X3T9.2/87-141

ENDL

August 12, 1987

To: X3T9.2/X3T9.3 Members

Subject: ESDI Document X3T9.3/87-005

The following is a copy of the letter received from Tom Wicklund of Ciprico which contains his list of recommendations to Rev 1.3.

Fortunately or unfortunately, I did not take a copy before I wrote all my comments as I was editing. The items which are ticked have been included in the document without committee discussion as they were, in my opinion, editorial in nature.

Two items need committee action:

o optical disk identification was raised by Donna Pope of Optimem at the Vancouver meeting and I am expecting a proposal from her on this subject.

o optical operations for erasure controls, offsets etc need to be discussed in general terms as to what we wish to do.

Update pages for those areas which had what I consider to be technical changes (including Jim Whitworth's proposal in Vancouver plus the connector drawings provided by AMP) are attached. As each page has two document pages, you must look to the heading as identifying Rev 1.4.

A copy of Rev 1.4 in its entirety but without change bars is at the meeting so that we have a clean copy of the latest document for plenary action to forward to X3T9 for letter ballot and public review.

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Comments on Revision 1.3 of the ESDI standard:

For all status and configuration response words in section 7, I suggest that fields which read "Reserved" be changed to "Reserved = 0" to make it explicit that all unused response fields must be zero. This ensures that somebody who doesn't read the standard cover to cover doesn't make a wrong assumption.

In addition, on page 7-5, section 7.3, add the comment "All reserved fields returned by the drive shall be set to zero by the drive". I can't find words to that effect in the standard, though it's implied.

Page 7-4, Table 7-3, the Set Configuration command entry should add "No" under the last two columns to be consistent with the rest of the table.

Page 7-10, table 7-7, under bit 10, capitalize "has".

Page 7-14, table 7-11B, "Rotational Speed" should be defined. At least change the text to read "Rotational Speed (RPM)". This is also true of table 7-13.

Page 7-14, table 7-11B, Notched drive data (subscript 12). This might be clearer if reworded to "Tracks in Current Zone" and "Sectors per Track, Current Zone". I believe these values change when a new zone is set.

Page 7-19, Table 7-13, I notice that read only optical disks are not one of the general configuration options. In addition, returning the drive type in the configuration word creates problems with drives which handle multiple types of media. I suggest that the configuration response be changed to return which types of media are supported (read only, WORM, erasable). Also add a status response to return the current media type.

These additions should allow for several new media types as optical is a very young industry.

There are enough unused bits in the General Configuration to list four drive types (bits 8 to 11) or subscript 2 could be used. A bit encoded list of allowed media types seems reasonable.

The status response could be bits 11 and 12 of Optical Standard Status, though this limits you to 4 optical media types. Better would be a new status word. The controller uses this in conjunction with Media Type Has Changed (bit 10 of standard status).

Page 7-23, Table 7-19, All commands except Reset Interface should be labeled as optional. The motor control commands are optional depending on a general configuration bit. Eject cartridge doesn't mean anything if a drive only has a manual eject. Erasure and Magnet controls don't mean anything on read only or WORM disks, and Spiral Operation seems like an optional feature.

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On the same page, Erasure Controls are specified as subscripts off one command while Magnet Controls are separate commands. It would be more consistent if both were subscripts or both were individual commands.

At the bottom of Table 7-19 is a note that Spiral Operation is time dependent relative to end of track. It isn't clear what is meant by this. My understanding is that the time dependency is whether a revolution is lost before the command takes effect.

Also, low cost ESDI implementations can require a significant amount of time to send a serial command (.5ms to 1ms on some existing drive / controller combinations). Add drive firmware overhead and this may mean 10% of rotation time. This won't be obvious when using a drive and more text may be useful.

Page 7-25, table 7-23, the addition of subscripted offsets creates a practical problem in recovering marginal data. As currently defined, a controller does not know the number of offsets possible for a given drive. In order to try all combinations of track offset, data offset, and laser power adjust in the most general case, the controller must try 511 cubed cases, or 133 million cases. For a 3600 RPM disk, this takes over 25 days. The controller designer needs to know when to quit trying offsets or the controller must keep trying for the full 25 days to ensure that the data is truely unrecoverable.

I suggest one of the following be done:

- Add new configuration words specifying the number of each type of offset available. If this number varies depending on the type of controller installed, the configuration response could change.

- Return "Invalid command" when setting too large an offset with subscripts. The controller would then give up on larger values of this offset.

Page 7-27, section 7.18, this should be divided into several subsections. For example, on page 7-28 the discussion of notched drives proceeds to comments on soft switch modifiers. When I first read this I assumed these modifiers were still talking about notched drives. Separate sections for each class of set configuration (vendor unique, synchronization, and notched drives) will be clearer.

Page 7-27, the note about configurable notched drives being identified by x'FF' should be moved to a section after table 7-11B.

Page 7-27, section 7.18, fourth paragraph, second line, a space is required after "this" before the left parenthesis and "selcted" should be "selected".

Page 7-28, table 7-29, the two valid switch parameters for synchronized masters should be explicitly listed. The valid values are currently buried in the text where they are not obvious. Alternately, change the text for this entry to "Set Synchronized Master or Slave". When I scanned the table I was left with the impression that you could only set a drive as a master.

