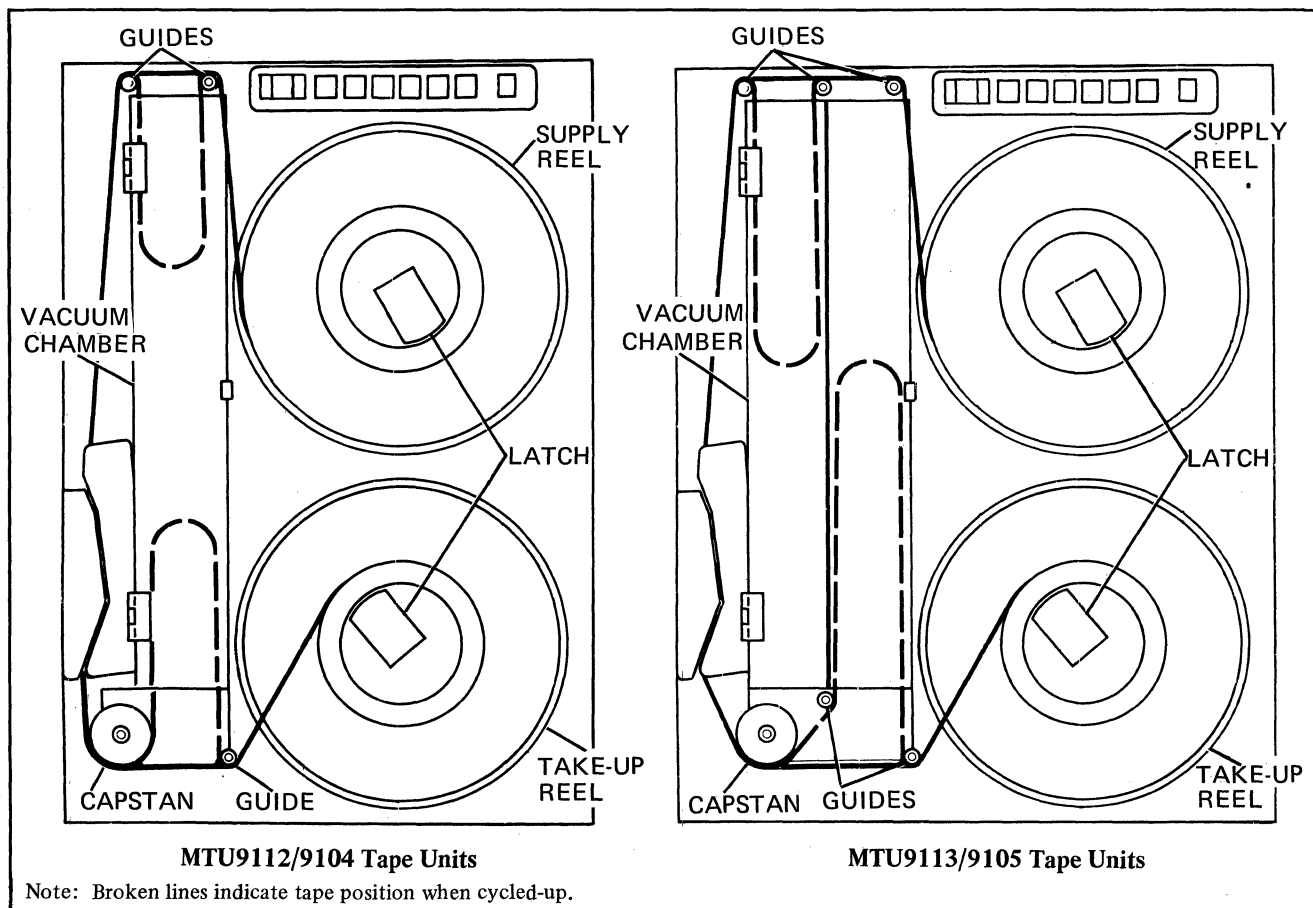Note: Broken lines indicate tape position when cycled-up.

Figure 14-6. Tape Threading Diagram

1. Press ONLINE button. The indicator will extinguish indicating that the handler is offline.
2. Press REWIND to rewind tape to the BOT marker.

> NOTE: Tape rewinds at 200/250 inches per second and continues at this rate until light is sensed by the reel sensor. At this point the tape decelerates to the normal read speed and continues to rewind at this rate until the BOT reflective marker is sensed.

