SYSTEMS
ENGINEERING LABORATORIES

Technical Manual
SEL 810A/810B
Diagnostics

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LIST OF RELATED PUBLICATIONS

The following publications contain information that is not included in the manual but necessary for a complete understanding of the SEL 810A Computer System.

Publication Title	Publication No.
SEL 810A General Purpose Computer Reference Manual	95049
SEL 810A Computer Technical Manual	95000
SEL 810A Computer Drawings Manual	95001
SEL 810A Interface Design Manual	95003
SEL 810A/810B General Purpose Computer Operating Instructions	95064
SEL 810A/840A FORTRAN IV Reference Manual	95054
SEL 810A Assembler Reference Manual	95052
SEL 810A Assembler Maintenance Manual	95094
Typewriter, Models 80-711 and 80-712 Series, Technical Manual	95007
Teletype Models 80-711 and 80-712 Series Drawings Manual	95070

SECTION I
Description

1-1 General

1-2 PURPOSE OF MANUAL

1-3 The purpose of this manual is to aid in the use of the Diagnostic Programs to isolate faults within the SEL 810A/810B mainframe, memory, and peripheral devices. The manual is prepared as a tool for both technician and programmer.

1-4 SCOPE OF MANUAL

1-5 This manual includes a general description, loading procedures and operation and, where necessary, a detailed description for all available SEL 810A/810B diagnostic programs. Also included are operating and loading procedures for the Manual Bootstrap and Load/Dump Package. Program listings are not included as part of this manual. The program listings can be ordered under their individual catalog number as listed in table 1-1. The operating and loading procedures assume that the diagnostic programs are contained on paper tape. The paper tapes are tagged with the same catalog number as the program listing.

1-6 Manual Usage

1-7 The following procedures will aid in the use of this manual:

a. If no problems are apparent and the diagnostics are to be attempted to exercise and determine the operating status of the system, run the diagnostics as per the procedure in paragraph 1-9. The diagnostics should be run in the following order:

1. Mainframe Diagnostics - to determine that the mainframe is functioning properly.
2. Memory Diagnostics - to determine that memory is functioning properly.
3. Input/Output Diagnostics - to determine that the associated I/O device is functioning properly.

b. If trouble is apparent in the system, the following procedure can aid in using this manual:

1. Attempt to determine from the error indications whether the mainframe, memory, or input/output device is the probable trouble source. If this is not possible, it may be necessary to run the mainframe, memory, and input/output diagnostics in that order.
2. Refer to Section III in this manual for a description and specification table for the diagnostics that pertain to the probable trouble source.
3. Read the applicable diagnostic descriptions to understand what the diagnostics functions are. If there is more than one that applies, select the order in which the diagnostics are to be performed.
4. Perform the procedure listed in paragraph 1-9.

1-8 Loading Procedures and Operation

1-9 The following gives the procedure for using this manual after determining the diagnostic to be run:

a. Obtain the paper tape for the diagnostic to be performed. The tape is labeled with the same catalog number as the program listing and description (refer to table 1-1.)

b. Refer to Section IV in this manual for loading and operation procedures for the diagnostic to be run. Load and run the diagnostic as per those procedures.

c. If an error is detected, refer to the error indications (Section IV), detailed description and program listing (not included in this manual) for aid in isolating the trouble source.

1-10 DIAGNOSTIC CATALOG NUMBERS

1-11 Table 1-1 lists the catalog numbers for all available diagnostics. The same catalog number is used for the catalogued program description (including listing) and paper tape label.

Table 1-1. Diagnostic Catalog Numbers

Catalog Number	Diagnostic	Catalog Number	Diagnostic
303001	SEL 810A Mainframe Exerciser	303016	SEL 810A/810B Mainframe Logic Exerciser Generator
303002	SEL 810A Instruction Simulation and Comparison	303017	SEL 810B Mainframe Logic Exerciser (ASR-33)
303003	SEL 810A Compare Memory to A, A Sign Test	303018	SEL 810A Mainframe Logic Exerciser (HSPT)
303004	SEL 810A Memory Exerciser Diagnostic (MEMDEX)	303019	SEL 810B Memory Diagnostic Tape Generator
303005	SEL 810A Load/Store/ Register Change Test	303020	SEL 810B Memory Diagnostic (ASR Version)
303006	SEL 810A Arithmetic Test	303021	SEL 810B Memory Diagnostic (HSPT Reader Version)
303007	SEL 810A Multiply Test	303022	SEL 810B Priority Interrupt Test Program
303008	SEL 810A Divide Test	303023	SEL 810B Memory Driver Turnoff Test
303009	SEL 810A Diagnostic Loading Procedure	323001	SEL 810A Card Reader Diagnostic
303010	SEL 810A Memory Worst Case Test	333001	SEL 810A Magnetic Tape Read-Write Parity Check
303011	SEL 810A Peper Tape Reader/ Punch Test	333002	SEL 810A Magnetic Tape Exerciser
303012	SEL 810A ASR-33/35 Teletype Test	373001	SEL 810A Line Printer Diagnostic
303013	SEL 810A Priority Interrupt Test	393001	SEL 810A X-Y Plotter Diagnostic
303014	SEL 810A Inter-Map Verification Check Program	393002	SEL 810A Interval Timer Diagnostic

Diagnostics not available at the time of printing of this manual may be obtained from Systems Engineering Laboratories Programming Department.

1-12 CONSOLE OPERATION

1-13 Refer to the SEL 810A/810B Operator Manual for information pertaining to manually operating the computer console panel.

SECTION II
Loading Procedures

2-1 **Introduction**

2-2 This section contains procedures for loading a diagnostic program.

2-3 **Preliminary Loading Procedure**

2-4 GENERAL

2-5 Before a program can be run on the computer, it must first be loaded into memory. Systems Engineering Laboratories supplies programs to the customer on punched paper tape. These paper tapes can be punched in absolute or relocatable format. If a paper tape is punched in relocatable format and the program was assembled to be relocatable, the program that it contains can be loaded into any portion of memory using a Relocatable Loader Program. If a paper tape is punched in absolute format, the program that it contains can be loaded into only that specific portion of memory as specified on the paper tape itself. Programs on paper tape that are punched in absolute format are read from paper tape and are loaded into memory using the Absolute Loader Program.

2-6 The Absolute Loader and Relocatable Loader Programs in absolute format are combined on one paper tape. This tape carries catalog number 300000 and is referred to as the Bootstrap Package Tape. It contains the Absolute Loader, Relocatable Loader, and Absolute Dump Programs in that order.

NOTE

The term Bootstrap Package refers only to the paper tape that contains an Absolute Loader, Relocatable Loader, and Absolute Dump Programs punched in absolute format. Once these three programs are loaded into memory, they are referred to as the Standard Load/Dump Package.

NOTE

The Absolute Dump Program is used to read out blocks of data from memory and punch this information on paper tape in absolute format.

2-7 In order to read the Bootstrap Package from the paper tape reader and load it into memory, a Manual Bootstrap Program must first be loaded into memory. The Manual Bootstrap Program is loaded into memory using the Computer Console Control Panel. There is a manual bootstrap for the console paper tape reader and another for the high-speed paper tape reader. The Manual Bootstrap Program causes the particular paper tape reader to be addressed and a paper tape read operation to commence.

2-8 The first program read from the Bootstrap Package paper tape and loaded into memory is the Absolute Loader Program. Program control is then transferred to the Absolute Loader Program which loads the Relocatable Loader and Absolute Dump Programs into memory. These three programs, after being loaded into memory are referred to as the Standard Load/Dump Package. After loading the Bootstrap Package, absolute or relocatable programs may be read from paper tape (or from magnetic tape if the program is relocatable) and loaded into memory. This is accomplished by loading programs using the Absolute Loader or the Relocatable Loader. If the program to be loaded is contained on paper tape in relocatable format, it may be loaded into any preselected area of memory using the Relocatable Loader Programs.

2-9 There is a Load/Dump Package Tape (absolute loader, relocatable loader and absolute dump) punched in relocatable format on a paper tape that has catalog number 300001. Therefore, the Load/Dump Package may be loaded using the relocatable loader into any preselected area of memory using the procedure described in paragraph 2-27.

2-10 **Manual Bootstrap**

2-11 GENERAL

2-12 The function of the Manual Bootstrap is to enable the operator to load into memory the Bootstrap Package Tape programs which include the Absolute Loader, Relocatable Loader, and Absolute Dump Programs. Once these three programs are loaded into memory, they are referred to as the Standard Load/Dump Package. The Manual Bootstrap is loaded into memory by operator manipulation of the Computer Console Control

Panel toggle switches and indicators. There are two Manual Bootstraps: one for the Console Paper Tape Reader and another for the High-Speed Paper Tape Reader.

2-13 LOADING THE MANUAL BOOTSTRAP

2-14 The Console Paper Tape Reader or High-Speed Paper Tape Reader Manual Bootstraps are loaded using the following procedure:

a. Turn computer power ON.

b. Lower the MASTER CLEAR switch on the computer console.

c. Manually load the starting address of the Manual Bootstrap into the program counter. (Starting address 00000 must be used for the Manual Bootstraps shown in figures 2-1 and 2-2.)

d. Enter first instruction of the Manual Bootstrap (see figures -1 or -2) into the T-Register.

e. Lower the MEMORY ENTER switch on the computer console.

f. Lower the STEP switch.

g. Lower the PROG HALT/CLEAR T switch.

h. Repeat steps d. through g. for the remaining instructions in the bootstrap. (Step e. may be eliminated by placing the MEMORY ENTER switch in the raised, locked position.)

i. Lower the MASTER CLEAR switch.

NOTE

No checksum is generated when loading the Manual Bootstrap.

2-15 The Manual Bootstrap is now loaded. Proceed to paragraph 2-16.

2-16 **Bootstrap Package**

2-17 GENERAL

2-18 The Bootstrap Package Tape (catalog number 300000) contains the Absolute Loader, Relocatable Loader, and Absolute Dump Programs punched in absolute format. After these three programs are loaded into memory, they are referred to as the Standard Load/Dump Package.

2-19 LOADING THE BOOTSTRAP PACKAGE

2-20 Operating procedures for loading the Bootstrap Package from either the Console Paper Tape Reader or High-Speed Paper Tape Reader are listed in the following:

a. Load the Console Paper Tape Reader or High-Speed Paper Tape Reader Manual Bootstrap into memory using the procedure described in paragraph 2-13.

b. Depress the MASTER CLEAR toggle switch on the Computer Console Control Panel.

c. Load the starting address of the Manual Bootstrap into the program counter. This address is 00000 for the Manual Bootstrap programs shown in figures 2-1 and 2-2.

d. Clear the T-Register by lowering the PROG HALT/CLEAR T toggle switch on the Computer Console Control Panel.

e. Mount the Bootstrap Package Tape (catalog number 300000) on either the Console Paper Tape Reader or the High-Speed Paper Tape Reader.

f. Ready the computer console input/output station by rotating the ON LINE/OFF/LOCAL switch to the ON-LINE position.

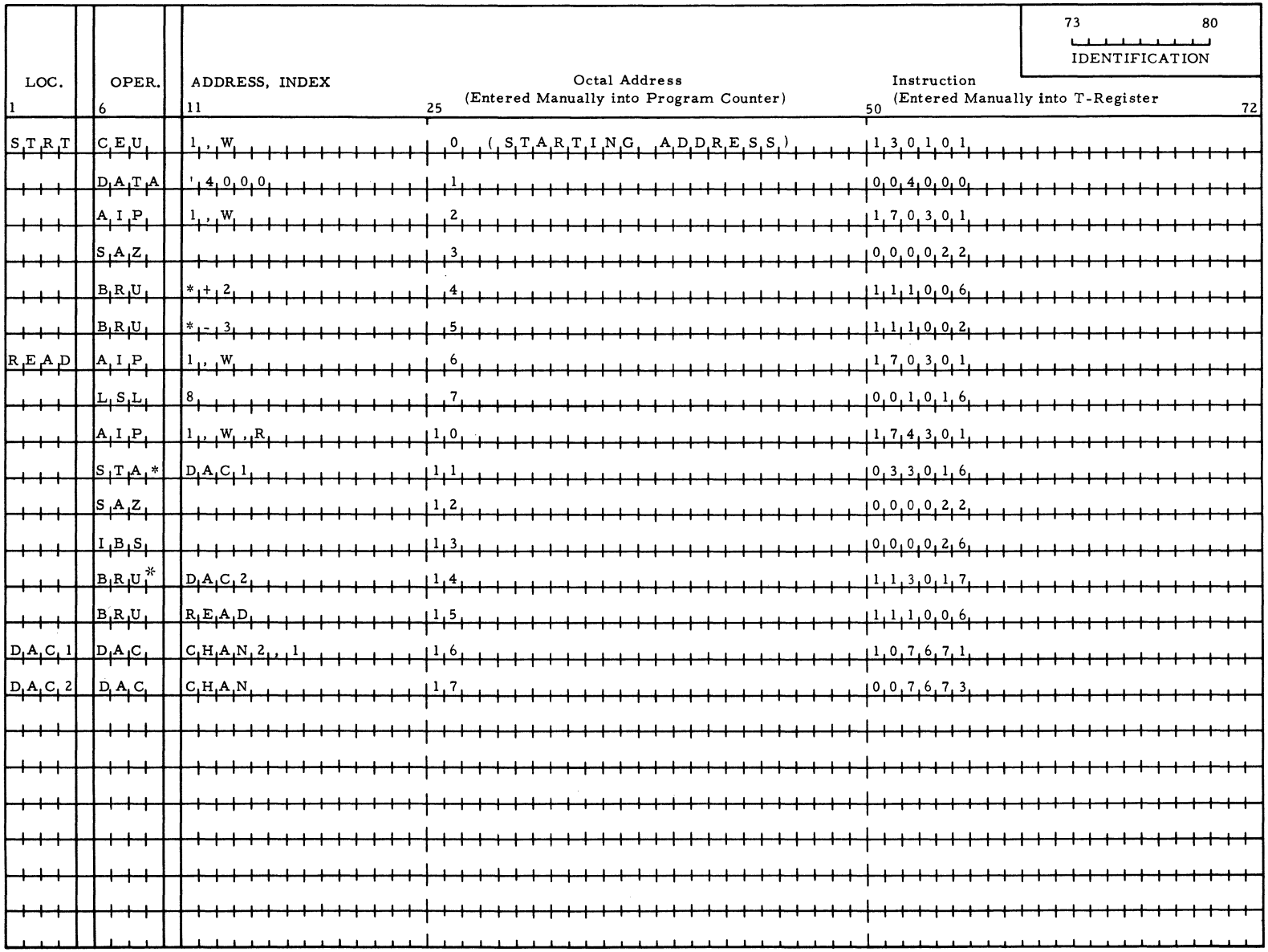

Figure 2-1. Console Input/Output Station Manual Bootstrap

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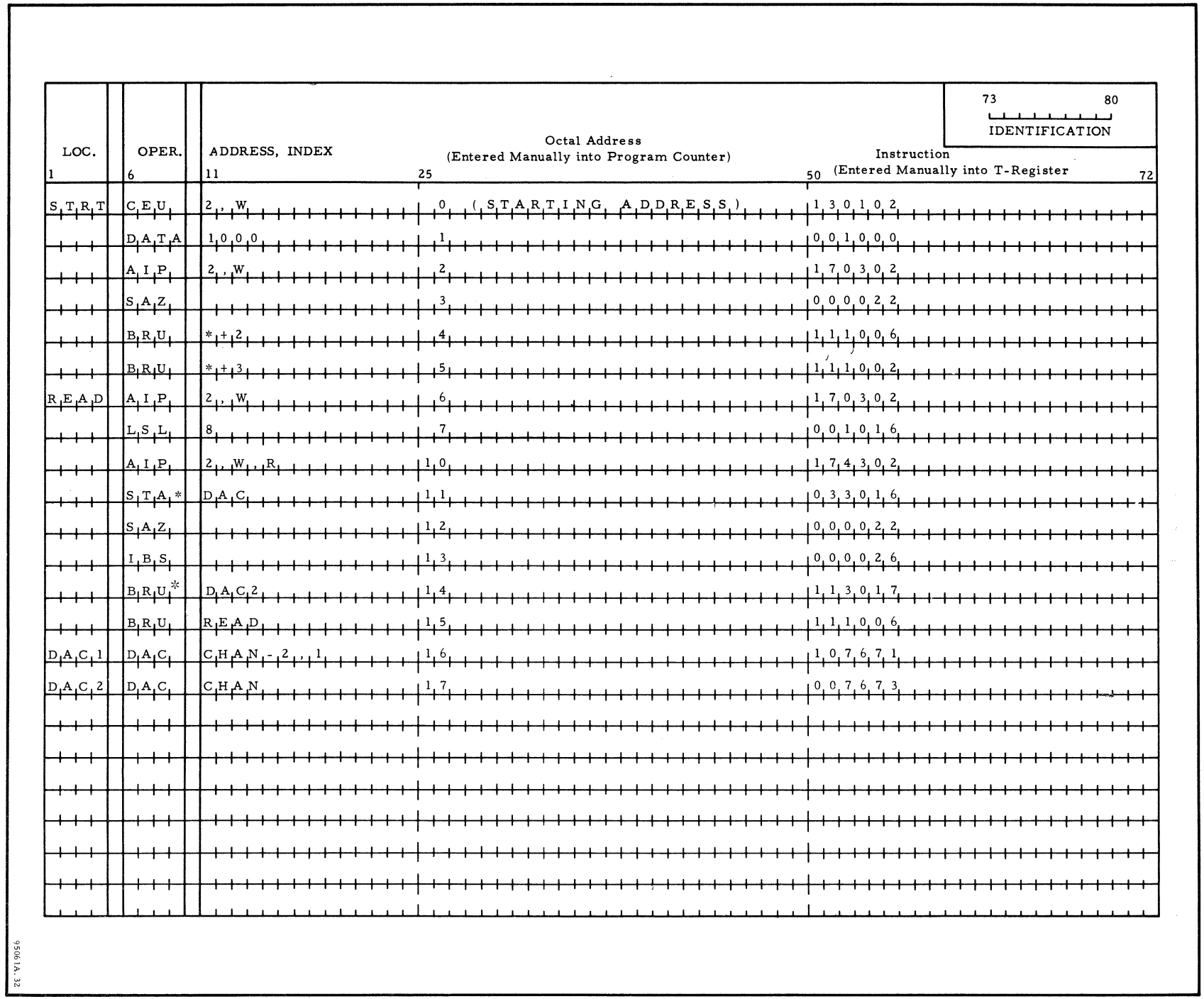


Figure 2-2. High-Speed Paper Tape Reader Manual Bootstrap

g. If the Bootstrap Package Tape is mounted on the Console Paper Tape Reader, ready the reader by positioning the START/STOP/FREE switch on the reader to the START position. If the Bootstrap Package is mounted on the High-Speed Paper Tape Reader, ready the reader by raising the POWER-ON switch located on the front of the reader.

h. If the Console Paper Tape Reader is the input device, center the Number 0 SENSE/HALT/LOAD T switch on the Computer Console Control Panel. If the High-Speed Paper Tape Reader is the input device, raise the Number 0 SENSE/HALT/LOAD T switch on the Computer Console Control Panel.

i. Lower the START/STOP toggle switch two times on the Computer Console Control Panel.

j. The computer cycles through the Manual Bootstrap Program. The Manual Bootstrap Program loads into memory the Absolute Loader, Relocatable Loader and Absolute Dump Programs contained on the Bootstrap Package Tape.

k. The computer is halted when a STOP CODE character is read from paper tape indicating that the Bootstrap Package load operation is completed. The OVERFLOW indicator on the Computer Console Control Panel should be lit.

l. The SEL 810A/810B Standard Load/Dump Package (just loaded from the Bootstrap Package Tape) now resides in the top of the lower 4K of memory. In order to relocate the Standard Load/Dump Package above 4K, the relocatable formatted Load/Dump Package Tape (catalog number 300001) must be loaded using the Relocatable Loader Program which starts at address 6017_8. This relocating procedure is described in paragraph 2-27.

2-21 Abnormal Conditions During the Loader Load Operation

2-22 If abnormal conditions occur, such as premature or no halt, no paper tape feed, etc., perform the following:

a. Check that the Manual Bootstrap was loaded properly. Compare the loaded bootstrap against figure 2-1 or figure 2-2. Reload the Manual Bootstrap if this check shows bootstrap loading errors.

b. If Step a. shows that the Manual Bootstrap was loaded properly, repeat all the steps in the operating procedure for loading the Bootstrap package as per paragraph 2-19.

2-23 Relocating the Standard Load/Dump Package

2-24 GENERAL

2-25 The Standard Load/Dump Package (absolute loader, relocatable loader, and absolute dump) which was read into memory using the Manual Bootstrap, as per paragraph 2-19, resides in the top of the lower 4K of memory. This package was read from the Bootstrap Package Tape (catalog number 300000) which is punched in absolute format. It is convenient to store the Standard Load/Dump Package in memory so that it does not have to be loaded every time it is required to load a program. The area that is generally selected for permanent storage of the load/dump programs is in the top of the upper 4K of memory.

2-26 There is a Standard Load/Dump Package tape (catalog number 300001) that is punched in Relocatable format. By loading this tape using the Relocatable Loader Program (loaded from Bootstrap Package Tape) the Standard Load/Dump Package can be relocated to any area of computer memory using the procedure described in paragraph 2-27.

2-27 PROCEDURE FOR RELOCATING THE STANDARD LOAD/DUMP PACKAGE

2-28 For relocating the Standard Load/Dump Package perform the following:

a. Load the Manual Bootstrap and Bootstrap Package Tape using the procedures described in paragraphs 2-13 and 2-19.

b. Mount the relocatable Load/Dump Package Tape (catalog number 300001) on the peripheral device to be used for input (console paper tape reader, high-speed paper tape reader or magnetic tape).

NOTE

If magnetic tape is used, the relocatable loader assumes that the Tape Controller is unit #6 and is connected to BTC #1. The Tape Transport is assumed to be unit #2.

c. Turn ON power and Ready the peripheral device selected for input (refer to SEL 810A/810B Operator's Manual for peripheral Turn-On and Ready procedures.

d. Set the A-Accumulator to the relocation base address.

e. Load address 6017_8 into the program counter. This is the starting address of the relocatable loader that was loaded from the Bootstrap Package Tape.

f. Set the computer console SENSE/HALT/LOAD T switches as per the following:

SENSE/HALT/ LOAD T Switch	State	Functions to be Performed
0	Raised	Input Accepted from Optional High-Speed Paper Tape Reader
0	Centered	Input Accepted from ASR-33 Paper Tape Reader
3	Raised	Input from Magnetic Tape Unit

g. Lower the START/STOP toggle switch on the Computer Console Control Panel two times.

h. The computer enters the Relocatable Loader Program. The relocatable loader loads the Standard Load/Dump Package into memory starting at the relocation base address that was loaded into the A-Accumulator. The starting addresses for the loader and dump programs are:

Relocatable Loader - Relocation Base $+17_8$
Absolute Dump - Relocation Base $+1561_8$
Absolute Loader - Relocation Base $+1673_8$

2-29 Loading A Diagnostic Program

2-30 GENERAL

2-31 The SEL 810A/810B Mainframe and Memory Diagnostic Programs are loaded into memory using the Absolute Loader Program. The SEL 810A/810B Input/Output Diagnostic Programs are loaded into memory using the Relocatable Loader Program. Both loader programs are loaded into memory using the Bootstrap Package Tape load procedure explained in paragraph 2-19.

2-32 PROCEDURE FOR LOADING A DIAGNOSTIC PROGRAM

2-33 The procedure for loading a diagnostic program into memory is as follows:

a. If the Standard Load/Dump Package has previously been loaded into computer memory proceed to c.

b. Load the Manual Bootstrap and Load/Dump Package into computer memory using the procedures described in paragraphs 2-13 and 2-19. Relocate the Load/Dump Package if necessary using the procedure described in paragraph 2-27.

c c. Turn ON power and Ready the peripheral device selected for input (refer to the SEL 810A/810B Operator's Manual for peripheral Turn-ON and Ready procedures.

d. Mount the diagnostic program paper tape on the peripheral device selected for input (refer to the SEL 810A/810B Operator's Manual for mounting procedures).

e. If the diagnostic program can be relocated, proceed to f. If the diagnostic program cannot be relocated (Mainframe or Memory Diagnostics), proceed to g.

NOTE

A program that is loaded with the relocatable loader may not necessarily be relocatable. Refer to the specification tables (memory storage) in Section III to determine if a program is relocatable.

f. Set the A-Accumulator to the relocatable base address.

g. Load the starting address for the absolute loader or relocatable loader into the program counter. Mainframe and memory diagnostics are loaded with the absolute loader and I/O diagnostics are loaded with the relocatable loader.

NOTE

If there is doubt whether a diagnostic is loaded with the absolute or relocatable loader, perform the following: examine the first character on the paper tape; if this character is all ones, load with the absolute loader.

The starting addresses for the absolute loader, relocatable loader, and absolute dump are given in table 2-1. Table 2-1 includes addresses for the loader/dump programs loaded from the Bootstrap Package Tape (absolute) and addresses for

the loader/dump programs that were loaded by the relocatable loader (relocatable).

Table 2-1. Starting Addresses for 4K Version of Loaders and Dump Programs

Program	Absolute Version Starting Address	Relocatable Version Starting Address
Absolute Loader	7673_8	Relocation Base $+17_8$
Relocatable Loader	6017_8	Relocation Base $+1561_8$
Absolute Dump	7561_8	Relocation Base $+1673_8$

h. Set the computer console SENSE/HALT/LOAD T switches as per table -2 or table -3 dependent on whether the absolute or relocatable loader is to be used to load the diagnostic program.

Table 2-2. SENSE/HALT/LOAD T Switch Settings for Relocatable Loader

SENSE/HALT/LOAD T Switch	State	Functions to be Performed
0	Raised	Input Accepted from High-Speed Paper Tape Reader
0	Centered	Input Accepted from ASR-33 Paper Tape Reader
1	Raised	Printed Output will List all Subroutines on the Console Printer
1	Centered	Will not List Subroutines
2	Raised	Will List all Subroutines not loaded
2	Centered	No Printed Output
3	Raised	Input from Magnetic Tape Unit

Table 2-3. SENSE/HALT/LOAD T Switch Settings for Absolute Loader

SENSE/HALT/LOAD T Switch	State	Functions to be Performed
0	Raised	Input Accepted from High-Speed Paper Tape Reader
0	Centered	Input Accepted from Console Paper Tape Reader

i. Lower the START/STOP toggle switch on the Computer Console Control Panel two times.

j. The computer cycles through the absolute or relocatable loader program. The absolute or relocatable loader program causes the diagnostic program to be read from either the console paper tape reader, the high-speed paper tape reader or magnetic tape and loaded into memory.

k. When a STOP code is read from paper tape, the computer halts with the OVERFLOW indicator lit, indicating that the diagnostic program has been loaded. Messages that may be typed out on the console printer during the diagnostic load operation are listed in table 2-4.

Table 2-4. Possible Printouts After Loading with the Absolute or Relocatable Loader

Loader	Printout	Meaning
Absolute	1. K	Checksum Error. This is the only printout for the absolute loader.
Relocatable	1. The highest location in Map Zero	

Table 2-4. Possible Printouts After Loading with the Absolute or Relocatable Loader (Cont'd)

Loader	Printout	Meaning
Relocatable (Cont'd)	2. The highest location in the main program	
	3. CK	Checksum Error
	4. MO	Attempting to load in area used by loader program
	5. CM	Common request before being defined.
	6. LC (LCEJ)	Loading Complete. This printout indicates that the program has been loaded complete with subroutines.
	7. EJ	End of Job. This printout indicates that the loading operation for a particular subroutine is complete.

SECTION III
Functional Descriptions

3-1 **Introduction**

3-2 This section includes a brief description and specification table for each diagnostic program.

3-3 **Mainframe Exerciser — MFE (Catalog Number 303001A)**

3-4 DESCRIPTION

3-5 The MFE is a fast, no loop program that executes and then verifies the operation of most of the mainframe instructions. Error halts are interspersed throughout the program in such a manner that the operation of a small number of instructions must be verified before the next small group of instructions is executed. If an error is detected, the computer is halted.

