DIGITAL COMPUTER OPTION 550 Micro-Magnetic Tape Control

Summary

The Type 550 Control can run up to four (4) 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).

Word assembly - by means of s six bit shift registers
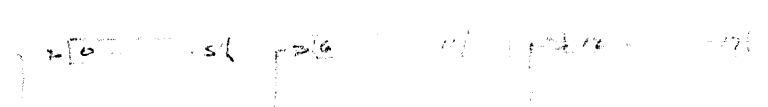
Motion Control

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 5 inches or 1-1/2 x a 256 word block.

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

Instruction List

PDP-4 Code

mmrd	707412	**Read** Transfers one word from tape IO buffer to machine. Clears Block and Data Flags.
mmwr	707404	**Write** Transfers one word from machine to tape IO buffer. Clears block and Data Flag.
mmlc	707504	**Load Control** Transfers 6 bits (AC 12-17 in PDP-4) to tape control buffer. Units operate according to this command.
mmse	707512	**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	707512	**Read Status** Transfers contents of tape status buffer to machine (AC bits 3-11 in PDP-4).
mm df	707401	**Data Flag** Skips on microtape data flag.
mm bf	707501	**Block Flag** Skips on microtape block flag.
mm ef	707441	**Error Flag** Skips on microtape error flag.

(Meaning of Flags)

Flag Type

DATA FLAG
(PGM INT)

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

Read: Contents of buffer is a data word.
Give mmrd $\leq$ 200μsec. 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
$\leq$ 200μs. 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
1.5m sec. Change to search must be done $\leq$
700μsec in order to catch next mark.
Change to write $\leq$ 900μsec in order to
start next block. Data and Block flags
are lowered.

Write: Load check sum word. Wait 450μsec
from flag occurence to change to mode.
Search must be given in $<$ 1m sec to search
next block mark. (Preferred method to
check next block address.) Read command in
$<$ 2m sec will obtain the first mark of next
block.

ERROR FLAG
(always raises a
Block End Flag)

Search: Status bits contain
        END' = off end of tape
        MISIND' = program too slow or
                  selected non-existent
                  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.

CONTROL TYPE 550

One 18-bit Read/Write serial-parallel buffer. One 18-bit
In/Out buffer which transfers in parallel to main machine.
One 7-bit Mark Track recognition register including six
6-bit Mark detection gates.

Mode buffer for Search, Read, Write, and Move Commands
Delays to establish up-to-speed. Program interrupt pulses
generated as each 18-bit data word is transferred between
the I/O buffer and the R/W buffer during transfer operations
(every 200 microseconds). During search operation interrupts
occur as each block mark (Forward or Reverse) pass under the
head. Every 53ms for 256 word blocks. Detection of an end
of tape mark causes a stop and sets a status flip flop.
Program too slow stops writing operation and sets Misind
status bit.

#13A

DIGITAL EQUIPMENT CORPORATION
Maynard, Mass.

FIELD SERVICE TECHNICAL TIPS

The following Technical Tip is an addition to Technical Tip #13 on the 550 DECtape Control - Unable Condition.

