X3T9.2/89-158

Accredited Standards Committee
X3, Information Processing Systems*

X3/89-1848-X,S
COMMENT #2
November 29, 1989
Project 375-D

To: X3T9-- FOR ACTION

Subject BSR X3.131-198x, Small Computer Systems Interface (SCSI-II)
TRANSMITTAL OF PUBLIC REVIEW COMMENT # 2

Attached is a comment on BSR X3.131-198x, from Mr. Philip Joslin of Photomarrix Corporation.

In order to provide administrative control, the Secretariat is maintaining a register of all comments received during the public review and has assigned the comment registry number indicated above.

The X3.131-198x, public review and comment period closes on February 16, 1990. The comment was received on November 20 , 1989.

If the Technical Committee action is to accept in whole or in part a proposal contained in the comment, then the changes should be sent to theCoordinator of Standards Processing together with any TC comments supporting the change. If the TC action is to reject in whole or in part proposals contained in the comment, the response should provide the rationale for the rejection.

The comment should be discussed at the next TC meeting, and if not definitively responded to at once, an interim acknowledgement should be sent along with an estimated date of action. When a final response is issued you must inform the commentors of their need to notify the Secretariat of their satisfaction or dissatisfaction with the committee's response. The commentor is required to send the Secretariat a written statement indicating acceptance or rejection of the TC response within fifteen working days. **The commentor must be made aware that failure to respond within fifteen working days indicates to the Secretariat that the comment has been withdrawn.**

Sincerely,

Lynn Barra

Lynn Barra
Coordinator, Standards Processing, X3

Attachment: Comment #2

cc: D. Shoemaker, X3T9 Chair
J. Ryland, SPARC Liaison

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October 23, 1989

X3 Secretariat/CBEMA
Lynn Barra, Administrator, Stds. Processing
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Ms. Barra;

I have recently obtained the SCSI-II draft proposal dated August 22, 1989 (X3T9.2/86-109, Revision 10b, X3T9/89-042). In reviewing Section 14, "Scanner Devices", there appear to be some aspects of the various commands that may need to be modified to accommodate the type of scanners which we produce. These are aperture card scanners (an aperture card being an IBM punch card with film embedded within it). Such a card is scanned in a different orientation than that described in the SCSI-2 draft and contains Hollerith data as well as image data.

Without going into a great deal of detail in this letter, I have enclosed a copy of our SCSI-2 specification as implemented on an aperture card scanner. Please refer to that copy in regards to the commands that are listed next. The major differences come in the following commands (I have marked these in the enclosed document with tabs for easier reference): REQUEST SENSE (lack of appropriate error codes), GET DATA BUFFER STATUS (lack of Hollerith data available, and lack of an adequate communication scheme with the initiator when breaking up images generated that are larger than the scanner memory can hold [i.e., buffered transfers as define do not adequately cover dynamic or "non-stop" scanning of an aperture card, which may produce up to 32 Megabytes worth of image data]), OBJECT POSITION (the object or media, in this case an aperture card, may be unloaded to 1, 2, or more "bins"; the "unload" position type of this command does not provide for this), and SET WINDOW (the X- and Y- axis orientation have been rotated on the aperture card scanner, as such what would be "Upper Left"

on a paper scanner is actually "Lower Left" and rotated on an aperture card scanner; other values in the Window Descriptor Block also differ slightly).

Thank you very much for your time and consideration. If you have any questions, please feel free to contact me.

Sincerely,

Philip Joslin
Senior Software Engineer

vlh
Enclosure
cc: Board of Standards Review
American National Standards Institute
1430 Broadway
New York, NY 10018

Photomatrix Aperture Card Scanner

SCSI Interface Command Protocol

Phase One Implementation

October 20, 1989

Photomatrix Document Number 89-0008

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Document Revision History

Document Revision	Date	Purpose	By Whom
x000	21 Jun 1989	Initial writing.	M. Landmeier
x001	25 Aug 1989		
x002	06 Sep 1989		
x003	17 Oct 1989	Bring up to SCSI-2 spec.	P. Joslin
x004	20 Oct 1989	Minor changes to reflect latest ver. of SCSI-2.	P. Joslin

Scanner Commands Descriptions

Table of Contents

1 ACS SCSI Commands

This section lists all of the SCSI Commands that are defined for the Photomatrix Aperture Card Scanner. They are modeled on the command definition in Section 14 (Scanner Devices) of the ANSI specification, Small Computer System Interface - 2 (SCSI-2) Working Draft Proposal (X 3.131-198x, X3T9.2/86-109, Revision 10b, X3T9/89-042) of August 22, 1989. All references to the SCSI-2 specification made within this document will be in the following format:

SCSI-2 WDP, p.<section>-<page number>

Throughout this document, the "Aperture Card Scanner" will be referred to simply as "scanner" or "ACS".

Command Name	Opcode	Type	Sect	Current Imple-mentation
Get Data Buffer Status	34h	O	1.2.1	I
Get Window	25h	O	1.2.2	NI
Inquiry	12h	M	1.1.1	I
Object Position	31h	O	1.2.3	I
Read	28h	M	1.2.4	I
Release Unit	17h	M	1.1.2	NI
Request Sense	03h	M	1.1.3	I
Reserve Unit	16h	M	1.1.4	NI
Scan	1Bh	M	1.2.5	I
Send	2Ah	O	1.2.6	NI
Send Diagnostic	1Dh	M	1.1.5	NI
Set Window	24h	M	1.2.7	I
Test Unit Ready	00h	M	1.1.6	I
Flush Buffer	C0h	VU	1.3.1	I
Lamp Control	C1h	VU	1.3.2	I
Light Calibration	C2h	VU	1.3.3	I
Reinitialize NVR	C4h	VU	1.3.5	I
Set Scanner Parameters	E0h	VU	1.3.6	I
Speed Calibration	C3h	VU	1.3.7	I

M = Mandatory command for Scanner Devices
O = Optional command for Scanner Devices
VU = Vendor Unique

I = Implemented in Phase One Implementation
NI=Not Implemented in Phase One Implementation

1.1 SCSI Generic Commands For Scanner Devices

The following sections describe those commands that are referred to as SCSI Generic Commands. The commands contained in this section are as follows;

Command Name	Opcode	Type	Sect	Current Imple-mentation
Inquiry	12h	M	1.1.1	I
Release Unit	17h	M	1.1.2	NI
Request Sense	03h	M	1.1.3	I
Reserve Unit	16h	M	1.1.4	NI
Send Diagnostic	1Dh	M	1.1.5	NI
Test Unit Ready	00h	M	1.1.6	I

M = Mandatory command for Scanner Devices
O = Optional command for Scanner Devices
I = Implemented
NI = Not Implemented in first phase interface development.

The following sections describe each of the SCSI Generic Commands.

1.1.1 Inquiry

Operation Code: 12h
Group Code:
CDB Size: 6 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	LUN			Reserved (0)				EVPD
2	Page Code (00h)							
3	Reserved (00h)							
4	Allocation Length							
5	Control Byte (00h)							

The **Inquiry** Command requests that information regarding parameters of the scanner/target be sent to the host/initiator.

Only the standard inquiry data is supported and returned by this command. As such, the **Enable Vital Product Data (EVPD)** bit must be cleared to zero and the **Page Code** field must be set to 00h. In the Phase Two implementation, the Inquiry command shall return a CHECK CONDITION status if these fields are not cleared (zero); for Phase One, these two fields are ignored.