3-6 There are no error type-outs in this program. If an error halt does occur, an examination of the program counter indicator on the computer console gives the address +1 where the error halt occurred. By using the halt log in Section IV of this manual in conjunction with the program listing (catalog number 303001), the failing instruction can be determined.

3-7 SPECIFICATIONS

3-8 Table 3-1 lists the specifications for the mainframe exerciser diagnostic program.

3-9 **Instruction Simulation and Comparison IS/C (Catalog Number 303002A)**

3-10 DESCRIPTION

3-11 The IS/C program is a looping, seventeen phase, mainframe program that executes and then verifies the manipulation and transfer of data between the A-Accumulator, B-Accumulator, and memory. Between transfers, the data is incremented, compared with previous transfers or constants, shifted, checked for positive and negative values, added, subtracted, ANDed or ORed, and complemented. The following program options are controlled by the computer console SENSE/HALT/LOAD T switches:

a. The number of successful cycles through the program is typed out. Each complete cycle requires 40 seconds.

b. The detection of an error is ignored.

c. The detection of an error causes a computer halt without a type-out.

d. The detection of an error causes a computer halt after an error type-out.

3-12 If an error does occur, an examination of the type-out format and error log in Section IV of this manual should isolate the failing operation or instruction. A more complete breakdown of the program is given in the program listing (catalog number 303002A).

3-13 SPECIFICATIONS

3-14 Table 3-2 lists the specifications for the instruction simulation and comparison diagnostic program.

3-15 **Compare Memory To A, A Sign Test — CMASAS (Catalog Number 303003A)**

3-16 DESCRIPTION

3-17 The CMASAS diagnostic is a looping program that tests every available memory location with a

Table 3-1. Specifications for Mainframe Exerciser Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
All mainframe instructions except DIV, LCS, SNS, TBV, TVB, PON, POF, Interrupt and I/O	Standard SEL 810A Computer	SEL 810A Symbolic Code	Memory Locations 2000_8 to 2303_8 and 3000_8 to 3021_8 not relocatable	SEL 810A Mainframe Diagnostic loading procedure	Approx. 1 ms cycle time

Table 3-2. Specifications for the Instruction Simulation and Comparison Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Mainframe Instructions	Standard SEL 810A Computer	SEL 810A ASSEMBLER Symbolic Code	Memory locations 1000_8 to 2605_8 and 0_8 to 22_8 not relocatable	SEL 810A mainframe diagnostic loading procedure	Approx. 40 secs. cycle time

Compare Memory to A-Accumulator (CMA) and a Skip on Sign of A-Accumulator (SAS) instructions. Various operands are used to check the proper skip function associated with the instruction and the operand being used. This program uses every available memory location.

3-18 If an error occurs, an error message is typed out on the console printer. An examination of the error type-out (see Section IV) and the program listing (catalog number 303003A) should aid in isolating the problem.

3-19 SPECIFICATIONS

3-20 Table 3-3 lists the specifications for the compare memory to A, A sign test diagnostic program.

3-21 Memory Exerciser Diagnostic — MEMDEX (Catalog Number 303004A)

3-22 DESCRIPTION

3-23 The MEMDEX is a fast, looping program that executes and verifies the transfer of data into and out of memory. The program loads and unloads various operands into all available memory locations. The operands are tested to determine if the load and unload operations are successful. This program uses every memory location in available memory. The program is composed of a number of test routines which are performed under option switch control.

3-24 If an error occurs, an error message is typed out on the console typewriter. An examination of the error type-out (see Section IV) and the program listing (catalog number 303004A) should aid in isolating the problem.

3-25 SPECIFICATIONS

3-26 Table 3-4 lists the specifications for the memory exerciser diagnostic program.

3-27 Load / Store / Register Change Test — LSRCT (Catalog Number 303005A)

3-28 DESCRIPTION

3-29 The LSRCT is a looping program that executes and then verifies the operation of the load; store and registers change instructions except for the LCS and CSB instructions. The program uses the instructions at a repetition rate that provides an excellent operational check on the A-Accumulator, B-Accumulator and memory. The data transferred is incremented by one and is used as a counter for each cycle through the program. This feature insures that all bit combinations are used. The following program options are controlled by computer console SENSE/HALT/CLEAR T switches:

a. The number of successful cycles through the program is typed out.

b. The detection of an error is ignored.

Table 3-3. Specifications for the Compare Memory to A, A Sign Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
CMA and SAS instructions for all memory locations	Standard SEL 810A Computer	SEL 810A ASSEMBLER symbolic code	Diagnostic is stored in 0000_8 to 411_8 not relocatable. Program uses all memory locations	SEL 810A mainframe diagnostic loading procedure	Dependent on memory size

Table 3-4. Specification for the Memory Exerciser Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
The transfer of all data combinations into and out of all memory locations	Standard SEL 810A Computer	SEL 810A ASSEMBLER symbolic code	Diagnostic stored in 0000_8 to 0502_8 not relocatable. Program uses all memory locations	SEL 810A Mainframe diagnostic loading procedure	Dependent on memory size

c. The detection of an error causes a computer halt without a type-out.

d. The detection of an error causes an error message and error location type-out followed by a computer halt.

e. The detection of an error causes an error message and error location type-out and no computer halt.

3-30 If an error does occur, an examination of the type-out format and halt log in Section IV of this manual should isolate the failing instruction. A more complete breakdown of the program is given in the program listing (catalog number 303005A).

3-31 SPECIFICATIONS

3-32 Table 3-5 lists the specifications for the load/store/register change test diagnostic program.

3-33 **Arithmetic Test — ADD0 (Catalog Number 303006A)**

3-34 DESCRIPTION

3-35 The ADD0 is a looping program that exercises the adder. The AMA, AMB, SMA, and RNA instructions are executed and verified at a high repetition rate. The operands used are produced by a software, random bit pattern generator. Memory is added to A and B and the results are compared. Memory is subtracted from A using the same operands, one in A, one in memory, then visa versa. The differences are compared, ignoring the signs. RNA is tested by a software, round A simulation. Overflow is checked and an error condition will be generated if the overflow latch is not set at the proper time. The following program options are controlled by the computer console SENSE/HALT/CLEAR T switches:

a. The detection of an error is ignored.

b. The detection of an error causes an error message to be typed out followed by a computer halt.

c. The detection of an error causes a computer halt with no error type-out.

3-36 If an error does occur, an examination of the error type-out (Section IV) and program listing (catalog number 303006A) should aid in isolating the problem.

3-37 SPECIFICATIONS

3-38 Table 4-6 lists the specifications for the arithmetic test diagnostic program.

3-39 **Multiply Test — MTPY (Catalog Number 303007A)**

3-40 DESCRIPTION

3-41 The multiply test is a looping program that executes hardware and software multiplies and

Table 3-5. Specifications for the Load/Store/Register Change Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
All the load/store and register change instructions except for LCS and CSB	Standard SEL 810A computer	SEL 810A ASSEMBLER symbolic code	Memory locations 1000_8 to 1371_8 - not relocatable	SEL 810A Mainframe diagnostic loading procedure	Approx. 2.5 ms per cycle

Table 3-6. Specifications for the Arithmetic Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
AMA, AMB, SMA, RNA instructions	Standard SEL 810A Computer	SEL 810A ASSEMBLER symbolic code	Memory locations 1000_8 to 1441_8 not relocatable	SEL 810A Mainframe diagnostic loading procedure	Approx. 400 μsec if no errors occur

then verifies by comparing the products. A software multiply arrives at a product by adding and shifting. The two operands used in both the hardware and software multiplies are produced by a software, random operand generator. An inequality between the resultant two products constitutes an error condition. The following program options are controlled by the computer console SENSE/HALT/LOAD T switches:

a. The detection of an error is ignored.

b. The detection of an error causes a computer halt without a type-out.

c. The detection of an error causes an error message type-out followed by a computer halt.

d. The same operands are used continuously.

3-42 If an error does occur, an examination of the type-out format (see Section IV) and program listing (catalog number 303007A) should aid in isolating the problem.

3-43 SPECIFICATIONS

3-44 Table 3-7 lists the specifications for the multiply test diagnostic program.

3-45 **Divide — DIV (Catalog Number 303008A)**

3-46 DESCRIPTION

3-47 The divide test is a looping program that executes and then verifies hardware and software divides in both single and double precision modes. A software divide arrives at a quotient and remainder by subtracting and shifting. Verification is accomplished by comparing the quotient and remainder of the hardware divide to the quotient and remainder of the software divide. The operands used in both the hardware and software divides are produced by a software, random operand generator. An inequality between the resultant two quotients and remainders constitutes an error condition. The following program options are controlled by computer console SENSE/HALT/CLEAR T switches:

a. The detection of an error is ignored.

b. The detection of an error causes a computer halt without a type-out.

c. The detection of an error causes an error message type-out followed by a computer halt.

Table 3-7. Specifications for the Multiply Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Hardware and Software multiplies	Standard SEL 810A Computer	SEL 810A ASSEMBLER symbolic code	Memory locations 1000_8 to 1270_8 not relocatable	SEL 810A Mainframe diagnostic loading procedure	A product should be produced every 0.75 ms. if no error occurs

d. The same operands are used continuously.

3-48 If an error does occur, an examination of the type-out format (see Section IV) and program listing (catalog number 303008) along with using the isolation and troubleshooting procedures, given in Section IV of this manual, should locate the problem.

3-49 SPECIFICATIONS

3-50 Table 3-8 lists the specifications for the divide test diagnostic program.

3-51 Memory Worst – Case Test — MEMTES (Catalog Number 303010A)

3-52 DESCRIPTION

3-53 The memory worst-case test is a fast looping program that executes and verifies the transfer of data into and out of all memory locations using bit configurations most likely to cause memory errors. MEMTES analyzes the program counter bits in conjunction with a Boolean expression to find which locations should be loaded with ones or zeros. After all memory is loaded, each location is unloaded sequentially. While unloading memory, the worst-case pattern will cause additive noise in the sense windings possibly causing bits to be dropped or picked up. All of memory is tested through the use of a ping-pong routine. After the upper portion of memory has been exercised (location 1000_8 and up), the program is modified to exercise the lower portion of memory (location 0 up to, but not including the highest map) and transferred to the highest map in memory. Once the lower portion is exercised, the program is reset to exercise upper memory and moved back to the lowest map. Worst-case program options are provided for a Ferroxcube 4K Memory; Ferroxcube, 8K Memory; Ampex, Mod 1, 8K Memory; Ampex, Mod 1, 4K Memory; and Ampex, Mod 2, Memory (all sizes). The memory option is selected by the computer console SENSE/HALT/LOAD T switches.

3-54 If an error does occur, an examination of the type-out format (see Section IV) and program listing (catalog number 303010A) should aid in isolating the problem.

3-55 SPECIFICATIONS

3-56 Table 3-9 lists the specifications for the memory worst-case test diagnostic program.

3-57 Paper Tape Reader / Punch Test — PTRP (Catalog Number 303011A)

3-58 DESCRIPTION

3-59 The Paper Tape Reader/Punch diagnostic program executes and then verifies all the electronic and mechanical operations performed on the High-Speed Paper Tape Punch and Reader. This test is designed to exercise the mechanical functions of the punch and reader as well as test the accuracy of data transfer. To test the mechanical functions of punch and reader, they are run in three modes:

a. Continuous mode

b. Start/Stop mode

c. Simultaneous mode

In the continuous mode, the punch and reader are operated at their maximum rates. In start/stop mode there is a delay of 0.02 seconds between each character punched and read. In the simultaneous mode, the punch and reader are operated simultaneously. To test the data transfer, the program punches and reads repeated forward and reverse binary progressions, going from 001 to 377_8, then 000, then 377_8 back to

Table 3-8. Specifications for the Divide Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Hardware and Software divide	Standard SEL 810A Computer	SEL 810A Assembler symbolic code	Memory Locations 1000_8 to 1270_8 not relocatable	SEL 810A Mainframe diagnostic loading procedure	Approx. 1.05 ms. cycle time if no errors occur

Table 3-9. Specifications for the Memory Worst-Case Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Worst-Case patterns in memory	Standard SEL 810A Computer	SEL 810A ASSEMBLER symbolic code	Memory locations 0000 to 0467_8. Every other location is used.	SEL 810A Mainframe diagnostic loading procedure	Dependent on memory size

001. A test cycle is one forward and reverse progression punched and read in each of the three modes. The program will keep repeating the test cycle until the operator terminates it or an error is detected. When an error is detected, a message is typed on the ASR-33 indicating what should have been read and what was read. The operator can determine by looking at the tape whether the reader or punch was in error. The operator then has the option to either restart the test or continue. The operator also has the option to eliminate type-out of errors, but they will be counted and the number of errors will be typed out upon termination of the test. The following program options are controlled by the computer console SENSE/HALT/LOAD T switches:

a. At the end of the present cycle, the program is terminated.

b. At the end of the present cycle, another cycle is started.

c. The detection of an error causes an error message to be typed out.

d. The detection of an error does not cause an error type-out.

e. The detection of an error causes a computer halt.

f. The detection of an error does not cause a computer halt.

3-60 If an error does occur. an examination of the error type-out (Section IV) and program listing (catalog number 303011) should aid in isolating the problem.

3-61 SPECIFICATIONS

3-62 Table 3-10 lists the specifications for the paper tape reader/punch test diagnostic program.

3-63 **Computer Console Input / Output Station Test — TTY Test (Catalog Number 303012A)**

3-64 DESCRIPTION

3-65 This diagnostic program executes and then verifies all the electronics and mechanical operations performed by the console paper tape punch, console paper tape reader, console keyboard, and console printer (ASR-33 and ASR-35 teletype). The particular portion of this test that is performed is under option switch control, as explained in Section IV.

3-66 If an error does occur, the computer will halt at a location dependent on the particular test that is performed.

Table 3-10. Specifications for the Paper Tape Reader/Punch Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Software instructions and mechanics necessary to perform all the operations on the high-speed paper tape reader/punch	SEL 810A computer with high-speed paper tape reader/punch	SEL 810A ASSEMBLER symbolic code	Less than one map - full above 2000_8	N/A	Thirty-one secs. per cycle (excluding error type-outs)

3-67 SPECIFICATIONS

3-68 Table 3-11 lists the specifications for the computer console input/output station test diagnostic program.

3-69 SEL 810A Priority Interrupt Checkout Program — PI Checkout (Catalog Number 303013A)

3-70 DESCRIPTION

3-71 The Priority Interrupt diagnostic program executes and then verifies the Priority Interrupt Enable (PIE), Priority Interrupt Disable (PID), and Turn Off Interrupt (TOI) instructions. Included in this test is a check on the power fail-safe feature. This diagnostic is performed without any input/output devices on-line. It is not intended to act as as a subroutine for any other program. The interrupts that are checked by this test must be simulated manually. This is accomplished by connecting the proper voltages to the priority interrupt card in the computer through jumpers or a test rig.

3-72 SPECIFICATIONS

3-73 Table -12 lists the specifications for the priority interrupt checkout program.

3-74 Inter-Map Verification Check Program — IMVC (Catalog Number 303014A)

3-75 DESCRIPTION

3-76 The IMVC program is a looping program that checks the proper execution of specific memory reference instruction which are located on the memory boundary between Map 2 and Map 3. The hardware used for Maps 2 and 3 is common to memory reference instructions for all maps. The program also checks several skip instructions for proper execution.

3-77 If an error is detected, the computer is halted. There are no error type-outs in this program. If an error halt does occur, an examination of the program counter indicator on the computer console gives the address where

Table 3-11. Specifications for the Input/Output Station Test Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Software, electronics and mechanics necessary to perform all the teletype operations	SEL 810A Computer	SEL 810A ASSEMBLER symbolic code	455_8 memory locations - relocatable with a bias of 2000_8	N/A	N/A

Table 3-12. Specifications for the Priority Interrupt Checkout Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
PIE, PID, and TOI instructions. Also checked is the power fail-safe interrupt and associated hardware	Standard SEL 810A Computer	SEL 810A Assembler symbolic code	Memory locations 00000 through 01375_8	SEL 810A diagnostic loading procedure	N/A

the error halt occurred. By referencing this address to the listing in paragraph 4-223, along with the program listing (catalog number 303014A), the failing instruction can be determined.

3-78 SPECIFICATIONS

3-79 Table 4-13 lists the specifications for the inter-map verification check program.

3-80 **Card Reader Diagnostic (Catalog Number 323001A)**

3-81 DESCRIPTION

3-82 The Card Reader Diagnostic program executes and verifies the electrical and mechanical operations performed by the SEL 80-410A Card Reader in both the binary and BCD modes. The data from the punched cards is read and is compared with either program stored data (Program Stored Card Test Mode) or with the data on the first card read (First Card in Buffer Test Mode).

3-83 If an error is detected, an error message is typed-out on the console printer under option switch control.

3-84 SPECIFICATIONS

3-85 Table -14 lists the specifications for the card reader diagnostic program.

3-86 **SEL 810A Magnetic Tape Read-Write Parity Checker — MTRWPC (Catalog Number 333001A)**

3-87 DESCRIPTION

3-88 This magnetic tape diagnostic program writes and then reads records on magnetic tape and detects if parity errors occurred during the transmission of data.

3-89 If a write parity error is detected, the teletype prints out WPE. If a read parity error is detected, the teletype prints out RPE. The records written are 128 words in length. The characters written on tape are determined by the configuration that is set into the computer console switches. A comparison is made between each word written and the value that was set into the console switches. If they do not compare, the incorrect data values are printed out by the teletype in octal format. This comparison feature also verifies if the parity checker is functioning properly. This test should be run with different configurations set into the computer console switches.

3-90 SPECIFICATIONS

3-91 Table 3-15 lists the specifications for the magnetic tape read-write parity checker diagnostic program.

Table 3-13. Specifications for the Inter-Map Verification Check Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Memory reference instructions and associated hardware necessary for inter-map reference	Standard SEL 810A Computer	SEL 810A Assembler symbolic code	Memory locations 2470_8 through 2515_8, 2773_8 through 3005_8, 3470_8 through 3505_8, 4000_8 through 4505_8, and 5000_8 through 5372_8	None	N/A

Table 3-14. Specifications for the Card Reader Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Software, electronics, and mechanics necessary to perform all the card reader operations	SEL 810A Computer and a SEL 80-400A card reader	SEL 810A ASSEMBLER symbolic code	02000_8 through 02654_8	Self-contained	N/A

Table 3-15. Specifications for the Magnetic Tape Read-Write Parity Checker Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Checks for read and write parity errors on magnetic tape	SEL 810A Computer with ASR-33 teletype and model 80-615-07	SEL 810A ASSEMBLER symbolic code	00000 through 00340_8	SEL 810A diagnostic loading procedure	N/A

3-92 **Magnetic Tape Exerciser — MTE (Catalog Number 333002B)**

3-93 DESCRIPTION

3-94 The magnetic tape exerciser diagnostic program executes and then verifies all the electronic and mechanical operations performed on a 7- or 9-track magnetic tape unit. The tape unit is given an optimum test in reading and writing fixed or variable length records. The MTE diagnostic consists of a number of tests that are selected individually with the SENSE/HALT/LOAD T switches. These tests are described in paragraph 4-433. After each test is completed, the program will type out a status table that lists the operations performed and the errors detected.

3-95 If an error is detected, the program, under SENSE/HALT/LOAD T switch control, will type out an error message on the console printer. An examination of the type-out along with the program listing (catalog number 333002) should aid in isolating the problem.

3-96 SPECIFICATIONS

3-97 Table 3-16 lists the specifications for the magnetic tape exerciser diagnostic program.

3-98 **Line Printer Diagnostic — LPD (Catalog Number 373001A)**

3-99 DESCRIPTION

3-100 The line printer diagnostic program executes and then verifies all the electronic and mechanical operations performed on a line printer. The printer is given an optimum test in responding to commands and generating different, specified, print-out patterns. The LPD test consists of a number of tests that are selected individually with the SENSE/HALT/LOAD T switches on the computer console. These tests, along with the print-out patterns are described in paragraph 4-457.

3-101 If a printer inoperable or printer memory parity error is detected, the program types out an error message on the computer teletypewriter.

Table 3-16. Specifications for the Magnetic Tape Exerciser Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Software instructions and mechanics necessary to perform all operations on the magnetic tape	SEL 810A Computer with a SEL model 80-615-07A or 80-615-09A magnetic tape unit. Optional SEL block transfer control unit	SEL 810A ASSEMBLER symbolic code	1. 1060_8 to 1077_8 if BTC is used 2. 2000_8 to 4703_8 for main program 3. 4705_8 to the specified record size for Input/Output locations	None	N/A

Other errors may be detected by comparing the print-out pattern with those shown in figures 4-6 through 4-10. If an error occurs, a visual examination of the error print-out and print-out pattern should aid in isolating the problem. The program listing (catalog number 373001) should also be consulted.

3-102 SPECIFICATIONS

3-103 Table 3-17 lists the specifications for the line printer diagnostic program.

3-104 **X-Y Plotter, SEL Model 81-810A (Catalog Number 393001A)**

3-105 DESCRIPTION

3-106 The X-Y plotter diagnostic program checks all possible movements of the plotter. It accomplishes this by lowering the pen, plotting an octagon, and raising the pen before halting.

3-107 There are no error type-outs in this program. This test is an operational check only. An error is detected by visual examination of the plotted octagon. The complete X-Y plotter diagnostic is included in program listing (catalog number 393007).

3-108 SPECIFICATIONS

3-109 Table 3-18 lists the specifications for the X-Y plotter diagnostic program.

3-110 **Interval Timer Diagnostic (Catalog Number 393002A)**

3-111 DESCRIPTION

3-112 The interval timer diagnostic program verifies that the interval timer and its associated interrupts are functioning properly.

3-113 If the interval timer frequency is not within tolerance or the interrupt is not detected, an error type-out occurs.

3-114 SPECIFICATIONS

3-115 Table 3-19 lists the specifications for the interval timer diagnostic program.

Table 3-17. Specifications for the Line Printer Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutine Required	Running Time
Software instructions and mechanics necessary to perform all operations on the line printer	SEL 810A Computer with teletype, SEL 80-730A series line printer Optional SEL Block Transfer Control Unit	SEL 810A ASSEMBLER symbolic code	Memory locations 2000_8 to 3315_8	None	The printer is driven at its normal rate. 1. 80-730A at 300 lines per minute 2. 80-731A at 600 lines per minute 3. 80-732A at 1000 lines per minute

Table 3-18. Specifications for the X -Y Plotter Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Software instructions and mechanics necessary to perform all movements of the X-Y plotter	Any SEL 810A with a Model 81-810A X-Y Plotter	SEL 810A ASSEMBLER symbolic code	41_8 memory locations - relocatable	SEL 810A Mainframe diagnostic loading procedure	N/A

Table 3-19. Specifications for the Interval Timer Diagnostic Program

Parameters Tested	System Configuration	Source Program Language	Memory Storage	Subroutines Required	Running Time
Instructions and logic necessary to initialize interval timer and detect the associated interrupts	SEL 810A Computer with an interval timer with an operating frequency between 10 and 999, 999 cycles per second	SEL 810A ASSEMBLER symbolic code	612_8 Memory locations	None	Dependent on interval timer frequency. The maximum time required for one cycle is approx. equal to the time required for the timer to count down from 65, 535

SECTION IV
Operation

4-1 General

4-2 This section includes loading and operating procedures for the SEL 810A/810B Computer diagnostic programs.

4-3 Mainframe Exerciser (Catalog Number 303001A)

4-4 LOADING AND OPERATION

4-5 To load and operate the mainframe exerciser diagnostic program, perform the following steps (Step a. is skipped if the absolute loader program has previously been loaded into memory):

a. Load the manual bootstrap and bootstrap package as explained in Section III.

b. Install the mainframe exerciser tape (catalog number 303001) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the mainframe exerciser diagnostic program into computer memory using the diagnostic loading procedure (absolute) described in paragraph 2-33. The mainframe exerciser tape is loaded by the absolute loader.

d. Manually load address 2000_8 into the program counter. Address 2000_8 is the starting address of the mainframe exerciser program.

e. Lower the START/STOP toggle switch on the computer console control panel two times.

4-6 ERROR-FREE OPERATION

4-7 The computer should repetitively cycle through the mainframe exerciser program. If no errors occur, the computer cycles through the program until it is manually halted.

4-8 ERROR INDICATIONS

4-9 Error indications are listed as follows:

Error Halts - If an error is detected the computer is halted prior to the end of the program.

Error Type-Outs - None

4-10 Isolating the Failing Instruction

4-11 An examination of the program counter indicator on the computer console gives the address +1 where the error halt occurred. Using this address, consult the halt log shown in the following listing. The halt log lists the addresses that are contained in the program counter for all the possible error halts along with the instruction that most probably caused the error. A more complete breakdown of the program is given in the program listing (catalog number 303001). The listing gives all the instructions between the error halts. The failing instruction is one of those between the halt address contained in the program counter and the previous halt instruction as indicated by table 4-1.

Table 4-1. Halt Log for Mainframe Exerciser

P-Counter Location	Instruction in Error
2006_8	AMA, SOF
2011_8	AMA
2020_8	AMB, SOF
2023_8	AMB
2030_8	LSL
2034_8	RSA, SMA
2041_8	FLL
2044_8	FLL
2051_8	FRA
2053_8	FRA
2061_8	LSA
2065_8	LSA
2071_8	CLA
2102_8	FRL

Table 4-1. Halt Log for Mainframe Exerciser (Cont'd)

P-Counter Location	Instruction in Error
2106_8, 2107_8	CMA
2112_8, 2114_8	CMA
2118_8, 2120_8	CMA
2125_8, 2127_8	STB
2134_8	ABA
2141_8	OBA
2153_8	NEG, CNS, SMA
2157_8, 2160_8	SAS
2163_8, 2165_8	SAS
2170_8, 2171_8	SAS
2200_8	FLA, SMA
2216_8	RSL, FRA, RNA, TAB, CLA, IAB, ASC
2222_8	SNO
2225_8	SNO
2232_8	LOB
2236_8	SMA
2241_8	IBS
2251_8, 2254_8	MPY
2262_8	MPY, SMA
2267_8	AMA, SMA, TBA
3003_8	BRU Indirect
3013_8	SOF
3016_8	SOF

NOTE

Refer to the SEL 810A Reference Manual for a description of the instructions.

4-12 Troubleshooting

4-13 A short program that causes a loop through the failing instructions may be written and inserted into memory using the computer control panel switches.

4-14 DETAILED DESCRIPTION

4-15 All instruction verification is performed by executing the instruction and transferring to a test subroutine which compares a memory location to the A-Accumulator. Examination of the registers can help establish the source of error. In many instances, instruction verification is a short processing sequence and operation in the single step mode is a practical method of establising error source. The complete mainframe exerciser program is includedin the program description, catalog number 303001.

4-16 Instruction Simulation and Comparison — IS/C (Catalog Number 303002A)

4-17 LOADING AND OPERATION

4-18 To load and operate the instruction simulation and comparison diagnostic program, perform the following steps (Step a. is skipped if the absolute loader has previously been loaded):

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Install the IS/C tape (catalog number 303002) on either the console paper tape reader or high-speed paper tape reader.

c. Load the IS/C diagnostic program from paper tape into computer memory using the absolute loader, loading procedure described in paragraph 2-33. The IS/C paper tape is loaded by the absolute loader.

d. Manually load address 1000_8 into the program counter. Address 1000_8 is the starting address of the IS/C program.

e. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. The switch controlled program operation options are:

1. S/H/L T switch 0 raised - the number of successful cycles through the program will be typed out. With no errors detected, this results in a type-out approximately every 40 seconds.

2. S/H/L T switch 1 raised - errors are ignored.

3. S/H/L T switch 2 raised - detection of an error causes a computer halt with no error type-out. The A-Accumulator contains the error location.

4. S/H/L T switch 3 raised - the detection of an error causes an error type-out followed by a computer halt.

NOTE

Initially, to detect an error, this diagnostic should be run with SENSE/HALT/LOAD T switches 0 and 3 in the raised position and SENSE/HALT/LOAD T switches 1 and 2 in the centered position. For troubleshooting purposes other switch configurations may be used.

f. Lower the START/STOP toggle switch on the computer console.

4-19 ERROR-FREE OPERATION

4-20 The following assumes that SENSE/HALT/LOAD T switches 0 and 3 raised and SENSE/HALT/LOAD T switches 1 and 2 centered.

