

PDP-12 HARDWARE

STUDENT GUIDE NO. 1

(Adjustments, Diagnostics & Troubleshooting)

Educational Services

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 - B. Checking the RIM Loader
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 - D. The Use of Checkerboard Low and High to Check Memory
 - E. How to Tune Memory
 - F. Program Development

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 - A. First Period
 - 1. Scoping Processor Timing
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 - A. Understanding the Front Panel Indicators
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PDP-12 LAB NO. 1 OUTLINE

Time: 2 hours

1. Loading the RIM Loader
2. Checking the RIM Loader
3. Loading the Binary Loader
4. The Use of Checkerboard Low and High to Check Memory
5. How to Tune Memory
6. Program Development

PDP-12 LAB JOB SHEET #1-1

TITLE: Loading the Rim Loader

OBJECTIVE: To insure that all students are capable of manually inserting Rim Loader into core successfully.

PROCEDURE: 1. The student should read information sheets 1, 2 and 3.

2. Using the procedure described in information sheet 4, load the rim loader as listed in info sheet 3.

3. Go to Job #1-2.

PDP-12 LAB JOB SHEET #1-2

TITLE: Checking the Rim Loader

OBJECTIVE: 1. To insure that the rim loader is correctly loaded into core.
2. To further usage of the keys Exam and Step Exam.

PROCEDURE: Use the procedure described in information sheet 5 and check the rim loader.

Upon completion of this exercise

Go to Job Sheet #1-3

PDP-12 LAB JOB SHEET #1-3

TITLE: Loading the Binary Loader

OBJECTIVE: To insure that all students understand the purpose of the binary loader and can successfully load the binary loader.

PROCEDURE:

1. Obtain a binary loader paper tape from the instructor.
2. Compare the format of this tape to the format as described in information sheet #2 binary format.
3. Read info sheets 6, 7, 8 and 9.
4. Use info sheet #9 and load the binary loader paper tape.
5. Upon successful completion

Go to job sheet #1-4

PDP-12 LAB JOB SHEET #1-4

TITLE: Using Checkerboard Low and High to Check Memory

- OBJECTIVE:
1. To insure that Rim and Binary loader have been used properly.
 2. To introduce the student to paper tape diagnostics.
 3. To insure that the memory stack is reliable before the memory tuning exercise.

- PROCEDURE:
1. Obtain paper tapes, checkerboard (Low and High) and their associated write-ups from the instructor.
 2. Using the procedure described in info sheet #10, load and run both programs.
 3. Upon completion
- Go to job sheet #1-5

PDP-12 LAB JOB SHEET #1-5

TITLE: How to Tune Memory

OBJECTIVE: To insure that all students can properly tune memory on the PDP-12.

PROCEDURE: Perform this memory tuning exercise by the procedure described in section 4.1 through 4.2.2 of the PDP-12 Adjustment Procedure manual.

PDP-12 LAB JOB SHEET #1-6

TITLE: Program Development

OBJECTIVE: To develop the confidence of the student in his ability to successfully program a processor.

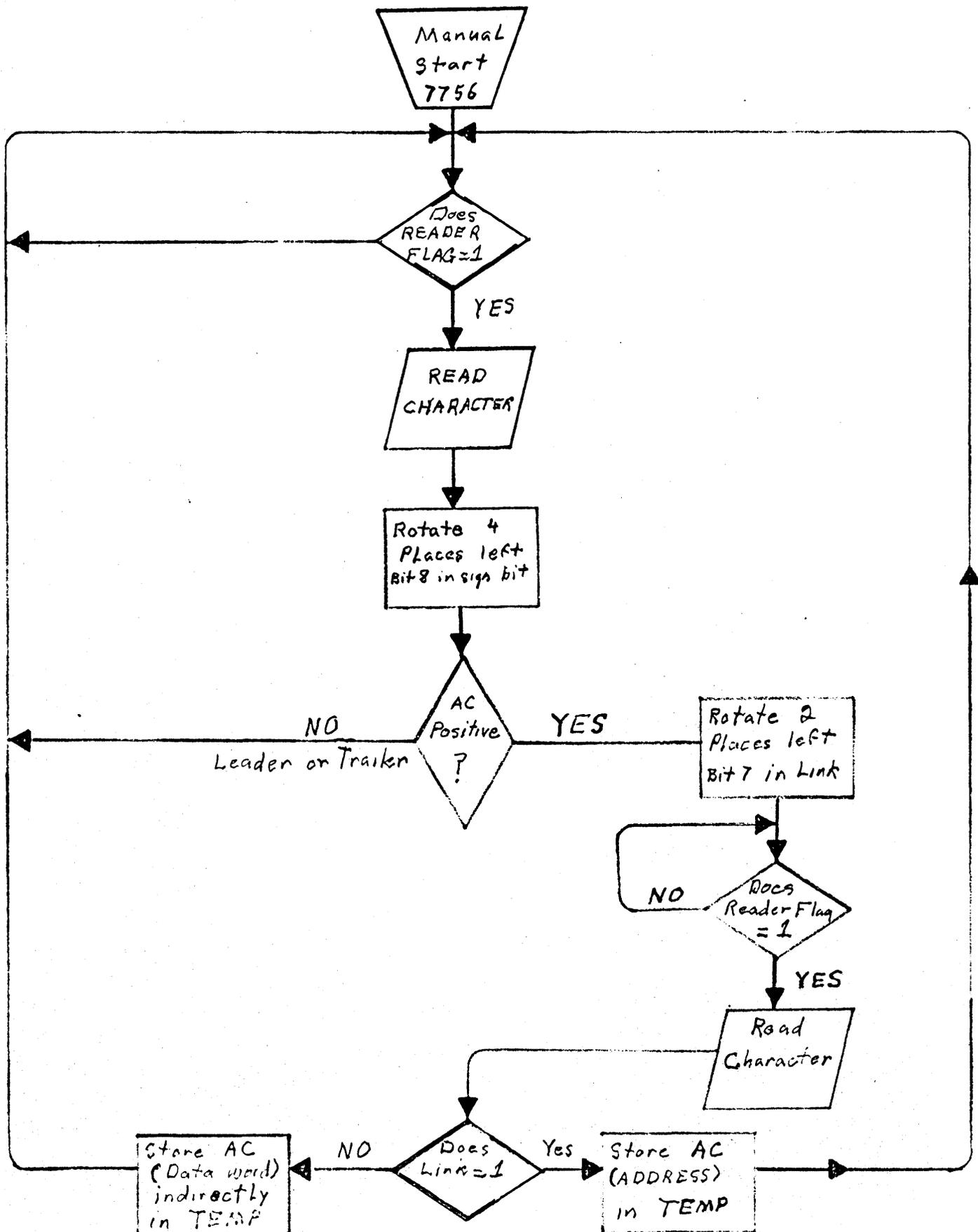
PROCEDURE: Write a program, using LINC or 8-mode instruction, that detects the number of 4K fields present in a processor. At the completion of the program, type "This processor has __ __ 4K Fields", then HLT.

Show this program to the instructor for technique development suggestions.

Save the program for further use.

FLOW CHART RIM LOADER PROGRAM

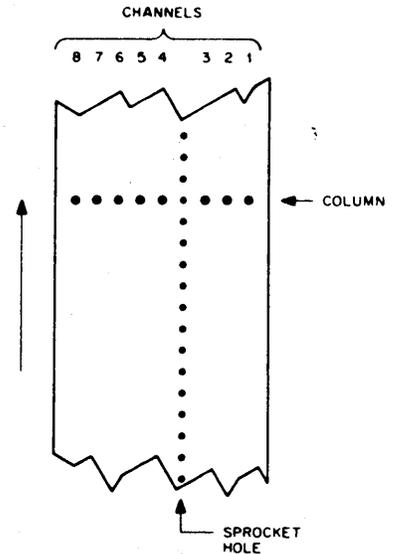
Preliminary
Draft



INFORMATION SHEET #1

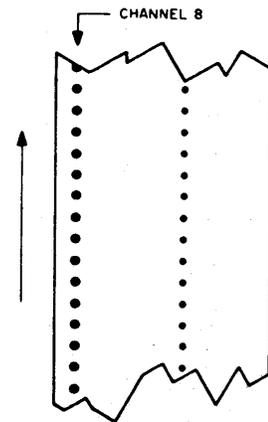
PAPER TAPE FORMATS

Data are recorded (punched) on paper tape by groups of holes arranged in a definite format along the length of the tape. The tape is divided into channels which run the length of the tape, and into columns which extend across the width of the tape as shown in the adjacent diagram. The paper tape readers and punches used with the PDP-8/1 computers accept 8-channel paper tape. The various formats are briefly explained and identified below.



