
Storage Technology Corporation

**3910
Detached
Diagnostic
Device**

Maintenance Manual

PN 9480

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PREFACE

SCOPE

This manual provides a description of the Storage Technology Corporation (STC) Model 3910 Detached Diagnostic Device (3910). The description includes general information, operating instructions including diagnostic test routines and utility programs, maintenance, and the removal and replacement of field replaceable units (FRUs).

PLAN

The manual is divided into five chapters plus an appendix.

Chapter 1 presents a general description of the 3910 Detached Diagnostic Device including features, options, and specifications.

Chapter 2 describes the system hardware including control, program mass storage, operator remote communications, and Serial Diagnostic Interface (SDI).

Chapter 3 provides information for operating the system and procedures for the care and handling of a floppy diskette and floppy drive head cleaning.

Chapter 4 describes the system software. Included is a description of the initial bring-up tests, the hardware monitor, instructions for running diagnostic test routines from the hardware monitor, hardware monitor commands, instructions for running diagnostic tests from the internal diagnostics diskette, and examples of utility programs.

Chapter 5 provides procedures for the removal and replacement of field replaceable units (FRUs).

Appendix A provides the modem test procedure.

RELATED PUBLICATIONS

STC 4500 Tape Subsystem Diagnostics Manual, PN 9595,
Doc Assy 400350101-4
STC 3910 User's Guide for 1900 Diagnostics, PN 9613,
Doc Assy 400001301-3
STC OS/3910 User's Guide, PN 9660

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CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

This chapter presents a general overview of the Storage Technology Corporation Model 3910 Detached Diagnostic Device. Included is a general description of the 3910, a list of its features and options, and the specifications.

1.2 GENERAL DESCRIPTION

The Storage Technology Corporation Model 3910 Detached Diagnostic Device is a portable, self-contained, offline maintenance processor capable of running diagnostic tests for functional verification, fault detection, and failure isolation on compatible STC products.

The 3910 (Figure 1-1) is mounted in an aluminum carrying case for portability. The keyboard CRT display, and floppy diskette drive are positioned directly in front of the operator. Six screws secure the 3910 in the carrying case for easy access to the circuit cards and power supply.

The standard features of the 3910 include:

1. Portable; capable of being hand-carried
2. Industry-standard interface to device under test
3. Serves as maintenance panel for the device under test
4. Connection for local hard copy
5. Capability for guided procedures
6. Internal diagnostics for self-test
7. Local terminal capability
8. Enables remote terminal capability

The options of the 3910 include:

1. Acoustic Coupler: 300 baud; Originate or Answer mode; full duplex.
2. 32K Memory

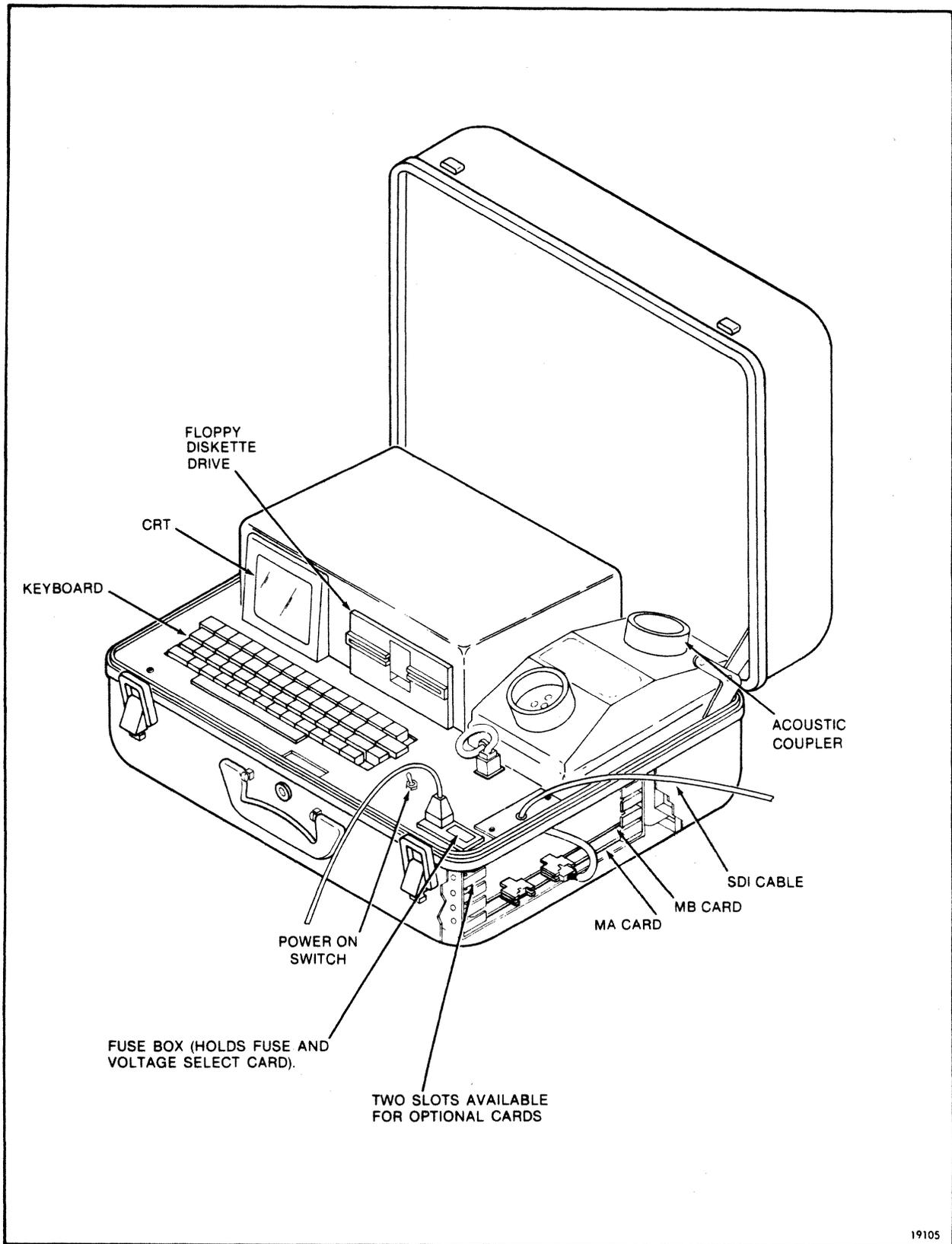


Figure 1-1. 3910 Detached Diagnostic Device

3. 1900 Diagnostic Feature: Tests STC 1930/192X, 1935/1921/195X, and 1960 Tape Subsystems; runs the standard STC 1900 Diagnostic Package; human interface similar to the STC 1900 PDP-11 Diagnostic Monitor; remote capability using an acoustic coupler.

1.3 SPECIFICATIONS

1.3.1 PHYSICAL DIMENSIONS

The 3910 is contained in an aluminum carrying case which is 9 x 17 x 21 inches. All components of the 3910 are mounted to a base plate such that the 3910 can be removed from the case and repaired on a bench. The acoustic coupler can be detached and moved to a telephone as required.

The basic 3910 weighs 37-1/4 pounds. The acoustic coupler option adds 1-3/4 pounds and the 1900 diagnostic option adds 2-1/2 pounds.

1.3.2 ENVIRONMENTAL REQUIREMENTS

1.3.2.1 Operating Environment

Temperature: +15 C to +32 C (+58 F to +90 F)
Relative Humidity: 8% to 80% (non-condensing)
Altitude: 0 to 3050 meters (0 to 10,000 feet)

1.3.2.2 Non-Operating Environment

Temperature: -40 C to +50 C (-40 F to +122 F)
Relative Humidity: Any, non-condensing
Altitude: 0 to 15 240 meters (0 to 50,000 feet)

1.3.3 POWER SPECIFICATIONS

The 3910 operates on either 60 Hz or 50 Hz without equipment changes. A four-way voltage select card in the 3910 is used to select any one of the following input ac line voltages:

- 100 Vac (90-110 Vac)
- 120 Vac (108-132 Vac)
- 220 Vac (198-242 Vac)
- 240 Vac (216-264 Vac)

The 120 Vac configuration has UL and CSA approval. A power cord and plug are supplied, but the customer may have to replace or use an adaptor on the plug for connection to the site facility power.

The 3910 uses 200 watts maximum.

CHAPTER 2
HARDWARE DESCRIPTION

2.1 INTRODUCTION

The 3910 logic is divided into four sections:

1. Control
2. Program Mass Storage
3. Operator/Remote Communication
4. Serial Diagnostic Interface (SDI)

Figure 2-1 is a simplified functional block diagram of the 3910. All control and program mass storage is located on the MA card; operator/remote communications and Serial Diagnostic Interface logic is on the MB card.

2.2 CONTROL

The control section consists of a Z80 microprocessor supported by 1K of boot/test PROM and 16K of program/data RAM.

2.2.1 MICROPROCESSOR

All functions of the 3910 are controlled by the Z80 microprocessor. The Z80 address and data buses are extended to the other functional areas of the unit for use as system buses.

The microprocessor includes a system clock generator which is a crystal-controlled oscillator at 40 MHz divided down to 4 MHz for the Z80. The Z80 performs at a 4 MHz clock rate and executes 158 different instruction types. The instruction set includes instructions for bit testing and data comparison as well as the standard arithmetic, logic, and testing instructions.

The Z80 microprocessor acknowledges interrupt requests generated by I/O devices. A request is honored at the end of the current instruction if the interrupt flip-flop is enabled and BUSREQ is inactive. When the microprocessor accepts the interrupt, an acknowledge signal is sent out at the beginning of the next instruction cycle. The following are the interrupting devices:

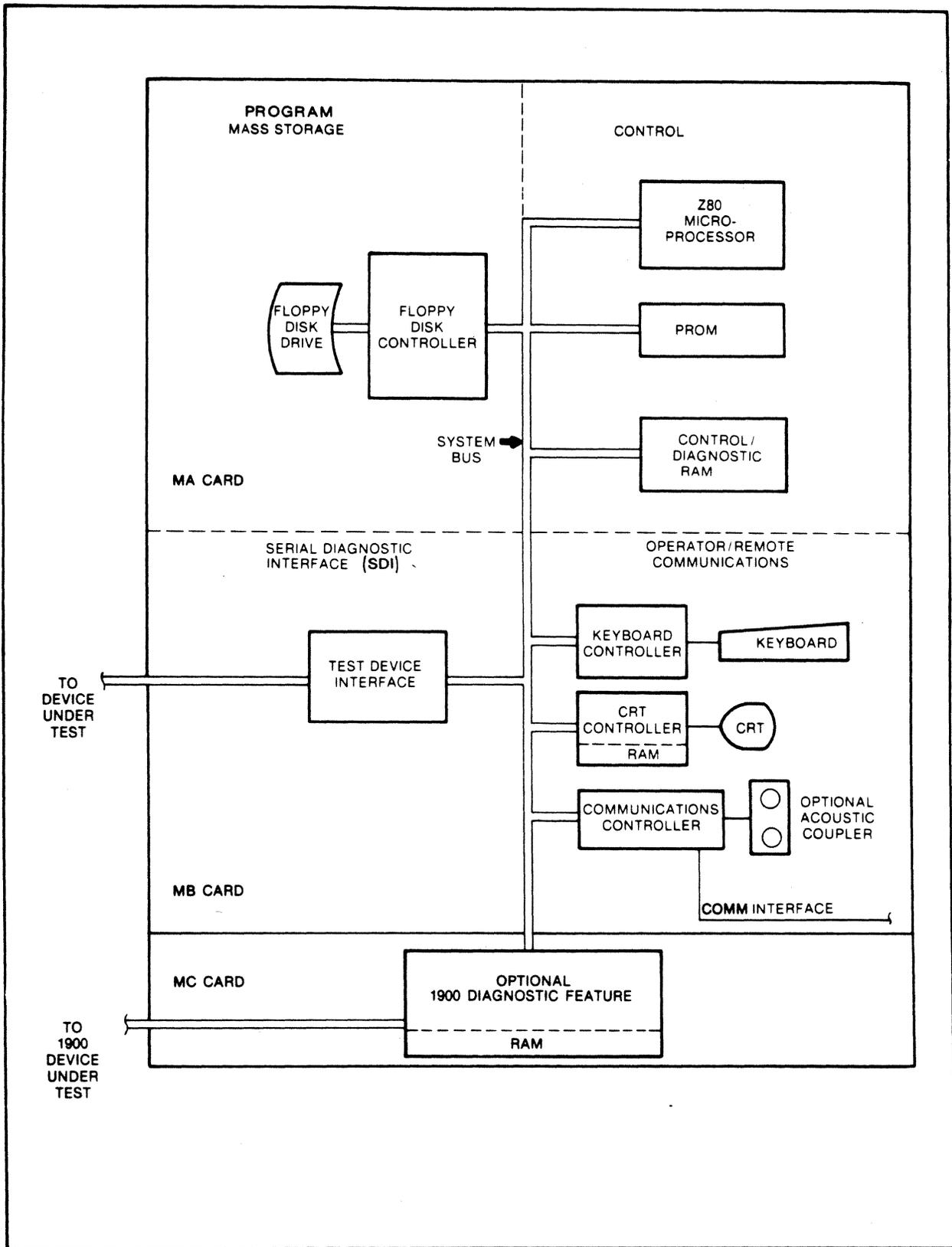


Figure 2-1. 3910 Block Diagram

Bit	Interrupting Line
0	SDI Receive, Current Loop
1	SDI Receive, RS-232-C
2	SDI Loop Back
3	COMM Receive, RS-232-C
4	COMM Receive, Current Loop
5	COMM Loop Back
6	Timer 2 Interrupt
7	Not used

2.2.2 MEMORY ORGANIZATION

The 3910 has 1K byte of PROM for the resident firmware including the bootstrap program, bring-up diagnostics, and the hardware monitor. The PROM utilizes addresses 0000 through 02FF.

The dynamic RAM contains 16K bytes for the functional program. The RAM addresses begin at 4000 hex, leaving a gap in the addresses between PROM and RAM (3000 through 3FFF) which is used by the RAM in the optional 1900 Diagnostic Feature. The memory map is shown in Table 2-1.

Table 2-1. Memory Organization

ADDRESS	FUNCTION
0000-03FF	Bootstrap
0400-07FF	CRT Refresh
0800-2FFF	Reserved
3000-3FFF	1900 Interface RAM
4000-7FFF	Program RAM
8000-BFFF	Reserved
C000-CFFF	I/O Address
D000-FFFF	Reserved

2.2.3 I/O ORGANIZATION

The Z80 uses the I/O instructions to access all peripheral circuits. The I/O address corresponding to each device register is mapped in Table 2-2.

Table 2-2. I/O Organization

ADDRESS	REGISTER
C000	FDC Command Register
C001	FDC Track Register
C002	FDC Sector Register
C003	FDC Data Register
C010	FDC Control Register
C020	CRT Controller Address Register
C021	CRT Controller Data Register
C030	Keyboard Data Register
C040	USART Control Register
C050	Timer 0: SDI Baud Rate
C051	Timer 1: COMM Baud Rate
C052	Timer 2: System Timer
C053	Timer Mode Register
C060	COMM USART Control/Status Register
C061	COMM USART Control/Status Register
C070	SDI USART Data Register
C071	SDI USART Control/Status Register
C080-C09F	1900 Diagnostic Feature I/O Registers

2.3 PROGRAM MASS STORAGE

The 3910 uses a floppy diskette drive system to store various software and data modules. The drive system consists of a floppy diskette drive and floppy diskette drive controller (FDC).

The floppy diskette drive is an industry-standard 5-1/4 inch, double-density, single-sided drive which will hold approximately 170K bytes of data. The FDC contains a 1791 controller, data separator circuits, and interface circuits to the Z80 bus. The controller is capable of reading and writing in both single and double density formats which are software selectable. Table 2-3 lists the floppy diskette drive connector signals.

The data format is 256 bytes per sector in single-density and 512 bytes per sector in double-density with 10 sectors per track. (In double-density, track 0 is written in single-density for compatibility with the PROM bootstrap program.) The track format is shown in Table 2-4.