4-21 The computer should continuously cycle through the IS/C program. If no errors occur, the program should run until halted manually. After each successful cycle through the program, (approximately 40 seconds) the number of successfully completed cycles is typed out.

4-22 ERROR INDICATIONS

4-23 The following error indications list assumes SENSE/HALT/CLEAR T switches 0 and 3 raised and SENSE/HALT/LOAD T switches 1 and 2 centered:

Error Halts - If an error is detected, the computer is halted.

Error Type-Outs - If an error is detected, the program causes an error type-out in the following format:

Successful Cycles - NNNN
NNNN = Decimal number of cycles in which no error occurred.

Machine error preceding location XXXXX
XXXXX = Octal location from which an SPB occurred after an error condition was found by the program.

4-24 Isolating the Failing Instructions

4-25 An examination of the XXXXX portion of the type-out format gives the address +1 from which a Store Place and Branch (STB) occurred following an error condition. Using this address, consult the detailed IS/C description in paragraph 4-28. This description separates the IS/C program into its 16 phases and gives the XXXXX address in the type-out format along with the probable trouble source. A more complete breakdown of the program is given in the program listing (catalog number 303002). The listing gives all the instructions between the error branches. The failing instruction is one of those between the STB instruction that caused the error branch (XXXXX minus 1) and the previous STB, error branch instruction.

4-26 Troubleshooting

4-27 Analyze the error type-out. To facilitate troubleshooting, the SENSE/HALT/CLEAR T switches may be set to a configuration that prevents the error condition from causing a halt. A short program may be written that causes a loop through the failing instructions. This program may be written into memory.

4-28 DETAILED DESCRIPTION

4-29 This section contains a description of the 16 separate phases of the IS/C test program. The XXXXX address in the error type-out format is given along with the probable trouble source. The complete IS/C diagnostic program is included in the program description, catalog number 303002.

4-30 Phase 1 - Clear A-Accumulator (CLAT)

4-31 The A-Accumulator is loaded with the counte and cleared. A is then checked for zero. The counter is then incremented. The test is repeated for every case. An error at location 1004_8 indicates a CLA error.

4-32 Phase 2 - Skip if A-Accumulator is Zero (SAZT)

4-33 The B-Accumulator is incremented and transferred to A. A is checked for zero by the SAZ and then A is checked for zero by the CMA. An error will occur at location 1022_8 if a skip occurs when A is not zero and at location 1025_8 if there is not a skip when A is zero. An error can also occur at 1031_8 if a skip does not occur when A iz zero, and if a skip occurs but A is not zero there will be an error indication at 1033_8 or 1035_8.

4-34 Phase 3 - Skip if A-Accumulator is Positive (SAPT)

4-35 B is incremented in the same manner as the zero test. An error at location 1045_8 means a skip should have occurred. An error at location 1056_8 indicates a skip occurred when A was not positive. A counter is used to test every case.

4-36 Phase 4 - Skip if A-Accumulator is Negative (SANT)

4-37 Operates in the same manner as the A positive test. An error at location 1071_8 indicates an illegal skip and an error at 1101_8 indicates no skip occurred.

4-38 Phase 5 - Skip on A-Accumulator Sign (SAST)

4-39 Runs similar to the previous tests except that there are three possibilities instead of two. An error at 1115_8 or 1117_8 indicates A was zero and the SAS did not detect this condition. An error at 1124_8 will occur when the SAS did not detect a positive sign. If a negative sign is not sensed, an error will occur at 1131_8.

4-40 Phase 6 - Compare Memory to A-Accumulator (CMAT)

4-41 The A-Accumulator is loaded with the counter, a CMA to zero is executed,and according to the skip after the CMA, the A-Accumulator is tested for more, less, or equal to zero.

An illegal skip to n+1 will cause an error at location 1145_8.
An illegal skip to n+2 will cause an error at location 1150_8.
An illegal skip to n+3 will cause an error at location 1157_8.

4-42 Phase 7 - Load and Store Instructions (LASA, LBSB)

4-43 The Accumulator is loaded with the counter and then stored in the location tagged STOP. A comparison between the stored data and the accumulator is then executed. The data is then compared with the counter. Errors at 1170_8 or 1172_8 indicates a bad STA, errors at 1174_8 or 1176_8 indicates a bad LAA. If an error occurs at location 1210_8 or 1212_8,the STB instruction failed; errors at 1215_8 or 1217_8 indicates LBA failed.

4-44 Phase 8 - Transfer and Interchange A & B (TATB)

4-45 A is loaded with the counter and transferred to B; B is then stored and compared to A. An error at 1232_8 or 1234_8 indicates this phase failed.

4-46 B is loaded with the counter and is then transferred to A. A is compared to the counter and an error will occur at location 1241_8 or 1243_8 if TBA fails.

4-47 IAB is tested by loading A with the counter and B with minus one. After an IAB, A is compared to minus one, B is stored,and A is loaded with STOR. A comparison then takes place. Errors at location 1259_8 or 1252_8 indicate A did not contain a minus one. If B did not contain the proper information, errors will occur at 1256_8 or 1260_8.

4-48 Phase 9 - Negative A-Accumulator (NEGT)

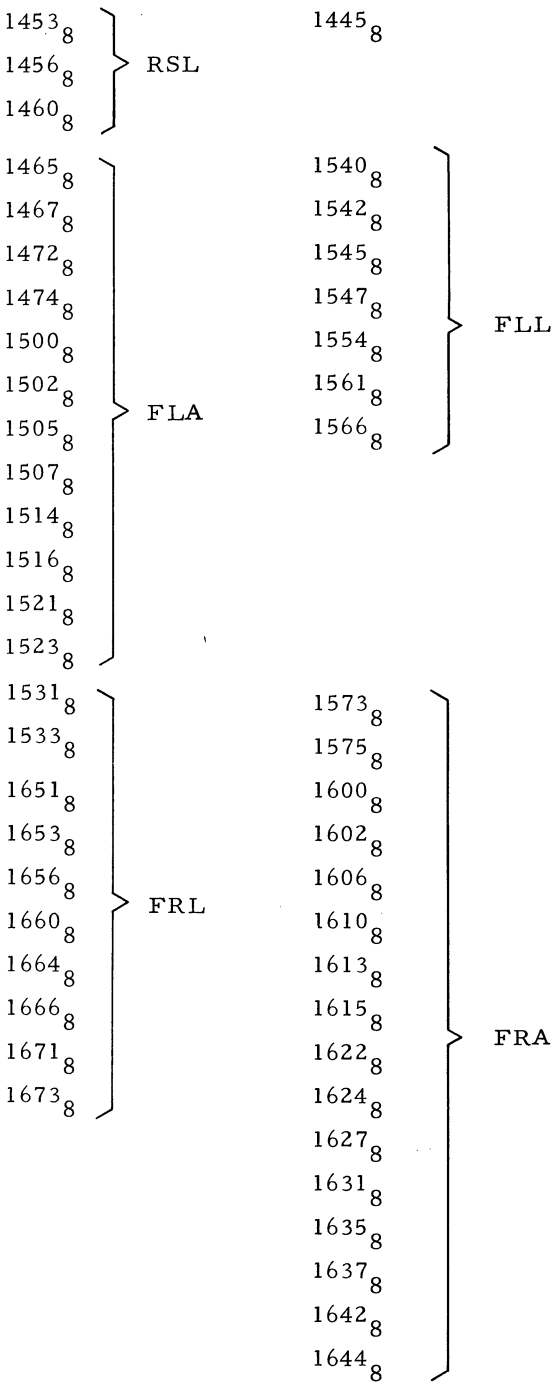
4-49 The counter is subtracted from zero in A and stored. A is then loaded with the counter and negated. The results are compared and an error will occur at location 1274_8 or 1276_8 if they are not equal.

4-50 Shift Instructions (BEG1). The RSA is tested extensively by loading A with a constant and shifting zero positions the first time. A comparison through an indirect address (DAT1, location 1343_8), checks the proper constant. The shift is incremented along with the indirect address. After all tests are completed, the shift and indirect address are returned to their original quantities. An error at 13068 or 1310_8 indicate an RSA error.

4-51 The rest of the shift instructions (SHTE) are tested two to six times, each shifting one position at a time. The results are compared to the proper constants.

4-52 Errors will occur at the following locations:

1352_8	LSA	1406_8	LSL
1354_8		1411_8	
1357_8		1414_8	
1361_8		1417_8	
1365_8			
1367_8		1423_8	RSA
1372_8		1435_8	
1374_8		1430_8	
1400_8		1432_8	
1402_8		1436_8	
		1440_8	
1451_8		1443_8	



4-53 Phase 10 - Add (ADD1, ADD3)

4-54 ADD1 - A is cleared, one is added to A, and the counter is incremented; the results are compared, and an error will occur at location 1737_8 or 1741_8 if there is a failure. This test is repeated in the B-Accumulator. A failure in B is indicated by an error at location 1754_8 or 1756_8.

4-55 ADD3 - The next test adds the counter to itself in A and B. The registers are then loaded with the counter and shifted left one position. The sums are compared and errors will occur at location 1771_8 or 1773_8 for an error in A and 2010_8 or 2012_8 for an error in B.

4-56 Phase 11 - Subtract (SUB1, SUB2, SUB3)

4-57 SUB1 - A is loaded with the counter. It is then subtracted; the A-Accumulator is then checked for zero. A type-out at location 2023_8 indicates an error.

4-58 SUB2 - Zero is subtracted from the counter. A is then compared to the counter. If there is an error, a type-out will occur at location 2033_8 or 2035_8.

4-59 SUB3 - The counter is multiplied by two, it is then subtracted. A should then be equal to the counter. A halt at location 2046_8 or 2050_8 indicates A is not equal to the counter.

4-60 Phase 12 - AND A and B, OR A and B (ANOR

4-61 Constants are ANDed and ORed, the results are compared to constants. Error indications at locations 2057_8, 2061_8, 2075_8, 2077_8, 2113_8, 2115_8, and 2131_8 or 2133_8 are errors in the ABA instruction. Error indications at locations 2065_8, 2067_8, 2103_8, 2105_8, 2121_8, 2123_8, and 2137_8 or 2141_8 are errors in the OBA instruction. All worst-cases are tested.

4-62 Phase 13 - Increment B and Skip (IBST)

4-63 B is loaded with minus one and incremented, the counter is operated in the same fashion. The B-Accumulator and the counter are compared. If no skip occurs while B is positive, an error will occur at location 2175_8; if B skips when it is negative, an error will occur at location 2210_8. An unequal comparison between B and the counter will cause an error at location 2200_8 or 2202_8 when B is positive and at location 2213_8 or 2215_8 when B is negative.

4-64 Phase 14 - Copy Sign of B - (CSBN, CSBP)

4-65 The CSB instruction is tested with the B sign bit on and off. With the bit on a CSB, NEG gets the bit into A; the counter is then negated and one is subtracted from it. The two answers are then compared. Error indications on this test are at locations 2234_8 and 2236_8.

4-66 With the B sign bit off, a CSB, NEG is used again but the counter is only negated. After the comparison the error indications are at locations 2251_8 and 2253_8.

4-67 Phase 15 - Complement Sign of A (ASCT)

4-68 The counter is loaded in A, the sign is changed by adding a minus sign. The counter's sign is then complemented. The two results are compared and if they are not equal, an error will occur at location 2267_8 or 2271_8.

4-69 Phase 16 - Change Number Systems (CNST)

4-70 If the counter is negative, the data is checked. If the data is zero, nothing is done. All other cases the counter is changed by a CNS and an ASC, the counter is then negated. The results are compared and if they are not equal, an error will occur at location 2313_8 or 2315_8.

4-71 The remaining part of memory contains the cycle counter, error routine, and type-out routines.

4-72 Compare Memory To A, A Sign Test — CMASAS (Catalog Number 303003A)

4-73 LOADING AND OPERATION

4-74 To load and operate the CMASAS diagnostic program, perform the following steps:

NOTE

This program destroys the contents of every memory location. If the absolute loader has previously been loaded, Step a. is skipped.

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Install the CMASAS tape (catalog number 303003) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the CMASAS diagnostic program from tape into computer memory using the absolute loader (loading procedure described in paragraph 2-33). The CMASAS diagnostic tape is loaded by the absolute loader.

d. Manually set the memory location 373_8 (designated TOP) with the proper bit 2 and 3 configuration, dependent on memory size as shown in the following listing:

Memory Size	Bits to be Set in TOP
4K	No bits
8K	Bit 3
12K	Bit 2
16K	Bits 2 and 3

e. Manually load address 00000 into the program counter. Address 00000_8 is the starting address of the CMASAS diagnostic program.

f. Lower the START/STOP toggle switch on the computer console two times.

4-75 ERROR-FREE OPERATION

4-76 If no errors are detected, the computer repetitively cycles through the CMASAS program until it is manually halted.

4-77 ERROR INDICATIONS

4-78 Error indications are listed as follows:

Error Halts - Name

Error Type-Outs - If an error is detected, the program causes an error type-out in the following format:

L xxxxxx n
L = letter C for CMA error
letter S for SAS error
xxxxxx = the location of the erroneous instruction

n - a number, if a CMA error the number indicates the operand in memory, A is always zero. If an SAS error the number is what was contained in A. There are three possible numbers; 1, 0, -1.

4-79 Isolating the Failing Instruction

4-80 The failing instructions location is included in the error type-out.

4-81 Troubleshooting

4-82 A short program that causes a loop through the failing instructions can be written and inserted into memory using the computer console switches.

4-83 DETAILED DESCRIPTION

4-84 The complete CMASAS program is listed in program description, catalog number 303003.

4-85 Memory Exerciser Diagnostic — MEMDEX (Catalog Number 303004A)

4-86 LOADING AND OPERATION

4-87 To load and operate the MEMDEX diagnostic program, perform the following steps:

NOTE

This program destroys the contents of every memory location. Step a. is skipped if the absolute loader has previously been loaded.

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Install the MEMDEX tape (catalog number 303004) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the MEMDEX program from paper tape into computer memory using the absolute loader, loading procedure described in paragraph 2-33. The MEMDEX diagnostic tape is loaded by the absolute loader.

d. Manually set memory location 227_8 (designated FIN) with the proper bit 2 and 3 configuration. The bit 2 and 3 configuration depends on memory size as shown in the following listing.

Memory Size	Bits to be Set in FIN
4K	No bits
8K	Bit 3
12K	Bit 2
16K	Bits 2 and 3

e. Manually load address 00000 into the program counter. Address 00000 is the starting address of the MEMDEX diagnostic program.

f. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. Any combination of these switches can be used to control the following program operation options:

1. S/H/L T raised 0 - the all ones, all zeros test will run.

2. S/H/L T 1 raised - the alternate bit pattern test will be run.

3. S/H/L T 2 raised - the walking one and walking zero test will run.

4. S/H/L T 3 raised - a halt will occur after an error type-out.

NOTE

Initially, to detect an error this diagnostic should be run with SENSE/HALT/LOAD T switch 3 raised. For trouble-shooting purposes, other switch configurations may be used.

g. Lower the START/STOP toggle switch on the computer console two times.

4-88 ERROR-FREE OPERATION

4-89 The computer should continuously cycle through the test specified by the SENSE/HALT/LOAD T switches. If no errors occur, the program will run until manually halted.

4-90 ERROR INDICATIONS

4-91 Error indications are listed as follows:

Error Halts - If an error is detected, the program types out an error message followed by a halt. The halt will only occur if SENSE/HALT/LOAD T switch 3 is in the raised position.

Error Type-Outs - If an error is detected, the program causes an error type-out in the following format:

12345 WORD aaaaaa
Memory Error
12345 - location at which the error occurred.

WORD - what the location should contain.
ZERO - if the location should contain a zero.
ONES - if the location should contain a zero.

1010 or 0101 - the sequence of binary bits for the alternate bit patterns.

1 or Z and XX - a walking one or zero error where XX = the left shift count from the farthest right position.

aaaaaa - the octal contents of the memory location in error.

h. To restart this program manually, load address 15_8 into the program counter and lower the START/STOP toggle switch two times.

4-92 Isolating the Failing Instruction

4-93 Refer to the error type-out. Consult the detailed description in paragraph 4-95

and the program listing (catalog number 303004).

4-94 Troubleshooting

4-95 Analyze the error type-out. To facilitate troubleshooting SENSE/HALT/LOAD T switch 3 can be centered which prevents an error condition from causing a halt. A short program can be written that causes a loop through the failing instruction. This short program can then be loaded into memory using the computer console switches.

4-96 DETAILED DESCRIPTION

4-97 The complete memory exerciser program is included in program description (catalog number 303004). The following includes a description of the separate, option switch controlled tests that can be performed with the MEMDEX.

4-98 Setup Routine

4-99 Sets the various addresses used to correspond with the highest memory address which is loaded into the location tagged FIN (227_8). FIN does not have to be changed if the machine in which the program is to be run has a 4096 location memory.

4-100 Sense Switch Routine (EXEC)

4-101 Checks the sense switches that are up and branches to the routine indicated by the sense switch settings.

4-102 All Ones, All Zeros Test (ALL1)

4-103 The zeros are obtained by clearing the A-Accumulator. The zeros are then stored and checked indirectly through the location tagged STAR (225_8). Ones are stored and checked indirectly through the location tagged FIN (227_8) which has its index bit set.

4-104 Alternate Bits Test (WORS)

4-105 The constant tagged ONE0 (234_8) is stored and checked indirectly through STAR. The constant OH1 (235_8) is stored and checked indirectly through FIN.

4-106 Walking One and Zero Test (WALK)

4-107 The Walk One routine is executed first. A one is loaded in A and shifted zero times. The A-Accumulator is then stored and checked indirectly through STAR. After all of memory is tested, the shift instruction is incremented and the test is repeated. When all bit positions are tested, the Walk Zero routine will be executed. The Walk Zero routine is executed in the same manner as the Walk One routine except that FIN is used as an indirect address.

4-108 Ping Pong Routine (PIPO)

4-109 The starting addresses are changed to include the map not exercised previously. The routine then moves the entire program to either the top or bottom map and modifies itself to return the program to the map from which it was moved.

4-110 Address Reset Routine (REST)

4-111 This routine is executed after every test to reset STAR and the index count contained in the B-Accumulator.

4-112 Load / Store / Register Change Test — LSRCT (Catalog Number 303005A)

4-113 LOADING AND OPERATION

4-114 To load and operate the LSRCT diagnostic program perform the following steps:

a. Load the manual bootstrap and bootstrap package as explained in Section

b. Install the LSRCT tape (catalog number 303005) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the LSRCT program from paper tape into computer memory using the diagnostic loading procedure (absolute) described in paragraph 2-33. The LSRCT is loaded using the absolute loader.

d. Depress the MASTER CLEAR switch on the computer console.

e. Manually load address 1000_8 into the program counter. Address 10000_8 is the starting address of the LSRCT program.

f. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. These switches control the following program operation options:

1. S/H/L T switch 0 raised - the number of successful cycles through the program will not be typed out.

2. S/H/L T switch 1 raised - errors are ignored.

3. S/H/L T switch 2 raised - the detection of an error causes a computer halt with no error type-out. The A-Accumulator contains the error location and locations 1256_8, 1257_8, and 1251_8 will contain the A- and B-Accumulators and the data counter respectively.

4. S/H/L T switch 3 raised - the detection of an error causes an error type-out followed by a computer halt.

NOTE

Initially this diagnostic should be run with SENSE/HALT/LOAD T switches 0, 1, and 2 in the lowered position and SENSE/HALT/LOAD T switch 3 in the raised position. For troubleshooting purposes, other switch configurations may be used.

g. Lower the START/STOP toggle switch on the computer console control panel two times.

4-115 ERROR-FREE OPERATION

4-116 Assuming SENSE/HALT/CLEAR T switch 0, 1, and 2 are centered and switch 3 is raised, the computer should cycle through the LSRCT program. If no errors occur, the program should continue to run until halted manually. After each successful cycle through the program the number of successfully completed cycles is typed out.

4-117 ERROR INDICATIONS

4-118 Error indications, assuming SENSE/HALT/LOAD T switches 0, 1, and 2 centered and switch 3 raised, are listed as follows:

Error Halts - If an error is detected, the computer is halted.

Error Type-Outs - If an error is detected, the program types out an error message in the following format:

Successful Cycles - NNNN
NNNN = the number of cycles completed without error.

Machine Error Preceding LOC XXXXX
AAAAAA BBBBBB CCCCCC

XXXXX = the location plus one from which an SPB occurred following an error condition.
AAAAAA = the contents of the A-Accumulator
BBBBBB = the contents of the B-Accumulator
CCCCCC = the contents of the counter

The locations listed are what will be typed out if an error occurs.

4-119 Isolating the Failing Instructions

4-120 Analyze the error type-out. The XXXXX portion of the type-out format gives the address +1 from which a Store Place and Branch (STB) occurred following an error condition. Using this address, consult the type-out format error log shown in paragraph 4-121. The error log lists the addresses that are contained in XXXXX of the type-out format for all possible error halts along with the instruction that most probably caused the error. A more complete breakdown of the program is given in the program listing (catalog number 303005). The listing includes all the instructions between the error branches. The failing instruction is one of those between the STB instruction that caused the error branch (XXXXX minus 1) and the previous STB error branch instruction.

4-121 Troubleshooting

4-122 Analyze the error type-out. To facilitate troubleshooting, the SENSE/HALT/LOAD T switches may be set to a configuration that prevents the error condition from causing a halt. A short program may be written that causes a loop through the failing instructions. This program may be written into memory using the computer console. (See table 4-2).

Table 4-2. Error Log For Load/Store/Register Change Test

Location XXXXX	OP Code
1003	CLA
1007, 1011	LBA
1014, 1016	IAB
1021, 1023	LAA
1027, 1031	TAB
1034, 1036	STA

4-123 DETAILED DESCRIPTION

4-124 The complete LSRCT program is included in program description, catalog number 303005.

4-125 **Arithmetic Test — ADD0 (Catalog Number 303006A)**

4-126 LOADING AND OPERATION

4-127 To load and operate the ADD0 diagnostic program perform the following steps (Step a. is skipped if the Bootstrap Package has been previously loaded):

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Install the ADD0 (catalog number 303006) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the ADD0 diagnostic program into computer memory using the diagnostic loading procedure (absolute) described in paragraph 2-33. The mainframe exerciser is loaded by the absolute loader.

d. Depress the MASTER CLEAR switch on the computer control panel.

e. Manually load address 1000_8 into the program counter. Address 1000_8 is the starting address of the arithmetic test diagnostic program.

f. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. The switch controlled program operation options are:

1. S/H/L T switch 0 raised - Errors are ignored.

2. S/H/L T switch 1 raised - A halt will occur after an error type-out.

3. S/H/L T switch 2 raised - No error type-out, a halt will occur.

NOTE

With S/H/L T switch 2 up, a halt at location 1131 indicates an RNA error. An add error will cause a halt at 1213_8 and a subtract error halts at 1264_8.

g. Lower the START/STOP toggle switch on the computer console two times.

4-128 ERROR-FREE OPERATION

4-129 The computer should repetitively cycle through the ADD0 program. If no errors are detected, the program should run until halted manually.

4-130 ERROR INDICATIONS

4-131 Error indications are listed as follows:

Error Halts - If SENSE/HALT/LOAD T switch 1 is in the raised position and an error is detected, an error message is typed out followed by a computer halt. If an error is detected and SENSE/HALT/LOAD T switch 2 is in the raised position, the computer is halted without an error type-out.

Error Type-Outs - If an error is detected and SENSE/HALT/LOAD T switch 2 is not in the raised position, the program types out an error message in the following format:

```
aaaaaa      bbbbbb
A nnnnnn OVFL
B mmmmmm OVFL
```

Indicates add error:

aaaaaa = operand in A for AMA, in memory for AMB
bbbbbb = operand in memory for AMA, in B for AMB
nnnnnn = the AMA sum
mmmmmm = the AMB sum

NOTE

If both sums are the same and the letters OVFL (indicating overflow) are not typed next to both sums, this indicates an overflow error. The letters will not always be typed, only if an overflow occurred.

```
aaaaaa   bbbbbb
S A   nnnnnn OVFL
  B  mmmmmm OVFL
```

Indicates an SMA error:

nnnnnn = difference of a-b
mmmmmm = difference of b-a

NOTE

Only the signs should be unlike. As in the add test overflow should occur on both subtracts.

```
aaaaaa     bbbbbb
  R   nnnnnn    mmmmmm
```

Indicates an RNA error:

a's = A-Accumulator
b's = B-Accumulator
nnnnnn = software RNA
mmmmmm = hardware RNA

4-132 Isolating the Failing Instruction

4-133 Refer to the error type-out. Consult the program listing, catalog number 303006.

4-134 Troubleshooting

4-135 Analyze the error type-out. To facilitate troubleshooting, the SENSE/HALT/LOAD T switches may be set to a configuration that prevents the error condition from causing a halt. A short program may be written that causes a loop through the failing instruction. This program may be written into memory using the computer console switches.

4-136 DETAILED DESCRIPTION

4-137 The complete ADDO program is included in program description, catalog number 303006.

4-138 Multiply Test — MTPY (Catalog Number 303007A)

4-139 LOADING AND OPERATION

4-140 To load and operate the MTPY diagnostic program, perform the following steps (Step a. is skipped if the absolute loader has been previously loaded):

a. Load the Manual Bootstrap and Bootstrap Packageas explained in Section

b. Install the MTPY tape (catalog number 303007) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the MTPY program from paper tape into computer memory using the diagnostic program loading procedure (absolute) described in paragraph 3-33. The multiply diagnostic is loaded by the absolute loader.

d. Depress the MASTER CLEAR switch on the computer console.

e. Manually load address 1000_8 into the program counter. Address 1000_8 is the starting address of the multiply diagnostic program.

f. Set the computer console SENSE/HALT LOAD T switches for the operation desired. The switch controlled program options are:

1. S/H/L T switch 0 raised - Errors are ignored.

2. S/H/L T switch 1 raised - The detection of an error causes a computer halt with no error type-out.

3. S/H/L T switch 2 raised - The same operands will be used continuously.

4. S/H/L T switch 3 raised - The detection of an error causes an error type-out followed by a computer halt.

NOTE

Initially, to detect an error, this diagnostic should be run with SENSE/HALT/LOAD T switches 0, 1, and 2 in the centered position and SENSE/HALT/LOAD T switch 3 in the raised position.

g. Lower the START/STOP toggle switch on the computer console control panel.

4-141 ERROR-FREE OPERATION

4-142 It is assumed that SENSE/HALT/LOAD T switches 0, 1, and 2 are centered and SENSE/HALT/LOAD T switch 3 is raised. The computer should commence to cycle through the multiply program. If no errors occur, the program should continue to run until halted manually.

4-143 ERROR INDICATIONS

4-144 Error indications, assuming SENSE/HALT/LOAD T switches 0, 1, and 2 are centered and SENSE/HALT/LOAD T switch is raised, are listed as follows:

Error Halts - If an error is detected, the computer is halted.

Error Type-Outs - If an error is detected, there is an error type-out in the following format:

Multiply Error

aaaaaa	bbbbbb
nnnnnn	mmmmmm
xxxxxx	yyyyyy

aaaaaa = multiplier (in memory)

bbbbbb = Multiplicand (in B-Accumulator)
nnnnnn = Software product in A
mmmmmm = Software product in B
xxxxxx = Product in A
yyyyyy = Product in B

4-145 Isolating the Failing Instructions

4-146 In order to determine whether the software or hardware multiply is at fault, the two operands must be known so that the correct product can be calculated. The aaaaaa and bbbbbb portions of the error type-out format give the operands from which the correct product may be calculated. A further examination of nnnnnn, mmmmmm, xxxxxx, and yyyyyy in the error type-out format indicates if the software or hardware product is incorrect.

4-147 Troubleshooting

4-148 After an error type-out and halt, raise sense switch 0 and 2 and center sense switch 3. The program runs continusouly using the operands that failed and the error condition is ignored thereby facilitating troubleshooting.

4-149 DETAILED DESCRIPTION

4-150 The complete MTPY diagnostic program is included in program description, catalog number 303007.

