

**XEBEC S1410
OWNER'S MANUAL
SUPPLEMENT**

AUGUST, 1982

ADDENDUM A S1410 REV E FIRMWARE

There are major changes on the S1410 Rev E firmware from Rev. D. All changes are downward compatible with software for Rev. D.

A. NEW COMMANDS ADDED

1. Format Alternate Track (OPCODE 'OE' Hex)

Format Alternate Track will format the header fields of the "Bad Track" with the alternate track information (assigned by the host). The alternate track is formatted to identify it as an alternate. The command bytes for Format Alternate Track are:

	7	6	5	4	3	2	1	0
Byte 0	0	0	0	0	1	1	1	0
Byte 1	0	d	d	LOGICAL ADDRESS HI				
Byte 2	LOGICAL ADDRESS MIDDLE							
Byte 3	LOGICAL ADDRESS LO							
Byte 4	0	0	0	INTERLEAVE				
Byte 5	r	r	F	0	s	s	s	s

d = drive, 0 or 1 s = step option, r = retries.

The logical address in the command bytes point to the "Bad Track". Sector address is ignored, defaulting to sector 0.

The interleave byte (4) is programmed the same as in the format command, and is used on the alternate track.

If Bit 5 of Control Byte (5) is set, the data in the existing sector buffer is used to fill the data field. If not set, the data field is written with hex 6C.

After issuing the command the controller will ask for 3 bytes. These bytes point to the host assigned alternate logical address. Again sector address is ignored.

	7	6	5	4	3	2	1	0
Byte 0	0	0	0	LOGICAL ADDR HI				
Byte 1	LOGICAL ADDRESS MIDDLE							
Byte 2	LOGICAL ADDRESS LO							

After receiving the command and the assigned alternate, the controller does the following:

- a) Seeks to "Alternate Assigned Track" and verifies it is not already an assigned alternate track, or flagged bad track.
 - If the track has already been assigned as an alternate or is flagged "BAD", then error code ID Hex is given, and the command is aborted. This usually implies that the host is attempting to assign two (2) bad tracks to the same alternate track.
- b) Formats the track as an assigned alternate track.
- c) Seeks to the "Bad Track" and formats the header as a spare track pointing to the assigned alternate.

NOTE: Data fields on both the bad track and alternate track are destroyed.

Using the Format Alternate Track Command

- a) The controller must be initialized to include the alternate tracks cylinder and head ranges.
- b) With alternate tracks, the entire disk is not available to the system. Generally the disk space is fixed in the system software, which leaves spare tracks at the inner cylinder of the disk, which can be assigned as alternates when needed.
The number of spare tracks is dependent on drive size and number of defects allowed by the drive manufacturer. Generally this is 1 spare track for each 50 to 100 tracks.
- c) Procedure for use is:
 - 1) Format entire disk, including spare tracks.
 - 2) Verify disk.
 - 3) For each media defect, assign an alternate track.
 - 4) Alternate tracks should also be assigned for drive manufacturer list of defects.
- d) In system operation, the alternate tracks are invisible to the host. The controller will automatically seek to the assigned alternate track when an access is made to a flagged defective track. "Consecutive" accesses to a flag track does not result in reseeking to the alternate track. The controller will maintain position on the alternate track.
- e) Direct access (seeking to, or attempted data transfer) to an alternate track results in an error code 'IC' Hex, and no data transfer takes place.

2. Write Sector Buffer (OPCODE 'OF' Hex)

Used to fill the sector buffer with a host given data pattern. No transfer of data takes place between the drive and the controller.

	7	6	5	4	3	2	1	0
Byte 0	0	0	0	0	1	1	1	1
Byte 1	/	/	/	/	/	/	/	/
Byte 2	/	/	/	/	/	/	/	/
Byte 3	/	/	/	/	/	/	/	/
Byte 4	/	/	/	/	/	/	/	/
Byte 5	/	/	/	/	/	/	/	/

This command accepts 256 or 512 bytes (depending on sector size jumper) of data, and stores it in the sector buffer.

3. Read Sector Buffer (OPCODE '10' Hex)

This command sends 256 or 512 bytes of data (depending on sector size jumper) to the host from the sector buffer.

	7	6	5	4	3	2	1	0
Byte 0	0	0	0	1	0	0	0	0
Byte 1	/	/	/	/	/	/	/	/
Byte 2	/	/	/	/	/	/	/	/
Byte 3	/	/	/	/	/	/	/	/
Byte 4	/	/	/	/	/	/	/	/
Byte 5	/	/	/	/	/	/	/	/

B. CHANGES TO FORMAT DRIVE COMMAND

If Bit 5 of control byte 5 of the command block is set on the format command (OPCODE 04), the sector buffer will be used as the data pattern written on the disk data fields.