Tape Demounting

The following procedure should be performed with the tape unit in the offline mode. (The ONLINE indicator should be extinguished, indicating that the unit is offline.)

o If the tape is positioned at BOT:

  a. Press REWIND to unwind remaining tape from take-up reel back onto the file reel.

  b. Open the front glass door on the tape unit.

  c. Open the supply reel hub loading latch and gently pull the supply reel from its reel mount by grasping the opposite sides of the reel with your fingers while pressing firmly with the thumbs against the reel hub.

  d. Close the supply reel hub loading latch and front glass door, unless another tape is to be mounted.

o If the tape is positioned past the BOT marker:

  a. Press REWIND to rewind tape to the BOT marker. Tape motion will automatically stop when the BOT reflective marker is sensed.

  b. Press REWIND again to unwind the remaining tape from take-up reel back onto the supply reel.

  c. Open the front glass door on the tape unit.

  d. Open the supply reel hub loading latch and gently pull the supply reel from its reel mount by grasping the opposite sides of the reel with your fingers while pressing firmly with the thumbs against the reel hub.

  e. Close the supply reel hub loading latch and front glass door, unless another tape is to be mounted.

OPERATOR MAINTENANCE

Operators are required to perform a limited amount of maintenance in order to keep the tape unit(s) functioning properly. This maintenance consists of cleaning the following major areas: read/write head, tape guides, capstan, tape cleaner, vacuum chamber, erase head and tape unit surfaces. Cleaning should be performed once a day or as often as required.

Prior to cleaning the unit, remove both supply and take-up reels and then power down the unit.

Cleaning

1. Open front glass door.
2. Remove both head covers (see Figure 14-7).
3. Use a lint-free cloth moistened with Honeywell Magnetic Tape Cleaner (Part No. 9704-2048-001) or equivalent solution (such as Freon "TF" solvent) and clean all exposed surfaces of the read/write, head, tape cleaner, erase head, and tape guides shown in Figure 14-7. Cotton swabs or a ½-inch acid-free brush dipped in these cleaner solvents can be used to remove stubbon oxide buildup in the slotted areas of the tape head as well as on the rubber surface of the capstan.

> NOTE: Heads are susceptible to damage. Keep all metallic objects away from tape head area.
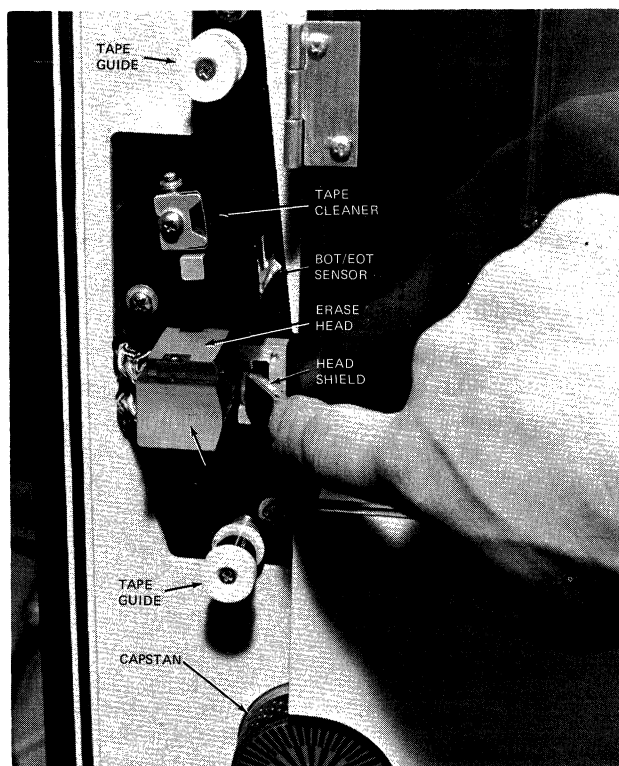
4. Replace both head covers.

Figure 14-7. Tape Head Assembly

5. Open the vacuum chamber door and clean vacuum column(s). Use a clean lint-free cloth dampened in one of the cleaner solvents. Cotton swabs may be used to clean walls of the vacuum column(s). Visually check that the air holes are clear.
6. Clean the vacuum chamber glass door and front glass door on the unit of all smudge marks with a lint-free cloth and a nonspray liquid window cleaner.
7. Close the vacuum chamber door.
8. The tape unit can now be put back into service.