NOTE: If the voltage across the 5Ω resistor is more than 20% with the different "select one" relays, it is quite possible that the diode in the damping network (consisting of 100Ω and a diode) is shorted. This, of course, is assuming that different "select one" relays means a difference from one selected drive to the next.
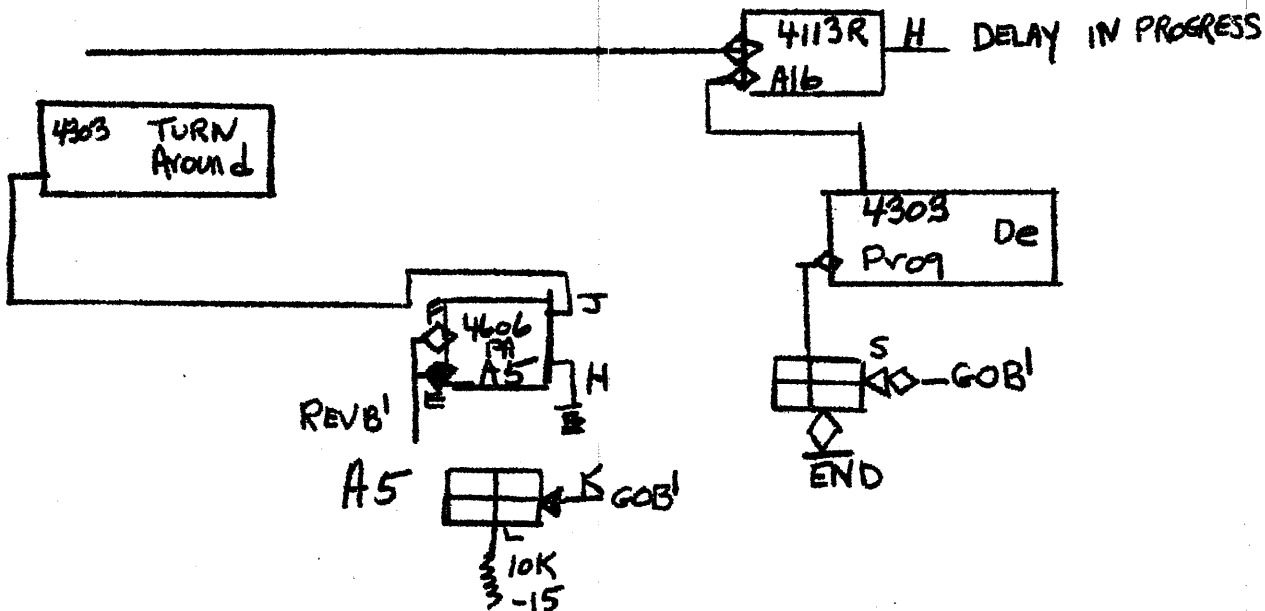
SUBMITTED BY: Don Vonada   **DATE:** 4-16-65

DIGITAL EQUIPMENT CORPORATION
Maynard, Mass.

FIELD SERVICE TECHNICAL TIPS

PROBLEM: 550 DECtape Control. Occasionally erasing block numbers --
Block Numbers are erased if they are different each time they
are read. If the circuit on C1 @ A7 looks like the following:

You will probably find the pulse (level change) at A5K and therefore the
turn around delay fires OFF when the "go flop" is zeroed rather than when
it is set to a one. This is due to a wiring error. To check, measure
voltage at A5K with transport stopped (Go Flop Zeroed). Pin K should be
at ground if it is correctly wired. The precise sequence of events which
cause the block numbers to be erased is unknown at present. It might be
well to check any and all GOB' levels that have anything to do with either
of the motion delays even if the logic looks somewhat different. It can
cause an unable condition in a different logic configuration.

SOLUTION: To the problem illustrated. Remove the wire on A5K. Remove
the 10K resistor to -15 on A5L. This gate is not necessary so
it can simply be deleted. In other logic configurations wire
to correct GOB'.

SUBMITTED BY: Don Busiek   **DATE:** April 12, 1965

ACTION: Engineering and Production have been notified. A formal mod
will follow.

INTEROFFICE MEMORANDUM

DATE   November 4, 1964

SUBJECT   Mod to the DECtape 555 Transport

TO   Jack Smith   FROM   Don Vonada
      Jack Shields

It has been found that the drive motors used in this transport are not being grounded to the base plate and in some instances the base plate is not being grounded to the chassis. The motor frames and the base plate are thus allowed to reach a voltage which will eventually break through the dielectric of the hard coating on the base plate. This causes electrical noise which is hard to detect and could be the cause of strange field problems.

A simple solution to this problem is to ground the motors and the base plate. This can be accomplished by removing one of the four mounting bolts in each of the four motors and replacing it with an external star washer and a stainless steel screw. This insures grounding between the motors and the base plate. Grounding the base plate to the chassis is somewhat more difficult. If it is not already grounded through the grounding strap that connects the static discharger to the chassis, it may be grounded via the supporting rod for the read relay board. If this rod is not grounded to the base plate other steps will have to be taken in which case please contact me. An ECO is presently in process to correct this situation. It is requested that this mod be performed on all transports within your area of responsibility as soon as practical.