The Write Sector Buffer command can be issued before the format command to initialize the sector buffer.

C. CHANGE TO FORMAT TRACK COMMAND

The Format Track Command will reformat the track, eliminating all references to bad and alternate tracks. Also if Bit 5 of control byte 5 of the command block is set, then the sector buffer will be used as the data pattern in the data field.

D. EXPANDED FAST STEP OPTIONS

The fast seek steps supported have been increased to include many of the popular drives. The new step option selection is downward compatible with previous step options supported.

The step options are encoded in control byte 5 of the command descriptor. The encoding is done with bits 0 thru 3 as follows:

DESCRIPTION	BITS			
	3	2	1	0
Default 3 msec step rate	0	0	0	0
Seagate ST506 (MLC2)	0	0	0	1
Tandon fast step	0	0	1	0
Texas Instrument fast step	0	0	1	1
200 usec buffered step	0	1	0	0
70 usec buffered step	0	1	0	1
30 usec buffered step	0	1	1	0
15 usec buffered step	0	1	1	1
Olivetti 2msec/step (561)	1	0	0	0
Olivetti (562) fast step (1.1 msec typical)	1	0	0	1
Spare (for future use)	1	0	1	1 thru
	1	1	1	1

Refer to the drive manufacturer manual in configuring the drive for fast, or buffer step options. In cases where the drive is hardware configured for fast step, all commands which require seek option selection must use the fast step option for that drive.

E. DESCRIPTION OF OVERLAP SEEKS WITH BUFFERED STEP DRIVES

For drives employing buffered seeks, seek commands can be overlapped. After the controller issues a seek to the drive, it returns with a completion status, not waiting for the drive to complete the seek. If the return status shows no error, then the seek was issued correctly. If there is an error, then the seek was not issued. After transferring the status, another command can be issued to either drive. If a new command is received for a drive with an outstanding seek, then the controller will wait, with Busy active, for the seek to complete before executing the new command (Except Test Drive Ready Command). There is no timeout condition in the controller, waiting for the buffered step seeks to complete.

The Test Drive Ready command can be used with overlapped seeks to determine when a drive has completed seeking before issuing the next command. If the drive is still seeking, the status byte at the end of the command will indicate an error, and the sense status will indicate "drive still seeking" (type 0 error, code 8). A sequence of Test Drive Ready commands can thus be used to determine when the drive is ready for the next command.

F. NEW ERROR CODES

NOTE: The address Valid Bit (bit 7) may or may not be set, and is not included here for clarity.

Error Code (Hex)	Description
IC	Illegal (direct) access to an alternate track.
ID	On a format alternate track command, the requested alternate track has already been assigned as an alternate, or is flagged as a bad track.

- IE When the controller attempted to access an alternate track from a spared track, the alternate track was not flagged as an alternate.
- IF On a format alternate track command, the bad track equalled the alternate track.

TIMING CLARIFICATIONS

A. CONTROLLER SELECTION

The SELECTION signal should NEVER be activated (SEL - =0) within 1 microsecond of the deactivation of the BUSY signal (BUSY - =1) or within 10 microseconds after a RESET; if this timing is violated, the controller may not be able to accept the selection sequence.

B. OTHER TIMING CONSIDERATIONS

<u>FROM</u>	<u>TO</u>	<u>TIME</u>
SEL	REQ	100 microseconds
RESET OR POWER ON	CONTROLLER READY	2 milliseconds
WRITE COMMAND	1ST DATA REQUEST	200 microseconds
MESSAGE BYTE	END OF BUSY	10 microseconds

ADDENDUM B

A. CONTROLLER RETRY ALGORITHMS

When any error is encountered, except an ECC error in the data field, the S1410 Controller examines Bit 7 of the Control Byte (Byte 5) to determine the retry method to use.

If Bit 7 is set, the Controller will not retry the operation, but reports the error immediately. If Bit 7 is reset, the Controller will retry the operation 3 times, then recalibrate the drive, seek back to the current track, and retry once more. For example, if an ADDRESS MARK (AM) NOT FOUND error occurs, the Controller attempts to reread the same sector 3 times. If the error persists, the Controller recalibrates the drive to track 0, seeks to the target track and rereads for the last time. If the error still persists, the Controller aborts the command and reports the error to the host.

