

Advanced Language Calculator
Microtape Peripheral
Design Specification

Consumer Products Group
Calculator Division

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Revision 1.1

SECTION 1

Introduction

1.1 Purpose of This Document

This specification describes the features and operational aspects of a microtape peripheral for the advanced language calculator. This document is meant to be used in formulating the detailed software design and to allow an accurate review of the product features.

1.2 Scope of This Document

This document describes the features of the product which are apparent to the user of an advanced language calculator. The interface from the BASIC language is used as an example throughout this specification. The electrical design is not discussed in detail although proposed gross concepts are presented. The interface of this (and other) peripherals to the peripheral bus is discussed in other documents.

1.3 Terminology

wafer, drive, drive controller, peripheral bus, file, record, directory, header, BOT/EOT, MRL, LUNO, DL, access mode, file type,

1.4 Related Documents

The following documents are referenced in the text or may contain other material of interest to the reader of this document. Copies of any of these may be obtained by contacting Tom Ferrio at TI Lubbock; phone 741-3362; MSG PLB.

Advanced Language Calculator Product A Functional Specification.

Advanced Language Calculator Microtape Peripheral Functional Specification.

Lonestar Intelligent Peripheral Bus Structure, Timing, and Protocol Specification.

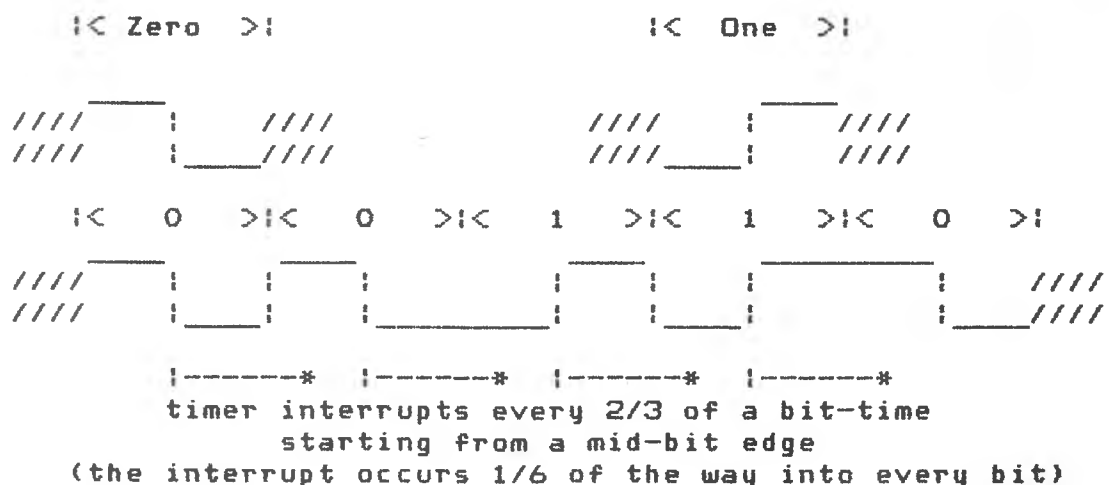
Lonestar Console Intelligent Peripheral Bus Software Design Specification.

SECTION 2

Product Overview

2.1 The Microtape Concept

The microtape peripheral is a magnetic tape drive which uses a small (1/8 inch) endless loop magnetic tape. The tapes come in various lengths from 5 to 75 feet and travel at about 10 inches per second when the motor is running. Data capacity amounts to about 1K bytes per foot. Thus the maximum access time and the amount of data storage can be adjusted by choosing tapes of a certain length. Each tape has a reflective Beginning Of Tape marker to form a reference point on the tape. The bit-level recording scheme uses a single track with ones and zeros recorded as shown below. The transitions key the timing and the levels determine the data content. Every bit has a transition in the middle. The scheme for reading data requires that this transition be found and the data level following the transition is read as a bit of data. It should be noted that transitions do not have to be present at a bit edge and must be ignored when they do occur. For this reason, once the bit time is known and a mid-bit edge found, a 2/3 bit-time wait must separate tests for the next mid-bit edge.