Leader/Trailer Format

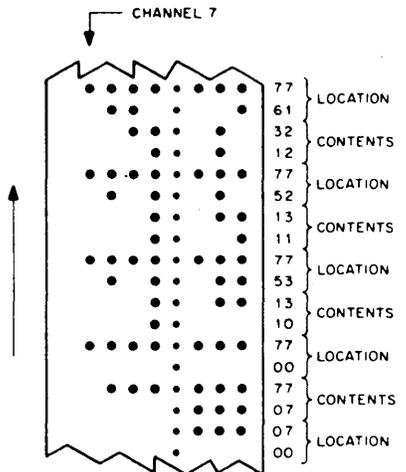
Leader/trailer tape is used to introduce and conclude the object program when punched on paper tape. Leader/trailer tape can be recognized by a consistent channel 8 punch only as shown in the adjacent diagram.



INFORMATION SHEET #2

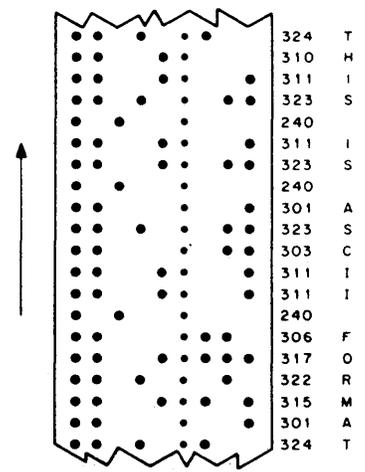
RIM Format

Paper tape punched in RIM format can be identified by the absence of a channel 8 punch, and by a channel 7 punch in every fourth column. The channel 7 punch indicates the start of a line of coding, and that (the first) column and the second column contain the location and the third and fourth columns contain the contents of the location.



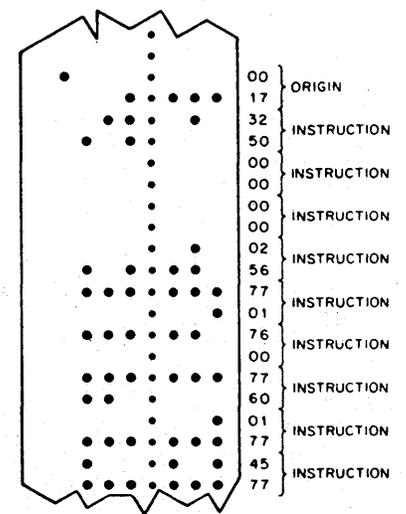
USASCII Format

USASCII (USA Standard Code for Information Interchange) format uses all eight channels to represent a single character (letter, number, or symbol) as shown in the adjacent diagram.



Binary Format

Binary format can be recognized by the absence of a channel 8 punch, an occasional channel 7 punch, and frequent sections of blank tape. The channel 7 punch denotes an origin of a program or subprogram or a change in origin, and subsequent columns contain the instructions (two columns per instruction) or data of succeeding locations.



READ-IN MODE (RIM) LOADER

PURPOSE

The RIM Loader is used to load into core memory programs punched on paper tape in RIM format, e.g., the Binary Loader. (See DEC-08-LRAA-D for details.)

STORAGE REQUIREMENTS

RIM requires locations 7756-7776 (21₈ locations). Starting Address=7756.

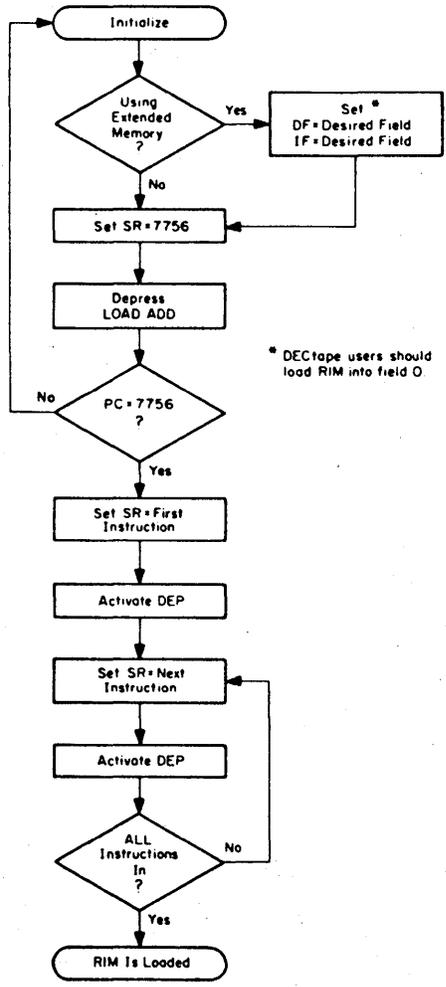
LOADING

RIM is loaded (toggled) into core memory using the console switches. RIM can use either the low- or high-speed readers when loading RIM coded program tapes into core. The locations and corresponding instructions for both input devices are listed below.

| Location | Instruction | |
|----------|------------------|-------------------|
| | Low-Speed Reader | High-Speed Reader |
| 7756 | 6032 | 6014 |
| 7757 | 6031 | 6011 |
| 7760 | 5357 | 5357 |
| 7761 | 6036 | 6016 |
| 7762 | 7106 | 7106 |
| 7763 | 7006 | 7006 |
| 7764 | 7510 | 7510 |
| 7765 | 5357 | 5374 |
| 7766 | 7006 | 7006 |
| 7767 | 6031 | 6011 |
| 7770 | 5367 | 5367 |
| 7771 | 6034 | 6016 |
| 7772 | 7420 | 7420 |
| 7773 | 3776 | 3776 |
| 7774 | 3376 | 3376 |
| 7775 | 5356 | 5357 |
| 7776 | 0000 | 0000 |

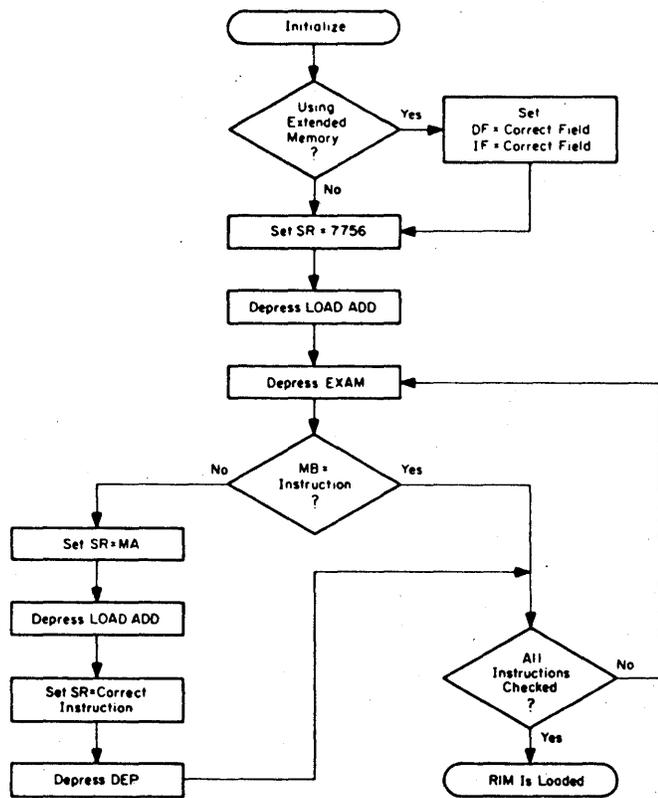


INFORMATION SHEET #4



Loading the RIM Loader

INFORMATION SHEET #5



Checking the RIM Loader

BINARY (BIN) LOADERPURPOSE

The BIN Loader is used to load into core memory binary coded programs punched on paper tape. When in core, BIN can be destroyed only by the user's program because DEC's programs (excluding Disk Monitor) do not use the last page of core (location 7600-7777). (See DEC-08-LBAA-D for details.)

STORAGE
REQUIREMENTS

BIN occupies locations 7625-7752 and 7777 (123₈ locations). Starting Address=7777

LOADING

RIM is used to load BIN into core. BIN must be loaded into the same field as RIM, and the input device (low- or high-speed reader) must be that which was selected when loading RIM.