4-151 **Divide Test — DIV (Catalog Number 303008A)**

4-152 LOADING AND OPERATION

4-153 To load and operate the DIV diagnostic program, perform the following steps (Step a. is skipped if the absolute loader has previously been loaded):

a. Load the Manual Bootstrap and Bootstrap Package, as explained in Section II.

b. Install the DIV tape (catalog number 303008) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the DIV program from paper tape into computer memory, using the diagnostic loading procedure (absolute) described in paragraph 2-33. The DIV diagnostic is loaded by the absolute loader.

d. Depress the MASTER CLEAR switch on the computer control panel.

e. Manually load address 1000_8 into the program counter. Address 1000_8 is the starting address of the DIV diagnostic program.

f. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. The switch controlled program operation options are:

1. S/H/L T switch 0 raised - errors are ignored.

2. S/H/L T switch 1 raised - the detection of an error causes a computer halt with no error type-out.

3. S/H/L T switch 2 raised - the same operands will be used continuously.

4. S/H/L T switch 3 raised - the detection of an error causes an error type-out followed by a computer halt.

NOTE

Initially, to detect an error, this diagnostic should be run with SENSE/HALT/LOAD T switches 0, 1, and 2 in the centered position and SENSE/HALT/LOAD T switch 3 in the raised position.

g. Lower the START/STOP toggle switch on the computer console control panel.

4-154 ERROR-FREE OPERATION

4-155 It is assumed that SENSE/HALT/LOAD T switches 0, 1, and 2 are centered and SENSE/HALT/LOAD T switch 3 is raised. The computer should commence to cycle through the DIV program. If no errors occur, the program should continue to run until halted manually.

4-156 ERROR INDICATIONS

4-157 Error indications, assuming SENSE/HALT/LOAD T switches 0, 1 and 2 are centered and SENSE/HALT/LOAD T switch 3 is raised, are listed as follows:

Error Halts - If an error is detected, the computer is halted.

Error Type-Outs - If an error is detected, an error message is typed out in the following format:

```
xxxxxx   yyyyyy
aaaaaa   bbbbbb
cccccc   dddddd
```

Single precision divide error:

xxxxxx = B-Accumulator operand
yyyyyy = memory operand
aaaaaa = quotient, software
bbbbbb = remainder, software
cccccc = quotient, hardware
dddddd = remainder, hardware

mmmmmm nnnnnn xxxxxx
aaaaaa bbbbbb

cccccc dddddd

Double precision divide error:

mmmmmm = A-Accumulator operand
nnnnnn = B-Accumulator operand
xxxxxx = memory operand
a's, b's, c's, d's = same as single precision

NOTE

If the letters "OVFL" are typed out on a double precision divide error in place of a quotient and remainder, this indicates that operation caused a divide overflow. The hardware should get overflow when the software does and the hardware should not get overflow when the software does not.

4-158 Isolating the Failing Instructions

4-159 In order to determine whether the software or hardware divide is at fault, the two operands (divisor and dividend) must be known so that the correct quotient can be calculated. The xxxxxx and yyyyyy (for single precision) and the mmmmmm and nnnnnn (for double precision) portions of the error type-out format denote the operands from which the correct quotient and remainder may be calculated. A further examination of the a's, b's, c's, and d's in the error type-out format indicates if the software or hardware quotient and remainder is incorrect.

4-160 Troubleshooting

4-161 After an error type-out and halt raise SENSE/HALT/LOAD T switch 0 and 2 and center SENSE/HALT/LOAD T switch 3. This causes the program to run continuously using the operands that failed and the error condition does not cause a halt thereby facilitating troubleshooting.

4-162 DETAILED DESCRIPTION

4-163 The complete DIV diagnostic program is included in program description, catalog number 303008.

4-164 **Memory Worst - Case Test — MEMTES (Catalog Number 303010A)**

4-165 LOADING AND OPERATION

4-166 To load and operate the MEMTES diagnostic program, perform the following steps:

NOTE

This program destroys the contents of every memory location. Step a. is skipped if the absolute loader has previously been loaded.

a. Load the manual bootstrap and bootstrap package as explained in Section

b. Install the MEMTES tape (catalog number 303010) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the MEMTES program from paper tape into computer memory using the diagnostic loading procedure (absolute) described in paragraph -33. The MEMTES diagnostic tape is loaded by the absolute loader.

d. Manually set the memory location 420_8 (designated FIN) with the proper bit 2 and 3 configuration, dependent on memory size, as shown in the following listing:

Memory Size	Bits to be Set in FIN
4K	No bits
8K	Bit 3
12K	Bit 2
16K	Bits 2 and 3

e. Manually load address 00000 into the program counter. Address 00000 is the starting address of the MEMTES diagnostic program.

f. Set the computer console SENSE/HALT/LOAD T switches for the type of memory under test. These switches are set as shown in the following:

1. No S/H/L T switches raised for: Ferroxcube, 4K Memory

2. S/H/L T switch 0 raised - Ferroxcub 8K Memory

3. S/H/L T switches 0 and 1 raised - Ampex Model 1, 8K Memory

4. S/H/L T switch 1 raised - Ampex Model 1, 4K Memory

5. S/H/L T switch 2 raised - Ampex Model 2, All Memories

NOTE

Be sure the proper sense switches are set before the program is started, otherwise the wrong worst-case will be used.

g. Lower the START/STOP toggle switch on the computer console, two times.

4-167 ERROR-FREE OPERATION

4-168 The computer repetitively cycles through the test specified by the SENSE/HALT/LOAD T switches. The program runs until halted manually.

4-169 ERROR INDICATIONS

4-170 Error indications are listed in the following:

Error Halts - None

Error Type-Outs - If an error is detected, the program causes an error type-out in the following format:

aaaaa b ccccccccccccccc

Memory Unload Error:

a's = octal memory location in error
b = a one or a zero, what every bit position of the error location should contain.
c's = sixteen binary bits which were unloaded from the error location.

NOTE

A parity error may also be caused when unloading a location. If a parity error occurs, there may not be an error type-out. The A-Accumulator may be displayed; if it does not contain either all ones or all zeros, the parity error may be cleared and the program started where it has stopped, the error type-out will follow. If, however, the A-Accumulator does contain all ones or all zeros, the B-Accumulator may be displayed to find the location that caused the parity error.

4-171 Isolating the Failing Instructions

4-172 Analyze the error type-out. Consult the program listing, catalog number 303010.

4-173 Troubleshooting

4-174 Use standard memory troubleshooting procedures and adjustments described in Systems Engineering Laboratories Magnetic Core Memory Systems Technical Manual, Publications Number 95050.

4-175 DETAILED DESCRIPTION

4-176 The complete MEMTES diagnostic program is included in program description, catalog number 303010.

4-177 Paper Tape Reader / Punch Test — PTRP (Catalog Number 303011A)

4-178 LOADING AND OPERATION

4-179 To load and operate the PTRP diagnostic program perform the following steps: (Step a. is skipped if the relocatable loader has previously been loaded.)

a. Load the manual bootstrap and bootstrap package as explained in Section II.

b. Install the PTRP tape (catalog number 303011) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the PTRP diagnostic program from paper tape into computer memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The PTRP diagnostic is loaded by the relocatable loader.

d. Manually load address 2000_8 into the program counter. Address 2000_8 is the starting address of the PTRP test.

e. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. These switches control the following:

1. S/H/L T switch 0
   Raised - terminate test at end of present cycle.
   Centered - start another cycle after present cycle.
2. S/H/L T switch 1
   Raised - eliminate type-out of errors.
   Centered - type message when error detected.

3. S/H/L T switch 2
Raised - restart test after detection of an error.
Centered - continue test after error.

4. S/H/L T switch 15
Raised - all type-outs eliminated
Centered - all type-outs performed.

NOTE

Initially, to detect an error, this diagnostic should be run with SENSE/HALT/LOAD T switches 0, 1, and 15 centered and switch 2 raised.

f. Lower the START/STOP toggle switch on the computer control panel.

g. The program causes the console typewriter to type out "TAPE READER/PUNCH TEST." The computer hangs up waiting for an operator's response. The operator types in the date and when finished types in a carriage return.

h. The program activates the punch and punches two forward and two reverse binary progressions. The program then deactivates the punch and causes the console typewriter to type out "PUT TAPE INTO READER THEN PRESS START."

i. Loop the leader of the paper tape from the punch through the reader head.

j. Lower the START/STOP toggle switch on the computer console.

4-180 ERROR-FREE OPERATION

4-181 The program causes the high-speed reader to punch and then read two forward and two reverse binary progressions. The program loops continuously until SENSE/HALT/LOAD T switch 0 is raised at which time the console printer types a message (if SENSE/HALT/LOAD T switch 15 is centered) in the following format:

NUMBER OF SUCCESSFUL CYCLES COMPLETED XXX

NUMBER OF ERROR DETECTED XXX (000 if no errors are detected).

After the type-out, the program deactivates the high-speed reader/punch and halts the computer.

4-182 ERROR INDICATIONS

4-183 Error indications assuming SENSE/HALT/LOAD T switches 0, 1, and 15 centered and switch 2 raised are listed in the following:

Error Halts - If an error is detected, the program causes the console printer to type-out an error message and then halts the computer. The operator may then restart the program under control of S/H/L T switch 2.

Error Type-Outs - If an error is detected, the console printer types out an error message if SENSE/HALT/LOAD T switches 1 and 15 are centered. If SENSE/HALT/LOAD T switch 2 is centered when an error is detected, the program types out the error message and continues on in the same loop after the START/STOP switch is lowered. If switch 2 is raised, the program types out the error message and causes the computer to halt. The program can then be restarted as per Step f. in this procedure.

The error messages are in the following format:

"ERROR CONDITION DETECTED
SHOULD HAVE READ XXX
DID READ XXX"

If SENSE/HALT/LOAD T switch 1 is set, the error is counted but otherwise ignored. (No halt or type-out.)

4-184 Isolating the Failing Instruction

4-185 Analyze the error type-out. The error type-out includes the data that should have been read and the data that was read. Refer also to the program listing, catalog number 303011.

4-186 Troubleshooting

4-187 The paper tape may have been punched wrong and read correctly or punched correctly and erroneously read. Compare the DID READ XXX portion of the type-out to the actual configuration punched on tape. The data that caused the error will be located to the left of the read head. The tape is punched in a binary progression which makes it easy to locate data. If the data punches agrees with the DID READ XXX, the reader is probably at fault. If the data does not agree with DID READ XXX, the punch is probably at fault. A short program that punches and reads the failing bit configuration continuously may be written and loaded into memory using the computer console switches. To facilitate troubleshooting, the SENSE/HALT/LOAD T switches may be set to a configuration that prevents the error from causing a computer halt.

4-188 DETAILED DESCRIPTION

4-189 The complete paper tape reader/punch test program is included in program description, catalog number 303011.

4-190 **Computer Console Input / Output Station Test — TTY Test (Catalog Number 303012A)**

4-191 LOADING AND OPERATION

4-192 To load and operate the TTY Test, perform the following steps (Step a. is skipped if the relocatable loader has been previously loaded):

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Install the TTY Test tape (catalog number 303012) on either the console paper tape reader or high-speed paper tape reader.

c. Load the TTY Test diagnostic program into memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The TTY Test is loaded by the relocatable loader.

d. Manually load address 2000_8 into the program counter. Address 2000_8 is the starting address of the TTY Test diagnostic program.

e. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. The SENSE/HALT/LOAD T switches control the following:

S/H/L T Switch 0 Raised

Test 1a. A binary progression will be punched and printed. A halt occurs at location 2057 to load punched tape into reader. Program counter will be set to 2060 + relocation bias.

Test 1b. Depress start and tape will be read, compared, and duplicated. A halt will occur at location 2146 to load duplicated tape into reader. The program counter will be set to 2147 + bias. To restart test 1b set the program counter to 2057 + relocation bias and lower start.

Test 1c. Depress start for high-speed read and compare.

NOTE

Any time program halts at location 2361, an error has occurred. The program counter will be set to 2363 + relocation bias. To restart test 1c set the program counter to 2146 + bias and lower start.

S/H/L T Switch 1 Raised

The keyboard turn-around test is executed. Input from keyboard is typed out on the console printer.

S/H/L T Switch 2 Raised

Reader will read tape on interrupt basis and punch will duplicate on interrupt basis.

S/H/L T Switch 3 Raised

All errors will be ignored and a continuous load will be executed during test 1b and 1c.

f. Lower the START/STOP toggle switch on the computer console two times.

4-193 ERROR-FREE OPERATION

4-194 The program should perform the test specified by the option switches (see step e., paragraph 4-192.)

4-195 ERROR INDICATIONS

4-196 Error indications assuming SENSE/HALT/LOAD T switch 3 in the raised position are listed as follows:

Error Halts - Refer to step e. in paragraph 4-192.

Error Type-Outs - None

4-197 Isolating the Failing Instruction

4-198 An examination of the program counter and step e. in paragraph 4-192 gives the address where the error halt occurred. Reference this address to the program listing (catalog number 303012). All the instructions pertaining to the test being performed are given in the program listing (catalog number 303012).

4-199 Troubleshooting

4-200 The particular test may be restarted as per step e. paragraph 4-192. To facilitate troubleshooting, SENSE/HALT/LOAD T switch 3 may be raised which prevents errors from causing a computer halt.

4-201 DETAILED DESCRIPTION

4-202 The complete TTY Test program is included in program description, catalog number 303012.

4-203 **SEL 810A Priority Interrupt Checkout Program — PI Checkout (Catalog Number 303013A)**

4-204 LOADING AND OPERATION

4-205 To load and operate the PI checkout diagnostic program, performs the following steps: (Step a. is skipped if the relocatable loader has previously been loaded.)

a. Load the Manual Bootstrap and Bootstrap Packageas explained in Section II.

b. Install the PI checkout tape (catalog number 303013) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the PI checkout diagnostic program into memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The PI checkout program is loaded by the relocatable loader. The intermap references must be relocated by inserting a map relocation base address of 0743_8 into the B-Accumulator.

d. Manually load address 0002_8 into the program counter. Address 0002_8 is the starting address of the PI checkout program. This address must be inserted whenever the program is initialized.

e. Set the computer console SENSE/HALT/LOAD T switches 14 and 15 for the operation to be performed as indicated in the following:

1. S/H/L T Switch 14

Raised - The program will disable the interrupt once it has been serviced. If the interrupt occurs again without program reinitialization, the conditions indicate a faulty PID instruction.

Centered - The interrupt will not be disabled after the output of the message to the teletype.

2. S/H/L T Switch 15

Raised - The program will suppress the printout of any messages. This control switch may be set to avoid teletype output when troubleshooting a faulty interrupt.

Centered - Type-outs performed.

f. Lower the START/STOP toggle switch on the computer console.

g. Using jumpers or a test rig, simulate an I/O device priority interrupt voltage level condition to the priority interrupt card in the computer. If PI card type 8634-2, 810A is used, a plus voltage causes a disable or no-request condition, and a zero-volt level causes the request latch to set. If PI card type 8634-3, 810A is used, a zero-volt level causes a disable or no-request condition,and a plus voltage causes the request latch to set.

4-206 ERROR-FREE OPERATION

4-207 The program loops until halted manually. The program performs a check on all the interrupt levels. The console printer types out the group and level of any interrupt that is detected by the program providing SENSE/HALT/LOAD T switch fifteen is centered. After servicing the priority interrupt that was simulated, the program disables the interrupt if SENSE/HALT/LOAD T switch 14 is in the raised position.

NOTE

If the program is restarted at location 00036_8,the type-outs that are available are printed out on the console printer followed by a computer halt at location 00063_8.

h. Repeat steps d. through g. for all interrupt levels.

4-208 ERROR INDICATIONS

4-209 Error indications, assuming SENSE/HALT/LOAD T switch 14 raised and switch 15 centered, are listed as follows:

Error Halts - None

Error Type-Outs - There are no error type-outs as such.

What constitutes an error in this portion of the test is if an interrupt was manually simulated and not indicated as being detected by the type-out or if an interrupt was not simulated (manually disabled) and is indicated as being detected in the type-out or if a particular interrupt occurs twice in succession without being re-simulated.

NOTE

The following steps are performed to check out the power fail-safe feature.

i. Reinitialize the program (memory address 00002_8), and while the program is running, depress the power OFF circuit breaker on the computer control panel.

j. Turn computer power back ON by depressing the power ON button on the computer console.

k. Lower the START/STOP toggle switch on the computer control panel.

4-210 ERROR-FREE OPERATION

4-211 While the computer power is dropping, the power fail-safe subroutine is accessed and performed. Upon power up-sequencing, a branch is taken from address 00000 to the fail-safe subroutine. The subroutine enables the computer to re-enter the main program. The branch instruction to the power-up subroutine in 00000 is automatically stored by the program while power is dropping.

4-212 ERROR INDICATIONS

4-213 Error indications are listed as follows:

Error Halts - If, after turning power back on and lowering the START/STOP toggle switch, the computer halts (does not re-enter the PI diagnostic program), an error is indicated. Either the power fail-safe interrupt was not detected, or the subroutine did not perform its function.

Error Type-Outs - None

4-214 Isolating the Problem

4-215 If a simulated interrupt is not serviced, check to see if the associated interrupt flip-flop is being set. If it is not, trace the interrupt signal from the point of simulation towards the interrupt flip-flop. If the interrupt flip-flop is being set, trouble exists with the hardware or software associated with servicing the interrupt.

4-216 DETAILED DESCRIPTION

4-217 The complete PI checkout diagnostic program listing is included in program description, catalog number 303013.

4-218 **Inter-Map Verification Check Program — IMVC (Catalog Number 303014A)**

4-219 LOADING AND OPERATION

4-220 To load and operate the IMVC diagnostic program, perform the following procedures: (Step a. is skipped if the relocatable loader has previously been loaded.)

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Install the IMVC tape (catalog number 303014) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the IMVC program from paper tape into computer memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The IMVC diagnostic tape is loaded by the relocatable loader.

NOTE

Do not relocate the IMVC program when loading (no relocation bias loaded into the A- or B-Accumulators).

d. Manually load address 5000_8 into the program counter. Address 5000_8 is the starting address of the IMVC diagnostic program.

e. Lower the START/STOP toggle switch on the computer console.

4-221 ERROR-FREE OPERATION

4-222 The computer should continuously cycle through all the 18 tests described in paragraph 4-231. If no errors occur, the computer will run until it is manually halted.

4-223 ERROR INDICATIONS

4-224 Error indications are listed as follows:

Error Halts - If an error is detected, the computer is halted.

Error Type-Outs - None

4-225 Isolating the Failing Instruction

4-226 When an error occurs, the computer is halted with the halt address in the program counter. This address may then be referenced

to the following table 4-3 which gives the test that failed and the instructions used in the test. A detailed description of the 18 tests used in the IMVC program is given in paragraph 4-231.

4-227 Troubleshooting

4-228 A short program that causes a loop through the failing instruction can be written and inserted into memory using the computer control panel switches.

4-229 DETAILED DESCRIPTION

4-230 The complete IMVC diagnostic program listing is included in program description, catalog number 303014. The program is designed to use locations 2774_8 through 3004_8 as test locations. The program will insert the operands that are to be checked into test locations starting at location 5000_8. The primary purpose of the program is to insure that memory reference instructions on a map boundary use the memory location within the same map as the instruction itself. A malfunction will be detected if the memory address accessed is in the next map instead of the map containing the instruction.

4-231 A detailed description of the 18 tests used in the IMVC test program is given in the following paragraphs:

Test 1. Store B-Accumulator

The program will execute a Store B-Accumulator instruction with the memory reference address

Table 4-3. IMVC Error Halts

Test Number	Halt (PC Location)	Instruction
Test 1	'5022	Store B-Accumulator
Test 2	'5040	Store A-Accumulator
Test 3	'5051	Load A-Accumulator
Test 4	'5063	Load B-Accumulator
Test 5	'5076	Add Memory to A-Accumulator
Test 6	'5111	Add Memory to B-Accumulator
Test 7	'5122	Subtract Memory from A-Accumulator
Test 8	'3002	Skip A Zero (A NQ Zero) B-Accumulator equal 1
Test 9	'3002	Skip A Negative (A not negative) B-Accumulator equal 2
Test 10	'3002	Skip A Positive (A not positive) B-Accumulator equal 3
Test 11	'3006	Skip A Negative (A not negative) B-Accumulator equal 4
Test 12	'3006	Skip A Positive (A not positive) B-Accumulator equal 5
Test 13	'3006	Skip A Zero (A NQ Zero) B-Accumulator equal 6
Test 14	'5225	Add Memory to A-Accumulator (Indirect) B-Accumulator equal 7
Test 15	'5241	Subtract Memory from A-Accumulator (Indirect) B-Accumulator equal 10
Test 16	'3003 '5265	Increment Memory and Skip B-Accumulator equal 11

Table 4-3. IMVC Error Halts (Cont'd)

Test Number	Halt (PC Location)	Instruction
Test 17	'3474	Store Place and Branch B-Accumulator equal 12
Test 18	'3003 '5311	Skip no Overflow B-Accumulator equal 13

in the same map as the instruction. The program location of the Store B-Accumulator command is location '02777 and the memory address is '02504. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	STB	T5	T5 location is '2504
'03000	BRU*	Test	Return to main program

Halt Location

If the CPU has functioned properly, the program will proceed to Test 2; otherwise a halt will occur at location '05022. This indicates that the memory address of the Store B instruction was in location '03505 of the next map rather than in location '02504 of the map that contained the instruction. The A-Accumulator contains the data from location '02504; the B-Accumulator contains the data from location '03504.

Test 2 - Store A-Accumulator

The program will execute a Store A-Accumulator instruction with the memory reference address in the same map as the instruction. The program will store the contents of the A-Accumulator from location '02777. The memory address is '02504. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	STA	T5	T5 location is '2504
'0300	BRU*	Test	Return to main program

Halt Condition

If the CPU has functioned properly, the program will proceed to Test 3, otherwise a halt will occur at location '05040. This indicates that the memory address of the Store instruction was in location '3504 of the next map rather than in location '2504 of the map that contained the instruction. The A-Accumulator contains the contents of location '2504 which should be '177777. The B-Accumulator contains the contents of location '3504 which should be '000000. If the data in A is '000000 and the B-Accumulator contains '177777, the CPU has a malfunction.

Test 3. Load A-Accumulator

The program will execute a Load A-Accumulator instruction with the memory reference address in the same map as the instruction. The A-Accumulator should contain '177777. If the memory address was in the next map, the A-Accumulator will contain zeros which indicate a CPU malfunction. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	LAA	T1	T1 location is '2500
'03000	BRU*	Test	Return to main program

Halt Location

If the CPU has functioned properly, the program will proceed to Test 4, otherwise the program will halt at location '05051. This indicates that the memory address of the Load A instruction was in location '3500 of the next map rather than in location '02500 of the map that contained the instruction. The A-Accumulator has the incorrect data.

Test 4. Load B-Accumulator

The program will execute a Load B-Accumulator instruction with the memory reference address in the same map as the instruction. The B-Accumulator should contain '177777. If the memory address was in the next map, the B-Accumulator will contain zeros which indicate a CPU malfunction. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	LBA	T1	T1 location is '3500
'03000	BRU*	Test	Return to main program

Halt Location

If the CPU has functioned properly, the program will proceed to Test 5, otherwise the program will halt at location '05063. This indicates that the memory address of the Load B-Accumulator instruction was in location '3500 of the next map rather than in location '2500 of the map that contained the instruction. The A-Accumulator has the incorrect data.

Test 5. Add Memory to A-Accumulator

The program will execute an Add Memory to A-Accumulator instruction with the memory reference address in the same map as the instruction. The A-Accumulator should contain '177777. If the memory address was from the next map the A-Accumulator will contain '077777.

Halt Location

If the CPU has functioned properly the program will proceed to Test 6, otherwise the program will halt at location '05076. This indicates that the memory address of the Add Memory to A-Accumulator was in location '03502 of the next map rather than in location '02502 of the map that contained the instruction. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	AMA	T3	T3 EQ T1 000001
'03000	BRU*	Test	

Test 6. Add Memory to B-Accumulator

The program will execute an Add Memory to B-Accumulator instruction with the memory address in the same map as the instruction. The B-Accumulator after execution of the instruction should contain '177777. If the memory address was in the next map, the B-Accumulator will contain '077777 indicating a malfunction in the CPU. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	AMB	T3	T3 EQ 000001
'03000	BRU*	Test	Return

Halt Location

If the CPU has functioned properly, the program will proceed to Test 7, otherwise a halt will occur at location '05111. The A-Accumulator will contain the incorrect data.

Test 7. Subtract Memory from A-Accumulator

The program will execute Subtract Memory from A-Accumulator instruction with the memory address in the same map as the instruction. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		A contains '177777
'02777	SMA	T4	T4 EQ to '100000
'03000	BRU*	Test	Return

Halt Location

If the CPU has functioned properly, the program will proceed to Test 8, otherwise a halt will occur at location '05122. The A-Accumulator will display the incorrect data value of '177777. The correct data value is '077777.

Test 8. Skip A Zero

The augmented instruction SAZ will be executed from location '02776. The data in the A-Accumulator is not equal to zero, therefore the program should not cross the map boundary.

Halt Locations

If the CPU has functioned properly, the program will proceed to Test 9, otherwise a halt will occur at location '03002. This indicates that the CPU has crossed the map boundary which is an error. The B-Accumulator will contain '000001 indicating the error number.

Test 9. Skip A Negative

The augmented instruction SAN will be executed from location '02776. The data in the A-Accumulator is not negative, therefore the program should not cross the map boundary.

Halt Locations

If the CPU has functioned properly, the program will proceed to Test 10, otherwise a halt will occur at location '03002. This indicates that the CPU has crossed the map boundary which is an error. The B-Accumulator will contain '000002 indicating the error number.

Test 10. Skip A Positive

The augmented instruction SAP will be executed from location '02776. The data in the A-Accumulator is not positive, therefore the program should not cross the map boundary.

Halt Location

If the CPU has functioned properly, the program will proceed to Test 11, otherwise a halt will occur at location '03002. This indicates that the CPU has crossed the map boundary which is an error. The B-Accumulator will contain '000003 indicating the error number.

Test 11. Skip A Negative

The augmented instruction SAN will be executed from location '02777. The data in the A-Accumulator will be a positive number, therefore the program will cross the map boundary to the first location of the next map.

Halt Location

If the CPU has functioned properly, the program will proceed to Test 12, otherwise a halt will occur at location '03006. This indicates that the CPU has crossed the map boundary but skipped incorrectly. The B-Accumulator will contain '000004 indicating the error number.

Test 12. Skip A Positive

The augmented instruction SAP will be executed from location '02777. The data in the A-Accumulator will be negative, therefore the program will cross the map boundary and execute the first instruction of the next map.

Halt Location

If the CPU has functioned properly, the program will proceed to Test 13, otherwise a halt will occur at location '03006. This indicates that the CPU has skipped on A positive when the data in A was negative. The B-Accumulator will contain '000005 indicating the error number.

Test 13. Skip A Zero

The augmented instruction SAZ will be executed from location '02777. The data in the A-Accumulator will not be zero, therefore the program will cross the map boundary and execute the first instruction of the next map.

Halt Location

If the CPU has functioned properly, the program will proceed to Test 14, otherwise a halt will occur at location '03006. This indicates that the CPU has skipped on A zero when the data in A was positive. The B-Accumulator will contain '000006 indicating the error number.

Test 14. Add Memory to A (Indirect)

The program will execute an Add Memory to A-Accumulator instruction with the indirect-bit set. The memory address will be indirect through the map which contains the instruction. When the command has been executed the value in A should be '177777. If the memory address was in the next map the value in A will be '100000. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	AMA*	T2	A EQ 177777
'03000	BRU*	Test	Return

Halt Location

If the CPU has functioned properly, the program will proceed to Test 15, otherwise a halt will occur at location '05225. The operator may visually observe the contents of A-Accumulator. The data value should be '177777. Any other value indicates an error. The B-Accumulator will contain '000007 indicating the error number.

Test 15. Subtract Memory from A (Indirect)

The program will execute a Subtract Memory from A Indirect instruction with the indirect address in the same map as the instruction. When the command has been executed, the data in the A-Accumulator should be '077777. If the memory address was in the next map the value will be '177777. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	FRA		A EQ 177777
'02777	SMA*	T4	T4 EQ 100000
'03000	BRU*	Test	Return

Halt Location

If the CPU has functioned properly, the program will proceed to Test 16, otherwise a halt will occur at location '05241. The operator may visually observe the contents of the A-Accumulator. The data should be '077777. Any other data indicates an error. The B-Accumulator will contain '000010 indicating the error number.

