Eaton Corp
NV-GSD/HE

SECS/GEM Interface
Manual

Part 8200677, Rev C

EATON
Semiconductor
Equipment

This manual version, Part No. 8200677 Revision C (final), corresponds to NV-GSD/HE software releases 2.7b03.1 or later, 2.8b03.1 or later, and 2.9b03 or later.

Eaton Corporation
Semiconductor Equipment Division
108 Cherry Hill Drive
Beverly, MA. 01915

EATON
Semiconductor Equipment

SAFETY INTRODUCTION

Safety is designed into all Eaton Corporation/Semiconductor Equipment Division products. Every effort has been made to eliminate safety hazards in the NV-GSD/HE series Ion Implantation System.

Certain hazards exist in all ion implantation systems. Never operate or service this system without a thorough knowledge of the dangers involved and the precautions to be followed for safe and efficient operation. Refer to Safety Manual, part number **8200692** for detailed instructions.

Throughout this manual, **DANGER**, **WARNING,** and **CAUTION** statements as well as **NOTES** are provided whenever a potential for injury to personnel or damage to equipment exists. **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or damage to equipment. **NOTES** convey information that aids in the performance of a procedure or the understanding of a concept.

It is essential that all **DANGER**, **WARNING**, **CAUTION** statements and **NOTES** be observed. Eaton Corporation/Semiconductor Equipment Division cannot be held responsible for injuries to personnel or damage to equipment resulting from ignoring any **DANGER**, **WARNING**, **CAUTION** and **NOTE.**

GENERAL SAFETY CONSIDERATIONS

Safety procedures described in this manual are minimum guidelines. Eaton believes that these guidelines will provide an acceptable level of Safety. When using this equipment. These guidelines should not be considered a substitute for determining your own internal Safety procedures in consultation with a competent Safety professional.

Use of controls, adjustments, or procedures other than those specified in this manual without consulting a competent Safety professional may result in exposure to potential hazards.

Always follow established industrial safety practices when operating any production equipment.

Never permit unauthorized or untrained personnel access to the system.

Never stand in water or on a wet surface while operating any electrically powered equipment.

Never put hands near moving parts in the end station during operation.

WARNING: Please note that whenever the machine SECS Protocol Type is changed, you must reboot both the Primary Sun and the Cell .

Revisions

December 20, 1994
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May 27, 1995
NV-GSD/HE
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June 14, 1995
Additional data for Binary Implant Data Logs, Stream 6 Function 8 and Stream 6 Function 9 Binary Format

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General rewrite
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March 1, 1998
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Rev C release (Preliminary)
Added appendices and index.

June 12, 1998
NV-GSD/HE
Rev C release (Final)
Added support for GEM version E30-95
Manual updated, including general edit

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Chapter 1
Overview

WARNING: Too many reports, traces, or limits monitoring could overload the SECS Data Link and impair system performance. Be sure to test customizations that place heavy demand on your data connection to your equipment before starting up full production.

The maximum data link transfer rate is approximately 1140 characters per second for a 9600 bit/second line. This limitation must be taken into account in the Host system design.

1.1 GEM Compliance

Note: This manual supports the E30-95 GEM configuration. This configuration includes the Year 2000 patch.

This section describes the GEM functions implemented in this Equipment. See Table 1-1, GEM Compliance Statement.

1. The GSD-HE never sends S2F25 (Loopback diagnostic) to the Host. It sends the appropriate S2F26 in response to an S2F25 message from the Host.
2. The GSD-HE never sends S9F13 (Conversation Timeout) to the Host. The Equipment can be defined as having an “infinite timeout” for conversations.
3. The GSD-HE never sends S10F7 (Multi-Block Not Allowed) to the Host. It accepts incoming messages consisting of printable characters and a maximum of 160 characters.

Table 1-1. GEM Compliance Statement

Fundamental GEM Requirements	Implemented?	GEM Compliant?
State Models	YES	YES
Equipment Processing States	YES	YES
S1F13/F14 Scenario	YES	YES
Event Notification	YES	YES
On-line Identification	YES	YES
Error Messages	YES	YES
Documentation	YES	YES
Additional Capabilities	**Implemented?**	**GEM Compliant?**
Establish Communications	YES	YES
Dynamic Event Report Configuration	YES	YES
Variable Data Collection	YES	YES
Trace Data Collection	YES	YES
Status Data Collection	YES	YES
Alarm Management	YES	YES
Remote Control	YES	YES
Equipment Constants	YES	YES
Process Program Management	YES	YES
Material Movement	YES	YES
Equipment Terminal Services	YES	YES
Clock	YES	YES
Limits Monitoring	YES	YES
Spooling	YES	YES

1.2 Basic Definitions

This manual describes the interface between two machines:

- The Eaton Manufacturing implantation equipment - hereafter, The Equipment
- A controlling host computer - hereafter, The Host.

The purpose of this manual is to supply all information necessary to write the Host-based software needed for it to perform its functions. This manual does not cover matters such as installation and commissioning. Communications standards are included for completeness.

Communication between the Equipment and the Host is based on the SECS-I and SECS-II standards published by the Semiconductor Materials and Research International (SEMI). It is based on the Generic Equipment Model (GEM). This implementation is based on G.W. Associates *gwgem* core software.

Certain chapters may not be relevant to your configuration. For example, if your system does not have a SMIF option, you may disregard Chapter 18 which describes it. Likewise, if you do not make use of an AGV, you may ignore Chapter 20.

1.3 Chapter Structure

This section gives a brief description of each chapter. See the table-of-contents for specific sections and subsections.

- Chapter 1 - Overview

  Purpose and scope of the manual.
- Chapter 2 - Startup

  Cable connections to Host, entering values into the configuration screens, bringing the Equipment to an ON-LINE condition.
- Chapter 3 - GEM Communications

  Streams and functions, communications standards, message structure, timing parameters.
- Chapter 4 - Data Item Dictionary

  Descriptions of data items such as **ABS, ACKC5, ACKC7**, and others.
- Chapter 5 - Variable Item Dictionary

  Descriptions of variable items such as **AlarmID, AlarmsEnabled, AlarmsSet, Clock**, and others.
- Chapter 6 - Reports, Status Variables, Collection Events

  Discusses status variables, reports, and collection events.
- Chapter 7 - Limits Monitoring

  Discusses how limits are defined and how the crossing of limits generates collection events.
- Chapter 8 - Alarm Management

  Describes alarms, how they are coded, associated reports and collection events.
- Chapter 9 - Remote Control

  Lists the commands for the ON-LINE REMOTE mode that may be issued from the Host and those that may be performed by the Equipment operator.
- Chapter 10 - Spooling

  Discusses the spooling facility used to save outgoing messages in the event of a communications breakdown.
- Chapter 11 - Process Program Management

  Describes the storing, editing, uploading, and downloading of process programs.
- Chapter 12 - Material Movement

  Describes the loading and unloading of cassettes, including those under operator and those under Host control.
- Chapter 13 - Equipment Terminal Services

  Describes the exchange of free text with the Host.

- Chapter 14 - Clock

  Describes the messages sent (a) to ascertain the clock reading and (b) to transmit the clock reading.
- Chapter 15 - Process States

  State diagrams and descriptive material for six different processes.
- Chapter 16 - Message Summary

  A list of all messages and their coding.
- Chapter 17 - SECS Scenarios

  A collection of message sequences for a variety of situations, along with comments regarding each message. Some of these also appear in the chapter where they are relevant.
- Chapter 18 - The SMIF Option

  Describes the purpose, modes of operation, configuration points and messages, and alarms of the Standard Mechanical Interface (SMIF).
-
- Chapter 19 - Custom Implant Data Log

  Procedures for creating a custom implant data log for those who prefer to have one shorter than the standard one.
- Chapter 20 - Automated Guided Vehicle

  Describes the purpose, modes of operation, configuration points and messages, and alarms of the Automated Guided Vehicle (AGV).

1.4 Wafer Handling Basics

This subsection describes the basic terms and procedures involved in wafer handling (moving silicon wafers onto the implanter and into position for semiconductor implanting, and removing completed wafers from the implanter).

1.4.1 Descriptions of Terms

- Wafers -- silicon disks that are the basic material for production of semiconductor chips.
- Cassettes -- portable containers for transporting silicon wafers to and from the implanter. Cassettes can hold 25 (some can hold 26) wafers.
- Moveable **table** -- a table that moves horizontally left and right to bring the cassettes into position where they can be reached by the stationary Robot Arm. Operators access the moveable table through a door which is opened only when cassettes are placed on or removed from the table.
- Port -- a receptacle on the moveable table for holding cassettes of wafers. There are four ports on the table numbered Port 1 through Port 4.
- Robot Arm -- the mechanical arm that moves wafers in and out of cassettes and to and from other locations on the endstation. The robot arm operates from a fixed position.

Figure 1-1 shows the moveable table with its four ports and the Robot Arm.