If Bit 6 is set, the Controller will not retry a read of a sector that contains a data error before attempting error correction. If Bit 6 is reset, the Controller will reread the sector before attempting error correction. It is faster and more reliable to read the data again than apply error correction immediately. If the data error is transient in nature, such as noise or electrical interference in the disk heads or read amplifier, noise in cable, or a power supply transient, then another read of the sector will be successful. If the error occurs twice in succession, the error is caused by a media defect, so ECC correction is used to recover the data.

B. FORMAT SECTOR INTERLEAVE

The S1410 controller will accept any interleave value between zero and the number of sectors per track minus one. The interleave value tells the Controller where the next logical sector is located in relation to the current sector. For example, an interleave value of one specifies that the next logical sector is physically the next sector on the track. An interleave of two specifies that the next logical sector is two sectors ahead of the current sector, so there is one sector between each logical sector. An interleave of three specifies that the next logical sector is three sectors ahead, so there are two sectors between each logical sector. Thus, the number of physical sectors between any two adjacent logical sectors is the interleave value minus one. An interleave of zero will be converted to interleave of 1 automatically. Any out of range interleave value will result in an Invalid Command Error.

The interleave value can be set to improve system throughput based on overhead time of the host software, overhead time in the disk driver, and overhead time for the S1410 controller to process a command. If the host system is capable of multisector transfers, system throughput can be optimized by setting the interleave value such that the next logical sector comes under the the heads just as the S1410 completes the data transfer of the previous sector. If the host is capable of passing a sector of data at DMA speed (one millisecond for a 256 byte sector), then the interleave value should be set to four to optimize multisector transfers. This is the minimum value for continuous sector transfers. If a sector data transfer takes between one and two milliseconds, set the interleave value to five. The best method is to experimentally determine the best interleave value for your system using a representative benchmark.

C. EXPANDED COMMAND CODE EXPLANATION

1. Test Drive Ready (Class 0, Opcode 00)

This command selects the drive specified by the Byte 1 of DCB and read back the status from that drive. If all status bits are in the correct state, the command will not return an error code. If the drive status is not OK, the command will return an error code, usually DRIVE NOT READY, or DRIVE STILL SEEKING.

This command is usually used in 2 occasions:

- a) When initially power on, the host should issue this command continuously with appropriate time out loop to insure the drive spins up to speed and comes ready.
- b) When implementing overlapped seeks. First, issue a seek command to the 1st drive, then issue another seek command to the 2nd drive. Now keep issuing a TEST DRIVE READY command to each drive until either drive finishes its seek operation. Then continue with the normal READ/WRITE operation on that drive.

2. Recalibrate (Class 0, Opcode 01)

This command will move the drive arm to the track 00 position. This command should only be used to attempt to correct a drive position error, since it is slower than a direct seek to track 0. Also, if retries are enabled, the Controller will recalibrate automatically in case of error. The difference between this command and a direct seek to track 0 is this command steps the drive one cylinder at a time looking for the signal TRACK00 from the drive to become active. A direct seek to track 0 is faster because the Controller steps the drive at the programmed step rate.

3. Request Sense Status (Class 0, Opcode 03)

This command must be executed immediately following a command in which the error bit is set in the completion status byte in order to determine the error code. This is necessary because the error code will be cleared when the Controller executes next command. (Refer to Owner's Manual page 21 for more detail)

4. Format Drive (Class 0, Opcode 04)

This command recalibrates the drive, then seeks to the starting address specified by the byte 1, 2 and 3 of the DCB. It times the spindle speed, divides the track into equal size sectors, and writes out address mark (AM) and header field for all sectors. The logical sector layout is specified by the interleave value contained in byte 4 of the DCB. Then it reads back the AM and header field and writes the DATA field for all sectors. The data pattern is defaulted to 6C Hex or the host can initialize the pattern by using OPCODE 0F Hex (WRITE SECTOR BUFFER) and then set bit 5 of the Control Byte of the DCB to 1 in the FORMAT DRIVE command to tell the controller not to change the buffer contents. Note that if the format command gets a hard error while formatting a track, the format operation stops immediately and the error is reported. To continue, the host software must provide the data fields for all logical sectors following the sector in error, then

continue with the format command at the beginning of the next track. Also note that the format operation always starts at the first sector of a track, even though the address specified in the DCB did not point to a track boundary.