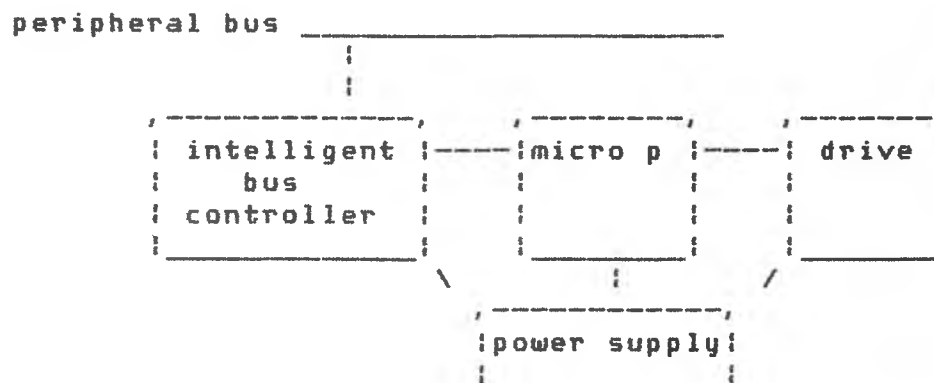


2.2 Product Configuration

The product will consist of one microtape controller/drive which connects to the ALC intelligent peripheral bus. Up to eight drives may be connected to the bus. Each drive on the bus must have a unique device code selected by two switches and a jumper inside the microtape cover. Device codes 1 through 8 in the Intelligent Peripheral Bus specification have been allotted for microtapes.

A microtape drive will consist of the following major parts:

- * Intelligent bus controller
- * 70C20 microcomputer
- * Drive electronics
- * Drive mechanics
- * Power supply



2.3 Data Format

Each microtape wafer will contain a file directory which will serve as an index to all files on the wafer. Each wafer will be able to support up to 16 active or inactive files. Each file will be represented in the directory by the the following information:

An active/inactive flag to indicate whether the file is active, deleted or superceeded.

A last/not last flag to indicate whether or not the file is

the last active file on the wafer. This also indicates the capacity to overwrite the file and/or open the file in certain modes.

A data type flag for internal or display format

The number of records contained in the file.

The length of the longest record in the file.

Each file has a filename associated with it. This filename occurs only in the file header record at the beginning of the actual file. The information in the directory is used to locate the beginning of each active file at which time the filename contained in the file header can be compared to the filename being searched for to determine if there is a match. This can be repeated until the file is found or a last file flag is found in the directory.

The first time a wafer is accessed, the directory is read into controller RAM. As various operations are performed on the wafer, the directory will be updated at certain points of access if the contents of the wafer are modified.

Each record in a file has a variable length format, and carries a 16 bit data length field. Each record in a file, including the file header record, contains the relative file number of the file as it occurs in the directory and the record number as it occurs in the file.

Every record on the wafer is separated from each adjacent record by a record gap which will provide for motor stop and start times between records. A synchronization data field will occur at the start of each record to indicate the beginning of valid data and provide tape speed calibration and acceptance.

At least 2 inches of tape on either side of the BOT/EOT mark must be regarded as unusable due to vendor assembly techniques.

2.4 General File Handling

Any currently non-existent file opened for output will become the last file on the wafer.

Any currently existing file opened for output will become inactive and will be recreated as the last file on the wafer.

If at any time the last file is deleted, the last file status will revert to the last active file. Any inactivated files following the last file will no longer be recognized and may be overwritten.

Any records contained in a file which is subsequently opened for output or deleted will become inaccessible to normal i/o operations. They must be transferred before the file becomes inactive if the application wants to keep them.