Test 16. Increment Memory and Skip

The program will execute an Increment Memory and Skip instruction with the memory address in the same map as the instruction. The A-Accumulator after execution of the instruction should contain 000000. If the memory address was in the next map, the data in A will be 000001. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented Code
'03000	IMS	T6	T6 EQ 177777
'03001	HLT		
'03002	BRU*		

Halt Location

If the CPU has functioned properly, the program will proceed to Test 17, otherwise a halt will occur at location '03003 or '05265. The B-Accumulator contains the error number count which is equal to 000011. The halt at '03003 indicates that the IMS instruction did not skip properly. The halt at '05265 indicates that the incremented memory address was in the next map rather than in the same map as the instruction.

Test 17. Store Place and Branch

The program will execute a Store Place and Branch instruction with the branch location in the same map as the SPB instruction. The subroutine in the same map will clear the A-Accumulator indicating that the subroutine was entered. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	NOP		Augmented instruction
'02777	SPB	THMP	location is 2470
'03000	BRU*	Test	Return

Halt Location

If the CPU has functioned properly, the program will proceed to Test 18, otherwise a halt will occur at location '03474. The operator may visually observe the contents of the A-Accumulator. The data value should be 177777 which indicates an error. The B-Accumulator should have a value of 000012. This verifies that the SPB test is the one which caused the failure.

Test 18. Skip No Overflow Test

The program will execute a Skip No Overflow instruction. The skip instruction crosses an intermap boundary. The overflow latch is not set. The test locations are as follows:

Location	OP Code	Address	Comment
'02776	SOF		Overflow not set
'02777	HLT		Incorrect skip
'03000	BRU*	Test	Return

Halt Location

If the CPU has functioned properly, the program will reset all counters and begin with Test 1, otherwise the program will halt at location '3003 or '05311. The B-Accumulator should contain a value of 000013. The halt at location '03003 indicates that the SOF did not skip properly to the next map.

4-232 Card Reader Diagnostic (Catalog Number 323001A)

4-233 LOADING AND OPERATION

4-234 The Card Reader diagnostic program has two test modes of operation; (1) The Program Stored Card Test Mode, and (2) The First Card in Buffer Test Mode. Both test modes can operate in binary or BCD. The following paragraphs give the procedure for both test modes:

4-235 Stored Card Test Mode

4-236 To load and operate the Stored Card Test portion of the card reader diagnostic, perform the following: (If the relocatable loader has previously been loaded into memory skip step a. of this procedure.)

a. Load the manual bootstrap and bootstrap package as explained in Section II.

b. Install the card reader diagnostic tape (catalog number 323001) on either the console paper tape reader or the high speed paper tape reader.

c. Load the card reader diagnostic program from paper tape into computer memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The card reader diagnostic program is loaded by the relocatable loader.

d. Manually load address 2000_8 into the program counter. Address 2000_8 is the starting address of the card reader diagnostic program.

e. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. These switches control the following:

S/H/L T Switch 0
Raised - Read card in binary mode.
Centered - Read cards in BCD mode. (Refer to the SEL 810A Reference Manual for Peripheral Unit Character Codes.)

S/H/L T Switch 1
Raised - Delay the feed time between cards by 0.4 microseconds.
Centered - Read cards at normal speed.

S/H/L T Switch 2
Raised - All errors are ignored.
Centered - Errors are typed out on the console printer.

S/H/L T Switch 3
Raised - Perform the Stored Card Test

f. If the Program Stored Card Test is to be performed in binary, load the card reader with a card deck punched as shown in figure 4-1.

If the Program Stored Card Test is to be performed in BCD, load the card reader with a card deck punched as shown in figure 4-2.

g. Lower the START/STOP toggle switch on the computer control panel.

4-237 ERROR-FREE OPERATION

4-238 The program causes the card reader to read the card deck. Data from each card is compared with a table stored by the program in memory locations 00534_8 through 00653_8 for binary and 00414_8 through 00533_8 for BCD. The program will run until all cards are read or until the computer is manually halted.

4-239 ERROR INDICATIONS

4-240 Error indications, assuming SENSE/HALT/LOAD T switch 2 is centered, are listed as follows:

Error Halts - None

Error Type-Outs - If the data read from cards does not compare with the data in the program-generated table, the computer types out an error message on the console printer. The error message is in the following format:

XXXX YYYY ZZ
where: XXXX Card input
YYYY Stored or first card buffer contents
ZZ Card column in error

BCD Mode: The format is the same as the binary mode type-out except that only two octal digits for the correct and incorrect data will be output along with the column number.

4-241 First Card in Buffer Test

4-242 To load and operate the First Card in Buffer Test portion of the card reader diagnostic perform the following steps: (Step a. is skipped if the relocatable loader has previously been loaded.)

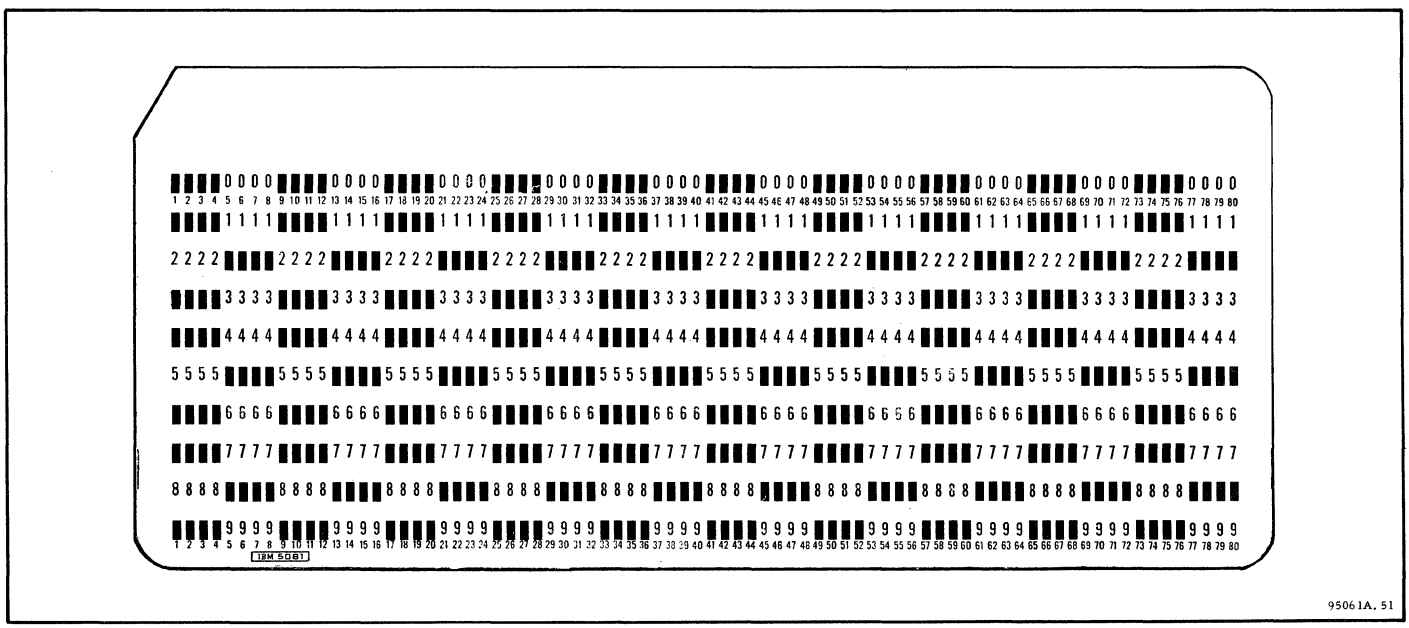


Figure 4-1. Binary Punched Card

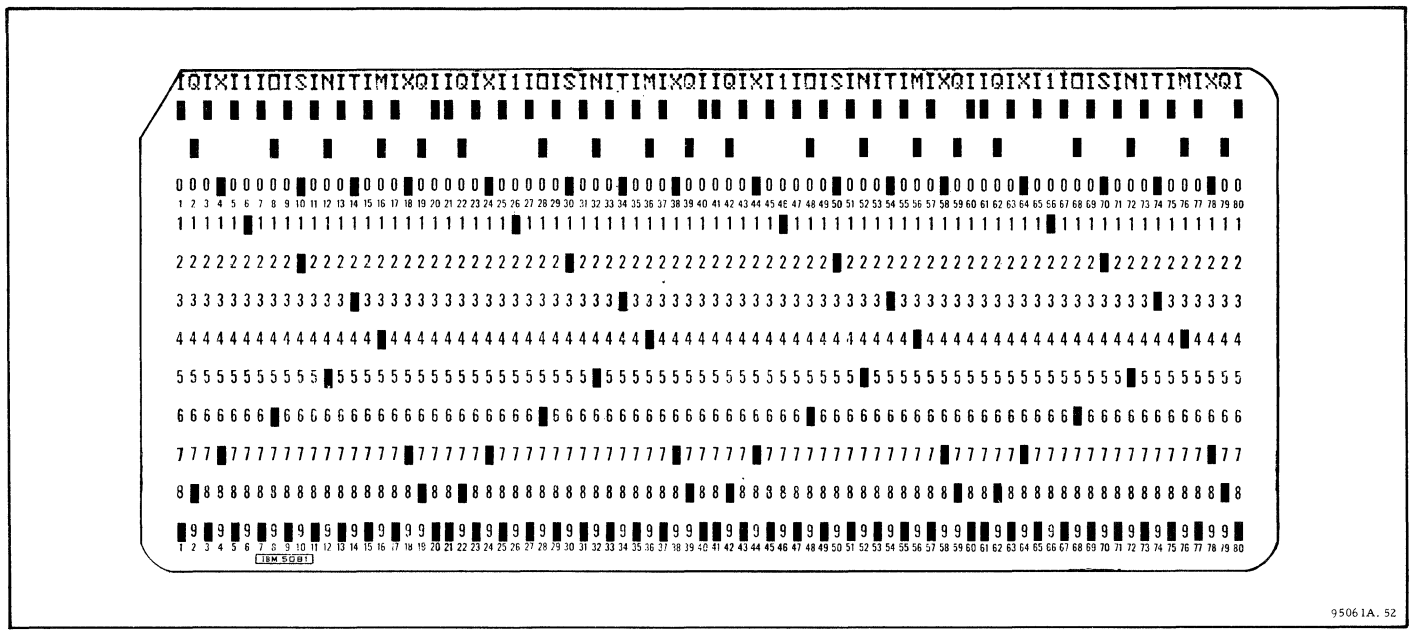


Figure 4-2. Binary Coded Decimal Punched Card

a. Load the Manual Bootstrap and Bootstrap Package as explained in Section II.

b. Perform steps b. through e. of the Stored Card Test Mode procedure (paragraph 4-236) with the exception that SENSE/HALT/LOAD T switch 3 is centered in step e.

c. Load the card reader with a card deck that has all the cards punched with identical patterns. The cards may be punched in binary or BCD, depending on the test to be performed. (See S/H/L T switch 0, step e, paragraph 4-236).

d. Lower the START/STOP toggle switch on the computer control panel.

4-243 ERROR-FREE OPERATION

4-244 The program causes the card reader to read the card deck. The data from the first card read is stored in memory in the First Card In Table. All subsequent card data input is compared with the data in the First Card In Table. The program will run until all cards are read, or until the computer is manually halted.

NOTE

For troubleshooting purposes, manual loading of the First Card In Table is provided as explained in paragraph 4-247.

4-245 ERROR INDICATIONS

4-246 Error indications, assuming SENSE/HALT/LOAD T switch 2 is centered, are listed as follows:

Error Halts - None

Error Type-Outs - If the data read from cards does not compare with the data in the First Card In Table, the computer types out an error message on the console printer. The error message is in the following format:

XXXX YYYY ZZ

where XXXX Card input
YYYY Stored or first card buffer contents
ZZ Card column in error

BCD Mode: The format is the same as the binary mode type-out except that only two octal digits for the correct and incorrect data will be output along with the column number.

4-247 Troubleshooting (Manual Loading of First Card In Table)

4-248 If a hardware problem exists and the First Card In Table Test is being performed, it is possible that an error will never be detected. The reason for this is that the error condition that causes a bit to be dropped or picked up will prevail for the first card as well as subsequent cards. For this

reason, manual loading of the First Card In Table is provided using the following procedure:

a. Manually load the First Card In Table in computer memory. The First Card In Table is located in memory locations 00274_8 to 00413_8.

b. Manually load address 02004_8 into the program counter. By starting at address 02004_8, the instructions that store the data on the first card into the First Card In Table are bypassed.

4-249 DETAILED DESCRIPTION

4-250 The complete Card Reader Diagnostic is included in program description, catalog number 323001.

4-251 **Mainframe Logic Exerciser Generator (Catalog Number 303016)**

4-252 LOADING AND OPERATION

a. Load with relocatable loader (300001). Set A-Accumulator to zero (0) and B-Accumulator to 0700 before loading. Program will be loaded in locations 0 through 015500.

b. When load is successful

1. Set sense switches to desired options.

SS0 = 1 Punch tape on high speed paper tape

SS0 = 0 Punch tape on ASR

SS3 = 0 Punch tape 303017 (ASR loader)

SS3 = 1 Punch tape 30301B (High Speed Paper tape loader)

2. Start program at location '15135

The program will punch a leader, the appropriate loader, more leader, and an absolute dump of the Mainframe Logic Exerciser.

3. Label the tape 303017 for ASR loader or 303018 for high speed paper tape loader.

4-253 METHOD

The loader produced is a special adaption of the absolute loader for use with the nine instruction bootstrap. The nine instruction bootstrap is used to enable the engineer to load the Mainframe Logic Exerciser with more ease than the standard bootstrap. The loader uses only the instructions as defined by the Pre-Requisite (Pre-Automatic Procedure) in Program Description 303017 or 303018. The use of this bootstrap requires the fixed assignment of the input media, and because of this the generator is required. The format of the remainder of the paper tape is compatible with the absolute loader found in the relocatable loader package (300001).

4-255 **810B Mainframe Logic Exerciser (ASR-33)(Catalog Number 303017)**

4-256 PREREQUISITE

4-257 Pre-Automatic Procedure

4-258 The Pre-Automatic Procedure must have been run successfully on the mainframe. The Pre-Automatic Diagnostic procedure is to allow the testing of all operations required to load the program. The error resolution procedure is included to checkout the CEU, AIP, HLT, SAZ, BRU, LSL, STA, IBS, SNS instructions; the I/O operation, the normal mainframe functions such as incrementing the program counter, and bringing up sequential instructions to be executed; display and store into memory; and all CPU console switch and indicator functions.

4-259 GENERAL

4-260 The Mainframe Logic Exerciser (MALE 810B) exercises all logic available to programming and performs verification tests at the smallest logic level. The program will start with the minimum logic programmable and test other parts of the logic. After the program is loaded it will assume that LAA, STA, SNS, and BRU* are operating correctly. From that point the SAZ logic is checked further. The program will then add SAZ logic to its operating instruction set. Each test will contain a minimum of instruction for ease of use by the maintenance personnel.

4-261 LOADING PROCEDURE

a. Load the following bootstrap loader into memory:

Location	Octal		
0	130101	CEU	1,W
1	004000	DATA	'4000
2	170301	AIP	1,W
3	001016	LSL	8
4	174301	AIP	1,W,R

Location	Octal		
5	034000	STA	0, 1
6	000022	SAZ	
7	110000	BRU	* - 7
10	110004	BRU	* - 4

b. Put paper tape catalog number 303017 into ASR.

c. Start execution of loader at first location. (Depress MASTER CLEAR, DISPLAY, TRANSFER, INSTR., and START in that order.) Program will halt after all of program is loaded. If a checksum is detected while the loading is taking place, a K will be typed on the teletypewriter and the program will halt at location '77. To ignore error depress START; otherwise start the load procedure over.

d. Set Sense Switch Options according to table below:

Sense Switch	Operation
SS2=0	Halt after every error.
SS2=1	Inhibit Halt after every error.
SS3=0	Go into a loop after error.
SS3=1	Go to next test after error.
SS4=0	Go to next test after success.
SS4=1	Loop on current test..
SS5=0	Halt at completion of program.
SS5=1	Bypass success Halt.
SS6=0	DO NOT Execute Sense Switch Test.
SS6=1	Execute Sense Switch Test.
SS7=0	DO NOT execute Index tests.
SS7=1	Execute Index Tests.
SS8=0	DO NOT execute VBR tests.
SS8=1	Execute VBR tests.

e. Start execution of program by depressing START or by MASTER CLEAR, entering 140 into the PROGRAM COUNTER and depressing START twice.

NOTE

1. If the absolute loader is resident above location '15000 it may be used to load the program by skipping the Loader on the punched paper tape.

2. If the loading of the tape is aborted the loader may be restarted by starting execution of the program at location '10 and skipping the loader on the punched tape.

3. If the program is not completely loaded the part that is loaded may be used by the following procedure.

   a. Enter '177 into the PROGRAM COUNTER.

   b. Depress DISPLAY.

   c. If Transfer Register contents are greater than '1000 or less than '13000 GO TO d, if not GO TO f.

   d. Depress TRANSFER PROG. COUNT.

   e. GO TO b.

   f. Enter '14000 into TRANSFER REGISTER.

   g. Depress MEMORY ENTER.

   h. GO TO step d of the LOADING PROCEDURE.

4-262 OPERATING PROCEDURES

4-263 Restarting

a. After the first pass the program may be restarted by depressing MASTER CLEAR STEP then START twice.

b. Any test may be entered by depressing MASTER CLEAR, entering the address of the test into A-Accumulator, and depressing START twice.

4-264 Sense Switch Test

a. Set SS6 while program is running to enter. When test is entered BIT 0 of A-Accumulator will be set.

b. Set SS(n) where n is the illuminated indicator in the A-Accumulator. Successful completion of check will cause indicator "n" to extinguish and "n" + 1 to come on.

c. Reset SS(n - 1) where n is the illuminated indicator in the A-Accumulator.

d. If all switches have been tested program will continue to the success HALT at location '1427.

4-265 SUCCESS INDICATIONS AND PROCEDURES

4-266 After the program makes a complete pass through all of its tests it will come to a HALT (subject to SS5 setting) at location "1427. If all tests were successful the A-Accumulator will be all ONE's. Each of the 16 bits (A0-15) represents a section of tests. If any one of the bits is equal to zero, the corresponding test was not successfully run. Table 4-4 lists the bits and the test section they refer to.

4-267 If the acceptance mode of operation is desired SS5, 2, 3, may be set. When SS5 is reset the program will typeout the pass count, the error count, and the logical AND of all of the resulting success words.

4-268 ERROR INDICATIONS AND PROCEDURE

4-269 In the normal mode, the program will HALT at location '226 when an error is detected. The A-Accumulator will contain information regarding the failure. This information will be defined in the listing. The B-Accumulator will normally contain the address of the failing test in the listing. The program listing will contain information as to the operations being performed and the logic being tested. If the Sense Switches are not set the program will go into a loop on the test (Test Loop) that failed. The only way to get out of the test loop is to set SS3=1. To continue program operation after the HALT, set the Sense Switches to the desired option (see loading procedure) and depress START.

4-270 If the program loses control such that the Error Wait Loop is not entered, information is available in the following locations:

Symbolic	Octal	Information
NOW	172	Address of test being executed when failure occurred.
NEXT	171	Address of next test to be executed.

Table 4-4. Success Bit Indicators (303017)

*	BIT	A-ACCUMULATOR
*		
*	0	SAZ LOGIC
*	1	SKIP LOGIC - SAP, SAN, SNO, OVS, SOF
*	2	SHIFT LOGIC
*	3	ADDER-CARRY IN TO A0
*	4	ADDER-BASIC COMPARE LOGIC
*	5	B-ACCUMULATOR
*	6	ADDER CARRY AND COMPARE
*	7	COMPARE A NOT EQUAL MEMORY
*	8	ADD INSTRUCTION
*	9	REGISTER OPERATION
*	10	INCREMENT AND SKIP
*	11	ADDRESSING
*	12	MPY
*	13	DIV
*	14	VBR
*	15	INDEX

Symbolic	Octal	Information
TAR	234	Success Bit indicator.
EC	173	Error Count

4-271 If a Sense Switch error occurs the program will loop in the section where the failure occurs. If indicator "n" fails to go out when the switch is set, the problem is likely to be in the execution of the SNS instruction. If the indicator appears to dim and indicator "n" + 1 fails to come on the problem is likely to be in the execution of the LCS instruction.

4-272 OPERATOR CONTROL SUMMARY

a. Starting location - '141

RESTART location - 2

START at desired test - Enter test address into A-Accumulator start program at location 1.

b. Sense Switch

2 = 1	Inhibit Halt after error
3 = 1	Go to next test after error
4 = 1	Unconditional loop
5 = 1	Bypass success Halt
6 = 1	Execute SS tests
7 = 1	Execute Index tests
8 = 1	Execute VBR tests

4-273 DETAILED DESCRIPTION

4-274 The MAINFRAME Logic Exerciser is a series of autonomous self-initializing test routines, a common error/option routine, and an update/initialize routine. The first location of each test routine contains the address of the next test routine. The last location contains a BRU to a conditional test routine or a "True" or "False" entry in the common error/option routine.

4-275 The update/initialize routine always retains the address of the current routine in the location whose symbolic name is "NOW," and the address of the next test to be executed in the location whose label is "NEXT," The error/option uses NOW to branch back to a failing routine. When a test routine has been successful the error/option transfers control to the update/initialize routine.

4-276 If the Error Loop Switch has not been activated because of the detection of an error, and Unconditional Loop is not requested, the update/initialize routine replaces the contents of NOW by the contents of NEXT. The contents of NEXT are replaced by address of the test routine to be executed following the test routine that will presently be executed.

4-277 Additional Test Sigments may be made by changing the pointer (DAC END) following the VBR tests to point to the new test and using DAC END as the first card of the last new test. All program changes must be made to the 810B Mainframe Logic Exerciser Generator (303016). The Generator may then be used to generate the special paper tape (303017).

4-278 Source comment cards are coded in column 10 so that Titles of Test areas and Failure indications may be sorted by the documentation section to assist in making up the trouble analysis chart.

Column 10
T means Title card
F means Failure Indication
C means a continuation of one of the above.

4-279 810B Mainframe Logic Exerciser (HSPT)(Catalog Number 303018A)

4-280 PREREQUISITE

4-281 Pre-Automatic Procedure

4-282 The Pre-Automatic Procedure must have been run successfully on the mainframe. The Pre-Automatic Diagnostic procedure is to allow the testing of all operations required to load the program. The error resolution procedure is included to checkout the CEU, AIP, HLT, SAZ, BRU, LSL, STA, IBS, SNS instructions; the I/O operation, the normal mainframe functions such as incrementing the program counter and bringing up sequential instructions to be executed; display and store into memory; and all CPU console switch and indicator functions.

4-283 GENERAL

4-284 The Mainframe Logic Exerciser (MALE 810B) exercises all logic available to programming and performs verification tests at the smallest logic level. The program will start with the minimum logic programmable and test other parts of the logic. After the program is loaded it will assume that LAA, STA, SNS, and BRU* are operating correctly. From that point the SAZ logic is checked further. The program will then add SAZ logic to its operating instruction set. Each test will contain a minimum of instructions for ease of use by the maintenance personnel.

4-285 LOADING PROCEDURE

a. Load the following bootstrap loader into memory:

Location	Octal		
0	130102	CEU	2,W
1	001000	DATA	'1000
2	170302	AIP	2,W
3	001016	LSL	8
4	174302	AIP	2,W,R
5	034000	STA	0,1
6	000022	SAZ	
7	110000	BRU	* - 7
10	110004	BRU	* - 4

b. Put paper tape catalog number 303018 into High-speed reader.

c. Start execution of loader at first location (depress MASTER CLEAR, DISPLAY, TRANSFER, INST, and START in that order). Program will halt after all of program is loaded. If a checksum is detected while the loading is taking place a K will be typed on the Teletypewriter and the program will halt at location '77. To ignore error depress START; otherwise start the load procedure again.

d. Set Sense Switch Options according to table below:

Sense Switch	Operation
SS2 = 0	Halt after every error.
SS2 = 1	Inhibit Halt after every error.
SS3 = 0	Go into a loop after error.
SS3 = 1	Go to next test after error.
SS4 = 0	Go to next test after success.
SS4 = 1	Loop on current test.
SS5 = 0	Halt at completion of program.
SS5 = 1	Bypass success Halt.
SS6 = 0	Do not execute Sense Switch Test.
SS6 = 1	Execute Sense Switch Test.
SS7 = 0	Do not execute Index tests.
SS8 = 0	Do not execute VBR tests.
SS8 = 1	Execute VBR Tests.

e. Start execution of program by depressing START or by MASTER CLEAR, entering 140 into the PROGRAM COUNTER and depressing START twice.

NOTE

1. If the absolute loader is resident above location '15000, it may be used to load the program by skipping the loader on the punched paper tape.

2. If the loading of the tape is aborted, the loader may be restarted by starting execution of the program at location '10 and skipping the loader on the punched tape.

3. If the program is not completely loaded, the part that is loaded may be used by the following procedure.

a. Enter '1776 into the PROGRAM COUNTER.

b. Depress DISPLAY.

c. If Transfer Register contents are greater than '1000 or less than '13000 GO TO d, if not GO TO f.

d. Depress TRANSFER PROG COUNT.

e. GO TO b.

f. Enter '1400 into TRANSFER REGISTER.

g. Depress MEMORY ENTER.

h. GO TO Step d of the LOADING PROCEDURE.

4-286 OPERATING PROCEDURES

4-287 Restarting

a. After the first pass the program may be restarted by depressing MASTER CLEAR STEP then START twice.

b. Any test may be entered by depressing MASTER CLEAR, entering the address of the test into A-Accumulator, and depressing START twice.

4-288 Sense Switch Test

a. Set SS6 while program is running to enter. When test is entered BIT 0 of A-Accumulator will be set.

b. Set SS(n) where n is the illuminated indicator in the A-Accumulator. Successful completion of check will cause indicator "n" to extinguish and "n" + 1 to come on.

c. RESET SS(n - 1) where n is the illuminated indicator in the A-Accumulator.

d. If all switches have been tested program will continue to the success HALT at location '1427.

4-289 SUCCESS INDICATIONS AND PROCEDURES

4-290 After the program makes a complete pass through all of its tests it will come to a Halt (subject to SS5 setting) at location '1427. If all tests were successful the A-Accumulator will be all ONE's. Each of the 16 bits (A0-15) represent a section of tests. If any one of the bits is equal to zero the corresponding test was not successfully run. Table 4-5 lists the bits and the test section they refer to.

4-291 If the acceptance mode of operation is desired SS5, 2, 3, may be set. When SS5 is reset the program will typeout the pass, count the error count, and the logical AND of all of the resulting success words.

Table 4-5. Success Bit Indicators (303018)

*	BIT	A-ACCUMULATOR
*		
*	0	SAZ LOGIC
*	1	SKIP LOGIC - SAP, SAN, SNO, OVS, SOF
*	2	SHIFT LOGIC
*	3	ADDER - CARRY IN TO A0
*	4	ADDER - BASIC COMPARE LOGIC
*	5	B-ACCUMULATOR
*	6	ADDER CARRY AND COMPARE
*	7	COMPARE A NOT EQUAL MEMORY
*	8	ADD INSTRUCTION
*	9	REGISTER OPERATION
*	10	INCREMENT AND SKIP
*	11	ADDRESSING
*	12	MPY
*	13	DIV
*	14	VBR
*	15	INDEX

4-292 ERROR INDICATIONS AND PROCEDURE

4-293 In the normal mode, the program will Halt at location '226 when an error is detected. The A-Accumulator will contain information regarding the failure. This information will be defined in the listing. The B-Accumulator will normally contain the address of the failing test in the listing. The program listing will contain information as to the operations being performed and the logic being tested. If the Sense Switches are not set the program will go into a loop on the test (Test Loop) that failed. The only way to get out of the Test Loop is to set SS3 = 1. To continue program operation after the Halt, set the Sense Switches to the desired option (see loading procedure) and depress START.

