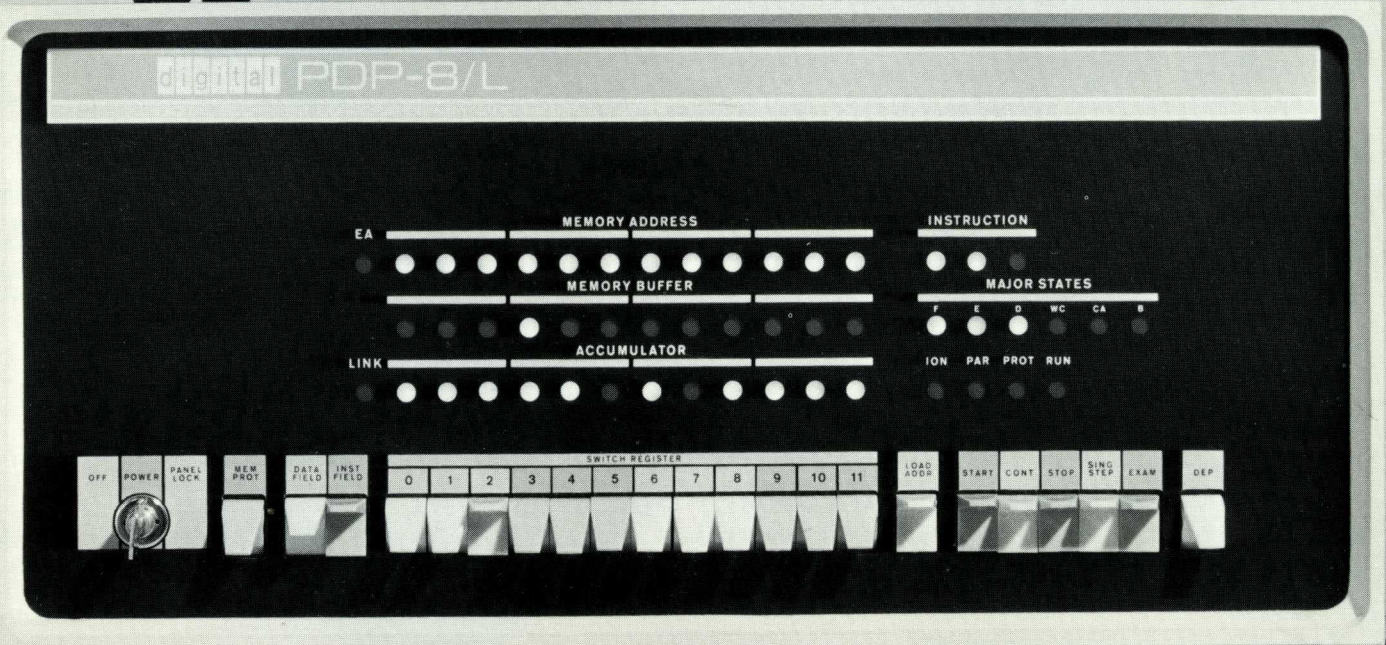
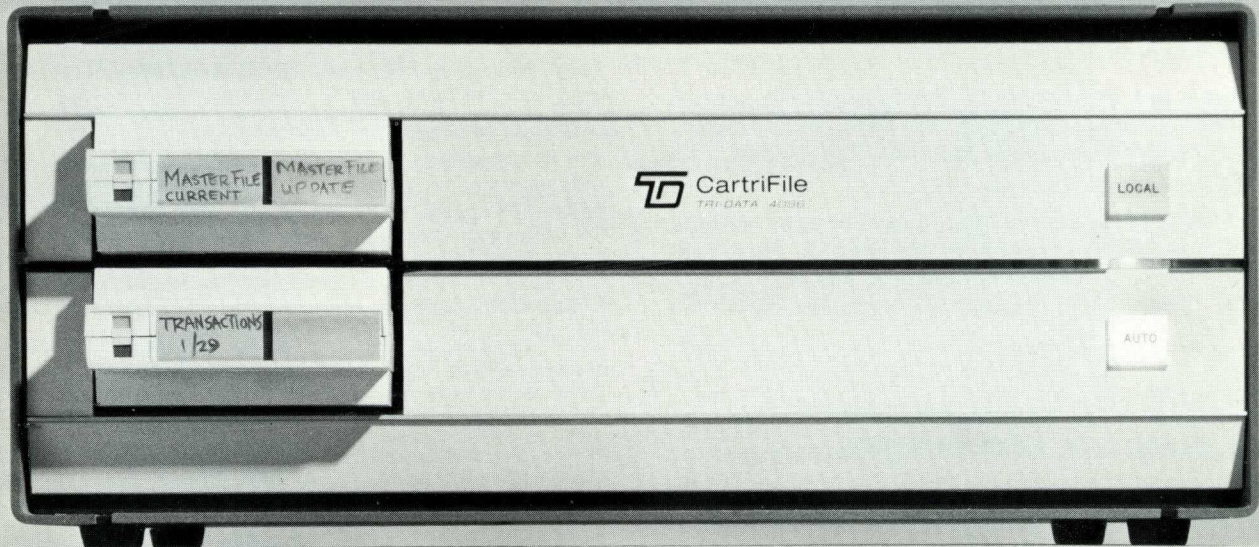




