ABSTRACT

The Tape Duplicator program performs the following functions:

1) creates master tapes from non-masters,

2) duplicates master tapes, and

3) verifies master tapes.

The program allows verfication to be carried on in parallel with functions 1) and 2) whenever the reader is free.

User's Manual

PROGRAM TAPE DUPLICATOR

093-000005-00

TAPE

Absolute Binary: 091-000008

Ordering No. 093-000005-00

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NOTICE

1. REQUIREMENTS

1.1 Memory

4K or larger for reasonable efficiency of operation.

1.2 Equipment

Teletype, paper tape reader, high speed punch

1.3 Other

None

2. OPERATING PROCEDURE

The Tape Duplicator must be loaded in the standard manner (see Binary Loader, 093-000003). To begin execution, enter the proper address in the data switches, press RESET, and then START.

Starting Address	Function
2, or 3	Duplication or verification
4	Master production

2.1 Verification

When started at location 2 or 3, the program types:

TYPE: 1-VERIFY, 2-DUPLICATE

To verify a stream of tapes placed in the reader, the user should respond

1↓

Should the reader be empty, the message will be repeated.

As each control block is encountered on the input tape, one of the following messages will be typed:

XX VERIFY OK

XX VERIFY ERROR

where: XX is the number of the control block in question, beginning with Ø1 for the first control block on the tape.

The first message implies that the control codes on the tape agree with those calculated by the program and that tape may be presumed to be correct.

The second message implies that the control codes disagree with those calculated. If subsequent verification also fails, the tape should be presumed to have been incorrectly punched, and should be disposed of.

Verification will continue until the reader empties. If the tape contains anything but blanks after the final control block, the message

? END OF TAPE WITHOUT CONTROL BLOCK

will be typed.

When the reader has been cleared and all of the above messages have been typed out, the program will again type:

TYPE: 1 -VERIFY, 2-DUPLICATE

During duplication or master tape creation, the message:

TO VERIFY, STRIKE A KEY

will appear whenever the reader is free but the punch is still busy. Striking any key results in the verification of tapes in the reader as described above. Messages concerning verification may be interspersed with messages concerning duplication or master creation. There should be no ambiguity, however, as the set of messages corresponding to each function is unique, once verification has begun.

If the message

TYPE NUMBER OF ADDITIONAL COPIES

is typed before the user responds to the message

TO VERIFY, STRIKE A KEY

user response will be interpreted as a response to the number of additional copies, not as an indication that verification

2. OPERATING PROCEDURE cont'd)

2.1 Verification (cont'd)

should be initiated. If appropriate, the verification message will be retyped, however.

2.2 Duplication

When started at location 2 or 3, the program will type:

TYPE: 1-VERIFY, 2-DUPLICATE

To duplicate a tape placed in the reader, the user should respond

2 ↵

The input tape will be read, and punching will begin. When the first control block is encountered in the input tape, the remainder of the tape will be ignored and one of the following messages will be typed:

VERIFY OK ON DUPLICATION

VERIFY ERROR

The second message implies that the input tape was incorrect or incorrectly read. Punching will stop, and the program will restart.

The first message implies that the input tape was properly read and punching will continue to completion. If punching is still in progress, the message:

TO VERIFY, STRIKE A KEY

will be typed. (For response to this message, see Section 2.1, Verification).

When punching has been completed, the message:

TYPE NUMBER OF ADDITIONAL COPIES

may be typed out. (See Note c., Page 3). The user may respond with any number up to 99 followed by a ↵. Any other response will result in the message being repeated.

When a valid response is entered, the punch will produce the number of copies requested.

2. OPERATING PROCEDURE (cont'd)

2.2 Duplication (cont'd)

Any verifications in progress will be continued, except that the reader may stop until a response to the copy message above has been received.

When verification has been completed, the message:

TO VERIFY, STRIKE A KEY

will be repeated, unless punching has also been completed. When punching of copies is completed, the message:

TYPE NUMBER OF ADDITIONAL COPIES

will be repeated.

This sequence of messages (including messages resulting from any verifications undertaken) will continue in any order until a response of

Ø ↵

is given for the number of additional copies. Any verifications then in progress will be completed before the message:

TYPE: 1-VERIFY, 2-DUPLICATE

is repeated.

NOTES:

a) If no control block is encountered on the input tape, the messages:

? END OF TAPE WITHOUT CONTROL BLOCK

and

TYPE: 1-VERIFY, 2-DUPLICATE

will be typed and punching will stop. The punch should be cleared of any tape punched to this point. (The program will not duplicate tapes having no control blocks.)