Table 2-3. Floppy Drive Connector Signals

PIN	SIGNAL	DEFINITION
1	+12V	
2	Ground	
4	+5V	
8	Floppy Diskette Index Pulse	One pulse for each revolution.
10	Floppy Diskette Drive Select	Selects drive and loads read/write head.
16	Floppy Diskette Motor On	Activates drive motor.
18	Floppy Diskette Direction	Selects Step In or Step Out for read/write head. (Actual head movement is initiated by Floppy Diskette Step.)
20	Floppy Diskette Step	Moves read/write head one track. (Direction is controlled by Floppy Diskette Direction.)
22	Floppy Diskette Write Data	Data to be written onto the diskette.
24	Floppy Diskette Write Gate	Active to enable writing (inactive establishes read mode).
26	Floppy Diskette Track 00	When active, read/write head is positioned over track 0.
28	Floppy Diskette Write Protect	When active, diskette is write protected.
30	Floppy Diskette Read Data	Read data from diskette.
<p>Odd-numbered pins (except pin 1) are ground. Pins 6, 12, and 14 are not used.</p>		

Table 2-4. Track Format

ITEM*	NUMBER OF BYTES	BYTE VALUE (Hex)	DESCRIPTION
1	11	FF	Gap 1
2	6	00	Sync
3	1	FE	ID Address Mark
4	1	00-22	Track ID
5	1	00	Zero
6	1	01-0A	Sector ID
7	1	00	Zero
8	2	-	CRC Characters
9	11	FF	Gap 2
10	6	00	Sync
11	1	FB	Data Address Mark
12	256 or 512	-	Data Bytes
13	2	-	CRC Characters
14	13	FF	Gap 3
<p>* Items 2 through 14 are repeated ten times for each sector. The remaining space on the track is then padded with bytes of FF (hex).</p>			

2.4 OPERATOR/REMOTE COMMUNICATIONS

The operator/remote communications section is comprised of a CRT, an alphanumeric keyboard, and a controller for the communications interface.

2.4.1 KEYBOARD

The keyboard contains a full alphanumeric set arranged in a format similar to a standard typewriter keyboard as well as several special function keys. Chapter 3 defines the special function keys.

2.4.2 CRT DISPLAY

The 5-inch (diagonal) CRT screen displays 16 lines of 64 alphanumeric characters per line. The display operates in two modes: single screen and split screen. In single screen mode, all 16 lines are used for line-by-line output of system messages. Each new message appears at the bottom line as other lines are scrolled up one line. In split screen mode, the bottom eight lines scroll as in single screen mode and the top eight lines are used as a fixed display frame of maintenance information.

The CRT monitor controls the trace on the CRT screen. The Horizontal Sync pulse returns the trace to the left of the screen every 63.5 microseconds. The Vertical Sync pulse returns the trace to the top of the screen at a repetition rate determined by the input line frequency: 50 or 60 pulses per second. The video signal controls the brightness of the screen (positive voltage increases illumination). Table 2-5 lists the signals of the CRT Connector.

Table 2-5. CRT Connector Signals

PIN	SIGNAL
1	Ground
6	Horizontal Sync
7	+12V
8	Video
9	Vertical Sync
10	Ground
Pins 2 through 5 are not used.	

2.4.3 COMMUNICATIONS INTERFACE CONTROLLER

The communications controller and associated acoustic coupler is available for remote or off-site uses including remote diagnostic routines, remote examination of error logs, and updating of central data bases with local information. The controller utilizes an industry-standard USART LSI chip and associated electronics to provide either an RS-232-C or an active 20 mA current loop. The RS-232-C is used primarily for acoustic coupler operation although either the RS-232-C or the current loop may be used to drive hard copy devices such as teletypes, punches, or printers. Baud rates are programmable from 110 to 9600 baud asynchronous. Connection to the communications (COMM) interface is made through a 12-pin Molex connector (Figure 2-2) mounted on the baseplate.

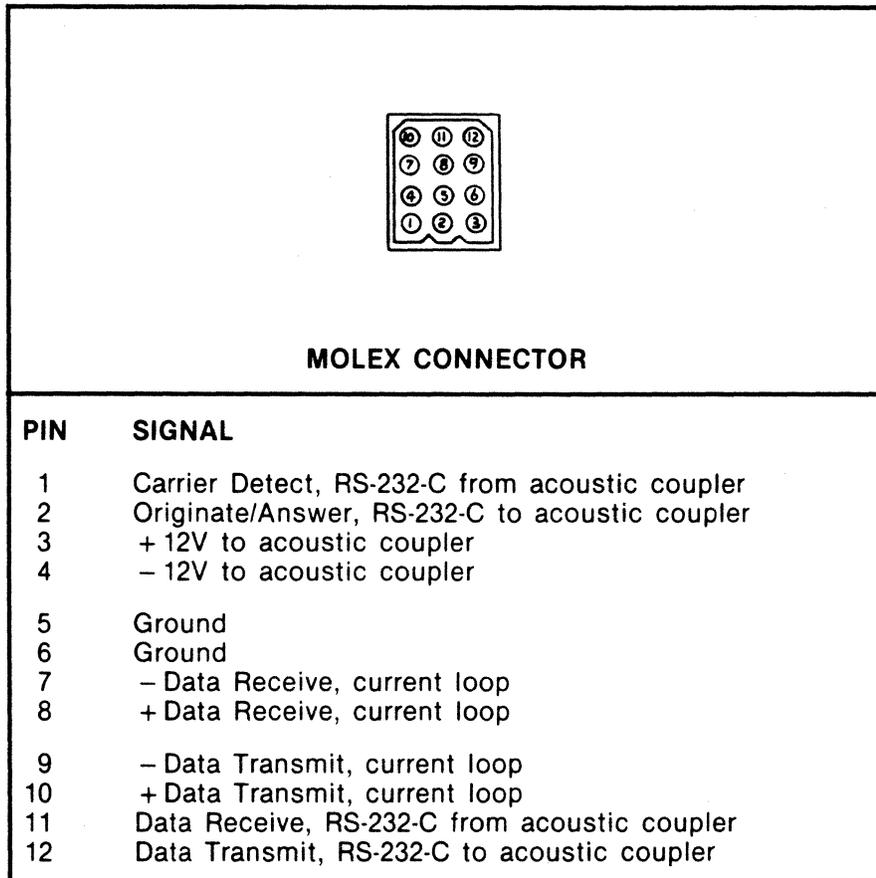


Figure 2-2. Communications Interface Connector

2.4.4 ACOUSTIC COUPLER (OPTION)

The optional acoustic coupler is used for remote operations including diagnostic testing, examination of error logs, and updating of data bases with local information. The acoustic coupler connects to the communications interface connector and is capable of a complete duplex operation with a standard telephone. The transmit, receive, and carrier detect signals are implemented in the communications connector as well as a signal to select Originate or Answer mode in the acoustic coupler.

2.5 SERIAL DIAGNOSTIC INTERFACE

The serial diagnostic interface (SDI) is used for communication between the internal processor of the device under test and the 3910. The interface is used to transfer diagnostic routines to the device under test and return diagnostic results, error status, and error logs to the 3910.

The SDI consists of a USART (universal synchronous-asynchronous receiver-transmitter) LSI chip and associated electronics for communications via the EIA (Electronics Industries Association) RS-232-C interface or a 20mA active or passive current loop interface.

The RS-232-C interface is selected by connecting the SDI cable to P2 on the MB card; the 20mA current loop interface is selected by connecting the SDI cable to P1 on the MB card (Figure 2-3).

The EIA RS-232-C interface definition consists of 25 lines but only six of the defined lines are implemented in the SDI (Table 2-6). The lines and their functions are:

Data Terminal Ready	Line from 3910: Logic ZERO indicates 3910 is connected, powered, and ready to send data.
Data Set Ready	Line from device under test: Logic ZERO indicates device is connected, powered, and ready to send data.
Transmit Data	Serial data from 3910 to device under test.
Receive Data	Serial data from device under test to 3910.
Transmit Clock	Line from 3910; used to provide a timing element for Transmit Data. A ZERO to ONE transition nominally indicates center of bit on Transmit Data.
Receive Clock	Line from device under test; used to provide a timing element for Receive Data. Device must provide a data signal in which transitions nominally occur at the ONE to ZERO transitions of Transmit Clock.

The logic levels of the RS-232-C interface conform to the RS-232-C standard: a logic ZERO is defined as +3V to +12V; a logic ONE is -3V to -12V. The transmission mode between devices is full duplex with either device able to transmit at any time.

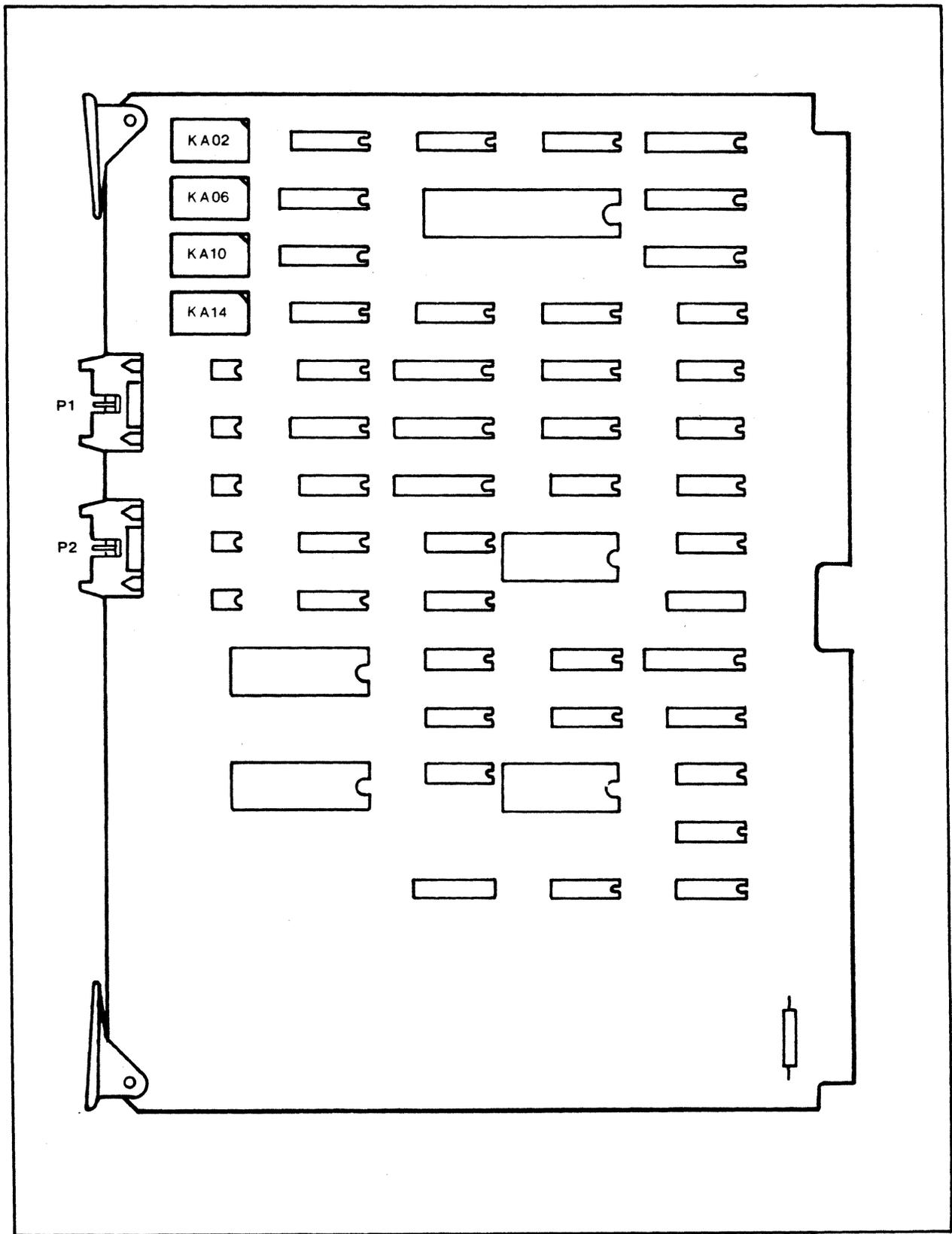


Figure 2-3. MB Card

Table 2-6. SDI Pin Assignments

PIN	RS-232-C	CURRENT LOOP*
1 2 3 4 5	Protective Ground** Transmit Data Receive Data	Protective Ground** +Data Receive Loop +Data Transmit Loop
6 7 8 9 10	Data Set Ready Logic Ground	+Data Terminal Ready Loop -Data Terminal Ready Loop
11 12 13 14 15	Transmit Clock	-Data Receive Loop +Clock Loop
16 17 18 19 20 21 22 23 24 25	Receive Clock Data Terminal Ready	-Data Transmit Loop -Clock Loop -Data Set Ready Loop +Data Set Ready Loop
<p>* In passive current mode, the polarity of the signal from the device under test is optional.</p> <p>** The protective ground is connected to the shield of the SDI cables and is not connected internally to the 3910.</p>		

The transmission rate is fixed with clocking by the start and stop bits or the Transmit Clock and Receive Clock lines.

The 20 mA current loop interface implements ten lines in the SDI, utilizing two pins for each line (Table 2-6). The line definitions are the same as for the RS-232-C lines. A logic ZERO is defined as no current flow; a logic ONE is defined as 20 mA current flow.

2.6 1900 DIAGNOSTIC FEATURE

The 1900 Diagnostic Feature is provided by the addition of the MC card. The MC card properly terminates all STC Standard Interface data and status lines. (All other attachments to the STC Standard Interface, including the PDP-11 Custom Interface, if used, must be disconnected from the FCU before attaching the 3910.) The MC card supplies to the 3910 processor all status and control line levels.

All registers used for initiating the 1900 commands are read/write to facilitate diagnostic capabilities. The diagnostic feature can supply and receive data at the rate necessary to write and read GCR records at 125 IPS tape speed.

The 3910 with the 1900 Diagnostic Feature is capable of executing the STC 1930/192X, 1935/1921/195X, and 1960 Tape Subsystem test routines. The STC 1900 diagnostics consists of the following test sections:

- Section 1: STC Standard Interface
- Section 2: Read Detection
- Section 3: PE Loop Write-to-Read
- Section 4: GCR Loop Write-to-Read
- Section 5: GCR Single-and Two-Track Error Correction

- Section 10: Drive Interface
- Section 11: Basic Motion
- Section 12: Write/Read Functional
- Section 13: Write/Read Complex Motion
- Section 14: Write/Read Reliability

Refer to the STC 3910 User's Guide for 1900 Diagnostics, PN 9613, for further information.

2.7 POWER SUPPLY

2.7.1 DC OUTPUTS

The 3910 power supply has four output voltages:

- +12 (± 0.6) Vdc, 3 amps maximum
- +5 (± 0.25) Vdc, 7 amps maximum
- 5 (± 0.25) Vdc, 10 milliamps maximum
- 12 (± 0.6) Vdc, 200 milliamps maximum

2.7.2 AC INPUT

The 3910 operates on either 60 Hz or 50 Hz input line frequency without equipment changes. A four-way voltage select card (Figure 2-4) is used to condition the 3910 for the available input line voltage (100, 120, 220, or 240 Vac). The voltage select card is located in the plastic-covered fuse box and the selected voltage is visible (upside down and facing the rear of the unit) when it is installed.

To select a line voltage compatible with the site voltage:

1. Disconnect the power cord from the 3910 connector at the fuse box.
2. Slide open the fuse box plastic cover (Figure 2-5).
3. Shift the fuse pull lever to the left to further expose the voltage select card.
4. Use a pair of needlenose pliers to grasp the voltage select card and pull the card up from its slot.
5. Orient the voltage select card such that the desired voltage appears upside down and toward the rear of the 3910.
6. Push the card down into its slot and shift the fuse pull lever to the right.
7. If changing from a high voltage (220 or 240 Vac) to a low voltage (100 or 120 Vac) or vice versa, the input fuse must be changed. (Refer to Table 2-7). In any case, push the input fuse into its position.
8. Slide the fuse box cover closed and plug the power cord into its connector.