The **Allocation Length** specifies the number of bytes that the host has allocated for returned Inquiry data. An allocation length of zero indicates that no Inquiry data shall be transferred. This condition shall not be considered an error. Any other value indicates the maximum number of bytes that shall be transferred.

The Inquiry command shall return a CHECK CONDITION status only when the scanner cannot return the requested Inquiry data. It is recommended that the Inquiry data be returned even though the scanner may not be ready for the other commands.

If an Inquiry command is received from the host with a pending unit attention condition (i.e., before the target reports CHECK CONDITION status), the scanner shall perform the Inquiry command

and shall not clear the unit attention condition (SCSI-2 WDP, p.7-18).

The Inquiry Data format is as follows:

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Device Type (06h)							
1	RMB	Device Type Qualifier						
2	ISO (0)		ECMA (0)			ANSI(2h)		
3	AENC	Reserved (0)			Response Data Format			
4	Additional Length (27h)							
5	Reserved (00h)							
6	Reserved (00h)							
7	RelAd	WB32	WB16	Sync	Link	0	CmdQu	SftRe
Vendor Related Parameters								
8-15	'PHOTOMTX'							
16-31	'APERTURE CD SCNR'							
32-35	Product Rev Level (Hardware 'XXXX')							
36-39	Vendor Specific (Model Number 'XXXX')							
40-43	Vendor Specific (S/W Rev Lev 'XXXX')							

The **Peripheral Device Types** are defined in Table 7-17 of SCSI-2 WDP, p.7-21. Type "06h" refers to scanner devices. A one (set) will be returned in the **Removable Medium Bit (RMB)**, indicating that the medium is removable. The **Device Qualifier** field contains a vendor-specific code, defined as follows for the ACS:

Device Qualifier	Scanner Type
01h	ACS 200 without Compression
02h	ACS 400 without Compression
03h	ACS 200 with Compression
04h	ACS 400 with Compression

A zero (0) in the **ISO** and **ECMA** fields shall indicate that the scanner does not claim compliance to the ISO or the ECMA version of SCSI. A two (2) in the **ANSI** field shall indicate that the scanner complies to the ANSI SCSI-2 Working Draft Proposal standard as referenced at the beginning of this document.

The **AENC** field will be zero (0), indicating that the ACS does not generate asynchronous event notifications. The **Response Data Format** field will be set to two (2), indicating that the ACS conforms to the ANSI SCSI-2 Working Draft Proposal standard as referenced at the beginning of this document.

The **Additional Length** field shall specify the length in bytes of the vendor and product identification parameters and of the vendor specific information. If the allocation length of the command descriptor block is too small to transfer all of the data available, the **Additional Length** field shall not be adjusted to reflect the truncation. In the ACS the **Additional Length** field shall be set to 39 (27h).

The first two bytes of the additional information returned are reserved (will contain 00h or be undefined). The next byte is bit mapped as per the SCSI-2 documentation (SCSI-2 WDP, p.7-23). The **RelAd** (Relative Address) bit will be zero (0), indicating that relative addressing for the ACS logical unit is not supported. The **WB32** and **WB16** bits will both be zero (0), indicating that the ACS supports only 8-bit wide data transfers. A **Sync** bit of one (1) indicates that the ACS supports synchronous data transfer; a value of zero (0) in this bit indicates that the ACS does not support synchronous data transfer (SCSI-2 WDP, p.5-7,8). The **Link** bit will be zero (0), indicating that linked commands are not supported by the ACS. The **CmdQu** bit will be zero (0), indicating that the ACS does not support command queuing. The **SftRe** bit will be zero (0), indicating that the ACS responds to the RESET condition with the hard reset alternative (SCSI-2 WDP, p.5-13,14).

The next eight (8) bytes will hold the vendor identification. For the ACS this will be **"PHOTOMTX"**. The sixteen (16) bytes that follow

will contain the product identification. For the ACS this will be "APERTURE CD SCNR". The next four (4) bytes will contain a hardware version (revision) level of the scanner, followed by an additional four (4) bytes containing the model number of the scanner (which shall be the ASCII characters " 200" or " 400", where the leading space is required). The last four (4) bytes will contain the software version (revision) level of the scanner. Phase Two implementation may change the model and S/W revision number formats.

1.1.2 Release Unit

This command is not implemented in the Phase One Implementation

1.1.3 Request Sense

Operation Code: 03h
Group Code:
CDB Size: 6 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Allocation Length							
5	Control Byte (00h)							

The **Request Sense** command requests that the ACS transfer Sense Data to the host.

The Sense Data will be valid for a CHECK CONDITION status returned on the prior command. This Sense Data will be preserved by the scanner for the host until retrieved by the Request Sense command or until the receipt of any other command from the host that issued the command resulting in the CHECK CONDITION status. All Sense Data will be cleared upon receipt of any subsequent command from the host receiving the CHECK CONDITION status.

The **Allocation Length** specifies the number of bytes that the host has allocated for returned Sense Data. An allocation length of zero indicates that no Sense Data will be transferred. The scanner will skip the DATA IN phase. Any other value indicates the maximum number of bytes that will be transferred. The scanner will terminate the DATA IN phase when Allocation Length bytes have been transferred or when all available sense data have been transferred to the host, whichever is less.

The Request Sense command will return a CHECK CONDITION status only to report fatal errors for the Request Sense command. For example:

(1) The scanner receives a non-zero reserved bit in the

Command Descriptor Block.
(2) An unrecovered parity error occurs on the SCSI Data Bus.
(3) A scanner malfunction prevents return of the Sense Data.

If any nonfatal error occurs during the execution of the Request Sense command, the scanner will return the Sense Data with GOOD status. Following a fatal error on a Request Sense command, Sense Data may be invalid.

The ACS will transfer 14 bytes of sense data to the host. The scanner supports only Error Code 70h (current errors). The sense data format is as follows:

Bit Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code (70h)						
1	Segment Number (00h)							
2	FM	EOM	ILI	0	Sense Key			
3	(MSB)	Information						
4								
5								
6								(LSB)
7	Additional Sense Length (06h)							
Additional Sense Information								
8	(MSB)	Command-Specific Information						
9								
10								
11								(LSB)
12	Additional Sense Code							
13	Additional Sense Code Qualifier							

The ACS will return zero (0) for the **Segment Number.**

The ACS will return zero (0) for the **FM** (Filemark) bit.

The ACS will return zero (0) for the **EOM** (End-Of-Medium) bit.

The **ILI** (Incorrect Length Indicator) bit indicates that the requested logical block length did not match the logical block length supported by the ACS.

The Sense Keys are described as follows;

Sense Key	Description
0h	**NO SENSE** - Indicates that there is no specific sense key information to be reported. This would be the case for a successful command or a command that received a CHECK CONDITION status because the ILI bit is set to one.
1h	**RECOVERED ERROR** - Indicates that the last command completed successfully with some recovery action performed by the scanner. Details may be determined by examining the Additional Sense Code and Additional Sense Code Qualifier bytes.
2h	**NOT READY** - Indicates that the scanner cannot be accessed. Operator intervention may be required to correct this condition.
3h	**MEDIUM ERROR** - Not Applicable.
4h	**HARDWARE ERROR** - Indicates that the scanner detected a unrecoverable hardware error while performing a command or during a self test. The Additional Sense Code byte will contain valid error information when this sense key is returned.
5h	**ILLEGAL REQUEST** - Indicates that there was an illegal parameter in the Command Descriptor Block (CDB) or in the additional parameters supplied as data for some commands. If the scanner detects an invalid parameter in the CDB or an invalid parameter in the additional parameters supplied as data, it will terminate the command.