DV/mro

John Mutgenick

INTEROFFICE
MEMORANDUM

DATE June 23, 1964

SUBJECT Microtape troubles at Keydata Corp.

TO Field Service   FROM D. Vonada

On 18 June 1964 Bob LaFlamme, Keydata talked with me concerning the Microtape installation there.

1. Selector switch knobs slip.
2. Hubs too loose or too tight.
3. Unable errors when writing and sometimes during reading.
4. Tape coasts off reel.
5. Records marginal or unreadable.
6. Error flag is raised but when status is checked there is no error.

Item 1 is straight forward. Item 2 is being corrected in mechanical design but as far as satisfying the customer, replace Key's hubs with ones that have been checked in house.

There is a good possibility that programming may be causing some of the problems of Items 3, 4, and 6. For example; the program may be loading the control with a write command while selecting unit "0". This would cause the unable condition. Not holding the STOP command on a selected unit long enough for the relays to react (17 msec) could be the answer to Item 4. Error flags raised but no errors found may be due to issuing an mmlc or mmse command before checking error status. Noise may also be a factor. Use a scope and check for noise spikes in excess of -15V on any unselected selection line to the transport. If noise exceeds this level the damping diodes across the relay coils in the transport may be bad. Replace with 1N1220's.

Records which become marginal or unreadable may be caused by a head which has marginal skew combined with a drive whose hubs are badly positioned along the motor shaft. Tape could be rubbing the side of the reel and thus cause the tape to temporarily distort. The Distortion could then shift the timing track which would in turn cause the errors. Solution: Skew check the head or heads giving the trouble and adjust the hubs so tape does not rub when being wound onto the reel. Also, the signal amplitude directly from the head should be 5 mv minimum and 7-10 mv average.

If there are questions please contact me.

DGV/mro

John Mutzeneek

INTEROFFICE
MEMORANDUM

DATE 10 July 1964

SUBJECT Timing restrictions in the control of the Model 555
Transport

TO All Field Service Personnel   FROM Jack Shields

The following is a copy of an interoffice memo from Don Vonada,
dated June 23, 1964.

"The timing restrictions imposed on the programmer of the
Model 555 Tape Transport are a direct result of relay operate
times. Therefore, to insure reliable operation, the commands
to the transport must be held for enough time to allow the
relays to respond. A table listing these minimum times is pro-
vided below. Times are multiple of the real time clock period.

Command	Selected Drive	Unselected Dr.
GO	17 msec.	51 msec.
FWD	17 msec.	34 msec.
REV	34 msec.	51 msec.
STOP	34 msec.	68 msec.

Commands to a selected drive may be changed at any time pro-
vided that last command is held for the time specified in the
table.

When transferring from one drive to the next, the last drive must
be deselected (select drive "0") for 34 msec.

If the real time clock is used, be sure to synchronize it with
your program."

MICRO TAPE DATA TEST

Micro Tape Data Test is a program which enables the operator to
check data transfer to and from the PDP-1 and the Micro Tape
control 555. The program also indicates to the operator (with Program
flags) what flags are being detected during the test.

The program has four options.

1) Setting SS1 to a 0 causes the program to run.

    Setting SS1 to a 1 causes the program to stop running.

2) Setting SS2 to a 1 causes the program to stop if there is
    a Data Error.

3) Setting SS3 to a 1 causes the program to stop if the Micro
    Tape Error flag is detected.. Status is displayed in the IO.

4) Setting SS4 to a 0 causes the program to take the data that
    is being transferred from the test word switches.
    Setting SS4 to a 1 caused the program to take the data that
    is being transferred from a counter.

Operating Procedure

A. Turn off all sense switches and read the program into the computer.

B. For a typeout of the detailed operating instructions, push start.

C. To run the program, put the desired micro tape mode command in
    the test word switches 12 through 17, read, write, search, etc.,
    and push continue.

