Advanced Language Calculator
Microtape Peripheral
Design Specification

Consumer Products Group
Calculator Division

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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 afford 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.

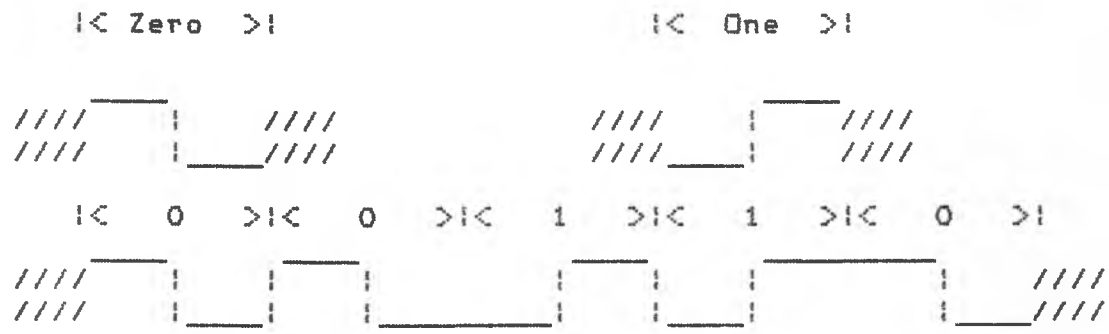
SECTION 2

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 called a wafer. The wafers vary in length from 5 to 75 feet. Tape speed is about 8 inches per second and the motor only runs during wafer access. Data density amounts to about 1.5K bytes per foot. However, the capacity of a wafer is reduced significantly by a file diectory, synchronization patterns preceeeding data records and motor start/stop time . considerations. Thus the maximum access time and the amount of data storage can be traded off 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. The data level read from the wafer will be the inverse of what was written so that the logic levels written must be the inverse of the desired read waveform. 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.

Read Data Patterns: high to low mid-bit transition is a 0
low to high mid-bit transition is a 1



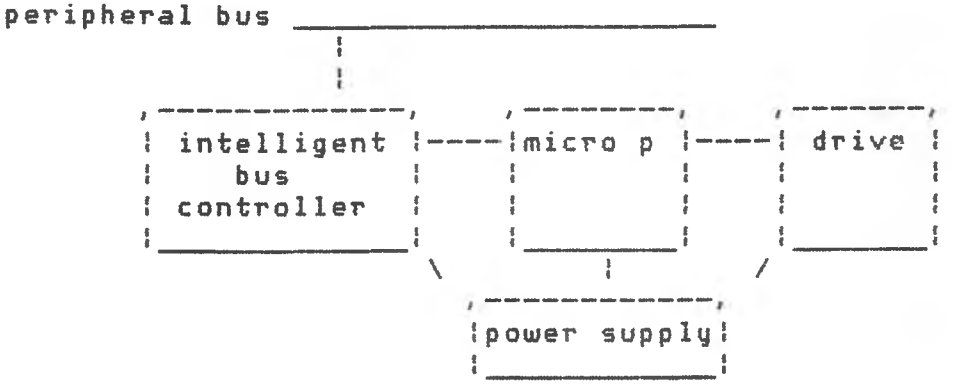
```
        |------*  |------*  |------*  |------*
* timer interrupts every 2/3 of a bit-time starting from a mid-bit
    (the interrupt occurs 1/6 of the way into every bit)
```

2.2 Product Configuration

The product will consist of one microtape controller/drive which connects to the ALC intelligent periperal 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 alloted for microtapes.

A microtape drive will consist of the following major parts:

* 70C20 microcomputer
* Drive electronics
* Drive mechanics
* Intelligent bus controller
* 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. For an existing active file to be opened in the update mode, it must be the last file on the wafer.

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 be repeated until the file is found or a last file flag is found in the directory.

The first time a file is accesssed, the directory is read into controller RAM. As various operations are performed on the file, 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 ordered number of the file as it occurs in the directory and the ordered number of the record 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.

Wafers may write protected by removing a reflective sticker on the cover of the wafer. The presence of this sticker is

detected by software to control whether or not the wafer may be written to.