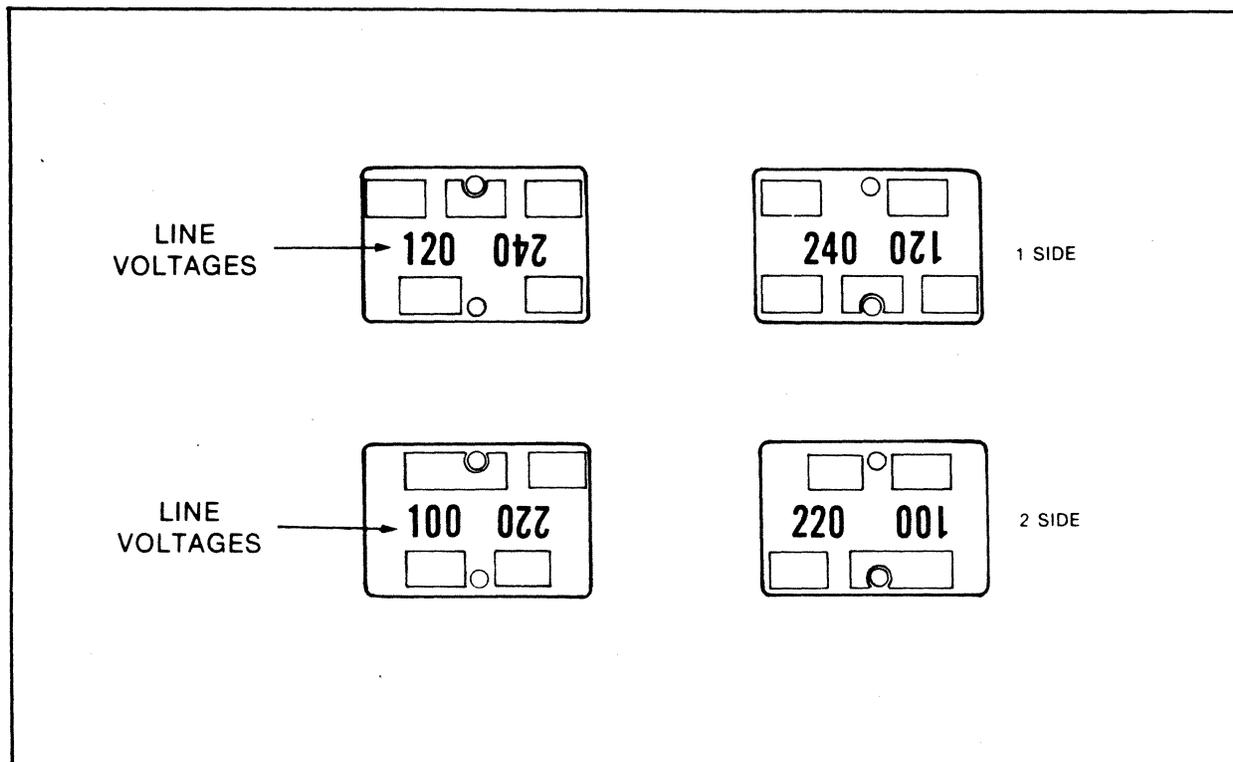


Figure 2-4. Voltage Select Card

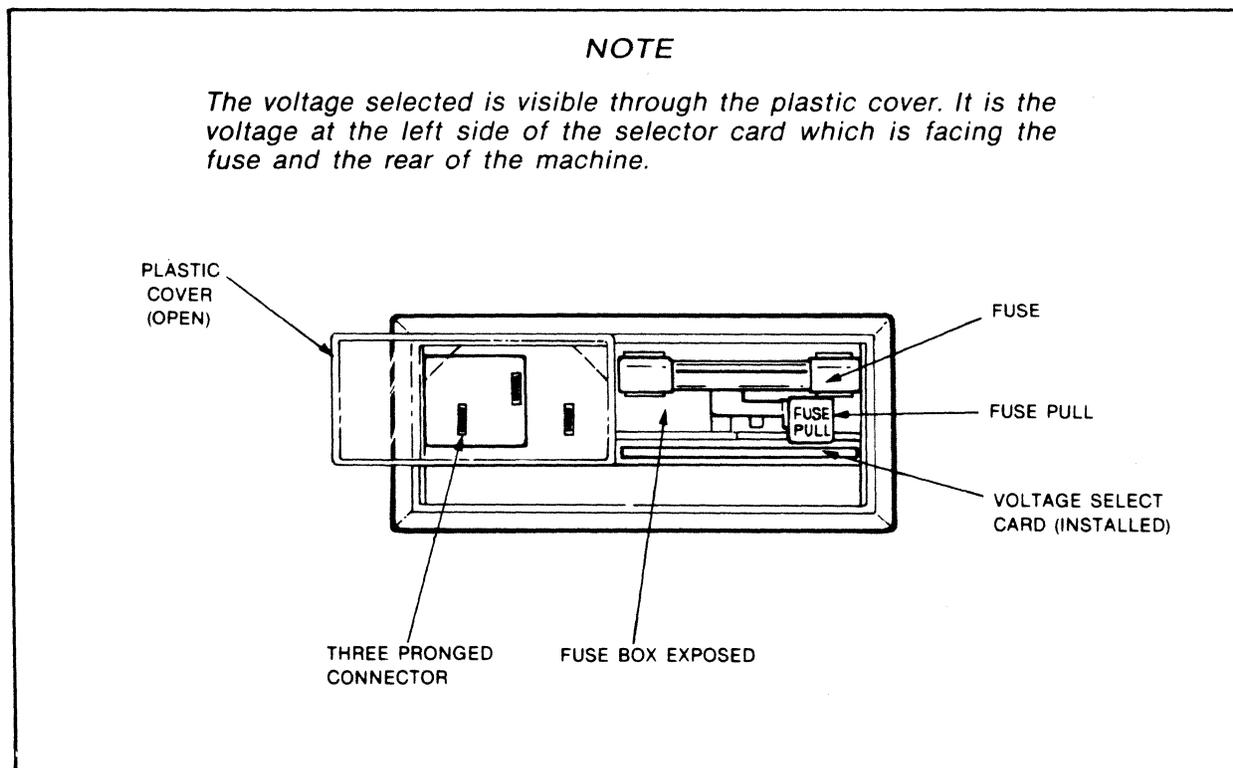


Figure 2-5. Fuse Box

Table 2-7. Fuse Protection

INPUT VOLTAGE		FUSE	
100 Vac (90-110 Vac)		3A, 250V, 3AG	
120 Vac (108-132 Vac)		3A, 250V, 3AG	
220 Vac (198-242 Vac)		2A, 250V, 3AG	
240 Vac (216-264 Vac)		2A, 250V, 3AG	
OUTPUT VOLTAGE	FUSE		
	Old	New	
+12 Vdc	4A, 250V, 3AG,	7A, 250V, 3AG, slow-blow	
+5 Vdc	7A, 250V, 3AG,	10A, 250V, 3AG, slow-blow	
-5 Vdc	None	None	
-12 Vdc	1/4A, 250V, 3AG	3/4A, 250V, 3AG, slow-blow	

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CHAPTER 3

OPERATION

3.1 INTRODUCTION

This chapter describes the machine controls, special function keys, floppy diskette information, drive read/write head cleaning, and procedure for modem tone adjustment.

3.2 MACHINE CONTROLS

3.2.1 POWER SWITCH

The power switch is located to the right of the keyboard. Power is applied by pushing the power switch to the ON position (away from the operator). When this switch is initially enabled, the bring-up diagnostics are automatically executed.

3.2.2 RESET (RES) KEY

Pressing the Reset key after power has been applied to the 3910 initializes the Z80 microprocessor to address the PROM and begin execution of the bring-up diagnostics. This process activates the machine and permits loading of other programs.

3.2.3 INTERRUPT (INT) KEY

Pressing the Interrupt key generates a non-maskable interrupt. During the first two seconds of the power-on sequence, the Interrupt key will cancel further execution of the bring-up diagnostics. This cancelling process resets the 3910 without destroying the contents of memory.

3.2.4 FLOPPY DISKETTE DRIVE LEDS

The LEDs on the floppy diskette drive illuminate whenever the drive attempts an operation.

3.3 KEYBOARD CONTROL KEYS

3.3.1 ALPHA LOCK

The Alpha Lock key locks all alphabetic characters into uppercase mode. This key should remain in its locked position at all times.

3.3.2 CONTROL (CTRL)

The Control key is used to enter control commands. This key is held down while another key is pressed. Control commands are defined in the routine descriptions where they are used. There are six general control commands that are listed below:

- CTRL C This command returns control to BASMON.
- CTRL O This command disables output from a program to the CRT until another CTRL O is entered. If a printer is attached, it will be affected by this command.
- CTRL Q This command restarts processing and output at the point where it was disabled by a CTRL S command.
- CTRL P This command sends output to the COMM USART as well as to the CRT screen. This command can be used to print files as they are displayed on the CRT screen.
- CTRL X This command cancels the CTRL P command. The command directs output to the CRT screen only.
- CTRL S This command suspends processing and output until a CTRL Q command is entered.

Note that control commands execute special functions as they are entered. They need not be entered with a RETURN.

3.3.3 RETURN

The Return key is used to input a command or response to the command buffer.

3.3.4 SHIFT

Pressing the Shift key will produce (display) the character of the key pressed with it.

3.4 FLOPPY DISKETTE

Write Protect Feature. The floppy diskette is equipped with a write protect feature. A write protect notch is located in the plastic diskette jacket. When the notch is covered with a tab, writing is inhibited. Figure 3-1 illustrates this feature.

Handling and Care. To protect the diskette, the same care and handling procedures recommended for magnetic tape should be followed. Following is a list of precautionary procedures for floppy diskettes.

1. Keep diskettes away from magnetic fields and ferromagnetic materials which might become magnetized. Strong magnetic fields can distort recorded data on the diskette.
2. Do not write on the plastic diskette jacket with a lead pencil or ballpoint pen. Use a felt tip pen.
3. Do not expose the diskette to heat or sunlight. Heat and contamination from a carelessly dropped ash will damage the diskette.
4. Do not touch or attempt to clean the diskette surface. Abrasions may cause loss of stored data.
5. Do not power up or power down the 3910 while a diskette is inserted.
6. After removal from the 3910, carefully return the diskette to its envelope and store properly.

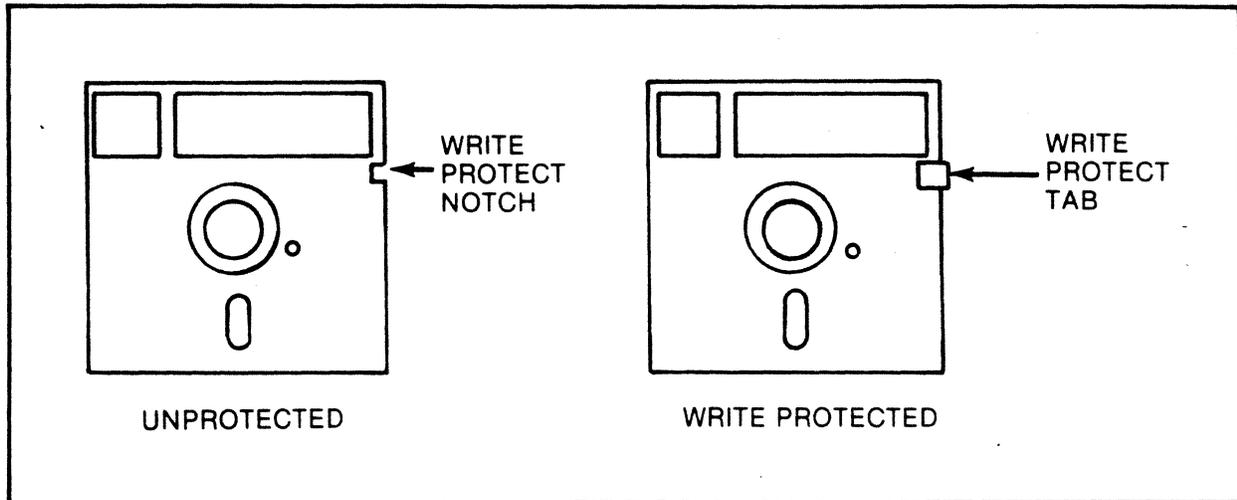


Figure 3-1. Floppy Diskette Write Protect

3.5 FLOPPY DISKETTE DRIVE HEAD CLEANING

Read/write errors of the same nature encountered on several floppy diskettes may be an indication that the read/write head has an oxide build up on it. The following procedure explains how to clean the head.

1. Remove the floppy diskette drive (Section 5.2).
2. Remove the screws securing the drive circuit card to the drive chassis, remove the head connector, and lift the card from the drive. There is no need to remove other connectors from the card.
3. Carefully lift the hinged load arm at the rear of the drive, and hold it away from the head.
4. Lightly wipe the read/write head with a lint-free cloth moistened with alcohol.

////////////////////
 /// CAUTION ///
 //////////////////////

Ensure that no alcohol is absorbed into the load button on the end of the load arm. Do not touch or rotate this button.

5. After the alcohol has evaporated, lightly polish the read/write head with a clean, dry, lint-free cloth.
6. Gently lower the arm towards the read/write head.
7. Replace the drive circuit card into the drive chassis and install the head connector.
8. Install the drive by reversing the procedure in Section 5.2.
9. Run the Floppy Drive and Controller test (Section 4.5.2) and the Floppy Drive Reliability test (Section 4.5.5).

3.6 MODEM TONE ADJUSTMENT

To adjust the volume of the modem tone in the optional acoustic coupler, perform the following steps:

1. Set the power switch to OFF.
2. Disconnect the Molex plug (P4), and remove the acoustic coupler from the 3910.
3. Remove the four screws from the base of the acoustic coupler cover. Lift the cover from the coupler, and lay it on its side.
4. Reconnect the Molex plug, and set the power switch to ON.
5. At the circuit card of the acoustic coupler, use a voltmeter to measure the voltage across P1. The reading should be 30 millivolts rms or 84 millivolts ($\pm 5\%$) peak-to-peak.
6. To adjust, at the circuit card of the acoustic coupler, locate the adjustment pot located between P1 and P2. To increase the volume, rotate the pot counterclockwise. To decrease the volume, rotate the pot clockwise.

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CHAPTER 4
SOFTWARE DESCRIPTION

4.1 INTRODUCTION

This chapter describes the software used to direct the operation of the 3910. Included is a description of the initial bring-up diagnostic tests, instructions for running diagnostic tests from the hardware monitor (HDWMON), hardware monitor commands, instructions for running diagnostic tests from the internal diagnostics diskette, and examples of utility programs.

The 3910 software consists of the following elements:

Resident Firmware, including:

Bootstrap Program
Bring-up Diagnostics
Hardware Monitor

Internal Diagnostics, including:

Diagnostic Routines
Utility Programs

The bootstrap program is located in the PROM and is used to load the system software from the floppy diskette.

4.2 BRING-UP DIAGNOSTICS

Bring-up diagnostics are automatically performed whenever power is applied to the 3910 or the Reset (RES) key is pressed. A series of six tests are executed to verify the proper operation of the functional hardware. Each test has a unique number which is displayed in the four LEDs on the MA card while the test is running. If a test fails, the microprocessor loops on the test that failed. After all tests have been successfully completed, the LEDs turn off and the hardware monitor is entered (Section 4.3).

A brief description of each test in its order of execution, its associated LED code (in parentheses), probable causes of test failures, and corresponding field replaceable units (FRUs) are included with each test description.

4.2.1 PROM CHECKSUM TEST (1001)

The PROM Checksum Test directs the processor to read the entire bring-up PROM and total the contents of all locations, including a preset checksum byte. If the sum is zero, the test was successfully run, and the Processor Test is executed.

Probable Cause of Failure	FRU
Incorrect PROM	MA Card
Control Buses	MA Card

4.2.2 PROCESSOR TEST (1000)

The Processor Test checks all internal processor functions (register transfers, arithmetic and logic units), all jumps, and any function not accessing external memory.

Probable Cause of Failure	FRU
Processor	MA CARD

4.2.3 RAM TEST (0100)

The RAM Test starts at the high end (address 7FFFH) of RAM and writes zeros down to the low end (address 4000H). The test then reads the data and compares it to the written zeros from the low end to the high end. Parity checking is not performed during this test. The test repeats with FF. If successfully run, the FDC Test is executed.

Probable Cause of Failure	FRU
RAM	MA Card
Refresh Memory	MA Card
Drivers on Address Bus	MA Card

4.2.4 FDC TEST (1100)

The FDC (floppy drive controller) test writes zeros into the data register, sector register, and track register contained in the drive controller. The test then reads from the track sector and data registers respectively and compares the data to the written zeros. The test repeats with FF. A successful test verifies

that the data buses from the controller are functioning properly. If successful, the CRT Test is executed.

Probable Cause of Failure	FRU
Drive Controller	MA Card
Drivers on Address Bus	MA Card

4.2.5 CRT TEST (0010)

The CRT Test is performed on the CRT refresh RAM with ZEROs and FF as in the RAM Test. If successful, the test initializes the CRT controller registers (contained in the CRT controller) with values from the PROM, and displays all characters in the character generator on the screen for two seconds. A visual problem on the screen indicates a problem with the CRT, CRT controller, or character generator but will not cause the test to fail. If successfully run, the COMM Test is executed.

