# PDP-12 LAB INSTRUCTOR's OUTLINE

I.   PDP-12 Lab #1                    2 Hours

    A. Loading the RIM Loader

    B. Checking the RIM Loader

    C. Loading the BINary Loader

    D. The Use of Checkerboard Low and High to Check Memory

    E. How to Tune Memory

    F. Program Development


II.  PDP-12 Lab #2                    4 Hours

    A. First Period

        1. Scoping Processor Timing

        2. Scoping Memory Timing

    B. Second Period

        1. Scoping Manual Timing

        2. Troubleshooting (as time permits)


III. PDP-12 Lab #3                   2 Hours

    A. Understanding the Front Panel Indicators

    B. Use of Paper Tape Diagnostics in Locating Machine Failures

    C. Troubleshooting (as time permits)


IV.  PDP-12 Lab #4                   2 Hours

    A. TU-55 Alignment, Torque and Brake Adjustments

    B. Troubleshooting Processor Problems

V. PDP-12 Lab #5                    2 Hours

    A. Dial Lecture

VI. PDP-12 Lab #6                    2 Hours

    A. Do Key Operation

    B. Use of Linc Instructions

VII. PDP-12 Lab #7                    2 Hours

    A. TU-56 Adjustments

    B. Troubleshooting Processor Problems

VIII. PDP-12 Lab #8                    2 Hours

    A. Program Debugging

    B. Program Development

    C. Troubleshooting Processor Problems

IX. PDP-12 Lab #9                    2 Hours

    A. Using Mark 12

    B. Use of Tape Instructions

X. PDP-12 Lab #10                    2 Hours

    A. Scoping Linc Tape Timing

    B. Scoping the Mark Track

    C. Linc Tape Bugs (as time permits)

XI. PDP-12 Lab #11                    2 Hours

    A. Tape Delay Adjustments

    B. Troubleshooting the TC-12

XII.   PDP-12 Lab #12                   2 Hours

    A. Use of Tape Diagnostics

    B. TC-12 Troubleshooting


XIII.  PDP-12 Lab #13                   2 Hours

    A. Calibration of AD-12

    B. Troubleshooting AD-12


XIV.   PDP-12 Lab #14                   2 Hours

    A. VR-12 Adjustments

    B. VR-14 Adjustments

    C. Troubleshooting the VC-12


XV.    PDP-12 Lab #15                   2 Hours

    A. KW-12A Diagnostic Usage

    B. KW-12A Troubleshooting


XVI.   PDP-12 Lab #16                   4 Hours

    A. PDP-12/10 System Troubleshooting

    B. PDP-12/20 System Troubleshooting

    C. PDP-12/30 System Troubleshooting

    D. PDP-12/40 System Troubleshooting

# PDP-12 LAB NO. 1 OUTLINE

<u>Time</u>: 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

<u>TITLE</u>:  Loading the Rim Loader

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

<u>PROCEDURE</u>: 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

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

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

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.

TITLE:  Program Development

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

PROCEDURE: Write a program, using LINC or 8-mode
instruction, that detects the number of 4K
fields present in a processor.  At the com-
pletion 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.

## 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.
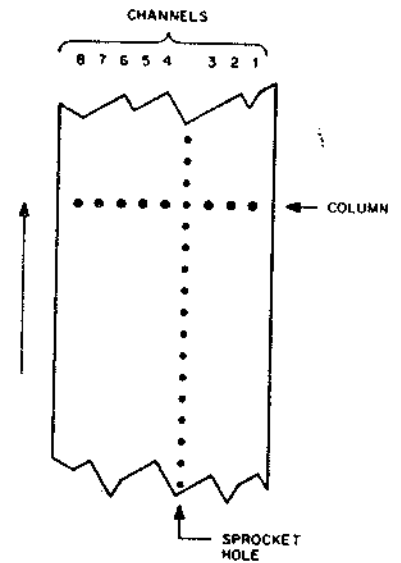
### Leader/Trailer Format

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.
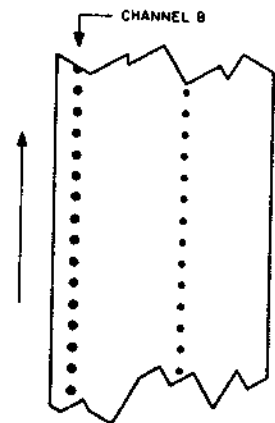
# INFORMATION SHEET #2

— CHANNEL 7

## 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.

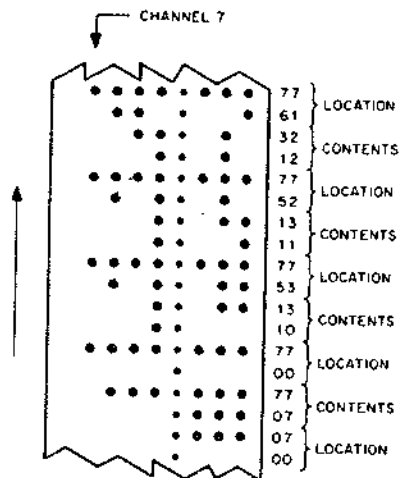| | |
|---|---|
| 77 61 | LOCATION |
| 32 12 | CONTENTS |
| 77 52 | LOCATION |
| 13 11 | CONTENTS |
| 77 53 | LOCATION |
| 13 10 | CONTENTS |
| 77 00 | LOCATION |
| 77 07 | CONTENTS |
| 07 00 | LOCATION |

## 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.

| | |
|---|---|
| 324 | T |
| 310 | H |
| 311 | I |
| 323 | S |
| 240 | |
| 311 | I |
| 323 | S |
| 240 | |
| 301 | A |
| 323 | S |
| 303 | C |
| 311 | I |
| 311 | I |
| 240 | |
| 306 | F |
| 317 | O |
| 322 | R |
| 315 | M |
| 301 | A |
| 324 | T |
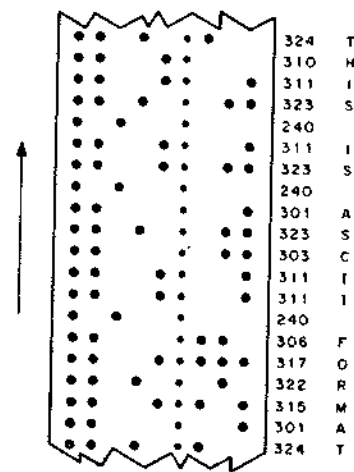
## Binary Format