INFORMATION SHEET #7

Example of Binary Loader Format

| Tape Channel 87 654 S 321 | Channels 8 and 7 Indicate | Program Proper | Notes |
|------------------------------|------------------------------|-------------------|--|
| 10 000 . 000 | Leader | No | |
| 01 000 . 010 00 000 . 000 | Origin | No | In octal the origin 0200. Loading will start at 0200. |
| 00 111 . 010 00 000 . 000 | Contents of 200 | Yes | The command 7200 or CLA. |
| 00 011 . 010 00 111 . 110 | Contents of 201 | Yes | The command 3276 or DCA Z 076. |
| 00 111 . 100 00 000 . 010 | Contents of 202 | Yes | The command 7402 or HLT. |
| 00 000 . 100 00 010 . 010 | Checksum | No | The program determines that these two characters are the checksum since trailer follows. |
| 10 000 . 000 | Trailer | No | |

The octal checksum in this example is 0422. Note that this is the following sum:

```

102  Origin
000
072  First word
000
032  Second word
076
074  Third word
002
422

```

Memory Extension Usage

Loading - It is recommended that the Binary Loader exist in field 0. This will insure a permanent program lining around location 7754 and 7755 which are used for TC01 DECTape. The loader will of course exist in any field, though caution must be taken not to use location 7754 and 7755 in field 0. This applies only to DECTape users. Also, when the proper field is chosen it should be noted that the RIM Loader must already be in that field.

Binary Loader Loading Procedure For Extended Memory Users

- a. Place the Binary Loader tape in the reader.
- b. Place the proper FIELD in the INSTRUCTION FIELD REGISTER when putting the starting address of the RIM Loader (7756) in the SWITCH REGISTER.
- c. Press the LOAD ADDRESS key.
- d. Press the START key.
- e. Start the reader. (ASR 33 - press READER CONTROL to start, 750 High-Speed Reader - should already be ready to start).

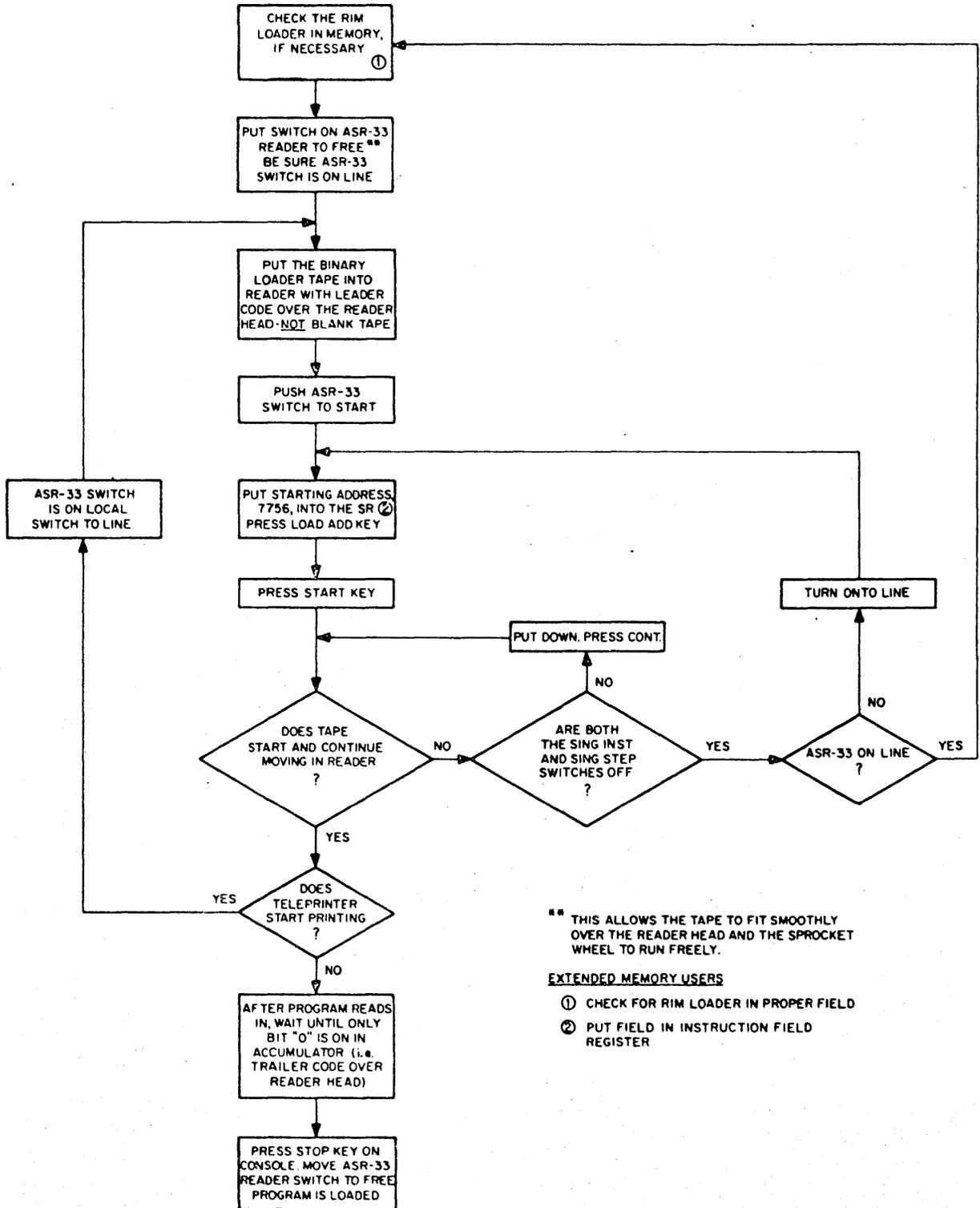
Operation and Usage For Extended Memory Users

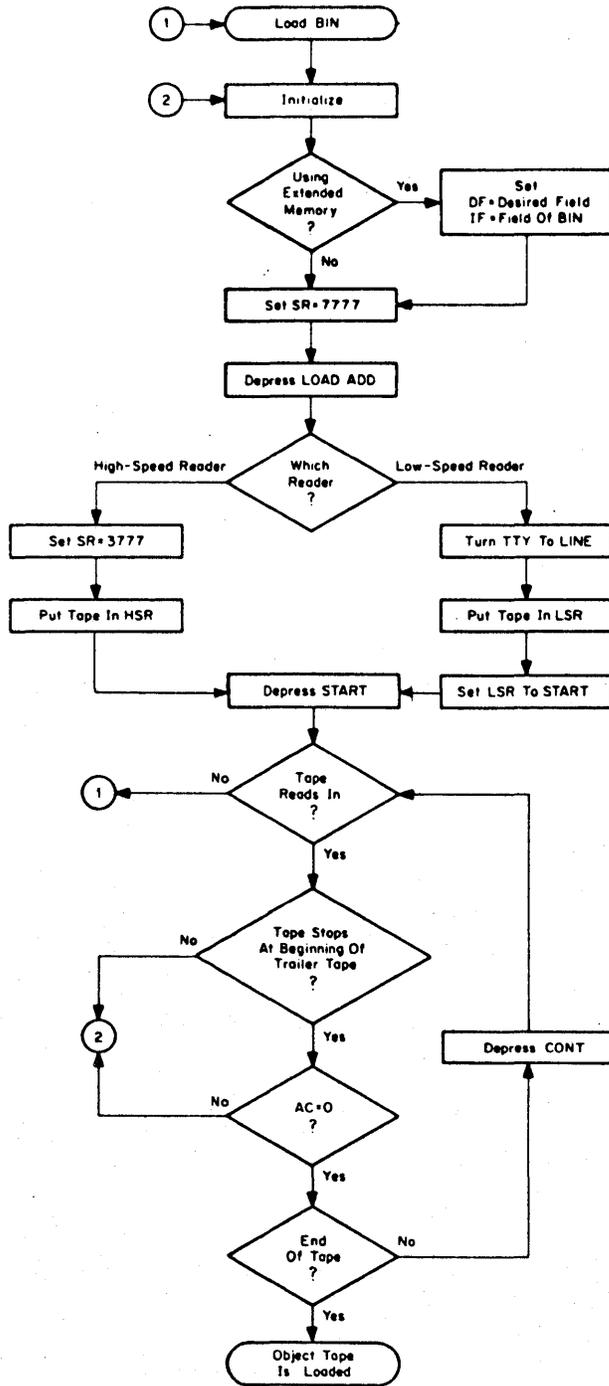
- a. Place the tape to be loaded (tape must be in binary format) in the reader.
When using the ASR 33, make sure reader is on-line. When using the 750, make sure reader is on and tape is positioned with leader/trailer over read head.
- b. In the DATA FIELD REGISTER place the field in which the program is to be loaded. In the INSTRUCTION FIELD REGISTER place the field that the binary loader is in. Place starting address of the Binary Loader (7777) in the SWITCH REGISTER.
- c. Press LOAD ADDRESS key.
When using the 750, change the SWITCH REGISTER to 3777 (bit 0 = 0). Omit this step if using the ASR 33.
- d. Press console START key.