2. OPERATING PROCEDURE (cont'd)

2.2 Duplication (cont'd)

b) Punching of multiple copies will continue until the number of copies requested has been punched. Entering excessive responses to the request for additional copies may result in jamming the punches unless tape is periodically removed from the output bucket.

c) Additional copies may be produced only if the input tape is small enough to fit in memory at one time. The message:

TYPE NUMBER OF ADDITIONAL COPIES

will not be typed if the input tape does not fit in memory.

d) No tapes produced by this program should be presumed correct until they have been verified, since they cannot be verified as they are being punched.

2.3 Creation of Master Tapes

If the program is restarted at location 4, it will read the tape in the reader and produce a duplicate containing control codes.

When reading is completed, either:

INPUT OK ON MASTER

or

? CONTROL CODES FOUND WHILE PROCESSING MASTER TAPE

will be typed. The first message signifies that no control codes were found, and the message will be followed by:

TO VERIFY, STRIKE A KEY

(For response to this message, see Section 2.1, Verification.)

The second message signifies that the input tape contained control codes. Punching is stopped, and the message:

TYPE: 1-VERIFY, 2-DUPLICATE

will be typed.

2. OPERATING PROCEDURES (cont'd)

2.3 Creation of Master Tapes (cont'd)

Multiple copies cannot be produced without taking the output tape and duplicating it. This is to encourage verification of new master tapes.

When punching is completed, the message:

MASTER COMPLETED

will be typed. Any verifications in progress will be completed before the message:

TYPE: 1-VERIFY, 2-DUPLICATE

is repeated.

CAUTION: MASTER COMPLETED signifies only that the punch has finished. Ther user should not assume that the master is correct without verifying it. Indeed, verification is no guarantee, since the reader may have misread the input tape. The control codes are correct for the tape as read.

The only way to guarantee the integrity of the new master tape is to perform a frame-by-frame comparison of the master and input tapes. However, if some degree of confidence is desired without a frame-by-frame comparison, producing another master and comparing control blocks will afford some protection.

Note that if the input tape is misread due to some physical flaw, such as excessive wear, this latter test will fail. To repeat, the only sure test is a frame-by-frame comparison.

3. DISCUSSION

3.1 Algorithms

The tape duplicator uses a group of ring buffers for I/O--two short ones for

3. DISCUSSION (cont'd)

3.1 Algorithms (cont'd)

teletype communication with the user, and a third which uses the rest of memory up to the beginning of the loaders at the top of memory. This large buffer is used to store input from the reader until the punch has used it.

All I/O takes place at interrupt time, as does the calculation of the control codes. This latter implies that data from tapes being verified need not be buffered, enabling simultaneous verification of a stream of tapes while punching a tape read previously, without using any memory space for the verification.

The control block consists of 8 frames alternating between 252 and 125 (used to signal the presence of control information.), followed by 4 frames of control information. The first 2 frames contain the 16-bit ones-complement sum (i.e., binary sum with end-around carry) of the preceding frames - starting with the first non-zero frame after the leader and ending with the 8th frame of the control block. The full-word sum is punched right half first. The last two frames contain a count (modulo 2^{16}) of the same frames that are contained in the sum.

Since the control codes are calculated at interrupt time, the suitability of the input tape for the function being performed can be determined as soon as reading has been completed. Thus, if the input is found to be in error, any punching initiated by that input can be halted immediately.

Buffering of input allows the reader to operate at full speed and not at punch speed (until the buffer becomes full).

3.2 Limitations and Accuracy

The accuracy of the program depends on the accuracy of the I/O devices. If the reader errs while making a master tape, the output tape will verify, but will be incorrect. If the punch errs, the output tape should fail to verify.

3.3 Size and Timing

The program requires about 2400 (octal) words, plus the large reader/punch buffer. A 4K machine is ample, though multiple copies of moderately long tapes will be impossible without reading the input tape again.

A 2K machine is adequate for verification (which requires no reader/ punch buffer). For duplicating tapes, a 2K machine would operate at roughly punch speed, since the buffer would fill so rapidly.

Verification takes place at maximum reader speed, and duplication at maximum punch speed. (Given an adequate reader/punch buffer, reading the input tape occurs at maximum reader speed, thereby freeing the reader for verification of other tapes.)

4. EXAMPLES

A sample teletype printout follows. Blocks are numbered to show the following features of the sample printout:

Block 1) shows verification of a tape (hereafter called TAPE1) with three control blocks and text after the last control block. The control codes in the second control block disagreed with those calculated from the second tape segment.

