digital
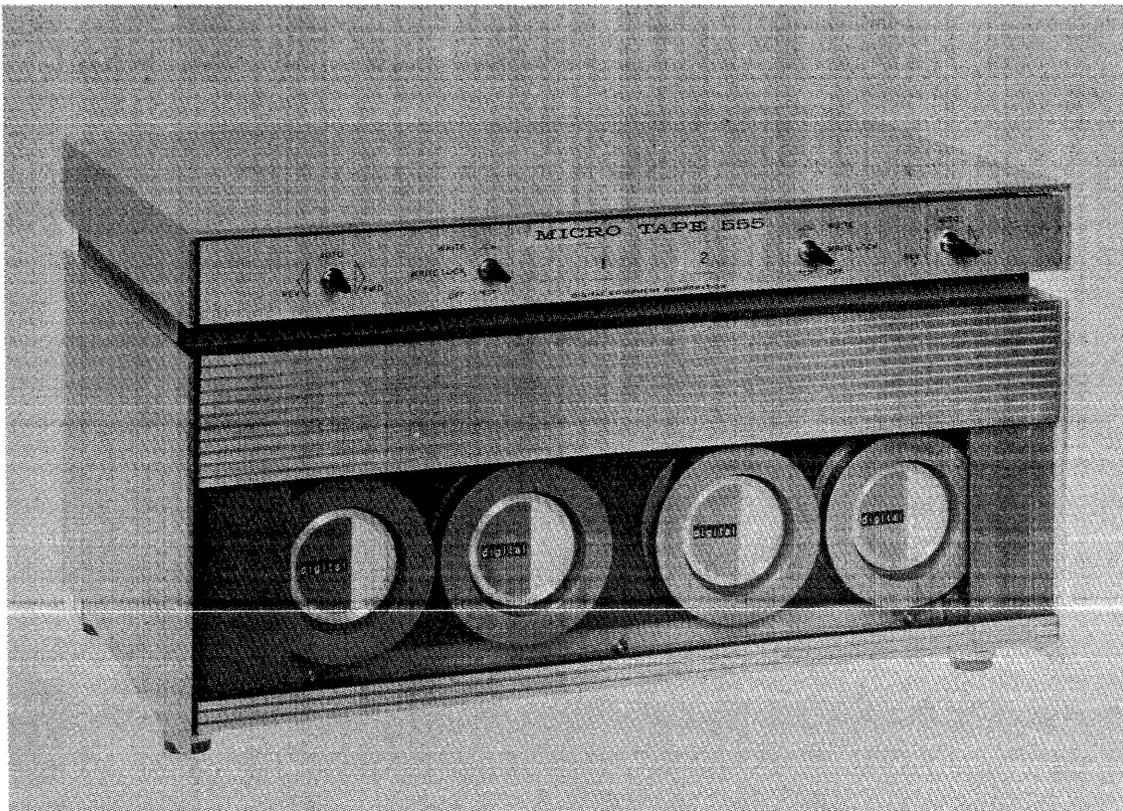
COMPUTER OPTIONS

555/550
MICRO-TAPE DUAL TRANSPORT & TAPE CONTROL

PRELIMINARY

MICRO-TAPE TRANSPORT 555

SUMMARY

The Micro-Tape Type 555 Dual Tape Transport consists of two logically independent tape drives capable of handling 250 foot reels of 3/4 inch mylar tape at a speed of 80 inches per second. Information is written on non-adjacent redundant tracks in the Phase Recording System at densities of 350, 3-bit characters per inch and may be transferred at a rate of 180,000 bits per second. A standard block of 256, 18-bit words can be transferred in 53 milliseconds. Total read or write time for a complete reel of tape is 42 seconds. Reading or writing may be performed in either direction, though, in reverse, unscrambling of the data by program is necessary. Electronics are located within a separately housed Tape Control. Controls are available at present for PDP-1 and PDP-4. Other controls are available on request.
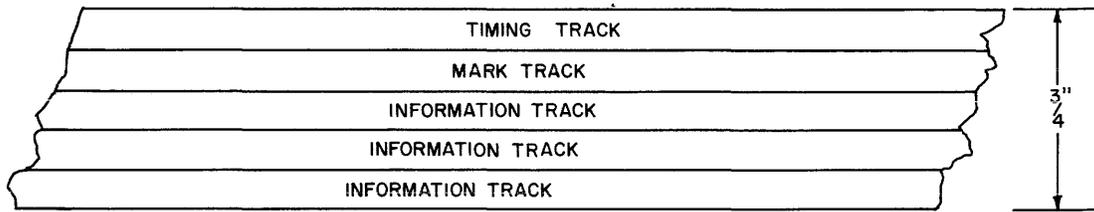
Figure 1 Track Allocation