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.

| | |
|---|---|
| 00 17 | ORIGIN |
| 32 50 | INSTRUCTION |
| 00 00 | INSTRUCTION |
| 00 00 | INSTRUCTION |
| 02 56 | INSTRUCTION |
| 77 01 | INSTRUCTION |
| 76 00 | INSTRUCTION |
| 77 60 | INSTRUCTION |
| 01 77 | INSTRUCTION |
| 45 77 | INSTRUCTION |
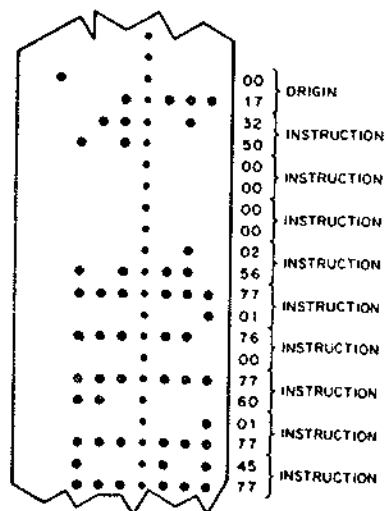
READ-IN MODE (RIM) LOADER

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 ($21_8$ 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

Initialize

Using Extended Memory ? — Yes → Set * DF = Desired Field IF = Desired Field

No

Set SR = 7756

Depress LOAD ADD

* DEC tape users should load RIM into field 0

PC = 7756 ? — No

Yes

Set SR = First Instruction

Activate DEP

Set SR = Next Instruction

Activate DEP

ALL Instructions In ? — No

Yes

RIM Is Loaded
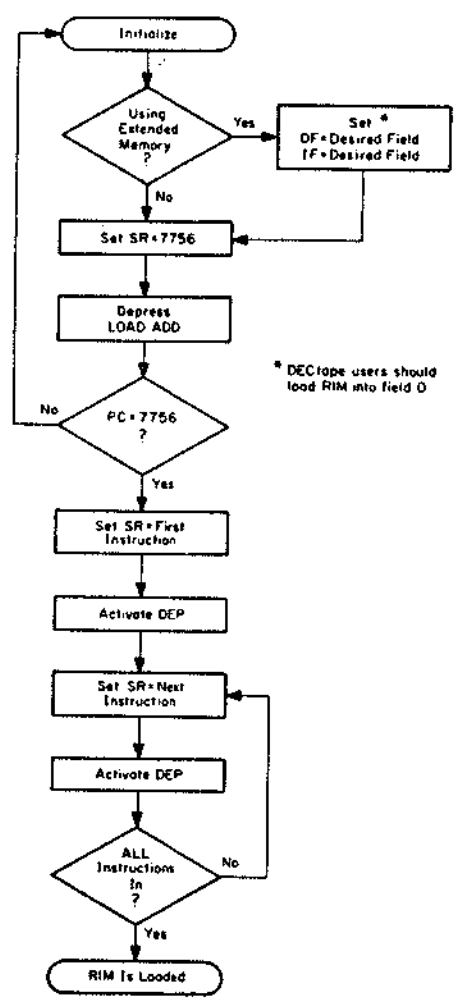
**Loading the RIM Loader**

INFORMATION SHEET #5

```
                        ┌──────────────┐
                        │  Initialize  │
                        └──────┬───────┘
                               │
                               ▼
                          ╱────────╲
                         ╱  Using   ╲   Yes    ┌────────────────────┐
                        ╱  Extended  ╲────────▶│        Set         │
                        ╲   Memory   ╱         │  DF = Correct Field│
                         ╲    ?     ╱          │  IF = Correct Field│
                          ╲────────╱           └─────────┬──────────┘
                               │ No                      │
                               ▼                         │
                        ┌──────────────┐                 │
                        │ Set SR = 7756│◀────────────────┘
                        └──────┬───────┘
                               │
                               ▼
                        ┌──────────────┐
                        │Depress LOAD ADD│
                        └──────┬───────┘
                               │
                               ▼
                        ┌──────────────┐
                        │ Depress EXAM │◀──────────────────┐
                        └──────┬───────┘                   │
                               │                           │
                               ▼                           │
                          ╱────────╲                       │
              No         ╱   MB =   ╲      Yes             │
        ┌───────────────╱ Instruction╲────────────┐        │
        │               ╲     ?      ╱            │        │
        │                ╲────────╱               │        │
        ▼                                         │        │
┌──────────────┐                                  │        │
│  Set SR = MA │                                  ▼        │
└──────┬───────┘                            ╱────────╲     │
       │                                   ╱   All    ╲  No │
       ▼                                  ╱ Instructions╲───┘
┌──────────────┐                          ╲  Checked   ╱
│Depress LOAD ADD│                         ╲    ?     ╱
└──────┬───────┘                            ╲────────╱
       │                                        │ Yes
       ▼                                        ▼
┌──────────────┐                         ┌──────────────┐
│Set SR=Correct│                         │ RIM Is Loaded│
│ Instruction  │                         └──────────────┘
└──────┬───────┘
       │
       ▼
┌──────────────┐
│ Depress DEP  │────────────────────────┘
└──────────────┘
```
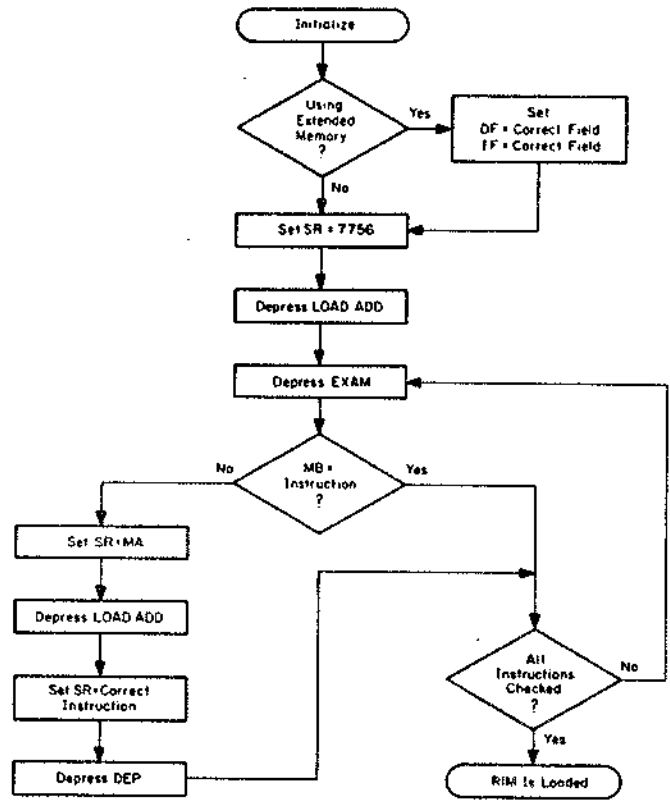
## Checking the RIM Loader