4-294 If the program loses control such that the Error Wait Loop is not entered, information is available in the following location.

Symbolic	Octal	Information
NOW	172	Address of test being executed when failure occurred.
NEXT	171	Address of next test to be executed.
TAR	234	Success Bit indicators.
EC	173	Error Count

4-295 If a Sense Switch error occurs the program will loop in the section where the failure occurs. If indicator "n" fails to go out when the switch is set the problem is likely to be in the execution of the SNS instruction execution. If the indicator (n) appears to dim and "n" + 1 fails to come on the problem is likely to be in the execution of the LCS instruction.

4-296 OPERATOR CONTROL SUMMARY

a. Starting location - '141

RESTART location - 2

START AT Desired Test - Enter Test address into A-Accumulator. Start program at location 1.

b. Sense Switch

2 = 1 Inhibit Halt after error.

3 = 1 Go to next test after error.

4 = 1 Unconditional loop.

5 = 1 Bypass success Halt.

6 = 1 Execute SS tests.

7 = 1 Execute Index tests.

8 = 1 Execute VBR tests.

4-297 DETAILED DESCRIPTION

4-298 The Mainframe Logic Exerciser is a series of autonomous self-initializing test routines, a common error/option routine and an update/initialize routine. The first location of each test routine contains the address of the next test routine or a "True" or "False" entry in the common error/option routine.

4-299 The update/initialize routine always retains the address of the current routine in the location whose symbolic name is "NOW" and the address of the next test to be executed in the location whose label is "NEXT." The error/option uses NOW to branch back to a failing routine. When a test routine has been successful the error/option transfers control to the update/initialize routine.

4-300 If the Error Loop Switch has not been activated because of the detection of an error and Unconditional Loop is not requested the update/initialize routine replaces the contents of NOW by the contents of NEXT. The contents of NEXT are replaced by address of the test routine to be executed following the test routine that will presently be executed.

4-301 Additional Test Segments may be made by changing the pointer (DAC END) following the VBR tests to point to the new test and using DAC END as the first card of the last new test. All program changes must be made to the 810B Mainframe Logic Exerciser Generator (303016). The Generator may then be used to generate the special paper tape (303018).

4-302 Source comment cards are coded in column 10 so that Titles of Test areas and Failure indications may be sorted by the documentation section to assist in making up the trouble analysis chart.

Column 10
T means Title card
F means Failure Indication
C means a continuation of one of the above.

4-303 **SEL 810B Memory Diagnostic Tape Generator (Catalog Number 303019)**

4-304 LOADING AND OPERATION

4-305 Load program using relocatable loader catalog number 300000B with A- and B-Accumulators set to 0.

a. When load is complete set sense switches to desired option.

SSW0 = 1 punch tape on HSPT reader
SSW0 = 0 punch tape on ASR
SSW3 = 0 punch tape 303020A (ASR loader)
SSW3 = 1 punch tape 303021A (HSPT loader)

b. Start program at location 15110 octal. The program will punch leader, the appropriate loader, more leader, and the absolute dump of the SEL 810B Memory Diagnostic.

c. Label the tape 303020A for ASR loader version or 303021A for the HSPT loader version.

4-306 DESCRIPTION

4-307 The loader produced is a special adaptation of the absolute loader for use with the nine instruction bootstrap. The nine instruction bootstrap is used to enable the operator to load the SEL 810B Memory Diagnostic with greater facility than the standard bootstrap. The use of the nine instruction bootstrap requires the fixed assignment of the input device, and because of this the generator is required. The format of the absolute dump portion of the tape generated is compatible with the absolute loader found in the Relocatable Loader Package (300001B).

4-308 **SEL 810B Memory Diagnostic (ASR Version)(Catalog Number 303020)**

4-309 LOADING AND OPERATION

a. Load the following bootstrap into memory:

Location	Octal	Instruction	
0	130101	CEU	1,W
1	004000	DATA	'4000
2	170301	AIP	1,W
3	001016	LSL	8
4	174301	AIP	1,W,$
5	034000	STA	0,1
6	000022	SAZ	
7	110000	BRU	*-7
10	110004	BRU	*-4

b. Mount paper tape Catalog No. 303020A in ASR.

c. Reset all sense switches and being execution of bootstrap at location zero. (This may

be done by manually loading the P counter to all ones and depressing start twice.)

d. At the first computer halt the following sense switch options are available to locate the program into one of four memory areas.

Sense Switch Settings	Program is loaded into:
SSW2 = 0, SSW6 = 0	field two, module one
SSW2 = 0, SSW6 = 1	field one, module one
SSW2 = 1, SSW6 = 0	field two, module one
SSW2 = 1, SSW6 = 1	field one, module two

e. Program will then load and halt whereupon the following sense switch options for the diagnostic may be exercised:

SSW0 = 1	Halt before execution of each test (A-Accumulator = address of test area, B-Accumulator = test number).
SSW1 = 1	Inhibit error typeouts
SSW2 = 1	Inhibit halt after error
SSW3 = 1	Advance to next test after error
SSW4 = 1	Loop on current test
SSW5 = 1	Inhibit TEST 1
SSW6 = 1	Inhibit TEST 2
SSW7 = 1	Inhibit TEST 3
SSW8 = 1	Inhibit TEST 4
SSW9 = 1	Inhibit TEST 5
SSW10 = 1	Inhibit TEST 6
SSW11 = 1	Inhibit program relocation
SSW12 = 1	Execute core heating test

f. Depress Start once.

4-310 If sense switches 4-11 are not set, the program will execute all tests in a field, relocate itself into the opposite field, and start anew. This sequence will continue indefinitely testing all of memory. Setting of sense switch 0 will halt the program.

4-311 GENERAL

4-312 The program consists of an executive and seven test subprograms. The program is capable of execution in either memory module. The executive handles all error reporting and program relocation. Upon completion of all tests on that area of memory common to a sense winding, the program relocates itself, within a module, to the opposite sense winding and commences testing the area vacated.

4-313 The test subprograms are:

1. All ZERO's test
2. All ONE's test
3. Sliding zero test
4. Addressing test
5. Maximum Delta test
6. Random Numbers test
7. Core Heating test

4-314 Error Procedures

a. When an error is detected and if sense switch 1 is not set, the following message will be typed out:

FAILURE TEST n

m:YY:XXX(PPPP) cccccc eeeeee

where:

n is the Test number

m is the module number

YY is octal Y address configuration

XXX is octal X address configuration

PPPP is location in octal of error word

cccccc is correct word contents in octal

eeeeee is error word contents in octal

b. If sense switch 2 is not set the program will halt after typing out with:

Contents of A = Test Number

Contents of B = error bits of error word

c. If sense switch 3 is set, the program will abort any further activity in this test and proceed to the next test. (The operator may wish to use this option to discontinue error messages for this test once enough errors have been typed out to establish the area of the memory logic at fault.)

4-315 Program Procedure

4-316 Loader. The loader is capable of loading the program into either field of either module under sense switch control (see Loading Procedures).

4-317 Relocator. The program, once loaded, will, upon completion of all tests in a field, relocate itself to the other field of the same module and recommence testing. As relocation involves a forward displacement in memory of 1000 octal, the program will reside at the following starting locations in the following sequence.

pass 1,	field 2,	loc 1000
pass 2,	field 1,	loc 2000
pass 3,	field 2,	loc 3000
pass 10,	field 1,	loc 12000
pass 11,	field 2,	loc 13000
pass 12,	field 1,	loc 00000
pass 13,	field 2,	loc 1000

4-318 The modules each contain 8192 locations; 4096 are in one field, and the remaining 4096 are in another field. A field is defined by the sense winding in which the locations cores are found. The address determination of fields is shown below:

ADDRESS BITS 3 4 5 6 7 8 9 10 11 12 13 14 15

Field 1 is denoted by:

x x x 0 0 x x x x x x x x
and x x x 1 1 x x x x x x x x
that is, exclusive NOR of bits 6 and 7.

Field 2 is denoted by:

x x x 0 1 x x x x x x x x
and x x x 1 0 x x x x x x x x
that is, exclusive OR of bits 6 and 7.

4-319 Figure 4-3 illustrates the positioning of the fields in a module and the areas occupied by the program in each of the two passes through memory.

4-320 Executive. Program control will commence by testing all available memory locations of Field One. The program will relocate itself into every available memory location of Field Two. When all of memory has been tested in this manner, the program will relocate itself into Field One and begin testing all available core locations of Field Two. The program will relocate itself into all available core locations of Field One. This process will continue until the operator stops the program or until an error condition is detected. See Error Procedures.

4-321 PROGRAM TESTS

4-322 Test 1 - All Zeros

4-323 The purpose of this test is to assure the memory's ability to store and read all zeros. This test will attempt to write ones and then zeros into each location in the field under test. It will then check each location to assure that it contains zeros.

4-324 Test 2 - All Ones

4-325 The purpose of this test is to assure the memory's ability to store all ones. This test will attempt to write ones into each location in the test area. It will then check each location to assure that it contains all ones.

4-326 Test 3 - Sliding Zeros

4-327 The purpose of this test is to assure proper cabling of the memory data lines and to detect crosstalk which may occur because of improper cable placement.

4-328 The test will write a pattern in each location of the test area with all bits except one equal to one. Each location will be checked for pack-up of this bit. The program will then circularly shift the pattern one place and repeat the above test. Therefore, 16 passes of this test are required for each test area.

4-329 Test 4 - Address Discrimination Test

4-330 The purpose of this test is to assure the ability of the memory to address every location in core and detect errors associated with addressing failures. The subroutine will write each location's address into the location (in the test area); after all addresses are stored the contents are checked.

4-331 Test 5 - Maximum Delta Tests

4-332 The purpose of this test is to assure the memory's ability to store and read out data with the maximum interference cause by the secondary characteristic, delta noise of the cores. The Worst Case Pattern is stored in the test area and then checked. The content of each location is then inverted, tested, and restored to the worst case condition. The Worst Case Pattern is defined by table 4-6.

4-333 Test 6 - Random Numbers

4-334 The purpose of this test is to assure the ability of the memory to operate under simulated program use. Pseudo random numbers will be generated from the contents of a memory location not disturbed by loading the program and written in the test area. They will then be read and checked.

4-335 Test 7 - Core Heating Test

4-336 The purpose of this test is to detect and indicate defects in the ferrite core material by

Field Representation In a Core Module Octal Address	Memory Allocation During First Pass of Program	Memory Allocation During Second Pass of Program
0 Field 1	Test Area	
'400 Field 2	'1000 Memory Executive	Test Area
'1400 Field 1	Test Area	'2000 Memory Executive
'2400 Field 2	'2400 Test Programs	Test Area
'3400 Field 1	Test Area	'3400 Test Program
'4400 Field 2	'4400 Heat Test	Test Area
'5400 Field 1	Test Area	'5400 Heat Test
17400 Field 2		Test Area
17777 Field 1	Test Area	

Figure 4-3. Field Representation and Memory Partitioning During Run Time of Program (303020)

maximizing core heating through program means and assuring that the memory logic will operate at the highest possible frequency.

4-337 The program will select a random location and write a negative 128 in the location. It will set up 127 IMS instructions to access the selected location causing cores 0-8 in the selected location to be changed 2 out of every 3 memory cycles for 127 times. The location will be checked and the operation repeated until the computed time for core stabilization is exceeded by 10 percent. The extended core heating test (selected by SS 13) may be used in checking all core locations if desired for acceptance or reliability testing.

4-338 Bits 9-15 of the selected locations are tested by means of loading and storing all ones in the selected location and setting up 127 LAA instructions to access the selected core. The location is checked for accuracy, and the operation is repeated until computed core thermal stabilization time is exceeded by ten percent. These bits will be reversed one out of every two memory cycles.

4-339 DETAILED DESCRIPTION

4-340 This program is designed to operate in portions of four separate memory maps. All inter-map referencing is adjusted by the program itself both at initial load time and as the program is moved throughout memory. The four portions

Table 4-6. Worst Case Pattern Determination

	Y Axis				X Axis									Pattern
Address Bits	3	4	5	6	7	8	9	10	11	12	13	14	15	
	x	0	x	x	0	x	x	x	x	0	x	x	x	0
	x	0	x	x	0	x	x	x	x	1	x	x	x	1
	x	0	x	x	1	x	x	x	x	0	x	x	x	1
	x	0	x	x	1	x	x	x	x	1	x	x	x	0
	x	1	x	x	0	x	x	x	x	0	x	x	x	1
	x	1	x	x	0	x	x	x	x	1	x	x	x	0
	x	1	x	x	1	x	x	x	x	0	x	x	x	0
	x	1	x	x	1	x	x	x	x	1	x	x	x	1

are selected so that the program will be contained in one module field. The memory locations defined in table 4-7 apply only to the first test run. Each additional test is relocated by a bias of '1000 until memory is exceeded. At this time, the program is relocated into the lowest core location of the opposite field.

Table 4-7. First Test Run Memory Locations

Memory Location	Program/Subroutines
'1000 - '1377	Absolute Loader, Error Routine
'2400 - '2777	Initialization, Exec, Move Routine
'3000 - '3400	Test 1-6, Control Test 7
'4400 - '4777	Core Heating Test (#7)

4-341 Subroutines: Error Report (ERRO)

a. A-Accumulator = Correct, Bit Configuration

B-Accumulator = Address of Memory Location in error

b. Format Correct Bit Configuration

c. Format Error Bit Configuration

d. Format Address of Memory Location in Error

e. Test SNS 1

OFF: Output Error Message
ON: GO TO 6

f. Test SNS 2

OFF: GO TO 7
ON: Halt with Bits in Error in A-Accumulator, Test Number in B-Accumulator

g. Restore Correct Configuration to Error Location.

h. Test SNS 3.

OFF: Repeat Current Test
ON: GO TO next test

4-342 Initialization (STRT)

a. Clear Test Number, Module Number.

b. Compute Memory High.

c. Adjust LWA for Move Routines.

d. Compute Current Program Location.

e. Set Test Field FWA to Opposite Field.

4-343 EXEC (XITO)

a. Test Sense Switch 5

ON: GO TO 3 (XITI)
OFF: Advance Test Index
Check for all Test Complete

NO: GO TO next test
YES: Reset Test Index to One
Advance Field Module

b. Relocate Program by '1000.

c. Set FWA of Test Field.

d. Clear Error Flag.

e. Set A = Field Module, B = Test Number.

f. Test Sense Switch Zero

OFF: Execute Test
ON: Halt

4-344 Relocation Routine (MOVE)

a. Fix DACS; Relocate Loader, Error Routine.

b. Fix DACS; Relocate Heat Test.

c. Fix DACS; Relocate EXEC, Test Routines.

4-345 Test One Through Test Six

4-346 Test routines one through six have an identical program structure except for the bit patterns stored in the memory locations being tested. The basic program procedure is as follows:

a. Go to Subroutine ADRS

This subroutine determines the FWA of the field being tested. Each field is subdivided into core groups of '400 locations each. ADRS will generate the next FWA of each group and will check for the end of the field. If the end-of-field is reached, the program will exit to the next sequential location; otherwise program control will return to the next location plus one. B-Accumulator will contain the FWA of the next '400 octal locations.

b. Generate Test Pattern in A-Accumulator.

c. GO TO Subroutine NXT.

This subroutine will store the correct bit configuration in the next '400 locations.

d. When the field is completely filled with the proper bit configuration(s):

e. GO TO Subroutine ADRS for FWA of Group.

f. Generate Test Pattern in A-Accumulator.

g. GO TO Subroutine NXTZ.

This subroutine will compare the correct bit configuration(s) with the contents of the memory location addressed by the B-Accumulator. If an error is detected, program control will exit to the Error Routine.

h. When the entire field has been checked for data errors, the test will exit to the Executive.

4-347 Test Seven

4-348 Test Seven (core heating test) has the same program structure described above for Tests One to Six. However, the memory location is selected by a random number generator. The actual 127 IMS instructions and 127 LAA instructions are generated prior to the execution of these. Program control will return to the Executive when the test is complete.

4-349 SEL 810B Memory Diagnostic (HSPT Reader Version) (Catalog Number 303021)

4-350 LOADING AND OPERATION

a. Load the following bootstrap into memory:

Location	Octal	Instruction	
0	13012	CEU	2, W
1	001000	DATA	'100
2	170302	AIP	2, W
3	001016	LSL	8
4	174302	AIP	2, W, R
5	034000	STA	0, 1
6	000022	SAX	
7	110000	BRU	*-7
10	110004	BRU	*-4

b. Mount paper tape Catalog No. 303021A in HSPTR.

c. Reset all sense switches and begin execution of bootstrap at location zero. (This may be done by manually loading the P counter to all ones and depressing start twice.)

d. At the first computer halt the following sense switch options are available to locate the program into one of four memory areas.

Sense Switch Settings	Program is loaded into:
SSW2 = 0, SSW6 = 0	field two, module one
SSW2 = 0, SSW6 = 1	field one, module one
SSW2 = 1, SSW6 = 0	field two, module two
SSW2 = 1, SSW6 = 1	field one, module two

e. Program will then load and halt, whereupon the following sense switch options for the diagnostic may be exercised:

SSW0 = 1	Halt before execution of each test (A-Accumulator = address of test area, B-Accumulator = test number).
SSW1 = 1	Inhibit error typeouts
SSW2 = 1	Inhibit halt after error
SSW3 = 1	Advance to next test after error
SSW4 = 1	Loop on current test
SSW5 = 1	Inhibit TEST 1
SSW6 = 1	Inhibit TEST 2
SSW7 = 1	Inhibit TEST 3
SSW8 = 1	Inhibit TEST 4
SSW9 = 1	Inhibit TEST 5
SSW10 = 1	Inhibit TEST 6
SSW11 = 1	Inhibit program relocation
SSW12 = 1	Execute core heating test

f. Depress Start Once:

If sense switches 4-11 are not set, the program will execute all tests in a field, relocate itself into the opposite field, and start anew. This sequence will continue indefinitely testing all of memory. Setting of sense switch 0 will halt the program.

4-351 GENERAL

4-352 The program consists of an executive and seven test subprograms. The program is capable of execution in either memory module. The executive handles all error reporting and program relocation. Upon completion of all tests on that area of memory common to a sense winding, the program relocates itself, within a module, to the opposite sense winding and commences testing the area vacated.

4-353 The test subprograms are:

a. All zeros test

b. All ones test

c. Sliding zero test

d. Addressing test

e. Maximum Delta test

f. Random Numbers test

g. Core Heating test

4-354 Error Procedures

a. When an error is detected, and if sense switch 1 is not set, the following message will be typed out:

FAILURE TEST n
m:YY:XXX(PPPP) cccccc eeeeee

where:

n is the Test number

m is the module number

YY is octal Y address configuration

XXX is octal X address configuration

PPPP is location in octal of error word

cccccc is correct word contents in octal

eeeeee is error word contents in octal

b. If sense switch 2 is not set the program will halt after typing out with:

Contents of A = Test number

Contents of B = error bits of error word

c. If sense switch 3 is set, the program will abort any further activity in this test and proceed to the next test. (The operator may wish to use this option to discontinue error messages for this test once enough errors have been typed out to establish the area of the memory logic at fault.)

4-355 Program Procedure

4-356 Loader. The loader is capable of loading the program into either field of either module under sense switch control (see Loading Procedures).

4-357 Relocator. The program once loaded will upon completion of all tests in a field relocate itself to the other field of the same module and recommence testing. As relocation involves a forward displacement in memory of 1000 octal, the program will reside at the following starting locations in the following sequence:

pass 1,	field 2,	loc 1000
pass 2,	field 1,	loc 2000
pass 3,	field 2,	loc 3000
pass 10,	field 1,	loc 12000
pass 11,	field 2,	loc 13000
pass 12,	field 1,	loc 00000
pass 13,	field 2,	loc 1000

4-358 The modules each contain 8192 locations: 4096 are in one field, and the remaining 4096 are in another field. A field is defined by the sense winding in which the locations cores are found. The address determination of fields is shown below:

ADDRESS BITS 3 4 5 6 7 8 9 10 11 12 13 14 15

Field 1 is denoted by:

x x x 0 0 x x x x x x x x
and x x x 1 1 x x x x x x x x
that is, exclusive NOR of bits 6 and 7

Field 2 is denoted by:

x x x 0 1 x x x x x x x x
and x x x 1 0 x x x x x x x x
that is, exclusive OR of bits 6 and 7

4-359 Figure 4-4 illustrates the positioning of the fields in a module and the area occupied by the program in each of the two passes through memory.

4-360 Executive. Program control will commence by testing all available memory locations of Field One. The program will relocate itself into every available memory location of Field Two. When all of memory has been tested in this manner, the program will relocate itself into Field One and begin testing all available core locations of Field Two. The program will relocate itself into all available core locations of Field One. This process will continue until the operator stops the program or until an error condition is detected. See Error Procedures.

Field Representation In a Core Module Octal Address	Memory Allocation During First Pass of Program	Memory Allocation During Second Pass of Program
0 Field 1	Test Area	
'400 Field 2	'1000 Memory Executive	Test Area
'1400 Field 1	Test Area	'2000 Memory Executive
'2400 Field 2	'2400 Test Programs	Test Area
'3400 Field 1	Test Area	'3400 Test Program
'4400 Field 2	'4400 Heat Test	Test Area
'5400 Field 1	Test Area	'5400 Heat Test
17400 Field 2		Test Area
17777 Field 1	Test Area	

Figure 4-4. Field Representation and Memory Partitioning During Run Time of Program (303021)

4-361 PROGRAM TESTS

4-362 Test 1 - All Zeros

4-363 The purpose of this test is to assure the memory's ability to store and read all zeros. This test will attempt to write ones and then zeros into each location in the field under test. It will then check each location to assure that it contains zeros.

4-364 Test 2 - All Ones

4-365 The purpose of this test is to assure the memory's ability to store all ones. This test will attempt to write ones into each location in the test area. It will then check each location to assure that it contains all ones.

4-366 Test 3- Sliding Zeros

4-367 The purpose of this test is to assure proper cabling of the memory data lines and to detect crosstalk which may occur because of improper cable placement.

4-368 The test will write a pattern in each location of the test area with all bits except one equal to one. Each location will be checked for packup of this bit. The program will then circularly shift the pattern one place and repeat the above test. Therefore, 16 passes of this test are required for each test area.

4-369 Test 4 - Address Discrimination Test

4-370 The purpose of this test is to assure the ability of the memory to address every location in core and detect errors associated with addressing failures. The subroutine will write each location's address into the location (in the test area); after all addresses are stored the contents are checked.

4-371 Test 5 - Maximum Delta Tests

4-372 The purpose of this test is to assure the ability of the memory to store and read out data with the maximum interference caused by the secondary characteristic, delta noise of the cores. The Worst Case Pattern is stored in the test area and then checked. The content of each location is then inverted, tested, and restored to the worst case condition. The Worst Case Pattern is defined by table 4-6.

4-373 Test 6 - Random Numbers

4-374 The purpose of this test is to assure the ability of the memory to operate under simulated program use. Pseudo random numbers will be generated from the contents of a memory location not disturbed by loading the program and written in the test area. They will then be read and checked.

4-375 Test 7 - Core Heating Test

4-376 The purpose of this test is to detect and indicate defects in the ferrite core material by maximizing core heating through program means and assuring that the memory logic will operate at the highest possible frequency.

4-377 The program will select a random location and write a negative 128 in the location. It will set up 127 IMS instructions to access the selected location causing cores 0-8 in the selected location

to be changed 2 out of every 3 memory cycles for 127 times. The location will be checked and the operation repeated until the computed time for core stabilization is exceeded by 10 percent. The extended core heating test (selected by SS 13) may be used in checking all core locations if desired for acceptance or reliability testing.

4-378 Bits 9-15 of the selected locations are tested by means of loading and storing all ones in the selected location and setting up 127 LAA instructions to access the selected core. The location is checked for accuracy, and the operation is repeated until computed core thermal stabilization time is exceeded by ten percent. These bits will be reversed one out of every two memory cycles.

4-379 DETAILED DESCRIPTION

4-380 This program is designed to operate in portions of four separate memory maps. All inter-map referencing is adjusted by the program itself both at initial load time and as the program is moved throughout memory. The four portions are selected so that the program will be contained in one module field. The memory locations defined in table 4-7 apply only to the first test run. Each additional test is relocated by a bias of '1000 until memory is exceeded. At this time the program is relocated into the lowest core location of the opposite field.

4-381 Subroutines: Error Report (ERRO)

a. A-Accumulator = Correct, Bit Configuration

   B-Accumulator = Address of Memory Location in Error

b. Format Correct Bit Configuration

c. Format Error Bit Configuration

d. Format Address of Memory Location in Error

e. Test SNS 1

   OFF: Output Error Message
   ON: GO TO 6

f. Test SNS 2

   OFF: GO TO 7
   ON: Halt with Bits in Error in A-Accumulator, Test Number in B-Accumulator

g. Restore Correct Configuration to Error Location

h. Test SNS 3

   OFF: Repeat Current Test
   ON: GO TO next test

4-382 Initialization (STRT)

a. Clear Test Number, Module Number

b. Compute Memory High

c. Adjust LWA for Move Routines

d. Compute Current Program Location

e. Set Test Field FWA to Opposite Field

4-383 EXEC (XITO)

a. Test Sense Switch 5

   ON: GO TO 3 (XITI)
   OFF: Advance Test Index
   Check for all Test Complete

      NO: GO TO next test
      YES: Reset Test Index to One
      Advance Field Module

b. Relocate Program by '1000

c. Set FWA of Test Field

d. Clear Error Flag

e. Set A = Field Module, B = Test Number

f. Test Sense Switch Zero

   OFF: Execute Test
   ON: Halt

4-384 Relocation Routine (MOVE)

a. Fix DACS; Relocate Loader, Error Routine

b. Fix DACS; Relocate Heat Test

c. Fix DACS; Relocate EXEC, Test Routines

4-385 Test One Through Test Six

4-386 Test routines one through six have an identical program structure except for the bit patterns stored in the memory locations being tested. The basic program procedure is as follows:

a. Go to Subroutine ADRS

This subroutine determines the FWA of the field being tested. Each field is subdivided

into core groups of '400 locations each. ADRS will generate the next FWA of each group and will check for the end of the field. If the end-of-field is reached, the program will exit to the next sequential location; otherwise program control will return to the next location plus one. B-Accumulator will contain the FWA of the next '400 octal locations.

b. Generate Test Pattern in A-Accumulator.

c. GO TO Subroutine NXT.

This subroutine will store the correct bit configuration in the next '400 locations.

d. When the field is completely filled with the proper bit configuration(s):

e. GO TO Subroutine ADRS for FWA of Group.

f. Generate Test Pattern in A-Accumulator.

g. GO TO Subroutine NXTZ

This subroutine will compare the correct bit configuration(s) with the contents of the memory location addressed by the B-Accumulator. If an error is detected, program control will exit to the Error Routine.

h. When the entire field has been checked for data errors, the test will exit to the Executive.

4-387 Test Seven

4-388 Test Seven (core heating test) has the same program structure described above for Tests One to Six. However, the memory location is selected by a random number generator. The actual 127 IMS instructions and 127 LAA instructions are generated prior to the execution of these. Program control will return to the Executive when the test is complete.

4-389 SEL 810B Priority Interrupts Test Program (Catalog Number 303022)

4-390 LOADING AND OPERATION

a. Load with standard relocatable loader, catalog number 300001B, with A-Accumulator set to 0 and B-Accumulator set to 2.

b. Program starting location is location 2000 octal. However, the teletype messages may be checked by starting at location 2040 whereupon the program will halt at location 2132 octal in the power failure interrupt processor. Master clear and depress start twice and the program will type out all interrupt messages and halt when complete at location 2073 octal.

c. Master clear, set Pc to 1777 and depress start twice.

d. Program will enable all interrupts and loop through locations 2001 - 2015 octal (BGN) waiting for interrupts to occur. The B-Accumulator will be counting during this loop for visual verification of program locale.

e. Turning off power will cause program to interrupt to the power fail interrupt processor where registers A and B will be saved, and a LOB back to the power fail interrupt processor will be stored in location 0. The program will halt prior to shut down of dc power. Restoring power, setting the program counter to all ones and depressing start twice will cause the program to execute the LOB at location 0 back to the power fail interrupt processor where the A and B registers will be restored and program con rol will revert back to BGN waiting for further interrupts.

f. Hardware activation of any of the other available interrupt lines will cause a typeout of: STALL if the stall interrupt line is activated, or GROUP n, LEVEL m where n is the group number and m is the level number of the interrupt level activated. Program control will then revert back to BGN waiting for further interrupts.

g. Note that if an interrupt is being processed (group and level being typed) and a higher priority interrupt is activated, the message in progress is aborted and the new interrupt will be processed. This sequence of events will necessitate halting the program and restarting at location 2000 octal for proper testing of further interrupts. This is because all interrupt levels share the same interrupt processor, and the processor does not disable all higher level interrupts prior to servicing the current interrupt.

h. Sense switch settings

1. Set SSW 15 to suppress typeout (normally used when scoping repetitive interrupts).

2. Set SSW14 to disable interrupt after interrupt is generated and processed (this facilitates testing of PID instruction).