CartriFile

TRI-DATA 4096

Cartridge loaded, multiple magnetic tape systems for Digital Equipment Corporation PDP-8 Series Computers



CartriFile – MULTIPLE MAGNETIC TAPES FOR PDP-8 COMPUTERS

- **4 Tape Units**
- **Tape Unit Controller**
- **Single Integrated Package**
- **Cartridge Loaded**
- **Simultaneous Operations**
- **12-bit Word Data Transfer**
- **Intrinsic Error Correction**

Four Magnetic Tape Units and a Tape-Unit Controller

The CartriFile is four separate computer magnetic tape units and the tape-unit controller combined in a single integrated unit. This new peripheral gives the PDP-8 computer the advantages of multiple magnetic tape files in a new, low-cost form.

CartriFile tapes are contained in interchangeable plug-in cartridges, each of which contains two independent tapes. Insertion of two cartridges loads the CartriFile quickly with its four tapes.

The CartriFile is a complete, multiple magnetic tape system, ready to be connected directly to the PDP-8, PDP-8/S, PDP-8/I and PDP-8/L computers. Integral electronics provide all of the tape unit and tape unit controller electronic functions.

WITH CartriFile THE PDP-8 BECOMES A GENERAL PURPOSE EDP SYSTEM

The CartriFile equips the PDP-8 computer for business data processing, data terminal applications and statistical problems requiring data storage, fast data input-output, sorting, merging and collating.

Program loading and program compilation times on CartriFile-equipped computers are a fraction of the times required using punched-paper-tape equipment. The four independent CartriFile magnetic tapes provide both program storage and data storage.

CartriFile tape cartridges are inexpensive and convenient for permanent data storage – yet reusable thousands of times. CartriFile gives your PDP-8 on-line magnetic tapes for:

- **Program Loading**
- **Data Input**
- **Sorting**
- **Merging**
- **Collating**
- **Intermediate Data Storage**
- **Data Output**
- **Program Storage**

FUNCTIONAL DESCRIPTION

The CartriFile connects directly to the PDP-8 computer input-output bus, and has connector receptacles providing continuation of the bus to other peripheral equipment.

Operating under programmed control of the computer, the CartriFile writes data from the computer onto any of four magnetic tapes, and reads data from the tapes into the computer. The data transfers are made through the computer accumulator. The four tapes may be used independently and in any sequence, and one tape may be written while any other is being read.

The data is written and read on the tapes in “records,” with the records separated by gaps. A record consists of any number of sequential 12-bit words; the record length may vary without restriction to suit the data organization. For each Write Tape or Read Tape operation, a tape is started, a record written or read, and the tape stopped. The gaps between records accommodate the fast-start and fast-stop tape-motion characteristics.