Hint

    If the write timing and mark mode (47) is used, tape is not
    necessary because the clock sets the data request flag. When
    any other mode is used, tape is necessary because the signals
    from tape are what set the data request flag.

Controls and Indications

Program starting address   20

The program uses unit 1 only.

Sense switch controls.

SS1 down = Program run

     up = Program stop

        To restart, push continue

SS2 down = Don't stop on data error

     up = Stop on data error

        The accumulator contains what was sent over.

        The In Out contains what was read back.

        To restart the program, push continue.

SS3 down = Don't stop if the error flag is detected.

     up = Stop if the error flag is detected.

        The I.O. displays the status bits that were read back when

        the error flag was detected.

SS4 down = Take the word that is being sent over and back from

        from the test word switches.

     up = Send over a count.

Program Flag indicates when = 1

PF 1 - Data flag is being detected when reading status.

PF 2 - Block flag is being detected when reading status.

PF 3 - Error flag is being detected when reading status.

PF 6 - Data Error

Test Word Switches

Put the micro tape mode command in test word switches 12 through 17 when starting the program.

MICRO TAPE DUMP AND RETRIEVE

Purpose

To allow the operator to store data on Micro tape or retrieve data from micro tape using the test word switches.

General Description

To store or retrieve information, the user only need indicate, via the toggle switches, the unit, starting block number, starting address in memory, and the final address in memory. To retrieve, set sense switch one to a zero. To store set sense switch one to a one. If an error should occur during a transfer, "error" is typed out on the typewriter and the computer halts with the micro tape status in the I.O. At the completion of a transfer, the computer halts with the number of last block used in the transfer displayed in the AC. Two versions of the program are available. One which goes in the low end of memory and starts at 0, and one which goes in the high end of memory and starts at 6000.

Use

1. To store data on tape set SS1 = 1
   To retrieve data from tape set SS1 = 0

2. Start at the starting address of the program
   0 for program in low memory
   6000 for program in high memory

3. Put the unit number in test word switches 13 through 17 and push continue.

4. Put the block number in test word switches 9 through 17 and push continue.

5. Put the starting address in test word switches 3 through 17 and push continue.

6. Put the final address in test word switches 3 through 17 and push continue.

7. At this point the transfer will be initialized and if it was error free, the program will halt with the number of the last block used displayed in the AC. If an error occurred during the transfer, "Error" will be typed out on the typewriter and the computer will halt with the Micro tape status displayed in the AC and the Micro tape control program status displayed in the IO.

The particular bit indications for these status reports are as follows:

Micro Tape Status

Bit = 1	Status
0	Data flag
1	Block flag
2	Error flag
3	Off end
4	Miss error
5	Reverse
6	Go
7	Mark track error
8	Unable

Micro Tape Control Program Status

Bit = 1	Status
0	Operation complete with no errors
1	Tape isn't going
3	Tape error condition See Micro tape status
4	Sum check error
5	Searching has been completed
6	Transfer was done with the going reverse

MICRO TAPE EXCISER

There are two modes of operation , both of which exercise
tape by writing and reading all the block between and in-
cluding two blocks specified by the user   All availablex
transports may be exercised together/

TWO modes of opeation.

Multiple block mode   sense switch 1 = 1

Ones are written in every block in the specified area and read to
check to contain all ones. Blocks written in acending order
and checked in decending order   When completed the program goes to the
next available transport

Individual block mode. sense switch 2 = 1

Program writes the contents of the test word switches in a block
in a specified area reads the same block and checks. THIS is
done to the same block number on all available transports and then to
the next sequenctial block.