Example Of Data Format On Wafer

	! BOT MARK	! BEGINNING OF TAPE MARKER
	!-----	
!	! DEAD SPACE	! LEAVE 2" OF DEAD SPACE BY BOT
!	!-----	
Tape	! SYNC	!
Travel	!-----	! REV. 0 TO ALLOW DRIVES TO BE
!	! DIRECTORY REV. 0	! DOWNWARD COMPATIBLE
!	!-----	
!	! ACT/DISP/3/100	! 1ST: ACTIVE, DISPLAY,
	!-----	! 3 REC. S, 256 MAX REC LEN
	! INACT/DISP/3/F	! 2ND: INACTIVE, DISPLAY,
	!-----	! 3 REC. S, 15 MAX
	! ACT/INT/4/9	! 3RD: ACTIVE, INTERNAL,
	!-----	! 4 REC. S, 9 MAX
	! ACT/LST/DISP/4/F	! 4TH: ACTIVE, LAST FILE, DISPLAY,
	!-----	! 4 REC. S, 15 BYTES MAX
	!-----	
	!-----	! 4TH FILE WAS CREATED WHEN 2ND
	!-----	! FILE WAS OPENED FOR OUTPUT
	!-----	! AFTER 3RD FILE HAD BEEN CREATED.
		! THE 3 RECORDS IN THE 2ND FILE
		! MAY HAVE BEEN SAVED BEFORE THE
		! FILE WAS OPENED SO THEY COULD BE
	-----	! TRANSFERRED
	!	
	!-----	
	!	! END OF DIRECTORY SPACE
	!-----	
	! LONG SYNC	! LONG SYNC FOR REWRITING DIRECTORY
	!-----	
	! FILE1	! FILE NAME OF 1ST FILE
	!-----	
	! SYNC	!
	!-----	
	! RECORD #1	! 1ST RECORD OF 1ST FILE

SYNC	

RECORD #2	2ND RECORD OF 1ST FILE

SYNC	

RECORD #3	

SYNC	

FILE2	FILE NAME OF 2ND FILE

SYNC	

RECORD #1	1ST RECORD OF 2ND FILE

SYNC	

RECORD #2	EVEN THOUGH THIS FILE IS
-----	INACTIVE IT'S RECORDS AND
SYNC	FILE NAME REMAIN INTACT.
-----	THE DIRECTORY WILL NOT ALLOW
RECORD #3	THESE RECORDS TO BE ACCESSED
-----	BY NORMAL MEANS SINCE THE FILE
SYNC	MAY HAVE BEEN RECREATED
-----	ELSEWHERE
FILE3	FILE NAME OF 3RD FILE

SYNC	

RECORD #1	

SYNC	

RECORD #2	

SYNC	

RECORD #3	

SYNC	

RECORD #4	

SYNC	

FILE2	FILE NAME OF 4TH FILE

SYNC	

SECTION 3

Input/Output Interface

This section describes the software interface to the microtape functions. Specifically the actions taken for each valid I/O command code are described as well as such ancillary subjects as error codes.

3.1 Capabilities

Each wafer contains up to 16 files composed of one or more data records of varying lengths. Any record length up to 32767 bytes may be supported by the microtape as the data rate of the bus will exceed the data rate of the drive and the record need not be buffered in memory.

The group of records following a file header define a sequential file. Random record access is not supported. The last record written will define the end of file. Up to 4095 records may be written to a file. In the update mode, write operations must be followed by a restore (or a close and open) before a read can be done. A read operation may be followed by a write operation which will maintain the preceding part of the file read and set a new End Of File.

The microtape controller recognizes device codes 01 through 08 as indicated by the device select switches

3.2 Standard Command Actions

This section discusses the controller response to various command messages. Both standard and special command codes are discussed. The PAB construction examples show the use for the microtape subset of the I/O standards. The examples do not necessarily conform to the standards presented in the Peripheral Bus Specification. Differences for the microtape primarily consist of don't care fields in certain bytes of the PAB which have defined values for standard access. Fields which subset the standard are noted with an asterisk (*) in the examples.

Between commands a microtape drive will be idling, waiting for the next command. The motor will be stopped, the front panel LED will be off, and the bus interface will be enabled.

The following general actions take place in the microtape during every command:

- *Read device code and compare to microtape device number
 - if microtape selected, then continue
 - if not selected, then inhibit bus and wait next command
- *Test for wafer write protect and set flag
- *Read remainder of command PAB
- *Decode command and execute

3.2.1 Open - 00. This command code is used to initiate the use of a drive. The controller will check access modes and ensure that the drive is not already open. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	00
Logical Unit Number	don't care* (LUND)
Record number	don't care*(next returned)
Buffer length	>= 0004
Data length	>= 0004 (0004 returned)
Return status	(returned)
Buffer address	as required

The data buffer will contain the following which will be sent to the peripheral:

Buffer length (2 bytes) - the maximum requested record length for operations to the device.