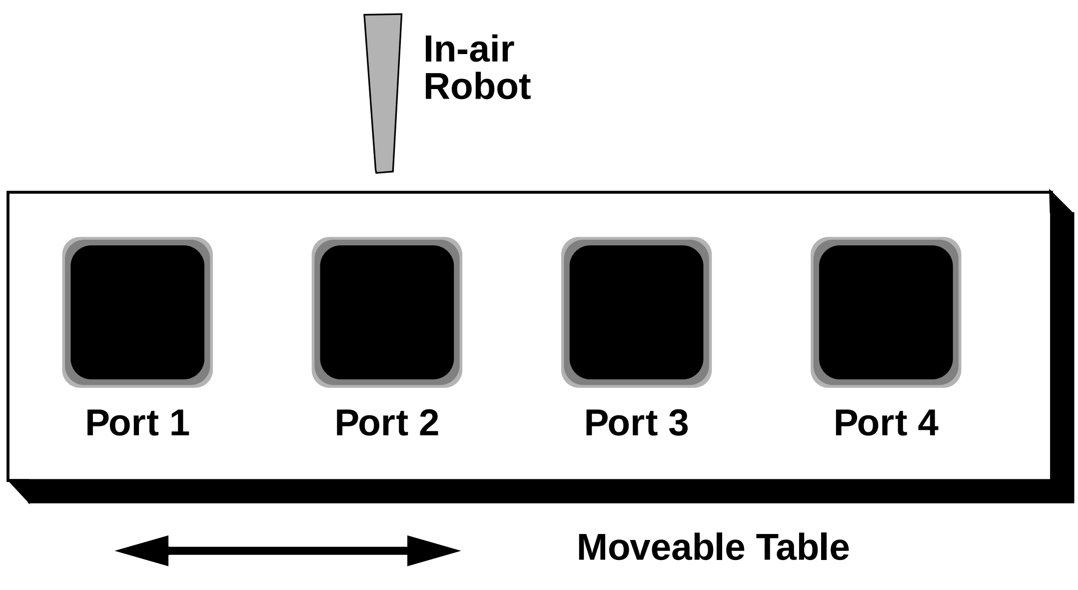

Figure 1-1. Moveable Table and In-air Robot

1.4.2 Placement and Extraction

Cassettes to be processed are placed (either by an operator or a mechanical device) in the ports on the moveable table. When the implanter is ready to process a specific cassette, the table moves to align the target port to the Robot

Arm.

The robot arm extracts wafers from the cassette by suction. The wafers are first moved to an alignment device for accurate alignment, then placed in a storage buffer where they await processing. When it is the turn of the wafers in the buffer to be processed, the robot arm moves them to a loader that places them on the large circular **disk** in the implanter. The wafers are placed on the implanter disk in a circular pattern, 13 to a disk. If fewer than 13 wafers are going to be processed, dummies must be used to maintain a proper balance on the disk.

After the implantation is complete, the whole process is performed in reverse to remove the wafers from the implanter and return them to their cassette, which can then be removed from the endstation.

1.4.3 Optional External Cassette Handling Devices

There are two optional cassette handling devices which provide a means of mechanically placing a cassette on the table. This avoids human handling and thus permits operation in a non-Clean Room environment. These two devices are:

- A SMIF Arm, discussed in Chapter 18
- An Automated Guided Vehicle (AGV), discussed in Chapter 20.

These are both optional equipment. These chapters are relevant only to those who have these equipment options.

1.5 Harel State Diagrams

The various states of the equipment and the transitions between states are described in **Harel State Diagrams.** This section presents such a diagram for each of the two phases: Communication and Control.

A Harel State Diagram, together with a supporting table, names each of the possible states the equipment can be in, the actions that can be taken from that state, and the resulting state it transitions to.

1.5.1 Harel State Diagrams Description

This subsection describes the Harel diagrams themselves.

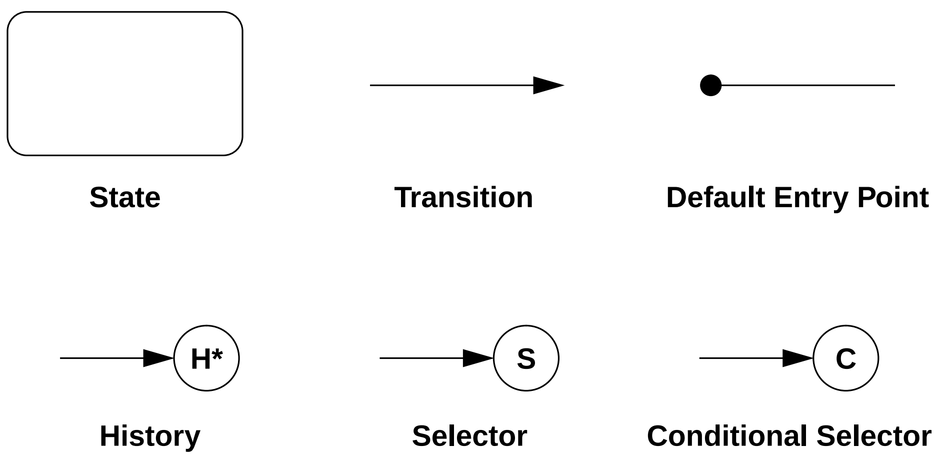

Figure 1-2. Symbols Used in Harel Diagrams

States are represented by rounded rectangles. Transitions between states are represented by an arrow from the old state to the new one. Such an arrow represents only the change in the indicated direction. If a change in the reverse direction is possible, it is indicated by a different arrow.

A state may be subdivided into substates. These substates can be one of two different types:

- OR substates are mutually exclusive. *Given* that we are in the parent state, then we are in one of the OR substates, or we are in the other one -- never in both at the same time.
  An example of this is the state of a light switch. It is either ON or it is OFF; it cannot be both at the same time.
- AND substates. If a parent state is comprised of two or more AND substates, then being in the parent state implies being in all of its AND substates.
  An example of this would be an auto engine in a running state. Among the AND substates are: ignition turned on, fuel pump working, and spark plugs firing. Being in the parent state “Engine running” implies being in all of those substates.

Figure 1-3 below is a state diagram for a lamp.

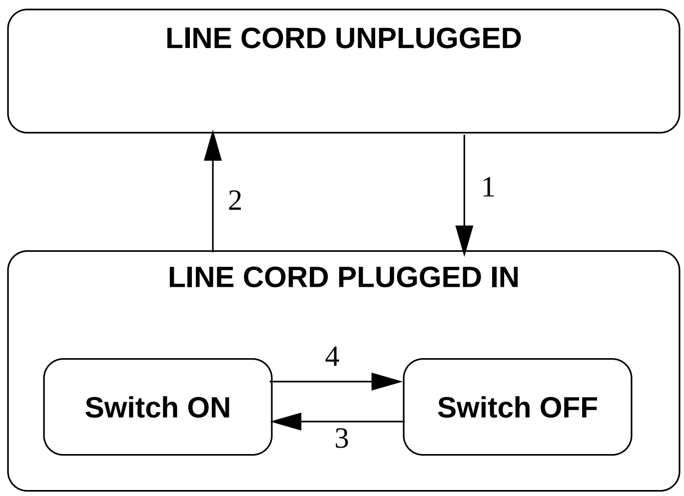

Figure 1-3. Harel State Diagram for a Lamp

The above figure shows all of the possible states of a lamp. There are the two main states: LINE CORD UNPLUGGED and LINE CORD PLUGGED IN. The second of these has the two substates: Switch ON and Switch OFF.

Table 1-2 describes the states and the possible transitions between states.

Table 1-2. State Transitions for the Lamp

#	Current State	Trigger	New State	Comment
1	LINE CORD UNPLUGGED	Connect line cord	LINE CORD PLUGGED IN	
2	LINE CORD PLUGGED IN	Unplug line cord	LINE CORD UNPLUGGED	
3	SWITCH OFF	Turn switch to ON	SWITCH ON	This is the only condition in which the lamp lights
4	SWITCH ON	Turn switch to OFF	SWITCH OFF	

Chapter 2
GEM Interface Configuration and Startup

2.1 Introduction

The implantation equipment is commissioned at the vendor's plant before it is delivered to the customer's site. The machine is configured with hardware that is specific to the customer's process (for example, pumps).

After the equipment is delivered, two additional procedures must be performed:

- Set up the GEM configuration. This is described in Section 2.3.
- Establish communications with the Host computer. This is described in Section 2.4.

This chapter is organized as follows:

- Section 2.1 Introduction
- Section 2.2 Connections to the Host Computer
- Section 2.3 Configuring for GEM
- Section 2.4 Setting up Host Communications
- Section 2.5 State Diagrams
- Section 2.6 Flow Diagrams.

WARNING: Whenever the SECS Protocol Type is changed, you must reboot both the Primary Sun and the Cell (Section 2.3.3).

2.2 Connections to the Host Computer

Figure 2-1 below shows the equipment block diagram with connections to the Host computer.

The Interconnect Panel is located under the Primary Sun computer.