CartriFile tapes are contained in the cartridges as endless loops. A photo-reflective Load Point tab marks both the “beginning” and “end” of the tape. A Load Point Search mode advances any tape on which writing or reading is completed to its Load Point.

Manual operations consist of selecting the tape cartridges to be used; File Protecting recorded tapes when desired; inserting and removing the cartridges; turning power on; and switching the unit to Automatic.

The tape format is bit-serial, two-track redundant, phase-encoded at a bit density of 600 bits per inch. CartriFile circuitry converts the 12-bit computer words to the tape format during writing and back to 12-bit parallel during reading. The tape speed is 10 inches per second in all operations, Write Tape, Read Tape and Load Point Search.

DATA TRANSFER RATE

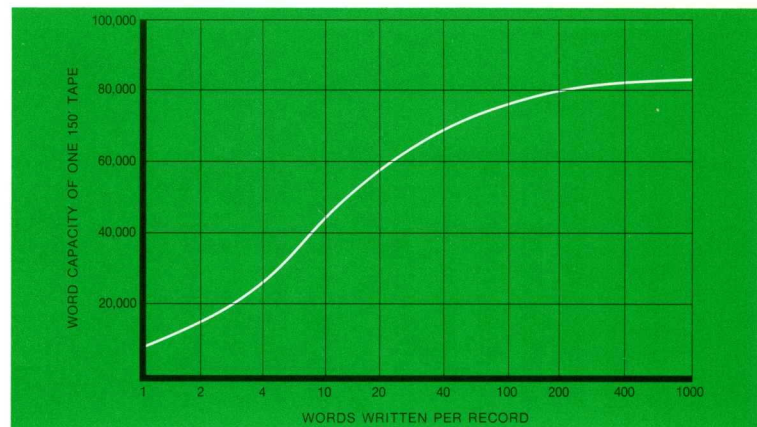
The data transfer rate between the computer and the CartriFile is 462 12-bit words per second during both writing and reading tape records. Start and Stop delays of 15 milliseconds and 10 milliseconds occur prior to and after the record transfer. The total time in seconds to write or read a tape record is therefore equal to the number of 12-bit words in the record divided by 462, plus 0.025 seconds.



DATA STORAGE CAPACITY

The data-storage capacity of each tape varies with the tape length and the number of words written in each record. Each word requires 0.02165 inches of tape, and the gap on the tape between each record is 0.2 inches, maximum. The total tape required per record is therefore $(N \times 0.02165) + 0.2$ inches, where N is the number of words in the record. CartriFile tape cartridges containing two 150-foot tapes, two 100-foot tapes, or two 50-foot tapes are standard.

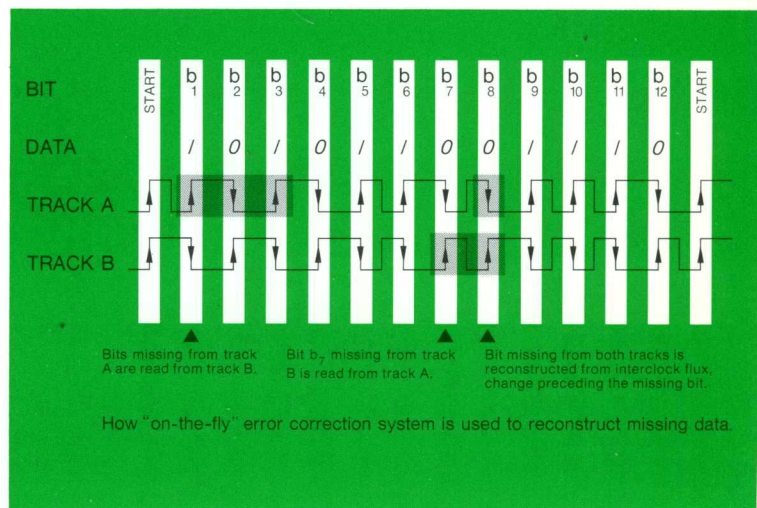
For given record lengths, the 12-bit word capacity of one 150-foot tape is shown in the graph. The total storage capacity of the CartriFile without reloading cartridges is the sum of the capacities of the four tapes contained in the two cartridges with which it is loaded.