2.4 General File Handling

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

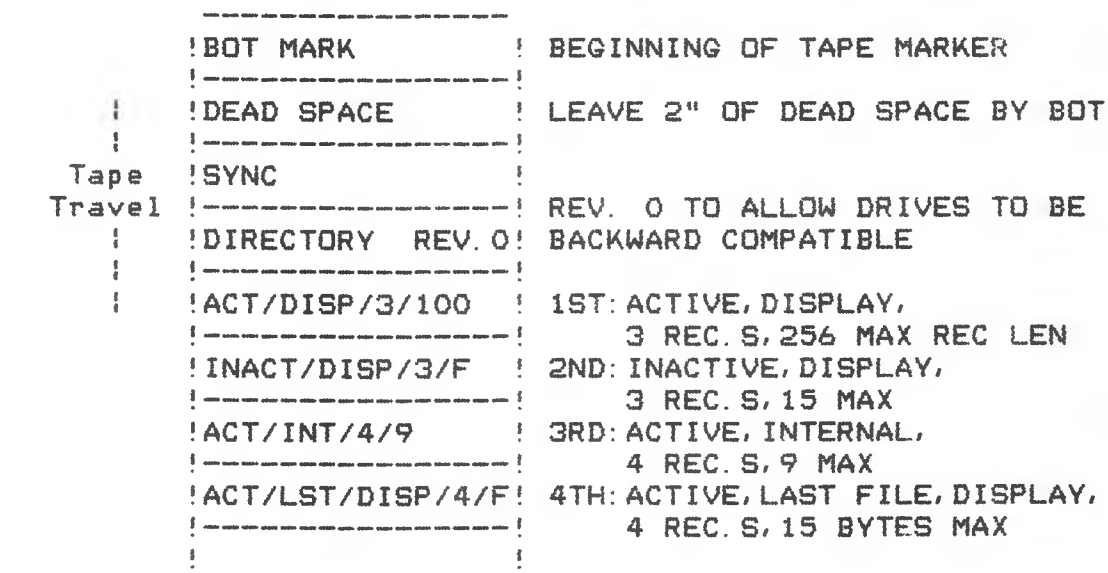
Any currently existing file opened for output will become inactive and will be recreated as the last file on the wafer.

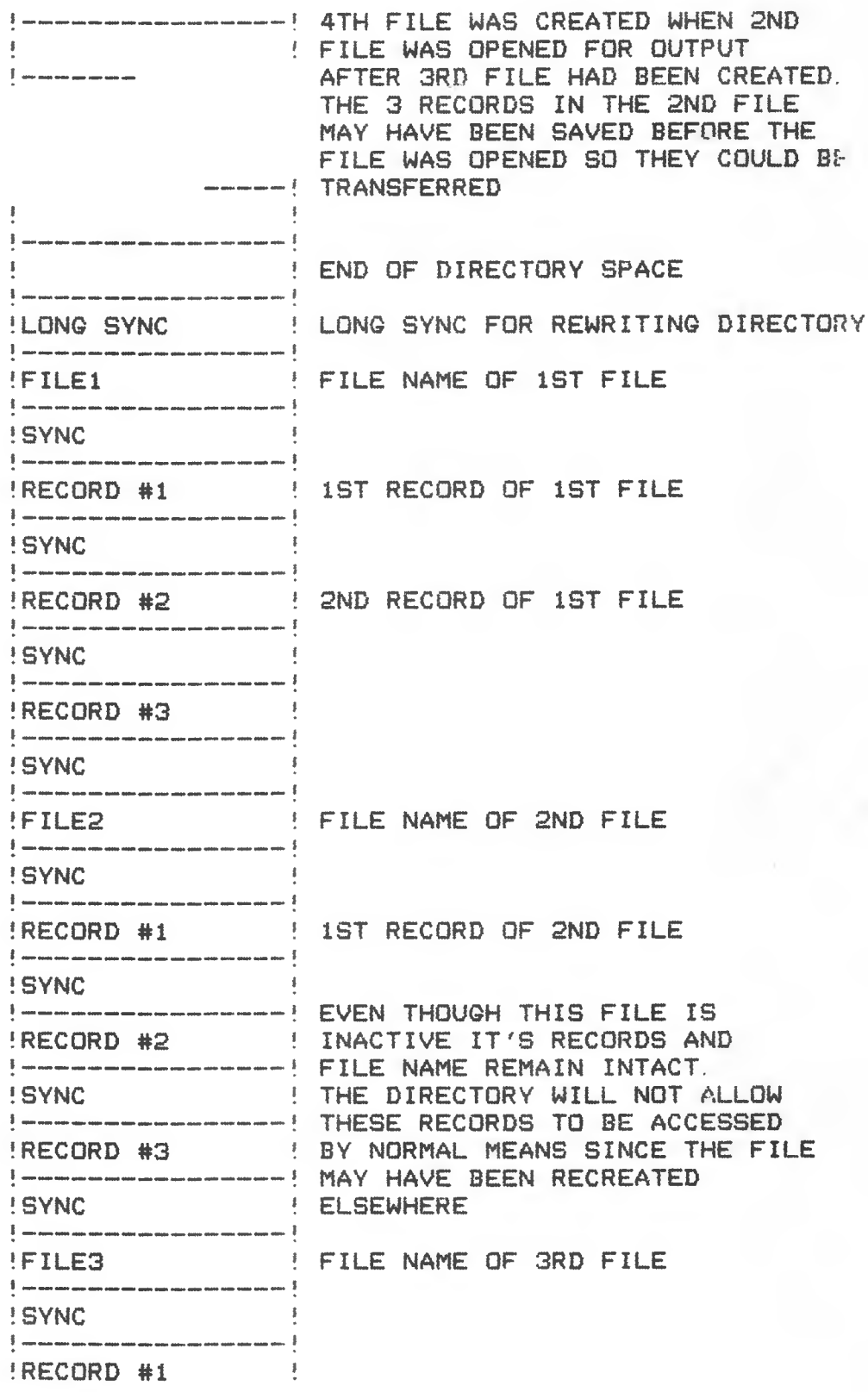
If at any time the last file is deleted, the last file status will revert to the last active file. Any inactivated files following the last active file will no longer be recognized and may be overwritten.