Probable Cause of Failure	FRU
CRT RAM	MB Card

4.2.6 COMM TEST (1010)

The COMM Test enables a loop in the COMM USART transmit and receive circuitry to allow internal testing of the COMM USART. A loop write-to-read with an 8-bit walking ONEs pattern is performed on the COMM USART.

Probable Cause of Failure	FRU
COMM USART	MB Card
Support Circuits	MB Card

4.3 HARDWARE MONITOR (HDWMON)

The hardware monitor is used to control and regulate 3910 operations and to oversee the bootstrap routine. After all initial bring-up tests have been successfully executed, the hardware monitor clears the CRT screen, clears the MA card LEDs, sets the stack pointer to 8000H, and displays a prompt (*) in the upper left corner of the CRT screen.

The hardware monitor can be manually accessed at any time by pressing the Interrupt (INT) key.

The hardware monitor can be used to initially load programs from the floppy diskette, access a memory address and inspect the contents of the memory, receive input from the COMM interface lines, and jump to a specific address in the address register. These functions are carried out when the appropriate hardware monitor commands are entered.

4.3.1 HDWMON COMMANDS

Hardware monitor commands are executed as soon as they are entered. There is no need to press the Return key.

4.3.1.1 L

The L command is used to initially load the floppy diskettes. The first track of the floppy diskette is loaded into RAM. The microprocessor then jumps to address 1400H and begins program execution.

4.3.1.2 M

The M command directs the microprocessor to accept the next four hex characters as an address and store them in the address register.

If the Space Bar is pressed after an M command and an address (in the form of two hex digits) has been entered, the contents of the memory location at the address will be displayed. The command then accepts the next two characters as new data to be stored at the location displayed. When the Space Bar is pressed a second time, the data is stored. If the Space Bar is pressed a second time without a preceding M command, one of the following occurs:

1. If new data was entered since the last Space, the data is stored at the displayed location, the address register is incremented by one and displayed, and the contents of the memory location is displayed.
2. If new data has not been entered, the address register is incremented and displayed, and the contents of the memory location is displayed.

4.3.1.3 R

The R command allows input from the COMM line. The input serves as records using a binary Intel-compatible format that is being transmitted from another 3910. These records contain memory addresses and contents to be loaded into these addresses. The receiving 3910 loads its own memory using this information. Required boot-up information is on the Internal Diagnostics diskette and can be transmitted over the COMM line using the Run Boot command string (Section 4.4.11). This enables a 3910 boot up from a COMM line rather than from a floppy diskette.

4.3.1.4 G

The G command directs the microprocessor to erase the prompt, jump to the address accessed by the M command, and begin program execution.

4.3.1.5 CTRL C

The CTRL C command is used to re-enter the hardware monitor.

4.3.2 HDWMON-CONTROLLED DIAGNOSTIC TESTS

Each bring-up diagnostic test plus the Floppy Read Test and the Walking ONEs Memory Test can be run individually from the hardware monitor (HDWMON). The M command is used to enter the appropriate address (Section 4.3.2.1) and the G command is used to execute the test.

4.3.2.1 Bring-up Diagnostic Tests

Each bring-up diagnostic test loops automatically, error or not. Table 4-1 lists each test, its hex address, and corresponding LED code. Note that the Floppy Read Test and the Walking ONEs Memory Test can be jumped to two addresses, each having different looping conditions.

Table 4-1. Bring-up Diagnostic Test Addresses

TEST	ADDRESS	LED CODE	COMMENTS
Processor	01A1	1000	
RAM	024F	0100	
FDC	0276	1100	
CRT	02A2	0010	
COMM	02F6	1010	
Floppy Read	0339	0110	Loops automatically, error or not.
Floppy Read	033F	0110	Executes once (loops only if there is an error.)
Walking ONEs Memory	0398	1110	Loops until an error is encountered, then stops.
Walking ONEs Memory	039E	1110	Executes once and stops.

4.3.2.2 Floppy Diskette Read Test (0110)

To run the Floppy Diskette Read Test, the Internal Diagnostics floppy diskette must be inserted in the floppy diskette drive. This test starts the diskette drive motor, steps to track 30, reads sector 10, and compares data read to the first 256 bytes of the PROM. Sector 10 should be initialized on the Internal Diagnostics diskette. If it is not, it must be initialized using the Generate option. If the test was initiated at address 0339, it will loop there and read sector 10 of track 30 again. If the test was initiated at address 033FH and the comparison is successful, the motor is turned off, Restore is issued (the diskette head moves to track 0), control is returned to HDWMON, and the LEDs turn off. If an error is encountered, the test loops.

Probable Cause of Failure	FRU
Floppy Head Needs Cleaning	None
Floppy Disk Controller	MA Card
Separator Circuits	MA Card
Interface Circuits	MA Card

4.3.2.3 Walking ONEs Memory Test (1110)

The Walking ONEs Memory Test starts at the low end (address 4000H) of RAM and writes a walking ONEs pattern to the high end (address 7FFF). The test then reads and compares bytes in the same order in which they were written. An error message 'MEMERR - 0460' is displayed and the microprocessor jumps to the HDWMON. The address of the error (lo-byte) is stored at location 0460H; the address of the error (hi-byte) is stored at location 0461H; write data is stored at location 0462H; read data is stored at location 0463H.

Probable Cause of Failure	FRU
Address Lines	MA Card
Specific RAM Chip	MA Card
Support Circuits	MA Card

4.4 UTILITY PROGRAMS

With the exception of the Run command, utility programs, (Table 4-2) on the 3910 Internal Diagnostics diskette are not specifically related to internal diagnostics. Utilities include programs to format, copy and edit diskettes, read and display the contents of a diskette sector, and configure the 3910 as a dumb terminal.

The programs are loaded from the diskette by the HDWMON L command. When the diskette is loaded, the BASMON label is displayed in the lower left corner of the CRT screen indicating the release and patch levels of the diskette.

BASMON is the basic monitor that interprets and executes commands on the floppy diskette. All 3910 configurations include BASMON. Other functions performed by BASMON include physical hardware I/O via keyboard input, CRT I/O, direct floppy diskette I/O, USART initialization, and setting of the stack pointer.

Under the BASMON label the prompt (>) for user input is displayed. Note that the entire command or the abbreviation can be entered. (System prompts are printed in uppercase letters.)

Table 4-2. Internal Diagnostic Tests/Utilities (Sheet 1 of 2)

COMMANDS	FUNCTION
RUN	Run a diagnostic test (Section 4.4.1).
BUILD	Build operational diskettes from a master tape and vice versa. This command creates an ANSI-standard tape with one file for each diskette copied to the tape (Section 4.4.2).
FRMT	Format and/or verify a diskette (Section 4.4.3).
COPY	Copy a diskette using one or two 3910s (Section 4.4.4).
PATCH	Patch a diskette (Section 4.4.5).
TERM	Initiate the terminal simulator program (Section 4.4.6).
AUDIT	Audit an ANSI-standard tape, used with Build (Section 4.4.7).
SET	Set the fill count (the number of null characters) to be sent to an alternate printing device (Section 4.4.8).
50	Set the CRT refresh cycle Vertical Sync frequency to 50 Hz (Section 4.4.9).
HELP	List all commands, diagnostic operands, and options available on the Internal Diagnostics diskette (Section 4.4.10).
OPERANDS	Used only with the Run command.
PROC	Processor Test (Section 4.5.1).
FLOPPY	Floppy Drive and Controller Test (Section 4.5.2).
KBD	Keyboard and CRT Test (Section 4.5.3).
DIAG	All diagnostics; run the Processor, Floppy and Keyboard Tests in a series.
USART	USART Test; requires test wrap cable (Section 4.5.4).

Table 4-2. Internal Diagnostic Tests/Utilities (Sheet 2 of 2)

COMMANDS	FUNCTION
RELY	Floppy Drive Read/Write Reliability Test (Section 4.5.5).
MC	MC card test (Section 4.5.6).
BOOT	Boot up a second 3910 via the COMM interface (Section 4.4.11).
OPTIONS	Used only with the Run command.
PRINT	Print the test title.
LOOP	Rerun the test after its completion.
STOP	Stop on the first error.
GENERATE	Write sector 10 of track 30 and generate diagnostic tracks (used only with Run Floppy on virgin diskettes).

4.4.1 RUN

The Run command is used to run a diagnostic test. This command is entered as part of the command string. Refer to Section 6.1 for instructions for using this command and the options and operands that can be used with this command.

4.4.2 BUILD

The Build program is used to build operational diskettes from master tapes and vice versa. An ANSI-standard tape is created with one file for each diskette copied to tape. To use this command, the 3910 must contain the optional MC card. The following is an example of a Build command run:

In response to the prompt for user input, type B then press the RETURN key. The 3910 will prompt with:

SELECT TAPE UNIT # (0-3):

Enter 0, 1, 2, or 3 to specify the tape unit. The next prompt is:

ENTER FILE NAME

Enter a file name consisting of one to six characters and an extension consisting of one to three characters, separated by a period. Letters used in the file name must be uppercase. The next prompt is:

DISK TO TAPE, TAPE TO DISK OR
VERIFICATION ONLY?
ENTER DT, TD, OR VO

Enter DT if writing to tape, TD if writing to disk, or VO if both the tape and disk are to be read and the contents of the files verified as matching. The verification process is automatically performed after writing a tape file from disk or vice versa. The response to this question determines the prompts to follow.

ENTER DATE (MM/DD/YY)

Enter the date on which the file is being written. The date is written on the tape in the header section. If DT was entered, the next prompt is:

INSERT DISKETTE BEING COPIED
AND PRESS THE RETURN KEY

Insert the diskette that is to be copied and press the RETURN key. The next prompt is:

IS TRACK 0 IN DOUBLE DENSITY FORMAT?

Enter YES or NO then press the RETURN key. The next prompt is:

ARE TRACKS 1-34 IN DOUBLE DENSITY FORMAT?

Enter YES or NO then press the RETURN key. The next prompt is:

DO YOU WANT TO START WRITING AT THE BEGINNING OF TAPE?

Enter YES if the tape is to be written to from the beginning, destroying the existing tape records, or NO to start writing to the tape after the last file currently on the tape. The program begins writing onto the tape after this prompt is answered. If TD was entered, the next prompt is:

INSERT DISKETTE BEING WRITTEN AND PRESS RETURN KEY

Insert the proper diskette, and press the RETURN key.

DO YOU WANT AN INTERLEAVED FORMAT?

This prompt is presented because the Build command formats the diskette before writing to it, alleviating the need to run the FRMT program first. An interleaved format places the sectors on the track in a staggered fashion such that each sector is a half

revolution from the sector which numerically precedes it. The format depends on the system that will be using the diskette. If VO was entered, the next prompt is:

INSERT DISKETTE FOR VERIFICATION

Insert the proper diskette and verification will begin.

4.4.3 FORMAT/VERIFY (FRMT)

The Format/Verify program is used to format and/or verify a floppy diskette by writing timing marks, sector numbers, and track numbers. Diskettes can be formatted in single or double density. The following is an example of a Format/Verify program run:

In response to the system prompt for user input, enter FRMT.

```
INSERT DISKETTE TO BE FORMATTED OR VERIFIED
ENTER <F> TO FORMAT AND VERIFY
OR <V> TO VERIFY ONLY
```

Enter F to format and verify the diskette or V to verify only. If F was entered, the following prompts will be displayed:

```
FORMATTING A DISK: ARE YOU SURE?
ENTER <Y> TO FORMAT ALL TRACKS OR
ENTER THE LIST OF TRACKS TO BE FORMATTED IF
ONLY FORMATTING SELECTED TRACKS.
ENTER <N> TO ABORT FORMAT.
```

Enter Y RETURN to format the entire diskette, a list of tracks to be formatted, or N to abort the format.

```
DOUBLE DENSITY?
```

Enter Y RETURN for double density formatting or N RETURN for single density formatting.

IF Y was entered, the following prompt will be displayed:

```
IS TRACK 0 TO BE FORMATTED DOUBLE DENSITY?
```

Enter Y RETURN to format the entire diskette in double density or N RETURN for track 0 to be formatted in single density and tracks 1 through 34 in double density.

As each track is formatted, it is displayed on the CRT screen:

```
TRACK 0 FORMATTED
TRACK 1 FORMATTED etc.
```

Note that if a track cannot be formatted, it is an indication that the diskette is defective.

If V was entered in response to the first prompt, the system will not format the diskette but will verify that it can be read. If any sector cannot be read, it will be indicated on the CRT screen:

UNABLE TO READ SECTOR X OF TRACK Y

X is the sector number 1 through 10 and Y is the track number 0 through 34.

When all tracks have been formatted or verified, the program ends and control is returned to BASMON.

4.4.4 COPY

The Copy utility is used to copy entire floppy diskettes. This can be accomplished with one or two 3910s. Note that the floppy diskette to be copied must be formatted before the copy is attempted. The following is an example of a Copy program run using one 3910 followed by an example using two 3910s.

In response to the prompt for user input enter COPY.

ARE YOU COPYING AN INTERNAL DIAGNOSTICS DISKETTE?

Enter Y if only tracks 0-30 are to be copied or N if all tracks of the diskette are to be copied.

ARE YOU USING A DOUBLE DENSITY DISKETTE?

Enter Y for double density or N for single density.

ARE YOU USING ONE 3910 TO TRANSMIT AND ONE 3910 TO RECEIVE?

Enter N.

DO YOU DESIRE WRITE PROMPTS FOR EACH TRACK?

Enter Y or N. If Y is entered, the prompt "TRACK XX?" will be displayed before each track is copied. Enter Y to copy the track or N to skip the track; otherwise all tracks will be copied. The program begins to copy and the following prompts are displayed:

INSERT DISKETTE BEING COPIED AND PRESS RETURN KEY

INSERT DISKETTE BEING WRITTEN AND PRESS RETURN KEY

When the copy is complete, the program is exited.

The following is an example of a Copy routine using two 3910s:

When two 3910s are used, install a cable connecting the COMM port of one 3910 to the COMM port of the other 3910. The cable must connect to the Transmit Data line of one 3910 and to the Receive Data line of the other 3910 and vice versa. The Receive end must be completely up and ready before the Transmit end is brought up. The Signal Ground line of each 3910 must also be connected, creating a total of three wires in the cable.

```
////////////////////  
//// CAUTION ////  
////////////////////
```

The modem can only be connected to or disconnected from a 3910 when the 3910 is powered off.

In response to the prompt for user input, enter COPY at the transmitting 3910. The system will display the following prompt:

ARE YOU COPYING AN INTERNAL DIAGNOSTICS DISKETTE?

Enter Y or N. If N was entered, the next prompt is:

ARE YOU COPYING A DOUBLE DENSITY DISKETTE?

Enter Y for double density or N for single density. The next prompt is:

ARE YOU USING ONE 3910 TO TRANSMIT AND ONE 3910 TO RECEIVE?

Enter Y. The next prompt is:

ARE YOU USING AN ACOUSTIC COUPLER?

Enter Y if an acoustic coupler is being used to transmit over a phone line or N if the communication link is the direct line from one 3910 to the other 3910. If an acoustic coupler (modem) is being used, the data rate is 300 baud; if a direct line is being used, the data rate 25,000 baud. The next prompt is:

SELECT TRANSMIT OR RECEIVE (ENTER "T" OR "R".)

The transmitting 3910 will display the following prompt:

INSERT DISKETTE BEING COPIED AND PRESS RETURN KEY

After the diskette is inserted and RETURN entered, the CRT screen will display:

TRANSMIT SECTION

The receiving 3910 will display:

RECEIVE SECTION

As each track is transferred to the receiving 3910, the track number will be displayed in the lower right corner of the CRT screen.

4.4.5 PATCH

The Patch program is used to read and display the contents of a disk sector on the 3910 CRT screen. Data is displayed in a hexadecimal format showing 16 bytes on each line of the CRT. Any hex digit of any byte can be modified and the sector can be rewritten as modified. Figure 4-1 shows a sample display.