# FLOW CHART  RIM LOADER PROGRAM

Preliminary
Draft

Manual
Start
7756

Does
READER
FLAG=1

YES

READ
CHARACTER

Rotate 4
Places left
Bit 8 in sign bit

AC
Positive
?

NO
Leader or Trailer

YES

Rotate 2
Places left
Bit 7 in Link

NO

Does
Reader Flag
= 1

YES

Read
Character

Store AC
(Data word)
indirectly
in TEMP

NO

Does
Link=1

Yes

Store AC
(ADDRESS)
in TEMP
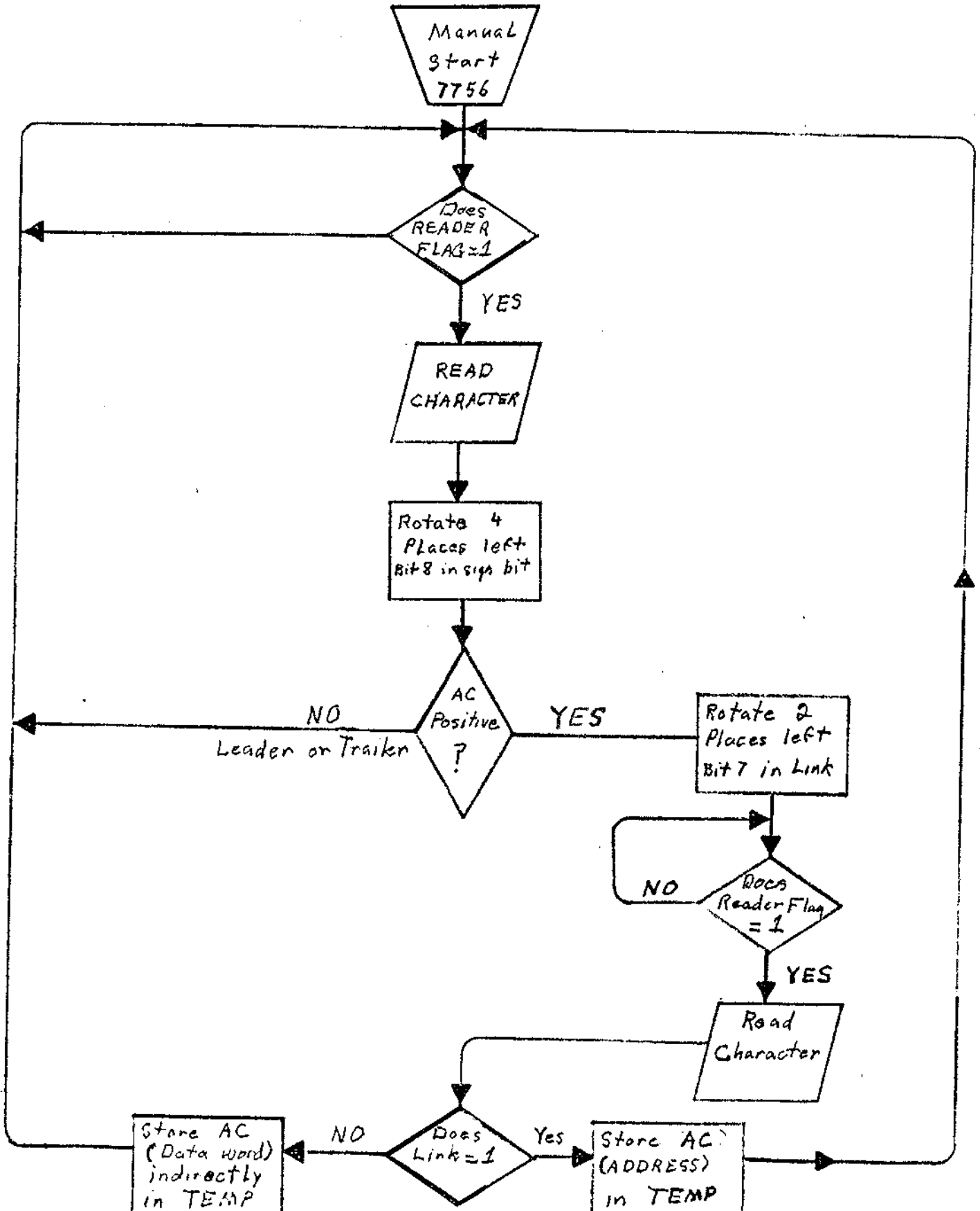
BINARY (BIN) LOADER