TIMING TRACK	
MARK TRACK	
INFORMATION TRACK	3/4"
INFORMATION TRACK	
INFORMATION TRACK	

Key to the system is Micro Tape's serially coded mark track whose function is to subdivide the tape into blocks made up of data and control words. Units of information as small as one word or less can be replaced on the tape without disturbing adjacent information. Drum-like, exact tape addressing is the result.

TAPE DIRECTION

BLOCK / BLOCK / BLOCK / BLOCK / BLOCK / BLOCK / BLOCK / BLOCK

I BLOCK 256 DATA WORD LOCATIONS

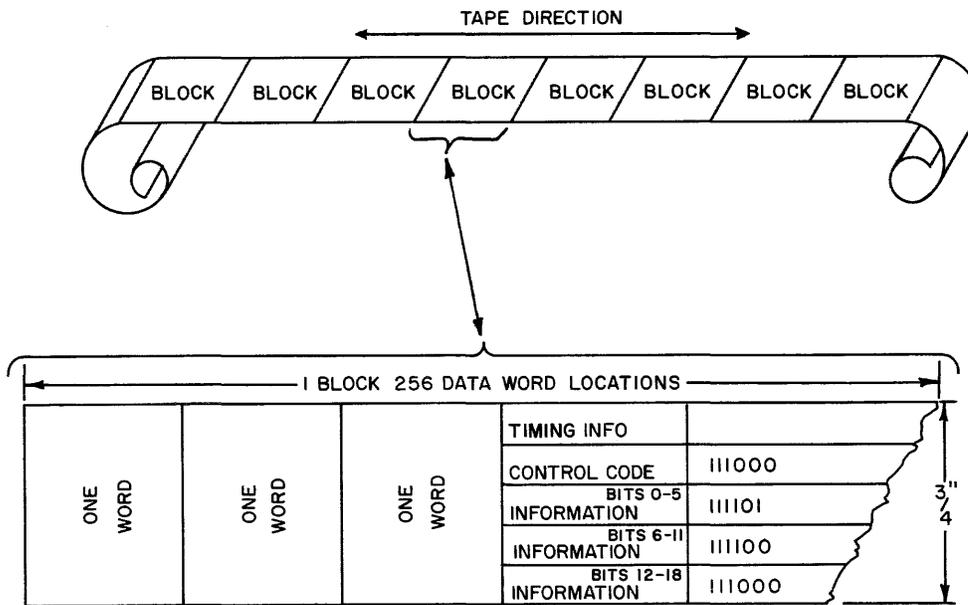| ONE WORD	ONE WORD	ONE WORD	TIMING INFO	
			CONTROL CODE	111000
			BITS 0-5 INFORMATION	111101
			BITS 6-11 INFORMATION	111100
			BITS 12-18 INFORMATION	111000

3/4"

Figure 2 Block Format

The Type 555 utilizes a ten track recording head to read and write five duplexed channels. Three distinct track pairs are available for data. The two remaining pairs are used for Timing and Mark information. Use of redundant recording minimizes dropouts due to variations in amplitude. Assuming the presence of a computer or pattern generator, mark tracks may be written in the field with both standard and non-standard formats.

STANDARD FORMAT SPECIFICATIONS

The standard Mark Track utilizes a serial code of 6-bit characters which divide the tape from end to end into word locations. Different codes are written on the mark track opposite various word locations to identify the type of information stored at that location on tape.