BOT Patch Mounting

The beginning and end of the working storage area on the tape is marked by a small, inch-long reflective marker. Marker dimensions are:

Length: 1.1 inch ± 0.2
Width: 0.19 inch ± 0.02
Thickness: 0.0008 inch (max.)

The BOT and the EOT markers are placed on the Mylar base side of the tape. Take care when placing the markers. They must be within 0.03 inch (0.08 cm), but not protrude beyond the reference edge of the tape, and free of wrinkles and adhesive.

The tape between BOT and the physical beginning of tape is referred to as the leader. If bad spots develop on the tape toward the leading edge, the BOT marker can be moved down so that the damaged section of the tape can still be used for information storage in the normal manner. A leader length of about 16 feet (5 m) is recommended for automatic threading.

Tape Handling and Storage

The following rules are prerequisite for proper magnetic tape handling and storage.
Keep tapes clean. Dust and dirt can reduce the intensity of reading or recording signals by altering the distance between the head and the tape. Therefore:
o Never touch the tape's oxide coating; body oils on tape attract dust and lint.
o Keep the tape in its dust-proof container until just prior to use on the tape drive.
o Keep tape containers clean and dust-free *inside* and *out*. Don't leave containers open when tape is in use.
o Keep the tape transport door closed when the tape drive is not in use.
o Avoid dangling the free end of the tape on the floor when changing reels.
o Don't smoke in the computer room. Smoke and ashes are dirt; hot ashes are destructive to magnetic tape. Food and drink should not be put near the tape devices.

o Identify reels with adhesive stickers, which are easily removed and leave no residue. Eraser particles are dirt. Change the label; don't erase it.
Handle and store tapes with care. Avoid damaging tapes and reels or placing tapes where temperature, dust, or magnetic fields affect them adversely. Follow these recommendations:
o When rewinding tape, be sure wind tension is proper (approximately 6 to 8 ounces (168 to 224 grams) for ½-inch (1.27cm) wide tapes. Loosely or tightly wound tape causes wrinkles and creases to appear on the tape, which in time disrupt contact between tape and tape drive head.
o Make sure that the tape leader is properly wound when tape is returned to its container. This avoids accidental crushing of the tape leader edges and possible damage to the tape itself.
o Avoid dropping reels. If a tape is dropped, the reel may become broken or dirty, resulting in possible damage to the tape. Reel damage can be determined by a visual inspection. Never use a reel that may cause damage to the tape or to the tape drive.
o Always store tapes in containers in a dust-free cabinet. The containers should be placed on edge so that the reel is in an upright position. Do not stack tape reels one on top of the other since there is a possibility of damaging the bottom containers from the excessive weight of the stacked reels.
o Never place reels of tape on top of a tape drive as this exposes them to heat and dust from the cooling system.
o Whenever possible, store tapes in the controlled environment where they are to be used to avoid subjecting the tapes to excessive variations in temperature and humidity. For short-term tape storage, the surrounding atmosphere should be controlled within the following limits:

Relative humidity: operational 40% to 60%
Temperature: operational 60°F to 80°F (16°C to 27°C)

o For long-term storage, the reel of tape in its container should be hermetically sealed in a moisture-proof bag. Temperature should be constant somewhere between 60°F and 80°F (16° to 27°C).
o When mounting or demounting tapes, handle the tape reels by the hub and not by the

flanges. Squeezed or bent flanges result in damaged tape edges and eventual loss of contact with the magnetic head.

o When mounting a reel onto the tape drive, apply pressure to the hub and not to the flanges.

o A routine library inspection of tape reels should be made. Check for protruding tape edges. Exposed edges are vulnerable to damage and cause loss of contact with the tape drive head.