PURPOSE

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 ($123_8$ 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<br>00 000 . 000 | Origin | No | In octal the origin 0200. Loading will start at 0200. |
| 00 111 . 010<br>00 000 . 000 | Contents of 200 | Yes | The command 7200 or CLA. |
| 00 011 . 010<br>00 111 . 110 | Contents of 201 | Yes | The command 3276 or DCA Z 076. |
| 00 111 . 100<br>00 000 . 010 | Contents of 202 | Yes | The command 7402 or HLT. |
| 00 000 . 100<br>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).
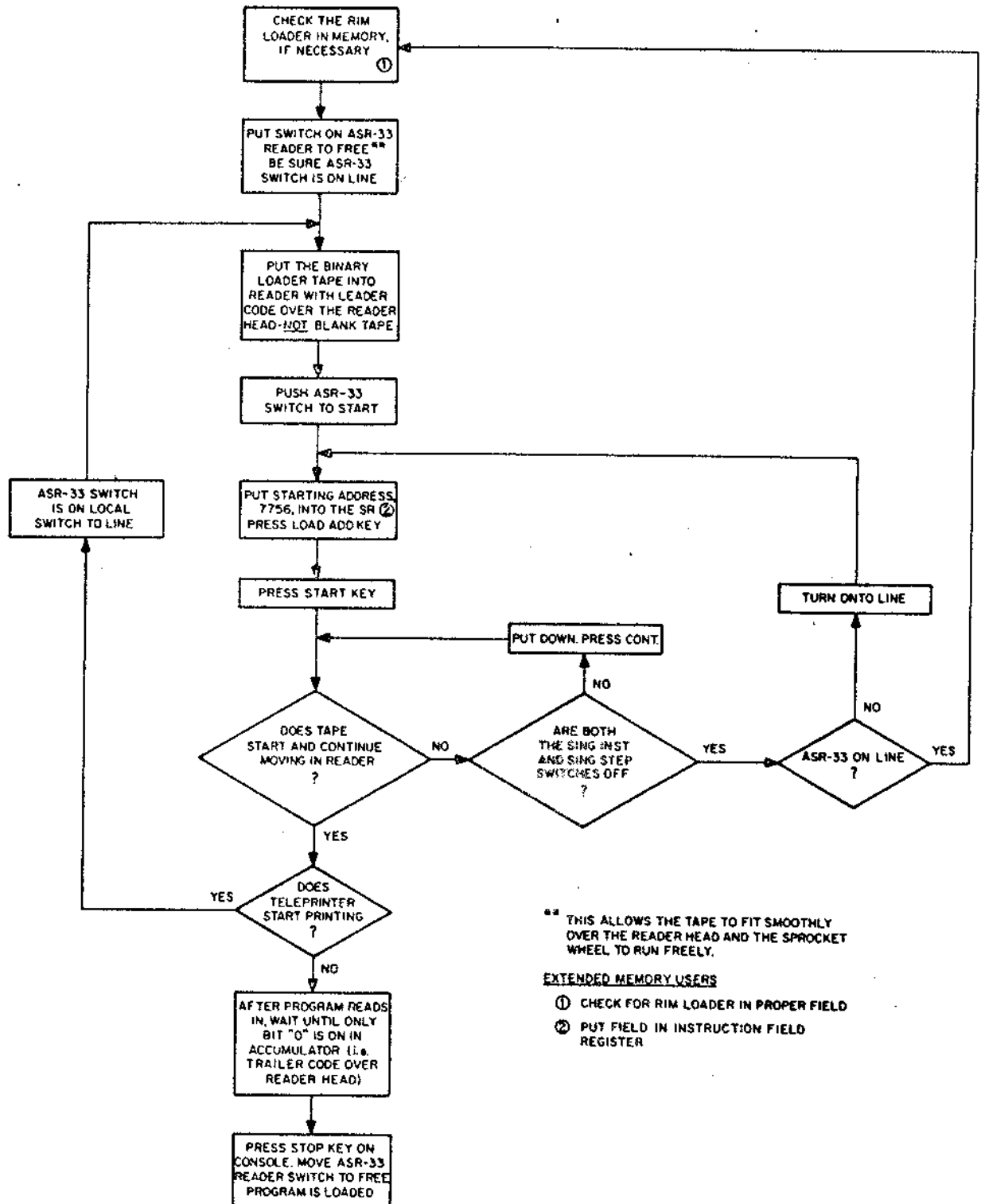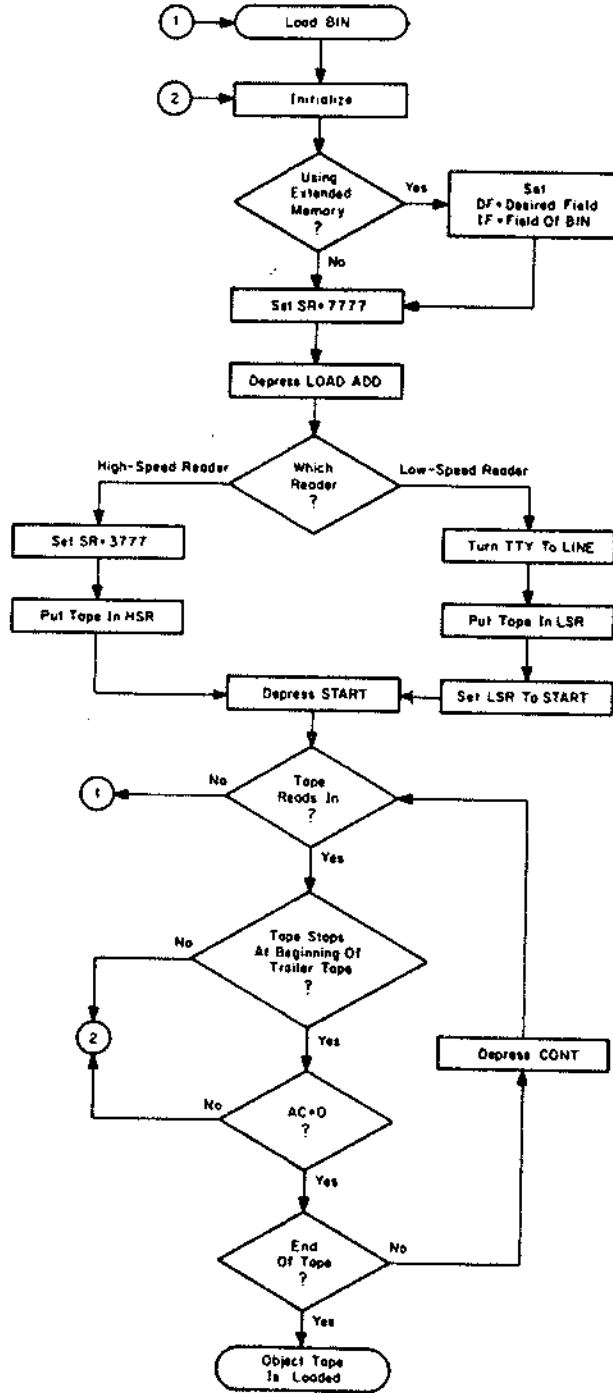
Operation and Usage For Extended Memory Users