Device attributes (1 byte)

Device characteristics (variable length) - file name, may contain string for name of file or a 1 or 2 digit unpacked bcd file number.

The following actions take place in the microtape during an OPEN command:

- *Read command data; buffer length, attributes
 - if any data is missing, then error
- *Read filename or number
 - if missing, then error

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        if filename data length gt 255, then error
        if filename data length gt 15, then truncate
        set flag for file by name or number
    *Check for valid directory present in controller ram
    *If no directory is present, load it
    *If no directory is found on the wafer, then error
    *If a file is already open on drive, then error
    *If not sequential file, then error
    *If not opening for input, then check for write protect
        if write protected, then error
    *Search for file or end of data
    *If the file is not found, then check access mode
        if output/append, then check number of files
            if room, then create new file, write file header
            if full, then error
        if update/input, then error
    *If the file is found then, check access mode
        if update, append, or input, then check file type
            if not same file type, then error
        if update or append, then check file position
            if last file, then continue
            if not last file, then error
        if input or update, then check buffer length
            if lt max record length, then error
            if ge max record length, then ok
            if eq zero, then return max record length
            if eq zero and mrl eq zero, then return 256
        if output, then check file position
            if last file, then recreate file
            if not last file, then check number of files
                if room, then locate wafer past last file,
                    create new file, write header,
                    inactivate old file, init mrl
                if full, then error
            if append or output, then check buffer length
                if eq zero, then return 256
                if ne zero, then maintain existing mrl
    *Test for EOT during OPEN
        if EOT found, then set EOT flag, reject record, error
    *Set restore flag
    *Set open flag
    *Reset print flag
    *Save attributes
    *Return buffer length, record number, and status

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The peripheral will accept any maximum record length since records need not be buffered in memory when they are written or read. If the requested record length is zero; asking for the default; then 256 is returned except in input mode. In input

mode the requested record length is compared to the maximum record length on the file. If the the maximum record length on the file exceeds that requested, then an error occurs. If the the length requested exceeds the length on the file then length requested is accepted. If a zero length is requested in input mode then the maximum length in the file header is returned. In update mode the maximum record length is not tested, this allows flexibility in data buffer use in the console but could cause a data length error if an INPUT is attempted. The device attributes byte contains flags used to indicate the access mode of the peripheral. Some bits are unused but should be set to zero to allow compatibility with future peripheral protocol enhancements. The bit definitions are as follows (bit 0 is the least significant bit).

7-6 - access mode

- 00 - append mode (write only, at end of file)
- 10 - output mode (write only)
- 01 - input mode (read only)
- 11 - update mode (read or write)

5 - relative(1)/sequential(0) (must be 0)

4 - internal(1)/display(0)

3-0 - don't care

Output mode specifies that data will only be written to the device and the "read data" command will not be used. Input mode specifies that data will only be read from the device and the "write data" command will not be used. Update mode means that data may be both read and written. A read operation cannot immediately follow a write operation in update mode, but must be separated by a restore. Bit 4 ignored, however, fixed length records may be written and read. This product and the associated peripherals will only support sequential files with variable length records.

The response buffer will contain the accepted/corrected buffer length and the next record number if there are no errors. Thus the response message for a successful open will be;

Data length	4
Data	Max. record length & record number
Operation status	0

An unsuccessful open will return a maximum record length and record number if the failure was related to the buffer length. If there was another type of error no data will be returned. The operation status byte may contain the following error codes:

- 00 - ok
- 01 - device characteristics error

02 - attributes error
03 - file not found
05 - file already open
06 - device error
08 - data/file too long
09 - write protect error
0B - too many files error
0C - buffer size error
50 - wafer full
51 - no directory found
52 - not last file for append or update
FF - time-out error

3.2.2 Close - 01. This command terminates the use of the device and rewrites the directory if necessary (after output mode or update mode with a write last). The data length for the close command will be zero (no command buffer is transmitted). The PAB should be set up as follows:

field	data
Device code	as required
Command Code	01
LUND	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	0000 (0000 returned)
Return status	(returned)
Buffer address	don't care*

The following actions take place in the microtape during a CLOSE command:

