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TITLE	TRI-DATA CARTRIFILE PAL III ASSEMBLER
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SOURCE LANGUAGE	PAL III

TRI-DATA CARTRIFILE PAL III ASSEMBLER

ABSTRACT

This is a revision of the PDP-8 basic PAL—III assembler; additional
features include CartriFile I-O capabilities, fixed formulating of listing
output, and page numbering corresponding to that used by the DEC editor
program.

REQUIREMENTS

PDP-8 series computer with 4K of memory.

One source program input device consisting of any of the following:
ASR-series teletype, high--speed paper-tape reader, or CartriFile.

One object program output device consisting of either of the following:
ASR-series teletype or high--speed punch.

If a program listing is desired, one listing device consisting of any of
the following: teletype, high-speed punch, or CartriFile.

USAGE

This program is loaded from magnetic tape by Tri-Data 8-012-U-RIM
CartriFile Binary Loader.

The operator must supply a source program tape at the desired input device
and must make ready his desired output devices if pass 2 or pass 3 of the
assembler is to be run. I-O device selection will be performed by the
program as follows:

a)   For all passes, if either the teletype paper-tape reader or the high-
speed paper-tape reader is ready, it will by used as the input device;
the other unused reader (if present) *must* be left unloaded or turned off.
If neither paper-tape reader is ready, the upper cartridge of the Cartri-
File will by used as the input device. CartriFile tape 1 will by used
first, followed by tape 2; as many input cartridges as needed may be used.

b)   For pass 2, the high-speed punch will be used as the output device
unless it is not ready, then the teletype punch will by used as the
output device.

c)   For all passes except pass 3, the teletype will be used to list error
diagnostics and the symbol table. During pass 3, if switches 10 and 11
are off, the teletype will be used as the listing device. If switch 11 is
on, the high-speed punch will be used as the listing device; and if switch
10 is on, the lower cartridge of the CartriFile will be used as the listing
device. CartriFile tape 3 will be used first, followed by tape 4; this
flip-flop action will continue for as many output cartridges as needed.

In all other respects, this program is identical in operation to the old PAL-III. The operator must load address 0200, set switches 0 and 1 to the desired pass number, and press START on the PDP-8 console. At the end of each pass, the operator need only set his switches for the next desired pass (and set switches 10 and 11 for a different pass 3 listing device) and press CONTINUE.

Two new diagnostic messages have been added to this version of PAL-III:

a)   The diagnostic "RE @NNNN" will be printed during all passes to signify that a CartriFile read error has occurred at program location NNNN.

b)   The diagnostic "RO @NNNN" will be printed during all passes to signify that a CartriFile input statement is longer than 74 characters and will be truncated. Note that if both the RE and RO errors occur, only the RO diagnostic will be printed.

This program halts upon detecting several conditions, as follows:

Halt Address	Meaning
0177	End of pass. Also occurs if neither switch 0 nor 1 was set (invalid pass number).
1177	A "PAUSE" statement has been processed. Load the next input paper tape and press CONTINUE on the PDP-8 console. For CartriFile input, merely press CONTINUE.
1533	A PO, PU, or ST error has occurred. The appropriate error diagnostic has been typed out. This is a dead-end halt; the source program must be analyzed and corrected.
1756	End of input tape on the paper-tape reader. A "PAUSE" statement may or may not have been read before this halt. Load the next input paper tape into the reader and press CONTINUE.
2046	A CartriFile input error has occurred. The appropriate error diagnostic has been typed out (refer to 4.4 above). The operator may (1) ignore the error and press CONTINUE, (2) examine and correct the input buffer starting at location 7302, or (3) terminate the assembly run.
2056	End of input cartridge on the CartriFile. Load the next input cartridge, place the CartriFile back in AUTO mode, and press CONTINUE.
2170	End of output cartridge on the CartriFile. Load the next output cartridge with both tapes enabled for writing, place the CartriFile back in AUTO mode, and press CONTINUE.

RESTRICTIONS

This program does *not* output a symbol table having a format acceptable to the DEC dynamic debugging scheme (DDT). Thus, DDT may not be used to debug programs produced by this assembler.

A CartriFile used by this program must have an interface that responds to the standard PDP-8 CartriFile I-O addresses of 30, 31, 32, and 33 *and* must be equipped with a new Load Point circuit board (Tri-Data part no. 10118-*002*). Also, if *either* CartriFile input *or* CartriFile listing output is requested, then *both* cartridge slots in the CartriFile should be loaded. If neither CartriFile input nor CartriFile output is requested, the CartriFile should be turned off or placed in LOCAL mode.

DESCRIPTION

This program duplicates the functions of the basic PAL-III assembler program for PDP-8 series computers. Any program written in the basic PAL-III symbolic language may be processed through this assembler.

The following additional features have been added to PAL-III:

a)   A symbol table capacity of 535 symbols, regardless of what input device is used. In addition, the extended-memory, EAE, power-failure, memory-parity, and CartriFile mnemonics have been affixed to the permanent symbol table. The DECTAPE mnemonics have been removed.

b)   Eleven-inch paging for listing output. A line of dashes is printed, indicating where roll-stock teletype listings should be cut. Fifty-five lines will be printed per page.

c)   Fixed listing formatting. A space before column 9 of a source statement causes the listing to "tab" to column 9. A slash before column 25 of a source statement causes the listing to "tab" to column 25. These rules do not apply to an entire line of comments whose slash appears in column 1. In addition, multiple spaces before the start of comments will be printed as one space on the listing, and a tab character will be interpreted as a space (but will *not* cause a "tab"). Thus, all operands on a listing need be separated by only one space; a line containing no symbol need have only one leading space; and a slash may directly follow the last operand. In all of the above cases, correct listing formatting will occur.

d)   Line numbering corresponding to the "pages" of the DEC editor. The input page number is incremented each time a form-feed is read, and the source statements are numbered consecutively within each source program page.

e)   The symbol table is printed in four columns rather than one. An undefined symbol will be preceded by an asterisk; the accompanying numerical value remains unchanged as the first location at which the undefined address was seen.

f)   Both the UA and IR diagnostics will print during pass 2 and during pass 3. Either of these diagnostics will cause an octal zero to be output on the paper tape along with a checksum of zero. In this fashion, minor errors may be "patched" into the binary program tape where a reassembly is not necessary.

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g)   Extraneous commas and equal signs will cause the IC diagnostic to print, rather than causing an assembler error.

METHODS

The methods used in this program are, in general, identical to those of the original PAL-III.

FORMAT

Input format and binary output format are the same as in the original PAL-III.

Listing lines are always preceded by a line-feed and terminated by a carriage return.

CartriFile records are always recorded with *one extra* 12-bit word at the *end* of each record: ØØØØ for a normal record or 7777 for a split record. A split record is recorded at the end of each tape when Load Point is sensed; the remainder of the split record always appears as the *first* record on the *next* magnetic tape in the file. The user must take account of this format if he desires to use source and listing magnetic tapes in his own PDP-8 programs.

EXECUTION TIME

Limited by I-O speed. Note, however, that the CartriFile is approximately 50 percent faster as an input device than the high-speed reader.