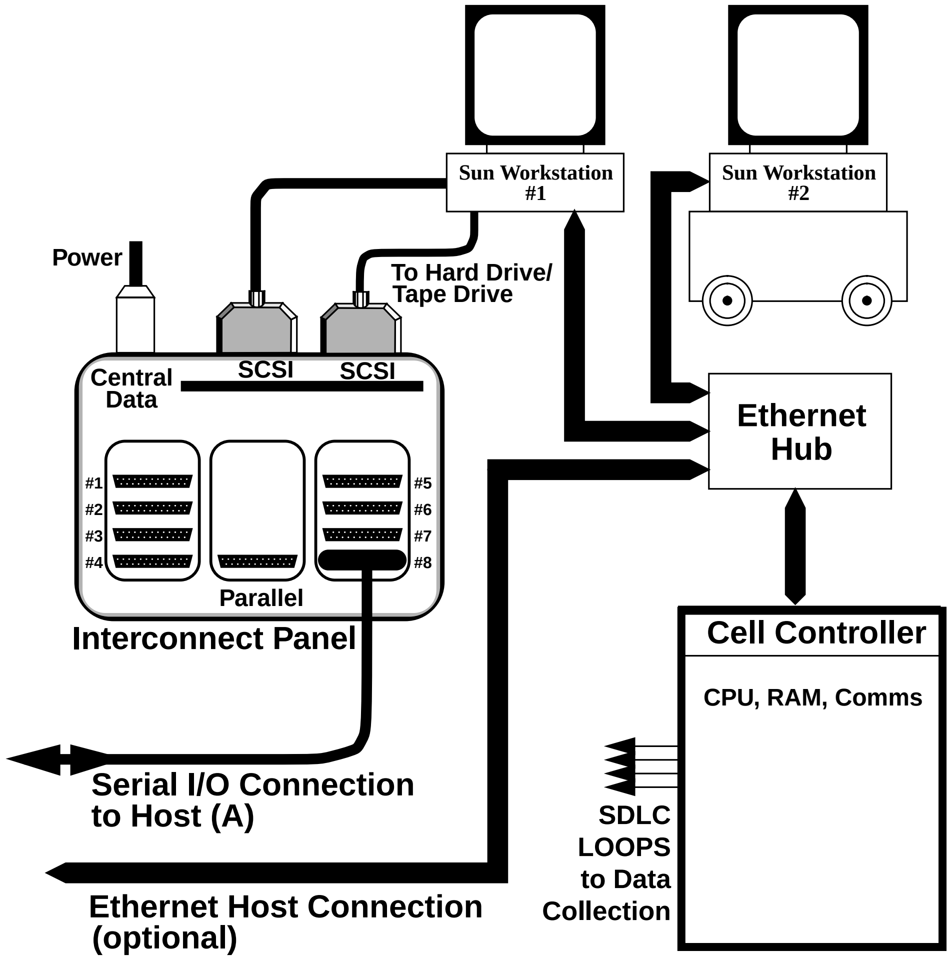

Figure 2-1. Equipment Block Diagram

2.3 Configuring for GEM

2.3.1 Logging In

1. Log in to the system to obtain the Main Menu screen, shown in Figure 2-2. To proceed, you must have supervisor privileges.

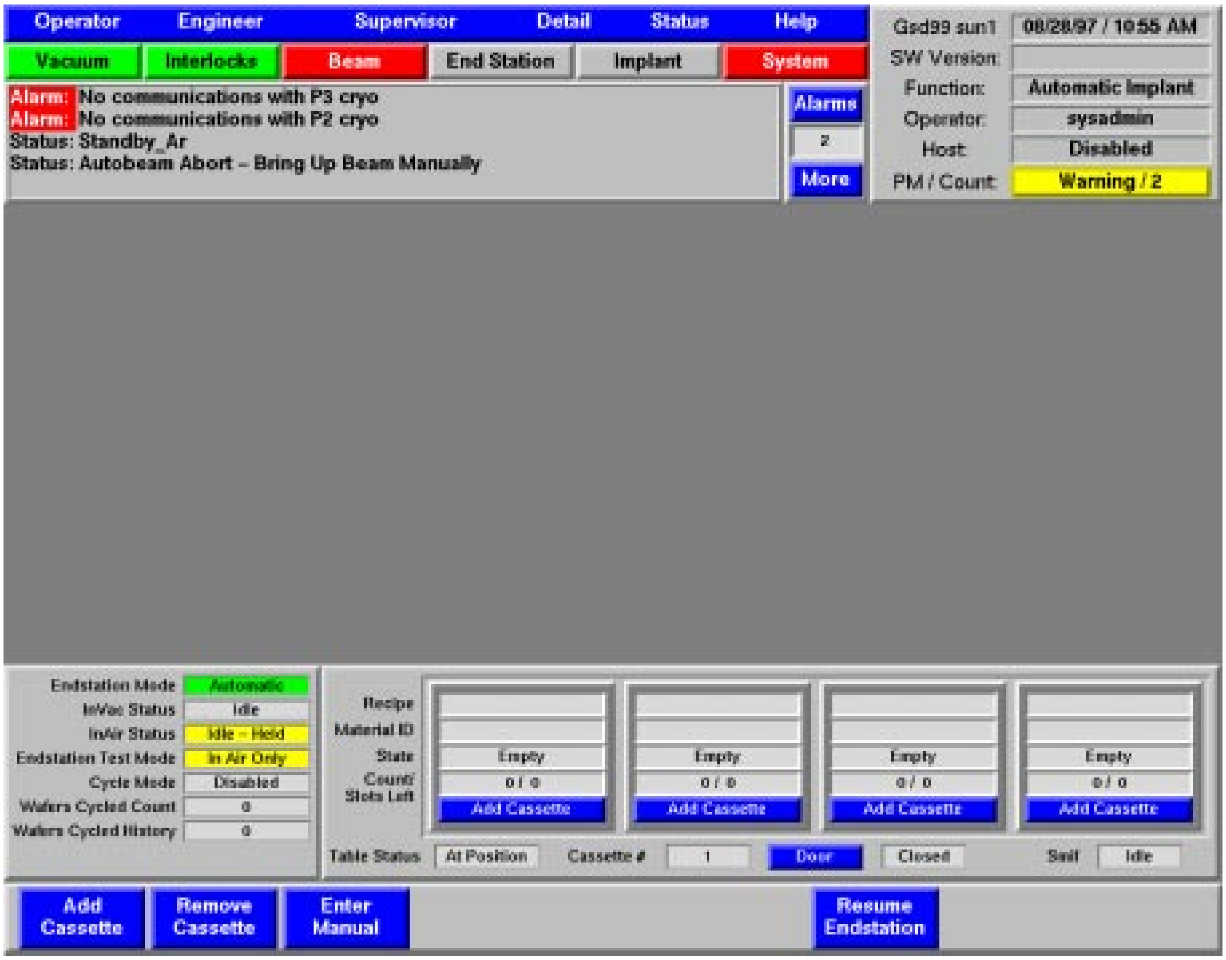

Figure 2-2. Main Menu Screen

2. From the menu bar at the top of the Main Menu, select **Supervisor:Configuration Editor.**

The Configuration Editor screen is displayed.