3. Set SSW13 to en-enable interrupts disabled by SSW14.

4-391 **SEL 810B Memory Driver Turnoff Test (Catalog Number 303023)**

4-392 LOADING AND OPERATION

a. LOAD with Relocatable Loader, Catalog Number 300001B with A- and B-Accumulators cleared.

b. When load complete set 7777_8 into P-Register.

c. If memory parity option tied to priority interrupt then set Sense Switch 1.

d. Depress start twice.

e. If Sense Switch 1 set computer will halt whereupon the dedicated location for the interrupt line used should be inserted into the A-Accumulator and Start depressed.

4-393 GENERAL

4-394 The program will load into and begin execution from location 10000_8. Core availability is determined by the program, and all of core memory from location 0 up to but not including location 10000_8 is tested for simultaneity in X and Y driver turn off. The program then relocates itself into lower memory at loc 0 and commences testing memory from loc 10000_8 to the end of memory. A pass no. XX, ERR Cnt YY message will then be typed out where XX is the number of passes in decimal and YY is the number of errors detected in decimal for this pass.

4-395 SENSE SWITCHES

4-396 The following sense switches are available for operator control:

SSW1 = 1 Include testing of parity bit

SSW2 = 1 Loop on current test address

SSW3 = 1 Inhibit error typeout

SSW4 = 1 Halt after error typeout

SSW5 = 1 Inhibit relocation of program

SSW6 = 1 Halt after pass complete message

4-397 ERROR PROCEDURES

4-398 Upon detection of an error the program will (if SSW3 = 0) cause the following message to be typed out:

LOC XXXXXX

CWD YYYYYY

EWD ZZZZZZ

NOTE

If YYYYYY = ZZZZZZ then memory parity error has occurred.

Where:

XXXXXX is the location in memory of the failing word in octal.

YYYYYY is the correct or expected contents of loc XXXXXX in octal.

ZZZZZZ is the error contents of loc XXXXXX in octal.

4-399 If SSW4 = 1 the computer will halt with the error address displayed in the B-Accumulator and the error contents displayed in the A-Accumulator.

4-400 BACKGROUND

4-401 The 2-1/2D core memory (SEL 810B Memory) utilizes a selection technique whereby two cores are common to an X-Y drive line pair. See figure 4-5; note that with drive lines X and Y passing currents as shown there is an additive effect in, and thereby selection of, core B. These same currents cancel in core A. As X current precedes Y current it is noted that the maximum current through core A in case 1 is a half select current which if repeated indefinitely will not change the state of core A.

4-402 The problem arises when X and Y currents do not turn off simultaneously as in cases 1 and 2, and where the resultant sums of the X and Y currents (including overshoot) in core A amount to more than a half select current. In case 2, if core A was a one, many read selections of core B would tend to "walk" core A down the hysteresis loop to the point that a read selection of core A would not produce a one on the sense winding. The inverse would prevail for case 3 where core A was originally a zero.

4-403 In the SEL 810B memory the directionality of read current in a Y drive line is determined by address bit 7, hereafter referred to as the phase bit. Consequently, cores common to the same X-Y drive pair have

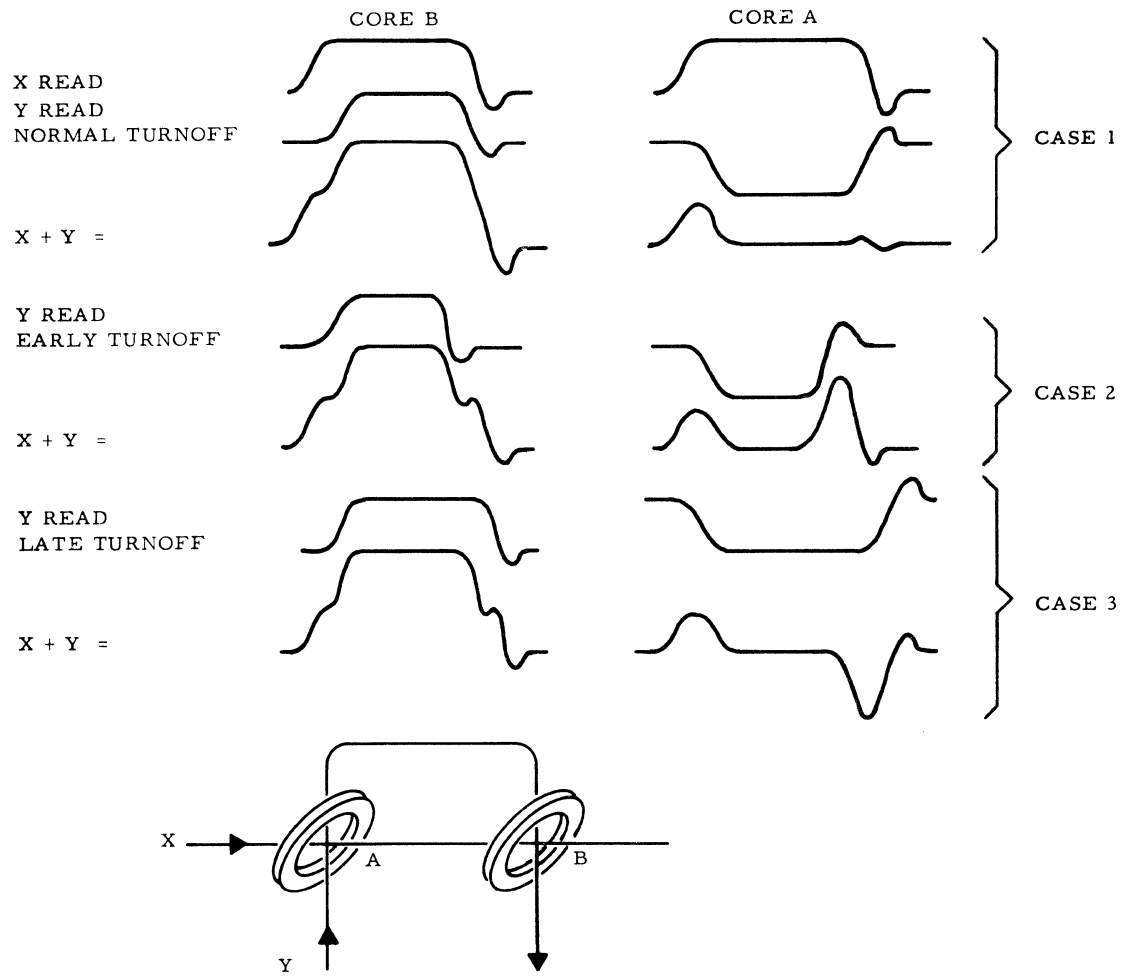


Figure 4-5. XY Read Select of Core B and Resultant Currents in Core A and B for Normal, Early, and Late Turnoff of X Drive Current

identical addresses except for their phase bit.

4-404 TEST DESCRIPTION

a. Starting with location n (n = 0).

b. If SSW1 = 1 go to step j.

c. Load loc n with 1, loc n + 400 with 0.

d. Execute 1000 read/restores on location n.

e. Enable memory parity interrupt.

f. Fetch and examine loc n + 400 for no change and no parity interrupt.

g. Reverse contents and roles of loc n and 1 loc n + 400 and execute steps d-f.

h. Load loc n and loc n + 400 with 1 and execute steps d-f.

i. Reverse roles of loc n and loc n 400 and execute steps d-f.

j. Load loc n with 0, location n + 400 with 177777_8 and execute steps d-f.

k. Reverse contents and roles of loc n and loc n + 400 and execute steps d-f.

l. Load loc n and loc n + 400 with 177777_8 and execute steps d-f.

m. Reverse roles of loc n and loc n + 400 and execute steps d-f.

n. Increment n and n + 400 by one such that the phase bit is always a zero in address n and always a one in address n + 400.

o. If n now equals first program location relocate program to loc 0 and set n to 10000_8.

p. If n now is greater than available memory print pass complete message and if SSW6 set halt, otherwise relocate program to location 10000_8 and set n to 0.

q. Go back and execute starting from step b.

4-405 Magnetic Tape Read-Write Parity Checker - MTRWPC (Catalog Number 333001A)

4-406 LOADING AND OPERATION

4-407 To load and operate the magnetic tape read-write parity checker, perform the following steps: (Step a. is akipped if the relocatable loader has previously been loaded into memory.)

a. Load the manual bootstrap and bootstrap package as explained in Section II.

b. Install the MTRWPC tape (catalog number 333001A) on either the console paper tape reader or high-speed paper tape reader.

c. Load the MTRWPC diagnostic program into memory using the diagnostic loading procedure (relocatable) defined in paragraph 2-33. Load with the relocatable loader using a base address of 00000.

d. Manually load the address 00000 into the program counter. Address 00000 is the starting address of the MTRWPC program.

e. Raise the appropriate control panel SENSE/HALT/LOAD T switches to select the data configuration to be written on magnetic tape. The program writes a 128-word record of the data using three characters per word. The three characters in a word are controlled as follows:

Switches 0 through 5 - first character
Switches 6 through 11 - second character
Switches 12 through 15 - third character (two zeros automatically included).

f. Lower the START/STOP toggle switch on the computer console control panel.

4-408 ERROR-FREE OPERATION

4-409 The program should write 128-word records on tape. After each record is written, a backspace is performed and the record is read back. The records should consist of 3 characters per word, the characters being equal to the control panel switch setting. When end of tape is detected, the program rewinds the tape and automatically restarts the program. The program continues in this manner until the computer is manually halted. If no read or write errors are detected there are no type-outs.

4-410 ERROR INDICATIONS

4-411 Error indications are as follows:

Error Halts - None

Error Type-Outs - WPE is typed-out on the console printer if a write parity error is detected. The tape handler is back-spaced and a read is performed. RPE is typed out if a read parity error is detected. A comparison is made between each word

written in a record and the value that is set into the console switches. Incorrect data values are typed out on the teletype in an octal format.

4-412 Isolating the Failing Bit

4-413 If a WPE and RPE type-out occurs for the same record, it is likely that a bit is being dropped during the write operation.

4-414 If an RPE is typed out without a WPE, it is likely that a bit is being dropped during the read operation.

4-415 When the word written does not correspond to the configuration set into the console switches, the incorrent data value is typed out. An examination of this type-out should indicate the bits that are being dropped or added. This can be verified by using different configurations for the data that is set into the control console switches.

4-416 DETAILED DESCRIPTION

4-417 Upon initialization, the program is designed to read the console switch settings (CS 0-15) and store the bit configuration into a 128-word core buffer. The program will write a 128-word record of the data using three characters per word at a density of 800 bpi. A test will be made to determine if a write parity error has occurred. If an error has occurred, the program will print out WPE on the teletype. The program will then backspace and read a record. If a read parity error has occurred, the program will print out RPE on the teletype. A comparison is made of each word in the record to the value which was set by the console switches. Incorrect data values are output to the teletype in octal format. The program continues in the above manner until the program is manually halted or end of tape is detected at which time the program will rewind the tape and restart the program. The complete MTRWPC diagnostic program listing is included in program description, catalog number 333001.

4-418 **Magnetic Tape Exerciser - MTE (Catalog Number 333002B)**

4-419 LOADING AND OPERATION

4-420 To load and operate the magnetic tape exerciser program, perform the following steps: (Step a. is skipped if the relocatable loader has previously been loaded into memory.)

a. Install the write ring on the magnetic tape reel.

b. Load the manual bootstrap and bootstrap package as explained in Section II.

c. Install the MTE diagnostic tape (catalog number 333002) on either the console paper tape reader or high-speed paper tape reader.

d. Load the MTE diagnostic program into memory using the diagnostic loading procedure (relocatable) defined in paragraph 2-33. The MTE is loaded by the relocatable loader.

e. Manually load address 02000_8 into the program counter. Address 2000_8 is the starting address of the magnetic tape exerciser program. All references to addresses, instructions, or programmed halts assume that the program has not been relocated.

NOTE

If the MTE diagnostic has been run at least once and it is not desired to change the program parameters, enter address 2007_8 into the program counter.

f. Lower the START/STOP toggle switch on the computer console.

4-421 ERROR-FREE OPERATION

4-422 The program causes the console printer to type-out BTC number and then stop. The program is now waiting for an operator's response through the console keyboard. Table 4-8 gives the print outs that will follow and what the operator's typed-in response should be. After the operator responds with a type-in, the program types out the next message and stops again, waiting for another operator response.

NOTE

The operator must type in leading zeros where necessary in order to fulfill the number of characters required by the response.

4-423 Once the parameters, specified in table 4-8, in paragraph 4-422, are entered, the MTE remains in a control switch loop waiting for a given test to be called for. The operator must now set up the SENSE/HALT/LOAD T switches to specify the type of tape unit to be tested and the operation that is to be performed.

g. Set the computer console SENSE/HALT LOAD T switches for the operation desired. The following listing describes the operations

Table 4-8. Type-Outs For Program Initialization

Type-Outs	Operator's Response
BTC NO	Type the BTC number connected to the tape control unit. BTC numbers are from 1 through 8. (Ignored in system if it has no BTC.)
TRANS NO	Type the transport number as an octal digit. Legal values are 0 - 7.
CHR/WD	The number of characters per word to be used by the program in setting up the tape transport. a. One character per word, type a 1. Seven-track tape transfers 6 data bits. Nine-track tape transfers 8 data bits. b. Two characters per word, type a 2. Seven-track tape transfers 12 data bits. Nine-track tape transfers 16 data bits. c. Three characters per word, type a 3. Seven-track tape transfers 16 data bits. Nine-track tape transfers 16 data bits.
MODE	Type in 0 for binary mode. Type in 1 for BCD mode.
DENSITY	Type in 0 for 200 bpi. Type in 1 for 556 bpi. Type in 2 for 800 bpi.
DATA	Type in six octal digits which will represent the fixed data used by the program in writing and reading. The first character must be 0 or 1.
R LENGT	Type in 6 octal digits which will represent the maximum size of the record. This number will correspond to the number of computer words not characters. The first character must be a zero. The maximum size of the record may be 3777 octal or the maximum size of core memory. The input/output buffer begins
R LENGT (cont'd)	at the end of the program. The starting location of the buffer is 4705_8.
F LENGT	Type in 6 octal digits which will represent the number for records written of each file. The maximum number of records is 037777_8. The first character must be zero.
NO OF EOFS	Type in 6 octal digits which will represent the number of end of files to be written or read by the program for a complete test. The maximum number is 037777. The first character must be zero.

performed under control of the control panel switches:

1. S/H/L T Switch 0
   Raised - Ignore typeout of any errors detected by the program.
   Centered - Typeout of errors detected by the program.

2. S/H/L T Switch 1
   Raised - Program will operate in the 9-track mode.
   Centered - Program will operate in the 7-track mode.

3. S/H/L T Switch 2
   Raised - Program must be operating in the 9-track mode and the tape control unit must have the SEL CRC corrector option.
   Centered - No effect on the program.

4. S/H/L T Switch 3
   Raised - The program will not use the BTC unit. Input and output will occur as follows:
   Input: AIP TAPE, W
   Output: AOP TAPE, W
   Centered - The program will use the BTC unit.

5. S/H/L T Switch 4
   Raised - The program will operate in the random number mode. Records will contain random numbers generated by the program.

Centered - The program will use the fixed data value which was input upon initialization.

6. S/H/L T Switch 5
   Raised - The program will generate variable records. The maximum record size will be decremented by one word until a one-word record is reached, whereby the program will increment the record until the maximum count is reached.
   Centered - The program will use the parameters which were entered upon program initiation.

7. S/H/L T Switch 7
   Raised - Activate Test One (Basic Test).
   Centered No effect once the program is activated.

8. S/H/L T Switch 8
   Raised - Activate Test Two (Write-Read Test).
   Centered - No effects on the program once the test is activated.

9. S/H/L T Switch 9
   Raised - Activate Test Three (Write Test).
   Centered - No effect on the program once the test is activated.

10. S/H/L T Switch 10
    Raised - Activate Test Four (Read Test).
    Centered - No effect on the program once the test is activated.

11. S/H/L T Switch 11
    Raised - Activate Test Five (EOF Test).
    Centered - No effect on the program once the test is activated.

12. S/H/L T Switch 14
    Raised - The program will output the word number of the incorrent data within the given record.
    Centered - The word number will not be output to the teletype.

13. S/H/L T Switch 15
    Raised - Terminate the test. The program will terminate the test output of the counters, rewind to load point, and return to the control switch loop.
    Centered - No effect on the program.

NOTE

A detailed description of the tests is given in paragraph 4-443.

h. Lower the START/STOP toggle switch on the computer console control panel.

4-424 ERROR-FREE OPERATION

4-425 The program should perform the test specified by the SENSE/HALT/LOAD T switches (see step e. paragraph 4-420). Upon completion of a test, the program types out a table of 16 counters on the teletype. These counters, as shown in table 4-9, are each identified by a two-character symbol.

4-426 ERROR INDICATIONS

4-427 Error indications are listed in the following:

Error Halts - None

Error Type-Outs - If an error is detected, the program types out an error status message providing SENSE/HALT/LOAD T switch zero is set. The error messages and their meanings are as follows.

Table 4-9. Program Counters and Output Upon Test Completion

Counter	Definition
WT	The total number of records written. This total includes the number of records which were rewritten because of a write parity error.
NW	The total of current number of records which were written. This total is exclusive of the records which were rewritten because of a parity error.
RT	The total number of records read. This total includes the number of records which were reread because of a read or CRC parity error.
NR	The number of records read exclusive of records reread because of parity errors.
FW	The number of end of file marks written.

Table 4-9. Program Counters and Output Upon Test Completion (Cont'd)

Counter	Definition
FR	The number of end of file marks read. Write parity error count. The number of write parity errors that have occurred.
WP	Total number of write parity errors.
W5	Write parity error after five attempts. This is the number of records for which five attempts were made to rewrite the record without a parity error.
RE	Read parity error. The number of read parity errors that have occurred.
R5	Read parity error after five attempts. This is the number of records which generated five consecutive read parity errors.
CE	CRC errors. The total number of CRC errors which have occurred.
C5	CRC error for five consecutive reads. This is the number of records which generated five consecutive CRC errors.
CR	Read parity and CRC parity counter. The number of records which generated both a read and CRC parity error.
OV	Overflow counter. The number of records which generated an overflow condition. The number of words transferred was less than the size of the record.
EF	End of file error count. Number of end of files detected which were not correctly written or a false indication of end of file.
CW	The counter is updated whenever an end of record gap is detected and the block transfer control unit has not been decremented to zero.

WP XXXXXX
Five consecutive write parity errors. If a write parity error is detected, the program will backspace over the record and attempt to rewrite it. If five consecutive parity errors occur, this message will be output to the teletype. The X's represent the record number.

RP XXXXXX
Five consecutive read parity errors. If a read parity error is detected, the program will backspace over the record and attempt to reread the record. If five consecutive parity errors occur, this message will be output to the teletype. The X's represent the record number.

CR XXXXXX
Five consecutive CRC parity errors. If a CRC parity error is detected, the program will backspace over the record and attempt to reread the record. Five consecutive CRC errors will cause the message to be output to the teletype. The X's represent the record number.

OV XXXXXX
Read overflow condition. If the data transfer is complete and no gap is detected, the program will output the message to the teletype. The X's represent the record number.

RN XXXXXX
Data error. The X's represent the record number in error. The data in each record which is read is compared to the fixed data or the random number pattern. When an unequal compare is detected, the program will output the erroneous data as follows:

Fixed Data Compare Message
XXXXXX (ZZZZZZ) optional where X represents the data which was read incorrectly and Z represents the word number in the record which will be output only when control switch 14 is set.

Random Data Compare Message
XXXXXX YYYYYY ZZZZZZ where X represents the erroneous number, Y represents the correct data, and Z will represent the word number in the record (Control Switch Set).

EF XXXXXX YYYYYY ZZZZZZ
End of file error. The program will test for EOF marks after each record is read. If an EOF is detected which is not properly record on the tape, the program will output the abov message.

X represents the incorrect number of EOF's

Y represents the number of correct EOF's which have been properly detected.

Z represents the record number preceding the incorrect EOF.

CW XXXXXX YYYYYY ZZZZZZ
Current word address error. The program must be operating in the block transfer mode. After each read operation, the program will input the current word address from the block transfer control unit. A comparison of this value is made to a calculated current word address. If the values are not equal this message will be output to the teletype. X represents the current word address from the block transfer control unit.

Y represents the current address as calculated by the program.

Z represents the record number.

The starting word address is initially set to location 04705_8. The current word address after the reading of a record should be equal to the starting address plus the word count. When a CWA message is output the difference in the CWA input from the BTC and the calculated current word address represents the number of words not transferred when the end of record gap was detected.

4-428 Isolating the Failing Bit Configuration

4-429 Run the tests specified in paragraph 4-423, step g. using different bit configurations (see DATA in listing in paragraph 4-422). Using this procedure, it may be possible to isolate the problem to the failing track.

4-430 Troubleshooting

4-431 To facilitate troubleshooting, SENSE/HALT/LOAD T switch 0 may be raised to eliminate error type-outs. Use the magnetic tape troubleshooting and adjustment procedures included in SEL Tape Control - Magnetic Tape Unit Systems Technical Manual, publications number 95005 and Ampex Memory Systems Technical Manual 3108966-10 (TM-7 and TM-9) or 3110278-10 (TM-11 and TM-12).

4-432 DETAILED DESCRIPTION

4-433 The complete MTE diagnostic program listing is included in the program description, catalog number 333002. The following describes the tests performed with the MTE diagnostic program:

4-434 Test 1. Basic Movement.

4-435 This test is designed to check the CEU format zero commands and to verify basic motion commands. The program will rewind tape and check for load point, then erase four inches of tape, and write an end of file record which will be searched forward and backward.

1. A successful cycle will result in the following output message:

   LPCK
   F
   EOF OK (forward end of file search)
   R
   EOF OK (reverse end of file search)

   This test will continue until control switch seven is reset.

2. Unsuccessful message output:

NO ADV	The tape did not advance from load point.
NO EOF	No end of file was detected.
NOLP	Load point check failed.

4-436 Test 2. Write, Read Test

4-437 Initially, the tape transport selected is rewound to load point. The program will then write a record, backspace, then read the record comparing the data input to the fixed data value or the random number. The program will operate under control of the parameters which were input upon initialization of the program.

4-438 Test 3. Write Test

4-439 Initially, the tape transport is selected and rewound to load point. The program will write fixed data, fixed size records, and files as were specified upon program initiation, or will write random numbers and variable records. The program will sense the control switches to determine its mode of operation. The program uses either the block transfer command or a character output command which is:

AOP TAPE, W

1. Write Error. If a write parity error is detected the program will backspace and attempt to rewrite the record. If a write parity error occurs after five consecutive attempts to rewrite the record the program outputs the write parity message and the record number.

2. Data. The program will write either fixed data or random data dependent upon control switch 4.

3. Variable Records. The program will write variable records in the following

manner. The maximum word size indicated in the parameter set up will be decremented until the word count is one whereby the word count will be incremented until the word count reaches its maximum size. An end of file will then be written. This will be considered to be one file. If more than one file was specified, the program will repeat the process until the specified number of files have been written or the test is terminated.

4. End of Test. The write test is concluded if one of three conditions occurs. Either the end of file count has reached zero; or the physical end of tape is detected; or the test is terminated by setting control switch 15.

4-440 Test 4. Read Test

4-441 The read test is similar to the write test except that the program reads each record into memory and compares it with the fixed data or ra random numbers which it generates for each read. The first record must be read starting from load point. This insures that the tape is always positioned properly for the start of the test. The following lists features included in Test 4:

1. Read Parity Error. When a read parity error occurs the program will reread the record up to a maximum of five attempts. If five consecutive read parity errors occur, the program will output the read parity message.

2. CRC Parity Error (9-Track). When a CRC parity error occurs the program will reread the record up to a maximum of five attempts. If the control unit has the CRC option, the program will issue the read commands using the CRC bit in an attempt to correct the error if it is correctable.

3. CWA Current Word Address. When the program is in operation using the block transfer control unit, the program will input the current word address from the block transfer control unit and determine if the current word address brought into the dedicated BTC address location is correct. This condition may occur when the end of record gap is detected prior to a word count of zero in the BTC. The program will then terminate the BTC and output the address of the next word that was to be output.

4. End of File Error. The program is designed to read an end of file as determined by the parameters input during initialization of the test. Any other end of file is considered to be an error. The program will check for an EOF after each read operation.

5. Overflow. The pro gram will check for read overflow after each read operation. Read overflow should not occur at any time during any given test. The read overflow condition is detected when the BTC word count has reached zero and the end of record gap has not been detected by the tape transport.

6. Variable Records. The program will read variable records beginning with the maximum size through one-word records and then increment to the maximum size. This read test should follow the write test.

7. End of Test. The read test is concluded if anyone of the following three conditions occur:

   Control switch is set.
   End of tape is detected.
   The specified number of records and files have been read.

4-442 Test 5. End of File Test

4-443 The program will advance the specified number of records and test for an end of file mark. The program will continue in the same manner until all file marks are detected which were input during initialization. If an EOF mark is detected erroneously, the end of file error message will be output to the teletype. When the test has been completed the following message will occur:

XXXXXX YYYYYY, where X represents the number of files that were to be detected, and Y represents the number which have been detected.

4-444 BCD Mode

4-445 In the BCD mode, random numbers or fixed data may be written the same as in binary. However, on the read pass all numbers compared between the generated number and the number from tape are checked to see if they are caused by 12 to 00 conversion. This occurs because both the character 00 and the character 12 will be written on tape as a 12 octal. This character will always be read into memory as a 00.

4-446 This program does not use the multiply or divide hardware instructions.

4-447 Three characters per word may be specified for 7- and 9-track tape; however, output and input will be 16 bits (one SEL 810A word).

4-448 Line Printer Diagnostic — LPD (Catalog Number 373001A)

4-449 LOADING AND OPERATION

4-450 To load and operate the line printer diagnostic, perform the following steps (step d. is skipped if the relocatable loader has previously been loaded into computer memory:

a. Prepare and load the 8-channel paper tape loop, vertical format tape, on the line printer vertical from control. The vertical format tape loop must be set up for 66 lines. The following lists the line numbers and channels to be punched on the format tape:

Line Number	Vertical Format Punch
4	1
10	2
20	3
31	4
40	5
50	6
57	7
61	8

b. Depress the top of form button on the line printer.

c. Place the paper into position on the printer with the second line of the paper directly over the print hammers.

d. Load the Manual Bootstrap and Bootstrap package as explained in Section II.

e. Install the line printer diagnostic tape (catalog number 373001) on either the console paper tape reader or high-speed paper tape reader.

f. Load the line printer diagnostic program into memory using the diagnostic loading procedure (relocatable) defined in paragraph 2-33. The line printer diagnostic is loaded by the relocatable loader.

g. Manually load address 2000_8 into the program counter. Address 2000_8 is the starting address of the line printer diagnostic program.

h. Set the computer console SENSE/HALT/LOAD T switches for the test to be performed as indicated in the following:

1. S/H/L T Switch 3
   Raised - The program will halt. Press start to continue.
   Centered - No effect on the program.

2. S/H/L T Switch 7
   Raised - Vertical Format Channel Test 1
   Centered - Terminate test and return to the computer switch loop.