000	00 00 00 11 AF 00 01 23 45 67 AB AA 00 12 22 FF	
010	12 23 34 45 56 67 78 89 9A BB CC DD EE FF FF	TRACK
020	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	02
030	20 38 46 20 1B 3C 56 67 DE 89 27 38 49 12 23 00	
040	12 23 34 ADCDCDCDCBCB5 B6 C7 39 4A 5B 6D 7E	SECTOR
050	80 7D EDD6 CDC4 C6 D5 E7 E8 FF FF FF FF FF FF	00
060	01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 00	
070	04 44 4D 18 D6 55 56 F6 F7 E5 E4 E3 E2 E1 EE FF	RELATIVE
080	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F	SECTOR
090	10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F	0014
0A0	B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BC BB BD BE BF	
0B0	21 22 2C 2B 2C 3C 4C 5D 6A 7E 88 87 86 85 84 99	CURSOR
0C0	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	POSITION
0D0	FF	0000
0E0	10 11 12 13 1B 67 8D FF DCCA 45 46 F6 F7 FF 34	
0F0	BC BD BE FF E4 E5 E3 A7 A9 90 9A CDE3 40 40 40	INVRTD DATA

Figure 4-1. Sector Display Example

The first three characters of each line is the starting address (within the sector) or the data on the line. The right side of the display contains five informational displays:

1. TRACK shows the number (hex) of the track containing the displayed sector.
2. SECTOR shows the sector number on the track being displayed.
3. RELATIVE SECTOR shows the sector number relative to the beginning of the diskette.
4. CURSOR POSITION shows the location of the cursor within the displayed sector.

5. INVERTED DATA shows that the data on the disk is complemented.

A hex digit can be changed by positioning the cursor under the digit (using the commands listed below) and typing over the old digit. This procedure is limited to hex digits only.

The following commands are used to modify the hex digits in a sector display and rewrite the sector as modified. These control commands are entered by holding down the Control (CTRL) key and pressing the appropriate letter.

Command	Function
CTRL L	Moves the cursor left one hex digit. If the cursor is located under the left hex digit of the leftmost byte of a line, it will move up one line and position itself under the right hex digit of the line. If the cursor is located on the top line of the CRT, it will wrap around to the bottom line of the CRT.
CTRL A	Changes the sector display from hexadecimal to ASCII.
CTRL H	Changes the sector display from ASCII to hexadecimal.
CTRL R	Moves the cursor to the right one hex digit. If the cursor is located under the right hex digit of the rightmost byte of the line, it will move down one line. If the cursor is on the bottom line, it will wrap around to the top line of the screen.
CTRL U	Moves the cursor up one line and leaves it in the same position on the line. If the cursor is on the top line, it will wrap around to the bottom line of the screen.
CTRL D	Moves the cursor down one line and leaves it in the same position on the line. If the cursor is on the bottom line, it will wrap around to the top line of the screen.
CTRL N	If a digit has been typed over: <ol style="list-style-type: none">1. The sector displayed on the screen will be rewritten to the floppy diskette.2. The next relative sector will be read and displayed.

If no digit has been typed over, the next relative sector will be read and displayed.

CTRL W If a digit has been typed over:

1. The sector displayed on the screen will be rewritten to the floppy diskette.
2. Patch will prompt for the next sector read.

If no digit has been typed over, Patch will prompt for the next sector to be read.

CTRL C If a sector is being patched, CTRL C will not write the sector back to the disk but will prompt for the next sector to be read. If the prompt "Enter Next Sector Number" is being displayed, CTRL C will exit Patch and return to BASMON.

The following is an example of a sector edit:

In response to the prompt for user input, enter SECT. The 3910 responds with:

```
SECTOR EDIT VN.N INSERT DISKETTE AND ENTER <RETURN>
```

Insert the diskette, and press RETURN. The next prompt is:

```
SINGLE OR DOUBLE DENSITY? (S/D)
```

Enter S for single density or D for double density. (The Internal Diagnostics diskette is single density.) The next prompt is:

```
3910 FORMAT (COMPLEMENTED DATA?) (Y/N)
```

Enter Y since complemented data is standard on the 3910. The next prompt is:

```
ENTER SECTOR NUMBER
```

Specify which sector is to be edited. Enter any number from 0 through 15D hex, or 0 through 349 decimal. Example: 56 return or .86 return (decimal)

```
////////////////////  
//// CAUTION ////  
////////////////////
```

Do not change diskettes while a sector is being displayed. If a diskette is changed while a sector is being displayed, the sector will be written on the new diskette, destroying existing data. Diskettes can be changed while the "ENTER SECTOR NUMBER" prompt is displayed.

After the sector number is entered, commands can be entered from the keyboard. The specified sector of a double density diskette or the first half of a double density diskette is displayed on the CRT screen. The display is divided into three columns. The leftmost column contains the relative byte address (within the sector) of the first data byte on the adjacent line. For a single density sector of the first half of a double density sector, the starting address of the line will always start with a zero. The starting address for the second half sector will always begin with a one. The middle column displays the actual contents of a single density sector or half of a double density sector. Sector contents can be displayed in either hexadecimal or ASCII format. Hexadecimal is the default mode of display. The remaining column contains informational displays.

4.4.6 TERMINAL SIMULATION (TERM)

The Terminal Simulation program is used to configure the 3910 as a dumb terminal. Parameters for the dumb terminal are established through responses to prompts displayed while the program is running. This program is run after the BASMON label is displayed followed by the prompt for user input. The following is an example of a Terminal Simulation run:

In response to the prompt for user input, enter TERM. The next prompt is:

```
ENTER BAUD RATE
```

Enter 110, 150, 300, 600, 1200, 2400, 4800, or 9600. If the acoustic coupler is used, 300 must be entered. After any entry, press the RETURN key.

```
SDI OR COMM?
```

Specify the USART to be used by entering S for SDI or C for COMM. If an acoustic coupler is used, C must be entered. The next prompt is:

BITS PER CHARACTER? (5, 6, 7 or 8)

Enter 5, 6, 7, or 8 to specify the number of valid data bits that are defined by the host system as one logical character. The entry does not include parity bits. When one 3910 is communicating with another 3910, 8 must be entered. Complete the input by pressing the RETURN key. The next prompt is:

PARITY: EVEN, ODD, OR NONE? (E, O, or N)

Enter E to specify even parity as defined by the host system, O, for odd parity, or N for no parity. If one 3910 is communicating with another 3910, N must be entered. Follow with a RETURN. The next prompt is:

ORIGINATE OR ANSWER?

Enter O for originate or A for answer mode. A 3910 used as a terminal for a host system should be in originate mode. One 3910 being used to communicate with another 3910 must be in originate mode and the other in answer mode. Follow with a RETURN. The next prompt is:

LOCAL ECHO OF KEYBOARD DATA?

Enter Y if the 3910 will echo (display) characters input at its keyboard or N if the input display for the 3910 will be provided by the host computer. Follow with a RETURN.

When the last prompt is answered, the CRT screen clears, and the cursor appears at the extreme left top of the screen. The 3910 is now a dumb terminal.

4.4.7 AUDIT

The Audit program is used to display a list of file names from the ANSI-standard tape such as those created by the Build command. The listing includes the file name, number of blocks in the file, and the creation date. To run this program, enter AUDIT.

4.4.8 SET

The Set utility is used to set the fill count (number of null characters) to be sent to an alternate print device.

4.4.9 50

The 50 utility is used to change the CRT refresh cycle (Vertical Sync frequency) from 60 Hz to 50 Hz.

4.4.10 HELP

The Help utility is used to display all of the commands, operands, options, and utility programs contained on the Internal Diagnostics diskette. (See Table 4-2.)

4.4.11 BOOT

The Boot program is a memory copy routine in that the memory of one 3910 is transferred to another 3910. Using this program, a program such as COPY, FRMT, or FLOPPY diagnostics can be loaded from the diskette of one 3910 and transferred to a second 3910. The Boot program is used with the RUN command in the PROM hardware monitor. This procedure might be performed due to a malfunctioning floppy drive or the necessary monitor diskette is unavailable or damaged.

To use this program, follow the procedure in the two-unit Copy procedure (Section 4.4.4).

After connecting the two 3910s, enter R at the receiving 3910 and load the required program at the transmitting 3910 by entering the appropriate command. (The program can be cancelled by entering CTRL C.) The transmitting 3910 will return to monitor mode at which time RUN BOOT is entered. From the hardware monitor of the receiving 3910, enter R. After transmission is complete, the receiving 3910 can execute the program sent to it. Note that if a minus symbol appears instead of the desired plus symbol, the receiving 3910 will not display the BASMON label. When the program has been transmitted to the receiving 3910, the BASMON label will be displayed.

When the program is complete, the program is exited.

4.5 INTERNAL DIAGNOSTICS

The internal diagnostics are located on the Internal Diagnostics diskette. To run diagnostics from the diskette, press the Reset (RES) key to access the hardware monitor (HDWMON), insert the diskette in the floppy diskette drive, and enter L to load the diskette. The CRT screen will clear and the BASMON label indicating the release and patch levels will be displayed in the lower left corner of the screen. On the next line the prompt (>) for user input will be displayed.

The Help (H) command can be entered to display a listing of the commands, operands (diagnostic tests), and options available on the diskette. The Help command must be followed with a RETURN.

To execute the diagnostic tests, command strings are entered. A command string consists of a command (the Run command is used), an operand (diagnostic test), and option (Table 4-2). Each item in the command string must be separated by a single blank. The entire verb or the first letter can be entered. For example, RUN PROC PRINT LOOP RETURN can be entered as R P P L RETURN. In this example the command string prints the test title, runs the Processor test, and loops after its completion.

The sections that follow describe the diagnostic tests on the diskette and provide instructions and examples for running these tests.

4.5.1 PROCESSOR TEST (PROC)

The Processor Test is divided into two sections. The first section tests all internal processor functions (register transfers, arithmetic and logic units), all jumps, and any function not accessing external memory.

Any failure in the first section outputs the message

PROCESSOR FAILURE

If this is the only message displayed after the test is complete, the processor is probably faulty. The Walking ONEs Memory Test should then be run to verify that the error is not the result of faulty memory reads.

The second section tests all instructions that read and write to RAM. This section is divided into two classes:

The first class consists of read/write instructions and generates one error message:

PROCESSOR READ/WRITE ERROR

If this message is displayed but "PROCESSOR FAILURE" is not, both the processor and RAM are equally suspect as being faulty.

The second class of this section tests a group of instructions which execute memory cycles in uninterrupted succession. The following are examples of instructions:

INC (HL)	Read cycle followed by write cycles
LD NN,(HL)	Write cycle followed by write cycles
LD (NN),HL	Read cycle followed by write cycles
CPIR	Succession of read cycles
LDIR	Succession of read and write cycles

These instructions read and/or write pulses to be output closer together than usual. Messages generated by these errors are:

ERROR IN EXECUTING SUCCESSIVE READ CYCLES
ERROR IN EXECUTING SUCCESSIVE WRITE CYCLES
ERROR IN EXECUTING READ CYCLE FOLLOWED BY WRITE CYCLE

If one or more of the preceding messages is displayed, but the PROCESSOR FAILURE error is not displayed, RAM or RAM support circuitry is more suspect as being faulty, even if the Walking ONEs Memory Test detects no error.

The final test checks to verify that the Z80 microprocessor input (INT) is not stuck in the active state. If it is, the following message is displayed:

MASKABLE INTERRUPT IS STUCK LOW

Note that a CTRL C command entered during the Keyboard/CRT Test ends that test and the Walking ONEs Memory Test is automatically executed on the CRT Refresh Memory. If the test was called in with the loop option specified, the Keyboard/CRT Test is bypassed and only the Walking ONEs Memory Test will be executed. If the MA card contains 32K of RAM, the additional 16K is automatically tested.

If an error is detected during the Memory Test, the following message is displayed:

CRT MEMORY ERROR AT LOCATION XXXX
EXPECTED DATA: YY BAD DATA: ZZ

where XXXX is the address of the memory error, YY the data written, and ZZ the hex address of the data actually read.

4.5.2 FLOPPY DRIVE AND CONTROLLER TEST (FLOPPY)

The Floppy Drive and Controller Test performs a series of tests in a predetermined sequence. Following each function in the test series, brief error messages are listed. For errors preceded by WW, see Table 4-3; for errors preceded by XX, see Table 4-4; for errors preceded by YY, see Table 4-5.

1. Sector, track, and data registers are written with all patterns and read for comparison.

- #1 'TRACK REGISTER INVALID'
- #1 'SECTOR REGISTER INVALID'
- #1 'DATA REGISTER INVALID'

2. Checks for detection of index pulses by interrupt.

- #2 'NO INDEX PULSES RECEIVED'

3. When the motor reaches five revolutions, the motor speed is tested for accuracy.

- #3 'MOTOR SPEED SLOW'
- #3 'MOTOR SPEED FAST'

4. Checks if the busy bit in the status register reflects the true state of the controller.

- #4 'BUSY BIT INVALID'

5. Issues every variation of head movement commands. The test also reads the track and sector registers and compares them with the expected results after each command is complete.

- 'HEAD POSITIONING ERROR
#WW COMMAND: XX STATUS REGISTER INCORRECT: YY'
EXPECTED VALUE: ZZ'

- 'HEAD POSITIONING ERROR
#WW COMMAND: XX TRACK REGISTER INCORRECT: YY'
EXPECTED VALUE: ZZ'

XX, YY, ZZ Assignments

Table 4-3. Floppy Drive and Controller Test Error Codes
(Sheet 1 of 2)

1	The first pattern written is FF, and the pattern is incremented by all combinations. The data register is written first, followed by the sector and track registers. After a 16 microsecond delay, the registers are read in reverse order (track, sector, data). An error is detected if the read and write data do not match.
2	A Force Interrupt command is issued to the controller causing it to interrupt as an index pulse is received from the drive. If an interrupt is not received after approximately 300 milliseconds, an error is detected.
3	The time between two index pulses is measured. If the measured time is not between 196 and 204 milliseconds, an error is detected.
4	The floppy drive controller status after a timing test reflects Not Busy or an error is detected and the test ends; if Not Busy is detected, then a Read command is issued. The status must then reflect the Busy status or an error is detected.
6	A Restore (with Verify) command is issued with HLT input still low. Thus, the controller must wait one second.
7	A Restore command is executed and 30 step-in commands are issued and a read performed on the ID field of the resulting track. If the track number is not 30, the message "SEEK TRACK 30 UNSUCCESSFUL" is displayed.
10	Head unloaded: HLT input not activated.
11	Head loaded: HLT input activated with Verify.
12	Head loaded: HLT input activated, h bit set in command.
13	Head unloaded: HLT input activated with Verify, h bit set in command.
14	Write: Sector 1, track 30, single density, data address mark is equal to FB.

Table 4-3. Floppy Drive and Controller Test Error Codes
(Sheet 2 of 2)

15	Read: Sector 1, track 30, single density.
16	Write: Sector 2, track 30, single density, data address mark is equal to F8.
17	Read: Sector 2, track 30, single density.
18	Write: Sector 3, track 30, single density, data address mark is equal to FB.
19	Read: Sector 3, track 30, single density.
1A	Read: Sector 32, track 30 not found.
1B	Read: Sector 1, track 29 not found.
1C	Write: Sector 1, track 30, DRQs are not serviced (lost data).
1D	Multi-sector read: Count DRQs, check sector update.
1E	Read: Sector 1, track 31, single density, CRC error in ID field.
1F	Write: Sector 1, track 31, single density, CRC error in ID field.
20	Read: Sector 2, track 31, single density, CRC error in data field.
21	Write: Sector 1, track 32, double density, data address mark is equal to FB
22	Read: Sector 1, track 32, double density.
23	Write: Sector 2, track 32, double density, data address is equal to F8.
24	Read: Sector 2, track 32, double density.
25	Write: Sector 3, track 32, double density, data address mark is equal to FB.
26	Read: Sector 3, track 32, double density.

Table 4-4. Command Summary (XX)

COMMAND	BITS							
	7	6	5	4	3	2	1	0
Restore	0	0	0	0	h	V	X	X
Step	0	0	1	u	h	V	X	X
Step In	0	1	0	u	h	V	X	X
Step Out	0	1	1	u	h	V	X	X
Read Sector	1	0	0	m	X	X	0	0
Write Sector	1	0	1	m	X	X	X	a0

X = Don't care
 h = Head Load flag (bit 3)
 h = 1, Load head at beginning
 h = 0, Unload head at beginning
 V = Verify flag (bit 2)
 V = 1, Verify on last track
 V = 0, No verify
 u = Update flag (bit 4)
 u = 0, No update
 u = 1, Update flag
 m = Multiple Record flag (bit 4)
 m = 0, Single records
 a0 = Data Address Mark (bit 0)
 a0 = 0, F8
 a0 = 1, FB

Table 4-5. Status Register Summary (YY)

BIT	MOTION COMMAND	READ COMMAND	WRITE COMMAND
7	Not Ready	Not Ready	Not Ready
6	Write Protect	0	Write Protect
5	Head	Record Type	Write Fault
4	Seek Error	RNF	0
3	CRC Error	CRC Error	CRC Error
2	Track 0	Lost Data	Lost Data
1	Index	DRQ	DRQ
0	Busy	Busy	Busy

where WW is the error number, XX the command issued, YY the contents of the status or track registers, and ZZ the expected status or track register (all numbers are in hex).