Sense Key	Description (Continued)
6h	**UNIT ATTENTION** - Indicates that the target has been reset.
7h	**DATA PROTECT** - Not Applicable.
8h	**BLANK CHECK** - Not Applicable.
9h	**VENDOR SPECIFIC** - This sense key is used by the scanner for reporting scanner unique conditions. The Additional Sense Code byte will contain valid information when this sense key is returned by the scanner.
Ah	**COPY ABORTED** - Not Applicable.
Bh	**ABORT COMMAND** - Indicates that the scanner aborted the command. The host may be able to recover by trying the command again.
Ch	**EQUAL** - Not Applicable.
Dh	**VOLUME OVERFLOW** - Not Applicable.
Eh	**MISCOMPARE** - Not Applicable.
Fh	**<RESERVED>**

The **Information** field is not defined if the **Valid** bit is zero. If the **Valid** bit is one, the **Information** field will contain the difference (residue) of the requested transfer length minus the actual transfer length in either bytes or blocks, as determined by the Read command. Negative values are indicated by two's complement notation (i.e., upper bit of MSB of **Information** field set to 1).

The **Additional Sense Length** field specifies the number of additional sense bytes to follow. If the allocation length as specified in the Command Descriptor Block is too small to transfer all of the additional sense bytes, the **Additional Sense Length** field is not adjusted to reflect the truncation. The ACS defines two (2) of the six (6) additional sense bytes returned: **Additional Sense Code** and **Additional Sense Code Qualifier**. The **Command-Specific Information** field will return zeros (0) or be undefined.

The **Additional Sense Code** and **Additional Sense Code Qualifier** bytes

will contain the additional sense codes and qualifiers as defined in the SCSI-2 documentation (SCSI-2 WDP, p.7-52 through p.7-55) or the following vendor unique error codes:

Additional Sense Code	Additional Sense Code Qualifier	Error Description
80h	n/a	No error.
81h	n/a	Compression error.
82h	n/a	No data available for READ.
90h	n/a	Lamp fault OR lamp low.
A0h	n/a	Card jam while loading.
A1h	n/a	Card jam while exiting.
A2h	n/a	Timeout while scanning.
A3h	n/a	No card present in input hopper.
B0h	n/a	Window parameter error.

("n/a" indicates that **Additional Sense Code Qualifier** will be zero or undefined and has no meaning.)

1.1.4 Reserve Unit

This command is not implemented in the Phase One Implementation

1.1.5 Send Diagnostics

This command is not implemented in the Phase One Implementation

1.1.6 Test Unit Ready

Operation Code: 00h
Group Code:
CDB Size: 6 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Control Byte (00h)							

The **Test Unit Ready** command provides a means to check if the ACS is ready. This is <u>not</u> a request for a self test. If the scanner can accept a Scan command without returning a CHECK CONDITION status, this command will return a GOOD status.

1.2 SCSI Scanner Specific Commands Description

The following sections describe those commands that are referred to as SCSI Scanner Specific Commands. The commands contained in this section are as follows;

Command Name	Opcode	Type	Sect	Current Imple-mentation
Get Data Buffer Status	34h	O	1.2.1	I
Get Window	25h	O	1.2.2	NI
Object Position	31h	O	1.2.3	I
Read	28h	M	1.2.4	I
Scan	1Bh	M	1.2.5	I
Send	2Ah	O	1.2.6	NI
Set Window	24h	M	1.2.7	I

M = Mandatory command for Scanner Devices
O = Optional command for Scanner Devices
I = Implemented
NI = Not Implemented on first phase interface development.

1.2.1 Get Data Buffer Status

Operation Code : 34h
Group Code: 1
CDB Size: 10 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (34h)							
1	LUN			Reserved (0)				Wait
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							
6	Reserved (00h)							
7	(MSB) Allocation Length							
8								(LSB)
9	0	X	Reserved (0)					

The **Get Data Buffer Status** command provides a means for the host to inquire about scan data availability.

The Wait bit defines the response time of the scanner. A value of one (1) indicates that the scanner will wait for "scan data" to become available before responding with Data Status in the DATA IN phase. This means the scanner will disconnect from the host until "scan data" becomes available. At that time, the scanner will reconnect with the host and return to the host the Data Status in the DATA IN phase. A value of zero (0) indicates that the scanner will respond immediately with Data Status in the DATA IN phase, whether or not "scan data" is available. "Scan data", as used in the implementation of this command on the ACS, may mean image data (partial or whole) or Hollerith data (see specifics which follow).

The **Allocation Length** specifies the number of bytes that the host has allocated for the returned data status. An allocation length of zero will cause the scanner to skip the DATA IN phase with no data status being transferred. Any other value indicates the maximum number of bytes that will be transferred. The scanner will terminate the DATA IN phase when the allocation length bytes have been transferred or when all available data status has been transferred to the host, whichever is less. It is recommended that this field allow enough space to hold an entire Data Status block (i.e., 12 bytes).

Since the ACS can return either image or Hollerith data, the user must specify the data type for which status is to be returned. This is done with Bit 6 of the **Control Byte**. If Bit 6 of the Control Byte is zero (0), then status will be returned regarding image data available. If Bit 6 is set (1), then status will be returned regarding Hollerith data available.

The Data Status format returned is as follows:

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				Data Transfer Length				
2								(LSB)
3	Reserved (0)							Block
Data Status Block								
0	Window Identifier (00h)							
1	**Scanner Status Byte**							
2	(MSB)							
3				Available Data Buffer				
4								(LSB)

(Continued on Next Page)

Data Status Block (Continued):

Bit / Byte	7	6	5	4	3	2	1	0
5	(MSB)							
6				Filled Data Buffer				
7								(LSB)

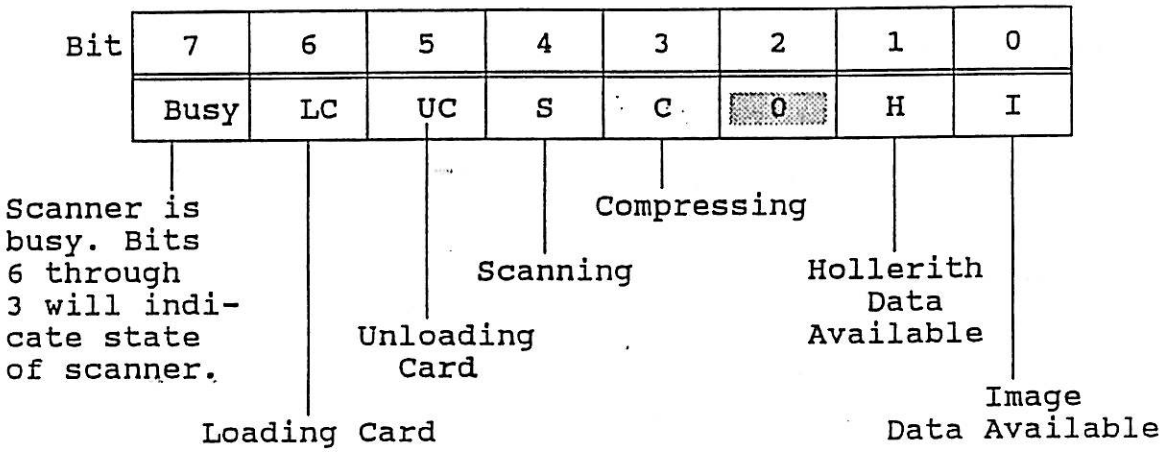
The **Data Transfer Length** specifies the length in bytes of the following data status that is available to be transferred during the DATA IN phase. The Data Transfer Length does not include the Data Transfer Length field of three bytes but does include the byte that holds the **Block** bit. Since only one window is supported on the ACS, the transfer length should always be 9 bytes.

