

1114 TECHNICAL MANUAL

212118 N/C

DISK CONTROLLER
FOR THE 1130 SYSTEM

CHI 1114
DISK STORAGE SYSTEM

INSTRUCTION MANUAL

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SECTION 1

SYSTEM DESCRIPTION

SCOPE OF MANUAL

PURPOSE

This technical manual describes the Computer Hardware Inc. 1114 Disk Storage System. It is intended for potential 1114 users, installers, and operators.

RELATED PUBLICATIONS

This manual is one of a series of manuals on the CHI 1114 Disk Storage System. There is one additional system manual (the 1114 DIAGRAM MANUAL) and a number of manuals for the individual components and options of the CHI 1114 Disk Storage System. A list of available manuals will be furnished by the CHI Customer Engineer upon request.

GENERAL DESCRIPTION

The Computer Hardware Inc. 1114 Disk Storage System, which consists of a CHI 1114 Control Unit and one or two Memorex 660 Disk Drives (see Figure 1-1), provides the IBM 1131 central processing unit with an additional on-line storage capacity of 20.48 million 16-bit words. The Memorex 660 high density disk pack drives are operated through a CHI 1114 Controller interfacing to the CPU at the Storage Access Channel. The system operates in two programmable modes - the IBM-compatible mode and the Bulk mode. The maximum on-line storage capacity is available only in the Bulk mode with the use of CHI software.

The IBM-compatible mode of operation provides the 1131 CPU with added on-line storage capacity equal to that provided by four IBM 2310 Disk Drives. The CHI 1114 System operates as a hardware replacement of the four IBM 2310 disk drives by electronically simulating each of those devices. In this mode of operation, the IBM disk drive commands are interrupted by the 1114 Controller which generates compatible commands for the 660 Disk Drive. The four surfaces of the 660 disk drives used in place of the 2310 areas are selected by Control Panel switches by the operator prior to initiating the program. Selection of any one of 40 surfaces for each of the IBM-compatible area codes provides an on-line storage capacity of 2.05 million words and an "on-line-standby" storage capability of 18.43 million words. The operator can gain access to the "on-line-standby" storage capacity by the "flick of a switch" between programs. No time is lost in bringing the data storage system to a halt and restarting it as is required when changing disk cartridges. As in the case of any disk storage system, the CHI 1114 Disk Storage System allows unlimited off-line storage capacity. The basic operations of the system are illustrated in Figure 1-2.

The disk cartridges used are IBM-2316, Memorex VI or equivalent. However, each disk cartridge must be processed by CHI prior to being used with the 1114 Disk Storage System. The processing entails writing sector check words on the pack.

DATA ORGANIZATION

Each disk pack has 20 usable surfaces with 203 tracks on each surface. The vertical alignment of tracks can be thought of as a cylinder of tracks (Figure 1-3). A total

The tracks are divided into eight segments called sectors. The data field of each sector is 321 words long. Therefore, the storage capacity of each surface is equivalent to the capacity of one IBM-2315 cartridge.

All data transferred to or from the CHI 1114 Control Unit are checked using the modulo-4 technique. Through this method four parity bits are appended to each data word. This causes each 16-bit word to have an effective length of 20 bits when it is written to the disk cartridge. These bits are stripped off during inbound transfers. If a data transfer error is detected, it is usually caused by checking circuits detecting an error in the modulo-4 checking circuit. The technique is exactly the same as that employed by IBM in reading from and writing to the IBM-1131 disk drives.

DATA PROTECTION*

In an IBM-1130 system, it is not uncommon to inadvertently destroy stored data. This is usually referred to as "bombing" a disk. The risk of this is even greater in systems used to simulate multiple disk drive systems. Destruction of stored data usually takes place when data is written in a location which is not correct. This can happen due to operator error, programmer error or electronic malfunction. The "Sector Protector" design protects against such errors.

The IBM 1131 monitor programming system always provides that data to be written to a disk are preceded by the sector address of their destination. This is the reason that 321 words are included in each disk transfer. The first word is always the sector address followed by 320 words of data. The "Sector Protector" design takes advantage of this consistent programming technique to assure the data are written only in the proper sector.

In the standard IBM system the data looks as shown in Figure 1-4. The purpose of the preamble is to synchronize the data transfer circuits prior to the transfer of the active data.

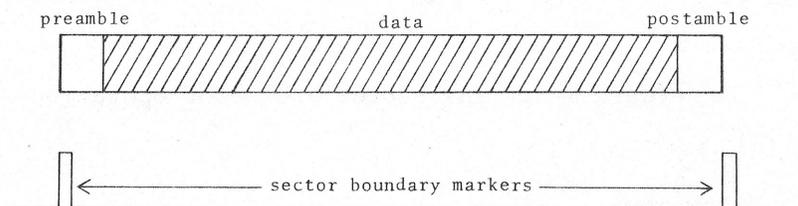


Figure 1-4. IBM Disk Sector

In the CHI 1114 system, the sector has been divided into two fields - a sector protect field and a data field. Both fields include a preamble and postamble. The CHI sector format is illustrated in Figure 1-5.

On all writes to the disk the address check word is read from the disk and compared against the sector address preceding the data in memory. If for any reason the address check word from the disk and the address word from memory are not equal, the write command is instantly terminated and the integrity of the data is preserved. If a "sector Protector" violation occurs, the CHI 1114 disk controller halts its

*Patent applied for

the system. The enable/disable switches are used to select one of the two 660 Disk drives. Through manipulation of the switches any surface may be made to simulate a disk pack in any of the four IBM 2310s.

OPTIONS

GENERAL

The CHI 1114 Control Unit is the basic enclosure for the disk drive controller, standard CHI 1114 options and special customer units. Normal supplied options include: (1) the SAC continuation which allows other peripheral devices to be connected to the 1131 Storage Access Channel; (2) a high speed line printer controller for the operation of the CHI 1103 in the native mode or as simulating the IBM 1403; and (3) a special device interface module for CHI hardware controllers. These options are described in the following paragraphs.