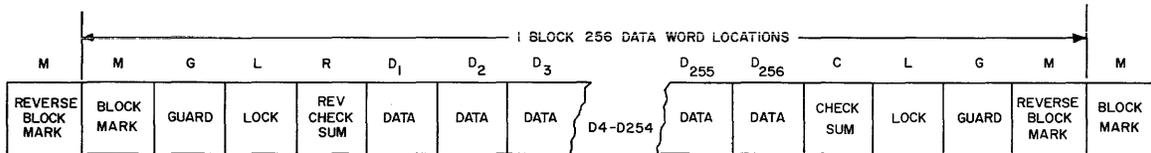| M	M	G	L	R	D_1	D_2	D_3		D_{255}	D_{256}	C	L	G	M	M
REVERSE BLOCK MARK	BLOCK MARK	GUARD	LOCK	REV CHECK SUM	DATA	DATA	DATA	D4-D254	DATA	DATA	CHECK SUM	LOCK	GUARD	REVERSE BLOCK MARK	BLOCK MARK

— 1 BLOCK 256 DATA WORD LOCATIONS —

Figure 3 Standard Mark Track Format

Block addresses are written for both forward and reverse directions and identified by two types of mark codes. A check sum is written at each end of the block. The first check sum written is minus zero (-777777_8). This information is stored in a register of the computer. As each succeeding data word is read from the block, a total is kept which represents the sum of words in the block. (Data words are added to -0.) Since the second check sum is the complement of the total, the addition of this number to the register should cause the appearance of -0.

The Final marks are used by the control to establish synchronism and raise Block End flags. Data Marks locate data words.

OPERATING SPECIFICATIONS

Tape and Reel
260 (240 usable) feet of 3/4 inch tape on a 3 1/2 reel. Tape is 1.0 mil Mylar. Could be 0.5 mil.

Bit Rate
One 3-bit character each 35 ± 2μsec. Bit rate is constant throughout a reel (although the velocity varies slightly, bit density changes serve to maintain constant bit rate result of constant rate timing track).

Speed
Varies according to reel diameter from 70 to 85 ips.

Density
Variable about 350 3-bit characters/inch 3 million bits/reel.

Acceleration
700 ± 150 ips/s.

Distance to Accelerate
8 inches max.

Command Signals
Select, Go, Rev-Relay Sig (end of 12 v. relay). 8 wires in select buss 2 connector plugs wired in parallel, for easy bussing. Automatic stopping on de-select or not-go commands.

Information Signals
5 shielded triplets. 5 mv. p-p normal read signal over 30 feet of cable. 120 ma nominal write current. Phase or Manchester recording used with reference to timing track zero crossing for read and write timing.

MICRO-MAGNETIC TAPE CONTROL 550

SUMMARY

The Type 550 Control can run up to four Type 555 Dual Tape Transports (8 drives) transferring data between tape and the Programmed Data Processor-4 or -1. Information is transferred word by word, or in blocks using subroutines. Assembly and disassembly between 3-bit lines on tape and 18-bit computer words is performed within the control. The tape format is established by a serially coded Mark Track which enables exact tape addressing and re-addressing as on a drum. All timing functions are performed by the tape transport in conjunction with the Control.

The action of the Control during reading is to assemble a word from tape and then to signal the machine by setting a program interrupt flag that the word is available. During writing, a flag indicates that a new word should be supplied to the tape control. In searching, only block numbers are read. During reading, all data words are read. Block ends are indicated by a second flag flip-flop. An error flag is set to indicate various error functions of the tape system or program. Error detection is by programmed check sum.

The timing and mark tracks are written by means of a computer program. The standard block length is 256 words (plus two check sum words).

CONTROL SPECIFICATIONS

INFORMATION REGISTERS   One 18-bit Read/Write serial parallel register.

One 18-bit In/Out register which transfers in parallel to the processor and to the Read/Write register.

One 7-bit Mark Track Recognition register plus six 6-bit Mark detection gates.