The **Block** bit specifies the buffer status of the ACS. A value of one indicates that all scan data available must be transferred to the initiator before more scan data will be processed. A value of zero indicates that the scanner is not currently blocked due to lack of available buffer space (see paragraph below dealing with the special Scanner Status Byte). The **Block** bit is ignored in PHASE ONE IMPLEMENTATION.

Each Data Status Block would normally be associated with a window as defined by the **Window Identifier** field. The **Window Identifier** defines the window for which data is currently being prepared. This value is defined as part of the Window Descriptor Block of the Set Window command. Since the ACS supports only one window, this value will always be 00h.

Byte 1 of the Data Status Block would normally be reserved. However, due to the nature of the ACS (its ability to scan images requiring up to 32 megabytes of memory), this byte has been used and defined to be a flag to the user that data, whole or partial, is available and must be read to ensure that the remainder of the scan data will be valid. Other scanner operation indicators are also available through this flag. This **Scanner Status Byte** is bit mapped as follows:

Scanner Status Byte



The **Available Data Buffer** is not used.

The **Filled Data Buffer** field indicates the amount of data in bytes available to be transferred from the scanner. This field should be used in conjunction with the **Scanner Status Byte** in determining the state of the scan data transfer. The following chart shows how these field should be used:

Filled Data Buffer	**Scanner Status Byte** Bit 7	Scanner State and Required User Action
Equal to 0	0	Scanner is NOT busy (no scan in progress). No scan data available.
Equal to 0	1	Scanner IS busy (scan in progress). No scan data available yet.
Greater than 0	1	Scanner IS busy (scan in progress). Scan data is available (number of bytes indicated by "Filled Data Buffer" field) and MUST BE READ by the user to ensure data validity.
Greater than 0	0	This condition is NOT a valid scanner state.

1.2.2 Get Window

Operation Code: 25h
Group Code: 1
CDB Size: 10 byte

THOUGH DESCRIBED BELOW, THIS COMMAND IS NOT IMPLEMENTED IN PHASE ONE IMPLEMENTATION.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (25h)							
1	LUN			Reserved (0)				Singl
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Window Identifier (00h)							
6	(MSB)							
7	Transfer Length							
8								(LSB)
9	Control Byte (00h)							

The **Get Window** command provides a means for the host to retrieve information describing previously defined windows.

The **Singl** bit determines the number of Sense Window Descriptors to be returned. A value of one (1) indicates that only data for the window specified by the Window Identifier field shall be returned. A value of zero (0) indicates that data for all previously defined windows shall be returned. Since the ACS supports only one window and will return only one Sense Window Descriptor, this bit may be either one or zero.

The **Window Identifier** field specifies which window parameters will be transferred to the host during the DATA IN phase. Since the ACS

supports only one window, this field should be set to 00h.

The **Transfer Length** specifies the number of bytes that the host has allocated for returned Sense Window Descriptor data. The scanner will terminate the DATA IN phase when the Transfer Length bytes have been transferred or when all available Sense Window Descriptor data has been transferred to the host, whichever is less. A Transfer Length of zero indicates that no Sense Window Descriptor data will be transferred. This condition causes the scanner to skip the DATA IN phase. This shall not be considered an error.

Data returned will consist of a Get Window Data Header (shown below), followed by one Window Descriptor block. The Sense Window Descriptor block is identical in format to the Window Descriptor block as found in section 1.2.7 ("Set Window Command") of this document.

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			Window Data Length			(00h)	
1							(2Eh)	(LSB)
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							
6	(MSB)			Window Descriptor Length			(00h)	
7							(28h)	(LSB)
Window Descriptor Block								
0 to 39	Window Descriptor Block							

The **Data Transfer Length** specifies the length in bytes of the Sense Window Descriptor data that is available to be transferred during

the DATA IN phase. The Data Transfer Length does not include the Data Transfer Length field of two bytes. For the ACS, this transfer length will be set to 46 (2Eh).

The **Sense Window Descriptor Block Length** specifies the length in bytes of a single Sense Window Descriptor Block. Since the ACS supports only one window, this field will be set to 40 (28h).

This command is not implemented in the Phase One Implementation

1.2.3 Object Position

Operation Code: 31h
Group Code:
CDB Size: 10 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (31h)							
1	LUN			Reserved		Position Type		
2	(MSB)							
3	Count							
4								(LSB)
5	Reserved (00h)							
6	Reserved (00h)							
7	Reserved (00h)							
8	Reserved (00h)							
9	0	X	Reserved (0)					

The **Object Position** command allows the host to command the ACS to load and unload an aperture card onto and off of the platen or set its absolute position in regard to the platen.

The ACS supports unloading of an aperture card into an accept bin or a reject bin. As such, Bit 6 of the **Control Byte** is used in conjunction with an unload **Position Type** to specify whether the aperture card will be unloaded into the accept or reject bins. The relationship between the Control Byte and Position Type are shown in the following table:

Position Type Bits: 2 1 0	Control Byte Bit 6	Scanner Action
0 0 0	0	Unload card to accept bin.
0 0 0	1	Unload card to reject bin.
0 0 1	n/a	Load card.
0 1 0	n/a	Position card (see detail below).
All Other Combinations	n/a	Will result in a CHECK CONDITION (ILLEGAL REQUEST).

(Where "n/a" means "not applicable" or "don't care".)

The following table describes the actions of this command in-detail:

Position Type	Action
Unload Card (Accept)	This position type causes the ACS to unload the current aperture card in the platen into the accept (rear) output hopper. If there is not a card in the platen, the ACS will immediately return a completion status to the initiator. This shall not be considered an error condition.
Unload Card (Reject)	This position type causes the ACS to unload the current aperture card in the platen into the reject (front) output hopper. If there is not a card in the platen, the ACS will immediately return a completion status to the initiator. This shall not be considered an error condition.

(Continue on Next Page)

Position Type	Action
Load Card	This position type causes the ACS to load an aperture card from the input hopper onto the platen. An error will result if there is not an aperture card present in the input hopper (Sense Key will be 09h, "Vendor Unique"; Additional Sense Code will be A3h, "No card in input hopper").
Absolute Positioning	This position type causes the ACS to move the platen to the scan line position, relative to the start scan position, specified in the Count field. This position is determined based on the current resolution settings.

1.2.4 Read

Operation Code: 28h
Group Code: 1
CDB Size: 10 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (28h)							
1	LUN			Reserved (0)				
2	Data Type Code							
3	Reserved (00h)							
4	(MSB)	Data Type Qualifier (00h)						
5							(00h)	(LSB)
6	(MSB)	Transfer Length						
7								
8								(LSB)
9	Control Byte (00h)							

The **Read** command requests that the ACS transfer data to the host.

The **Data Type Code** is set to zero (00h) to read image data and is set to 80h (a vendor unique transfer type) to read Hollerith data from the last card loaded onto the platen.

The **Data Type Qualifier** field is not used and should be set to zero.

The **Transfer Length** specifies the maximum number of bytes the host has allocated for the returned data. If the actual transfer length is less than the specified Transfer Length, a CHECK CONDITION will result. Upon a following Request Sense, the sense data returned will have the ILI (Incorrect Length Indicator) and Valid bits set to one. The information bytes in Request Sense data will be set to the difference (residue) between the requested Transfer Length and

the actual transfer length. No more than Transfer Length bytes will be transferred to the host during the DATA IN phase. When the Transfer Length is zero, no data will be transferred, and the scanner will skip the DATA IN phase. This shall not be considered an error.