SAC EXTENSIONS

The 1114 Control Unit has an option for the continuation of the SAC port for connecting other peripheral devices to the 1131 CPU. The SAC Extension provides a port which is identical to the SAC 1 of the CPU. During program control operations, the continuation feature allows a device plugged into the SAC Extension to operate as if the 1114 Control Unit were not there. Cycle stealing is multiplexed in the 1114 Control Unit; however, this multiplexer is transparent to devices on the SAC Extension. The highest priority level on the interrupt line is assigned to the 1114 Controller with SAC continuation devices being of lower priority.

HIGH SPEED LINE PRINTER CONTROLLER

The CHI 1114 has a high speed line printer controller option which allows the operation of a CHI 1103 either in its native mode with CHI routines or as simulating an IBM 1403 with IBM routines. The high speed printer may be connected via its controller to the SAC Extension. However, this is an expensive setup as compared to the use of the optional high speed printer controller in the CHI 1114.

SPECIAL OPTION INTERFACE MODULE

The 1114 has space for optional interface modules which are used to interface special CHI devices to the CPU. The options provided are for interfacing such devices as paper tape controller, small process control systems (analog to digital converters, etc.), interactive terminals (display screen and keyboard), and electrostatic printers. An optional 60 cycle time base Programmable Interval Timer, which produces periodic interrupts to the CPU, allows the handling of real time data for computer operations such as customer service time. The special option module is an area within the 1114 Control Unit in which specially wired units can be field installed. This option can be used for standard CHI modules or for customized modules upon request. Figure 1-7 lists some of the available option units. All the options shown in this figure cannot be installed in a single 1114 system. Contact a CHI Customer Engineer for information concerning a specific group of options.

SPECIFICATIONS

STORAGE CAPACITY (16-BIT WORDS)

On-Line:	Bulk Mode - 20.48 million (2 drives) IBM-Compatible Mode - 2.05 million
Stand-By:	IBM-Compatible Mode - 18.43 million
Off-Line:	Unlimited

OPERATING TIMES

Seek Time:	35 ms (average)
Data Transfer:	8 μ s (125,000 words per second)

OPERATING ENVIRONMENT

Temperature:	60° to 90°F
Relative Humidity:	20% to 80%
Maximum Wet Bulb:	15°F per hour

NONOPERATING ENVIRONMENT

Temperature:	<10° to 110°F
Relative Humidity:	8% to 80%
Maximum Wet Bulb:	80°F

POWER REQUIREMENTS

Voltage:	208/230 AC
Frequency:	60 cycle
Phase:	single
Circuit Breaker:	30 amps

PHYSICAL CHARACTERISTICS

CHI 1114

Size:	45 inches high, 24 inches deep, 30 inches wide
Access:	3 feet front and rear; none on sides
Weight:	300 lbs.

660 Disk Drive

Size:	39 inches high; 24 inches deep, 30 inches wide
Access:	3 feet front and back (each unit)
Weight:	395 lbs.

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SECTION 2

INSTALLATION

PRELIMINARY PLANNING

LOCATION

The CHI 1114 Disk Storage System and optional devices interface with the IBM 1131 CPU both functionally and aesthetically. The cabinets are designed so that when positioned alongside the 1131 the appearance of all units blends into that of a single system. Preliminary planning for the installation of the 1114 system should include consideration for placement, hook-up and access to each unit.

The operational access to the 1114 is limited to the control switch panel. The operator must set the rotary and lever switches to select the 660 disk drive surfaces to be used in the IBM-compatible mode. He also requires access to the ERROR and POWER FAIL lamp/switches when a system failure occurs. Cable lengths limit the separation distance between the 1114 Controller and the CPU to 10 feet. This is also the maximum separation between the 1114 and disk drives.

The operator requires access to the Memorex 660 Disk Drives for the replacement of disk packs. Access requirements are specified in the Specifications in Section 1.

POWER ACCESS

The 1114 Controller and disk drive units require a single 208/230 VAC outlet within 15 feet of the intended location of the control unit. The outlet should be a standard three-prong receptacle (Hubbell 9350 or equivalent) equipped with a 30 ampere circuit breaker. A common earth or conduit ground, whichever is supplied to the 1131 CPU, must be available for connecting to the L-shaped contact on the 1114 Control Unit. The 1114 AC is isolated, therefore, no AC neutral is required. The common ground should also be available to all other units.

CAUTION

DO NOT CONNECT AC NEUTRAL TO THE
L-SHAPED CONTACT OF THE 1114.

The disk drive requires no power outlet access as it is powered by the 1114 Control Unit. Other devices (printers, tape punches, etc.) connected to the 1114 require separate power outlets as specified for each individual device.

INTERFACING

All units interface to the CPU through the 1114 Control Unit. The disk drives are also interfaced to each other. Aside from the common ground, all required interface cabling is provided for the units of the CHI 1114 System. General descriptions of the 1114 interfacing cables are provided in Table 2-1.

CHI 1114 CONTROL UNIT

The 1114 Control Unit is wrapped in plastic and stored in a cardboard box. There are no internal physical restraints. The exterior surfaces of the control unit should be examined for scratches. Control panel switch knobs should be visually checked and switches should be tested for smooth operation. If there is evidence of external damage, the panels should be removed and the interior inspected for damage. PC boards should not be removed for inspection unless there is evidence of possible damage.

