

INTERNAL REPORT No. 37

"Magnetic Tape Software  
for PDP-11"

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Feb. 28, 1972

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# MAGNETIC TAPE SOFTWARE FOR PDP-11

## 1. Abstract

A number of programs from the DEC Paper Tape Software library have been modified to handle magnetic tape input/output, and in some cases include additional useful features. These all use IOXMTA for all I/O operations, and run under the SRLSYS magnetic tape monitor. The programs described in this report are: ED-11M text editor, PAL-11M absolute assembler, PAL-11MR relocateable assembler, LINK-11M linker, and LOAD-11M magnetic tape absolute loader.

### 1.1 Conventions

All numeric quantities are octal representations unless specified otherwise. Carriage-return is specified as <CR>. Lower case letters in prototype command fields represent octal digits supplied by the user.

### 1.2. Related Documentation

The basic features of all these programs are described in the DEC publications PAPER TAPE SOFTWARE PROGRAMMING HANDBOOK (DEC-11-GGPB-D), and PAL-11S ASSEMBLER AND LINK-11S LINKER PROGRAMMER'S MANUAL (DEC-11-YRWA-D). The input/output executive IOXMTA is described in SPACE RADIATION LABORATORY INTERNAL REPORT NO. 32, and the monitor SRLSYS is described in SRL INTERNAL REPORT NO. 33.

## 2. Common Features

### 2.1. Device Specification

In general, the first letter of a command string is interpreted as the device code (note difference from LINK-11S). Standard specifications are:

L Low speed reader or low speed punch  
 H High speed reader or high speed punch  
 Mn Magnetic tape unit n, first file  
 Mn:mmm Magnetic tape unit n, file mmm (octal)  
 T Teletype keyboard or printer, where applicable  
 P Line printer for PAL-11M and PAL-11MR. This is not implemented in current version of IOXMTA (V008C), and will cause an error if used.

Device codes are usually followed by a slash ("/") if anything else follows in the command string.

## 2.2. Tape Format

Magnetic tapes are always read/written at 800 (decimal) bytes per inch. Coredump mode (2 tape characters per core byte) is used with 7-track tapes.

## 2.3 Magtape Double End-of-File

Two consecutive EOF's on a magnetic tape define the logical end of the tape. Attempts to space beyond a DEOF will result in a message of the form

```
?DEOF ON UNIT n--FILE=mmmmmmmm
```

where mmmmmmm is the number of the empty file between the two EOF's. If the program restarts itself, the tape cannot be processed beyond the DEOF. If the command string is requested again without a program restart (see para. 2.5), the same command string may be repeated and the

DEOF will be forgotten.

## 2.4 Magtape Errors

In addition to the error processing done by IOXMTA, the higher-level programs do some error handling of their own. Generally, if double buffering is used (e.g. PAL-11 source input and listing output) error recovery is minimal, and errors are either fatal or ignored. In other cases, error recovery attempts are indicated by the program typing:

RETRY?

after an error message. Typing <CR> will cause an attempt to recover from the error (e.g. a reread in case of parity error). Typing any other character will abort the recovery procedure and usually cause a program restart.

## 2.5. Start/Restart Procedures

Standard cold start addresses are at location 50 (except for LOAD-11M). Location 54 is a restart address whose function is program-dependent. A program start is indicated by the typing of the program name, version number, and creation date on the teletype. An IOXMTA RESET is performed, and the stack is initialized. Restart by means of CTRL-P (↑P) is as described in the DEC publications mentioned in paragraph 1.2, above, for each program.

Cold start may be performed by either:

- a) HALTING the processor, setting 50 in the switch register, and pressing LOAD ADDR, ENABLE, and START; or

b) typing CTRL-C (↑C) followed by the monitor Go command.

## 2.6 Procedure with Low Speed Punch

Output directed to the low speed punch will generally not begin until some special action is taken to inform the program that the punch is ready. A program may ask

```
LSP ON?      or
PUNCH READY?
```

When this occurs, turn the punch on and type <CR>. When punching stops, turn the punch off and type <CR> again. NOTE: whenever a program "stops" for no other apparent reason, with the console lights indicating that something is running, check the punch. If it was on, turn it off and type <CR>.