5. Check Track Format (Class 0, Opcode 05)

This command will generate an interleave table from the byte 4 of the DCB, seek to the target track (without recalibrating), and read each sector from sector 0 to the last sector. While reading each sector, the Controller checks for a bad ID field with the value generated in the interleave table. If a discrepancy occurs between the sector number read and the value in the interleave table, the controller will report the error code 0A hex, wrong interleave. The Controller does not read the DATA field in this command.

6. Format Track (Class 0, Opcode 06)

This command recalibrates the drive, seeks to the target track specified in byte 1, 2 and 3 of the DCB, and writes the ID and DATA fields with the interleave value specified in byte 4 of the DCB. This command can be used to clear the defective or alternate track bits, or to reformat one track that lacks data integrity on a drive.

7. Format Bad Track (Class 0, Opcode 07)

This command is the same as FORMAT TRACK command except the BAD TRACK flag is set in the ID field. DATA fields are not written. This command is used to prevent system access to defective tracks. There is an alternate way to process bad tracks. See OPCODE 0E Hex ASSIGN ALTERNATE TRACK for details.

8. Read (Class 0, Opcode 08)

This command will read 1 to 256 sectors as specified by the byte 4 of the DCB. The starting address is specified by byte 1, 2 and 3 of the DCB. The address specified by the address field is the linear sector number from the beginning of the disk. The first sector of the disk is sector zero. The Controller converts this linear address to the physical cylinder, head, and sector address for the drive. If an error occurs during a multiple sector transfer, the transfer will terminate at the sector where the error occurs. For example, assume the user wants to read 10 sectors starting at logical address 1000. If a correctable data error occurs at logical address 1005, the Controller completes the transfer of 6 sectors, including the sixth one because the data was corrected. It terminates the read operation and sets the completion status byte error bit high. The host issues REQUEST SENSE Command to determine what error has occurred. To continue the operation, the host calculates the difference between sectors desired and sectors completed. In this case, 6 out of 10 are completed, therefore, the host should issue a second read command of 4 remaining sectors at starting logical address 1006. If any other error code occurred, the data is not returned to the host, so the retry logical address is one sector less, and the retry sector count one sector more than the continuation after a correctable data error. In the previous example, the restart logical address is 1005, and the transfer length is 5 sectors for any error other than a correctable data error.

9. Write (Class 0, Opcode 0A)

This command will write from 1 to 256 sectors as specified by the byte 4 of the DCB, starting at the address specified by bytes 1, 2 and 3 of the DCB. The multiple sector transfer scheme works the same as the READ command.

10. Seek (Class 0, Opcode 0b)

This command is used to seek to the target address as specified by byte 1, 2 and 3 of the DCB. Byte 5 of the DCB of this command instructs the Controller what type of seek algorithm to execute for this drive. There are currently 10 different seek types supported in REV F, both buffered and non-buffered modes. Buffered Step Drives are supported at 15, 30, 70, or 200 microseconds per step. Buffer step means the drive has seek intelligence built-in. It can accept step pulses at a fast rate, typically under 200 microseconds per step. After the Controller stops sending the drive step pulses (i.e. the Drive doesn't receive any more pulses within its timeout limit), the Drive seeks based on its own stepping algorithm (typically from firmware built-in to the drive). This scheme allows the Controller to finish the command without having to process the physical seek operation, making overlapped seeks possible. There are 2 more fixed step rates, 2 and 3 milliseconds per step. The other 4 step rates are custom fast step rates for Seagate, Texas Instrument, Tandon and Olivetti drives. Please see S1410 OWNER'S MANUAL Supplement (REV. E-4) for more details.

11. Initialize Drive Characteristics (Class 0, Opcode 0C)

This command is fully described in the S1410 OWNER'S MANUAL page 27. If the drive and controller are powered from a different power supply than the host system, the software driver should issue this command before each seek or data transfer operation. This prevents the Controller from "forgetting" the drive parameters if a power line transient resets the controller, but doesn't reset the host computer. Two different drive types may be supported on the same Controller by always issuing this command for each drive before any seek or data transfer operation.

12. Read ECC Burst Error Length (Class 0, Opcode 0D)

This command is only valid following a Correctable Data Error (Error Code 18-Hex). It will transfer one byte to the host indicating the length of the error corrected. The error length is determined by counting the number of bits between the first and the last bit in error, including the first and the last bits. For example:

Assume the drive is formatted with the default format data pattern 6C Hex. The first 2 bytes expanded to the binary level has the pattern — 0110 1100 0110 1100. This is the 2 byte pattern stored on the disk. Now, if the data read back from the disk has an error, then:

CORRECT PATTERN	:	0110 1100 0110 1100	0
READ BACK PATTERN	:	0111 1100 0110 1100	1
READ BACK PATTERN	:	0111 1100 1110 1100	6
READ BACK PATTERN	:	0111 1100 0110 1110	12

From the 3 pattern read above, the first and second patterns are correctable because the error bit span is less than or equal to 11 bits. The third pattern is uncorrectable since it exceeds the Controller's Correction capability, which is 11 bits.