DISK DRIVES

Upon removal of the plastic wrappings and completion of the visual inspection of the exterior surfaces of the disk drive, a visual check should be made to assure that the head assembly is not protruding into the disk pack chamber. Next, the three internal restraints should be removed. These restraints are shown in Figure 2-1 and described below:

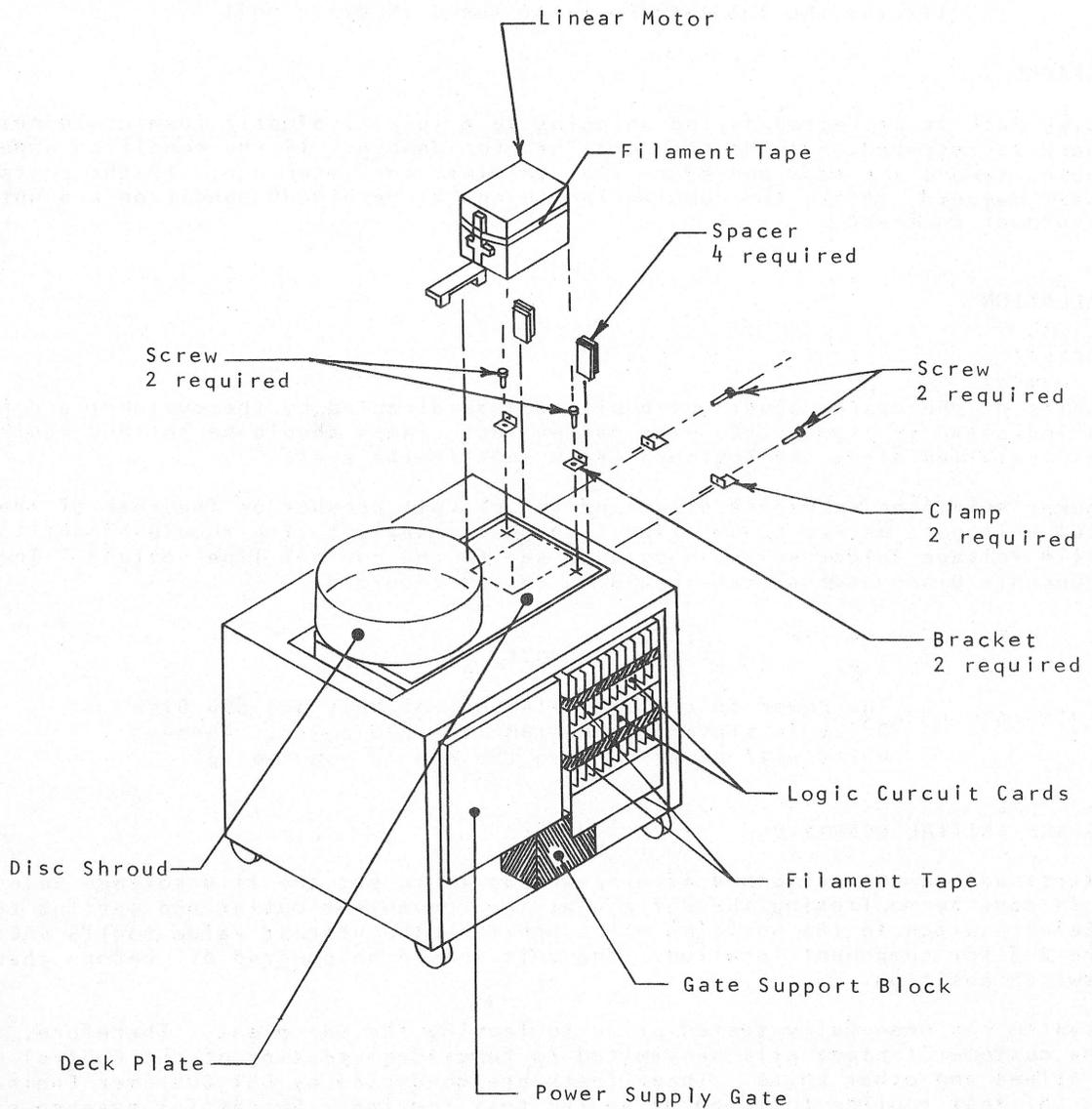


Figure 2-1. Disk Drive Shipping Restraints

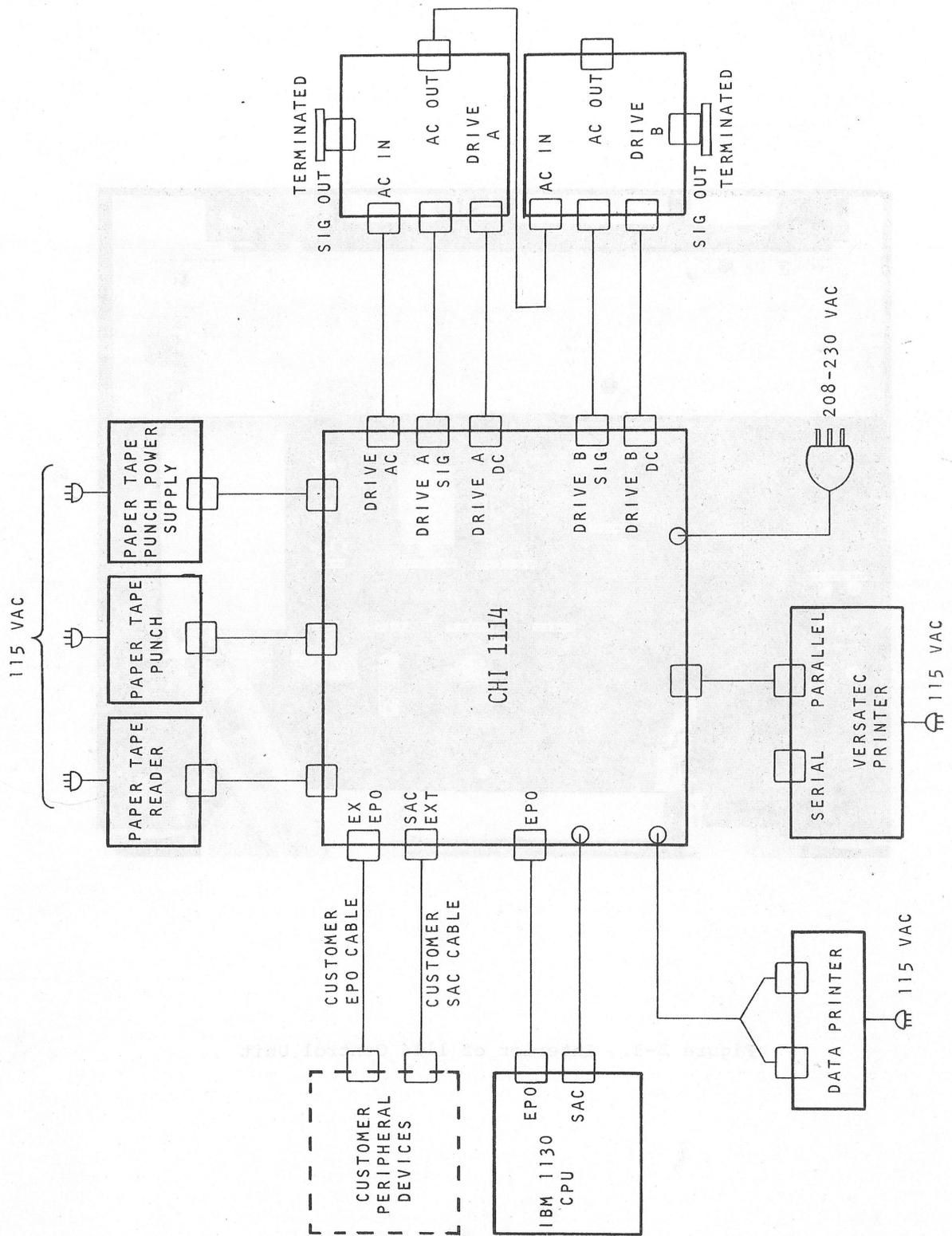


Figure 2-2. CHI 1114 Cable Interconnections

SECTION 3

OPERATION

CHI 1114 CONTROL UNIT

INDICATORS AND RESET SWITCHES

There is a set of four indicators on the left-hand side of the 1114 Control Panel (see Figure 3-1). Two of these indicators contain push-type reset switches. Details of these indicator/switches are given below.

1. POWER UP INDICATOR. The blue indicator lights when the 1114 Control Unit is in the power-up state. The 1114 power is slaved to the 1131 CPU.
2. SELECT INDICATOR. Each time the CPU accesses the 1114 Disk Storage System the yellow indicator will light for .3 seconds. This is an operator convenience to let him know when the 1114 is in use.

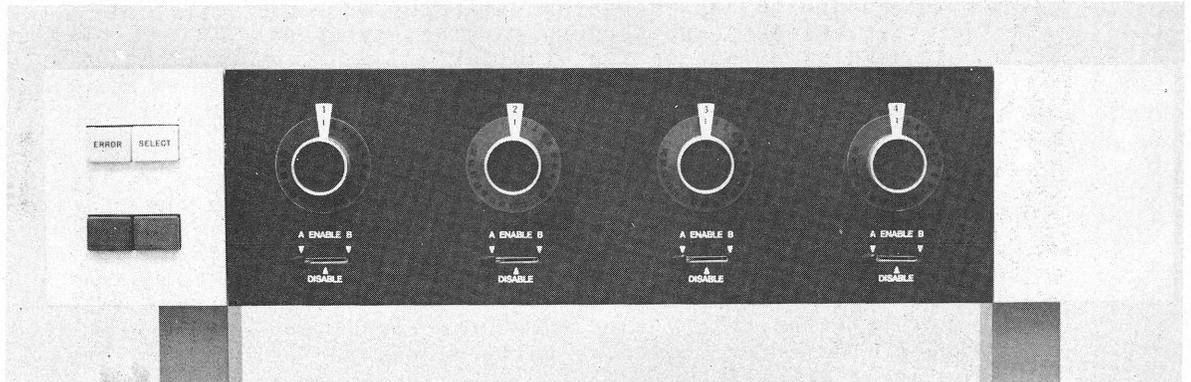


Figure 3-1. 1114 Indicators and Switches

3. POWER FAULT INDICATOR/SWITCH. AC and DC power failures are indicated by the red lamp. The power failure detection circuits have a 40 ms hold-off to allow stabilization. When AC power is interrupted, the hold-off circuit must recycle. This takes from 20 to 40 seconds. If the AC power is returned prior to completion of the recycle time, the hold-off will not be in full delay and the power fault lamp will light. The indicator and detection circuits must be manually reset by pressing and releasing the FAULT button when the power interrupt is shorter than the automatic reset period.

SURFACE SELECTOR SWITCHES