## 3. ED-11M Text Editor

### 3.1. Command String Option

ED-11M normally reads and writes unformatted ASCII records 400 bytes long. This is not compatible with PAL-11M (or MR) if it is on magnetic tape. To produce formatted ASCII (one line per record) records with maximum length of 110<sub>8</sub> bytes, use the /L (Line-blocking) switch in the output command string. Either format is acceptable as input to ED-11M; however, the standard format uses much less tape, and is therefore faster.

### 3.2. Additional Commands

## 3.2.1. Q Command

Identical to I (Insert) command, except that text comes from the low speed reader instead of the keyboard. The insert is terminated by any of:

- a) CTRL-S ( $\uparrow$ S, XOFF) on paper tape
- b) linefeed not immediately preceded by <CR> on paper tape
- c) turning off reader and typing linefeed or  $\uparrow$ S on keyboard.

The terminating linefeed or  $\uparrow$ S will not enter the page buffer.

## 3.2.2 W Command

Rewind unit n. Specified as

nW

where  $0 \leq n \leq 7$ .

## 3.2.3. Z Command

Write an EOF on unit n. Specified as

nZ

where  $0 \leq n \leq 7$ . This function should always be used to end file on the output device (if it is magtape) at the end of an edit.

## 3.3. EOF on Input Tape

To combine several input files, use the O (Open) command when EOF is read. This will cause input to continue from the next sequential input tape file. To combine non-sequential input files, use SRLPIP (cf. SRL INTERNAL REPORT NO. 36).

#### 4.4. Dummy Devices

Any output function can be directed to a dummy device by typing D in response to the appropriate command request. D is not an acceptable response to \*S however.

#### 5. PAL-11MR Assembler

This assembler combines all the features of PAL-11M, described above, and the features of the DEC program PAL-11S. The latter include the special assembly directives:

```
.ASECT
.CSECT
.GLOBL
.LIMIT
.RAD50
.TITLE
```

and the conditional assembly directives:

```
.IFZ           .IFG
.IFNZ          .IFGE
.IFL           .IFDF
.IFLE         .IFNDF
              .ENDC
```

The output of PAL-11MR must be processed by LINK-11M.

#### 6. LINK-11M Linker

- 6.1. The main difference between LINK-11M and LINK-11S (aside from magtape capability) is that a device specification is optional each time the program types an asterisk and waits for input. Normally, a <CR> is typed as the response to the asterisk, and the next object module is taken from the current position of the primary input device (the device specified in the \*I command string). However, if a device specification

is given as a response to the asterisk, the next module is taken from the specified device. Subsequent asterisk-<CR> combinations will revert to the primary input device. To get a list of acceptable replies to asterisk, type a question mark.

6.2. LINK-11M types \*TOP instead of \*T, etc.

## 7. LOAD-11M Absolute Loader

The output from PAL-11M and LINK-11M is in absolute binary format, and can be loaded by the Paper Tape Software Absolute Loader if it is on paper tape. If it is on magnetic tape, it can be loaded using the SRLSYS Monitor A command, or by using the stand-alone loader LOAD-11M. This program will load formatted binary blocks up to 560 (octal) bytes in length into any position in memory not occupied by itself. It is position-independent, and so may be relocated anywhere by the PTS Absolute Loader.

### 7.1. Operating Procedure

- 1) Use the PTS Absolute Loader to load (relocated) LOAD-11M where desired. It will start itself, then pause.
- 2) Set the desired file number in the switch register.
- 3) Mount the desired tape. Select unit 1.
- 4) Press CONT. The tape should load.
- 5) When the loader halts, the DATA lights should indicate zero. If not, a checksum error or magtape error occurred. If it was a checksum error, only the low byte of the DATA lights will be non-zero. If



it was a magtape error, MTS will be displayed in the DATA lights. A magtape NXM error thus cannot be distinguished from a checksum error except by looking at the ADDRESS lights and the program listing.

- 6) LOAD-11M functions analogously to the PTS Absolute Loader, except that no relocation may be specified in the switch register.

## 8. Start/Restart Functions

### 8.1. ED-11M

Starting at loc. 50 causes the page buffer to be cleared. Starting at loc. 54 preserves the page buffer. Restarting by typing ↑P (CTRL-P) takes the action corresponding to the last start address used. It is a good idea to list a few lines of the page buffer at the beginning of an edit to find out what (if anything) it contains.