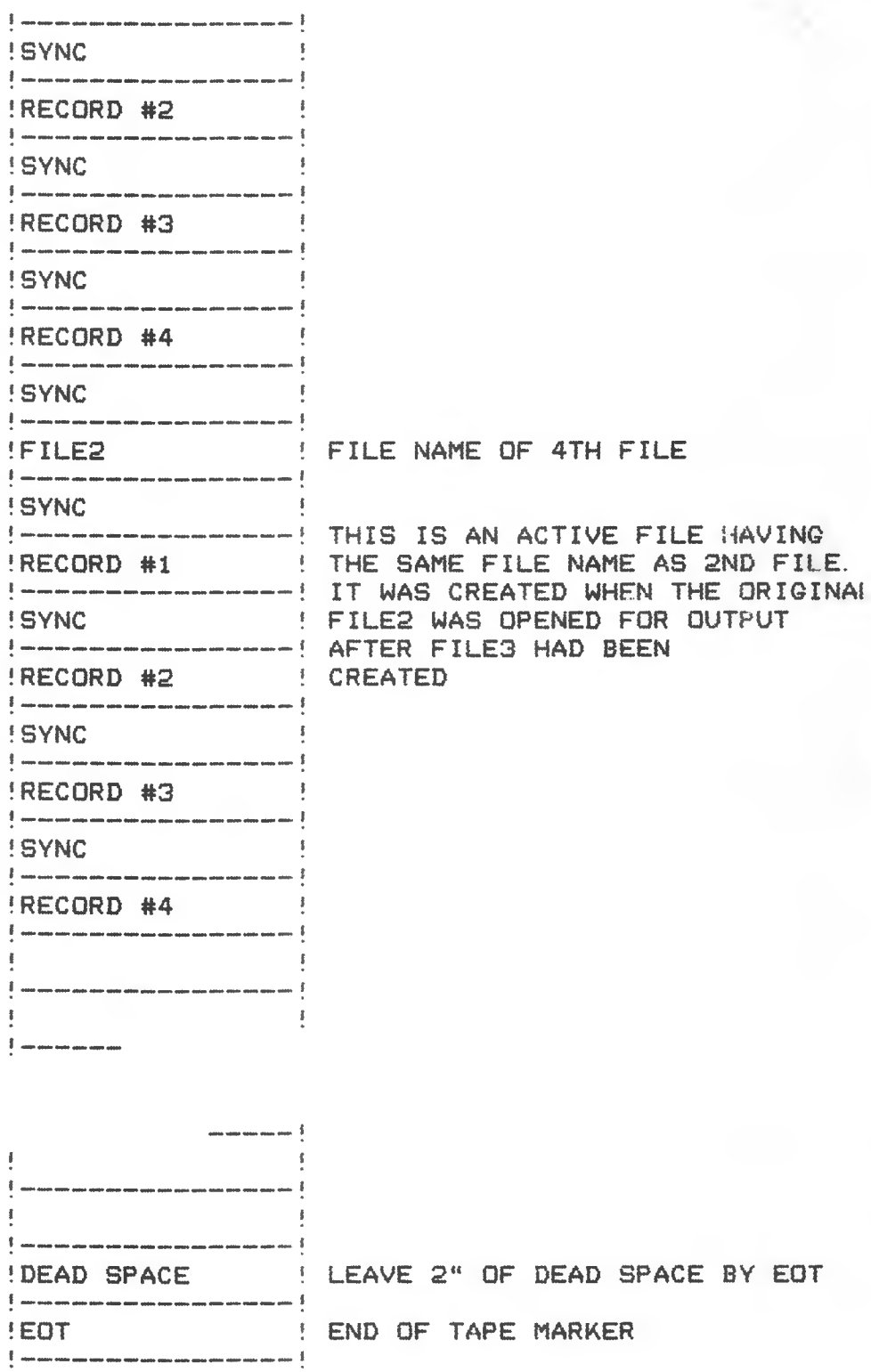
Any records contained in a file which is subsequently opened for output or deleted will become inaccessible to normal I/O operations. They must be transferred before the file becomes inactive if the application wants to keep them.