13.Format Alternate Track (Class 0, Opcode 0E)

This command is fully described in the S1410 OWNER'S MANUAL Rev. E-1 (in the S1410 OWNER'S MANUAL Supplement)

14.Write Sector Buffer (Class 0, Opcode 0F)

This command is usually used in 2 ways:

- a) Write a test pattern to the Controller and read it back to verify the Controller's buffer memory is functioning.
- b) If the user wants another data field pattern for format such as E5 Hex for CP/M compatibility, the user can initialize the data pattern by writing the data pattern to the Controller. Then, before issuing the FORMAT DRIVE or FORMAT TRACK command, set byte 5 of the DCB high to tell the Controller to use the data pattern in the buffer instead of the default format data pattern.

15.Read Sector Buffer (Class 0, Opcode 10)

This command is also usually used in 2 ways:

- a) Read the contents of the data buffer after writing it using WRITE SECTOR BUFFER command to test the RAM.
- b) If an uncorrectable data error occurs, the Controller will not send data to the host, but reports the error immediately. If the host wants to corrupt data, then the host issues this command to retrieve it.

16.Ram Diagnostic (Class 7, Opcode 00)

This command does a walking 1 and walking 0 pattern test of its internal RAM buffer.

17.Drive Diagnostic (Class 7, Opcode 04)

This commands recalibrates the disk drive, then reads sector 0 of each track to verify that both ID and data field are correct.

18.Controller Internal Diagnostic (Class 7, Opcode 04)

This command checksums the EPROM by adding the value of each memory location modulo 256 across the programmed area. The newly calculated checksum is compared to the checksum stored permanently in the EPROM. If the checksums do not compare, then a CHECKSUM ERROR (Error Code 31 Hex) is returned. The data buffer test is the same as RAM DIAGNOSTIC. The ECC circuitry is tested by introducing an artificial error to the data and check that the ECC circuitry detects the error. It also passes a good pattern and sees if the ECC circuitry detects no ECC error.

19. Read Long (Class 7, Opcode 05)

This command is used to test the ECC circuitry. When the host issues a write command to the Controller (assume 256 bytes/sector), the Controller writes to the disk the 256 bytes sent by the host and appends the four bytes generated by the ECC hardware. During a normal read command, the Controller reads the 256 data bytes plus the 4 ECC bytes into the buffer. But the Controller sends only the 256 data bytes to the host. The 4 ECC bytes are used to determine if an ECC data error occurred. The only difference between READ LONG and READ is the Controller appends the 4 ECC bytes to the data transfer, making the sector transfer 260 bytes long. The method to test the ECC circuitry is as follows:

- a) Use the normal READ command to find a sector that does not have any data errors.
- b) Use READ LONG to read that sector plus ECC into the host.
- c) Modify the data pattern in a known way.
- d) Use WRITE LONG to write the pattern to the same sector.
- e) Use the READ command to read the same sector again .
- f) If the pattern change is less than or equal to 11 bits in length, the Controller flags it as a correctable data error. If the change is greater than 11 bits in length, the Controller will flag it as an uncorrectable data error.
- g) Use a WRITE command to restore the sector for system use.

20. Write Long (Class 7, Opcode 06)

When this command is used, the host supplies the 4 bytes of ECC information following the 256 bytes data. This command is used to test the Controller's ECC circuitry only. For detail description of the test, see the READ LONG command above.

D. EXPANDED ERROR CODE EXPLANATION

This section details the S1410 Error Codes returned in the REQUEST SENSE STATUS command. The cause of the error is given, followed by the most probable source of the error. The error codes numbers are given in HEX notation.

- | | |
|----|---|
| 00 | No error occurred. This code is always returned if no error had occurred during the previous command. |
| 01 | No index Signal from the Drive. This error occurs during any data transfer or format command if a normal drive select occurs, the drive is ready, but |

no index signal is detected from the drive within two revolutions of the disk. Possible error causes are:

- Bad Drive
- Control Cable (J1)
- Controller

02

No Seek Complete Signal from the Drive. This error occurs on non-buffered seek processing if the controller does not receive the Seek Complete signal from the Drive within one second following the last step pulse.