The first image data read after a scan will start at the beginning of the image buffer and transfer the number of bytes specified. Subsequent reads from the same image will continue from where the prior read completed.

If a Read command is received by the scanner after the entire image data has been read or the Hollerith data has been read, a CHECK CONDITION will result. Upon a following Request Sense, sense data will be returned indicating no data available (Sense Key set to 09h, "Vendor Unique"; Additional Sense Code set to 82h).

1.2.5 Scan

Operation Code: 1Bh
Group Code:
CDB Size: 6 byte

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Transfer Length							
5	Control Byte (00h)							

The **Scan** command instructs the ACS to begin a scan operation. If a card is not in the platen, one will be loaded from the input hopper before scanning. If there is not a card in the input hopper, a CHECK CONDITION status will result. Upon a following Request Sense, sense data will be returned indicating that there is no card in the input hopper (Sense Key set to 09h, "Vendor Unique"; Additional Sense Code set to A3h).

The **Transfer Length** specifies the length in bytes of the Window List that will be sent during the DATA OUT phase. A Transfer Length of zero indicates that no Window List data will be transferred. In this case, the window parameters for the scan will be the current window parameter settings. PHASE ONE IMPLEMENTATION IGNORES THIS FIELD (since there is only one window, the current window parameter settings are always used).

IN PHASE TWO IMPLEMENTATION, if the Transfer Length is used, it should be set to one (1) and a Window List of one (1) byte sent. This one-byte Window List shall contain the Window Identifier of 00h (since the ACS supports only one window). This Window Identifier corresponds to the Window Identifier specified in the Window Descriptor block of the Set Window command.

1.2.6 Send

This command is not implemented in the Phase One Implementation

1.2.7 Set Window

Operation Code: 24h
Group Code: 1
CDB Size: 10 byte

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (24h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							
6	(MSB)							
7	Transfer Length							
8								(LSB)
9	0	1	Reserved (0)					

The **Set Windows** command provides a means for the host to specify one complete set of window parameters to the ACS. Each window contains parameters for the location of a rectangular scan region and the mode in which that region is to be scanned.

The **Transfer Length** specifies the length in bytes of the window parameters data that will be sent to the scanner during the DATA OUT phase. As the ACS supports only one (1) window, this transfer length will always be 48 (30h), indicating 8 bytes for the Set Window Data Header and 40 bytes for the Window Descriptor block.

The window parameters data will contain one (1) complete Window Descriptor block. If the **Transfer Length** is set to zero, then no window parameters data will be transferred. This condition shall not be considered an error. However, the scanner will skip the DATA OUT phase and all windows will remain unchanged.

Due to the orientation of the media through the scanner, the "Upper Left X" and "Upper Left Y" values of the Window Descriptor block (see below) have been changed to "Lower Left X" and "Lower Left Y". PHASE ONE IMPLEMENTATION ONLY DOCUMENTS THIS DIVERGENCE FROM THE SCSI-2 SPECIFICATION. IN THE PHASE TWO IMPLEMENTATION, to distinquish this orientation from the standard format for this command, the user will set bit 6 of the **Control Byte** (indicating a vendor unique condition). If this is not done, the ACS will return a CHECK CONDITION. The data returned by a following Reguest Sense command would return ILLEGAL REQUEST in the Sense Key field and B0h ("Window Parameter Error") in the Additional Sense Code field.

The Set Window Data Header format is as follows:

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved (00h)							
1	Reserved (00h)							
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							
6	(MSB) Window Descriptor Length (00h)							
7							(28h)	(LSB)

The **Window Descriptor Length** specifies the length in bytes of the Window Descriptor block. As the ACS supports only one (1) window, the **Window Descriptor Length** should be set to 40 (28h) bytes. Many of the parameters in the Window Descriptor (as described below) must be set to a specific value. FOR PHASE TWO IMPLEMENTATION, if at any time a value other than those indicated for a given parameter is sent, a CHECK CONDITION will result. The data returned by a following Reguest Sense command would return ILLEGAL REQUEST in the Sense Key field and B0h ("Window Parameter Error") in the Additional Sense Code field. AS OF PHASE ONE IMPLEMENTATION, NO

RANGE OR VALIDITY CHECKING IS PERFORMED.

The Window Descriptor block format is as follows:

Bit / Byte	7	6	5	4	3	2	1	0
0	Window Identifier (00h)							
1	Reserved (0)							Auto
2	(MSB)	X-Axis Resolution						
3								(LSB)
4	(MSB)	Y-Axis Resolution						
5								(LSB)
6	(MSB)	X-Axis Lower Left						
7								
8								
9								(LSB)
10	(MSB)	Y-Axis Lower Left						
11								
12								
13								(LSB)
14	(MSB)	Window Width (X Pixels)						
15								
16								
17								(LSB)

(Continued on Next Page)

Window Descriptor Block (Continued):

Bit Byte	7	6	5	4	3	2	1	0
18	(MSB)							
19								
20				Window Length (Y Lines)				
21								(LSB)
22	Brightness (00h)							
23	Threshold (00h)							
24	Contrast (00h)							
25	Image Composition (00h)							
26	Bits Per Pixel (01h)							
27	(MSB)							
28				Halftone Pattern				(LSB)
29	RIF	Reserved (0)				Padding Type		
30	(MSB)							
31				Bit Ordering				(LSB)
32	Compression Type							
33	Compression Argument							
34 to 39	Reserved							

(00h)
(00h)
(00000000b)
(00000XXXb)

Since the ACS supports only one (1) window, the **Window Identifier** should always be set to 00h.

The new window parameters will be placed into the specified window storage area, and the current operational window parameters will be changed to the new values. This assures that the next scan will be controlled by the new window values.

The **Auto** bit is not used and should be set to zero (0).

The **X-Axis Resolution** field specifies the resolution along the scan line (i.e., vertical direction) in pixels per inch. A zero value in this field indicates that the scanner is to use its default vertical resolution of either 200 or 400 pixels per inch.

In PHASE ONE IMPLEMENTATION, the **Y-Axis Resolution** field is ignored (since the X and Y resolutions must be equal, only the X resolution is used).

IN PHASE TWO IMPLEMENTATION, the **Y-Axis Resolution** field will specify the resolution in the cross-scan (i.e., horizontal) direction in scan lines per inch. A zero value in this field indicates that the scanner is to use its default horizontal resolution of either 200 or 400 lines per inch.

The ACS will support any resolution that is the result of the default resolution, 200 or 400, being divided by a reduction factor in the range of 1.00 to 8.00.

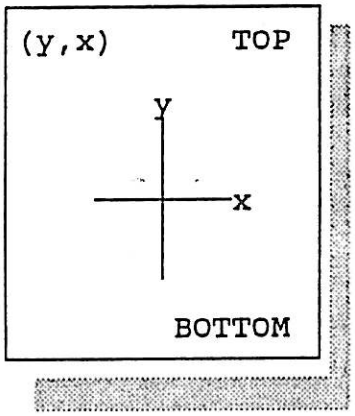
The ACS supports only X and Y resolutions that are the equal. IN PHASE TWO IMPLEMENTATION, if the values are not equal, a CHECK CONDITION will result. The data returned by a following Reguest Sense command would return ILLEGAL REQUEST in the Sense Key field and B0h ("Window Parameter Error") in the Additional Sense Code field.