- *If no directory is in controller RAM, then error
- *If no file is open on drive, then error
- *If a file is open, then check access mode
 - if update, append, or output, then rewrite directory
- *Reset open flag
- *Return status

The response message will only contain a status byte and a zero data length (two bytes). The error status indications are;

00 - ok
04 - no file open
06 - device error
51 - no directory found
FF - time-out error

3.2.3 Close and Delete - 02. This command terminates the use of the device, attempts to delete the file and rewrites the directory if necessary (if the wafer is not write protected). The data length for the close and delete command will be zero (no command data is transmitted). The PAB should be set up as follows:

field	data
Device code	as required
Command Code	02
LUND	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	0000 (0000 returned)
Return status	(returned)
Buffer address	don't care*

The following actions take place in the microtape during a CLOSE command:

- *If no directory is in controller RAM, then error
- *If no file is open on drive, then error
- *If a file is open, then check WP status
 - if WP, then reset open flag and return error
 - if not WP, then inactivate file
- *If file was last, then find new last file
- *Rewrite directory
- *Reset open flag
- *Return status

The response message will only contain a status byte and a zero data length (two bytes). The error status indications are:

- 00 - ok
- 04 - no file open
- 06 - device error
- 09 - write protect error
- 51 - no directory found
- FF - time-out error

3.2.4 Read Data - 03. This command is used to request a data record from the wafer. The command message will contain a zero-length data field. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	03
LUND	don't care*
Record number	don't care*
Buffer length	max record length
Data length	0000 (length returned)
Return status	(returned)
Buffer address	as required

No data will be sent with the command message.

The following actions take place in the microtape during a READ DATA command:

- *If no directory is in controller RAM, then error
- *If no file is open on drive, then error
- *If output or append mode, then error
- *If EOF, then error
- *Read data length and record and transmit over bus
- *Return status

The response message will contain the data requested.

The record number field is ignored for this peripheral although others may use it.

The following error status codes may occur:

+M+ +T=11+

++F'

- 00 - ok
- 02 - attributes error
- 04 - no file open
- 06 - device error
- 07 - EOF error
- 0C - buffer size error
- 0F - read in write only mode
- 19 - data error
- 51 - no directory found
- FF - time-out error

The device error will occur if the record sync data is not found before the BOT mark is sensed. Valid records will not coincide with the EOT/BOT mark being sensed, or occur between the EOT/BOT mark and the directory as this is detected during WRITE DATA and would not be valid.

3.2.5 Write Data - 04. This command is used to send a data record to the device. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	04
LUND	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	record length (0000 returned)
Return status	(returned)
Buffer address	as required

Data will be sent after the command PAB assuming the data length was non zero.

The following actions take place in the microtape during a WRITE DATA command:

- *If no directory is in controller RAM, then error
- *If no file is open on drive, then error
- *If input mode, then error
- *If EOT flag is set, then error
- *Receive and write record
- *Test for EOT during WRITE DATA
 - if EOT found, then set EOT flag, reject record, error
- *Replace number of records count with current record number
- *Compare DL of record to maximum record length (MRL)
 - if DL is greater than MRL, then replace MRL with DL
- *Return DL of 0, status

The response message will contain zero-length data and the operation status. The following error status codes may occur:

- 00 - ok
- 02 - attributes error
- 04 - no file open
- 06 - device error
- 0E - write in read only mode
- 50 - wafer full
- 51 - no directory found
- FF - time out

The "Wafer Full" error will occur if the EOT marker is sensed while writing the data or while the motor is winding down.

3.2.6 Position to Record - 05. This command is used to position the wafer to a particular record of the currently open file. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	05
LUND	don't care*
Record number	as required
Buffer length	don't care*
Data length	0000 (0000 returned)
Return status	(returned)
Buffer address	don't care*

The wafer is repositioned at the beginning of the record indicated in the record number field in the PAB or at the EOF if the record indicated can not be found.