Page 7-27 and 7-28, the original notched drive proposal is still present. I thought two of these commands (Set tracks / zone and set sectors / track) were going to be removed. I see two problems with them:

1. Set Tracks / Zone -- this implies a very flexible notched drive implementation. At the last ESDI meeting this was argued against. In addition, as written this is very ambiguous. Does

this set the number of tracks per zone for all zones on the drive, or for the current zone? If the latter, a procedure for setting up a drive must be given or computing the start cylinder of each zone isn't possible.

2. Set Sectors / Track -- This is inconsistent with the rest of the standard. For non-notched drives, the controller sets unformatted bytes per sector and the drive returns the sectors per track it decided to give the controller. If both commands are present there are ambiguities in the setup of notched drives. Which takes precedence, this command or an earlier set unformatted bytes per sector? What is the procedure for setting up a drive? If different drive vendors use different procedures, general controller implementation becomes impossible.

Page 8-2, section 8.2.7, the new subscript describing write propogation delay should be referenced.

Page 8-7, section 8.3.6, the high speed port requirement of alternative 2 should be documented.

Should the format alternatives be renumbered so that glitching write gate is alternative 1? This will become the required form for high speed controllers, and probably become the only form used in new designs.

Good Idea

Pages ~~10-8~~ 10.10 and 10-9, note 2 is not applicable (only applies to write timing). It should be dropped, possibly renumbering the notes on these figures and the next two.

Appendix A, defect list, especially with defect lists longer than 256 bytes, the following should be added:

> "The controller should set unformatted bytes per sector to a value larger than the defect list sector size in order to successfully read the defect list."

In addition, there is no comment about interactions between notched drives and the defect list. Since I never tell the drive whether I'm doing a defect list read or a data read, I suggest adding the following to ensure the proper data rate is used:

> "In a Notched Drive, the controller must set Zone 0 before attempting to read the defect list."

Appendix A, fifth paragraph, the initial word "The" should be removed, so the sentence reads:

> "Sector 0 of each surface will contain the defects for that surface only."

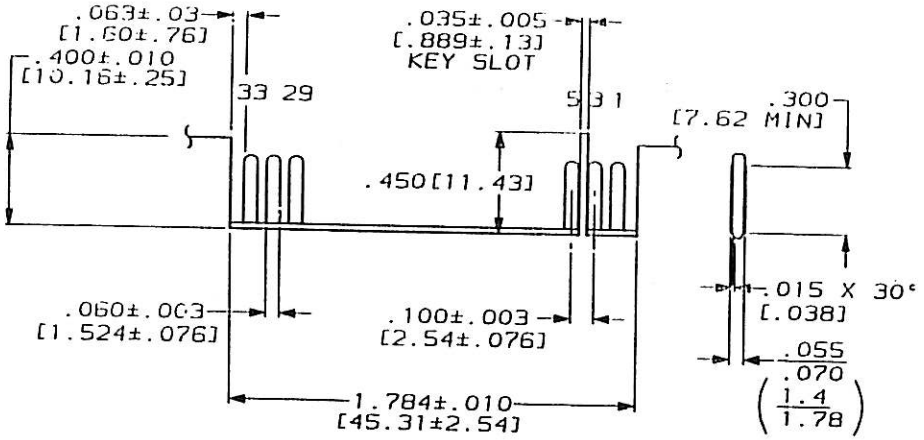
Appendix A, the following was agreed to in the last ESDI meeting and should be added under rules for reading and writing:

> o Header and data fields are recorded (and read) most significant bit of each byte first.

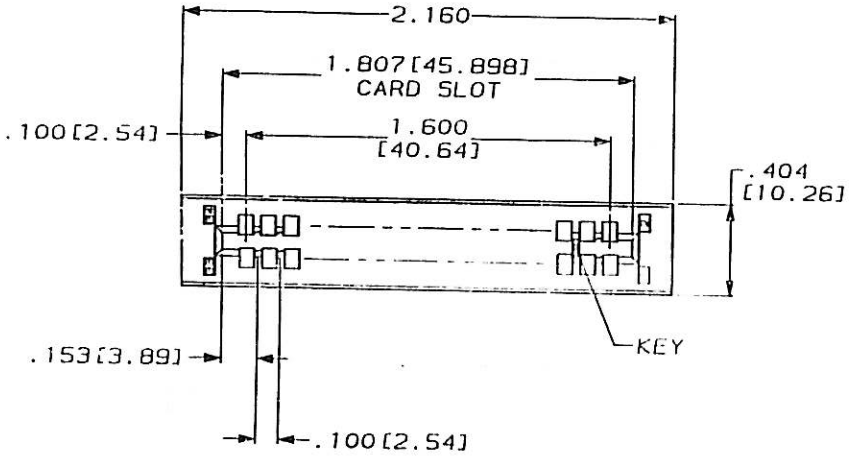
Appendix A, year field of the defect list, since the year 2000 is fairly close and ESDI will probably still be used then, change the definition of the year to be "year - 1900". It also isn't clear that the x'52-xx' currently shown means 1982 as the base year.