Inactivated files may be opened by file number and the data records may be read if the file occurs before the last active file. Inactive files may never be opened by file name since the same name may occur later in an active file.

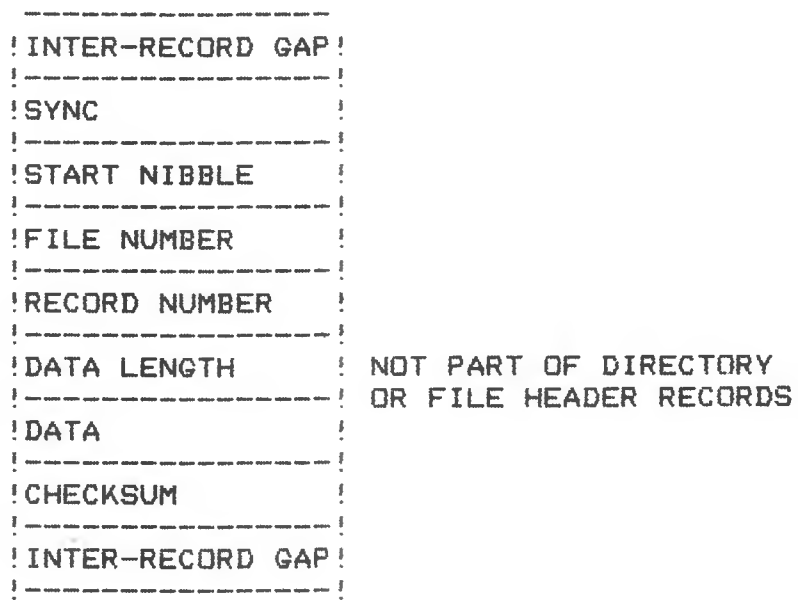
Example Of Data Format On Wafer




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
SYNC
RECORD #3
SYNC
EVEN THOUGH THIS FILE IS INACTIVE IT'S RECORDS AND FILE NAME REMAIN INTACT. THE DIRECTORY WILL NOT ALLOW THESE RECORDS TO BE ACCESSED BY NORMAL MEANS SINCE THE FILE 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
RECORD #1
THIS IS AN ACTIVE FILE HAVING
THE SAME FILE NAME AS 2ND FILE.
IT WAS CREATED WHEN THE ORIGINAL
FILE2 WAS OPENED FOR OUTPUT
AFTER FILE3 HAD BEEN
CREATED
SYNC
RECORD #2
SYNC
RECORD #3
SYNC
RECORD #4
DEAD SPACE
LEAVE 2" OF DEAD SPACE BY EOT
EOT
END OF TAPE MARKER