Block 2) shows duplication of a tape (TAPE2) which verified upon being read. TAPE1 was verified. Verification ended before punching of the duplicate tape, and Line 2.1 was therefore typed.

A key was struck with TAPE1 in the reader, but punching was completed before the first control block of TAPE1 was encountered, so Line 2.2 was typed. No messages from the verification of TAPE1 appeared until a response was given to Line 2.2

Verification again finished first and was reinitiated with TAPE1 in the reader. This time, the first control block of TAPE1 was encountered before punching of the copy was completed (Line 2.3). Another copy was requested (Line 2.4), and verification continued.

4. EXAMPLES (cont'd)

Block 2) (cont'd)

Again, verification was completed first (Line 2.5), but this time no key was struck. As a result, when another copy was requested, Line 2.6 was typed. Since no additional copies were requested at Line 2.7, when verification completed, the program restarted (line 3).

Block 3) shows creation of a master tape, i.e., the program was restarted at location 4 instead of responding to Linc 3). The input was OK (had no control block); verification of the four copies of TAPE2 was undertaken; and since the master was completed before verification was completed, no further verification could be requested. All four copies of TAPE2 were OK.

Block 4) shows an attempt to make a master of a

4. EXAMPLES (cont'd)

tape containing control codes, which is illegal as input to master mode.

Block 5) shows an attempt to duplicate a tape with no control block. In both Blocks 4) and 5), punching halted when the error in input was discovered.

Block 6) shows duplication of a tape which exceeded the buffer size. Verification of TAPE1 was undertaken and completed before the duplication was completed. No further verifications were requested, and when punching was completed, Line 7) was typed--since extra copies can be made only if the entire input tape can fit in the buffer at onc time.

Block 7) shows attempted duplication of a tape with an incorrect control block.

```
1)    TYPE:  1-VERIFY,2-DUPLICATE 1
      Ø1 VERIFY OK
      Ø2 VERIFY ERROR
      Ø3 VERIFY OK
      ? END OF TAPE WITHOUT CONTROL BLOCK

2)    TYPE:  1-VERIFY,2-DUPLICATE 2
      VERIFY OK ON DUPLICATION
      TO VERIFY, STRIKE A KEY.
      Ø1 VERIFY OK
      Ø2 VERIFY ERROR
      Ø3 VERIFY OK
      ? END OF TAPE WITHOUT CONTROL BLOCK
2.1   TO VERIFY, STRIKE A KEY.
2.2   TYPE NUMBER OF ADDITIONAL COPIES 1
      Ø1 VERIFY OK
      Ø2 VERIFY ERROR
      Ø3 VERIFY OK
      ? END OF TAPE WITHOUT CONTROL BLOCK
      TO VERIFY, STRIKE A KEY.
2.3   Ø1 VERIFY OK
2.4   TYPE NUMBER OF ADDITIONAL COPIES 1
      Ø2 VERIFY ERROR
      Ø3 VERIFY OK
      ? END OF TAPE WITHOUT CONTROL BLOCK
2.5   TO VERIFY, STRIKE A KEY.
      TYPE NUMBER OF ADDITIONAL COPIES 1
2.6   TO VERIFY, STRIKE A KEY.
      Ø1 VERIFY OK
2.7   TYPE NUMBER OF ADDITIONAL COPIES Ø
      Ø2 VERIFY ERROR
      Ø3 VERIFY OK
      ? END OF TAPE WITHOUT CONTROL BLOCK

3)    TYPE:  1-VERIFY,2-DUPLICATE

      INPUT OK ON MASTER
      TO VERIFY, STRIKE A KEY.
      Ø1 VERIFY OK
      MASTER COMPLETED
      Ø2 VERIFY OK
      Ø3 VERIFY OK
      Ø4 VERIFY OK

4)    TYPE:  1-VERIFY,2-DUPLICATE
      ? CONTROL CODES FOUND WHILE PROCESSING MASTER TAPE

5)    TYPE:  1-VERIFY,2-DUPLICATE 2
      ? END OF TAPE WITHOUT CONTROL BLOCK

6)    TYPE:  1-VERIFY,2-DUPLICATE 2
      VERIFY OK ON DUPLICATION
      TO VERIFY, STRIKE A KEY.
      Ø1 VERIFY OK
      Ø2 VERIFY ERROR
      Ø3 VERIFY OK
      ? END OF TAPE WITHOUT CONTROL BLOCK
      TO VERIFY, STRIKE A KEY.

7)    TYPE:  1-VERIFY,2-DUPLICATE 2
      VERIFY ERROR

      TYPE:  1-VERIFY,2-DUPLICATE
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