Page App-20, table G-1, remove the low speed port entries for data rates >15MHz and high speed port for entry for 5MHz. These data rates aren't allowed by the standard.

Page App-23, second to the last paragraph, move the text starting "e.g." to the next paragraph, starting it "For example, ...".

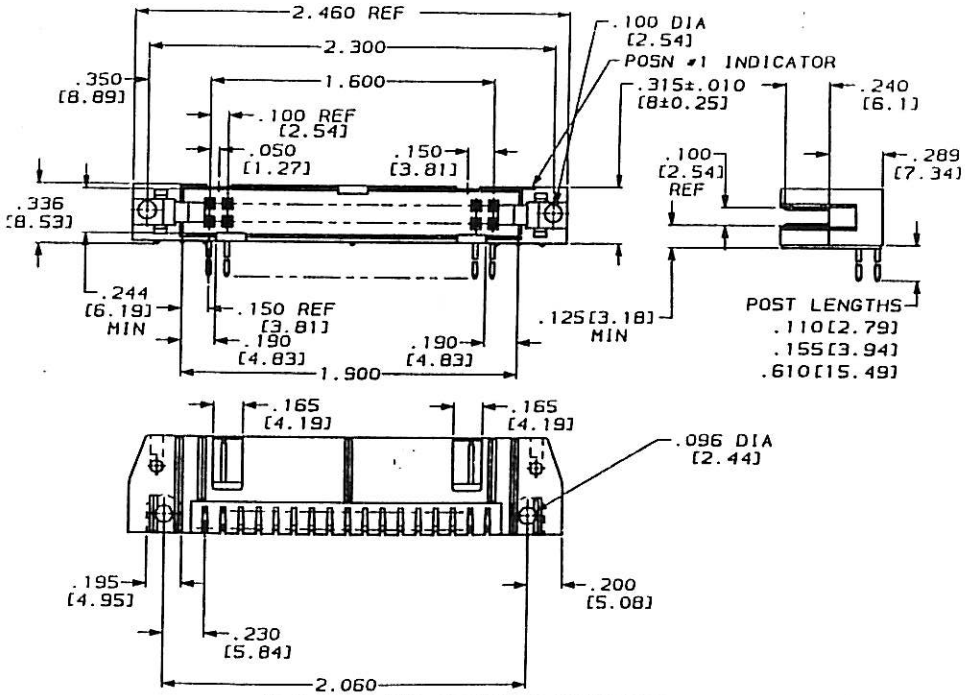