ERROR CORRECTION SYSTEM

CartriFile's error-correction system uses bit-serial phase encoding which, on average, is 100% redundant. Simultaneous recording of the code on two tracks provides 300% total average redundancy. A positive flux change at clock time represents a "one" bit, and a negative flux change at clock time represents a "zero" bit. A positive flux change midway between clock times indicates adjacent zero bits, a negative flux change midway between adjacent clock times indicates adjacent one bits, and no flux change midway between adjacent clock times indicates adjacent bits of opposite sign. Recording on the second track is the complement of the first track except for the start bit which occurs before each 12-bit character and consists of positive-going flux changes in both tracks.

If a flux change is not detected at clock time from the first track, the read system derives its input from the second track. If there is no flux change from the second track, the missing bit is reconstructed from the inter-clock flux change preceding or following the missing flux change on the first or the second track, thereby achieving "on-the-fly" error correction.





SYSTEM OPERATION

The PDP-8 computer operates the CartriFile under program control using ten microinstructions to check tape unit status and perform Write Tape, Read Tape and Load Point Search operations on the four CartriFile tapes.

The CartriFile is normally supplied wired to use addresses 30, 31, 32, and 33. A SIMPLE WIRING CHANGE WILL ACCOMMODATE OTHER ADDRESSES WHEN REQUIRED.

OCTAL INSTRUCTION AND OPERATION DESCRIPTIONS

6305 Check Tape Unit Status

6303 Check Tape Error and Automatic (System Ready) Status

Each of these two instructions clears the computer accumulator (AC) and causes the CartriFile to transfer a word containing status information into the AC.

The 12-bit AC word response to 6305 shows Read Ready tape 1, 2, 3, 4; Write Ready tape 1, 2, 3, 4; and At Load Point tape 1, 2, 3, 4. The first 4 bits of the word response to 6303 show three possible Read Error conditions and the Automatic (System Ready) condition; the remaining 8 bits are not significant.

6314 Tape Action Command

Initiates Write Tape, Read Tape and Load Point Search operations. The operations initiated and the tapes selected are determined by a control word in the AC at the time the instruction occurs.

Any operation may be initiated or be occurring on any tape independently of the status of the other three tapes, with two exceptions:

While one tape is writing, writing may not be initiated on any other tape. (The same data may be written simultaneously on any number of the tapes if their writing is initiated simultaneously.)

While one tape is reading, no other tape may be read.

6311 Skip on Load Point Attained Flag

6321 Skip on Write Word Call Flag

6332 Skip on Read Word Call Flag

Each of these three instructions increments the Program Counter by one if the CartriFile internal flag is true at the time the instruction occurs.

One of three flags in the CartriFile will go true when any tape has reached a ready condition corresponding to the flag. The significance of each flag is given in the following tape operation descriptions. Program interrupt is requested at the rise of each flag; if the interrupt is not used, program loops must periodically test the flags with the skip instructions.

6324 Load Tape Buffer

Transfers AC bits 0 through 11 to the CartriFile for writing, and clears the Write Word Call flag.

Write Tape Operation: A Write Tape Command (instruction 6314) causes the CartriFile to start the selected tape and, after a 15 ms delay, raise the Write Word Call flag (the delay is between 200 and

OCTAL INSTRUCTION AND OPERATION DESCRIPTIONS

350 ms in starting the record at the beginning of a tape, i.e., when the tape is at Load Point). The program must test for the Write Word Call flag (instruction 6321), and Load Tape Buffer (instruction 6324) with the first word to be written within 1.9 ms after the flag rise. The flag is raised by the CartriFile at 2.17 ms intervals after the first rise, and either the Load Tape Buffer (instruction 6324) or a Write Stop Command (instruction 6312) is required within 1.9 ms after each rise.