Individual Record Structure



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. In update mode, a read 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, waitng 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:

*Initialize interrupts and stack, reset drive controls
*Enable bus communication at start of next message
*Wait for SOM
*Turn on sensors and LED
*Read device code and compare to microtape device number
    if microtape selected, then continue
    if not selected, then restart sequence
*Read remainder of command PAB
*If NULL command, then restart sequence
*Test for wafer write protect and set flag
*Decode command and execute
*If unsupported command, then ERROR 13

*If, while reading, the drive loses its position on the wafer, then ERROR 6
*If, while writing, the end of tape mark is detected, then ERROR 32

3.2.1 Open - 00. This command code is used to initiate access to a paricular file on a drive. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	00
Logical Unit Number	don't care* (LUNO)
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 (vaiable length) - file name, may

contain string for name of file or a 1 digit hexadecimal 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 1
*Read filename or number
    if missing, then ERROR 1
    if filename data length gt 12, then ERROR 1
    set flag for file by name or number
*If a file is already open on drive, then ERROR 5
*Load directory from wafer
*If no directory is found on the wafer, then ERROR 26
*If not sequential file, then ERROR 2
*If opening for append, then ERROR 2
*If not opening for input, then check for write protect
    if write protected, then ERROR 9
*Search for file or end of data
*If the file is not found, then check access mode
    if output/update, then check number of files
       if room, then create new file, write file header
       if full, then ERROR 11
    if input, then ERROR 3
*If the file is found then, check access mode
    if update or input, then check file type
       if not same file type, then ERROR 23
    if update, then check file position
       if last file, then continue
       if not last file, then ERROR 80
    if input or update, then check buffer length
       if bl lt max record length, then ERROR 12
       if bl ge max record length, then ok
       if bl eq zero, then check max record length
           if mrl eq zero, then return 256
           if mrl not zero, then return mrl
    if output, then check file position
       if last file, then continue
       if not last file, then check number of files
           if room, then create new file, write header,
                    inactivate old file, init mrl
           if full, then ERROR 11
    if output, then check buffer length
       if bl eq zero, then return 256
       if bl ne zero, then maintain existing mrl
*Test for EOT while writing file header
    if EOT found, then set EOT flag, reject record,
                  dont open file, ERROR 32
*If new file was created, then set new last flag,
```

```
                                    set file type flag
   *If bl gt 32767, then ERROR 8
   *Set open flag
   *Save attributes
   *Return buffer length, record number, and status
```

The peripheral will accept any maximum record length up to 32767 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 of 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. 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. This product and the associated peripherals will only support sequential files with variable length records. Only input and update modes check the file type bit of an existing file. Opening an existing file for output allows the file to be recreated for any data type.

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 e type of error no data will be returned. The operation status byte may contain the following error/status 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 (11)
0C - buffer size error (12)
17 - wrong file type (23)
1A - no directory found (26)
20 - wafer full (32)
50 - not last file for append or update (80)
FF - time-out error (255)

3.2.2 Close - 01. This command terminates access to a file and rewrites the directory if necessary (after output or update mode). The PAB should be set up as follows:

field	data
Device code	as required
Command Code	01
LUNO	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 file is open on drive, then ERROR 4
*Reset open flag
*If update, or output mode, then check write protect flag
    if not write protected, then rewrite directory
    if write protected, then ERROR 9
*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
FF - time-out error (255)

3.2.3 Delete Open - 02. This command terminates access to a file, attempts to delete the file and and rewrite the directory (if the wafer is not write protected). The PAB should be set up as follows:

field	data
Device code	as required
Command Code	02
LUNO	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 DELETE OPEN command:

*If no file is open on drive, then ERROR 4
*Reset open flag
*If write protected, then ERROR 9
*Inactivate file
*If file was last, then find new last file
*Rewrite directory
*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
FF - time-out error (255)

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

field	data
Device code	as required
Command Code	03
LUNO	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 file is open on drive, then ERROR 4
*If output mode, then ERROR 15
*If EOF, then ERROR 7
*Read data length and data and transmit over bus
*If there is a checksum mismatch, then ERROR 16
*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,

00 - ok
04 - no file open
06 - device error
07 - EOF error
0F - read in write only mode (15)
10 - data error (16)
FF - time-out error (255)

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 allowed.

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

field	data
Device code	as required
Command Code	04
LUNO	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 file is open on drive, then ERROR 4
*If write protected, then ERROR 9
*If input mode, then ERROR 14
*If data length is too big, then ERROR 8
*Receive and write record
*Test for EOT during WRITE DATA
    if EOT found, then set EOT flag, reject record,
                close file, ERROR 32
*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 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
08 - data too long
09 - write protected
0E - write in read only mode (14)
20 - wafer full (32)
FF - time out error (255)

The "Wafer Full" error will occur if the EOT marker is sensed any time the motor is running during a write operation.

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

field	data
Device code	as required
Command Code	05
LUNO	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 wafer is positioned to access the first record of an open file.

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

*If no file is open on drive, then ERROR 4
*Save file number
*If not write protected, then rewrite directory
*If write protected, then poition to beginning of wafer
*Search for file by number
*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
FF - time out (255)

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
LUNO	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 (vaiable length) - file name, may contain string for name of file or a 1 digit hexadecimal file number.

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