J1 PCB EDGE CONNECTOR DIMENSIONS



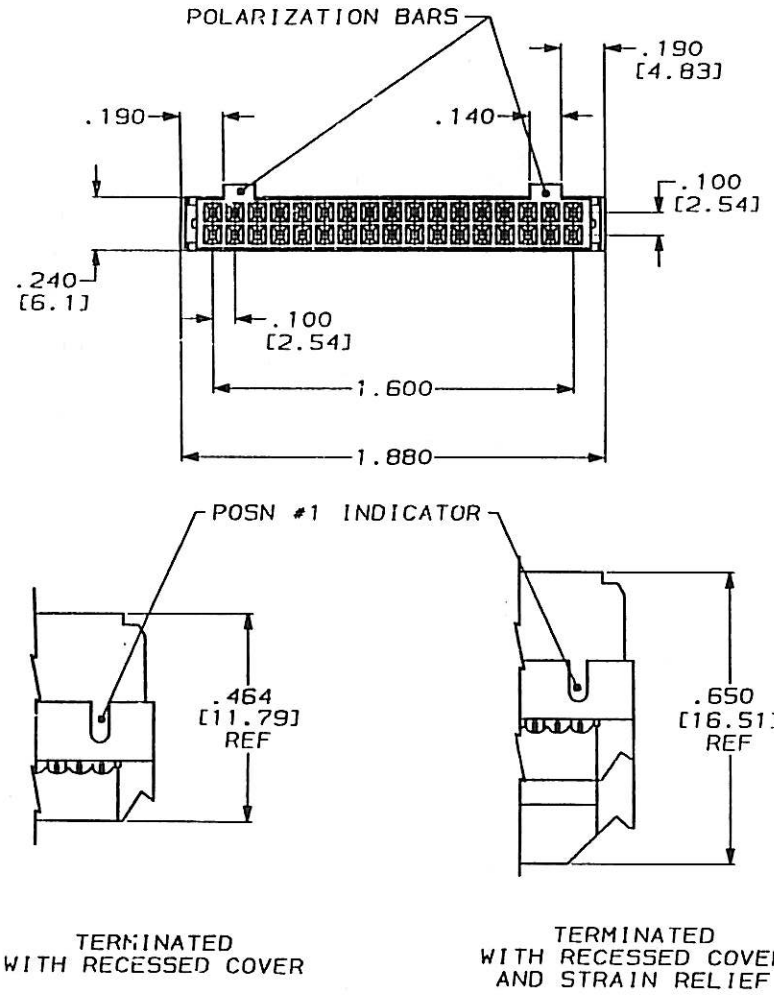
P1 CARD EDGE CONNECTOR DIMENSIONS

DRAWING 5-1 J1/P1 EDGE CONNECTOR DIMENSIONS

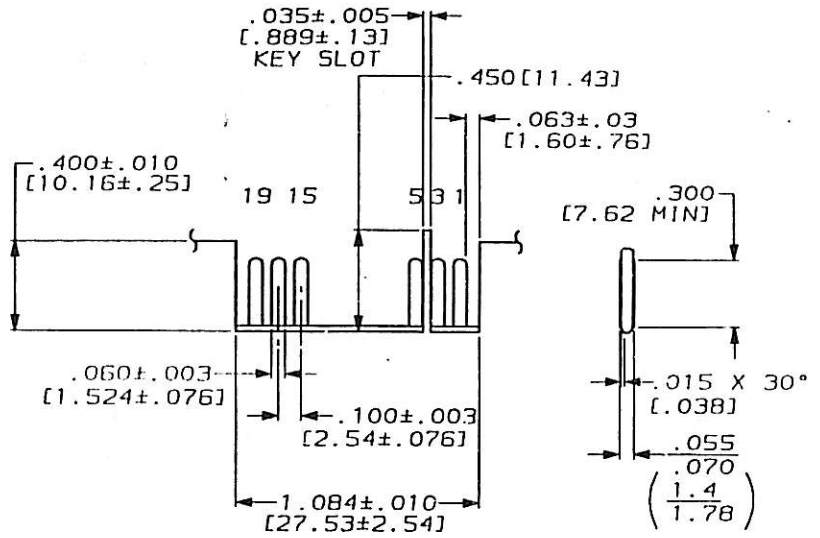


J1 PCB HEADER CONNECTOR DIMENSIONS
METRIC DIMENSIONS ARE IN PARENTHESIS

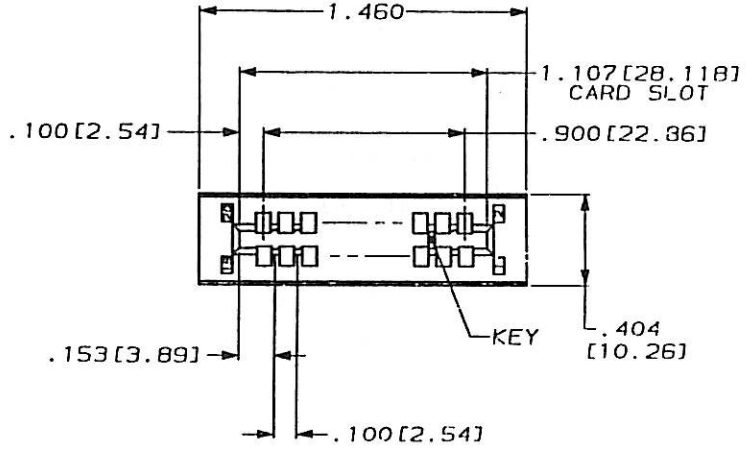
DRAWING 5-2A J1 HEADER CONNECTOR DIMENSIONS