FLOW CHARTS

Loading Binary (BIN) Loader

DEC Library Tape No: Digital-8-2-U





Loading A Binary Coded Object Tape Using BIN

PDP-12 Lab No. 2 Outline

4 hours

FIRST PERIOD

1. Scoping Processor Timing
Job #2-1
2. Scoping Memory Timing
Job #2-2

SECOND PERIOD

3. Scoping Manual Timing
Job #2-3
4. Bugs (as time permits)
Troubleshooting Memory Problems, (as time permits)

PDP-12 LAB WORK SHEET #2-1

TITLE: Signal name, Pin location, and Page reference chart.

OBJECTIVE: To aid the student in the generation of a cycle time chart.

PROCEDURE: 1. With reference to signal, both numbered and named, on worksheet No. 21 A, draw in the waveform as seen on the scope with relation to CTP1 as the triggering source, on Worksheet No. 2-1B

2. Scope settings .2us/CM sweep
 Sync Ext
 Scope Pos
 Sweep Alt

3. On chan. 1 look at TP1
 On chan. 2 look at the time relation to the numbered signals.

4. At location ~~0000~~ place a JMP~~0~~.

Upon completion go to Job Sheet #2-2

PDP-12 LAB JOB SHEET #2-1

- TITLE: Generation of a processor cycle time chart.
- OBJECTIVE: To aid the student in generating a processor cycle timing chart, and in understanding processor cycle time with reference to CTP1.
- PROCEDURE: Use the procedure described in Lab Worksheet #2-1.
Upon completion, go to Job Sheet #2-2

PDP-12 Lab Worksheet #2-1A

| <u>Signal Number</u> | <u>Pin Location</u> | <u>Part designation</u> |
|----------------------|---------------------|-------------------------|
| 1 | J12 E1 | CPT |
| 2 | M39 F1 | CST |
| 3 | J05 N2 | CPTP |
| 4 | J06 E1 | CPT |
| 5 | J21 E1 | RCL |
| 6 | J10 C1 | CPTP |
| 7 | H06 F1 | CPTP |
| 8 | J04 N1 | CPT |
| 9 | J07 E1 | CPTP |
| 10 | E14 S2 | MCT |
| 11 | J06 S1 | CPT |
| 12 | J21 L1 | RCL |
| 13 | J06 J2 | CPT |
| 14 | J04 L2 | CPT |
| 15 | J03 P2 | CPT |
| 16 | J04 K1 | CPTP |
| 17 | J03 D2 | CPT |
| 18 | H09 J1 | CPTP |
| 19 | H09 F1 | CPTP |
| 20 | H03 J1 | CPTP |
| 21 | K06 B1 | CPS |
| 22 | H07 F1 | CPTP |

PDP-12 Lab Job Sheet
#2-2

- TITLE: Generation of a memory cycle time chart
- OBJECTIVE: To aid the student in generating a memory cycle timing chart and, in understanding memory cycle time with reference to Mem Start.
- PROCEDURE: Draw a timing chart of memory cycle time using Worksheet #2.

Upon completion, go to Job Sheet #2-3

PDP-12 Lab Worksheet #2-2

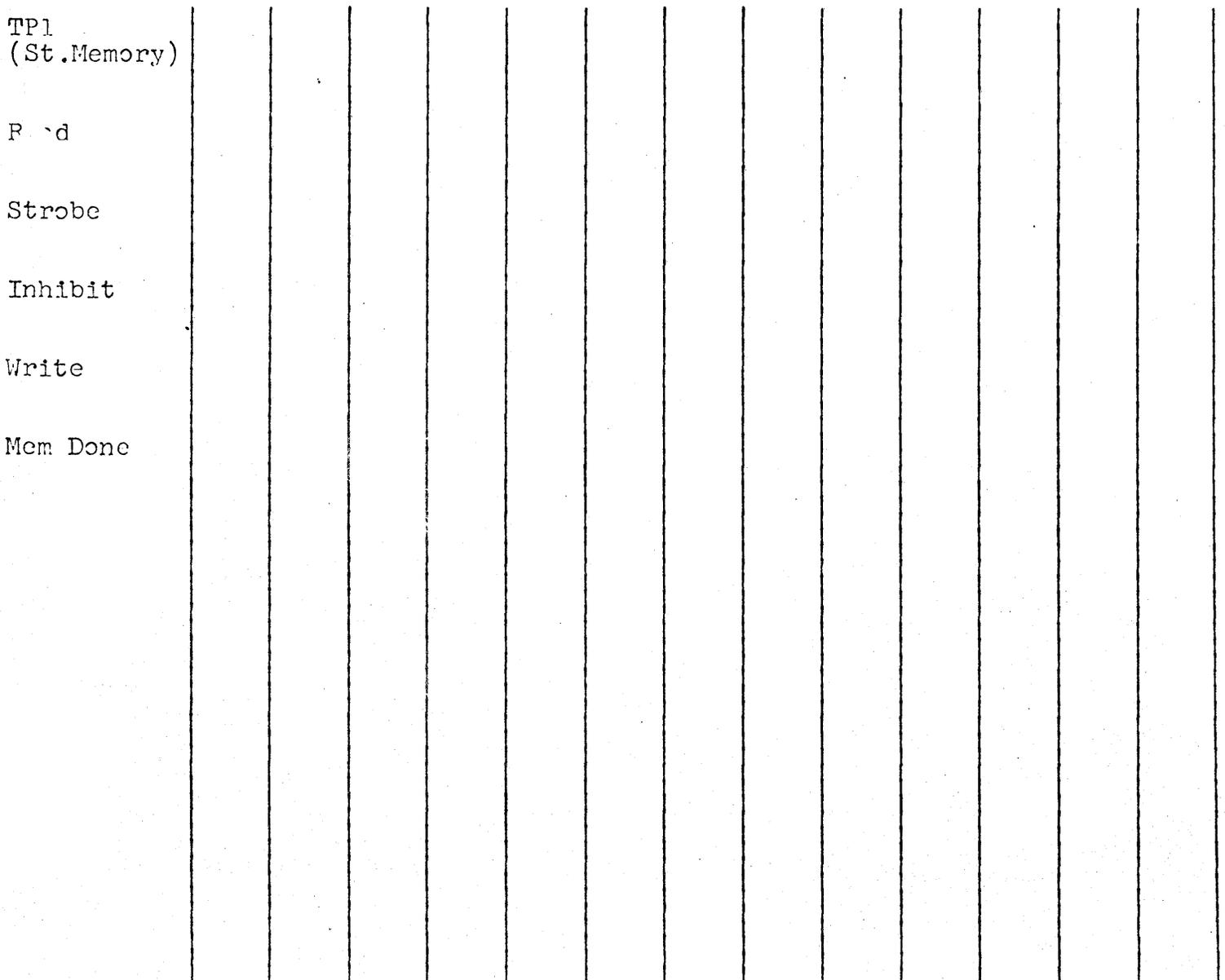
TITLE: Memory timing chain

PROCEDURE: Draw a waveform chart of the signals named below using the scope.

Reference all time relation to start memory.

All signals can be located through the MCT page.

The chart is calibrated at 200 ns/dev.



PDP-23 Lab Job Sheet #2-3

TITLE: Manual timing functions

OBJECTIVE: To aid the student in his understanding of the PDP-12 manual timing chain and the operation of the key step exam.

PROCEDURE: 1. Tape M1, N1, P1, R1 of M117 in slot L22 removing all console inputs from Schmitt trigger. CST(A,7)

2. Tape C1 of M113 in slot L40 removing IO preset or PWF restart from CST Ø AC. CST (C $\frac{1}{2}$, 7)

3. If the processor has the KP-12 option, remove the PWF card.

If the processor does not have the KP-12 option, there should be a connection between K33V1 and K32R2. Tape K33V1 removing +3v from K32R2.