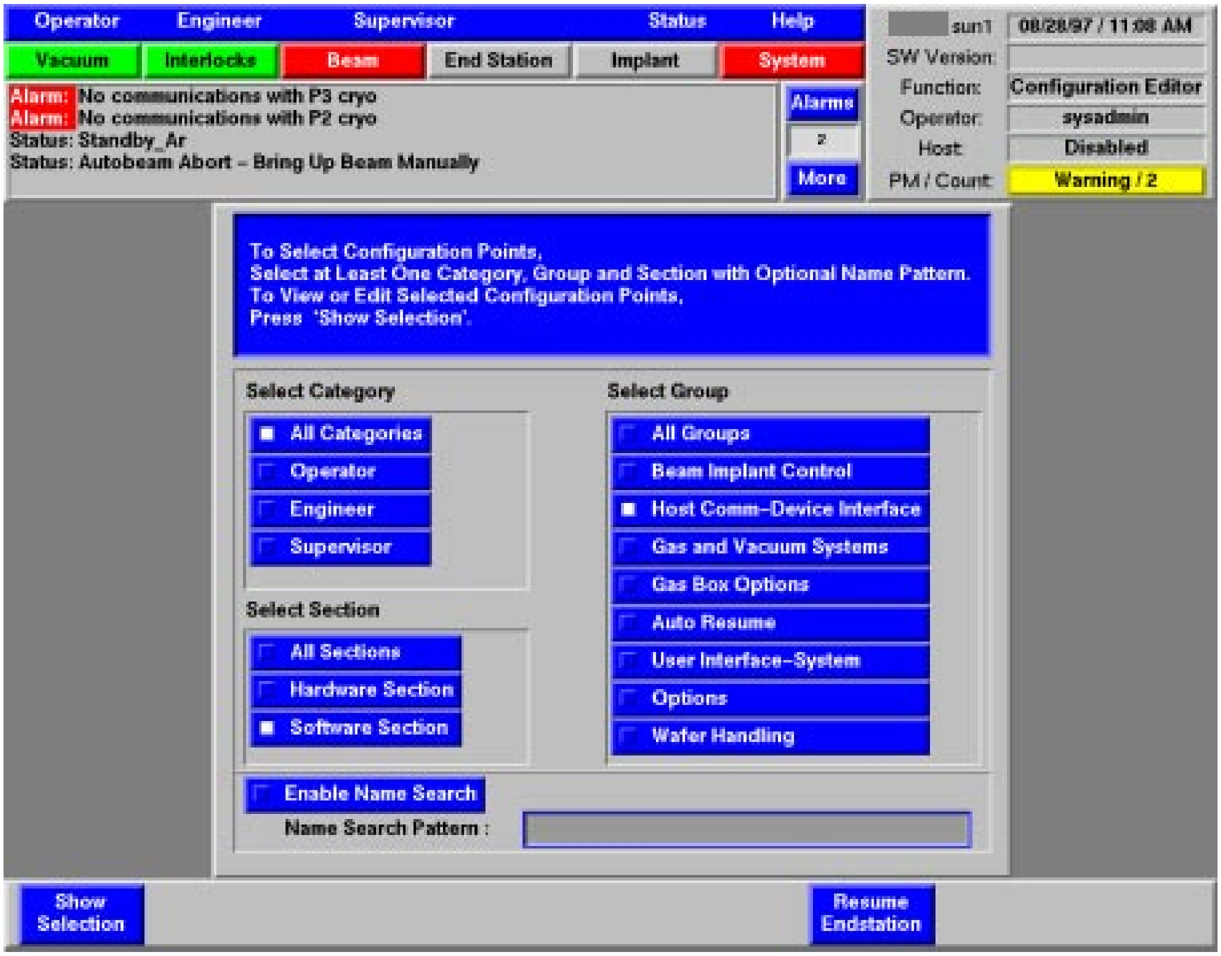

Figure 2-3. Configuration Editor Screen

3. Click on the three choices shown:
   - Select Category -- All Categories
   - Select Section -- Software Section
   - Select Group -- Host Comm - Device Interface

   Be certain that **Enable Name Search** is not selected.
   Then click **Show Selection**. The Configuration Points screen is displayed.

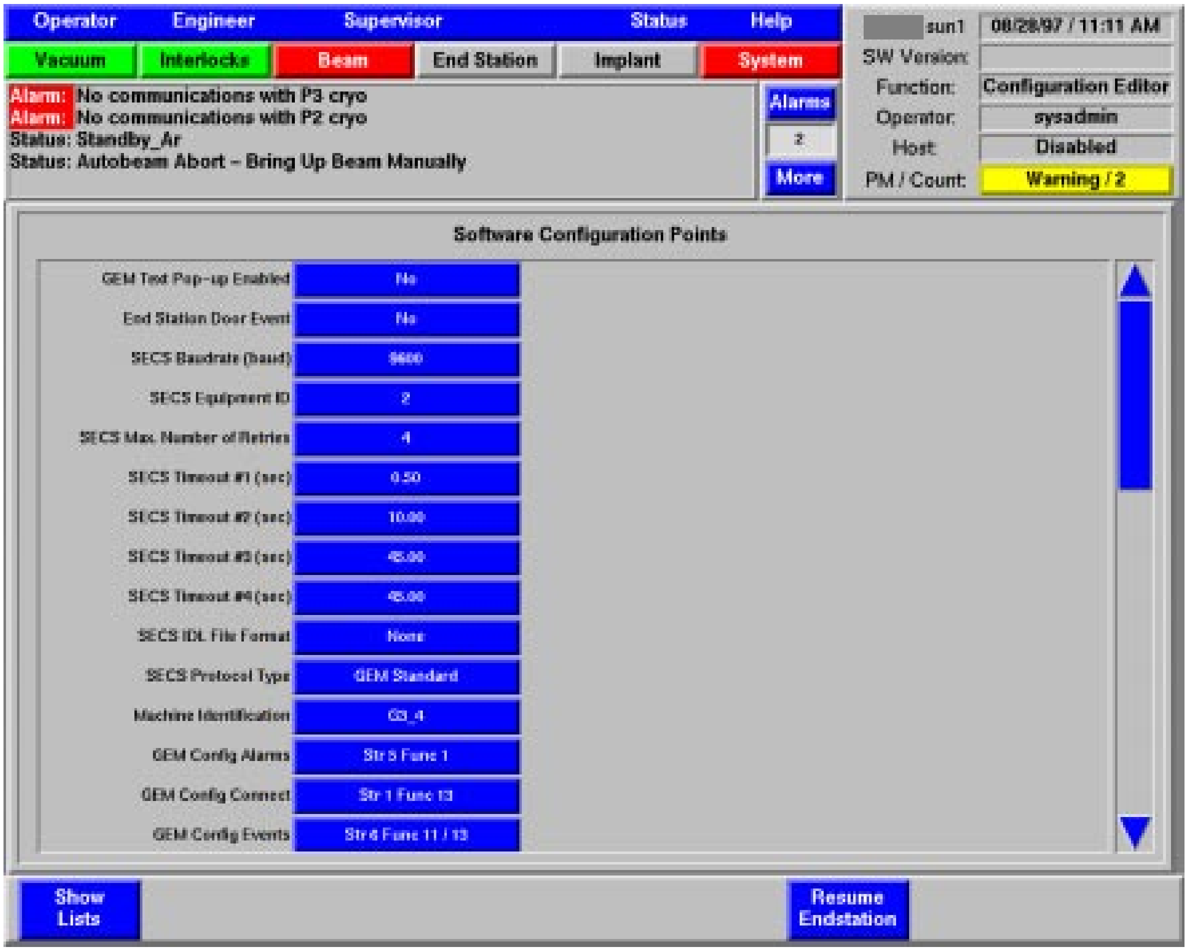

Figure 2-4. Configuration Points Screen

There are twice as many configuration points as you see here on this screen; use the scroll bar on the right to scroll down to the others.

2.3.2 Entering Configuration Values.

Enter values for the configuration points that apply to your installation. Table 2-1 below describes the function and values of each configuration point. The entries in this table are listed in the order corresponding to the configuration points on the Software Configuration Points screen.

Most of the configuration points in Table 2-1 can be set from the host; those that cannot must be set from the Configuration Points screen on the equipment. These are indicated as “Not settable by Host” in the table. All configuration points are backed up in battery-backed RAM on the equipment, so those that are not settable from the host need only be set once on the equipment.

Note that for each entry in the table, there are three different names (sometimes two are the same):

- Equipment constant. The name by which an item is commonly known.

- Database name. The item’s name in the database.
- Config Table name. The name on the configuration screen.

Table 2-1. Equipment Constants

Equipment Constant	**ECID**	**Database name**	**Config Table name**
	Format	**Range/default/increment** **(Example: For T1, range is 0.1-10 secs default is 0.5 secs increment is 0.1 secs)**	**Options M,C,N,H,R** M: must be configured for GEM C: compatible with GEM and should be so configured N: cannot be used with GEM H: configurable by the Host R: Restart GEM for change to take effect
	Comments, possible choices **Default choice**		
GEM Text Pop-up Enabled	2815	DB_CF_GEM_TXT_PU_ENABLED_IV	Gem Text Pop-up Enabled
		yes, no	
	Not settable by Host. yes = Text messages from Host appear in a pop-up window no = Test messages from Host appear in a regular status window Default = **no**		
End Station Door Event			End Station Door Event
	Not settable by Host		
Baud Rate	10061	Host_Req_Baud	SECS Baudrate (baud)
	U4	300, 1200, 2400, 4800, 9600,19200 Default = 9600	H, M, R
	WARNING; Changing the Baud rate from the Host can result in lost communications.		
SECS Equipment ID	10062	Host_REQ_Gem_Equip_Id	SECS Equipment ID
	U4	0-32767/1/1	H, M
	Default = 1		
RTY	10063	Host_Req_Gem_Retry	SECS Max Number of Retries
	U4	0-31/3/1	H, M
	Transmit failure retry limit. Default = 3		
T1	10064	Host_Req_Gem_TOne	SECS Timeout #1
	F4	0.1-10 secs/0.5/0.1	H, M
	Inter-character timeout. Default = 0.5		
T2	10065	Host_Req_Gem_TTwo	SECS Timeout #2
	F4	0.2-25 secs/10.0/0.1	H, M
	Protocol timeout. Default = 10.0		
T3	10066	Host_Req_Gem_TThree	SECS Timeout #3
	F4	1-120 secs/45/1.0	H, M
	Transaction timeout. Default = 45.0		

Table 2-1. Equipment Constants (Continued)