DRAWING 5-2B P1 RECEPTACLE CONNECTOR DIMENSIONS

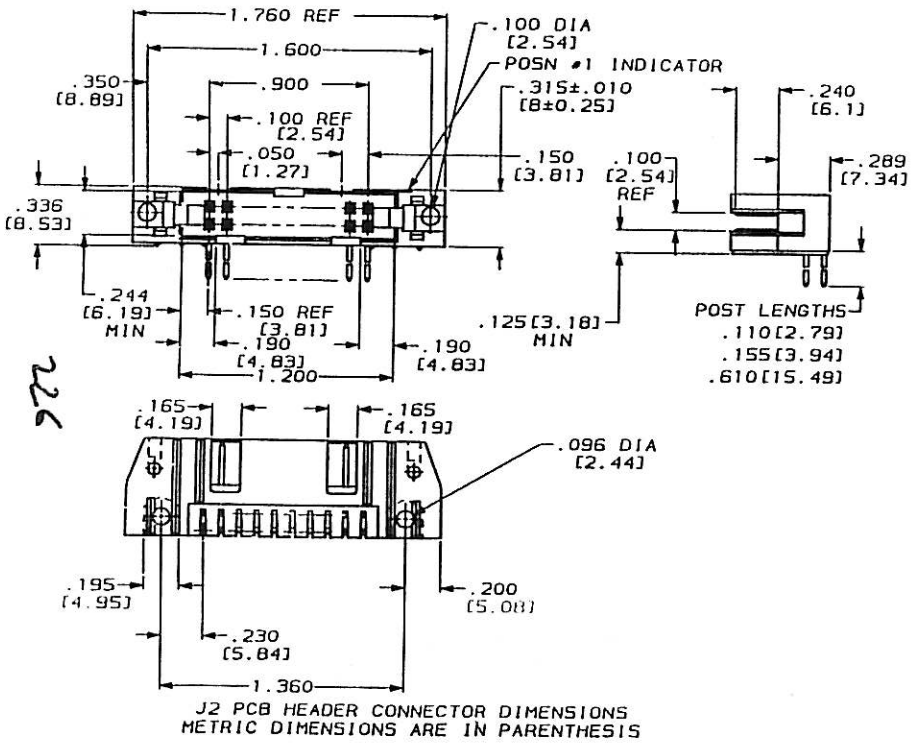


J2 PCB EDGE CONNECTOR DIMENSIONS

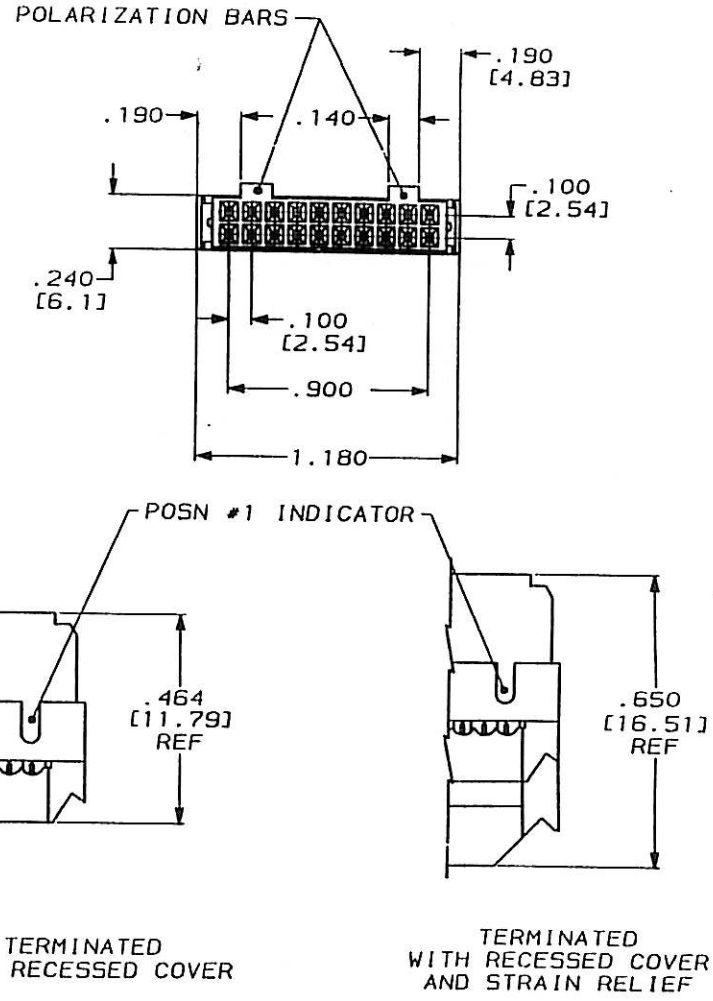


P2 CARD EDGE CONNECTOR DIMENSIONS

DRAWING 5-3 J2/P2 EDGE CONNECTOR DIMENSIONS

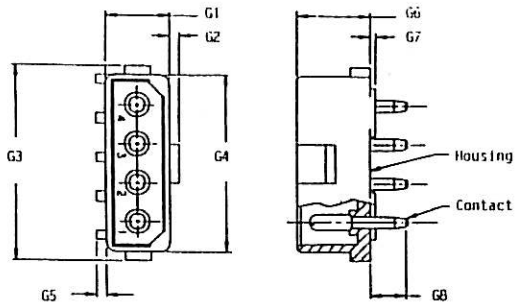


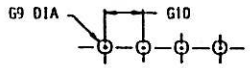
DRAWING 5-4A J2 HEADER CONNECTOR DIMENSIONS



P2 RECEPTACLE CONNECTOR DIMENSIONS
METRIC DIMENSIONS ARE IN PARENTHESIS

DRAWING 5-4B P2 RECEPTACLE CONNECTOR DIMENSIONS





Recommended Layout for
1.57 (.062 inch) thick P.C. BOARD

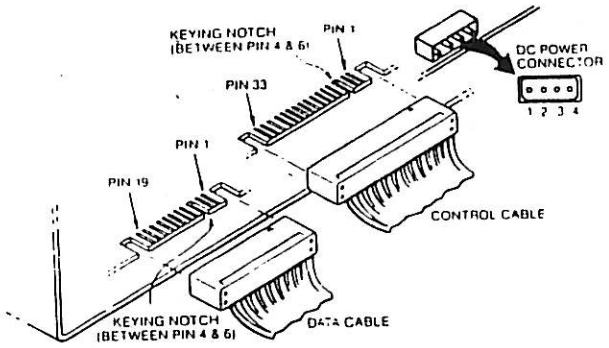
NOTES:
(1) Tolerances ± 0.38mm (0.015 inch) noncumulative, unless specified otherwise.
(2) Dimensions listed with asterisks (*) are shown for reference only.