6. Issues a Restore (with Verify) command, causing the head to return to track 0, while the head load timing (HLT) input is set to zero. The test then checks that the controller waits until the HLT input is activated before verifying.

#6 'DID NOT WAIT FOR HLT'

7. Attempts to locate track 30. If track 30 is not found, the test will end without performing any read/write tests.

#7 'SEEK TRACK 30 UNSUCCESSFUL'

8. Sectors 1 through 3 are written in an incrementing binary data pattern. Each sector is read and the data compared. Data requests are counted to make certain that all data is read. Soft errors occasionally occur during sector reads. Ten or fewer errors for every 100 test runs are acceptable.

#WW INSUFFICIENT DATA REQUESTS

#WW WRITE AND READ DATA DO NOT MATCH
READ/WRITE ERROR

#WW COMMAND: XX STATUS REGISTER INCORRECT: YY
EXPECTED VALUE: ZZ

REFER TO XX, YY, AND ZZ ASSIGNMENTS.

9. Issues a Write Sector command but does not service data requests and expects the data lost bit to be set in the status register.

READ/WRITE ERROR
#WW COMMAND: XX STATUS REGISTER INCORRECT: YY
EXPECTED VALUE: ZZ

10. Issues a multi-sector write and read, counts data requests, and verifies sector completion.

'WW INSUFFICIENT DATA REQUESTS'

#A 'SECTOR REGISTER NOT UPDATED IN MULTI-BLOCK R/W
OPERATION'

11. Steps to track 31, and if the Generate option is specified in the command string, a bad track is generated on track 31. Track 31 consists of two sectors: sector 1 has a faulty CRC in the ID field and sector 2 has a faulty CRC in the data field.

```
' TRACK 31 NOT FOUND'  
  
' READ/WRITE ERROR  
#WW COMMAND: XX STATUS REGISTER INCORRECT: YY'  
EXPECTED VALUE: ZZ'
```

Note that the Generate option must be used each time a new floppy diskette is used.

If the Generate option is not specified, it is assumed that track 31 has been written to during an earlier execution of this test. Once track 31 has been successfully generated, it should not be regenerated with each subsequent run. Track 31 may not be properly generated if the controller or drive is malfunctioning.

12. Steps to track 32, and if the Generate option is specified in the command string, track 32 is formatted in double density. Next sectors 1 through 3 are written and read in double density.

4.5.3 KEYBOARD AND CRT TEST (KBD)

The Keyboard and CRT Test checks keyboard/CRT interaction. The interaction is used to test every key on the keyboard and all characters in the character generator.

The interaction test, when executed, clears the CRT screen and displays a blinking cursor in the upper left corner.

Following is a list of the functions performed in this test:

1. Each keyboard character is displayed where the cursor is located and moves the cursor one position to the right.
2. A CTRL U moves the cursor up one line. If the cursor exits at the top of the screen, it will enter at the top.
3. A CTRL D moves the cursor down one line. If the cursor exits at the bottom of the screen, it will enter at the top.
4. A CTRL R (or CTRL L) moves the cursor to the right (left) one position. If the cursor exits at the right (left) side of the screen, it will enter at the left (right) side.
5. A CTRL C clears the CRT screen and positions the cursor at the upper left corner of the screen.
6. A CTRL S terminates the interaction test and executes a Walking ONEs Memory Test on the CRT refresh memory.

If an error is detected during the Memory Test, the following message is displayed:

```
"CRT MEMORY ERROR AT LOCATION XXXX:"
"EXPECTED DATA: YY BAD DATA: ZZ"
```

where XXXX is the hex address of the memory error, YY is the data written, and ZZ is the hex data actually read.

Note that if this test is initiated with the loop option specified, the Keyboard/CRT Test will be bypassed and the Memory Test will be executed. If the MA card contains 32K of RAM, the additional 16K will automatically be tested.

4.5.4 COMM/SDI USART TEST

The COMM/SDI USART Test requires a diagnostic cable plugged between the output jacks of the two USARTs and passive jumpers in the SDI data transmit/receive and clock circuits. Either the SDI data set ready (DSR) or the data terminal ready (DTR) loop circuits must be in the passive mode and the other loop circuit in the active mode. Table 4-6 provides the location of the jumpers on the MB card.

Table 4-6. MB Card Jumper Locations

LOOP CIRCUIT	PASSIVE	ACTIVE
Data Transmit	KE02 - KE04 KF02 - KF04	(KE10 - KE12) (KF10 - KF12)
Data Receive	KA06 - JKA08	(KA14 - KA16) (KB14 - KB16)
Clock	KC02 - KC04 KD02 - KD04	(KC10 - KC12) (KD10 - KD12)
DSR	(KA02 - KA04) (KB02 - KB04)	KA10 - KA12 KB10 - KB12
DTR	KB06 - KB08	(KC14 - KC16) (KD14 - KD16)

The system prompts to verify that the diagnostic cable is installed and the passive/active jumpers are properly placed. When these prompts are answered, the test begins by transmitting from each USART to itself. If the cable is installed, the test continues, transmitting between one USART and the other in EIA RS-232-C mode. If the jumpers are installed, the USART will transmit to each other using the current loop.

The error messages that print out as a result of an unsuccessful run consists of two parts: the heading and the error itself.

Headings:

COMM TO COMM (EIA) TRANSMIT/RECEIVE ERROR:
SDI TO SDI (EIA) TRANSMIT/RECEIVE ERROR:
COMM TO SDI (EIA) TRANSMIT/RECEIVE ERROR:
SDI TO COMM (CURRENT LOOP) TRANSMIT/RECEIVE ERROR:
COMM TO SDI (CURRENT LOOP) TRANSMIT/RECEIVE ERROR:
SDI TO SDI (CURRENT LOOP) - DSR ERROR:

Errors:

TRANSMITTER NEVER READY
RECEIVER NEVER READY
TRANSMIT AND RECEIVE DATA DO NOT MATCH
BREAK DETECT ERROR
COMM DSR ERROR
SDI ERROR NOT DETECTED
PARITY ERROR NOT DETECTED
OVERRUN ERROR NOT DETECTED
FRAMING ERROR NOT DETECTED

Secondary errors:

The last three errors in the list above could result from the transmitter or receiver not being ready. If this were the case, the message would include the following:

BECAUSE: TRANSMITTER NEVER READY

or

BECAUSE: RECEIVER NEVER READY

4.5.5 FLOPPY DRIVE RELIABILITY TEST (RELY)

The Floppy Drive Reliability Test obtains a quantitative measure of the floppy drive's ability to write data to and read data from a floppy diskette. The test writes to a sector once and reads that sector 100 times, counting all read errors that occur. Initially, the drive motor speed is measured to verify its accuracy.

This test can be performed on the drive motor speed only or as a complete reliability test to test sector 1 or all sectors of each track, the four inside tracks or all tracks, read only or

write/read functions, single or double density. These parameters are selected during test initialization. When this test is run with the loop option, the selected parameters are maintained for the duration of the test.

Example of a Floppy Drive Reliability Test run:

In response to the prompt for user input, enter RUN RELY RETURN or RUN RELY LOOP RETURN.

TIME MOTOR SPEED ONLY?

Enter Y RETURN if only the drive motor speed portion of the test is to be run or N RETURN to execute the complete Reliability test.

DO JUST FIRST SECTOR OF EACH TRACK?

Enter Y RETURN for the first sector of each selected track to be tested or N RETURN to test all sectors of each selected track.

DO INNERMOST FOUR TRACKS ONLY?

Enter Y RETURN to test only the four inside tracks or N RETURN to test all tracks except track 0.

READ ONLY (NO WRITE)?

Enter Y RETURN for each selected sector to be read 100 times without writing to it first or N RETURN to write to each selected sector before it is read.

Note that the read-only option can be used to test the diskette without altering any of its data, isolate problems to either the write or read path circuits, or allow one 3910 unit to test the read/write capabilities of another 3910.

DOUBLE DENSITY?

Enter Y RETURN to select a double density operation or N RETURN to select a single density operation.

INSERT DISKETTE FOR RELIABILITY TEST, ENTER <RETURN>

Insert the Internal Diagnostics diskette, and enter RETURN.

Period of revolution = XXX MSEC (XXX is the time for one revolution of the diskette). The nominal value is 200 ms. Any value between 196 and 204 ms is acceptable.

The writing and reading portion of the reliability test begins after the drive speed test. If an error occurs while writing in a sector, the test ends and the following message is displayed:

ERROR IN WRITING TRACK X, SECTOR Y

where X is the track number from 1 through 34, and Y is the sector number from 1 through 10.

After a sector has been read 100 times, an error summary is printed giving the total number of record-not-found errors, CRC errors, and data mismatches. An error count of fewer than 10 is acceptable.

4.5.6 OPTIONAL MC CARD DIAGNOSTICS

MC diagnostics are designed to run specified tests to exercise the major circuitry of the 3910/1900 interface. These tests evaluate any failures and isolate problems to specific areas of circuitry. MC diagnostics can be run by looping the tests on the first failure or by continuing to the next test in line. A Stop option is also available to stop tests. When a failure is encountered, the program prompts for the wrap cable verification to determine whether or not to run the simulated 1900 read/write tests.

All MC Card diagnostic tests evaluate failures encountered to determine a major problem area. If a failure were encountered in the data bus, the failure would be evaluated before the testing of any particular device on that data bus.

The basic loop option of internal diagnostics is available plus two others:

"STOP ON ANY ERROR" and "CONTINUE" "STOP"???

When the diagnostics are initiated, the prompt "CONTINUE ON ERROR?" is displayed. If YES is entered, the diagnostics will continue to the next test. If an error is detected, a response of NO causes the diagnostic test to exit to the BASMON monitor. The next prompt is:

STOP ON ANY ERROR

A NO response causes the diagnostics to continue, even if an error is detected. A YES response causes the diagnostic test to stop on any error and evaluate it. If the error is detected, MC diagnostics again prompts for a response:

CONTINUE

STOP?

A response of "CONTINUE" restarts the tests. A response of "STOP" causes the program to exit to the hardware monitor. The Continue and Stop responses allow four options:

1	Pause = No Continue = No	Detects the first error and returns to BASMON.
2	Pause = Yes Continue = No	Repeats the first test or returns to BASMON.
3	Pause = No Continue = Yes	Runs all tests, lists all errors, and does not stop for user prompts.
4	Stop = Yes Continue = Yes	Runs all tests and stops on errors with the option to continue or returns to the monitor.

If the diagnostics have been run through one pass and returned to BASMON, the next time the Run MC Loop command is entered, the program will assume that all options have been selected and will not stop for option selection. In this case the options can be changed by entering R MC with no L. This will cause the program to prompt "DO YOU WISH TO CHANGE OPTIONS". If YES RETURN is entered, options can be selected.

IF a CTRL C is entered while the program is running, the program will exit to BASMON but will not change the selected option except for the Loop option, if it is set.

4.5.6.1 Read/Write Register Tests (C080-C086H)

The Read/Write Register Tests include the Register Access Test. These tests write various patterns into all read/write registers (addresses C080-C086H) to verify that bits are not stuck in a logical ONE or ZERO condition. Failures detected are output to the CRT. Major failures are listed first, followed by any related failures. For example, if the MC card data bus bits 0 and 3 were stuck in a logical ONE condition, the following error message would occur:

REG DATA BIT(S) 0, 3 STUCK HI

This is the major failure detected. The test could be continued from this point, and the following error messages would be listed:

```
REG C080 BIT(S) 0, 3, STUCK HIGH ALL ZERO TEST  
REG C081 BIT(S) 0, 3, STUCK HIGH ALL ZERO TEST
```

If continued, these error messages would indicate that all registers (C080-C086H) had bits 0 and 3 stuck high in all ZERO and Walking ONES Tests.

Register Access Test. This test writes each register with an individual pattern and checks each register to verify that all registers have been correctly accessed. For example, if register C080 had a pattern that should have been in register C081, the following message would occur:

```
REG C080 SELECT REG C081 TEST
```

This message would indicate that both registers (C080 and C081) had been selected simultaneously.

4.5.6.2 Memory Circuits Tests (3000-3FFFH)

The Memory Circuits tests consist of three separate tests to verify the proper operation of memory circuits.

1. Memory Data Bus Test
2. Memory Addressing Test
3. Walking ONE/ZERO Test

4.5.6.3 Memory Data Bus Test

The Memory Data Bus Test writes all memory locations with various patterns to test the memory data bus for any bits stuck in a logical ONE or ZERO condition. Any failures detected are listed on the CRT with major failures listed first. For example, if the memory data bus 7 were tied to ground, the error message would read:

```
MEM DATA BIT(S) 7, STUCK LO
```

The next related failure would be:

```
EVEN MEM DATA BIT(S) 7, STUCK LO  
ODD MEM DATA BIT(S) 7, STUCK LO
```

In the latter example, the major failure is in the memory data bus. If this failure had only been in the odd memory bit 7, the major failure message would have read:

ODD MEM DATA BIT(S) 7, STUCK LO

Related failure messages would have read:

ODD MEM LO DATA BIT(S) 7, STUCK LO
 ODD MEM DATA BIT(S) 7, STUCK LO

To determine which memory circuits might be faulty, Table 4-7 serves as a guide.

Table 4-7. MC Card Circuits

EVEN LOCATIONS	ODD LOCATIONS
Logic Sheet MC 030	Logic Sheet MC 035
Lo = Address 3000-37FEH	Lo = Address 3001-37FFH
Memory ICs selected by -Mem Sel 1 & 2 MC025CK2	Memory ICs selected by -Mem Sel 5 & 6 MC025EM6
Hi = Addresses 3800-3FFFH	Hi = Addresses 3801-3FFFH
Memory ICs selected by -Mem Sel 3 7 4 MC025CK3	Memory ICs selected by -Mem Sel 7 & 8 MC025EL6

4.5.6.4 Memory Addressing Test

The Memory Addressing Test writes separate data patterns between all address boundaries to verify that all memory locations have been accessed correctly. For example, if read/write address line 6 (logic sheet MC 025) was stuck in a logical ONE or ZERO condition, the following error message would print out:

READ WRITE ADR 6 STUCK

Failure of address lines 1 through 0 would appear in the same message format of the last example.

A failure in the odd/even memory select (logic sheet MC 025) would result in the following error message:

READ WRITE ADR 0, ODD EVEN SELECT STUCK

Similarly, a failure in the hi/lo memory select circuits would result in the following error message:

```
READ WRITE ADR 11, HI LO SELECT STUCK
```

4.5.6.5 Walking ONE/ZERO Test.

The Walking ONE/ZERO Test verifies that each bit of all memory bytes can be reliably written to and read from. An example of a failure in this test: if location 3751H bit 6 failed, the Walking ZERO test would output the following error message:

```
ODD MEM LO BIT(S) 6 BAD WALK ZERO TEST
```

4.5.6.6 Simulated 1900 Read/Write Tests

The Simulated 1900 Read/Write Tests are a series of four tests to exercise the data transfer circuits of the MC card.

1. Read Test
2. Write Test
3. DML Write Test
4. Status Signal Test

Before running these tests, make certain that a wrap tool is installed.

4.5.6.7 Read Test

The Read Test is a 4K-byte simulated read from tape. The test checks all transfer signals, the byte counter, and memory address counter with each transfer of data. All memory locations should be ZERO when the test is complete.

Possible failures in this test include read counter and read data failures. As an example of a read counter failure, bit 4 of low byte counter failed to decrement. The resultant error message would be:

```
LO BYTE COUNTER BIT(S) 4 DECREMENT BAD
```

This indicates that the MSD of the low byte counter or the borrow output of the LSD of the byte counter could be failing. Similar error messages will occur for address counter failures.