T4	10067	Host_Req_Gem_TFour	SECS Timeout #4
	F4	1-120 secs/45/1.0	H, M
	Inter-block timeout. Default = 45.0		
SECS IDL File Format		DB_SECS_IDL_FORMAT_IV	SECS IDL File Format
	U4		C
	Not settable by Host. ASCII File, Binary, ASCII and Binary, None. Default = **NONE**		
SECS Protocol Type		DB_CF_MACHINE_SECS_TYPE_IV	SECS Protocol Type
	U4	Standard, Extended, GEM Standard, String 64, Option 9	M, R
	Not settable by Host. Default = **GEM Standard**.		
Machine Identification		DB_CF_MACHINE_ID_SV	Machine Identification
	ASCII	string	
	Not settable by Host. Default = **NONE**		
GEM Config Alarms	10001	ConfigAlarms	GEM Config alarms
	U1	0,1, or 2 (see comments)	H,M
	Selects the message the equipment will send for alarm reports Str5 Func73 (2) Str5 Func71 (1) Str5 Func1 (0) Default = **Str5 Func1**		
GEM Config Connect	10002	ConfigConnect	GEM Config Connect
	U1	0,1, or 2 (see comments)	H,M
	Selects which message the equipment will send for a Connect Request Str1 Func13 (2) Str1 Func 65 (1) Str1 Func1 (0) Default = **Str1 Func13**		
GEM Config Events	10003	ConfigEvents	GEM Config Events
	U1	0 or 1 (see comments)	H,M
	Str6 Func11/13 (1) Str6 Func3/9 (0) Default = **Str6 Func11/13** NOTE; The choice between --for example-- Func11 and Func13 is made by **GEM Report Type.**		

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Table 2-1. Equipment Constants (Continued)

GEM Init Comm State	10009	GemInitCommState	Gem Init Comm State
	U1	Enabled, Disabled (see comments)	H,M
	1=Enabled........ Equipment powers on in the NOT COMMUNICATING state 0=Disabled....... Equipment powers on in the DISABLED state Default = **Disabled** (See Figure 2-10, Flow Diagram for Startup)		
GEM Init Control State	10010	GemInitControlState	GEM Init Control State
	U1	Online (1) Offline (0)	M,H,R
	1=Online .... Equipment powers on in the ONLINE state 0=Offline ....Equipment powers on in the OFFLINE state Default = **Offline**		
GEM Write Bit Stream 10	10019	WBitS10	GEM Write Bits Stream 10
	U1	Set, Clear (see comments)	H,M
	Determines whether S10 primary messages sent by the Equipment will have their W-bit set to 0 or to 1. Set ...... W-bit is set to 1 Clear ... W-bit is set to 0 Default = **Set**		
GEM Write Bit Stream 5	10020	WBitS5	GEM Write Bits Stream 5
	U1	0,1 (see comments)	H,M
	Determines whether S5 primary messages (Str5 Func1/Func71/Func73) sent by the Equipment will have their W-bit set to 0 or 1. Set ...... W-bit is set to 1 Clear ... W-bit is set to 0 Default = **Set**		
GEM Write Bit Stream 6	10021	WBitS6	GEM Write Bits Stream 6
	U1	Set, Clear	H,M
	Determines whether S6 primary messages (Str6 Func1/Func3/Func9/Func11/Func13) send by the Equipment will have their W-bit to set 0 or to 1. Set ...... W-bit is set to 1 Clear ... W-bit is set to 0 Default = **Set**		
GEM Est Comm Delay	10006	GemEstabCommDelay	GEM Est Comm Delay
	U2	0-65000 secs/60/1	H,M
	Time between attempts to establish communications. A value of 0 disables an Equipment-initiated request. Default = **60**.		

Table 2-1. Equipment Constants (Continued)

<table>
<tr><td rowspan="3">GEM Heart Beat</td><td>10011</td><td>GemPollDelay</td><td>GEM Heart Beat</td></tr>
<tr><td>U2</td><td>0-65000 secs/30/1</td><td>H,M</td></tr>
<tr><td colspan="3">Interval between successive sendings of an Str1 Func1 “heartbeat” to assure the Equipment that it is still communicating with the Host. A value of 0 disables this function.
Default = 30.</td></tr>
<tr><td rowspan="3">GEM Report Type</td><td>10018</td><td>RpType</td><td>GEM Report Type</td></tr>
<tr><td>BOOLEAN</td><td>Normal (false); Annotated (true)</td><td>H,M</td></tr>
<tr><td colspan="3">Determines whether the equipment will send normal or annotated event reports.

False ... . Equipment sends “normal” event reports (S6F9/F11)
True .... Equipment sends annotated event reports (S6F3/F13)

Default = FALSE</td></tr>
<tr><td rowspan="3">GEM Device Name</td><td>10005</td><td>GemDeviceName</td><td>GEM Device Name</td></tr>
<tr><td>ASCII</td><td>16 characters max</td><td>H</td></tr>
<tr><td colspan="3">Default = NV-20A</td></tr>
<tr><td rowspan="3">Extended SECS Mode</td><td></td><td>DB_EXTENDED_SECS_MODE_IV</td><td>Extended SECS Mode</td></tr>
<tr><td></td><td></td><td>M, R</td></tr>
<tr><td colspan="3">Extended A, __B, __C, __D, __E, __F
Not settable by Host.
Default = Extended A</td></tr>
<tr><td rowspan="3">Limits Monitor Interval</td><td>10086</td><td>GemLimitsDelay</td><td>Limits Monitor Interval</td></tr>
<tr><td>U2</td><td>5-32000/10/1 seconds</td><td>H,M,R</td></tr>
<tr><td colspan="3">Default = 10</td></tr>
<tr><td rowspan="3">Max Number of Messages to Transmit for a S6F23</td><td>10070</td><td>GemMaxSpoolTransmit</td><td>Max Number of Messages to Transmit for a S6F23</td></tr>
<tr><td>U4</td><td>0-32000/0/1</td><td>H,M,R</td></tr>
<tr><td colspan="3">Default = 0</td></tr>
<tr><td rowspan="3">Spooling Enabled</td><td>10071</td><td>GemConfigSpool</td><td>Spooling Enabled</td></tr>
<tr><td>U1</td><td>yes (1), no (0)</td><td>H,M,R</td></tr>
<tr><td colspan="3">Default = no</td></tr>
<tr><td rowspan="3">Overwrite Spool When Full</td><td>10072</td><td>GemOverWriteSpool</td><td>Overwrite Spool When Full</td></tr>
<tr><td>BOOLEAN</td><td>True, false</td><td>H,M,R</td></tr>
<tr><td colspan="3">Default = False</td></tr>
</table>

Table 2-1. Equipment Constants (Continued)

GEM Off-line Substate	10076	GemOfflineSubstate	GEM Off-line Substate
	U1	1, 2, or 3 (see comments)	H,M,R
	Determines the state the Equipment passes to once Host communication has been established. EQPT OFF-LINE (1) ATTEMPTING ON-LINE (2) HOST OFF-LINE (3) Default = **EQPT OFF-LINE** See Figure 2-8, Flow Diagram for Startup		
GEM On-line Fail Substate	10077	GemOnlineFailed	GEM On-line Fail Substate
	U1	1, 3	H,M,R
	Determines the state the Equipment passes into in the event of a failure to go on-line. EQPT OFF-LINE(1) HOST OFF-LINE(3) Default = **EQPT OFF-LINE** See Figure 2-10, Flow Diagram for Setup		
GEM On-line Substate	10075	GemOnlineSubstate	GEM On-line Substate
	U1	4,5	H,M,R
	Determines the state the Equipment passes to once it succeeds in getting on-line. ON-LINE LOCAL(4) ON-LINE REMOTE (5) Default = **ON-LINE LOCAL**		
GEM E30 Version	5583	DB_CF_GEM_E30_VERSION_IV	E30 Version
		E30-92 (1), E30-95 (0)	M, R
	Not settable by Host. E30-92 does not support the Control Model. Default = **E30-95**		

Table 2-1. Equipment Constants (Continued)

GEM Time Format	10101	TimeFormat	Gem Time Format
	U1	0, 1 (see comments)	H, M
	Determines the format of the time data displayed in the GemTime variable (10040). Format can be 12 (0) or 16 (1) characters. 0=yymmddhhmmss, where: yy=year mm=month dd=day hh=hour mm=minute ss=second 1=yyyymmddhhmmsscc, where: yyyy=year mm=month dd=day hh=hour mm=minute ss=second cc=centisecond Default=0		

The following table shows the configuration required to support the GEM E30-95 Mode of Operation with the GEM “Control State”.

Table 2-2. Host Communication Configuration for GEM E30-95 Support

Configuration Point	Value
SECS Protocol Type	GEM Standard
GEM Config Alarms	S5 F1
GEM Config Connect	S1 F13
GEM Config Events	S6 F11/13
GEM Init Comm State	(as required)
GEM Init Control State	(as required)
GEM Report Type	Normal
GEM Extended Mode	Extended A
Limits Monitor Interval	10
GEM Off-line Substate	(as required)
GEM Off-line Fail Substate	(as required)
GEM On-line Substate	(as required)
GEM E30 Version	E30-95
AGV Present	No

The AGV Present configuration point is located on the Hardware Configuration Points list.

This configuration is intended for systems without an Automated Guided

Vehicle (AGV). If there is an AGV servicing your Equipment, use the GEM E30-92 Mode of Operation recommended in Table 20-1.