DIMENSIONS	MILLIMETERS	INCHES
G1	8.38	.330
G2*	1.27	.050
G3*	25.4 ± 0.25	1.000 ± .010
G4	23.24	.915
G5*	1.27	.050
G6	9.53	.375
G7	0.76 ± 0.13	.030 ± .005
G8	4.57/3.81	.180/.150
G9*	1.78 ± 0.08	.070 ± .003
G10*	5.08 ± 0.13	.200 ± .005

DRAWING 5-5 J3/P3 CONNECTOR

J3 Connector Pin	Voltage
1	+12V DC +5%
2	12V RETURN
3	5V RETURN
4	+ 5V DC +5%

TABLE 5-3 J3/P3 CONNECTOR PIN ASSIGNMENTS



(BACK-END VIEW OF DRIVE)

DRAWING 5-6 TYPICAL PCB CONNECTOR ORIENTATION

TO BE SUPPLIED BY AMP

DRAWING 5-7 J4/P4 FRAME GROUND CONNECTOR

7.11 TRACK OFFSET (0111) (D-O)

This optional command causes the drive to perform a track offset in the direction and amount specified by bits 11-8 as shown below in Table 7-23:

Command Modifier Bits 11-8	Subscript 7-0	Function
0 0 0 x	0	Restore Offset to Zero
0 0 1 0	0-255	Positive Offset One
0 0 1 1	0-255	Negative Offset One
0 1 0 0	0	Positive Offset Two
0 1 0 1	0	Negative Offset Two
0 1 1 0	0	Positive Offset Three
0 1 1 1	0	Negative Offset Three
1 x x x		Reserved

TABLE 7-23 TRACK OFFSET COMMAND MODIFIER BITS

Seek and recalibrate commands restore offsets to zero. Simultaneous Track and Data Strobe offsets are allowed by use of multiple commands.

Drives that implement only one value of offset, Data Strobe or Track, shall respond to unimplemented offset commands as a legal offset function. Support of controller definable offset values is optional. If the drive supports subscripting, a value may specify up to 255 instead of being limited to 3 by the separate commands.

7.12 INITIATE DIAGNOSTICS (1000) (D-O)

This optional command causes the drive to perform internal diagnostics. COMMAND COMPLETE indicates the completion of the diagnostics. ATTENTION with COMMAND COMPLETE indicates that a fault was encountered and status should be requested to determine the proper course of action.

The command modifier bits 11-8 shall be zero to perform the standard diagnostics. Alternatively, these bits may be used by the device to invoke alternate vendor diagnostics. See Table 7-24.

The alternate diagnostic routines shall be numbered in order beginning with x'01', and command reject issued when any unimplemented routines are requested. If the alternate diagnostics are not supported by the device then the command modifier bits may be ignored.

The diagnostic parameter bits may be used to modify the routine per vendor specifications, but all routines shall execute when a default value of zero is present.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	P
CMD Function				Diagnostic No				Diagnostic Parameter								x

TABLE 7-24 DIAGNOSTIC PARAMETER BITS

7.13 SET UNFORMATTED BYTES/SECTOR (1001)(D-x) (Optional)

This optional command causes the drive to set the number of unformatted bytes per sector indicated in bits 11-0 (if implemented). This command is valid only if the drive is configured to be in the drive hard sectored mode. This command is used only if the drive uses a settable counter for the number of bytes per sector and that counter is controllable from the interface.

The unformatted bytes per sector may be adjusted by the drive to meet the drive's requirements. If adjusted, the drive should attempt to retain the number of sectors per track desired by the controller (unformatted bytes per track divided by controller-requested unformatted bytes per sector) but may set a different number if format restrictions on the drive require this.

After setting a new value for Unformatted Bytes per Sector the controller shall re-request the Unformatted Bytes per Sector and Sectors per Track Configuration Responses to verify that the drive is set to the expected values.

7.14 SET HIGH ORDER VALUE (1010) (D-O)

7.14.1 Disk (UNFORMATTED BYTES/SECTOR) (Optional)

This optional command shall be issued prior to the Set Unformatted Bytes per Sector command (1001). It sets the high order 4 bits of a 16 bit value for the number of unformatted bytes per sector. The low order 12 bits are set by Set Unformatted Bytes per Sector (see 7.13), and the characteristics of that command apply to this one also.

COMMAND COMPLETE is asserted when the value is valid, has been accepted, and the drive is ready to execute the next command. If the value is invalid e.g. out of range, ATTENTION shall be asserted in conjunction with COMMAND COMPLETE.

7.14.2 Optical (SEEK ADDRESS)

If Seek Absolute Address is implemented this command is used to define the value of the upper 4 bits of the Seek Address in bits 3-0. This command shall be issued prior to the Seek command (0000) if the high order value in the address has changed since the previous seek was executed. COMMAND COMPLETE is asserted when the high order seek address is valid, has been accepted, and the drive is ready to execute the next command. If the address is invalid e.g. out of range, ATTENTION shall be asserted in conjunction with COMMAND COMPLETE.

If Seek Distance/Direction is implemented this command is used to define the

value of the upper four bits of the seek distance in bits 3-0. This command shall be issued prior to the seek command (0000) if the high order distance value has changed, or if the direction has changed, since the previous seek was executed. COMMAND COMPLETE is asserted when the high order seek distance is valid, has been accepted, and the drive is ready to execute the next command. If the seek distance is invalid, i.e. out of range, ATTENTION shall be asserted in conjunction with COMMAND COMPLETE.