3. S/H/L T Switch 8
   Raised - Character Spiral Test 2
   Centered - Terminate the test.

4. S/H/L T Switch 9
   Raised - Triangle Test 3.
   Centered - Terminate the Test.

5. S/H/L T Switch 10
   Raised - One line per character Test 4.
   Centered - Terminate the test.

6. S/H/L T Switch 11
   Raised - Diagonal Test 5.
   Centered - Terminate the test.

7. All Switches Reset
   The program loops until a test is called for with the switches or the program is halted manually.

NOTE

A detailed description of the tests is given in paragraph 4-458.

i. Lower the START/STOP toggle switch on the computer console two times.

4-451 ERROR-FREE OPERATION

4-452 The program should perform the test specified by the option and control switches. Once a specified test is activated, the program repetitively cycles through the test until the operator resets the SENSE/HALT/LOAD T switch.

4-453 ERROR INDICATIONS

4-454 Error indications are listed in the following:

Error Halts - None

Error Type-Outs - The program types out the following messages on the console printer. Other errors can be detected by comparing the line printer output to the sample printouts shown in figures 4-6 through 4-10.

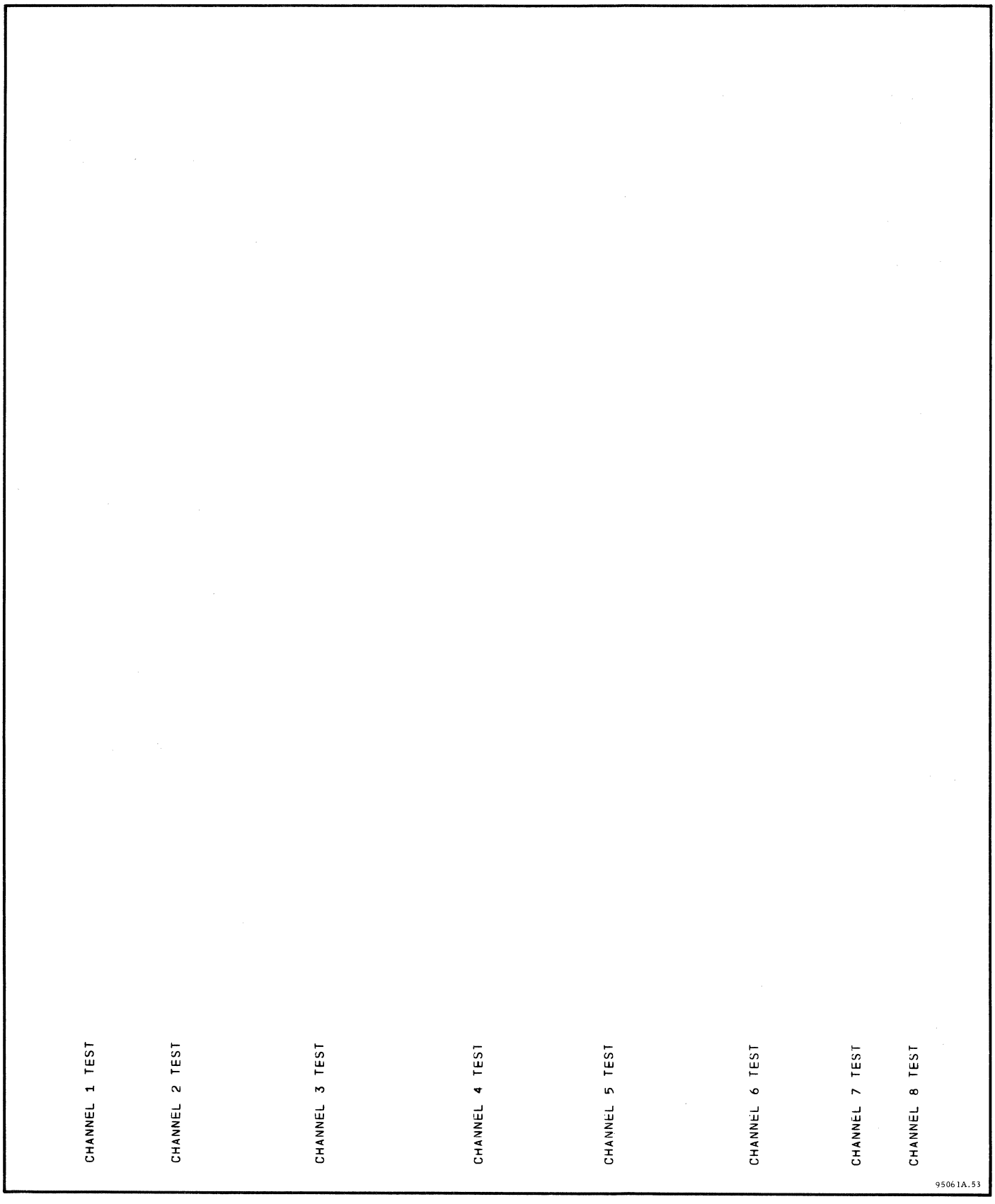


Figure 4-6. Test One Sample Print-Out

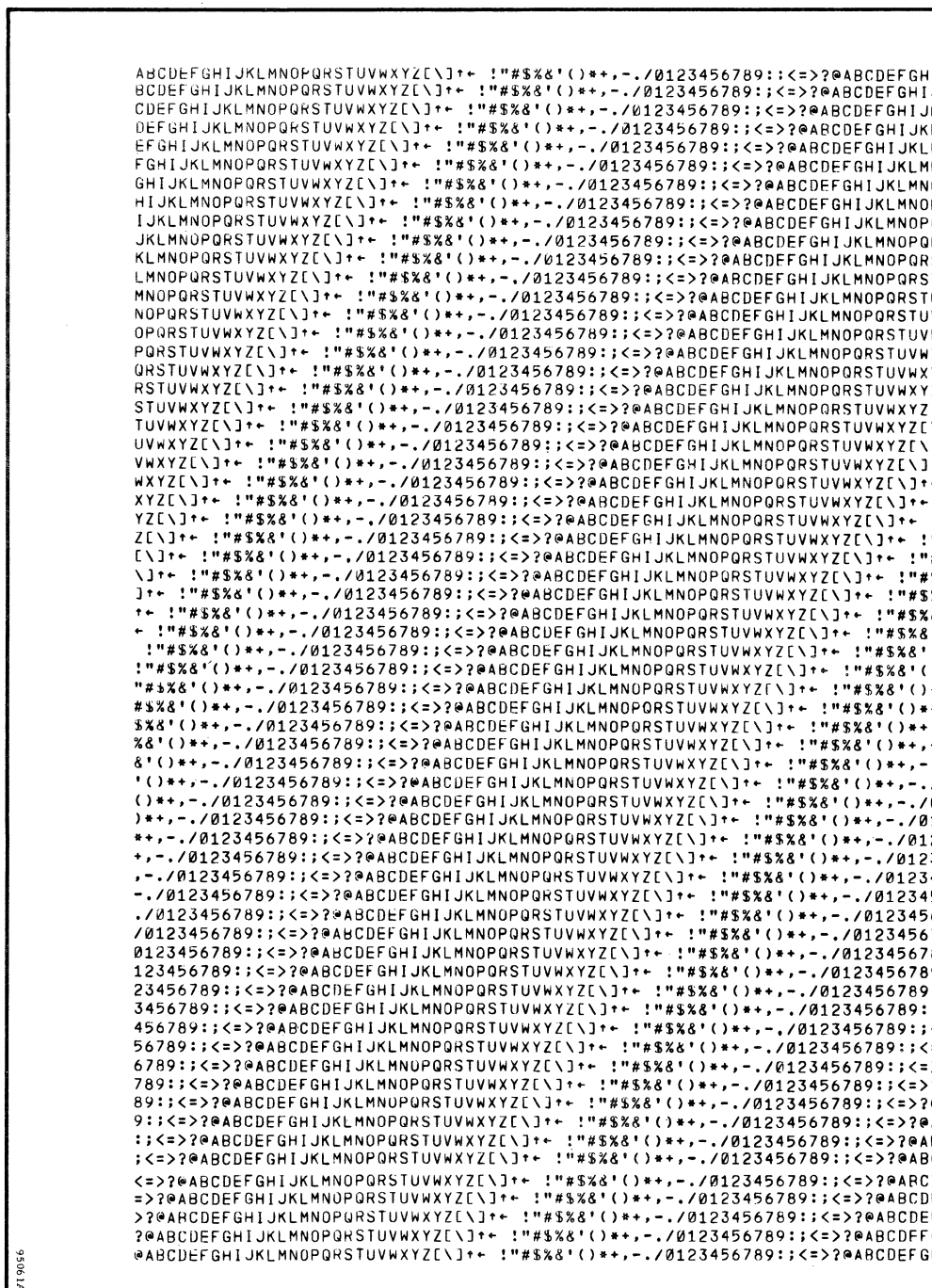


Figure 4-7. Test Two Sample Print-Out

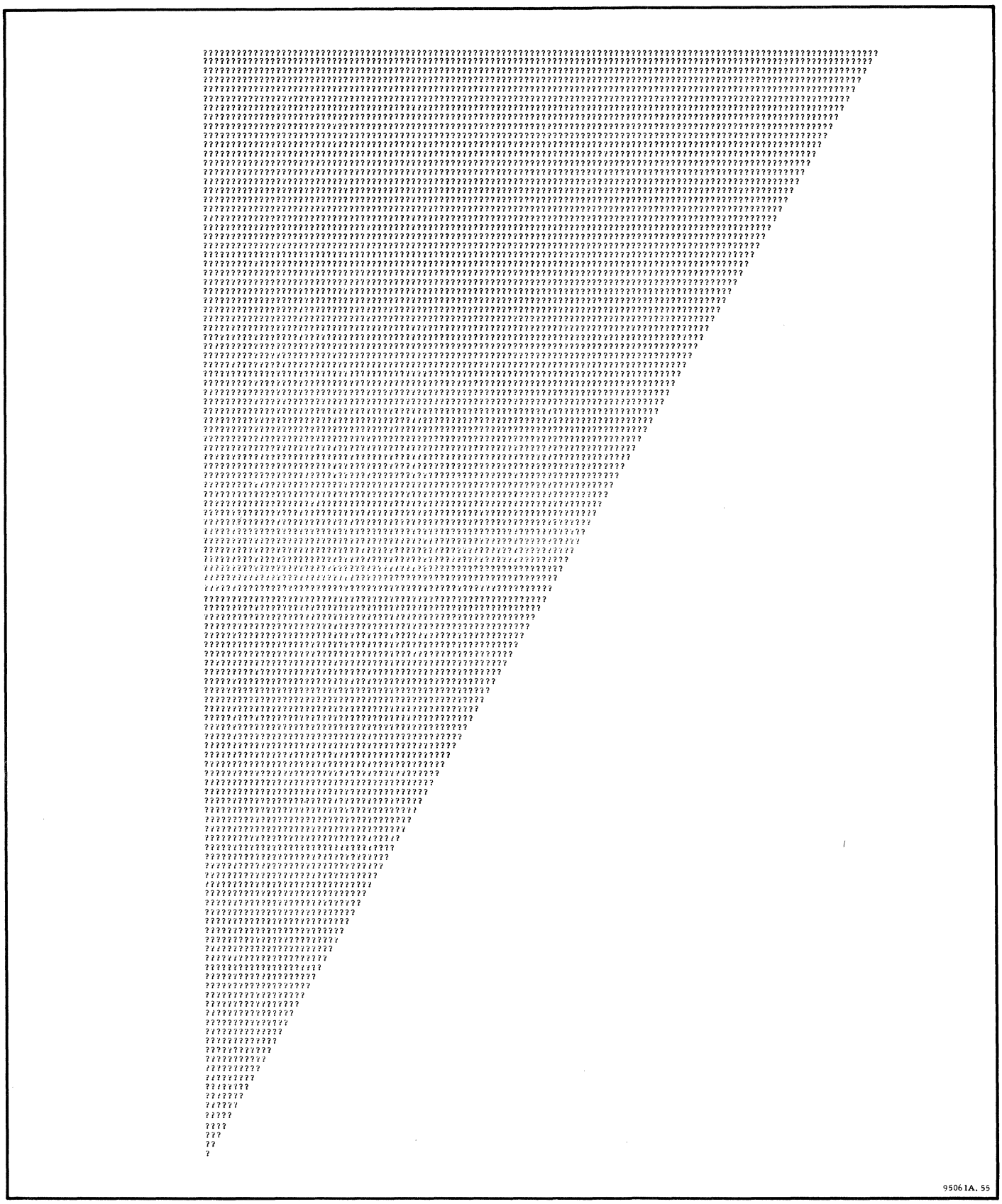


Figure 4-8. Test Three Sample Print-Out

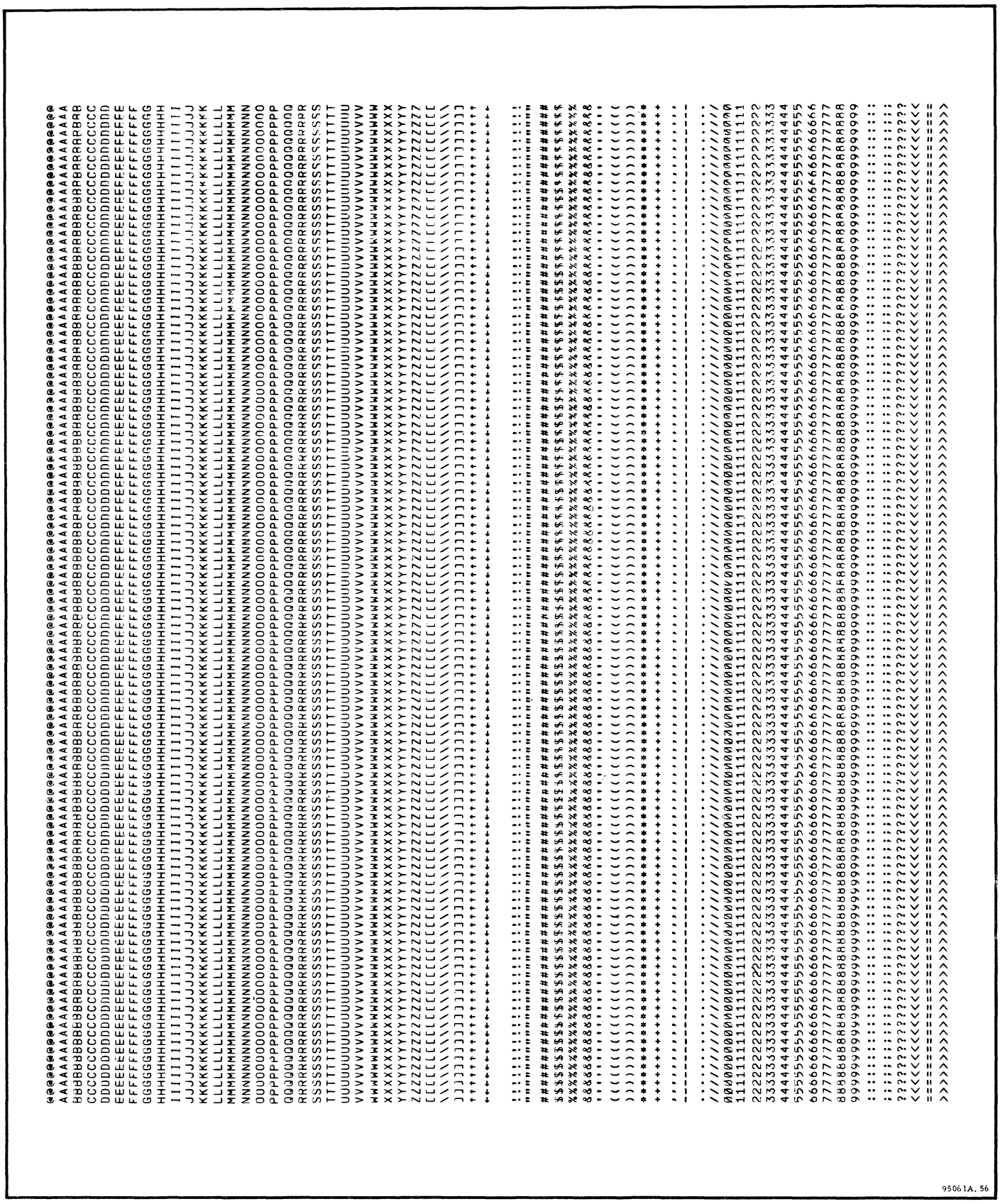


Figure 4-9. Test Four Sample Print-Out

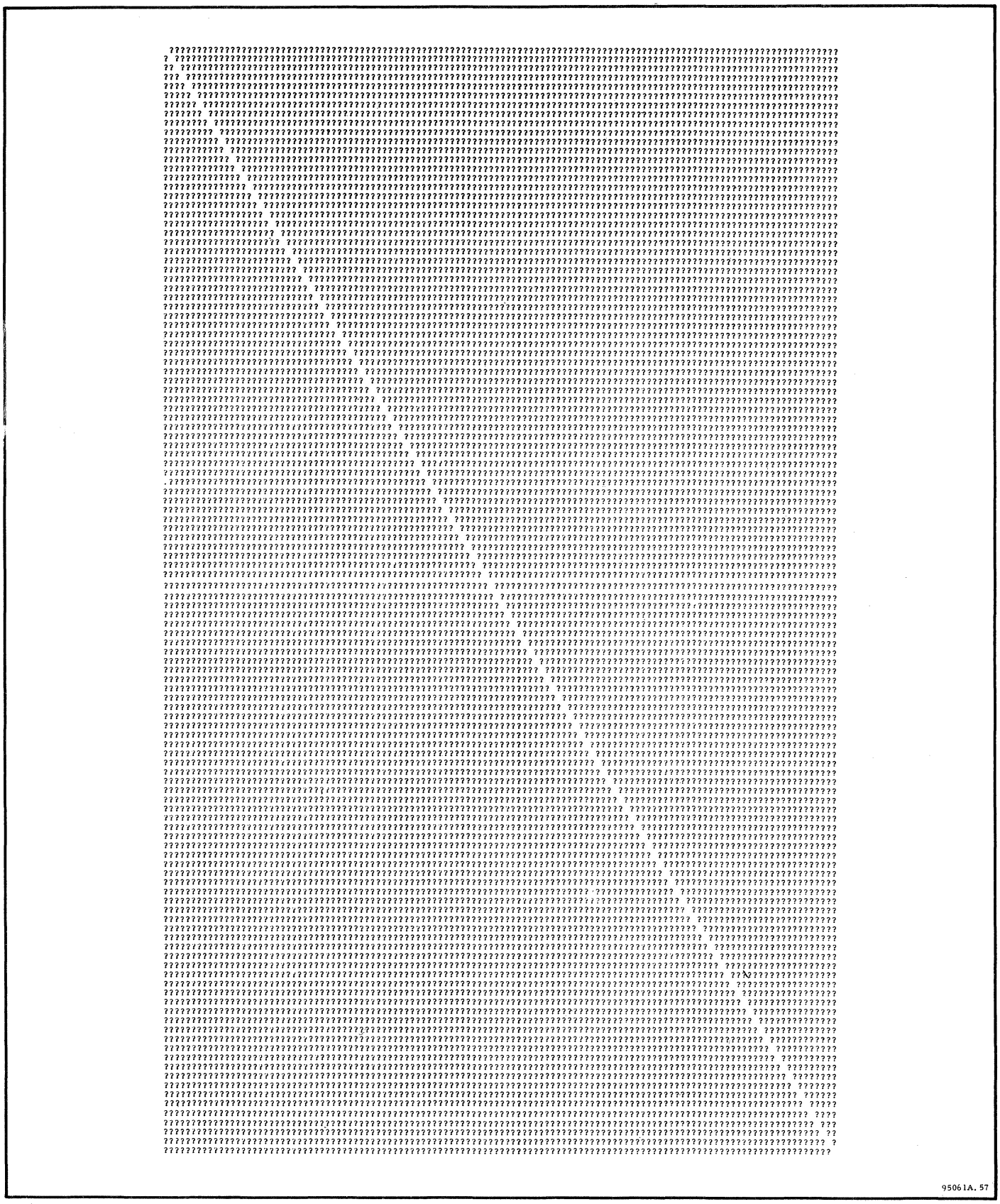


Figure 4-10. Test Five Sample Print-Out

Type-Out	Errors
Inoperable	Line printer out of paper, yoke open, etc.
Parity Error	Printer memory parity error.

4-455 Troubleshooting

4-456 Refer to the line printer troubleshooting, adjustment, and repair procedures included in SEL Technical Manual for the 80 Series Printer Systems, publication number 95010, and Anelex Product Service Manual for the Anelex Series 5 Printer Systems.

4-457 DETAILED DESCRIPTION

4-458 The complete line printer diagnostic program listing is included in program description, catalog number 373001. The following describes the tests performed by the line printer diagnostic: (Figures 4-6 through 4-10 show sample printouts.)

4-459 Test 1. Vertical Format Channel Test

4-460 This test will issue a series of vertical format commands beginning with top of form through bottom of form.

4-461 A message is printed after the execution of the format command which will indicate the carriage channel which was sensed by the line printer. Figure 4-6 is a sample of a printout of this test. Maximum output per line is 14 characters.

4-462 Test 2. Character Spiral Test

4-463 This test will print the Standard SEL 64-character set in a spiral effect until the characters have their original positions. Figure 4-7 is a sample of the output of this test.

4-464 Test 3. Triangle Test

4-465 This test will begin to output a full line of question marks to the printer. Each successive line will be one character less than the previous line and will also be equal to the number of characters transmitted to the buffer. Figure 4-8 is a sample of the output of this test.

4-466 Test 4. One Line Per Character Test

4-467 Test test is designed to print one full line of each standard character available on the line printer. Figure 4-8 is a sample of the output of this test.

4-468 Test 5. Diagonal Test

4-469 This test will print a diagonal of a space in a field of one character (question mark). Figure 4-10 is a sample of the output of this test.

4-470 X-Y Plotter, SEL Model 81-810A (Catalog Number 393001A)

4-471 LOADING AND OPERATION

4-472 To load and operate the X-Y plotter diagnostic program perform the following steps: (Step a. is skipped if the relocatable loader has previously been loaded into memory.)

a. Load the manual bootstrap and bootstrap package as explained in Section II.

b. Install the X-Y plotter diagnostic tape (catalog number 393001) on either the console paper tape reader or high-speed paper tape reader.

c. Load the X-Y plotter diagnostic program into computer memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The X-Y plotter diagnostic tape is loaded by the relocatable loader.

d. Manually load the starting address of the X-Y plotter diagnostic into the program counter. If no relocation bias was used during loading, the starting address is 00000.

e. Set the carriage fast and drum fast control switches on the plotter to the desired scale factor.

f. Lower the START/STOP toggle switch on the computer console control panel.

4-473 ERROR-FREE OPERATION

4-474 The computer should commence to run through the X-Y plotter diagnostic program. A symmetrical octagon is plotted and the computer halts. After the halt, the program counter indicator should contain an address of 00011. To restart the program, lower the START/STOP toggle switch on the computer console.

NOTE

This diagnostic should be run with different settings of the carriage fast and drum fast plotter switches. These switches determine the size of the plotted octagon.

4-475 ERROR INDICATIONS

4-476 Error indications are listed in the following:

Error Halts - None

Error Type-Outs - None

Other - Distortion in the plotted octagon.

4-477 Troubleshooting

4-478 Refer to the X-Y plotter troubleshooting, adjustment, and repair procedures included in SEL Technical Manual, X-Y Plotter SEL Models 80-810 and 80-812 Series, publications number 95012, and Calcomp Digital Incremental Plotter Model 565 Manual.

4-479 DETAILED DESCRIPTION

4-480 The complete X-Y plotter diagnostic program listing is included in program description, catalog number 393001.

4-481 **Interval Timer Diagnostic Program (Catalog Number 393002A)**

4-482 LOADING AND OPERATION

4-483 To load and operate the interval timer diagnostic program, perform the following steps: (Step a. is skipped if the relocatable loader has previously been loaded into memory.)

a. Load the manual bootstrap and bootstrap package as explained in Section II.

b. Install the interval timer diagnostic test tape (catalog number 393002) on either the console paper tape reader or the high-speed paper tape reader.

c. Load the interval timer diagnostic program into memory using the diagnostic loading procedure (relocatable) described in paragraph 2-33. The interval timer diagnostic program is loaded by the relocatable loader.

d. Manually load address 2000$_8$ into the program counter. Address 2000$_8$ is the starting address of the interval timer diagnostic program.

e. Set the computer console SENSE/HALT/LOAD T switches for the operation to be performed. These switches control the following:

S/H/L T Switch 1
Raised - Continuously repeat Interrupt Test.

S/H/L T Switch 2
Raised - Continuously repeat Accuracy Test.

S/H/L T Switch 1 and 2
Centered - Continuously cycle both tests.

S/H/L T Switch 3
Raised - Inhibit printing cycle count.

The Interrupt and Accuracy Tests are described in paragraph 4-233.

f. Lower the START/STOP toggle switch on the computer console.

4-484 ERROR-FREE OPERATION

4-485 The program should cause the console printer to type out messages requesting that the interval timer unit number, the interrupt level, and the frequency (in cps) be entered from the ASR-33 keyboard. These values should all be specified by entering decimal integers followed by carriage returns. Any non-numeric character (other than carriage return) will cause the program to reject the entry and repeat the request. The interrupt level is specified by a number from 1 to 36 where 1 specifies group 0, level 1. The program should automatically cause the specified interrupt to be turned ON and be detected. The number of execution cycles is printed out if SENSE/HALT/LOAD T switch 3 is centered.

4-486 ERROR INDICATIONS

4-487 Error indications are listed in the following:

Error Halts - None

Error Type-Outs - The following describes the Interrupt and Accuracy Tests and the associated error type-outs:

4-488 Interrupt Test

4-489 The program loads the interval timer with 2 counts and allows 50 milliseconds for the interrupt to occur. If the interrupt fails, the following message will be printed:

NO INTERRUPT

4-490 Accuracy Test

4-491 The program loads the interval timer with a maximum value of 65,535, and then counts cycles until interrupted. Then the frequency of the timer is computed from the elapsed cycles and this value is compared to the expected frequency entered from the keyboard. When these values differ by

more than 2, the message below is printed:

```
EXPT   ACTL
XXXXX  YYYYY
```

where XXXXX is the expected frequency scaled at the power of 10 required to carry 4 digits of accuracy, and YYYYY is the computed frequency scaled the same way.

NOTE

If the computed frequency is within the tolerances, no message is printed. In either case, the number of execution cycles is printed unless sense switch three is set.

4-492 Troubleshooting

4-493 Refer to the troubleshooting, adjustment, and repair procedures included in SEL Interval Timer SEL Model 80-030A Technical Manual.

4-494 DETAILED DESCRIPTION

4-495 The complete interval timer diagnostic program listing is included in program description, catalog number 393002. The following describes the features of the diagnostic in detail:

4-496 This program is capable of testing any interval timer having a frequency between 10 and 999,999 cycles per second.

4-497 Decimal scaling is used to increase accuracy in calculating the interval timer frequency. When the expected frequency is entered from the keyboard, the value is scaled to carry four decimal digits of accuracy. The scaling process is based on the number of digits entered. As the expected frequency is scaled, a constant is saved to allow scaling the computed frequency at the same place. The actual frequency is computed as shown:

$$\text{Frequency } (10^{4-x}) = \frac{\text{Counts } (10^{4-x})}{\text{Seconds}}$$

$$= \frac{\text{Counts } (10^{10-x})}{\text{Microseconds}}$$

$$= \frac{\text{Counts } (10^{10-x})}{(7/4)\ \text{Cycles}}$$

$$= \frac{\text{Counts } (1/7)\ (10^{4})}{\text{Cycles } (1/4)\ (10^{x-6})}$$

$$= \frac{\text{Counts } (10^{4}/7)}{(\text{Cycles}/4)/10^{6-x}}$$

where x is the number of digits entered for the expected frequency.

The value for Cycles/4 is determined from the contents of two counters which are incremented while waiting for an interrupt. This value is reduced to single precision by dividing by the scale factor (10^{6-x}). The value for counts $(10^4/7)$ is a double precision computed by dividing this constant by the quotient obtained in the first division.

4-498 The execution time (per cycle) of this program may be reduced by decreasing the value used for loading the timer during the accuracy check. This requires that the double precision integer constant representing counts $10^4/7$ be modified accordingly. These two values are specified by the labels MXVL and TVAL, respectively.