2.3.3 Re-boot the Primary Sun and the Cell

Be sure to reboot the Primary Sun and the Cell after making GEM configuration changes. This is especially necessary when the machine SECS Protocol Type is changed.

1. After you have entered all values, verify the following two conditions:
    - The vacuum system is in the safe state
    - The endstation is empty of wafers
2. Reset the system:
    a) Reboot the Primary Sun.
    b) When the red window appears on the Primary Sun, then reboot the cell by pressing the red **RESET** button on the VME card.

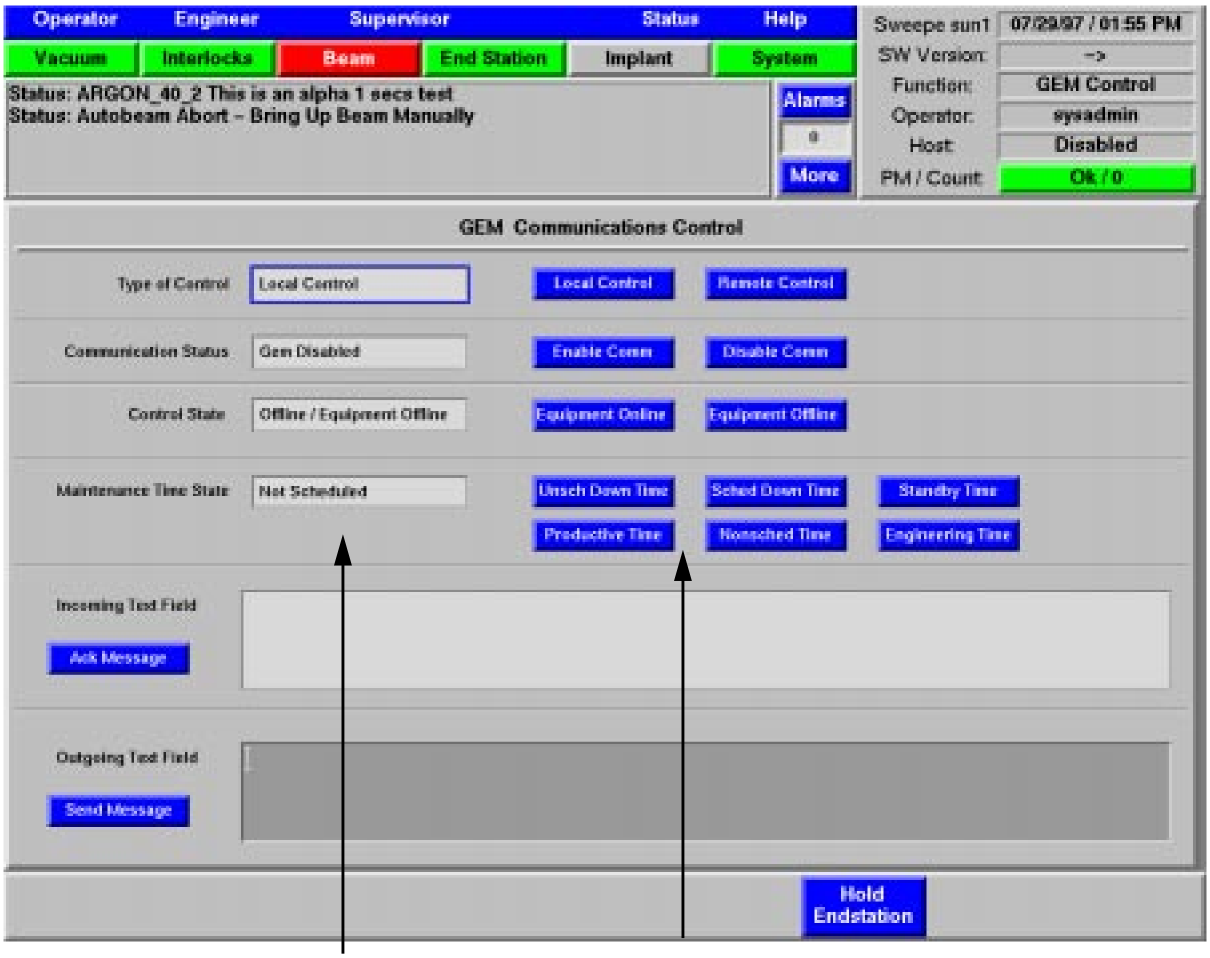
    This may take several minutes.

The reboot enables the following equipment constants:

- SECS Protocol Type
- Extended SECS Mode
- Limits Monitor Interval
- Max Number of Messages to Transmit for S6F23
- Spooling Enabled
- Overwrite Spool when Full

2.4 Setting up Host Communications

1. Select **Operator:Gem Control** from the menu bar at the top of the screen. (For this step, the operator must have "GEM/Host Screens" privileges.) The Operator's Display Initial Startup screen is displayed.



Status Displays Clickable Buttons

Figure 2-5. Operator's Display at Initial Startup (DISABLED state)

Note first the four Status Display fields. They are:

- **Type of Control** (currently: Local Control)
- **Communication Status** (currently: GEM disabled)
- **Control Status** (currently: Offline/Equipment Offline
- **Maintenance Time State** (currently: Not Scheduled)

The first three fields are related to host communication set up process; the fourth field is for maintenance purposes.

There are ten clickable buttons, starting with **Local Control**.

The state displayed in Figure 2-5 is the GEM DISABLED state.

From this state, the operator clicks the **EnableComm** button. This puts the Equipment into the GEM ENABLED state. (Communication with the Host has yet to be established.) In the GEM ENABLED state the Equipment sends an S1F13 message to the Host and “listens” for an answering S1F14. (Either may initiate this exchange.) The successful completion of this exchange puts the Equipment into the COMMUNICATING state. (Refer to the flow diagram of Figure 2-10.)

Figure 2-6 shows the screen that appears when the Equipment has passed into the COMMUNICATING state.

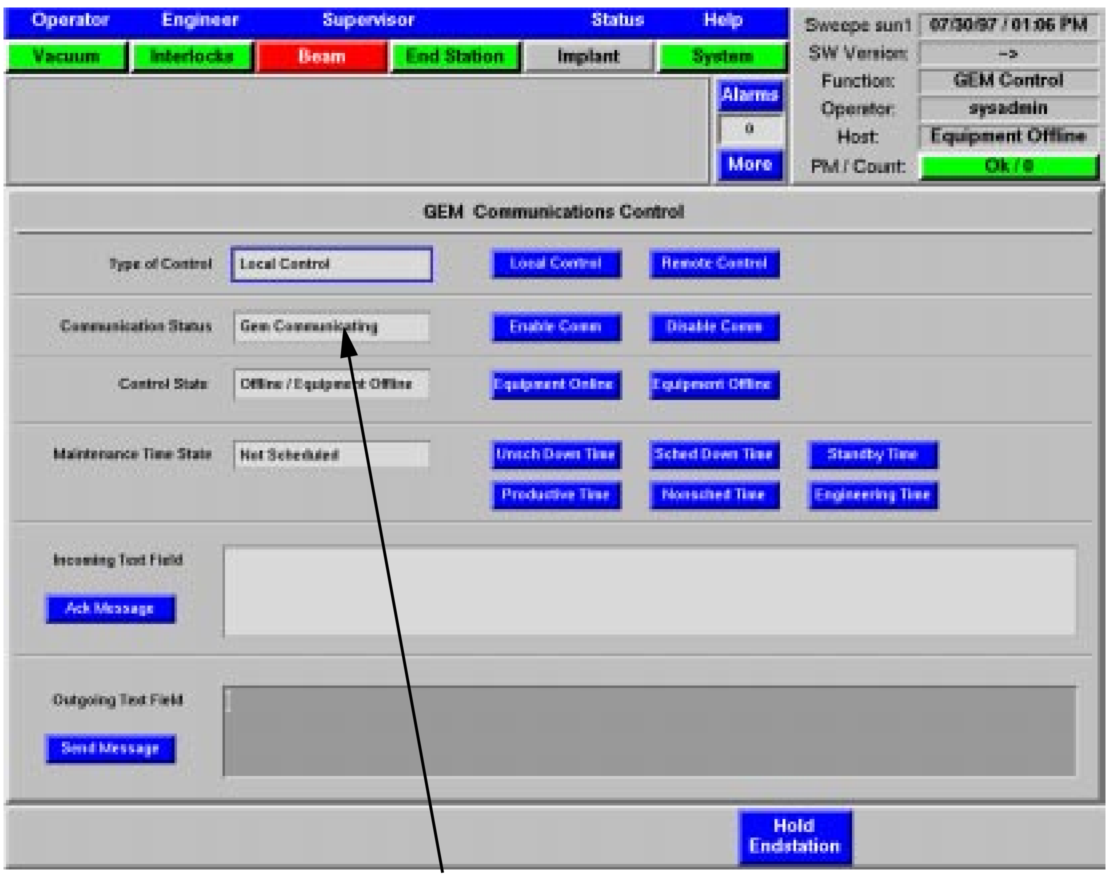


Figure 2-6. Operator’s Display in the COMMUNICATING State

Note that the **Communication Status** field has changed from GEM Disabled to Gem Communicating.