4. Using a jumper wire of sufficient length, connect at K32R2 your selected T10 clock rate on M452 in slot NØ8 pin K2 (220H), N2 (440 H), J2 (880H).

5. Tape the key step exam to the one state.

6. Referring to the manual functions flow diagram observe all operations with the oscilloscope and generate a timing chart for the key step exam from the beginning of manual timing to the end of processor timing using Lab Worksheet 2-3A.

PDP-12 Lab Worksheet #2-3A

PROCEDURE: Scope setup
 Ext. trigger
 Mode alternate
 Sweep rate 2 us/cm
 Manual trigger setup

Key examine manual timing

Tape the key step exam onto console. On the cst print remove the connection between M117 S1 slot L22 by placing a piece of tape over the pin.

Connect a jumper wire between (TTO TTI clock H R2) and input to M700 K32 L32 pin KR2.

Generate a timing chart, as in Jobs 21 and 22, for the key step exam.

PDP-12 Lab #3 Outline

1. Understanding the front panel indicators
2. Use of paper tape diagnostics in locating machine failures.
3. Bugs (as time permits)

PDP-12 Lab Job Sheet #3-1

TITLE: Understanding the front panel

OBJECTIVE: To insure that the student will learn to use the front panel indicators as aids in system troubleshooting.

PROCEDURE: Complete the steps described in Lab Worksheet #3-1
Any discrepancies should be corrected at this time.

Upon completion go to Job Sheet #3-2

PDP-12 Lab Worksheet #3-1

Console Checks - Assuming a cold start, check the following console functions. If any malfunctions occur, repair the problem before continuing with the procedure. Refer to Chapter 4 - PDP-12 Adj Procedures - for appropriate adjustments.

1. Power on Are IR bits 0, 1, and 2 set (on), and in 8 Mode; is RUN off*, and is power up to specification (refer to Paragraph 4.1)?
2. I/O PRESET Does the AC clear? Does it set the INST FIELD and DATA FIELD to 2 and 3, respectively? Do the INSTRUCTION REGISTER bits 0, 1, and 2 set to the one state (on)? Can both modes be selected? Do all other indicators remain unchanged?
3. FILL Do the RIGHT SWITCHES transfer to the MB? Do the LEFT SWITCHES transfer to the MA?
4. EXAM Do the LEFT SWITCHES transfer to the MA? Do the contents of the location addressed by the MA transfer to the MB?
5. FILL STEP Do the RIGHT SWITCHES transfer to the MB? Do the RUN and INT PAUSE lights illuminate? Do the contents of the MA increment? Do the contents of the new location addressed by the MA transfer to the MB?
6. STEP EXAM Do the contents of the MA increment? Do the contents of the new location addressed by the MA transfer to the MB?
7. AUTO RESTART Can FILL STEP and STEP EXAM be auto-restarted? Does the AUTO light illuminate?
8. While depressing both the AUTO and the FILL STEP keys, sequentially set the AUTO RESTART DELAY - COURSE (starting at position 4) to position 3; then to position 2, then to position 1. Note that the MEMORY ADDRESS register fills (counts up) at a slower rate as the AUTO RESTART DELAY - COURSE selector is moved through the four positions.
9. Examine memory for any bits that may be picked up.
10. Set RIGHT SWITCHES to 7777 (all 1's), repeat steps 8 and 9.
11. Examine memory for any bits that may be dropped.
12. Depress SING STEP key.
13. Depress START 20.
 - a. Does the MA = 0020?
 - b. Does the PC = 0021?
 - c. Does the MB = 7777?
 - d. Does the IR = 7777? (depending on contents of location 0020)
14. Reset SING STEP; clear memory; depress STOP key.

*Unless the KP12 Power Fail Option is installed.

15. Depress START 400.
 - a. Does the MA = 0000?
 - b. Does the PC = 0401?
 - c. Does the MB = 0000?
 - d. Does the MA = 0000?
 - e. Does the IR = 0000?

16. Reset STOP; depress CONT.
 - a. Does the RUN light illuminate?
 - b. Do the MA and PC cycle through 4K of memory?
 - c. Does the AC remain closed?
 - d. Are the FETCH and EXECUTE indicators set (on)?

17. Set and reset STOP key; depress I/O PRESET key to LINC Mode; fill LINC memory field 2 with 0016s (NOP).

18. Depress the STOP key.

19. Depress START 20.
 - a. Does the MA = 4020?
 - b. Does the PC = 4021?
 - c. Does the MB = 0016?
 - d. Does the IR = 0016?

- 20.. Reset the STOP key; depress CONT.
 - a. Does the RUN light illuminate?
 - b. Do the MA and PC cycle through 1K of memory?
 - c. Does the AC remain cleared?

21. Depress SING STEP.

Does the computer stop?

22. Depress CONT repeatedly. Does the computer stay in the FETCH state?

23. Depress and hold AUTO RESTART; depress CONT; release all switches. Does the computer cycle through 1K of memory at a rate determined by AUTO RESTART DELAY, COARSE and FINE adjustments?

24. Set several different instructions into the LEFT SWITCHES; depress DO. (Be sure that the CP is in the proper mode for each instruction). Does the CP react to each instruction as expected? If the CP performs these operations successfully, manual timing, memory timing, and CP timing are "in the ball park." Proceed with system troubleshooting.

PDP-12 Lab Job Sheet #3-2

TITLE: Use of paper tape diagnostics

OBJECTIVE: To familiarize the student to the use of paper tape diagnostics as an aid to troubleshooting.

PROCEDURE: Read lab handout #3-2 Upon completion ask the instructor to install a problem in your processor.

Determine the failure through front panel indicators or paper tape diagnostics.

Document all problems using PDP-12 Failure Documentation sheet.

Upon completion, ask the instructor for another problem.

GOOD LUCK!

Maintenance Test Programs

Table 1-2 lists approximately 25 processor test programs designated MAINDEC; collectively, these programs provide a complete check of the logic.

Functionally, the programs fall into two categories: Diagnostic and reliability. The diagnostic tests isolate the guine go/no-go type of hardware failures that are easily recognizable. The reliability programs isolate failures that are more difficult to detect because they are marginal in nature and/or occur infrequently or sporadically. The family of test programs are written so that, when run successively, they test the processor, beginning with small portions of the hardware and gradually expanding until they involve the entire system.

The test programs are made up of numerous self-contained routines. In those programs that are diagnostic in nature, each routine is involved with a specific circuit or logic function. In the simplest form, for example, a separate routine is used to check each leg of an AND gate. When the diagnostics have been run to completion, the processor has been exercised to the extent that it has been proved capable of executing all instructions. However, such proof is conditional because it is based on the execution of instructions using pre-established constants as operands.

Further tests are necessary to establish that the computer properly executes instructions using operands and various combinations of operands other than those used in the diagnostics. The reliability test programs provide this additional testing. Primarily, each routine in the reliability test programs establishes a loop whereby a specific instruction or group of instructions is repeated many times. Each repeat is executed using operands whose magnitudes are established by a pseudo-random number generator, or a binary upcount. This procedure makes certain that machine capabilities are checked under a maximum number of unique conditions.

When an error is detected with diagnostics, the program halts at the end of the unsatisfied routine. The reason for the halt may then be determined by using the console controls and indicators, maintenance switches, error type-outs on Teletype, and the program listings included in the software package. The use of the data switches for selecting error indications is defined in the MAINDEC write-ups provided with the software package.