Command Modifier Bits 11-8	Function
0 0 0 0	Absolute Seek Address
0 0 0 1	Direction towards Track Minimum
0 0 1 0	Direction towards Track Maximum
0 0 1 1 to 1 1 1 1	Reserved

TABLE 7-25A HIGH ORDER SEEK ADDRESS MODIFIERS

7.15 FORMAT (1011) (x-O)

7.15.1 Optical (FORMAT) (Optional)

This command is used to format one track on the disk. It is used only when unformatted media is supported by the drive. Header fields and clocking bits shall be laid down by the drive. The controller is responsible to check the validity of the recorded fields.

This command is optional and manufacturer specific.

7.16 Reserved (1100)

7.17 Reserved (1101)

7.18 SET CONFIGURATION (1110) (D-O)

This optional command should be rejected if it is not supported.

The Soft Switch Number provides up to 16 Identification values and the Soft Switch Parameter is a modifier. See Table 7-29.

Soft Switch modifiers are used to configure disk drives capable of handling variable frequency recording, sometimes referred to as MCAV (Modified Constant Angular Velocity) or as Notched drives. The disk may be divided into zones of recording frequency that support a different number of sectors per track.

7.18.1 Synchronized Drives

The controller may use Set Configuration with synchronized drives to set this (the selected) drive to act as master (7-0 = x'01') or as slave to another drive (7-0 = x'00').

7.18.2 Notched Drives

The controller may use Set Configuration to identify the zone to be worked with (the first zone is numbered as 1 and begins at cylinder 0).

When a drive has been set to operate with a zone, then all information reported is relative to that zone. To find the configuration of a notched drive the controller shall repeat the same procedure for each zone (as it would for a drive which does not support notches) until the command is rejected because there are no more zones.

When set to Zone 0 the drive shall not respond as a notched drive but as a regular drive with only one recording frequency, that of the inner radius. If the drive is unable to respond in this way it shall reject the command.

7.18.3 Soft Switches

Soft Switch modifiers are available for the vendor to use as a method of defining configuration information. The implementation of this feature provides users the advantage of reduced installation effort and vendors the advantage of being able to set up automatic testing procedures for different drive configurations.

As an example of the way in which this command may be used by a vendor, the dip switches could be numbered and parameter used to identify how the switches are to be set (1=On, 0=Off). This command would then override any physical position to which the switches are set.

It is recommended that the device be capable of retaining the switch configuration information between power cycles.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	P	Switch Parameter
CMD Function				Switch No													
1	1	1	0	0	0	0	0										Vendor Unique
					to												
				0	x	x	x										
				1	0	0	0										Reserved
					to												
				1	0	1	1										
				1	1	0	0										Set Synchronized Drive x'00' = Slave x'01' = Master
				1	1	0	1										Notched Drive Zone Number
				1	1	1	0										Reserved
				1	1	1	1										Reserved

Example: If a magnetic disk drive is capable of supporting soft or hard sector operation according to the setting of Dipswitch 1 then the configuration would be described as follows:

1	1	1	0	0	0	0	1	xxxx xx01 = Set Soft Sector xxxx xx10 = Set Hard Sector

TABLE 7-29 SET CONFIGURATION SOFT SWITCH PARAMETER BITS

7.19 Reserved (1111)

8. READ, WRITE AND FORMAT PARAMETERS

8.1 CRITICAL READ FUNCTION TIMING PARAMETERS (D-x)

Controller variations of the read timing are allowed if the following drive-dependent parameters are met:

8.1.1 Read Initialization Time.

A read operation may not be initiated until (0.7*ISG) following head switch. Drives not able to meet 15 usec head switching time shall drop COMMAND COMPLETE upon a head switch.

8.1.2 READ GATE Timing

READ GATE may not be asserted during a Write Splice area (READ GATE shall be negated one bit time minimum before a Write Splice area and may be asserted one bit time minimum after a Write Splice area).

READ GATE shall be enabled within 16 bit times from where the write function was previously initiated or according to the subscripted values provided in Request General Configuration subscripts. The write function is defined by either:

- o leading edge of WRITE GATE or
- o trailing edge of ADDRESS MARK ENABLE during hard sector format (as defined in Figure 10-14) or soft sector format.

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8.1.3 Read Propagation Delay

Data (read) at the interface is delayed by up to 9 bit times from the data recorded on the disk media or according to the subscripted value provided in Request General Configuration subscripts. See manufacturer's drive product specification for exact value if subscripting is not supported.

8.1.4 READ CLOCK Timing

READ CLOCK and READ DATA are valid within the number of PLO sync field bytes specified by the drive configuration after Read Enable and a PLO sync field is encountered. The READ/REFERENCE CLOCK line may contain no transitions for up to two REFERENCE CLOCK periods for transitions between reference and read clocks. The transition period shall also be one-half of a REFERENCE CLOCK period minimum with no shortened pulse widths.

8.1.5 REFERENCE CLOCK Valid Time

The READ/REFERENCE CLOCK lines shall contain valid reference clocks within two REFERENCE CLOCK periods after the negation of READ GATE. Pulse widths shall not be shortened during the transition time but clock transitions may not occur for up to two REFERENCE CLOCK periods.

8.1.6 READ CLOCK Valid Time

The READ/REFERENCE CLOCK line shall contain valid Read clocks within two

(16)

Clock periods after PLO synchronization is established. Pulse widths shall not be shortened during the REFERENCE CLOCK to READ CLOCK transition time, but missing clocks may occur for up to two clock periods.