CONTROL REGISTERS   One 6-bit Mode buffer for Search, Read, Write, and Move commands.

One 3-bit Unit Selection register.

Start and Reverse time delays.

CONTROL FUNCTIONS

Data flags are generated as each 18-bit data word is ready for transfer between the I/O buffer and the processor buffer during Read or Write modes (every 200 microseconds).

Data flags are generated as each block mark is read during the Search mode (every 53 milliseconds or 256 word blocks).

Block End flags are generated during Transfer modes at the correct time for loading or unloading the check sum.

Error and Block End flags are generated by End, Slow Program or Missed Mark indicators.

Status flip-flops are set by End, Slow Program or Missed Mark and sent to the processor along with Flag, Go, and miscellaneous status information.

Motion Control

Delays exist in the tape control which delay tape operation during start up time and reverse time. The start delay of 0.1 sec is initiated by the GO F/F transition to a ONE. The reverse delay of 0.4 sec is initiated by Reverse F/F transition if the GO command is given.

Commands

Start:

the command to bring the tape up to speed after which timing pulses are allowed. The time is about 0.15 sec during which the tape moves approximately 6 inches or 1 1/2 x a 256 word block.

Stop:

Stopping is done automatically upon de-select of tape unit or command Stop ($\overline{\text{GO}}$). The stop time and distance to stop are less than those required to start.

TRANSFER OPERATION CHART

(Meaning of Flags)

Flag Type

DATA FLAG
(PGM INT)

Search: Buffer contains Block Mark. mmrd or mmwr must be given in $\leq$ 400 microseconds and transfer completed $\leq$ 53 m microseconds.

Read: Contents of buffer is a data word. Give mmrd $\leq$ 200 microseconds. First data flag indicates check sum. Data and Block flags lowered upon mmrd, change to Search or Move mode permissible.

Write: Load buffer with data word. mmwr $\leq$ 200 microseconds. The initial -0 check sum is written automatically, Data and Block flags lowered automatically. Change of mode while writing not permissible.

Move: No data flags raised. Tape motion continuous. Useful for rewinding and timing. No data transferred.

BLOCK END FLAG
(PGM INT)

Search: Flag indicates an error.

Consecutive Blocks
(can be read or
written automatically)

Read: Contents of buffer in check sum. First data flag of next block occurs in 1.5 microseconds. Change to Search must be done $\leq$ 700 microseconds in order to catch next mark. Change to write $\leq$ 900 microseconds in order to start next block. Data and Block flags are lowered.