### 8.2. PAL-11M and PAL-11MR

Starting at loc. 50 clears the symbol table; starting at loc. 54 preserves it. The latter may cause multiple symbol definition errors, and should be used with caution.

### 8.3. LINK-11M

Locations 50 and 54 both cause a cold start.

### 8.4. LOAD-11M

The start address is specified in the TRA block of the object tape, as modified by the Absolute Loader relocation facility.

ADDENDUM to SRL Internal Report #37  
Operating System Release 2

20 April 72  
JWB

- 2.1.1. Mn:\* may be used to specify that tape unit n is to be used, starting at its current position (not necessarily the beginning of the current file.)
  
- 2.4.1. If the reply to RETRY? is the letter "A", the bad record will be accepted and the error ignored.
  
- 3.4. Trailer  
The T command produces four inches of blank paper tape if the output device is a paper tape punch. No such output is produced if the output device is magnetic tape.
  
- 4.1.1. The symbol table has been expanded in PAL-11M V004A. The 16 K version can handle about 2400 (decimal) user symbols, and the 12 K version can handle about 1250 (decimal).
  
- 5.1. PAL-11MR V002A Symbol Table  
16 K version - about 2095 (decimal) user symbols;  
12 K version - about 945 (decimal) user symbols.  
By comparison, PAL-11MR itself contains 470 (decimal) symbols.

2.4.2 WRITE ERROR RECOVERY

The write error retry procedure in ED-11M V003A does not work properly. This will be fixed in V004A. (System RELEASE 3)

4.4.1 DUMMY DEVICE SPECIFICATION

Do not use D as a response to \*T for symbol table listing device in PAL-11M V004A or PAL-11MR V002A. Use a <CR> to inhibit symbol table listing. This will be fixed in System RELEASE 3.

ADDENDUM #3 to SRL Internal Report #37

ED-11M V004A

20 OCT 72

26 OCT 72

TLG

2.4.3. Magtape Errors

Replying with an "X" to a "RETRY?" query from ED-11M V004A after a write error will cause the record to be written with extended record gap.

3.2.4. U Command

This command enables one to redefine the input/output Units. It is useful for combining text from several units or files. It can also be used to skip text by specifying a dummy output device.

ADDENDUM #4 to SRL Internal Report #37

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PAL-11M V004A

JWB

4.1.2. PAL-11M V004A contains an error which prevents proper reinitialization of the symbol table after an assembly. The error may be corrected by making the following patch:

<u>Location</u>	<u>Old</u>	<u>New</u>
2534	172656	172644 (for 12K version) 166250 (for 16K version)

The version and date should be changed to V004B 14-NOV-72 as follows:

<u>Location</u>	<u>Old</u>	<u>New</u>
1110	20101	20102
1112	34461	32061
1114	40455	47055
1116	51120	53117

If PAL-11M is to be reassembled, delete line 3568 on page 74 of the listing:

STSIZE = 005122

ADDENDUM #5 to SRL Internal Report #37

1 FEB 73

ED-11M V005A

JWB

Operating System RELEASE 3

3.2.4.1 If the reply to \*I or \*0 is a <CR>, the device remains unchanged from what was last specified.

3.2.5. ? Command

The ? command causes the listing of the number of characters specified in the argument. For example, -5?<CR> will cause the five characters preceding Dot to be listed.

ADDENDUM #6 to SRL Internal Report #37

8 FEB 73

PAL-11M V004C

JWB

Operating System RELEASE 3

The following patches should be made to change PAL-11M V004C to V004D:

<u>LOCATION</u>	<u>OLD</u>	<u>NEW</u>	
1110	20103	20104	
7340	4	5737	TST @#DEVICE+6
7342	7340	1632	
7344	2404	1001	BNE .+4
7346	26727	207	RTS R7
7350	172260	4	IOT
7352	10	7350	.-2
7354	2406	2404	.BYTE WTCMD,STSL0T
7356	4	207	RTS R7

This will correct the problem of using a dummy device for the symbol table listing, and also prevent an extra EOF from being written if the symbol table is on magtape.