Possible error causes are:

- Bad Drive
- Control Cable (J1)
- Controller

03

Write fault Signal Received from the Drive. This error occurs if the controller detects an active write fault signal from the disk drive either at the completion of a sector data transfer or initially after a successful drive select and the drive indicates ready.

Possible error causes:

- Drive Power supply voltages out of range
- Bad Drive
- Control Cable (J1)
- Unit Cable (J2, J3)
- Controller

04

Disk Drive Not Ready. This error occurs if the controller fails to receive the select signal from the drive, or the drive indicates not ready after selection.

Possible error causes:

- Drive Power supply voltages out of range
- Drive not yet up to operating speed following power on
- Bad Drive
- Control Cable (J1)
- Controller

06

Track 00 Not Found. After stepping the drive 200 more steps than the number of cylinders during a recalibrate command, the Track 00 Signal was not received from the drive.

Possible causes are:

- Incorrect Drive Size Initialization (too few cylinders)
- Bad Drive
- Control Cable (J1)
- Bad Controller

08 Disk Drive Still Seeking. This status is returned in response to a test drive ready command if a buffered step seek was issued to a drive and the drive has not returned the seek complete signal. Software must time the seek to insure no system hang occurs if the drive fails to return the seek complete signal. Treat a seek incomplete condition the same as error code 02.

10 ID Field Read Error. During a data transfer or format command, address marks were detected, but the target sector was not found and an ECC error occurred on one or more ID fields.

Possible causes are:

- Media Defect on Drive
- Bad Drive (If errors are excessive or continuous)
- Bad Controller (If errors are excessive or continuous)

Media defects may be overcome by deleting the defective sectors from system use or assigning an alternate track.

11 Uncorrectable Data Error in the Data Field. The controller detected a data error that could not be corrected using ECC. The error span is greater than 11 bits.

Possible causes are:

- Media Defect on Drive
- Bad Drive (If errors are excessive or continuous)
- Bad Controller (If errors are excessive or continuous)

Media defects may be overcome by deleting the defective sectors from system use or assigning an alternate track.

12 Sector Address Mark Not Found. The controller did not detect an address mark (AM) from the

drive within its timing window. An address mark is a special recording pattern preceding the ID field of a sector. The AM is only written at format time. The AM tells the controller where new sector starts. The error may occur during any data transfer or format commands. The error may mean that no address marks were detected on the track, or the target sector address mark was not detected.

Possible causes are:

- Media Defect on Drive
- Drive has not been formatted
- Bad Drive
- Bad Unit Cable (J2, J3)
- Bad Controller

Media defects may be overcome by deleting the defective sectors from system use or assigning an alternate track.

14

Target Sector Not Found. The target sector was not located within two revolutions of the disk. This error usually occurs when there is a media defect in the address mark field of the target sector.

Possible causes are:

- Media Defect on Drive
- Invalid Format (Changing sector strap from 512 to 256 bytes and not reformatting the drive).
- Bad Drive
- Bad Controller

15

Seek Error. After a seek, the target disk address did not match the ID address read from the disk. Either the cylinder or head bytes did not match.