Transfer signal and stop errors might display the following possible messages:

```
TRAK NOT SET WHEN MUX 1 ASSERTED THRU WRAP
TRAK NOT RESET WHEN MUX 1 RESET THRU WRAP
STOP SET BEFORE BEC = 00 READ TESTS
STOP NOT SET AT BEC = 00 READ TESTS
```

All locations in memory should be ZERO when the data transfer is complete. If not, a read data failure was encountered. If Dat 1, MC040CB4 were tied to ground, the following error message would occur:

```
DATA FROM DRIVE 1, STUCK HI
```

If Dat 1 in the last example had only intermittent failures, the intermittent message would be added to the error message.

4.5.6.8 Write Test

The Write Test consists of a simulated long record write, 64K bytes. Two passes of this test are made. The first pass is an all ZEROs test; the second pass is an all ONES test.

Write data from memory is wrapped back to register C092 where it is checked for correct data patterns. Data patterns are checked with each data transfer. For example, a failure of Dat 7, MC040CJ2 during an all ZEROs pass would cause the following message:

```
READ C092 WRITE DATA TEST BIT(S) 7 STUCK HI
```

During write tests, the byte counters and address counters are tested with every transfer. Any failures are reflected in error messages similar to those in the Read Test except that "WRITE TEST" is added to the error message.

The stop and transfer signals are tested with each data transfer as in the Read Test. Any failures reflect the same error messages as the Read Test except that "WRITE TEST" is added to the error message.

4.5.6.9 DML Write Test

The DML Write Test is a 2K-byte data transfer. Odd locations of memory bit 0 contain parity information which is wrapped to register C093, bit 0 where it is checked for proper operation. Each transfer of data increments the memory address by two and decrements the byte count by one.

Any DML failure will cause the bit(s) in error to be included in the error message display indicating a DML write failure.

Failure to receive proper parity information will result in the following error message:

DML WRITE TEST PARITY BAD THRU WRAP TO C093 BIT 0

4.5.6.10 Status Signal Test

The Status Signal Test checks the status line to verify that the signals can be read properly. Any failure causes an error message to occur indicating the line that failed, and the origin and destination of the failing status signal. For example, if status line overruns failed to set, the following error message would print out:

OVRNS NOT SET THRU WRAP FROM C080 BIT 4 TO C090 BIT 4

This message indicates that register C080 bit 4 was used to simulate overrun signals and that this signal was not detected at register C090 bit 4 (status register).

(INTENTIONALLY LEFT BLANK)

CHAPTER 5
REMOVAL AND REPLACEMENT

5.1 INTRODUCTION

This chapter provides procedures for the removal and replacement of the field replaceable units (FRUs) of the 3910.

Before removing any parts from the 3910, power off the 3910, disconnect the power cord, and allow the 3910 to sit undisturbed for at least one minute to allow high voltage capacitors to discharge to safe levels.

Access to the internal parts is gained by removing the six screws securing the cover, lifting the cover from the unit, and setting the cover aside. Then lift the unit from the carrying case.

5.2 FLOPPY DISKETTE DRIVE

1. Disconnect the two cable connectors from the floppy diskette drive circuit card.
2. Remove all circuit cards from the card cage.
3. Under the baseplate, remove the screws that secure the drive to the baseplate (two screws are accessible behind the card cage, the third is accessible through the opening in the card cage) and remove the drive.
4. To install a floppy diskette drive, reverse this procedure.

5.3 CRT ASSEMBLY

1. Disconnect the cable connector from the CRT circuit card.
2. Under the CRT support bracket, remove the four screws securing the CRT assembly to the CRT support bracket and remove the CRT assembly.
3. To install the CRT assembly, reverse this procedure.

5.4 KEYBOARD ASSEMBLY

1. Perform the CRT assembly removal procedure (Section 5.3).
2. On the upper side of the baseplate, remove the three screws securing the card at the front of the unit.
3. On the upper side of the baseplate, remove the two screws securing the transformer bracket at the front of the unit.
4. On the upper side of the baseplate, remove the screws securing the keyboard assembly.
5. Disconnect the cable connector from the keyboard circuit card.
6. Holding the card cage and the transformer bracket out of the way, slide the keyboard assembly out the front of the unit.
7. To install a keyboard assembly, reverse this procedure.

5.5 CARD CAGE ASSEMBLY

1. Remove all circuit cards from the card cage.
2. Perform the floppy diskette removal procedure (Section 5.2).
3. Loosen, but do not remove, the two screws securing the right side of the keyboard assembly.
4. Disconnect the cable connector from the card cage motherboard.
5. Disconnect the cable connector in the leads to the backpanel pins.
6. On the side of the card cage, remove the cable clamps.
7. On the upper right side of the baseplate, remove the six screws securing the card cage assembly.
8. Pull the card cage assembly toward the front of the unit and remove it from the baseplate.
9. To install a card cage assembly, reverse this procedure.

5.6 POWER SUPPLY CHASSIS

1. Perform the floppy diskette drive removal procedure (Section 5.2).
2. Disconnect the leads from the fan, disconnect the cable connector in the power supply leads to the transformer, and disconnect the cable connector in the power supply leads to the card cage backpanel pins.
3. On the upper side of the baseplate, remove the six screws securing the power supply chassis to the baseplate and remove the power supply.
4. To install a power supply, reverse this procedure.

5.7 TRANSFORMER

1. Perform the CRT assembly removal procedure (Section 5.3).
2. Disconnect the two cable connectors in the leads to the transformer.
3. Remove the four screws securing the transformer bracket. Two screws are located on the upper side of the baseplate at the front of the keyboard; two screws are located on the upper side of the CRT support bracket. Remove the transformer and its bracket.
4. Remove the four screws securing the transformer to the transformer bracket and remove the transformer.
5. To install a transformer, reverse this procedure.

5.8 POWER MODULE

1. Disconnect the fan leads from the fan.
2. Disconnect the cable connectors in the power module leads to the power switch and to the line filter.
3. Disconnect the cable connector in the power module leads to the card cage assembly and remove the cable clamps.

4. Under the baseplate assembly, push upward on the clamp that secures the power module and remove the clamp.
5. Pull the power module out through the baseplate.
6. To install a power module, reverse this procedure.

5.9 LINE FILTER

1. Disconnect the cable connector in the line filter leads to the power module.
2. Remove the two screws securing the line filter to the baseplate (one screw secures the green ground wire) and remove the line filter.
3. To install a line filter, reverse this procedure.

5.10 POWER SWITCH

1. Disconnect the cable connector in the power switch leads to the power module.
2. On the upper side of the baseplate, remove the locking ring securing the power switch to the baseplate and pull the switch out from the underside of the baseplate.
3. To install a power switch, reverse this procedure.

5.11 SIGNAL CABLE

1. Perform the floppy diskette drive removal procedure (Section 5.2)
2. Perform the CRT assembly removal procedure (Section 5.3)
3. Loosen, but do not remove, the four screws securing the transformer bracket.
4. Disconnect the cable connector from the keyboard circuit card.

5. Loosen, but do not remove, the six screws securing the power supply chassis.
6. Disconnect the cable connector from the card cage motherboard and pull the cable clear of the card cage and power supply chassis.
7. Push the COMM connector out under the baseplate.
8. Disconnect the cable connectors from the floppy diskette drive circuit card and from the CRT circuit card and remove the signal cable from the unit.
9. To install a signal cable, reverse this procedure.

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APPENDIX A

MODEM TEST

A.1 INTRODUCTION

This appendix provides the procedures for testing the modem (acoustic coupler) for proper operation. As the acoustic coupler is usually used in remote/local operations, these procedures use two 3910 Detached Diagnostic Devices equipped with acoustic couplers. It is assumed that one unit and its acoustic coupler have been tested and are known to be functioning properly. To test and isolate the problem(s) of the possible malfunctioning unit, follow the procedure below:

A.2 MODEM TEST PROCEDURE

Both Units

1. Properly seat the acoustic couplers on the baseplate assemblies, and connect the cables to the external COMM ports.
2. Set the power switches to the ON position.

```
////////////////////  
//// CAUTION ////  
////////////////////
```

To prevent power supply damage, do not plug in the acoustic coupler while the power switch is in the ON position.

(At power on, an audible tone can be heard from the acoustic couplers.)

3. Enter L at the keyboards of the 3910s to load the diskettes.

The CRT screens will display "BASMON" indicating that the systems are under the control of the BASMON monitor, and the tone from the acoustic couplers can no longer be heard.

Functioning Unit

4. Enter T RETURN to enter the terminal mode.

5. In response to the prompt "ENTER BAUD RATE", enter 300 RETURN.
6. In response to the prompt "RS-232/OR MA CURRENT LOOP", enter RS232 RETURN.
7. In response to the prompt "SDI OR COMM", enter COMM RETURN.
8. In response to the prompt "BITS PER CHARACTER? (5, 6, 7 OR 8)", enter 8 RETURN.
9. In response to the prompt "PARITY: EVEN, ODD, OR NONE? (E, O, OR N)", enter N RETURN.
10. In response to the prompt "ORIGINATE OR ANSWER", enter 0 RETURN.
11. In response to the prompt "LOCAL ECHO OF KEYBOARD", enter N RETURN.
12. The telephone near the unit should ring as the operator at the site of the malfunctioning unit has dialed the number to this site and placed the receiver into the acoustic coupler. Pick up the receiver, and place it in the acoustic coupler.

Unit Under Test

13. At the keyboard, make the following entries:

```
CTRL,P (then wait 10 seconds)
CTRL,X
CTRL,P
CTRL,C
```

The CRT screen of both units should display "BASMON". If not, there is a malfunction in the receiver section of the acoustic coupler of this unit.) When "BASMON" displays, make the following entries:

```
CTRL,X
CTRL,A
```

These entries transfer control to the functioning unit.

Functioning Unit

14. Enter the Run Processor test command (R P L RETURN), and verify that the processor test is looping on both units. If this is not the case, the receiver in the unit under test is faulty.

Unit Under Test

15. At the keyboard of the unit under test, enter "CTRL,X" to regain control, and enter "CTRL,C" to stop the diagnostics.
16. At the keyboard, enter T RETURN to enter the terminal mode.
17. In response to the prompt "ENTER BAUD RATE", enter 300 RETURN.
18. In response to the prompt "RS232/OR MA CURRENT LOOP", enter RS232 RETURN.
19. In response to the prompt "SDI OR COMM", enter COMM RETURN.
20. In response to the prompt "BITS PER CHARACTER? (5, 6, 7, OR 8)", enter 8 RETURN.
21. In response to the prompt "PARITY: EVEN, ODD, OR NONE? (E, O, OR N)", enter N RETURN.
22. In response to the prompt "ORIGINATE OR ANSWER", enter 0 RETURN.

Functioning Unit

23. At the keyboard make the following entries:

```
CTRL,P (then wait 10 seconds)
CTRL,X
CTRL,P
CTRL,C
```

The CRT screens of both terminals should display "BASMON".
At that time, enter the following:

```
CTRL,X
CTRL,A
```

These entries transfer control to the unit under test.

(INTENTIONALLY LEFT BLANK)

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**3910 DETACHED DIAGNOSTIC DEVICE
ILLUSTRATED PARTS CATALOG**

PN 9545



STORAGE TECHNOLOGY CORPORATION

3910 DETACHED DIAGNOSTIC DEVICE

ILLUSTRATED PARTS CATALOG

Part No. 9545

PREFACE

This Illustrated Parts catalog contains listings and illustrations of the replaceable assemblies and subassemblies for the STC 3910 Detached Diagnostic Device. Part number information is accurate as of STC week 7925.

Information contained in this publication is subject to change. In the event of changes, the publication will be revised. Comments concerning the contents of this manual should be directed to the Publications department at the address below. Requests for additional copies should be directed to the Machine Level Control department. A prepaid Reader's Comment Form is provided at the back of the manual.

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LIST OF EFFECTIVE PAGES

Publication No. 9545

Issue Date: JULY 1979 EC 46037

Change Date: AUGUST 1982 Change 12 Kit PN 91913-4

Total number of pages in this document is 15, consisting of the following pages:

Page	EC No.	Kit PN	Disposition
Cover	EC 46037	NONE	
Cover Back	Blank	NONE	
i thru ii	EC 46037	NONE	
iii	EC 46113	91913-4	REPLACE
iv	Blank	NONE	
v	EC 46037	NONE	
vi	Blank	NONE	
vii thru ix	EC 46037	NONE	
x	Blank	NONE	
1	EC 46113	91913-4	REPLACE
2	EC 46113	91913-4	REPLACE
3	EC 46092	98688-5	
4	EC 46112	99054-9	
5	EC 46113	91913-4	REPLACE
6	Blank	NONE	
Reader's Comment Form	EC 46037	NONE	
Business Reply Mailer	EC 46037	NONE	



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2.	BASEPLATE ASSEMBLY	3
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HOW TO USE THE ILLUSTRATED PARTS CATALOG

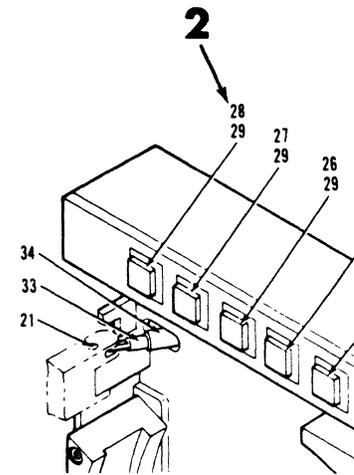
GENERAL

Illustrations always precede their parts lists, and when possible, appear on the facing page; multi-page illustrations and parts lists are exceptions. Blank pages are numbered on the printed side only.

The first number in each list identifies the figure in which the listed parts are shown (see Arrow 1). The index numbers (see Arrow 2) key the parts in the figures to the related information in the list. On subsequent pages of the same list, the first line repeats the figure number and gives the index of the next item listed (Arrow 3).

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION			
		1	2	3	4
1 → 2-	42011510-7	DECK ASSEMBLY, 1910			
	42002410-1	DECK ASSEMBLY, 1920			
		SEE FIGURE 1-1 FOR NHA			
	1	00002708-6	CLEANER BLOCK ASSEMBLY		
	2	42005001-5	EOT/BOT ASSEMBLY		
	3	42420021-0	CAPSTAN WHEEL		

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION			
		1	2	3	4
3 → 2-	52	42024900-5	CABLE ASSEMBLY, DECK SIGNAL		
			SEE FIG. 7-6, 8, 10, 13, 22, 24, 28, 29 FOR TERMINATIONS		
		42008510-2	CABLE ASSEMBLY, DECK SIGNAL		
			SEE FIG. 7-3, 10, 22, 28, 34, 75 FOR TERMINATIONS		



The figure numbers and assemblies follow a logical sequence of breakdown. If an assembly is further detailed elsewhere in this catalog, the figure is referenced in the description column (Arrow 4).

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION				USABLE ON CODE	SPARES				QTY PER ASM
		1	2	3	4		R	A	B	C	
2-	30400202-5	FINAL ASSEMBLY (SEE FIGURE 1-29 FOR NHA)									1
	1	30450217-2	CONTROL SWITCH PANEL ASSEMBLY (SEE FIGURE 9 FOR DETAILS)								1
	2	10028059-3	NUT, HEX, 8-32								4
	3	30455501-4	AC POWER SUPPLY, 60 HZ				Y	O	O	1	1
		30456301-8	AC POWER SUPPLY, 50 HZ (SEE FIGURE 4 FOR DETAILS)				Y	O	O	1	1
	4	10013062-4	SCREW, MACHINE, SBNH, 10-32 X .75								3
5	10030505-1	WASHER, LOCK, NO. 10								3	

Detailed figures refer back to the next higher overall view or next higher assembly (NHA) (Arrow 5). Assemblies that are not detailed can be ordered only as complete assemblies.

A detail part may be unlisted for several reasons; it is part of a matched set, part of an assembly that is purchased as a unit, or part of a welded or bonded assembly. If you need an unlisted part, you must order the assembly that contains it, and not the detailed part.

LEVEL OF ASSEMBLY

The indented parts list indicates the subordination of major assemblies, subassemblies, detail parts, and attaching hardware. The top assembly (figure number) in each parts list is level 1 (Arrow 6). Descriptions preceded by a single dot (.) (Arrow 7) are second level assemblies or details which are subordinate to those not preceded by a dot. Descriptions for levels 3 and 4, are preceded by two dots - ". . .", are subordinate to level 2, or those preceded by one dot (Arrow 8).