DIAGNOSTIC PROGRAMS

| Program Name | Mnemonic | DEC Number | Use |
|---------------------------|----------|------------------|--|
| JMP SELF Test | JMPSELF | MAINDEC-12-D1BA | Memory Addressing Test |
| Relay Test | RELAYTST | MAINDEC-12-D8AB | Tests the Operation and Transfer to/from the AC of 6 Relays |
| Tape Register Test | ADDRS12 | MAINDEC-12-D3AC | Tests Tape Control Logic and Inter-register Transfers |
| Memory Data Test | MEMDATA | MAINDEC-12-D1EA | Tests Memory Reliability |
| Memory Address Test | ADDRS12 | MAINDEC-12-D1CA | Tests Memory Addressing (LINC Mode) |
| VR12 Display Test | DISPTST | MAINDEC-12-D6BA | Tests Display System Using DIS and DSC Instructions |
| Instruction Test 1A | INST1 | MAINDEC-8/I-DO13 | Tests AND, TAD and Operate Instructions |
| Instruction Test 2 | INST2 | MAINDEC-8/I-DO2D | Tests Auto Indexing, Indirect Addressing, and DCR Instructions |
| Instruction Test 2B | INST2B | MAINDEC-08-DO2B | Tests 2's Complement ADD(TAD) and Rotate Instructions |
| Random ISZ | ISZ | MAINDEC-08-007B | Tests ISZ Instruction (LINC Mode) |
| Random JMP | JMP | MAINDEC-08-DO48 | Tests JMP Instruction (LINC Mode) |
| Random JMP-JMS | JMPJMS | MAINDEC-08-DO5B | Tests JMS Instruction (LINC Mode) |
| Checkerboard Low | CBL | MAINDEC-08-D1L1 | Tests Lower Memory Susceptibility to Noise |
| Checkerboard High | CBH | MAINDEC-08-D1L2 | Tests Upper Memory Susceptibility to Noise |
| Memory Address Test, High | ADDRSHI | MAINDEC-08-D1B1 | Tests High Memory Address Selection Logic |
| Memory Address Test, Low | ADDRSLO | MAINDEC-08-D1B2 | Tests Low Memory Address Selection Logic |
| On/Off Test | ONOFF | MAINDEC-08-D1AC | Tests Memory Data Validity after Simulated Power Failure |
| Teletype Test Part 1 | TTY1 | MAINDEC-08-D2PE | Tests Teletype Instruction Control Logic |
| Teletype Test Part 2 | TTY2 | MAINDEC-08-D2QD | Teletype Test Control |

| | | | |
|--------------------|--------|-----------------|---|
| Instruction Test 1 | CPTST1 | MAINDEC-12-DOBA | Tests Instruction (LINC Mode) |
| Instruction Test 2 | CPTST2 | MAINDEC-12-DOAB | Tests SKIPs and Data Handling (LINC Mode) |
| A-D Test | ADTST | MAINDEC-12-D6CB | Tests A-D Converter and allows Calibration of Preamplifiers |

PDP-12 Lab #4 Outline

1. TU-55 Alignment torque and brake adjustment
2. Troubleshooting Processor problems

PDP-12 Lab Job Sheet #4-1

TITLE: TU-55 Adjustments

OBJECTIVE: To insure that all students can successfully perform the required adjustment of the TU-55 Tape Transport

PROCEDURE: With the aid of a scope, perform the adjustments prescribed in Information Sheet #4-1

Upon completion, ask the lab instructor to insert failures pertaining to Lab #4. Document all troubleshooting using PDP-12 Lab Failure Documentation Handout.

PROBLEM: Inconsistency in Adjustment of TU-55 Brakes and Torque

1. Brake Adjustment

- A. Energize the brake for at least 5 minutes.
This will insure that the following adjustments will not be too tight, causing brake drag when the unit warms up.
- B. With power off bring the brake shoe into the brake solenoid, then bring it back to the point at which the shoe rotates free.
- C. The brakes may be considered properly adjusted when repeated energizing produces a minimum of audible "click" and yet the shoe doesn't rub on the high spot. If this cannot be accomplished it is probably due to a shoe with too much run out. The ideal situation is to have no "click" and no drag.

2. Torque Adjustment

- A. Without tape on the transport, apply idle torque to the motor. With a scope, observe the bottom tab terminal on the rear of the G850. Set the scope to 2 M.S./C.M. at 10v/CM. The waveform should be similar to what is shown in Fig. 1. If it is not, make the necessary adjustments shown in Fig. 2.
- B. Repeat step "A" with trailing torque applied to the motor.
- C. Run a start - stop - turn around test, and adjust delay (Loc AB4) until there is a minimum of tape slap. This should be approximately 80 M.S. to 90 M.S.

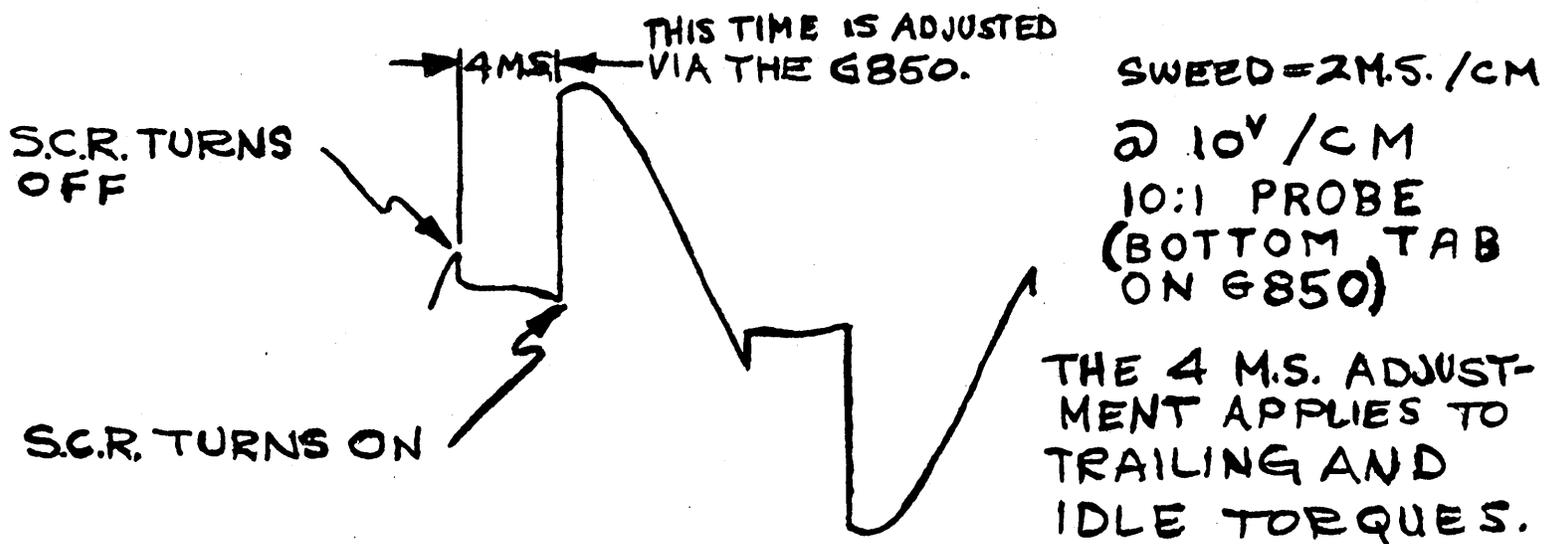


FIG. 1

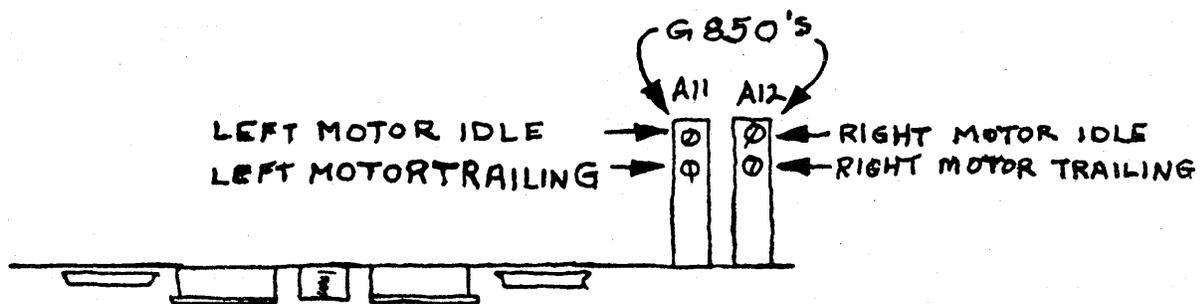


FIG. 2

AMP. CONN.

G851 RELAY
IN TUSS
LOC ABI

AMPHENOL PLUG
REAR OF MODULE
HEAD CONN.