Should a tape reach Load Point during writing, the Load Point Attained flag is raised, after which 60 more words may be written before a Write Stop Command (instruction 6312) is mandatory. The programs may test the Load Point Attained flag (with instruction 6311) during writing to assure that the "end-of-tape warning" is recognized.

6312 Write Stop Command

Causes the CartriFile to cease writing, after completing the last word transfer, and to stop the tape.

A subsequent Write Tape operation may not be initiated on any tape for 10 ms after the Write Stop Command terminates writing a record. The Write Ready status of all tapes is false during this delay (checked by instruction 6305).

6335 Read Tape Buffer

Clears AC, transfers the CartriFile data output word into bits 0 through 11 of AC, and clears the Read Word Call flag.

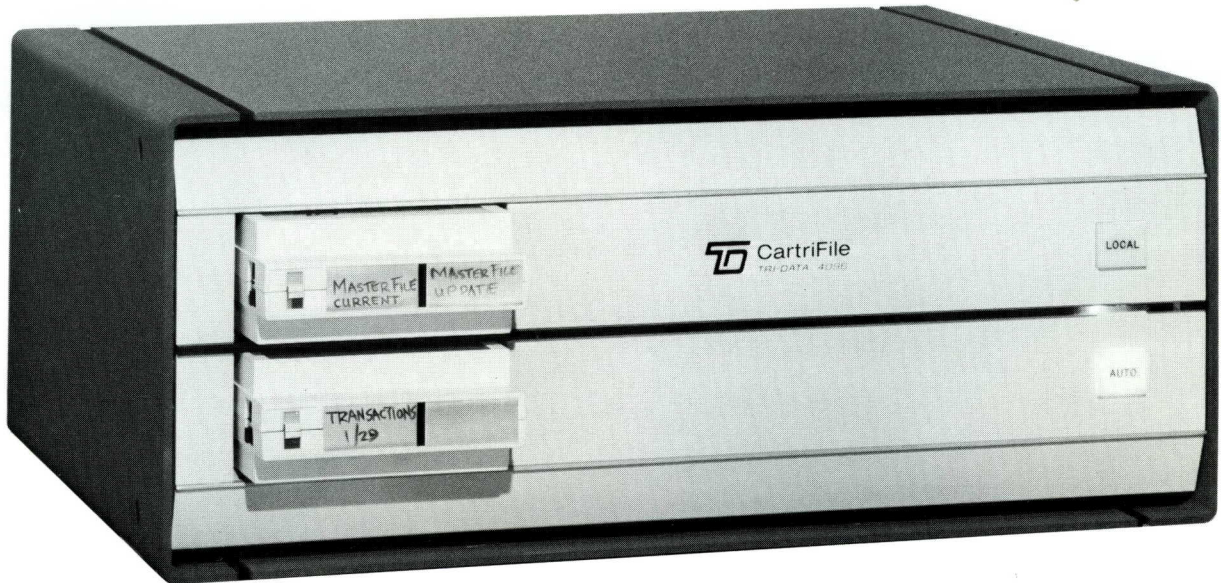
Read Tape Operation: The Read Tape operation, timing of events, and programming requirements correspond to those of the Write Tape operation previously described; the Read Word Call flag rise requires that instruction 6335 transfer the word read from the tape into the AC within 1.9 ms after its rise. However, a Read Stop instruction is not required. The CartriFile recognizes the absence of data in the gap between records and performs the Read Stop.

Load Point Search Operation: A Load Point Search Command (instruction 6314) causes the selected tape to advance at 10 inches per second until it reaches its Load Point, at which time the tape stops and the Load Point Attained flag is raised. The program may, through instruction 6311, skip to instruction 6305 and thus determine if the tape desired for a following operation is at its Load Point.