The following actions take place in the microtape during a RESTORE/ REWIND command:

- *If no directory is in controller RAM, then error
- *If no file is open on drive, then error
- *Check access mode
 - if append, then error
- *Search for record indicated
 - if the wafer is cycled and file is not refound, then error
 - if the record is not found, then position to EOF, error
- *If at first record, then set restore flag
- *Return status

The response message will contain zero-length data and the operation status. The following error status codes may occur:

- 00 - ok
- 02 - attribute error
- 03 - file not found
- 04 - no file open
- 06 - device error
- 07 - EOF
- 51 - no directory found
- FF - time out

A file not found error may occur if the wafer needs to be cycled and the file can not be found again

3.2.7 Delete - 06. This command deletes a file from the wafer. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	06
LUND	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	>=0001 (0000 returned)
Return status	(returned)
Buffer address	as required

The following data is sent in a DELETE command:

Device characteristics (variable length) - file name, may contain string for name of file or a 1 or 2 digit unpacked bcd file number.

The following actions take place in the microtape during a DELETE command:

- *If no directory is in controller RAM, then error
- *If a file is open, then error
- *Read filename or number
 - if missing, then error
 - if filename data length gt 255, then error
 - if filename data length gt 15, then truncate
 - set flag for file by name or number
- *Search for file
- *If file not found, then error
- *If file found, then inactivate file
- *If file was last, then find new last file
- *Rewrite directory
- *Return status

The response message will contain zero-length data and the operation status. The following error status codes may occur:

- 00 - ok
- 03 - file not found
- 05 - file already open
- 06 - device error
- 09 - write protect
- 51 - no directory found
- FF - time out

3.2.8 Return Status - 07. This command is used to return device status information. The information is returned in the data

buffer. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	07
LUND	don't care*
Record number	don't care*
Buffer length	>= 0001
Data length	0000 (>=0001 returned)
Return status	(returned)
Buffer address	as required

The bit fields in the return data are as follows (bit 0 is the least significant bit).

- 7 - end of file has been reached
- 6 - random access supported (zero returned)
- 5 - file is protected (zero returned)
- 4 - file/device open
- 3-2 - device type (01 returned)
 - 0 - display type
 - 1 - storage type
 - 2 - undefined
 - 3 - undefined
- 1-0 - I/O modes (11 returned)
 - 1 - read only
 - 2 - write only
 - 3 - read/write

The return status call must normally be proceeded by an open call. If it is not preceded by an open call than the returned value in bit 4 will be zero. The following error status codes may be returned

- 00 - ok
- FF - time out

3.2.9 Verify - OC. This command is used to verify a data record written to or read from the microtape peripheral. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	OC
LUND	don't care*
Record number	as required
Buffer length	don't care*
Data length	record length (0000 returned)
Return status	(returned)
Buffer address	as required

Data will be sent after the command pab assuming the data length was non zero.

The following actions take place in the microtape during a VERIFY command:

- *If no directory is in controller RAM, then error
- *If no file is open on drive, then error
- *Search for record indicated
 - if the wafer is cycled and file is not refound, then error
 - if the record is not found, then position to EOF, error
- *Receive and compare record
- *If any differences are found in dl or data, then error
- *Return status

The response message will contain zero-length data and the operation status. The following error status codes may occur:

- 00 - ok
- 04 - no file open
- 06 - device error
- 07 - EOF
- FF - time out

3.2.10 Null - FE. This is a dummy command and should be ignored by all devices. No data will be sent and if a device is caught waiting for it, that device is a dummy! The PAB should be set up as follows:

field	data
Device code	00
Command Code	FE
LUNO	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	0000
Return status	(none returned)
Buffer address	none

The only response to a NULL command is to inhibit bus communication until the next message. The transmitter will time out

3.2.11 Reset - FF. This command causes all devices on the bus to close any and all open files. No response will be returned since all devices execute this command. The data length for the close command will be zero (no command buffer is transmitted). The PAB should be set up as follows:

field	data
Device code	as required
Command Code	FF
LUNO	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	0000
Return status	(none returned)
Buffer address	don't care*

The following actions take place in the microtape during a RESET command:

- *If no directory is in controller RAM, then inhibit bus
- *If no file is open on drive, then inhibit bus
- *If a file is open, then check access mode
 - if update, append, or output, then rewrite directory
- *Reset open flag
- *Inhibit bus

There will be no response to a RESET command. The transmitter will time out.