    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

```
        ┌─────────────────┐
        │  CHECK THE RIM  │
        │ LOADER IN MEMORY│◄──────────────────────────────┐
        │  IF NECESSARY ① │                               │
        └────────┬────────┘                               │
                 ▼                                         │
        ┌─────────────────┐                               │
        │PUT SWITCH ON ASR-33                              │
        │READER TO FREE**                                 │
        │BE SURE ASR-33                                   │
        │SWITCH IS ON LINE│                               │
        └────────┬────────┘                               │
                 ▼                                         │
   ┌──►┌─────────────────┐                                │
   │   │ PUT THE BINARY  │                                │
   │   │ LOADER TAPE INTO│                                │
   │   │READER WITH LEADER                                │
   │   │CODE OVER THE READER                              │
   │   │HEAD-NOT BLANK TAPE                                │
   │   └────────┬────────┘                                │
   │            ▼                                          │
   │   ┌─────────────────┐                                │
   │   │  PUSH ASR-33    │                                │
   │   │ SWITCH TO START │                                │
   │   └────────┬────────┘                                │
   │            ▼                                          │
   │   ┌─────────────────┐                                │
   │   │PUT STARTING ADDRESS                              │
   │   │7756, INTO THE SR ②                               │
   │   │PRESS LOAD ADD KEY│              ┌──────────────┐ │
   │   └────────┬────────┘              │ TURN ON TO LINE│
   │            ▼                        └──────────────┘ │
   │   ┌─────────────────┐                                │
   │   │ PRESS START KEY │                                │
   │   └────────┬────────┘                                │
   │            ▼        ┌──────────────────┐             │
   │            ◄────────│PUT DOWN. PRESS CONT.│          │
   │                     └──────────────────┘             │
```

DOES TAPE START AND CONTINUE MOVING IN READER ?  — NO → ARE BOTH THE SING INST AND SING STEP SWITCHES OFF ? — YES → ASR-33 ON LINE ? — YES ──→ (back to top)

ARE BOTH ... OFF ? — NO → PUT DOWN. PRESS CONT.

ASR-33 ON LINE ? — NO → TURN ON TO LINE

DOES TAPE START AND CONTINUE MOVING IN READER ? — YES → DOES TELEPRINTER START PRINTING ?

DOES TELEPRINTER START PRINTING ? — YES → ASR-33 SWITCH IS ON LOCAL SWITCH TO LINE

ASR-33 SWITCH IS ON LOCAL SWITCH TO LINE → (back to PUT THE BINARY LOADER TAPE INTO READER)

DOES TELEPRINTER START PRINTING ? — NO →

┌─────────────────┐
│AFTER PROGRAM READS│
│IN, WAIT UNTIL ONLY│
│BIT "0" IS ON IN │
│ACCUMULATOR (i.e.│
│TRAILER CODE OVER│
│READER HEAD) │
└────────┬────────┘
         ▼
┌─────────────────┐
│PRESS STOP KEY ON│
│CONSOLE. MOVE ASR-33│
│READER SWITCH TO FREE│
│PROGRAM IS LOADED│
└─────────────────┘

** THIS ALLOWS THE TAPE TO FIT SMOOTHLY
OVER THE READER HEAD AND THE SPROCKET
WHEEL TO RUN FREELY.

EXTENDED MEMORY USERS

① CHECK FOR RIM LOADER IN PROPER FIELD

② PUT FIELD IN INSTRUCTION FIELD
REGISTER

```
  ①──▶( Load BIN )

  ②──▶[ Initialize ]
            │
            ▼
        ╱Using ╲          Set
       ╱Extended╲──Yes──▶ DF = Desired Field
       ╲Memory ╱          IF = Field Of BIN
        ╲  ?  ╱
           │No                  │
           ▼                    │
      [ Set SR = 7777 ]◀────────┘
           │
           ▼
     [ Depress LOAD ADD ]
           │
           ▼
High-Speed Reader ╱Which ╲ Low-Speed Reader
      ◀──────────╱ Reader ╲──────────▶
                 ╲   ?   ╱
      │                            │
      ▼                            ▼
[ Set SR = 3777 ]          [ Turn TTY To LINE ]
      │                            │
      ▼                            ▼
[ Put Tape In HSR ]        [ Put Tape In LSR ]
      │                            │
      ▼                            ▼
      └───────▶[ Depress START ]◀──[ Set LSR To START ]
                     │
                     ▼
         No    ╱ Tape ╲
   ①◀─────────╱ Reads In ╲◀────────┐
              ╲    ?    ╱           │
                  │Yes              │
                  ▼                 │
            ╱ Tape Stops ╲          │
      No   ╱ At Beginning Of ╲      │
   ┌──────╲  Trailer Tape  ╱        │
   │       ╲      ?     ╱           │
   │            │Yes                │
   ▼            ▼              [ Depress CONT ]
   ②     ╱ AC = O ╲                 │
         ╲   ?   ╱──No──────────────┘
    No◀──╲     ╱                    ▲
             │Yes                   │
             ▼                      │
         ╱ End ╲                    │
         ╱ Of Tape ╲──No────────────┘
         ╲    ?   ╱
             │Yes
             ▼
        ( Object Tape
          Is Loaded )
```

**Loading A Binary Coded Object Tape Using BIN**

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)

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

OBJECTIVE:   To aid the student in the generation of a <u>cycle time chart.</u>

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 CPTP1 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 ØØØØ place a JMPØ.

Upon completion go to Job Sheet #2-2

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 CPTP1.

PROCEDURE: Use the procedure described in Lab Worksheet #2-1.