The **X-Axis Lower Left** field specifies the X coordinate of the lower left corner of the rectangular scan region. This coordinate is measured in pixels from the lower edge of the scan line using the resolution specified in the X Resolution field. This parameter is referred to as the "Pixel Offset" in scanner terminology. (See following diagram.)

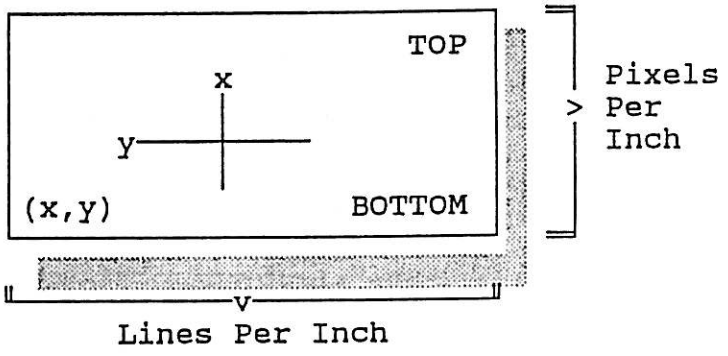
The **Y-Axis Lower Left** field specifies the Y coordinate of the lower left corner of the rectangular scan region. This coordinate is measured in scan lines from the logical start-of-medium using the resolution specified in the Y Resolution field. This parameter is

referred to as the "Line Offset" in scanner terminology. (See following diagram.)

Standard Orientation:



Aperture Card Scanner Orientation:



The **Window Width** field specifies the size in pixels along the scan line of the rectangular scan region. The number of pixels must be a multiple of 16.

The **Window Length** field specifies the size in scan lines of the rectangular scan region.

The **Brightness** is not used by the scanner and should be set to zero (00h).

The **Threshold** and **Contrast** fields are not used by the scanner and should be set to zero (00h). To set thresholding values, see vendor unique command **"Set Scanner Parameters"**, section 1.3.6.

The **Image Composition** code specifies the type of image acquired. The ACS currently supports only bi-level black and white images. As such, this field should be set to zero (see SCSI-2 WDP, p.14-10).

The **Bits Per Pixel** field must be set to one (01h).

The **Halftone Pattern** field is not used and should be set to zero (0).

The **RIF (Reverse Image Format)** bit is applicable only for images represented by one bit per pixel. A RIF bit of zero indicates that background pixels are to be indicated by zeros and data pixels are

to be indicated by ones. A RIF bit of one indicates that background pixels are to be indicated by ones and data pixels are to be indicated by zeros.

The **Padding Type** field should be set to zero (0), indicating that no padding available.

The **Bit Ordering** field defines the order in which pixel data is transferred to the host across the SCSI interface from the scanner. Ordering will include direction of pixels in a scan line, direction of scan lines within a window, and data packing within a byte. Bits 0, 1, and 2 of this field (00000XXXb) perform the following operations when they are set (1):

Bit	Type of Bit Ordering
0	Swap bytes within a word.
1	Rotate the bits within a byte.
2	Start with the last byte of image to be transferred first.

The following are examples of the effect of the Bit Ordering field values. The first four bytes of a transfer will be shown with the placement of the first 32 bits of the image indicated. "XXXb" indicates bits 2, 1, and 0 repectively.

DATA

Bits / Bytes	7	6	5	4	3	2	1	0
1	8	7	6	5	4	3	2	1
2	16	15	14	13	12	11	10	9
3	24	23	22	21	20	19	18	17
4	32	31	30	29	28	27	26	25

BIT ORDERING BITS

XXXb = 000
(No Action)

Bits Scanned

DATA

BIT ORDERING BITS

XXXb = 001 (Bit 0)
(Swap Bytes)

Bits / Bytes	7	6	5	4	3	2	1	0
1	16	15	14	13	12	11	10	9
2	8	7	6	5	4	3	2	1
3	32	31	30	29	28	27	26	25
4	24	23	22	21	20	19	18	17

Bits Scanned

XXXb = 010 (Bit 1)
(Rotate Bits)

Bits / Bytes	7	6	5	4	3	2	1	0
1	1	2	3	4	5	6	7	8
2	9	10	11	12	13	14	15	16
3	17	18	19	20	21	22	23	24
4	25	26	27	28	29	30	31	32

Bits Scanned

XXXb = 011 (Bits 1,0)
(Swap bytes and
Rotate Bits)

Bits / Bytes	7	6	5	4	3	2	1	0
1	9	10	11	12	13	14	15	16
2	1	2	3	4	5	6	7	8
3	25	26	27	28	29	30	31	32
4	17	18	19	20	21	22	23	24

Bits Scanned

The **Compression Type** and **Compression Argument** fields specify the compression technique to be applied to the scanned data prior to transmission to the host and are defined as follows:

Compression Type	Compression Description	Compression Argument
00h	No Compression	Reserved
01h	CCITT Group III, 1 dimensional	Reserved
02h	CCITT Group III, 2 dimensional	K factor
03h	CCITT Group IV, 2 dimensional	Reserved

IN PHASE TWO IMPLEMENTATION, values other than these will result in a CHECK CONDITION status. The data returned by a following Request Sense command would return ILLEGAL REQUEST in the Sense Key field and B0h ("Window Parameter Error") in the Additional Sense Code field.

1.3 Vendor Unique Commands

This section lists the commands that are unique to the ACS. As such, they are not part of the standard command definitions for scanner devices. These command are referred to as Vendor Unique commands.

Command Name	Opcode	Type	Sect	Current Imple-mentation
Flush Buffer	C0h	VU	1.3.1	I
Lamp Control	C1h	VU	1.3.2	I
Light Calibration	C2h	VU	1.3.3	I
Reinitialize NVR	C4h	VU	1.3.5	I
Set Scanner Parameters	E0h	VU	1.3.6	I
Speed Calibration	C3h	VU	1.3.7	I

VU = Vendor Unique command for ACS
I = Implemented
NI = Not Implemented in Phase One Implementation

1.3.1 Flush Buffer

Operation Code: C0h
Group Code:
CDB Size: 6 byte

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (C0h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Control Byte (00h)							

The **Flush Buffer** command instructs the ACS to reset the state of the scan buffer. Any pending data shall be lost. A Read command received following this command and prior to a Scan command will generate a CHECK CONDITION result. Upon a following Request Sense, a No Data Available status will be returned (see section 1.2.5, "Read Command").

1.3.2 Lamp Control

Operation Code: C1h
Group Code:
CDB Size: 6 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (C1h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (0)							O/F/SBY
5	Control Byte (00h)							

The **Lamp Control** command provides the Host with the ability to control the state of the scanner lamp.

The **O/F/SBY** bits are defined as follows:

O/F/SBY Bits: 1 0	Description
0 0	Do not change lamp state (NOT an error).
0 1	Turn lamp off.
1 0	Turn lamp to standby.
1 1	Turn lamp to full on.

1.3.3 Light Calibration

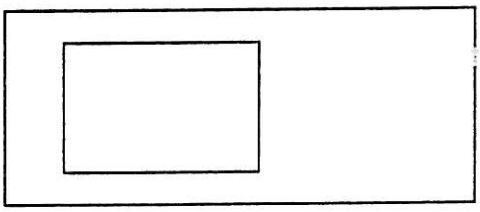
Operation Code: C2h
Group Code:
CDB Size: 6 byte

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (C2h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (0)							Cal
5	Control Byte (00h)							

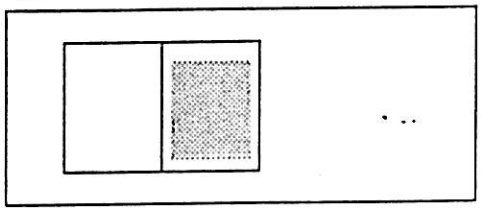
The **Cal** (Calibration type) bit determines whether "Light Calibration Type One" is used (**Cal** bit is zero) or "Light Calibration Type Two" is used (**Cal** bit is set to one).