8.2 CRITICAL WRITE FUNCTION TIMING PARAMETERS (D-x)

Controller timing variations in the record-update function are allowed if the following drive-dependent write (and inter-related read) timing parameters are met:

8.2.1 Read-to-Write Recovery Time

Assuming head selection is stabilized, the time lapse from negating READ GATE to asserting WRITE GATE shall be five REFERENCE CLOCK periods minimum.

8.2.2 WRITE CLOCK-to-WRITE GATE Timing

WRITE CLOCKs shall precede WRITE GATE by a minimum of two and a half REFERENCE CLOCK periods.

8.2.3 Write Driver Plus Data-Encoder Turn-On From WRITE GATE

The write driver plus data-encoder turn-on time (write splice width) is between 3 and 7 REFERENCE CLOCK periods or defined according to the subscripted value provided in Request General Configuration subscripts.

8.2.4 Write-Driver Turn-Off from WRITE GATE

To account for data-encoding delays, WRITE GATE shall be held on for at least two byte times after the last bit of the information to be recorded.

8.2.5 Write-to-Read Recovery Time

The time lapse before READ GATE or ADDRESS MARK ENABLE can be asserted after negating the WRITE GATE is defined by the "ISG Bytes after Index/Sector" in Configuration Data Response.

8.2.6 Head Switching Time

WRITE GATE shall be negated at least 1 usec before a head change.

WRITE GATE shall not be asserted until 15 usec after a head change or COMMAND COMPLETE is asserted.

8.2.7 Write Data Delay

Write data received at the I/O connector shall be delayed by the write data encoder by up to 8 bit times maximum prior to being recorded on the media or according to the subscripted value provided in Request General Configuration subscripts.

APPENDIX A: MAGNETIC DISK DEFECT LIST

The drive's defect list is capable of being read in modified soft sectored operation as well as hard sectored.

The defect list shall reside on Sector 0 of the maximum cylinder and be repeated on two other cylinders; maximum cylinder minus 8 and cylinder 4095 (x'FFF'). This allows for redundancy should an error occur on the maximum cylinder.

All ESDI disks shall ship with copies of the defect list on three cylinders. The cylinder at the address of 4095 is a drive-unique location. It may be located anywhere on the drive that the manufacturer chooses. Cylinder 4095 may be write protected by the manufacturer i.e. the cylinder can be read, but not re-written, in the field.

The manufacturer shall guarantee that the defect list contents at either maximum cylinder or the cylinder at 4095 is error free. If cylinder 4095 is write protected it should be error free at the time of shipment.

Sector 0 of each surface will contain the defects for that surface only.

The format for the data field portion (see Figure A-1) of this sector is normally 256 bytes with 2 bytes of CRC (x(16) + x(12) + x(5) + 1):

- o Defect locations are 5 bytes long and the bytes are defined in Figure A-1.
- o The start of the actual defect may be off by up to 7 bits due to the one byte resolution. This resolution is drive dependent.
- o The end of the defect list for each surface will be indicated by 5 bytes of ones in the defect location field or the end of the sector.
- o The Byte Count field is the number of bytes from INDEX.
- o The CRC check bytes should be used by the controller if that capability exists but may be ignored if multiple reads are a more desirable approach (the drive manufacturer is required to supply CRC in the format).

The following rules apply to the reading (and writing) of the Defect List:

- o The CRC seed shall be zero (intitialized state)
- o The Sync Byte will be included in the CRC calculation (applies to both header and data fields).
- o Header and Data fields are recorded (and read) most significant byte first.

Provision has been made for future growth in the number of bytes in a Defect List data sector by defining the following fields in the two least significant bits of the Header field Flag byte. Bits 7-2 shall be zero.

Bit 1	Bit 0	
0	0	256 Byte Defect List Data Field
0	1	512 Byte Defect List Data Field
1	0	Reserved for 1,024 Byte Defect List Data Field
1	1	Reserved for 2,048 Byte Defect List Data Field

Only one size of Defect List shall be recorded per drive and must be the minimum sector size which will contain the locations of the maximum number of defects allowed per track.

A 256 byte Defect List data field can list up to 50 defects, and a 512 byte data field can list up to 101 defects.

Header and Data Field bytes are recorded (and read) with Most Significant Byte of each field first and Most Significant Bit of each byte first.

The last Defect Location entry is followed by x'FF' to end of sector. The controller should recognize either 5 bytes of x'FF' or end of sector as terminating the list.

The controller should set Unformatted Bytes per Sector to a value larger than the defect list sector size in order to successfully read the defect list.

If the disk is a notched drive, the controller has to set the drive to operate on Zone 255 before attempting to read the defect list. The drive can accept this as a valid zone only for the defect list cylinders and adjusts its rate according to whether the controller is reading maximum cylinder, maximum cylinder minus 8, or cylinder 4095.

NOTE: On drives developed prior to this standard being defined there may be a deviation from the formatting rules as not all drives provide a write splice between the header and data fields. The controller may first try recovering the data field assuming that a write splice is formatted between the header and the data field. If the data field cannot be read without error then the controller may then assume that there is no write splice formatted between the header and the data field, and retry the read function.