           Upon completion, go to Job Sheet #2-2

| Signal Number | Pin Location | | Page designation |
|---|---|---|---|
| 1 | J12 | E1 | CPT |
| 2 | M39 | F1 | CST |
| 3 | LØ5 | N2 | CPTP |
| 4 | JØ6 | E1 | CPT |
| 5 | J21 | E1 | RCL |
| 6 | J1Ø | C1 | CPTP |
| 7 | HØ6 | F1 | CPTP |
| 8 | JØ4 | N1 | CPT |
| 9 | JØ7 | E1 | CPTP |
| 10 | E14 | S2 | MCT |
| 11 | JØ6 | S1 | CPT |
| 12 | J21 | L1 | RCL |
| 13 | JØ6 | J2 | CPT |
| 14 | JØ4 | L2 | CPT |
| 15 | JØ3 | P2 | CPT |
| 16 | JØ4 | K1 | CPTP |
| 17 | JØ3 | D2 | CPT |
| 18 | HØ9 | J1 | CPTP |
| 19 | HØ9 | F1 | CPTP |
| 20 | HØ3 | J1 | CPTP |
| 21 | KØ6 | B1 | CPS |
| 22 | HØ7 | F1 | CPTP |

100 . 'dev

Ons

| # | Signal |
|---|--------|
| 1 | CYC DONE |
| 2 | EN MEM |
| 3 | MEM IDLE |
| 4 | TS1 o |
| 5 | LOAD MA |
| 6 | ST MEM |
| 7 | TP10 |
| 8 | TS2 |
| 9 | TP2 |
| 10 | STROBE |
| 11 | TS3 |
| 12 | LOAD MB |
| 13 | TS4 |
| 14 | TP4 |
| 15 | TS5 |
| 16 | TPSS |
| 17 | OFF PAUSE |
| 18 | TP5 |
| 19 | TP50 |
| 20 | LTP5 |
| 21 | TP1 |
| 22 | TP3 |

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

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.

TP1
(St.Memory)

R  ~d

.robe

Inhibit

Write

Mem Done

(
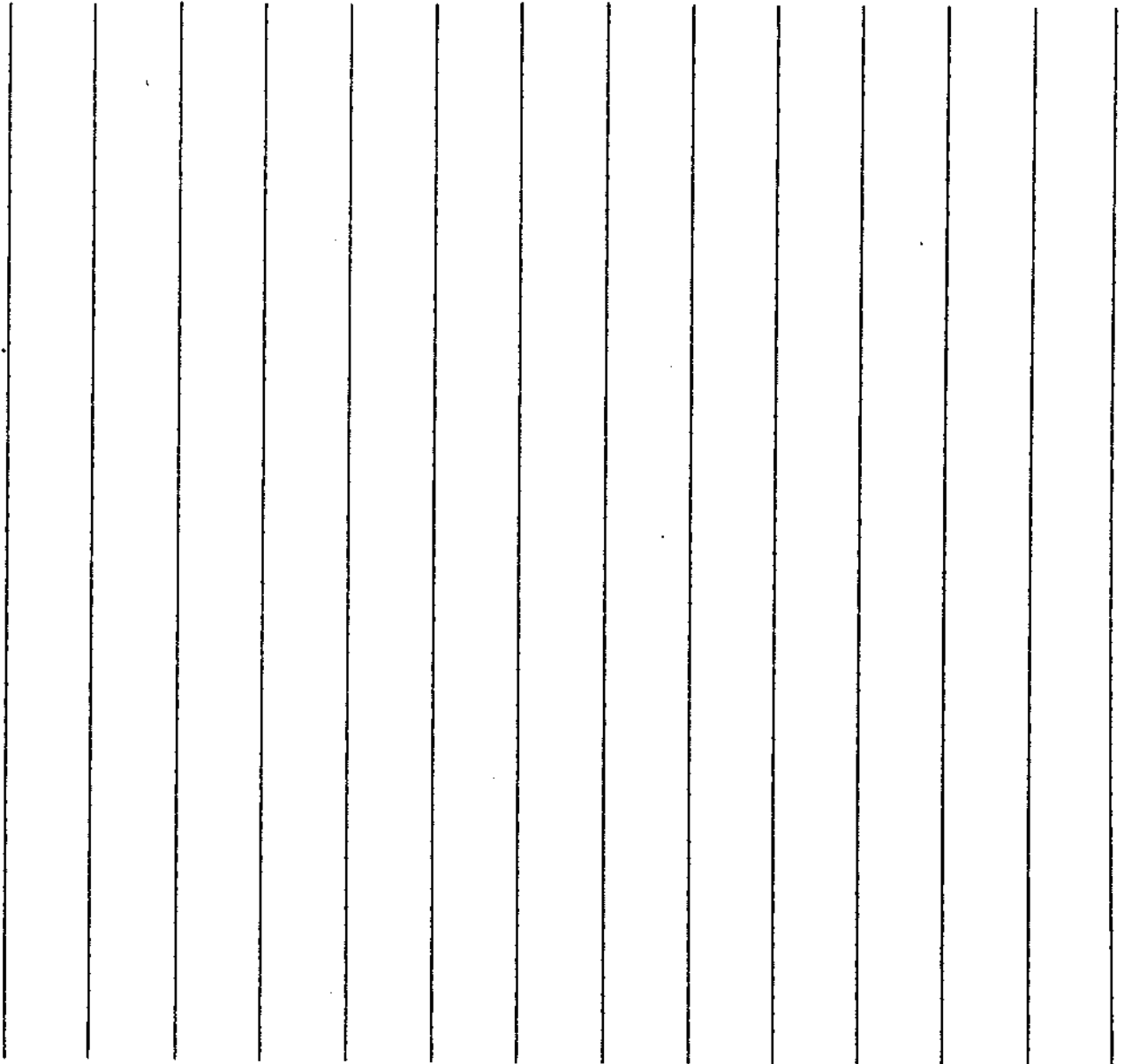
TITLE:          Manual timing functions

OBJECTIVE:      To aid the student in his understanding of the
                PDP-12 manual timing chain and the operation of
                the key stop 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 TTO 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 pro-
                cessor timing  using Lab Worksheet 2-3A.

PROCEDURE:   <u>Scope setup</u>

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 #2 Failure Directory

1. Exam key

2. Fill key

3. Strobe

4. Mem Done

5. Address

6. Sense Amp

7. Memory Buffer

8. Inhibit Drive

1. Understanding the front panel indicators

2. Use of paper tape diagnostics in locating machine failures.

3. Bugs (as time permits)

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

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 adjustment

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 unchange

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 o 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 th 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.