APPENDIX
PERIPHERAL DEVICE
ID NUMBERS

TABLE A-1. PERIPHERAL DEVICE ID NUMBERS

Peripheral Device	Device ID Number
CARD EQUIPMENT	
CRU9101/9102/9103/9104	2008
CRU9108/9109/9110/9111/9112/9113	2008
CONSOLE EQUIPMENT	
TTU9101/9103	2018
TTU9102/9104	2019
DKU9101/9102	201A
TWU9101	2018
TWU9104/9106	201C
DISK EQUIPMENT	
DIU9101/9102	2010
CDU9101	2330
CDU9102	2331
CDU9103	2332
CDU9104	2333
CDU9114	2331
CDU9116	2333
PRINTER EQUIPMENT	
PRU9101	2004
PRU9102	2006
PRU9104/9106	2000
PRU9104/9106 with PRF9102	2001
PRU9103/9105	2002
PRU9103/9105 with PRF9102	2003
MAGNETIC TAPE EQUIPMENT	
MTU9112	2169 (@ 556 cpi)/2171 (@ 800 cpi)
MTU9113	216A (@ 556 cpi)/2172 (@ 800 cpi)
MTU9104	2145
MTU9105	2146
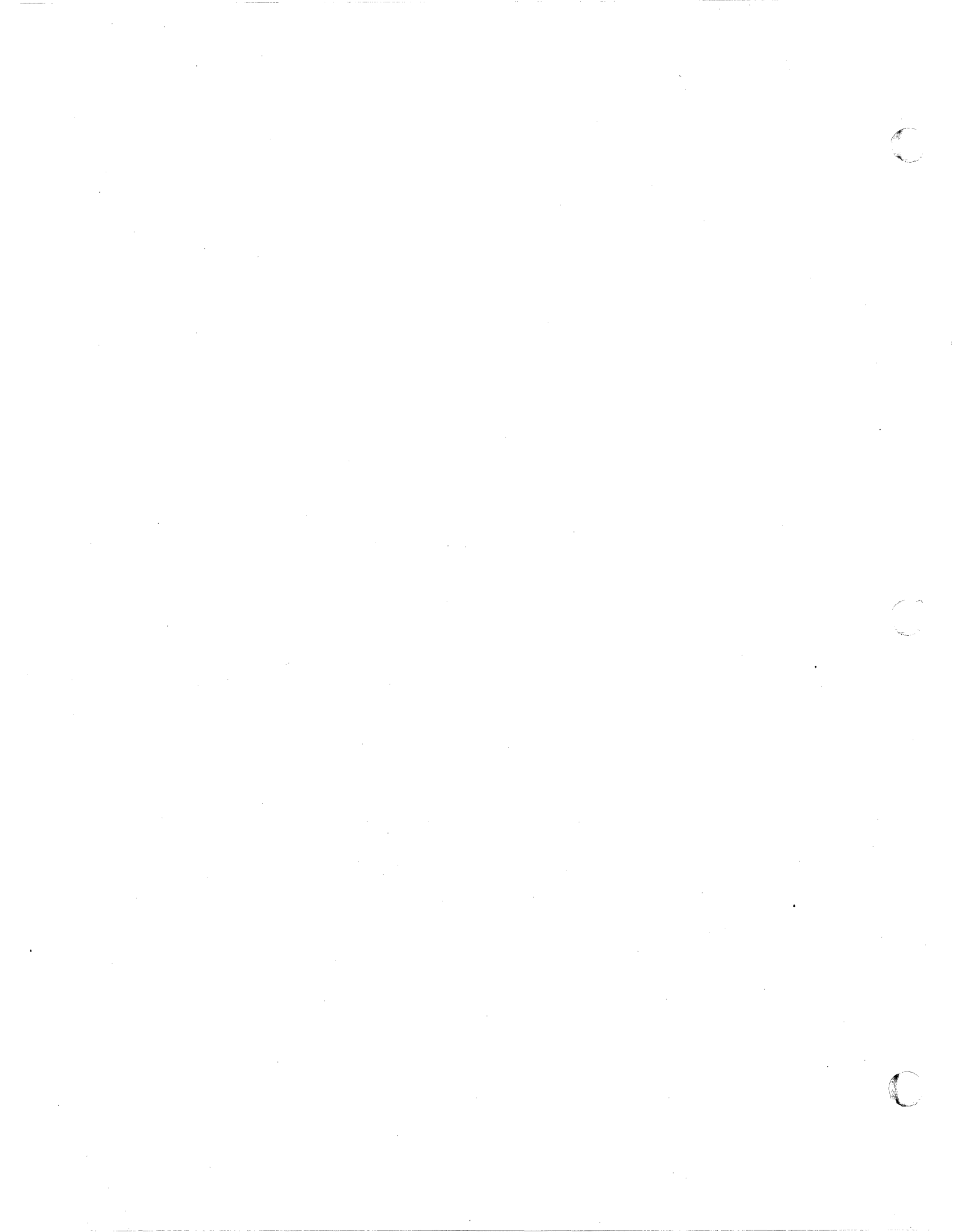
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