There are four pairs of surface selector switches located across the front of the control panel. Each pair of switches consists of a 20-position rotary switch and a three-position lever switch. Each pair of switches is used to select a surface on the 660 Disk System to replace one of the IBM 2315 surfaces. The switches represent drives 1 to 4 from left to right, respectively. These switches are only active in IBM compatible programming. When the Bulk mode is programmed, drive and surface selection are fully controlled by the program.

The lever switch is used to select which drive will be used and the rotary switch is used to select the surface number on that drive. Any combination of drive and surface selection is permitted provided no two area codes are assigned to the same drive and surface. The drive select switches can be set to ENABLE DRIVE A, ENABLE DRIVE B, or DISABLE. In the disable position the 1114 system cannot be accessed through the area code assigned to that pair of switches. The Device Status Word indicates a "file not ready" in response to the Status Requests.

AREA CODE OPERATE/DISCONNECT SWITCHES

The CHI 1114 Control Unit contains six Area Code Operate/Disconnect switches on the circuit gate. These switches are normally set to the OPERATE position. However, if there are devices on the SAC line which respond to one of the area codes of the 1114 system, that area code must be switched to DISCONNECT to avoid a conflict whenever the CPU accesses that area code. This condition might arise if a customer has IBM 2310 drives installed and he adds a 1114 System. The Area Codes corresponding to the installed IBM drives must be disconnected in the 1114. These switches are normally set during installation. They will only require change if the certain devices are added or removed from the SAC line. See Section 4 for area code assignments in the CHI 1114 System.