AF & AH

TYPE 453
SCOPE &
X1 PROBE

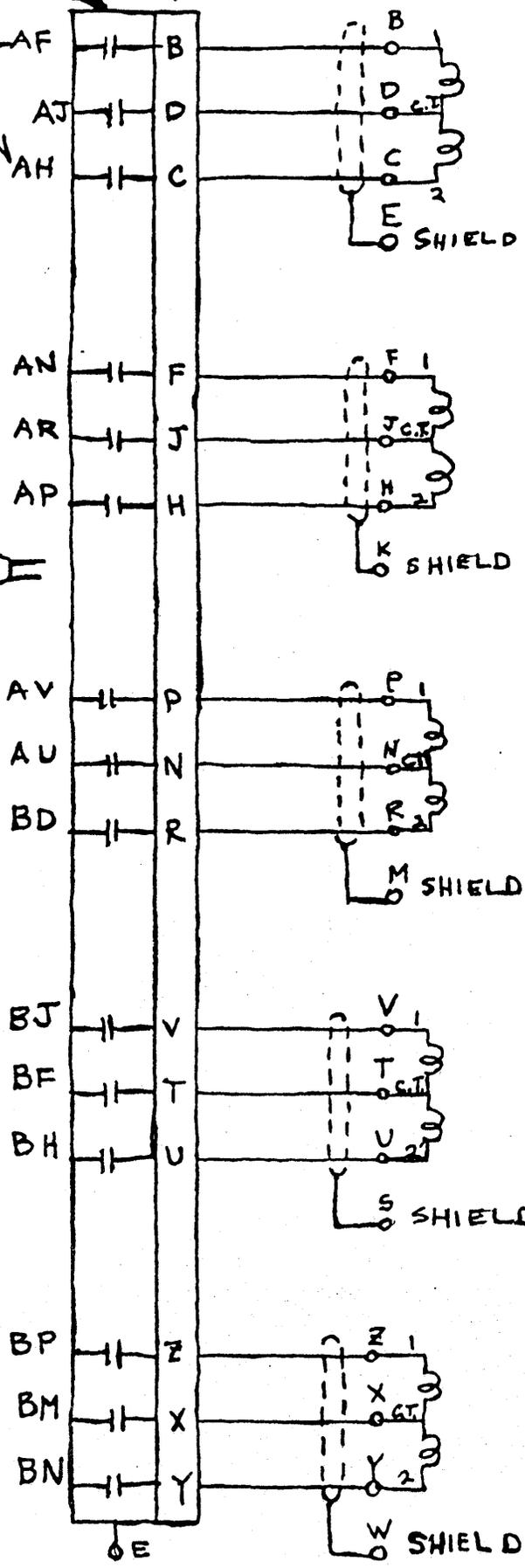
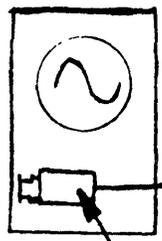
AN & AP

.01μfd, 50V CAP FROM
SIG. LINE TO PROBE GND.

AV & BD

BJ & BH

BP & BN



T.T.

M.T.

D3

D2

D1

PROBLEM: Cannot check DEctape Head Amplitude with a Type 453 Scope.

SOLUTION:

1. Obtain a 1:1 probe and attach a .01 Cap. on the end of it between the probe sig. lead and the probe case gnd. If a ready made probe isn't available use co-ax cable.
2. Float the scope gnd, via a 3-prong adapter.
3. Attach the scope tip and gnd. lead to the points indicated on the attached diagram. If the unit is a 555 or the head cannot be easily selected, then observe the pins on the head connector.

The scope should be set for 5 M.V./C.M. at about 10 msec /C.M. A 9-12 M.V. P-P signal should be observed.

A sinusoidal signal will be observed on the timing track (T.T.), however the mark track (M.T.) and data tracks (D1, D2, D3) will not be perfectly sinusoidal due to the randomness of the data written.

PDP-12 LAB #5 LESSON PLAN

To be Supplied

PDP-12 Lab #6 Outline

2 Hours

1. Do key operation
2. Use of instructions

PDP-12 Lab Job Sheet #6-1

TITLE: Do key operation

OBJECTIVE: To insure that, by examples, all students are able to use and understand the DO key for the various instruction classes of the PDP-12

- PROCEDURE:
1. Perform an LDA instruction using the four different IB configurations. Note the way each configuration addresses memory, using the DO key.
 2. Using the DO key, perform an STA instruction noting the way that the four different IB configurations address memory.
 3. Using the DO key, load a number into the AC from a Data Field location.
 4. Using the DO key, store the above number in another Data Field.
 5. Using the DO key, perform the following instruction:
8 Mode: TAD DIR cpg 50
DCA IND cpg 50
OSR

L Mode: IOB,KSF
SET and SET
DIS AUTO
HLT
WRC then RDC

PDP-12 Lab Job Sheet #6-2

- TITLE:** Use of Linc Mode Instructions
- OBJECTIVE:** To challenge the students' instruction knowledge and programming ability by providing each student with a thought provoking programming problem which, when solved, will provide him with a greater understanding of the Linc Mode instructions and therefore self-confidence in his ability to program the system.
- PROCEDURE:** Write a program to add the contents of Loc. 06000-06010, store their sequential sums in location 00100-00107. If overflow occurs at any time, stop the addition, ring the TTY bell once and display the number of words which have been added before overflow occurred in the AC.

PDP-12 Lab #7 Outline

Hours

1. TU-56 adjustments
2. Bugs

PDP-12 Lab Job Sheet #7-1

TITLE: TU-56 Adjustments

OBJECTIVE: To insure that all students understand the similarities and differences in the adjustment procedures for TU55 and TU56.

PROCEDURE: Perform the adjustments described in the TU-56 Maintenance Manual, Chapter 6.

PDP-12 Lab #8 Outline

2 Hours

1. Program Debugging
2. Program Development
3. Bugs

PDP-12 Lab Job Sheet #8-1

TITLE: Program Debugging

OBJECTIVE: Each student will successfully write a program to display a line on the VR-12 or VR-14

PROCEDURE: Debug the Display Line program and demonstrate its operation to the instructor.

TITLE: Program Development

OBJECTIVE: To challenge the student's instruction knowledge and programming ability by providing each student with a thought provoking programming problem which, when solved, will provide him with a greater understanding of the Linc Mode instructions and therefore self-confidence in his ability to program the system.

PROCEDURE: Using the previously developed Display Line programs, modify the program with a sense switch option to develop a two-part program:

1. Line Display
2. Sweeping Line Display

PDP-12 LAB #9 OUTLINE

1. Using Mark 12
2. Use of Tape Instructions

TITLE: Using Mark 12

OBJECTIVE: To ensure that all students understand the purpose and use of the Mark 12 program and its options.

PROCEDURE: Using the procedure described in PDP-12 Lab Handout #9-1A, mark a virgin tape using all three Mark 12 options and observing front panel indication as each option is running.

MARK TAPE, COPY TAPE, PRINT DIAL INDEX EXERCISE

NOTE: See reference to paragraphs (ex.5,2) on pp. (ex.1-5) in the LAP 6 DIAL Manual.

Initial Starting Procedure

1. Place dial tape on top unit.
Select unit \emptyset (8) on TU55 transport.
2. Mount another tape on the lower transport
Select unit 1

NOTE: a. This is only required for commands AS, LI, QL, and SB (See 1.8 commands).
b. This is also required when using the Mark 12 program.
c. If this is a new DECTape rather than Linc tape, it must be placed on the left hub and an empty spool on the right hub. The left spool must now be wound on the right using "LOCAL" and " \rightarrow (SW)".

3. Set switches on both tape units to "REMOTE" and set unit \emptyset (8) to "Write Enable".
4. Set the Mode Switch to "LINC" mode and press "IO PRESET" to preset Linc IF2 and Linc DF to 3.
5. Set "LSW" to $\emptyset 7 \emptyset 1$ and "RSW" to 73 $\emptyset \emptyset$.

NOTE: Depressing switch on the panel side (of the switch) is a \emptyset and on the operator side equals a 1.

If tape comes off the spool, you didn't wind enough on it. Turn "REMOTE" switch "OFF", rewind spool with leader and switch to "REMOTE" again.

6. Press to "DO" switch (memory is initialized by tapes).
7. When tape motion stops, press "START 2 \emptyset " (starting address of Dial).

Dial Program Selection

1. Turn A-D knobs 3 (Cursor Control) and 7 (Line Control) fully CW (See 2.1)
2. Using the keyboard, type Linefeed (\rightarrow , ) "cursor" appears at the lower left of DISPLAY) DX RETURN () to obtain the Dial Index (See 5.4)

5. "LINEFEED" cursor lower left

NOTE: Do not use LO for PIP -- has an auto loader type PDP & RETURN.

6. Select "A" (auxilliary options) and "RETURN"

NOTE: At this point tape to be duplicated should be to transport \emptyset (8)

7. Select "D" (duplicate) and "RETURN"

NOTE: Duplication begins.