```
*Read filename or number
    if missing, then ERROR 1
    if filename data length gt 12, then ERROR 1
    set flag for file by name or number
*If a file is open, then ERROR 5
*If write protected, then ERROR 9
*Search for file
*If file not found, then ERROR 3
*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
01 - characteristics error
03 - file not found
05 - file already open
06 - device error
09 - write protect
FF - time out error (255)
```

3.2.8 Return Status - 07. This command is used to return device status information. to the data buffer. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	07
LUNO	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 preceeded 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 - 0C. 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	0C
LUNO	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 VERIFY command:

*If no file is open on drive, then ERROR4
*If EOF, then ERROR 7
*Read wafer and compare to bus data received
*If data length not same, then ERROR 24

*If data mismatch, then ERROR 24
*If checksum mismatch, then ERROR 16
*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 error
10 - data error (16)
18 - verify error (24)
FF - time out error (255)

3.2.10 Format Wafer - OD. This command code is used to initialize a wafer before data is written. The PAB should be set up as follows:

field	data
Device code	as required
Command Code	OD
LUNO	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 5
*If write protected, then ERROR 9
*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
05 - file already open
06 - device error
09 - write protect

FF - time out error (255)

3.2.11 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	>= 0012
Data length	0000 (0012 returned)
Return status	(returned)
Buffer address	as required

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

*Set file name number flag to number
*If a file is already open on drive, then ERROR 5
*If file number in PAB is 0, then read directory
*Find file by number, read file name from header
*If file not found, then ERROR 3
*Position to end of file
*If buffer length is lt 18, then ERROR 12
*Return data length of 18
*Return file number
*Return file name
*Return maximum record length
*Return number of records
*Return flags (active,last,file type)
*Return status

The data buffer returned will contain the following information.

File number	1 byte
File name	12 bytes
Number of records	2 bytes
Maximum record length	2 bytes
Flags	1 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 (12)
FF - time out error (255)

3.2.12 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	as required (usually 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

3.2.13 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 commandd. The PAB should be set up as follows:

field	data
Device code	as required (usually 00)
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	none

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

*If no file is open on drive, then end command
*Reset open flag
*If update, or output mode, then check write protect flag
if not write protected, then rewrite directory

```
        if write protected, then ERROR 9
    *Inhibit bus
```

There will be no response to a RESET command. The transmitter will 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 (13).

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 magic words:

```
OLD (n.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, Go directly to jail, Take 2 giant steps forward, Insert
tab A into slot B, Watch out where the huskies go, Don't you eat
that yellow snow, Take the rest of the day off
```

The user will enter the first three and a half letters 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

File management requires certain information to be maintained in the local processor memory. The memory information block consists of the following:

item		
Current file flags	1 byte	
EOF flag	bit 7	
Error flag	bit 6	
Write protect flag	bit 5	
File open flag	bit 4	
File/record found flag	bit 3	
EOT flag	bit 2	
File reference flag (name/#)	bit 1	
Unused	bit 0	
Device attributes	1 byte	(described in OPEN)
Permanent file flags	.5 bytes	
Active flag	bit 15	
Last file flag	bit 14	
Unused	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 handling an 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

p1/(Utilities) What other utilities should be included? Mud wrestling