MEMOREX 660 DISK DRIVE

INDICATORS

There are four indicators on the 660 Disk Drive Unit. They indicate when the unit is ready for access, unsafe, in the "read only" mode, and the cylinder address of the heads. The indicators are shown in Figure 3-2 and details of these indicators are given below.

1. ZERO SELECT PLUG INDICATOR. The file ready indicator is located behind the zero select plug. When lighted, this green zero indicates the unit is ready to be accessed.



Figure 3-2. Disk Drive Indicators and Controls

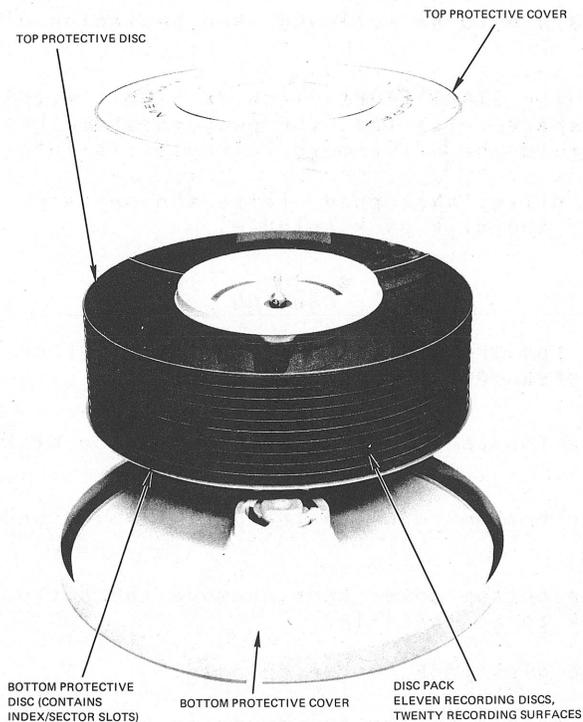


Figure 3-3. Disk Pack and Cover

4. When labeling a disk pack, use a pen or felt-tip marker that DOES NOT produce residue. DO NOT use a lead pencil. Microscopic lead particles can damage disk surfaces and read/write heads.
5. Write on the label before it is applied to the disk pack.
6. Place the label only on the center hub.
7. Use a new label if changes to label information is necessary. NEVER ERASE a label that is on a disk pack. Microscopic eraser particles can damage disk surfaces and read/write heads.
8. Removal or placement of labels can be done only when a disk pack is installed in the drive. Do not attempt to remove the top cover when the disk pack is out of the system.
9. When not installed in a drive, each pack should be set flat on a shelf, not on edge or on another disk pack.
10. Store each pack in a clean, enclosed metal cabinet or a similar fire-resistant container, in a machine room atmosphere as specified in Section 1.
11. If a disk pack must be stored in a different environment, allow two hours for adjustment to machine room atmosphere before using.

SECTION 4

THEORY OF OPERATION

BLOCK DIAGRAM DISCUSSION

The following discussion describes the functions and operations performed by the various modules within the CHI 1114 Disk Storage System. Refer to Figure 4-1 for a visual illustration of the relationship among these modules.

1. INPUT/OUTPUT MODULE. The input/output interface between the 1131 CPU and the 1114 Controller is provided at the Input/Output Modules where the 1131 CPU output signals are conditioned to levels acceptable to the 1114 circuits by a network of signal receivers. Input signals to the CPU from the 1114 are conditioned to acceptable levels for the 1131 CPU by a network of signal drivers.
2. PRINTER CONTROL MODULE. The 1114 Controller contains control circuits for operating a high speed printer from the 1131 SAC.
3. OPTION MODULES. The 1114 Controller is prewired to accept standard optional modules for the control of special devices as requested by the customer. The option includes real time clocks, paper tape readers, CRT terminals, electrostatic printer and others. The Option Module allows the special unit to be an integral part of the 1114 Controller instead of an external unit.
4. SAC EXTENSION MODULE. The SAC port of the 1131 is made available for other peripheral devices through the SAC Extension Modules of the 1114 Control Unit. The SAC Extension has receiver/driver circuits which are identical to those in the Input/Output module. This allows the customer to connect additional peripheral devices to the 1114 SAC 1 provided such devices respond to area codes not used by the 1114 Controller. The 1114 cycle-steal multiplex is connected to the SAC Extension to control all cycle-steal requests.
5. TIME STROBE MODULE. The CPU timing signals are applied to the 1114 Time Strobe Control Module. The output timing signals from this module are supplied to the various 1114 Control circuits.
6. AREA/FUNCTION DECODER MODULE. The CPU instruction word is decoded by the area decoder. If the area code is one of the six acceptable codes for the 1114 Controller, the function is decoded and used with the timing strobe to control the required internal operations. Four of the area codes are IBM-compatible (one corresponding to each of the IBM codes assigned to the 2310 Disk Drives). The other two 1114 Controller area codes are non-IBM-compatible. These are CHI area codes assigned to each of the two 660 Disk Drives for the Bulk Mode operation.
7. PANEL CONTROL SWITCH MODULE. The Panel Control Switch Modules are active only when one of the four IBM-compatible areas is being accessed. There are four switch modules, each one assigned to one of the IBM-compatible areas. The switch module is used to select which surface of either of the two 660 disk packs will be used as the storage for that area code. This allows a total of 40 surfaces

to be selected for each of the IBM-compatible codes. During a program, only four surfaces will be on-line for the IBM-compatible codes. Any of the remaining 36 can be put on-line electronically by use of the control panel switches. This saves shutdown and start-up time required when changing disk packs.