Once the operator clicks the **Enable Comm** button, the S1F13/F14 exchange is completed in a time that is imperceptible to the operator. The Equipment appeared to pass directly from the GEM DISABLED to the COMMUNICATING state. It also passed through the intermediate state GEM ENABLED.

If the F13/F14 pair is not completed, then the Equipment remains in the GEM ENABLED state and the Communication Status field reads Gem Enabled rather than Gem Communicating.

From the COMMUNICATING state the equipment passes immediately to one of the three CONTROL STATES: EQPT OFF-LINE, ATTEMPT ONLINE, HOST OFFLINE. This depends on what was programmed into **Gem Offline Substate**. (See Figure 2-10 and Table 2-1.)

Suppose that the equipment was programmed to pass from the COMMUNICATING state to EQPT OFF-LINE. To put the equipment in an on-line state, the operator clicks the button **Equipment Online**. This puts the Equipment into the ATTEMPT ON-LINE STATE.

While in the ATTEMPT ON-LINE state, the Equipment Sends an S1F1 message to the Host and “listens” for an S1F2 reply. A successful completion of this message pair puts the Equipment at the circled point (6) from where it passes into one of the two on-line states (ON-LINE LOCAL or ON-LINE REMOTE), depending on what was programmed into **GEMOnLineSubstate**.

The screen shown in Figure 2-7 is displayed when the Equipment has arrived at the ON-LINE LOCAL state. Compare this with Figure 2-6 and note that the **Control State** field has changed from **Offline/Equipment Offline** to **Online/ Local**.

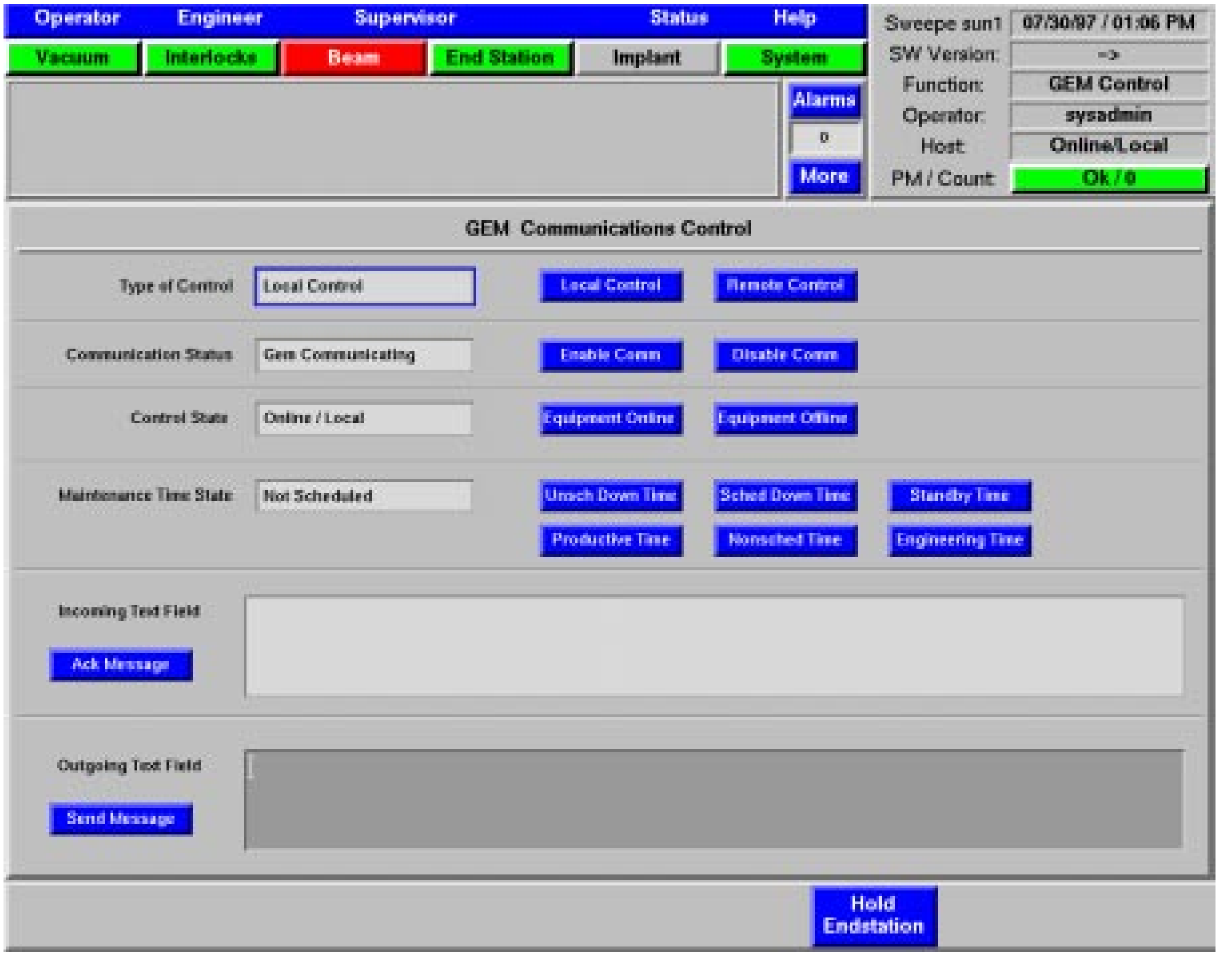


Figure 2-7. Operator's Display Panel with the Equipment On-line

From this condition the operator could click the **Remote Control** button, which would put the equipment in the ON-LINE REMOTE STATE.

2.5 State Diagrams

2.5.1 State Diagram for the Communication Phase

Figure 2-8 shows the State Diagram for the Communication phase.

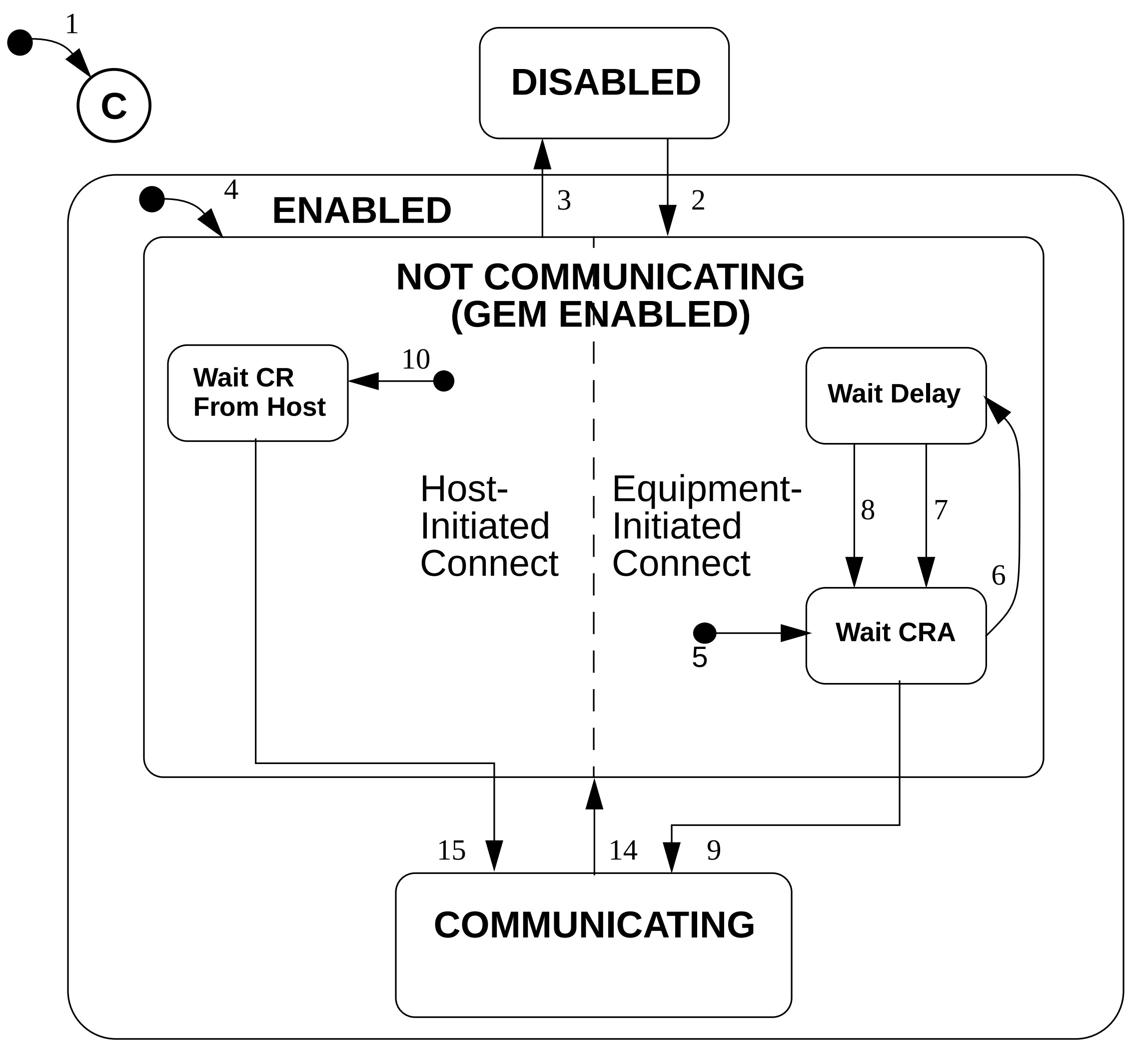


Figure 2-8. Diagram for the Communication Phase

Table 2-3 shows the transitions for the Communication Phase.