Observe tape instruction register on the PDP-12 panel

Tape Instruction Register

- a. 000 702 RDE - Unit \emptyset (8)
- b. 000 706 WRI
- c. 000 707 CHK } - Unit 1

8. "CONTROL D" together - back to DIAL

9. Linefeed - cursor lower left

Print Index

1. LINE FEED PRINT INDEX UNIT RETURN



PX

comma
(,UNIT)



Sec. 5.5

Print out occurs

3. To view the entire index use the following keys:

| <u>KEY</u> | <u>ACTION</u> |
|------------|--------------------|
| 1 | Forward one frame |
| 2 | Forward one line |
| Q | Backward one frame |
| W | Backward one line |

4. When the MARK 12 program listing is found, perform the following steps using the keyboard:

a. Strike key "RETURN & LINE FEED"

1. Return gets you back to DIAL.
2. Line Feed stations the cursor in the lower left of Display

b. Type

1. "LO" (load)
2. "SPACE" ()
3. "MARK 12" (w/no space)
4. "COMMA" (,)
5. "Ø"
6. "RETURN" (↵) MARK 12 instructions should be seen on the Display.

Refer to MARK 12 program listing (Program Library)

5. Follow instructions on the Display

Returning to DIAL

1. Using the keyboard type:

- a. "2"
- b. "LINE FEED"

— NOTE: Depending on programs used (other than MARK 12) there are numerous ways to remove the current display, typing:

1. "RETURN" (clears the screen, back to DIAL)
2. "CONTROL D" (at the same time, gets Dial back)
3. "CONTROL P" (together, gets you back to PIP)

Copy Tape

1. "LINE FEED" -- cursor moves to lower left.
2. Type "DX & RETURN" (returns Index)
3. Locate PIP (peripheral interchange program) in the Index
4. "RETURN" back to DIAL

5. "LINEFEED" cursor lower left

NOTE: Do not use LO for PIP -- has an auto loader type PDP & RETURN.

6. Select "A" (auxilliary options) and "RETURN"

NOTE: At this point tape to be duplicated should be to transport \emptyset (8)

7. Select "D" (duplicate) and "RETURN"

NOTE: Duplication begins.

Observe tape instruction register on the PDP-12 panel

Tape Instruction Register

a. 000 702 RDE - Unit \emptyset (8)
 b. 000 706 WRI }
 c. 000 707 CHK } - Unit 1

8. "CONTROL D" together - back to DIAL

9. Linefeed - cursor lower left

Print Index

1. LINE FEED

PRINT INDEX

UNIT

RETURN



PX

comma
(,UNIT)



Sec. 5.5

Print out occurs

TITLE: Use of Tape Instructions

OBJECTIVE: To introduce the student to all tape instruction and front panel indications as each instruction is executed.

PROCEDURE: Using the Do key, perform each of the below tape instructions and note all front panel indications during the tape instruction and at the completion of the instruction.

RDE

RDC

RCG

WRI

WRC

WCG

CHK

MTB

PDP-12 LAB #10 OUTLINE

TIME: 2 Hours

1. Scoping Linc Tape Timing
2. Scoping the Mark Track
3. Linc Tape Bugs (as time permits)

PDP-12 LAB JOB SHEET #10-1

TITLE: Scoping Linc Tape Timing

OBJECTIVE: To introduce the student to procedure by which he may determine Linc Tape failures.

PROCEDURE: Using an oscilloscope, observe the waveform at pin D2, G882 (read amplifier) in slot F05.

Compare the above waveform to the waveform at Pin U2.

Note that there is an output from the amplifier with no tape motion.

Deposit at Loc. 4020 /0702
/7000
/0702
/7777
/6020

Before running the program, decide what it should do.

Run the program.

Make a timing chart which reflects the following signals:

1. LTR Head T H
2. LTR T Read H
3. LTT Read \emptyset L
4. LTT TP \emptyset H
5. LTT TP1 H
6. LTT TP2 H
7. LTT TP3 H
8. LTT TP4 H

Go to Job Sheet #10-2

PDP-12 LAB JOB SHEET #10-2

TITLE: Scoping the Mark Track

OBJECTIVE: To give the student confidence in his ability to successfully scope the Mark track decoding.

PROCEDURE: Using an oscilloscope, observe the data into the window (LWN Wind data IN L)

Sync on LWN DM H

Observe the Data Mark code being shifted into the window.

TIME: 2 hours.

1. Tape Delay Adjustments
2. Troubleshooting the TC-12

PDP-12 LAB JOB SHEET #11-1

TITLE: TC-12 Tape Delay Adjustments

OBJECTIVE: To familiarize the student with the adjustments of the TC-12 delays and the problems that occur from maladjusted delays.

PROCEDURE: Using the procedure described in the PDP-12 Maintenance Manual, Volume 2, perform the following adjustments:

3.5.1 Tape timing pulses

3.5.2 LTD XTLK Delay

3.5.3 LTD TTOK Delay

3.5.4 LTD TAPE FAIL Delay

3.5.5 LTD ACIP Delay

3.5.6 Mark Clock Adjustment

PDP-12 LAB #12 OUTLINE

TIME: 2 Hours

1. Use of Tape Diagnostics
2. TC-12 Troubleshooting

PDP-12 LAB JOB SHEET #12-1

TITLE: Use of Tape Diagnostics

OBJECTIVE: To ensure that all students understand the procedure for running tape diagnostics

PROCEDURE: Using a PDP-12 maintenance tape or paper tapes, load and run the following Maindecs:

Tape Quickie

TC 12-I

TC 12-II

Tape Data

Any failures should be corrected at this time.

PDP-12 LAB #13 OUTLINE

TIME: 2 Hours

1. Calibration of AD-12
2. Troubleshooting AD-12

PDP-12 LAB JOB SHEET # 13-1

TITLE: Calibration of AD-12

OBJECTIVE: To ensure that all students understand and can perform the calibration of the AD-12.

PROCEDURE: Perform the adjustments described in the PDP-12 Maintenance Manual, Volume 2, section 3.8.5--3.9.2 .

PDP-12 LAB #14 OUTLINE

TIME: 2 Hours

1. VR-12 adjustments
2. VR-14 adjustments
3. Troubleshooting the VC-12

PDP-12 LAB JOB SHEET #14-1

TITLE: VR-12 Adjustments

OBJECTIVE: To ensure that all students are capable of correctly adjusting the VR-12 display.

PROCEDURE: Does your PDP-12 system contain a VR-12 or a VR-14?

VR-12: Use Job Sheet #14-1. Upon completion, go to a system which contains a VR-14 and use Job Sheet #14-2.

VR-14: Use Job Sheet #14-2. Upon completion, go to a system which contains a VR-12 and use Job Sheet #14-1.

Perform the adjustments described in the PDP-12 Maintenance Manual, Volume 2, section 3.8 through 3.8.4 .

PDP-12 LAB JOB SHEET #14-2

TITLE: VR-14 Adjustments

OBJECTIVE: To ensure that all students are capable of correctly adjusting the VR-14 display.

PROCEDURE: Does your PDP-12 system contain a VR-12 or a VR-14?

VR-12: Use Job Sheet #14-1. Upon completion, go to a system which contains a VR-14 and use Job Sheet #14-2.

VR-14: Use Job Sheet #14-2. Upon completion go to a system which contains a VR-12 and use Job Sheet #14-1.

Perform the adjustments described in the PDP-12 Maintenance Manual, Volume 2, section 3.8 through 3.8.4 .

PDP-12 LAB #15 OUTLINE

TIME: 2 Hours.

1. KW-12A Diagnostic usage
2. KW-12A Troubleshooting

PDP-12 LAB JOB SHEET #15-1

TITLE: KW-12A Diagnostic

OBJECTIVE: To ensure that all students can successfully run the KW-12A diagnostic and understand any failures which the diagnostic should indicate.

PROCEDURE: Load and run the KW-12A diagnostic. If failures occur, obtain the appropriate write-up and correct the problem.

PDP-12 LAB JOB SHEET #15-1

TITLE: KW-12A Diagnostic

OBJECTIVE: To ensure that all students can successfully run the KW-12A diagnostic and understand any failures which the diagnostic should indicate.

PROCEDURE: Load and run the KW-12A diagnostic. If failures occur, obtain the appropriate write-up and correct the problem.

PDP-12 LAB #16 OUTLINE

1. PDP-12/10 System Troubleshooting
2. PDP-12/20 System Troubleshooting
3. PDP-12/30 System Troubleshooting
4. PDP-12/40 System Troubleshooting

PDP-12 LAB JOB SHEET #16-1, 2, 3, 4

To be Supplied