8. OPERATION CONTROL MODULE. The internal operations of the 1114 are controlled by Operation Control Modules which translate decoded functions and timing signals into 1114 Controller operation signals.
9. DISK ACCESS MECHANISM CONTROL MODULE. The positioning modules electronically simulate six disk drives and transform the CPU instruction to commands acceptable for operating the 660 Disk Drive. The drive and head selection is made by the control panel switch settings for IBM-compatible programs and by program words in the non-IBM-compatible programs. Cylinder selection is made by updating a storage register to the latest programmed cylinder number and comparing this position to the actual position of the disk drive access mechanism. Incremental movement is provided as required. Cylinder register updating is performed during the seek operation. The actual positioning head and sector selection are not made until after the CPU issues an initiate read or write instruction.
10. INTERRUPT AND STATUS MODULE. The disk operational system of the CPU is supplied with interrupt status level and device status words via the Interrupt and Status Modules of the 1114 Controller. The disk drive status, cylinder register status, read errors, etc. are handled via these modules. These modules also contain the cycle stealing request and multiplexer circuits.
11. READ/WRITE CONTROL MODULE. The processing of data between the CPU and the disk surfaces is provided in the Read/Write Control Modules. These modules contain the address register, maintain the transfer word count, update the address register, initiate the cycle steal request, convert the data between parallel and serial forms, check for read errors (Modulo 4) and perform sector protection verifications. Sector selection is accomplished by comparing the output of the Sector Generator/Counter with the sector address requested by the CPU.
12. ERROR DETECTOR/INHIBIT MODULE. The Error Detector Modules are used to sense various conditions in the 1114 Controller, the 660 Disk Drives and the data being transferred. Detection of any fault is routed to either the CPU via the Device Status Word or to the 1114 Controller Inhibit Module which shuts down the entire 1114 system.
13. DISK DRIVE RECEIVER/DRIVER MODULES. The interfacing between the 1114 Controller and the 660 Disk Driver is provided by the Disk Driver Receiver/Driver Module. The required conditioning of control and data signals between the units are provided by these modules.

SEEK OPERATION

The Seek instruction is decoded by the 1114 in the area and function decoder. The 1114 Controller then updates the cylinder register of the area being accessed. See Figure 4-2 for an illustration of the Seek operation and Figure 4-3 for the 1114 components involved in the Seek operation. In addition, head and drive selecting are determined at this time. In the IBM-compatible mode, head and drive selections are made by the control panel switches. The program supplies the head and drive information when the Bulk mode is being accessed.