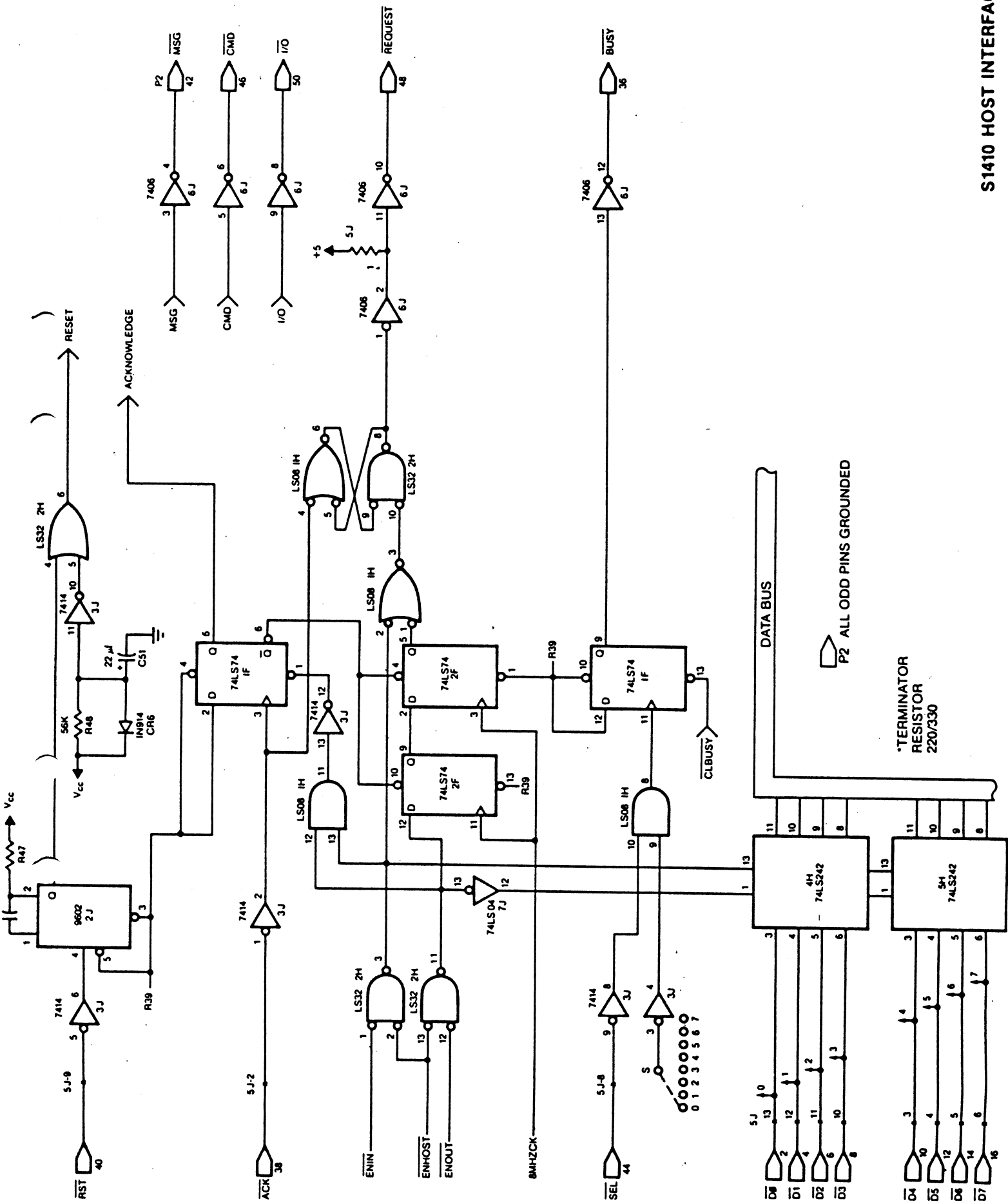
Possible causes are:

- Incorrect Seek Option Specified in the Command.
- Bad Drive
- Bad Control Cable (J1)
- Bad Controller

18

Correctable Data Error. The controller detected a media error while reading that was corrected by ECC. This error code informs the host software that error correction has taken place. This is the only error where the data is passed to the host before returning the error status.