The ACS requires that the Gain and Offset of the CCDs' analog electronics be adjusted as the lamp ages and changes intensity. This process is known as **Light Calibration.** There are two types of Light Calibration proceedures. A Type One Calibration Card has clear film in the aperture. A Type One Calibration Process consists of placing the clear film aperture card in the platen and moving the platen so that the CCDs are illuminated when the lamp is turned on. Then the lamp is cycled on and off as the Gains and Offsets are adjusted to get the best response from the Analog-to-Digital conversion process. A Type Two Calibration Card has clear film on one side and dark film on the other (see the following diagram).

Type One Calibration Card



Type Two Calibration Card



The Type Two Light Calibration Process consists of loading a Type Two Calibration Card onto the platen and leaving the lamp on while the platen is shuttled back and forth between the clear and dark film halfs to alternatively illuminate and un-illuminate the CCDs as in the type one process when the lamp was turned on and off.

1.3.4 Reinitialize Non-Volatile Memory

Operation Code: C4h
Group Code:
CDB Size: 6 byte

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (C4h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Control Byte (00h)							

The **Reinitialize Non-Volatile Memory** command loads default values into all programable scanner parameters.

1.3.5 Set Scanner Parameters

Operation Code: E0h
Group Code:
CDB Size: 10 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (C3h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							
6	(MSB)							
7	Transfer Length							
8								(LSB)
9	Control Byte (00h)							

The **Set Scanner Parameters** command provides a means for the Host to set individual programmable parameters in the ACS. This is done by sending a list of parameters to be changed along with the new values for those parameters. Each parameter is represented by a Parameter Group. The first byte of each Parameter Group is the parameter number while the remaining bytes of the group are the new values for that parameter. The length of each Parameter Group is static (i.e., contains a specific number of bytes) and unique for that group.

The **Transfer Length** specifies the length in bytes of the list of Parameter Groups that will be sent to the scanner during the DATA OUT phase. The Transfer Length is calculated by adding up the total bytes in each Parameter Group sent. PHASE ONE IMPLEMENTATION ALLOWS ONLY ONE PARAMETER GROUP PER SET SCANNER PARAMETERS COMMAND. ONLY THE FIRST GROUP ENCOUNTERED WILL BE SEEN AND ACTED UPON. In Phase

Two Implementation, concatenation will be allowed, providing a mechanism for setting ALL of the parameters listed below using a single command.

The Parameter Groups are defined in the following sections.

1.3.5.1 Speed Control Parameter Group

The **Speed Control Parameter Group** consists of two (2) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (01h)							
1	Speed Control							

The **Speed Control** byte is defined as follows:

Speed Control Byte	Description
00h	Do not change state (NOT an error).
01h	Scan at full speed.
02h	Scan at half speed.
03h	Scan at quarter speed.

The ACS scans at different speeds depending on two parameters, the Reduction Factor (RDF) and the Speed Control setting. This is defined in the following table:

ACS 200/400

RDF / Speed	1.00 to 1.99	2.00 to 3.99	4.00 and Greater
FULL	5/9 SECONDS	3/5 SECONDS	3/3 SECONDS
HALF	10/20 SECONDS	6/10 SECONDS	6/6 SECONDS
QUARTER	20/60 SECONDS	15/20 SECONDS	15/15 SECONDS

1.3.5.2 Line Delay Parameter Group

The **Line Delay Parameter Group** consists of six (6) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (02h)							
1	Line Delay CCD 1 (0-63)							
2	Line Delay CCD 2 (0-63)							
3	Line Delay CCD 3 (0-63)							
4	Line Delay CCD 4 (0-63)							
5	Line Delay CCD 5 (0-63)							

The **Line Delay** parameters establish the number of lines that each CCD is delayed from the Start of Scan position. These parameters are used to compensate for mechanical misalignment of the CCDs in the horizontal direction.

1.3.5.3 Pixel Overlap Parameter Group

The **Pixel Overlap Parameter Group** consists of nine (9) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (03h)							
1	(MSB)	Pixel Overlap CCD 1 & 2						
2								(LSB)
3	(MSB)	Pixel Overlap CCD 2 & 3						
4								(LSB)
5	(MSB)	Pixel Overlap CCD 3 & 4						
6								(LSB)
7	(MSB)	Pixel Overlap CCD 4 & 5						
8								(LSB)

The **Pixel Overlap** establishes the location of the first usable pixel in CCDs 2 through 5. These parameters are used to compensate for mechanical misalignment of the CCDs in the vertical direction.

1.3.5.4 Hollerith Data Parameter Group

The **Hollerith Data Parameter Group** consists of two (2) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (04h)							
1	Hollerith Data Orientation							

The **Hollerith Data Orientation** Byte is used to tell the ACS how it should interpet the Hollerith data that it reads from the aperture card. This byte allows the ACS to know if the card is loaded into the input hopper with the top of the card up (Hollerith Data Orientation byte set to 01h) or down (Hollerith Data Orientation byte set to 02h).

1.3.5.5 Buffered Scan Parameter Group

The **Buffered Scan Parameter Group** consists of two (2) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (05h)							
1	Buffered Scan							

The **Buffered Scan** byte will enable (byte set to FFh) or disable (byte set to 00h) buffered scanning. A Buffered Scan will allow data to be transferred to the Host before the actual scan process is finished. This is necessary if the image data size is larger than the buffer memory available. When Buffered Scan is enabled, the ACS will scan until one forth of the buffer memory is full and then post the number of bytes available in the Scan Data Available field of the information returned by a Get Data Status command (see section 1.2.2). If the Buffered Scan is disabled, the ACS will not indicate that data is available until the scan process is finished (CARE SHOULD BE TAKEN IF THE BUFFERED SCAN IS DISABLED SINCE A LARGE IMAGE MAY OVERRUN THE AVAILABLE BUFFER MEMORY RESULTING IN INVALID IMAGE DATA).

1.3.5.6 Contrast and Tracking Parameter Group

The **Contrast and Tracking Parameter Group** consists of four (4) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (06h)							
1	Contrast Level (1-8)							
2	Local Area (IP) Tracking (On/Off)							
3	Large Area (STAR) Tracking (On/Off)							

The **Contrast Level** sets the contrast from darker (value of 1) to lighter (value of 8).

The **Local Area** and **Large Area Tracking** combine to provide a dynamic background and contrast tracking funcition for the ACS. A detailed description of their operation and the differences between them is beyond the scope of this document. For normal scanning, both of these functions are normally turned "ON" (value of FFh; "OFF" is a value of 00h).

1.3.5.7 Individual Threshold Parameter Group

The **Individual Threshold Parameter Group** consists of ten (10) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (07h)							
1	Contrast Level Control (0,1-8)							
2	CCD Number (1-5)							
3	Upper Threshold (0-255)							
4	Lower Threshold (0-255)							
5	Processed Threshold (0-255)							
6	Local Area Tracking							
7	Voting Register							
8	Reserved (00h)							
9	Reserved (00h)							

There are eight (8) contrast levels as well as an operational or current contrast level. Within each level, there may be specified a group of seven (7) threshold values per CCD (i.e., five sets of seven thresholds per level). The **Contrast Level Control** specifies into which one of the eight (8) contrast levels the seven threshold bytes described in the command block above are to loaded (bytes 3 through 9 in the block above represent one set of seven thresholds). This action does not select any of the contrast levels as the operational or current contrast level. That must be done through a subsequent Contrast and Tracking Parameter Group. However, a Contrast Level Control of 00h loads the seven threshold bytes into the operational or current contrast level, leaving the eight stored levels unchanged.