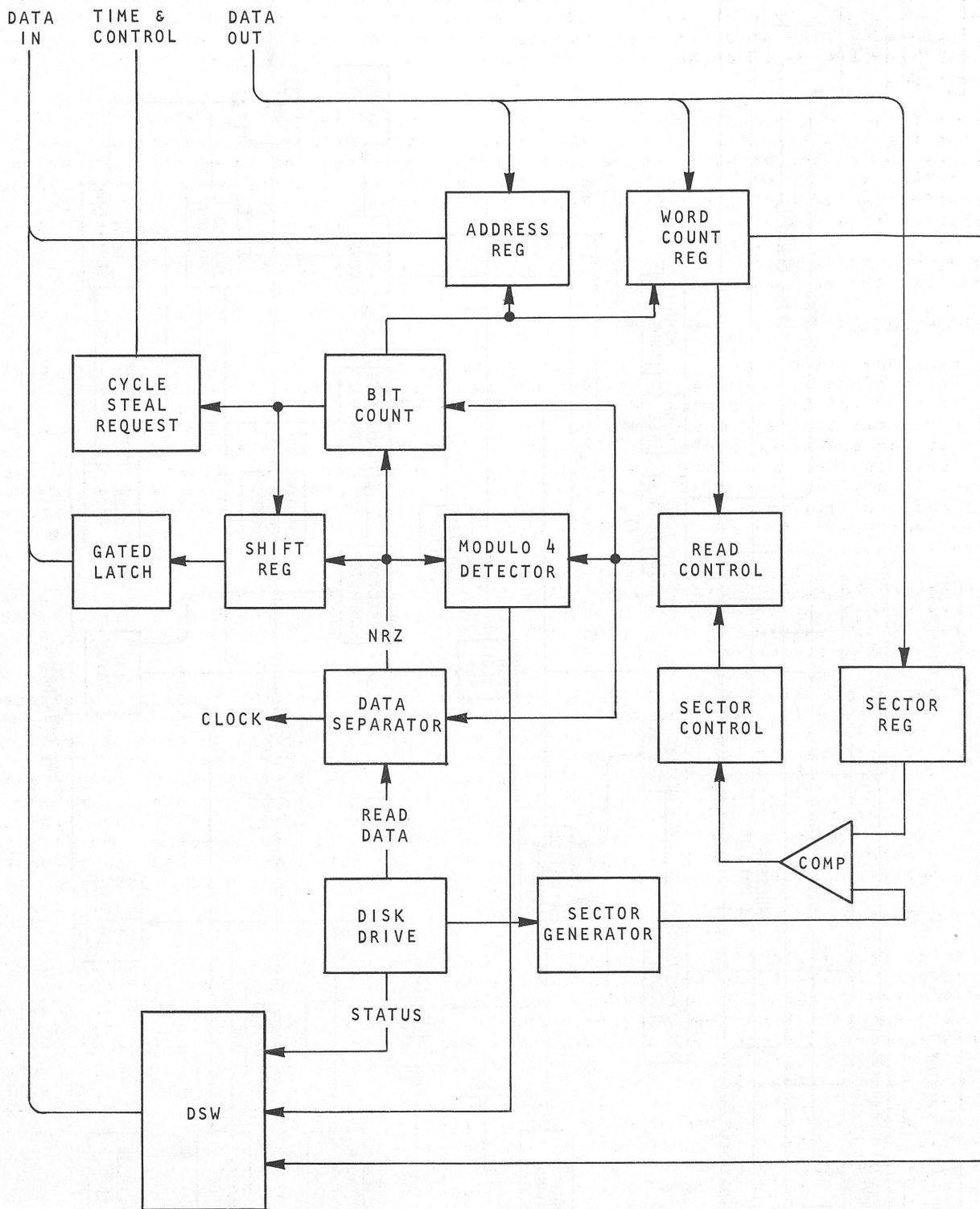


Figure 4-4. Read Operation

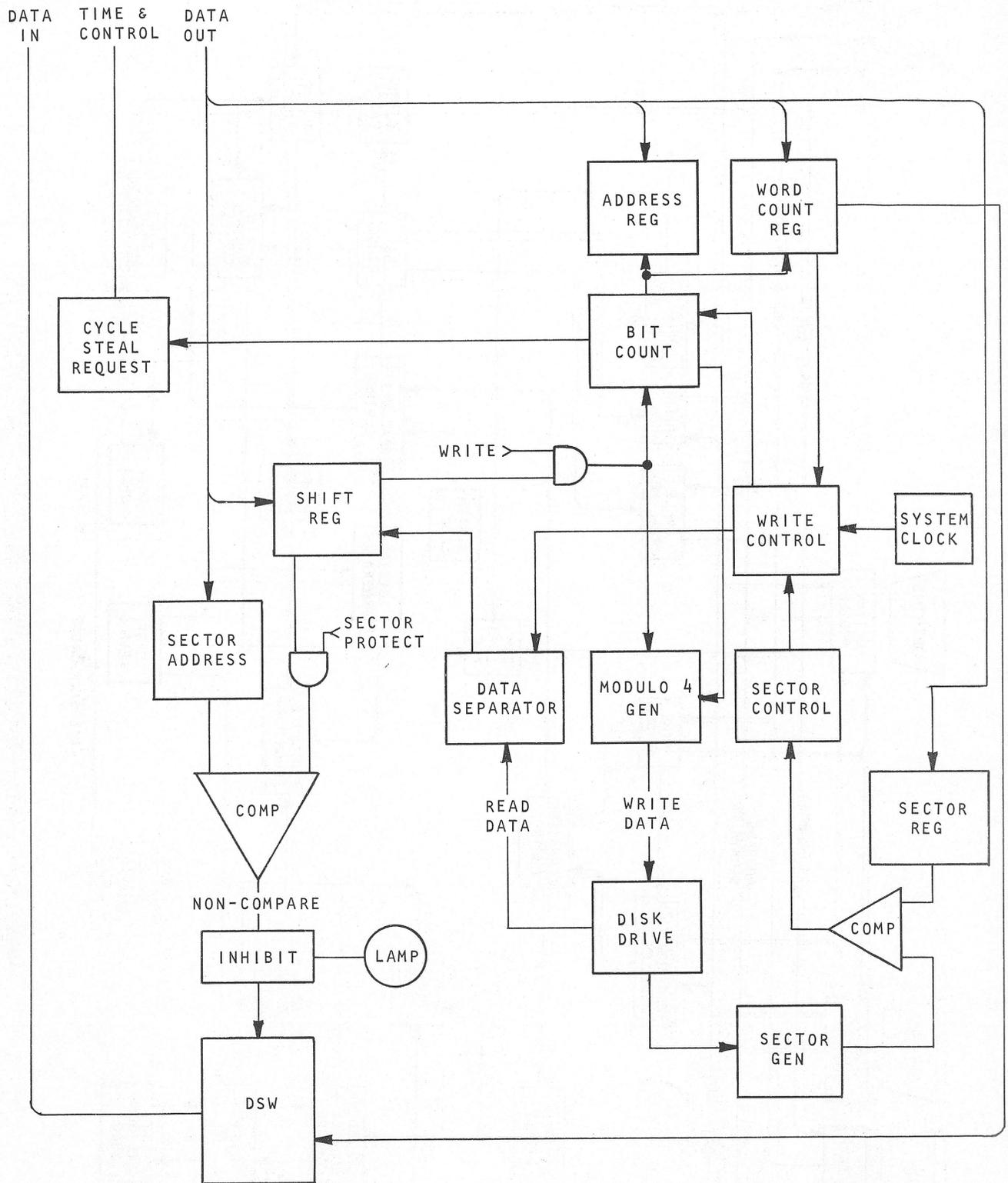


Figure 4-6. Write Operation

If the Sector Address Check Word agrees with the sector address in core, the 1114 Controller write command is enabled and it writes the sync word and then issues a cycle-steal request. The sector address word in the write buffer is again transferred from the CPU through the Shift Register through the Mod-4 Generator to the 660 Disk Drive and written on the disk surface. This transfer is followed by the transfer of the first data word from the write buffer and the process continues until the Word Counter indicates that all the words have been transferred from the CPU to the disk. The Bit Counter keeps track of each word passed through the Shift Register by decrementing the Word Count Register and issuing a cycle-steal request as required. When the Word Count Register indicates zero, the 1114 Controller writes zeroes to the end of the sector and then issues an interrupt request to the CPU to inform it that the write operation is completed.

PROGRAMMING INFORMATION

DISK FILE ORGANIZATION

Each disk surface is divided into eight sectors. Each sector contains 321 data words. Four disk pack surfaces are accessed as if they were single disk packs in 4 IBM 2310 Disk Drives. Any one of the 20 surfaces on one drive may be accessed through a fifth or sixth device code. The area codes are listed in Table 4-1 with other device data.

Table 4-1. Drive Data

EQUIVALENT PHYSICAL DRIVE NO.	DEVICE CODE (Command Bits 0-4)	AREA	ILSW BIT
1	10001	IBM-Compatible	1
2	10010	"	2
3	10011	"	3
4	10100	"	4
5	10110	Bulk	5
6	10000	Bulk	6

DEVICE COMMANDS

The formats of the commands used with the 1114 are as follows:

1. **SEEK** - This command modifies the contents of a register in the control unit and does not cause any disk drive response. The access mechanism movement takes place just prior to the execution of a read or write.