6322 Set or Clear Flag

Sets or clears the Load Point Attained, Write Word Call or Read Word Call flags, as determined by the position of 1-bits in the AC at the time the instruction occurs. This instruction adds programming flexibility. Sequences using 6322 with 6311, 6321 and/or 6332 may be used to request interrupt, clear AC and/or increment the Program Counter.

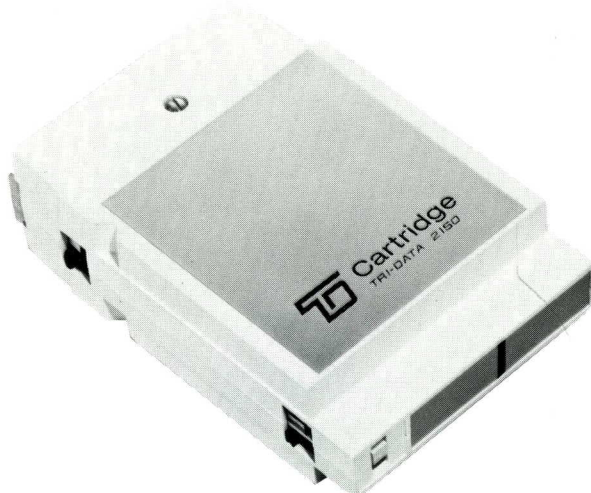
SPECIFICATIONS



CartriFile TRI-DATA 4096-03 and 4096-09

Number of tape units	4 with integral controller for PDP-8 computers and read/write electronics
Number of cartridges	2 — each containing 2 tapes
Simultaneous operations	Data may be written on one tape while data is read from another. Other tapes may be in Load-Point Search.
Capacity of system	320,000 12-bit words
Capacity per tape	80,000 12-bit words in 200-character records. Capacity varies with tape length and record length.
Record length	Variable
Word length	12 bits
Tape speed	10 inches per second
Transfer rate	462 12-bit words/second
Inter-record gap	0.2 inch
Start time	15 milliseconds
Stop time	10 milliseconds
Load-Point search time	90 seconds average for 150-foot file. Time required is inverse to amount of data stored.
Recording density	600 bits per inch, 1200 flux changes per inch

Recording technique	Bit-serial, phase-encoded, 2-track redundant
Error correction	Based on redundant tracks and redundancy of phase encoding
Power	105 — 125V, 57 — 63 Hz, 80 watts or 210 — 250V, 47 — 53 Hz, 80 watts; all units operate from either
Mounting	Desk top or Option —01, 19-inch rack-mount
Size	17 inches wide, 7 inches high, and 16 5/8 inches deep. Requires 7 inches rack space when rack mounted.
Weight	35 pounds
Operating-temperature range	+40° to 110° Fahrenheit
Operating-humidity range	20% to 90% relative humidity without condensation
Prices	TRI-DATA 4096-03 \$5,700.00 TRI-DATA 4096-09 \$6,000.00 Add \$50.00 for Option —01, rack mounting



CartriFile TAPE CARTRIDGES

Size	4" wide by 6" long by 1 3/4" thick
File protect	Switch and indicator for each of two tapes
Tape	Endless loops of 1/4-inch-wide computer-grade magnetic tape, two per cartridge
Certification	Tapes are tested and certified error-free
Tape life	200 hours minimum, tape in motion

TRI-DATA CARTRIDGES			
	2050	2100	2150
Number of tapes	2	2	2
Length of each tape	50 feet	100 feet	150 feet
Price	\$15	\$18	\$21

PROGRAMS SUPPLIED

A diagnostic routine for the Cartrifile, and routines for Write Tape, Read Tape and Load Point Search operations are included in the instruction manual furnished with the CartriFile. These routines use the following instructions and mnemonics:

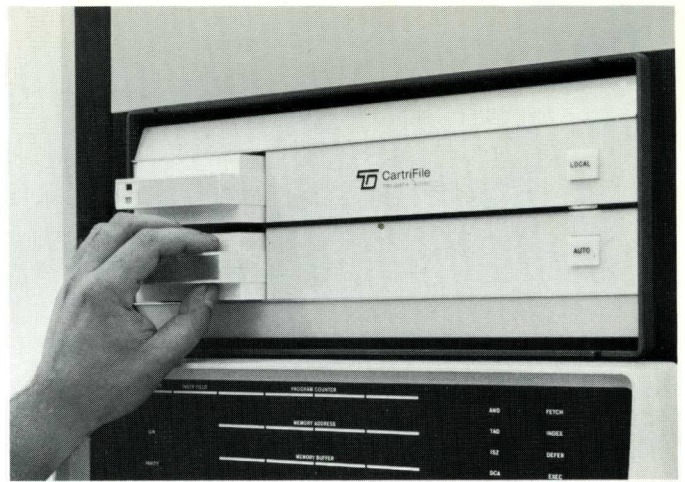
OCTAL	MNEUMONIC	INSTRUCTION
6303	LTSB	Check Tape Error and Automatic Status
6305	LTSA	Check Tape Unit Status
6311	SLPA	Skip on Load Point Attained flag
6312	WSPC	Write Stop Command
6314	ACMD	Tape Action Command
6321	SWWC	Skip on Write Word Call flag
6322	RSFF	Set or Clear Flag
6324	LTB	Load Tape Buffer
6332	SRWC	Skip on Read Word Call flag
6335	RTB	Read Tape Buffer

EQUIPMENT SUPPLIED

CartriFiles for the PDP-8 are supplied ready-to-use with all electronics, power supply and cabinet, two tape cartridges each containing two tapes, power cord and two instruction and maintenance manuals.

Tri-Data 4096-03 matches positive-logic PDP-8 systems as typified by the PDP-8/L. A receptacle at the rear of the 4096-03 accepts three DEC M904C connectors for terminating cables from the computer I/O bus, and three additional M904C connectors for continuation of the I/O bus to other peripheral equipment. CABLES AND CONNECTORS ARE NOT FURNISHED BY TRI-DATA.

Tri-Data 4096-09 matches negative-logic PDP-8 systems as typified by the PDP-8/S. A receptacle at the rear of the unit accepts six logic-level-conversion circuit-board connectors which are supplied as part of the 4096-09. DEC I/O cables from the computer I/O bus are user-attached to these connectors. The receptacle also accepts six DEC W011C connectors for continuation of the negative-logic I/O bus to other peripheral equipment. CABLES AND CONTINUATION CONNECTORS ARE NOT FURNISHED BY TRI-DATA.



PACKAGING

CartriFile is packaged in an attractive cabinet for desk-top use, and brackets are available for standard rack mounting.

The front panel contains switches with back-lighted indicators for Local and Automatic status, and a portion of the front decorative trim strip is illuminated when the unit is supplied with AC power. A power relay provides remote control of power.

The front panel may be quickly snapped off, providing ready access to the tape-drive mechanism and the data and control electronics. The drive mechanism swings forward out of the cabinet, and the circuit boards may be brought out with an extender card which is included.

THE CartriFile MAGNETIC TAPE CARTRIDGE

The CartriFile tape cartridge contains two separate magnetic tapes. Insertion of two cartridges loads the CartriFile quickly with its four tapes. No threading is required, and a cartridge cannot be inserted incorrectly or in a manner that would damage the tapes.

The cartridge is its own permanent storage container which completely protects the encased tapes from dust, dirt and damage. Data content may be labeled on a space provided at the front of the cartridge.

A manual File Protect switch and indicator on the cartridge for each of the two tapes provides write lock-out.

Tapes are contained in the cartridge as endless loops. A reflective marker determines the Load Point during operation of the CartriFile. Cartridges are furnished with standard tape lengths of 50, 100 and 150 feet.