The **CCD Number** field specifies for which CCD the threshold bytes are intended. A CCD Number field of zero (00h) indicates that the threshold bytes are to be loaded into all CCD threshold sets for

the indicated Contrast Level.

A detailed description of the operation and function of each of the threshold bytes is beyond the scope of this document. These bytes will normally not be set by the user. They are automatically set with their normal or default values when a Contrast Level is selected by the Contrast and Tracking Parameter Group.

1.3.5.8 STAR Parameter Group

The **STAR Parameter Group** consists of eight (8) bytes as shown below:

Bit / Byte	7	6	5	4	3	2	1	0
0	Parameter Number (08h)							
1	Mode (0-4)							
2	Low Delta (0-100)							
3	High Delta (0-100)							
4	Smoothing On/Off							
5	Small Averaging Fraction (0-12)							
6	Leak Rate (00h-FFh)							
7	Gray Scale Data Polarity (Pos/Neg)							

A detailed description of the operation and function of each of the **STAR Parameter Group** bytes is beyond the scope of this document. These bytes will normally not be set by the user. They are automatically set with their normal values when a Contrast Level is selected by the Contrast and Tracking Parameter Group.

1.3.6 Speed Calibration

Operation Code: C3h
Group Code:
CDB Size: 6 byte

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (C3h)							
1	LUN			Reserved (0)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Control Byte (00h)							

The **Speed Calibration** command will cause the ACS to perform a speed calibration function. A Good return from this command indicates that the process ran successfully. A CHECK CONDITION result from this command indicates that at least one of the scanner speeds was not able to calibrate properly. At this time, no additional information will be returned by a following Request Sense command.

2 ACS Status Definitions

The ACS will return to the host a single Status byte during the STATUS phase at the termination of each command unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message, or by a "hard" reset condition.

The Status byte is as follows:

Status Byte Bits: 7 6 5 4 3 2 1 0	Hex	Description
0 0 0 0 0 0 0 0	00h	Good Status
0 0 0 0 0 0 1 0	02h	Check Condition
0 0 0 0 0 1 0 0	04h	Condition Met/Good
0 0 0 0 1 0 0 0	08h	Busy
0 0 0 1 0 0 0 0	10h	Interemediate/Good
0 0 0 1 0 0 1 0	12h	Interm/ConditionMet/Good
0 0 0 1 1 0 0 0	18h	Reservation Conflict

A description of the Status byte codes is as follows:

GOOD -
This Status indicates that the scanner has successfully completed the command.

CHECK CONDITION -
Any error, exception, or abnormal condition that causes sense data to be set, will cause this Status to be returned by the scanner. A Request Sense command should be issued by the host to determine the nature of the condition.

CONDITION MET -
<NOT IMPLEMENTED>

BUSY -
This code indicates that the scanner is busy (off-line) and is unable to accept a command from any host. The host may retry the command at a later time.

INTERMEDIATE -
<NOT IMPLEMENTED>

INTERMEDIATE CONDITION MET -
<NOT IMPLEMENTED>

RESERVATION CONFLICT -
<NOT IMPLEMENTED>

3 ACS Message System Specification

The following section describe how the ACS makes use of the SCSI Message System.

The ACS implements the required COMMAND COMPLETE message. The scanner also implements several other messages. The following paragraphs describe the Message System Protocol as implemented by the ACS.

The ACS indicates its ability to accommodate more than the COMMAND COMPLETE message by responding to the ATN (Attention) SCSI control signal when asserted by the host during the Selection Phase. The scanner responds to the ATN condition by going into the Message Out Phase.

When the scanner is Selected with ATN, the scanner goes into the Message Out Phase to receive from the host the IDENTIFY message. This message, which is expected by the scanner, identifies the LUN that the host wishes to select and it establishes whether Disconnect/Reconnect will be used or not for the ensuing SCSI dialogue. Since the scanner supports Disconnect/Reconnect, it also supports the DISCONNECT message which it sends to the host just prior to breaking the physical connection. In connection with the DISCONNECT message, the scanner supports the SAVE DATA POINTER message which it uses to direct the host to save the current data pointers used during data transfers. The scanner uses this message to reliably break up long data transfers into smaller blocks.

The last message the scanner supports is the MESSAGE REJECT message which the scanner must support. It is used to reject an invalid or inappropriate message received from the host.

The messages referred to above are summarized and defined in more detail below. (For a detailed description, see SCSI-2 WDP, p.5-17 through p.5-35.)

Code	Type	Description	Direction
00h	M	Command Complete	In
02h	O	Save Data Pointer	In
04h	O	Disconnect	In
07h	O	Message Reject	In Out
80h - FFh	O	Identify	In Out
***	O	Sync Data Xfer Req	In Out

*** = Extended Message,
M = Mandatory, O = Optional
In = Scanner-to-Host, Out = Host-to-Scanner

COMMAND COMPLETE -
This message is sent from the scanner to the host to indicate that the execution of a command has terminated and that valid status has been sent to the host. After successfully sending this message, the target will go to the BUS FREE phase before releasing BSY.

SAVE DATA POINTER -
This message is sent from the scanner to the host to direct the host to save a copy of the currently active data pointer for the transfer in progress.

DISCONNECT -
This message is sent from the scanner to inform the host that the present physical path is going to be broken because the scanner plans to disconnect by releasing BSY, but that a later reconnect will be required in order to complete the current operation. If the host detects the BUS FREE phase (other that as a result of a RESET condition) without first receiving a DISCONNECT or COMMAND COMPLETE message, the host will consider this a catastrophic error condition and will clear the current command. This message must not cause the host to save the data pointer. Therefore, each time the scanner disconnects to break a long data transfer into multiple shorter transfers, the SAVE DATA POINTER message will be used in conjunction with the DISCONNECT message.

MESSAGE REJECT -
This message is sent by either the scanner or host to indicate that the last message it received was invalid or not supported.

IDENTIFY -
This message is sent by either the scanner or the host to establish the physical path connection between them.

Bit 7 : This bit is always set; it distinguishes this message as the Identify message.

Bit 6 : This bit is only set by the host. When set to one, it indicates that the host can accommodate the disconnect/reconnect feature.

Bits 5-3 : Always set to zero (0).

Bits 2-0 : These bits specify the logical unit number in the scanner. The ACS supports LUN zero (0) only.

Only one LUN can be identified for any one selection sequence; a second IDENTIFY message with a new LUN must not be issued before the bus has been released (BUS FREE phase).

When the IDENTIFY message is sent from the scanner to the host during reconnection, an implied RESTORE POINTERS message (not explicitly supported or sent by the scanner) will direct the host to restore the data pointers associated with this transfer.

SYNCHRONOUS DATA TRANSFER REQUEST (SDTR) -
An SDTR message exchange shall be initiated by a SCSI device whenever a previously-arranged data transfer agreement may have become invalid. In addition, a SCSI device may initiate an SDTR message exchange whenever it is appropriate to negotiate a new data transfer agreement (either synchronous or asynchronous. SCSI devices that are capable of synchronous data transfers shall not respond to an SDTR message with a MESSAGE REJECT message.

The SDTR message exchange establishes the permissible transfer periods and REQ/ACK offsets for all logical units and target routines on the two devices. This agreement applies only to data phases.