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 prove capable of executing all instructions. However, such proof is conditional becaus 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-D013 | Tests AND, TAD and Operate Instruc tions |
| Instruction Test 2 | INST2 | MAINDEC-8/I-D02D | Tests Auto Indexing, Indirect Addr sing, and DCR Instructions |
| Instruction Test 2B | INST2B | MAINDEC-08-D02B | 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-D04B | Tests JMP Instruction (LINC Mode) |
| Random JMP-JMS | JMPJMS | MAINDEC-08-D05B | 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

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 pre-
              scribed in Information Sheet #4-1

              Upon completion, ask the lab instructor to insert
              failures pertaining to Lab #4.  Document all trouble-
              shooting 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 show 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.

THIS TIME IS ADJUSTED VIA THE G850.

|4MS|

S.C.R. TURNS OFF

S.C.R. TURNS ON

SWEEP = 2M.S./CM
@ .10ᵛ/CM
10:1 PROBE
(BOTTOM TAB ON G850)

THE 4 M.S. ADJUSTMENT APPLIES TO TRAILING AND IDLE TORQUES.

FIG. 1



G850's

A11   A12

LEFT MOTOR IDLE →
LEFT MOTOR TRAILING →

← RIGHT MOTOR IDLE
← RIGHT MOTOR TRAILING
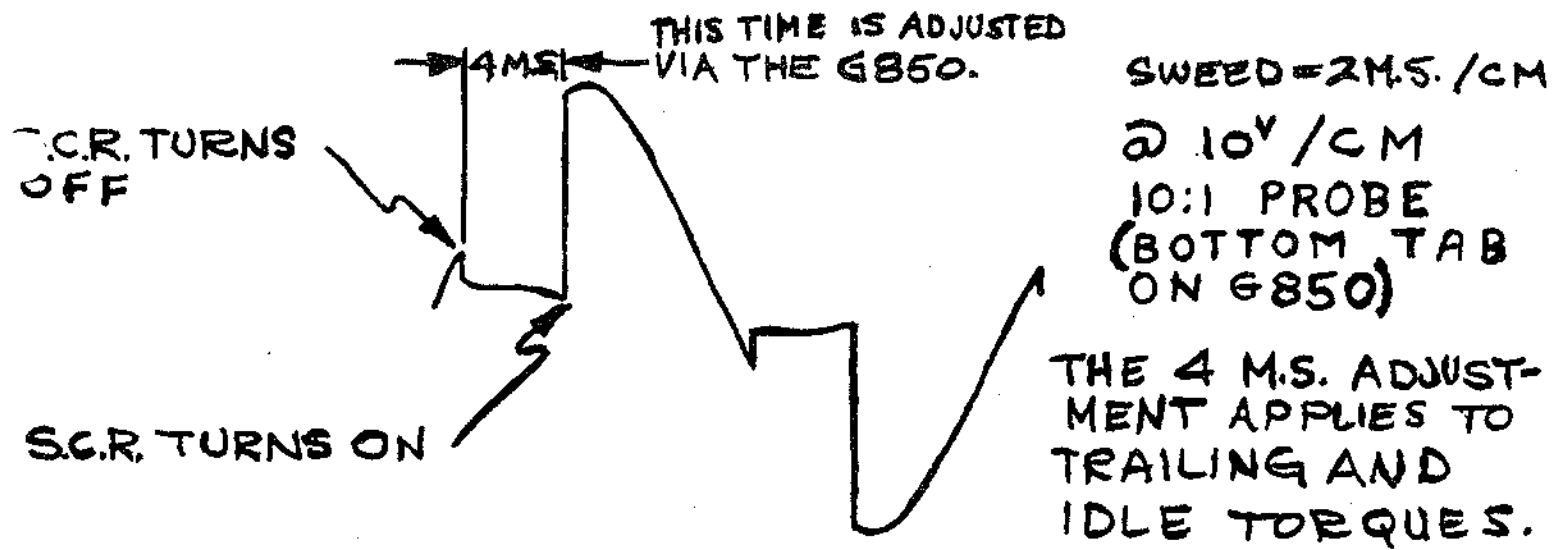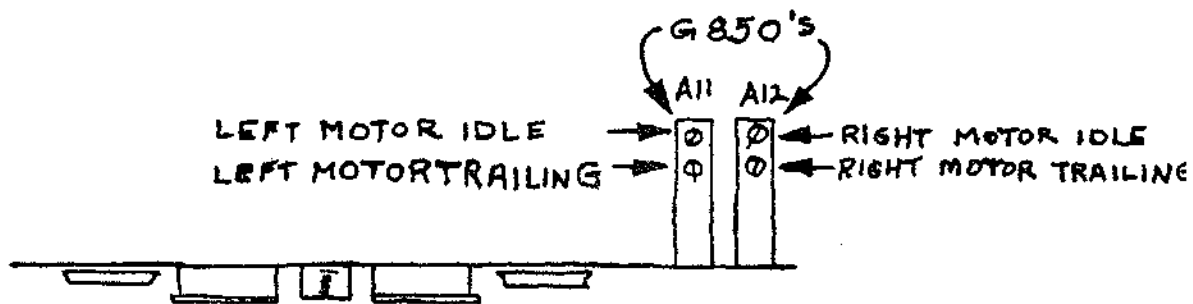
FIG. 2

AMP. CONN.

G851 RELAY
IN TUSS
LOC AB1

AMPHENOL PLUG
REAR OF MODULE

HEAD CONN.

AF & AH

| AF | | B |
| AJ | | D |
| AH | | C |

B
D   C.T.
C
E   SHIELD

T.T.

TYPE 453
SCOPE &
XI PROBE

AN & AP

| AN | | F |
| AR | | J |
| AP | | H |

F   1
J.C.T.
H   2
K   SHIELD

M.T.

PROBE
GND.