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION	USABLE ON CODE	SPARES				QTY PER ASM
				R	A	B	C	
3-	42012310-1	CAGE ASSEMBLY, 1910	A					1
	42012410-9	CAGE ASSEMBLY, 1920 SEE FIG. 1-2 FOR NHA	B					1
- 1	42420367-7	HOSE, MANUAL EXHAUST	A					1
	42420369-3	HOSE, AUTO EXHAUST	B	Y	O	O	1	1
- 2	42420370-1	HOSE, VACUUM		Y	O	O	1	1
	42005700-2	PNEUMATIC SUPPLY ASSEMBLY SEE FIG. 6 FOR DETAILS		Y	O	O	1	1
- 4	42420368-1	HOSE, EXHAUST 2.25 LONG	B					1
- 5	42420389-1	TUBE, FLEXIBLE 62 X 36.0	B					1
- 6	42007200-1	DIVERTER VALVE ASSEMBLY	B	Y	O	O	1	1
- 7	PN COMP	CKT CD, DP, 1900 PC ASSEMBLY		Y	O	O	1	1
- 8	PN COMP	CKT CD, DC, 1900 PC ASSEMBLY						1
- 9	10037013-9	FAN, AXIAL, 125 VAC, 6 IN. DIA						1
	42005810-9	COVER ASSEMBLY, REAR						1
-10	42001400-6	RECTIFIER ASSEMBLY						1
-11	42024500-3	SERVO HEAT SINK ASSEMBLY SEE FIG. 5 FOR DETAILS						1
-12	42007730	TRANSFORMER ASSEMBLY						1
-13	42021000	CABLE ASSEMBLY, SERVO SIGNAL						1

USABLE ON CODE

Usable On Code identifies all related parts (Arrow 9). The code relationships are explained at the beginning of each list (Arrow 10). If there is no code identified, the specific part is interchangeable with all codes.

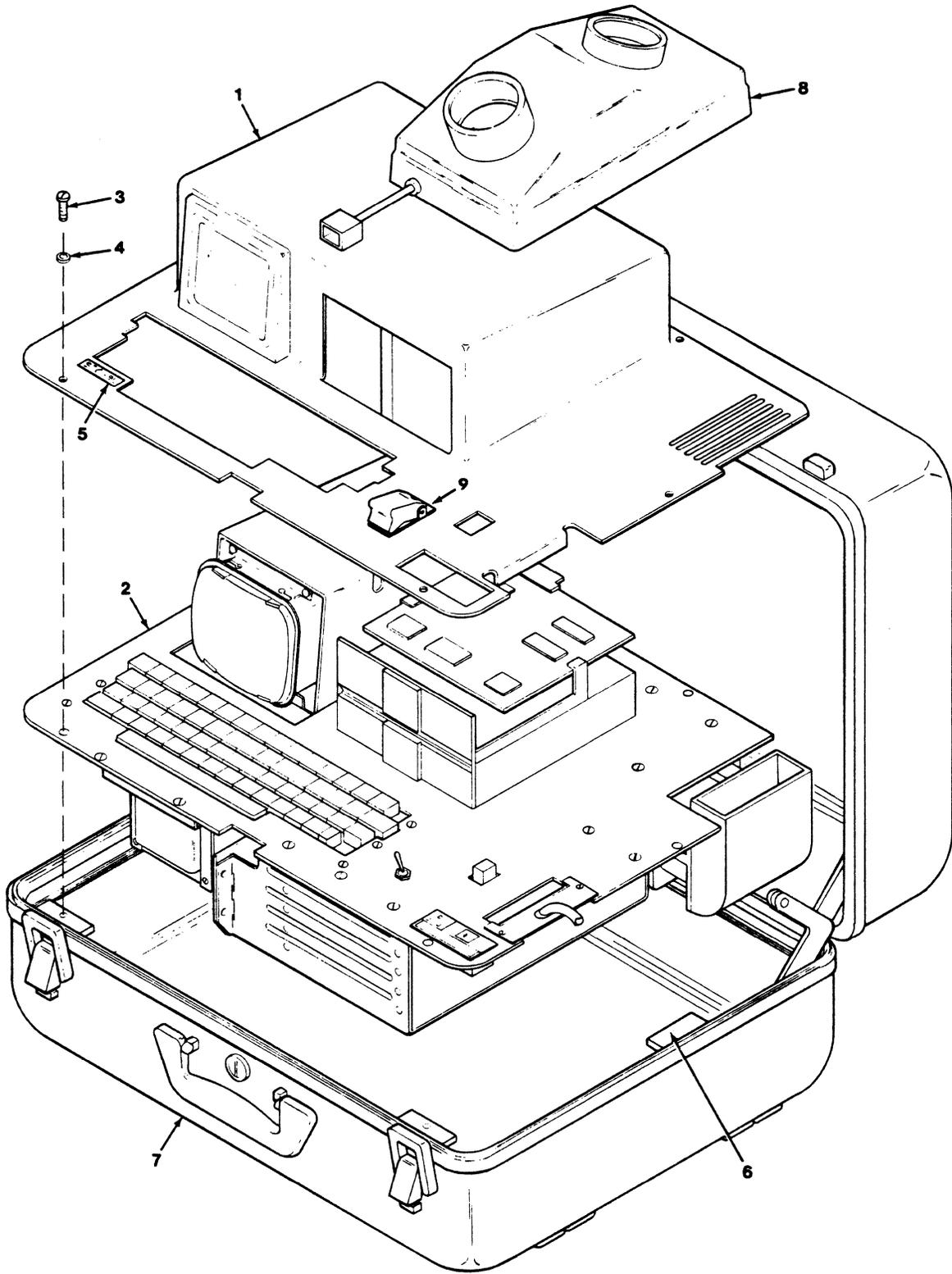
NUMERICAL INDEX

The numerical index beginning on page 5 of this catalog, list all part numbers in numerical order. The part number is cross referenced to each figure and index number where the part can be found in the catalog. For example (Arrow 11): Part No. 00010245-9 can be found on Figure 7, Index No. 33.

NUMERICAL INDEX

PART NUMBER	FIGURE & INDEX NUMBER						
00007708-6	2-1	10081010-0	4-1	42017600-0	2-25	42420408-9	4-22
00010245-9	7-33	10096273-7	2-7	42017700-8	2-24	42420421-2	2-50
10037013-9	3-9	10097224-9	7-31	42017800-6	2-23	42420421-2	2-47
10037015-4	6-3	10097245-4	5-3	42017900-4	2-39	42420434-5	2-16
10041010-9	7-25	10111000-2	2-68	42018200-8	2-32	42420451-9	2-33
10041011-7	7-18	10111004-7	2-69	42018600-9	2-74	42420465-9	2-65



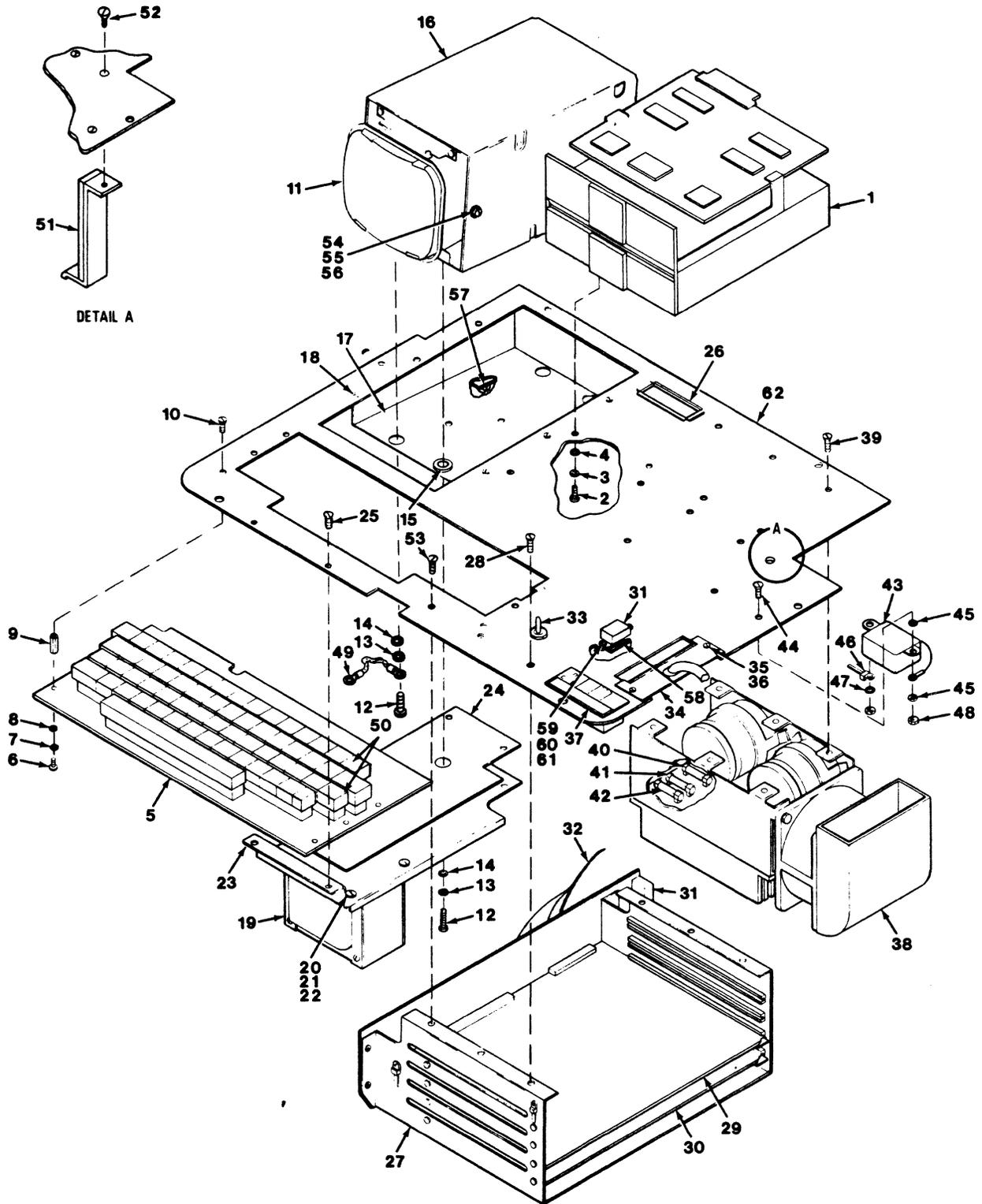


3901

FIGURE 1. DETACHED DIAGNOSTIC DEVICE

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION				USABLE ON CODE	QTY PER ASM
		1	2	3	4		
1-	40000104-2	DETACHED DIAGNOSTIC DEVICE					1
- 1	400039303-5	. DECORATIVE COVER ASSEMBLY					1
- 2	400002607-2	. BASEPLATE ASSEMBLY (SEE FIGURE 2 FOR DETAILS)					1
- 3	10096037-6	. SCREW, MACHINE, SBNH, 10-32 X .750					6
- 4	10096058-2	. WASHER, FLAT, B, BLK OXIDE, 10R					6
- 5	400039901-6	. LOGO, 3910					1
- 6	400004401-8	. BRACKET, ENCLOSURE MOUNTING					6
- 7	400004601-3	. ENCLOSURE					1
- 8	400003903-4	. ACCOUSTIC COUPLER ASSEMBLY					1
- 9	401311001-2	. COVER ASSEMBLY, POWER ON					1

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3902

FIGURE 2. BASEPLATE ASSEMBLY

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION	USABLE ON CODE	QTY PER ASM
2-	400002607-2	BASEPLATE ASSEMBLY		1
- 1	400002201-4	. MINI FLEXIBLE DISK DRIVE		1
- 2	10013027-7	. SCREW, MACHINE, SBNH, 6-32 X .500		3
- 3	10105503-6	. LOCK WASHER NO. 6		3
- 4	10027020-6	. WASHER, FLAT, B, NO. 6		3
- 5	400002902-7	. KEYBOARD ASSEMBLY		1
- 6	10013026-9	. SCREW, MACHINE, SBNH, 6-32 X .375		6
- 7	10105503-6	. WASHER, LOCK NO. 6		6
- 8	10027020-6	. WASHER, FLAT, B, NO. 6		6
- 9	10200008-0	. STANDOFF, FF, R, N, 6-32 X .250 OD X .625		6
-10	10009027-3	. SCREW, MACHINE, SFHC, 6-32 X .500		6
-11	400048401-6	. CRT ASSEMBLY		1
-12	10013028-5	. SCREW, MACHINE, SBNH, 6-32 X .625		4
-13	10105503-6	. WASHER, LOCK NO. 6		4
-14	10027020-6	. WASHER, FLAT, B, NO. 6		4
-15	400003201-3	. SHOCK MOUNT		4
-16	400009103-5	. CRT SHIELD		1
-17	400003102-3	. CRT SUPPORT BRACKET		1
-18	10009027-3	. SCREW, MACHINE, SFHC, 6-32 X .500		6
-19	400003305-2	. TRANSFORMER		1
-20	10013063-2	. SCREW, MACHINE, SBNH, 10-32 X .500		4
-21	10027026-3	. WASHER, FLAT, B, NO. 10		4
-22	10028046-0	. NUT, HEX, 10-32		4
-23	400038802-7	. BRACKET, TRANSFORMER		1
-24	400039701-0	. INSULATOR, KEYBOARD		1
-25	10009027-3	. SCREW, MACHINE, SFHC, 6-32 X .500		4
-26	10097312-2	. GROMMET STRIP, .174 X .240, POLY		AR
-27	400003503-2	. CARD CAGE ASSEMBLY		1
-28	10009027-3	. SCREW, MACHINE, SFHC, 6-32 X .500		6
-29	(PN COMP)	. WW CARD ASSEMBLY, MB		1
-30	(PN COMP)	. WIRE WRAP CARD ASSEMBLY, MA		1
-31	400009002-9	. SIGNAL CABLE ASSEMBLY		1
-32	400008903-9	. CABLE ASSEMBLY, POWER, MBO		1
-33	400006303-4	. SWITCH ASSEMBLY		1
-34	400009401-3	. CABLE ASSEMBLY, SDI		1
-35	10096029-3	. SCREW, MACHINE, SBNH, 6-32 X .500		2
-36	10096055-8	. WASHER, FLAT, B, BLK OXIDE 6N		2
-37	400039402-5	. POWER MODULE ASSEMBLY		1
-38	400009809-7	. CHASSIS, ASSEMBLY, POWER SUPPLY		1
-39	100009027-3	. SCREW, MACHINE, SFHC, 6-32 X .500		6
-40	10080009-3	. FUSE, 4A, 250V, FAST-ACT		1
-41	10080013-5	. FUSE, .25A, 250V, FAST-ACT		1
-42	10080003-6	. FUSE, 6A, 250V, FAST-ACT		1
-43	400039502-2	. LINE FILTER ASSEMBLY		1
-44	10009027-3	. SCREW, MACHINE, SFHC, 6-32 X .500		2
-45	10105520-0	. WASHER, LOCK, EXT, TYPE A, NO. 6, HW, PS		2
-46	10075022-3	. CABLE CLIP, T, 1.750 NO. 10		5
-47	10105503-6	. WASHER, LOCK NO. 6		1
-48	10028043-7	. NUT, HEX, 6-32		2
-49	42420503-4	. CABLE, GROUND		1
-50	400048001-4	. LABEL, KEYPAD		AR
-51	400047501-4	. CARD LOCK ASSEMBLY		1
-52	10003027-9	. SCREW, MACHINE, SFH, 6-32 X .500		1
-53	10009026-5	. SCREW, MACHINE, 6-32 X .375		1
-54	10013026-9	. SCREW, MACHINE, SBNH, 6-32 X .375, PS		2
-55	10027020-6	. WASHER, FLAT, B, NO. 6		2
-56	10028043-7	. NUT, HEX, 6-32		2
-57	10075042-1	. CLAMP, CABLE, FLAT CABLE, ADHESIVE BACK		3
-58	400043602-4	. PLATE, CONNECTOR MOUNTING		1
-59	10013014-5	. SCREW, MACHINE, 4-40 X .375, PS		2
-60	10030502-8	. WASHER, LOCK, HEL, MED, PS, NO. 4		2
-61	10028002-3	. NUT, HEX, 4-40		2
-62	400002107-3	. BASE PLATE		1

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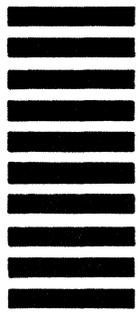
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