SPECIFIED AREA ON TAPE

The program uses block 1 through 1077 inclusively in both modes
unless otherwise specified   The user cans, specifiy a low block limit
and a high block limit between which the program will use tape, including
the two blocks specified as limits   To specify these limits,
put sense switch up before selecting the mode with sense switches
one or two   When you slect the mode the computer will halt
put the number of the low block limit in the test word switches,
and deptess continue   When the computer halts again, put the number
of the high block limit in the test word switches and depress
continue   The remainder of the operating procedure is the same as when t
th specifie area on tape is not given

OPERATING PROCEDURE

1 Set all sense switches km and test word switces to zero and
   read the program into the computer
2. Put all the available transports in sequential order starting
   with one and enable them to write
3. Set sense switch 3 to a 1 [up] if limits are to be specified
   Leave it set at zero if the program is to use the entire tape.
4. Select the desired mode with sense switch one or two
   SxSx   S.S 1 up for multiple block mode
            s s. 2 up for individual block mode
   If s s 3 is up do steps A= B and C below   If SS 3 is down
   do only step C

      A Put the low limit block number in the test word switches
          and push continue

      B Put the high limit in the test word switches and push continue

      C Put the number of the final transport number in the test word
          switches and push continue

5. If the program is running in the indiv. blowk mode, set the test
    word switches to the pattern that is to be written on tape

6. To stop running in either of the two modes, put the sense switchs
      to sx zero that selected that mode.

ERROR MESSAGES

When an error is made the unit number, block number and the type
of error made is typed out on the typewritter. When a data error
is made the program halts xx with the bad word displayed in the AC
To restart the program, depress continue. The program will halt
and display every bad word in the x AC before continuing on to
the next tape cycle. To prevent the computer from halting where
there is a data error, set SS 4 to a one [up]

CONTROLS

SS1= 0   Don't run in the multiple block mode

SS1= 1   Run in multiple block mode

SS2= X→0   Don't run in individual block mode

SS2= X 1   run in individual block mode

SS3= X 0   Use all blocks on tape

SS3= X 1   Specify area on tape

SS4=   0   Hlat to disply data error

SS4=   1   Don't stop to display data error

MICRO TAPE FORMAT PACK

Micro Tape Format Pack is a program to write the mark track, timing track and block numbers from 0 to 1077_8 on tape. It also allows the operator to check the tape after it was written. The blocks written are 400_8 words long with a count in them going from 1 to 400_8. Any errors are typed out on the on line typewriter.

Controls

SS1 = 0	Don't write the timing and mark track
SS1 = 1	Write the timing and mark track
SS2 = 0	Don't check the tape for errors
SS2 = 1	Check the tape for errors
TWS 14 - 17	Unit in octal
Start Address = 0	

Operating Procedure

1. Put all sense switches and test word switches down (=0) and read the program into the computer.

2. Read the tape on the desired transport and position it so that there is as little tape on the take up reel (right side) as necessary.

3. Put the switch on the transport in the write position and turn the write timing and mark track mode switch on.

4. Select the desired unit in octal with test word switches 14 through 17.

5. Put up sense switch 1 and the program will start writing the new tape. When the tape stops or runs off the reel, the tape has been written. Put sense switch 1 back down.

6. To check the tape, position it so that the feed reel (on the left) has a few feet of tape on it and turn off the "write timing and mark track" mode switch.

7. Select the desired unit in octal with test word switches 14 through 17 and put up test word switch 2. Any errors that occur will be typed out on the on line typewriter. When the checking is completed, "OK" will be typed out on the on line typewriter. If sense 2 is up when the checking is finished, the program will check the tape again.

8. To restart the program when it is in the computer, follow the operating procedure explained above; but instead of reading the program in as described in step 1, set all the address switches to zero (down) and push the start switch down.

1. Purpose

    The program allows the user to oscillate tape over a desired
    area of tape for debugging purposes. Unit 1 is used.

2. Brief Description

    The program has two modes of operation.
    A. Time mode   Sense Switch 1 = 1 (up)
        In this mode tape is moved in both directions for a time
        which is set in the test word switches.
    B. Block mode   Sense Switch 2 = 1 (up)
        In this mode tape is moved in both directions between two
        blocks which are specified by the user.

Searching

When running in the time mode, the program will search and display
the block numbers in the IO register if sense switch 4 is set to
a 1 (up).

When running in the block mode the program will search and display
the block numbers in the accumulator, if the user has not commanded
it to read or write by setting sense switches 5 or 6 to a 1.