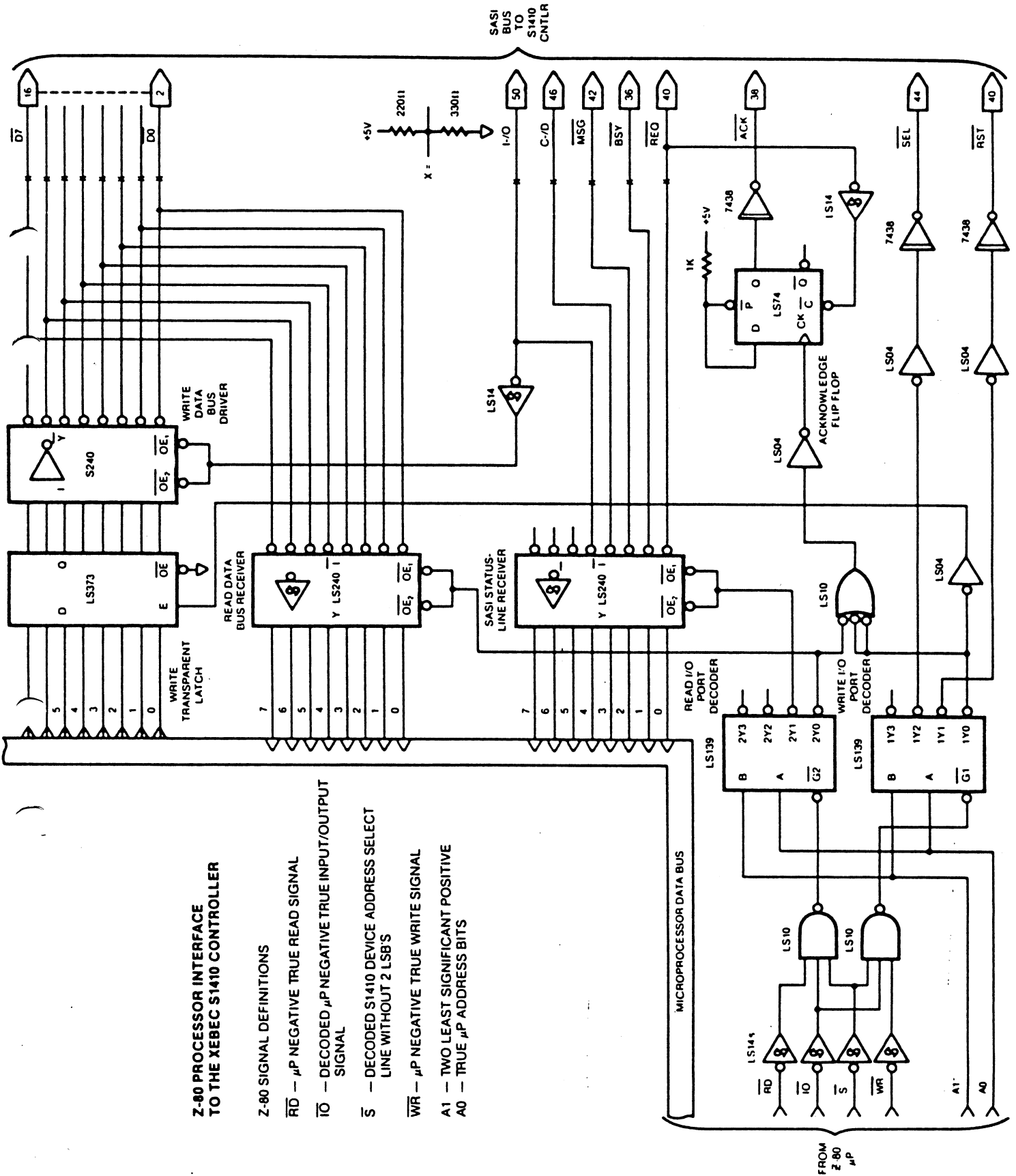
- 19 Track is Flagged Bad. The last data transfer command encountered a track that had been flagged defective using the Format Bad Track command. Host software is responsible for insuring that deleted tracks are never accessed.
- 1A Format Error. During execution of a check track command, the controller detected an unformatted track, the wrong interleave on disk, or an ID ECC error on at least one sector.
- 1C Controller Detected a Direct Access to an Alternate Track. A track that has the alternate track flag set in the ID has been directly accessed by the host, instead of coming from the defective track that is assigned to this alternate track. Care must be used in software to insure that the alternate track area is not accessed during data transfer commands.
- 1D The Designated Alternate Track is already assigned to another Defective Track. Host software has attempted to assign an alternate track to replace a defective track, but the alternate had previously been assigned to a defective track. If an alternate track is no longer needed, the host software must reformat the track using the FORMAT TRACK command before attempting to reassign the track again.
- 1E Assigned Alternate Track Not Found. A defective track has been assigned an alternate track, but the alternate track does not have the alternate track bit set in the ID field. This may be caused by reformatting the alternate track with the format track command without reprocessing the defective track.
- 1F The Alternate and Defective Track Addresses point to the same track. Host software has attempted to assign a defective track to itself. That is not allowed in this alternate track scheme.
- 30 RAM Diagnostic Failure. The controller fails to pass the RAM memory test diagnostic. Replace the controller.
- 31 Program Memory Checksum Error. The controller was unable to obtain a match between the calculated and compare checksum values. This is caused by a defect in the program memory chip of the controller.
- 32 ECC Check Failure. The controller ECC diagnostic failed, replace the controller.



**Z-80 PROCESSOR INTERFACE
TO THE XEBEC S1410 CONTROLLER**

Z-80 SIGNAL DEFINITIONS

- \overline{RD} — μ P NEGATIVE TRUE READ SIGNAL
- \overline{IO} — DECODED μ P NEGATIVE TRUE INPUT/OUTPUT SIGNAL
- \overline{S} — DECODED S1410 DEVICE ADDRESS SELECT LINE WITHOUT 2 LSB'S
- \overline{WR} — μ P NEGATIVE TRUE WRITE SIGNAL
- A1 — TWO LEAST SIGNIFICANT POSITIVE A0 — TRUE μ P ADDRESS BITS



FROM
Z-80
 μ P

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