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

AV & BD

| AV | | P |
| AU | | N |
| BD | | R |

P   1
N   C.T.
R   2
M   SHIELD

D3

BJ & BH

| BJ | | V |
| BF | | T |
| BH | | U |

V   1
T   C.T.
U   2
S   SHIELD

D2

BP & BN

| BP | | Z |
| BM | | X |
| BN | | Y |

Z   1
X   C.T.
Y   2
W   SHIELD

D1

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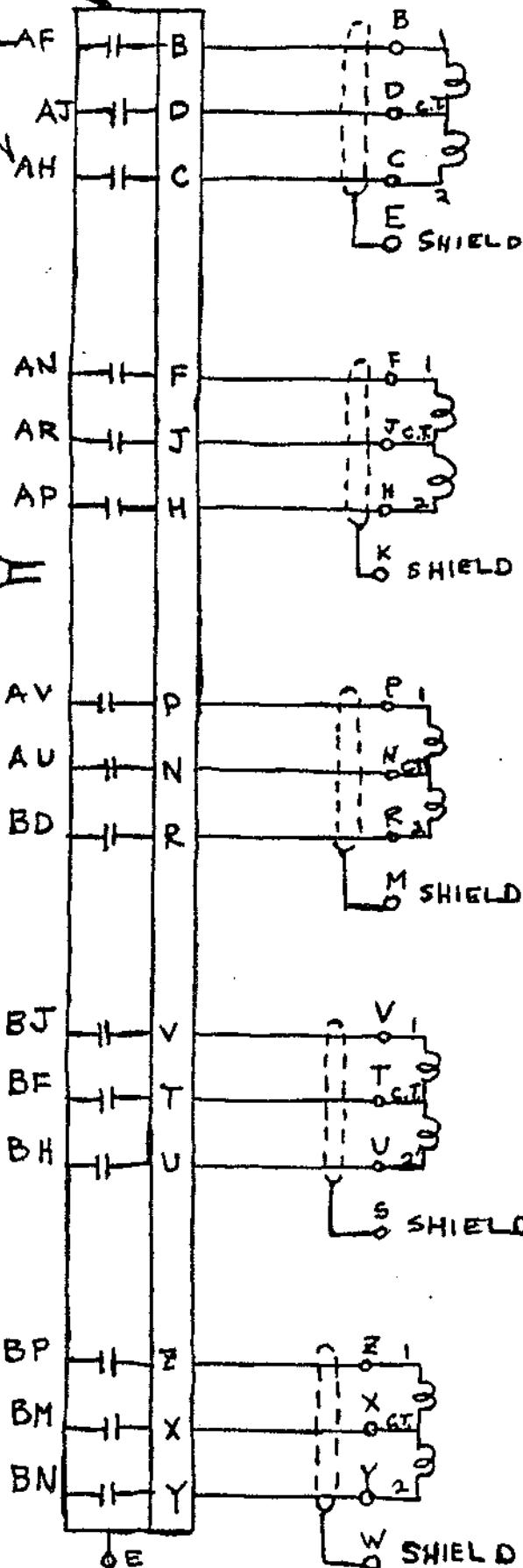
PROBLEM:   Cannot check DECtape Head Amplitude with a Type 453 Scope.


SOLTUION:

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 in-
     dicated 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.

<u>INSTRUCTOR COPY</u>

<u>PDP-12 Lab #4 Failure Directory</u>

1.  Manual Timing

2.  Key Function

3.  Memory Timing

4.  Instruction

5.  Instruction

6.  Auto Index

7.  Interrupt

8.  IO Timing

9.  IO Bus

10.  Power Supply

1.  DIAL  -  V2   Lecture

2.  DIAL  -  MS   Overview

To be Supplied

2 Hours

1. Do key operation

2. Use of instructions

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

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 occured in the AC.

## PDP-12 Lab #6 Failure Directory

1. Linc incrementing

2. IR decode

3. Linc Indirect (EN DF)

4. St 20 key

5. St 400 key

6. Single step key

## PDP-12 Lab #7 Outline

2 Hours

1.  TU-56 adjustments

2.  Bugs

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 #7 Failure Directory

1. Reg Bus

2. IR

3. XSK instr

4. Dial Failure

5. Field Failure

2 Hours

1.   Program Debugging

2.   Program Development

3.   Bugs

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 ob-
             serving 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 Ø (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 " ➤(SW)".

3.  Set switches on both tape units to "REMOTE" and set unit Ø (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 Ø7Ø1 and "RSW" to 73ØØ.

_____  NOTE: Depressing switch on the panel side (of the switch) is a Ø
           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 2Ø" (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 (➤,▲ "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. 0●0   702   RDE - Unit $\emptyset$ (8)
b. ●●0   706   WRI⎫
c. ●●●   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      )        Sec. 5.5
                                     (,UNIT)
    Print out occurs

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

| KEY | ACTION |
|---|---|
| 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 t ˜e to be duplicated shoul ` be to transport ∅ (8)

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

——— NOTE:  Duplication begins.
Observe tape instruction register on the PDP-12 panel

Tape Instruction Register

```
a. 0●0   702   RDE - Unit ∅ (8)
b. ●●0   706   WRI⎫
c. ●●●   707   CHK⎭ - Unit 1
```

8. "CONTROL D" together - back to DIAL

9. Linef... - cursor lower left


## Print Index

1. LINE FEED    PRINT INDEX    UNIT   RETURN

    →     PX     comma    ⎭    Sec. 5.5
                   (,UNIT)
    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 instruc-
              tion  and at the completion of the instruction.

                  RDE

                  RDC

                  RCG

                  WRI

                  WRC

                  WCG

                  CHK

                  MTB

TIME:  2 Hours

1.  Scoping Linc Tape Timing

2.  Scoping the Mark Track

3.  Linc Tape Bugs (as time permits)

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

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.

# LINC TAPE FAILURE DIRECTORY

1. No Tape Select      TØ6

2. No Stop        TØ5

3. Group Counter      TØ3

4. Tape Head       THØ7

5. No Carry Insert     TØ4

6. Will not find desired block TØ1

7. No Block Major State   TØ2

TIME:    2 hours.

    1.   Tape Delay Adjustments

    2.   Troubleshooting the TC-12

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

<u>PDP-12  LAB #12</u>    <u>OUTLINE</u>

TIME:    2 Hours

    1.  Use of Tape Diagnostics

    2.  TC-12 Troubleshooting

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

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

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 .

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 .

TIME:  2 Hours.

1.  KW-12A  Diagnostic usage

2.  KW-12A  Troubleshooting

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.

TITLE:       KW-12A Diagnostic

OBJECTIVE:   To ensure that all students can suc   sfully
             run the KW-12A diagnostic and unders.and 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.

To be Supplied