3.2.12 Format Wafer - 0D. This command code is used to initialize a wafer before data is written. It is also useful if

garbage on the tape has caused trouble detecting the record sync data. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	0D
LUND	don't care*
Record number	don't care*
Buffer length	don't care*
Data length	0000 (0000 returned)
Return status	(returned)
Buffer address	as required

This command will write a tape header showing zero records on the tape.

The following actions take place in the microtape during a FORMAT command:

- *If a file is open, then error
- *If write protected, then error
- *Initialize directory in the controller RAM, no active files
- *Write the directory to the wafer
- *Return status

The response message will contain zero-length data and the operation status. The following error status codes may occur:

- 00 - ok
- 06 - device error
- 09 - write protect
- FF - time out

If the BOT mark cannot be found then the device error (06) status code will be returned.

3.2.13 Read Catalog - OE. This command will read the directory and the file headers and return the file information therein. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	OE
LUNO	don't care*
Record number	file number
Buffer length	>= 0016
Data length	0000 (0016 returned)
Return status	(returned)
Buffer address	as required

The following actions take place in the microtape during a READ CATALOG command:

- *Check for valid directory present in controller ram
- *If no directory is present, load it
- *If no directory is found on the wafer, then error
- *If a file is already open on drive, then error
- *Search for file specified in record number field
 - if file not found, then error
- *If buffer length less than 22, then error
- *Read file header, return file number and file name
- *Pad file name to 15 characters with trailing zeros
- *Return number of records
- *Return maximum record length
- *Return flags (active, last, EOT, file type)
- *Return status

The data buffer returned will contain the following information.

File number	1 byte
File name	15 bytes
Number of records	2 bytes
Maximum record length	2 bytes
Flags	2 bytes

The following error status codes may occur.

- 00 - ok
- 03 - file not found
- 05 - file already open
- 06 - device error
- 0C - buffer length error
- FF - time out

3.2.14 Unsupported Commands.

After the PAB has been read, if the command is determined to be unsupported, the microtape will wait until the bus becomes idle and then return a data length 0000 and status 0D.

SECTION 4

Stringy Floppy Utilities

Utilities will be provided for backing-up wafers, testing drives and wafers, and other functions as needed. The utilities will be supplied on a microtape wafer provided with the controller/drive. The utilities are written in assembly language and execute in the calculator RAM memory. The special I/O calls described above will be used by the utilities.

4.1 Operation

The utilities are invoked from the BASIC interpreter with the following.

```
LOAD 10 (or drive containing the utilities)
RUN
```

When the utilities begin the display will show;

```
MICROTAPE UTILITIES V:1.0
```

This will be displayed for 4 seconds or until a key is pressed. Then the main prompt is displayed.

```
Back-up, . . . . , Quit
```

The user will enter the first letter of the desired command and the utilities will prompt for further information.

4.1.1 Back-up.

The software will prompt for the device number and ask the user for verification.

```
enter source device number:
enter destination device number:
verify back-up ss to dd (enter)
back-up begun
complete; n files
```

4.1.2 Quit.

SECTION 5

Implementation Overview

Each open file requires certain information to be maintained in the local processor memory. The memory information block for an open file consists of the following:

item		
Current file flags		1 byte
Directory present flag	bit 7	
Wafer write protect flag	bit 6	
Filename/filenumber flag	bit 5	
File open flag	bit 4	
File/record/eot found	bit 3	
File restored flag	bit 2	
EOF flag	bit 1	
Error flag	bit 0	
Device attributes	1 byte	(described in OPEN)
Permanent file flags	5 bytes	
Active flag	bit 15	
Last file flag	bit 14	
EOT flag	bit 13	
File type flag	bit 12	
Number of records in file	1.5 bytes	(bit 11 - 0)
Current record number	2 bytes	
Maximum record length in file	2 bytes	
Current file number	1 byte	

The current file flags are changed and tested on a command to command basis and, for the most part, apply to the currently open file. The permanent file flags refer strictly to one file and are kept in the directory when that file is not open and will be written onto the wafer as a part of the directory.

SECTION 6

Issues

6.1 Open Command

The issues here are error handling; specifically

1. Does sending device characteristics cause an error or are they ignored?

6.2 Utilities

What other utilities should be included?