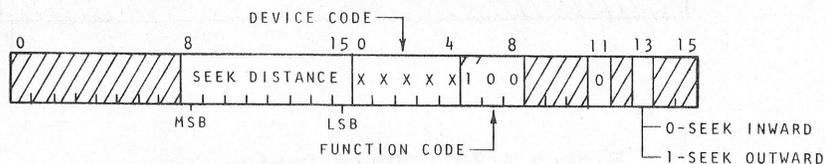


Figure 4-8. Seek Command

2. **SET HEAD**- This command causes the head address to be stored in the control unit. Just prior to a read or write from areas 16 or 22 only, the head specified by this command is selected. This command must precede an *INITIATE READ* or *INITIATE WRITE* command to areas 16 and 22 if a new head address is required.

- b. The disk file did not complete a read or write within one sector.
- c. The disk drive experienced a seek incomplete on a seek prior to the read or write.
- d. Sector Protection Violation
- e. Too long a seek (cylinder address >202)

This indicator is turned off by a 1 in the bit 15 position of the sense device command except for conditions d and e.

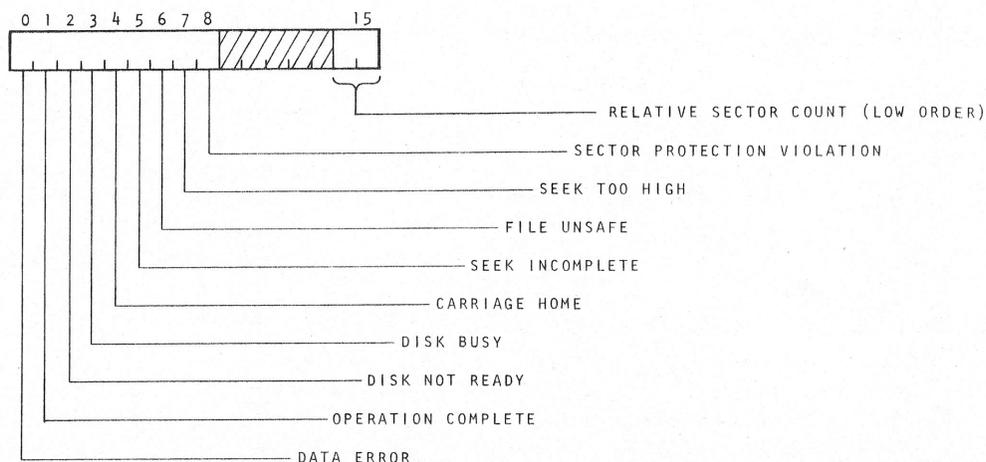


Figure 4-13. Device Status Word

2. OPERATION COMPLETE - Bit 1 is turned on at the completion of a read or write or to acknowledge a seek command. It also is turned on if a seek incomplete occurs on the seek prior to the read or write. This is the only bit that will cause an interrupt. This indicator is turned off by a true bit 15 of the sense device command.
3. DISK NOT READY - Bit 2 indicates that the disk drive is not ready, disabled, or unsafe or that the control unit is in the process of executing a command.
4. DISK BUSY- Bit 3 indicates that the control unit is executing a command.
5. CARRIAGE HOME - Bit 4 indicates that a register in the control unit which stores a carriage address is at 0. This bit does not reflect the actual carriage position of the disk drive.
6. SEEK INCOMPLETE - Bit 5 indicates that the disk drive has experienced a seek incomplete. This condition terminates the read or write operation which it precedes and sets the error indicator.
7. FILE UNSAFE - Bit 6 indicates that the disk drive is experiencing an unsafe condition. The control unit is inhibited from executing any commands while this bit is on. This condition also causes a disk not ready indicator.

SECTION 5

MAINTENANCE

CLEANING

FILTERS

There is one fiberglass mat filter in each 660 Disk Drive and the 1114 Control Unit. These must be replaced periodically. The length of serviceable life depends upon the environment in which the units are used. Normal replacement time should be 90 days. Information for the 1114 Control Unit filter is provided in Figure 5-1. The glass filter in the 660 Drives snap in and out of place. Access is through the rear panel.

The fiberglass filter of the 1114 is in a holder above the fans and it is removed by sliding it out and forward. Access to this filter is via the front panel.

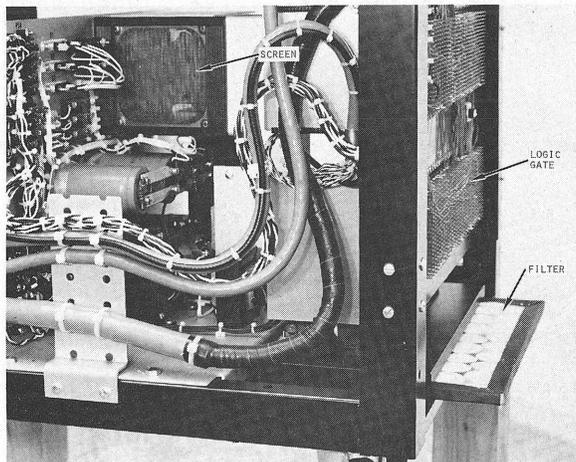


Figure 5-1. Filter and Screen Location

There is a metal screen in front of the power supply fan in the 1114 Control Unit. This screen should be inspected semi-annually and cleaned as required. Figure 5-1 also provides visual access information for the metal screen which is snapped in place by a plastic retainer. Access is either via the front panel or the left side panel.

EXTERIOR SURFACES

The exterior vinyl surfaces should be cleaned with some sort of glass cleaner or isopropyl alcohol only. Do not use detergents or solvents other than these.

DRIVE HEADS AND DISK SURFACES

Under no circumstances should the operator attempt to clean either the disk surfaces or the drive unit heads. The CHI Customer Engineer should be notified if dirt is noted on these units.





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