Write: Load check sum word. Wait 450 microseconds from flag occurrence to change to mode. Search must be given in < 1 microsecond to search next block mark. (Perferred method to check next block address.) Read command in < 2 microseconds will obtain the first mark of next block.
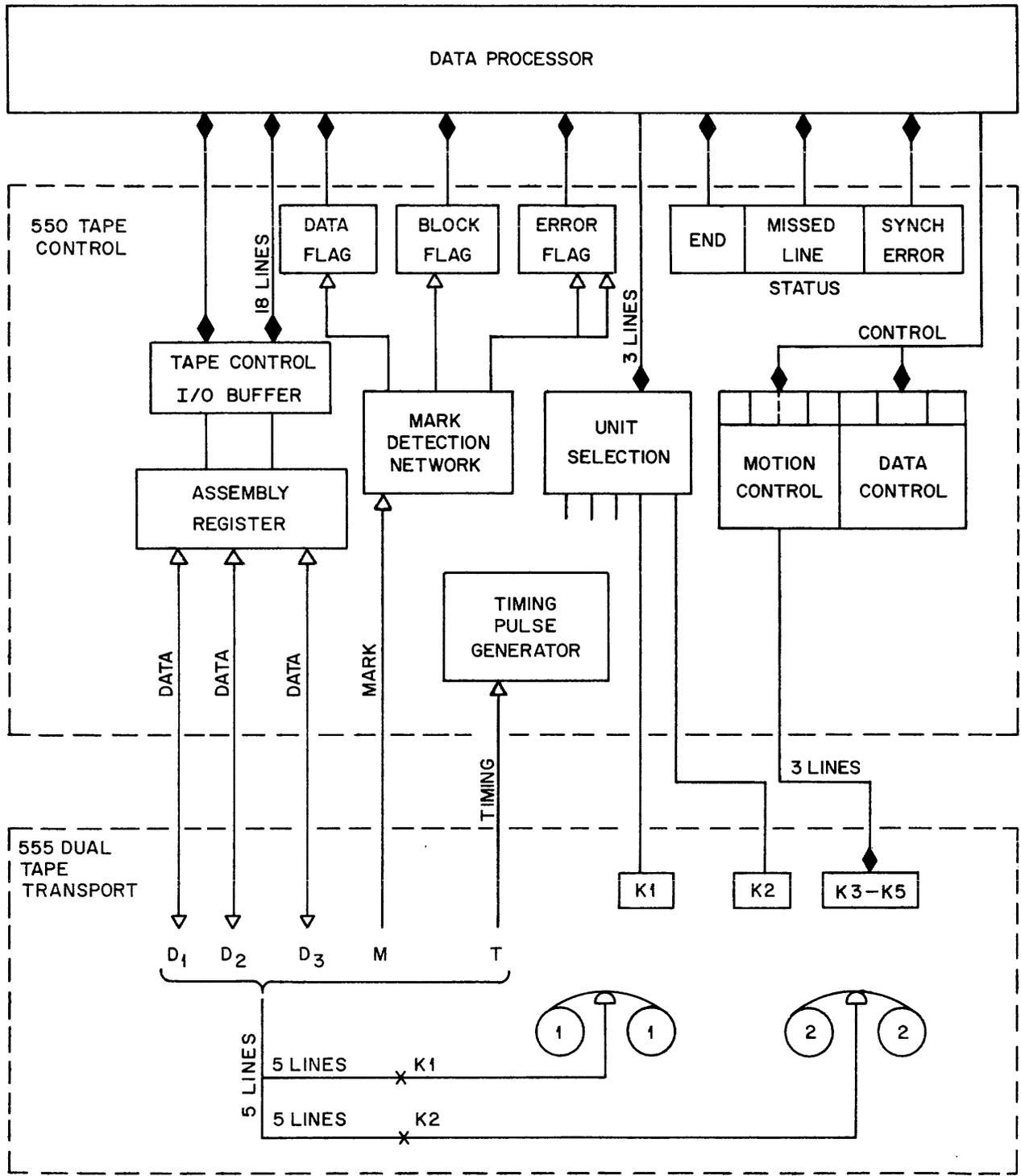
ERROR FLAG
(always raises a
Block End Flag)

Search: Status bits contain
   END^{1} = off end of tape
   MISS^{1} = program too slow or selected nonexistent
      transport.

Read: As above

Write: As above

Move: Only on end.

Notes: 1. Stop permissible only on Block End.

2. Exceptions possible but not available in the form of operating rules.

MICRO TAPE SYSTEM DIAGRAM

INSTRUCTION LIST
PDP-4 CODE

mmrd	707512	**Read** Transfers one word from tape IO buffer to machine. Clears Block and Data Flags.

| mmwr | 707504 | **Write**
Transfers one word from machine to tape IO buffer. Clears Block and Data Flag. |

| mmlc | 707604 | **Load Control**
Transfers 6 bits (AC 12-17 in PDP-4) to tape control buffer. Units operate according to this command. |

| mmse | 707612 | **Select**
Transfers 3 bits of unit selection information to tape control. Unit is selected by this command (AC 0-2 in PDP-4). |

| mm rs | 707612 | **Read Status**
Transfers contents of tape status buffer to machine (AC bits 3-11 in PDP-4) |

| mm df | 707501 | **Data Flag**
Skips on microtape data flag. |

| mm bf | 707601 | **Block Flag**
Skips on microtape block flag. |

| mm ef | 707541 | **Error Flag**
Skips on microtape error flag. |