Reading   Sense switch 5 = 1

When operating in the time mode the program will execute a read
instruction every time a data flag is set. The data read is displayed
in the IO.

When operating in the block mode, the program will read and check
the sum of every block. If there is a sum check error, program flag
one will be set.

<u>Writing</u>   Sense switch 6 = 1

When operating in the time mode, the program will execute a **write** instruction every time a data flag is set.

When operating in the block mode, the program will write the contents of the test word switches and the proper check sum in each block.

<u>Scope Sync Mode</u>   Sense switch 4 = 1

This mode is provided to allow the user to sync his scope on a desired spot on tape when operating in the block mode.

When the number of data flags in a specified block while reading is the same as the number in the test word switches, the program will execute a MSE command which can be used to sync the scope by syncing externally on 1A7P.

Regardless of the direction in which tape is moving, the sync pulse is generated the word before the word whose number is set in the test word switches.

<u>Illustration</u>

Assume the block was 10 words long and the number 3 was set in the test word switches.

```
              1  2  3  4  5  6  7  8  9  10
Forward       1  1  1  1  1  1  1  1  1  1


Reverse
```
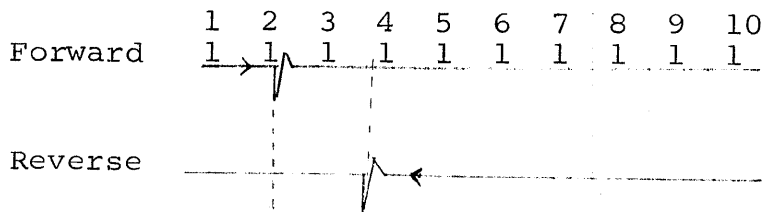
When the tape is moving forward, the sync pulse is generated when the flag for the second data flag is raised.

When the tape is moving reverse, the sync pulse is generated when the flag for the seventh word is raised.

Error Indication

When running in the time mode, there are no error indications.
When running in the block mode, the program flags have the following
indications:

PF = 1	Indications
1	Sum check error
2	Miss error
3	Reverse
4	Mark track error
5	Unable

Operating Procedure

Set all sense switches and address switches to zero (down) and read
the program into the computer. If the program is already in the
computer, set all sense switches to zero and push start.

Time Mode Operation

To run the program in the time mode, set sense switch 1 to a 1 and
set the desired time in the test word switches. The remainder of
the sense switches have the following effect.

SS2 = 0   Don't run in the block mode

SS2 = 1   Run in the block mode. Program will not switch
            to the block mode when running in the time mode.

SS3 = 0   Tape move in the time mode.

SS3 = 1   Stop tape when running in the time mode.

SS4 = 0   No effect.

SS4 = 1   Display the block numbers in the In Out register as
            they are read off of tape.

SS5 = 0   Don't read from tape.

SS5 = 1   Read the data and display it in the In Out register when
            a data flag is detected.

SS6 = 0   Don't write on tape.

SS 6 = 1   Give a write command when a data flag is detected.

Block Mode Operation

To run the program in the block mode, set sense switch 2 to a 1 and the program will halt. Put the low number block in the test word switches and push continue. Put the high number block in the test word switches, and push continue. Then put the number of the block in the test word switches at which you went to generate the sync pulse and push continue. The program will position the tape at the low order block and start running in the block mode.

The remainder of the sense switches have the following effect.

Sense switch 1 = 0	Don't run in the time mode.
Sense switch 1 = 1	Run in the time mode. Program will not switch to the time mode when running in the block mode.
Sense switch 2 = 0	Don't run in the block mode.
Sense switch 2 = 1	Run in the block mode.
Sense switch 3	No effect
Sense switch 4 = 0	Don't generate a scope sync pulse.
Sense switch 4 = 1	Generate a scope sync pulse
Sense switch 5 = 0	Don't read
Sense switch 5 = 1	Read the data in each block and check the sum
Sense switch 6 = 0	Don't write
Sense switch 6 = 1	Write the contents of the test word switches on tape and the proper check sync for each block.