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Table 2-3. State Transitions for the Communication Phase

#	Current State	Trigger	New State	Action	Comment
1	Entry to communications	System Initialization	System Default	none	The system default may be set to ENABLED or to DISABLED
2	DISABLED	Operator clicks **Enable Comm**	ENABLED	none	Host establishes communication
3	ENABLED	Operator clicks **Disable Comm**	DISABLED	none	no communication is possible
4	Entry to ENABLED	Any entry	NOT COMMUNICAT ING	none	May enter at initialization or operator switch
5	Entry to Equipment-initiated connect	Entry to NOT COMMUNICAT ING	Wait CRA	Initialize communication s. S1F13 is sent.	Begin attempt to establish communications
6	Wait CRA	connection transaction failure	WAIT DELAY	Initialize CommDelay timer	Wait for timer to expire
7	WAIT DELAY	CommDelay timer expired	WAIT CRA	Send S1 F13	Wait for S1F14 from host. May receive S1F13.
8	WAIT DELAY	Received message other than S1F13	WAIT CRA	Discard Message	Indicates opportunity to establish communications.
9	WAIT CRA	Received S1F14 with COMMACK=0	COMMUNICAT ING	none	Communication has been established
10	Entry to HOST-INITIATED CONNECT	Any entry to NOT COMMUNICAT ING	WAIT CR from Host	none	Wait for S1F13 from Host
14	COMMUNICATI NG	Communication failure	NOT COMMUNICAT ING	Dequeue all messages queued to send	Dequeued messages may be placed in spool buffer as appropriate.
15	WAIT from Host	Received S1F13.	COMMUNICAT ING	Send S1F14with COMMACK=0.	Communications are established.

2.5.2 State Diagram for the Control Phase

As soon as communication with the host has been established the equipment immediately enters the Control Phase, in which it attempts to go on-line with the Host. Being in this condition is necessary for the Host to be able to completely control the processing operation.

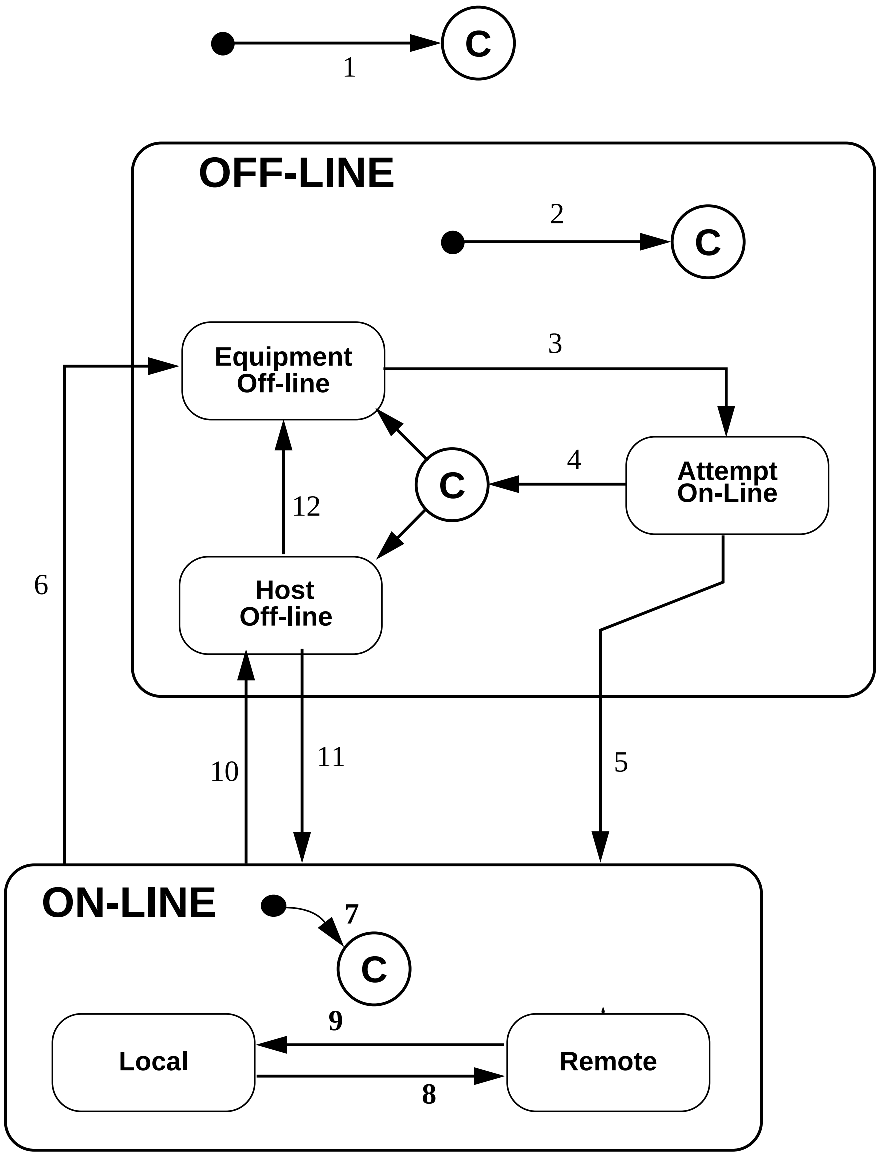

Figure 2-9. State Diagram for the Control Phase

Table 2-4 shows the state transitions for the Control phase.

Table 2-4. State Transitions for the Control Phase

#	Current State	Trigger	New State	Comment
1	(Undefined)	Entry into CONTROL phase (system initialization)	CONTROL (substate depends on configuration)	Equipment may be configured to enter either EQPT OFF-LINE, ATTEMPT ON-LINE or HOST OFF-LINE
2	(Undefined)	Entry into an OFF-LINE STATE	OFF-LINE (substate depends on configuration	Equipment may be configured to enter either EQPT OFF-LINE, ATTEMPT ON-LINE or HOST OFF-LINE
3	EQPT OFF-LINE	Operator clicks **Equipment Online**	ATTEMPT ON-LINE	Upon entering this state, the equipment sends S1F1
4	ATTEMPT ON-LINE	S1F0	New state depends on configuration	This may be due to a communication failure or reply timeout. Configuration may be set for either EQPT OFF-LINE or HOST OFF-LINE.
5	ATTEMPT ON-LINE	Equipment receives expected S1F2 from the Host	ON-LINE	Host is notified of transition to ON-LINE at transition 7.
6	ON-LINE	Operator clicks **Equipment Offline**.	EQUIPTMENT OFF-LINE	“Equipment OFF_LINE” events occurs. Event reply will be discarded while OFF-LINE is active.
7	(Undefined)	Entry to ON-LINE state	LOCAL or REMOTE depending on configuration	“ON-LINE LOCAL” or “ON-LINE REMOTE” event is reported
8	LOCAL	Operator clicks **Remote Control**	REMOTE	“ON-LINE REMOTE” event is reported
9	REMOTE	Operator clicks **Local Control**	LOCAL	“ON-LINE LOCAL” event is reported
10	ON-LINE	Equipment accepts S1F15 (set off-line) message from Host	HOST OFF-LINE	“Equipment OFF-LINE’ event is reported
11	HOST OFF-LINE	Equipment accepts host request to go on-line. (S1F17).	ON-LINE	State may be ON-LINE LOCAL or ON-LINE REMOTE. An appropriate event report is sent.
12	HOST OFF-LINE	Operator clicks **Equipment Offline**	EQUIPMENT OFF-LINE	Equipment OFF-LINE event occurs.

2.6 Flow Diagrams of the Startup Process

Flow diagrams provide another way to describe the startup process. This has the advantage of showing the process as a whole rather than from the viewpoint of either the equipment or of the host. Also, it shows how one arrives at a state as well as how one leaves it.

The flow diagram of Figure 2-10 describes the process by which the equipment, beginning from a cold start, arrives at the condition of being fully connected to and communicating with the host. Once turned on the equipment is ordinarily left on, unless it is being transported or there is some exceptional maintenance situation.

There are two steps for the equipment to become fully operational from a cold start:

1. Establishing communication with the host. This is the **Communication** phase.
2. Coming On-line. This is the **Control** phase.

The equipment enters the Communication phase at power-up. When communication with the host has been established, that phase is complete and the equipment passes immediately to the Control phase where (subject to the operator’s choice) it attempts to get on-line. It is fully operational only when it is online.

The two phases are independent of each other in the sense that the actions in either phase are independent of any constants programmed for the other phase.

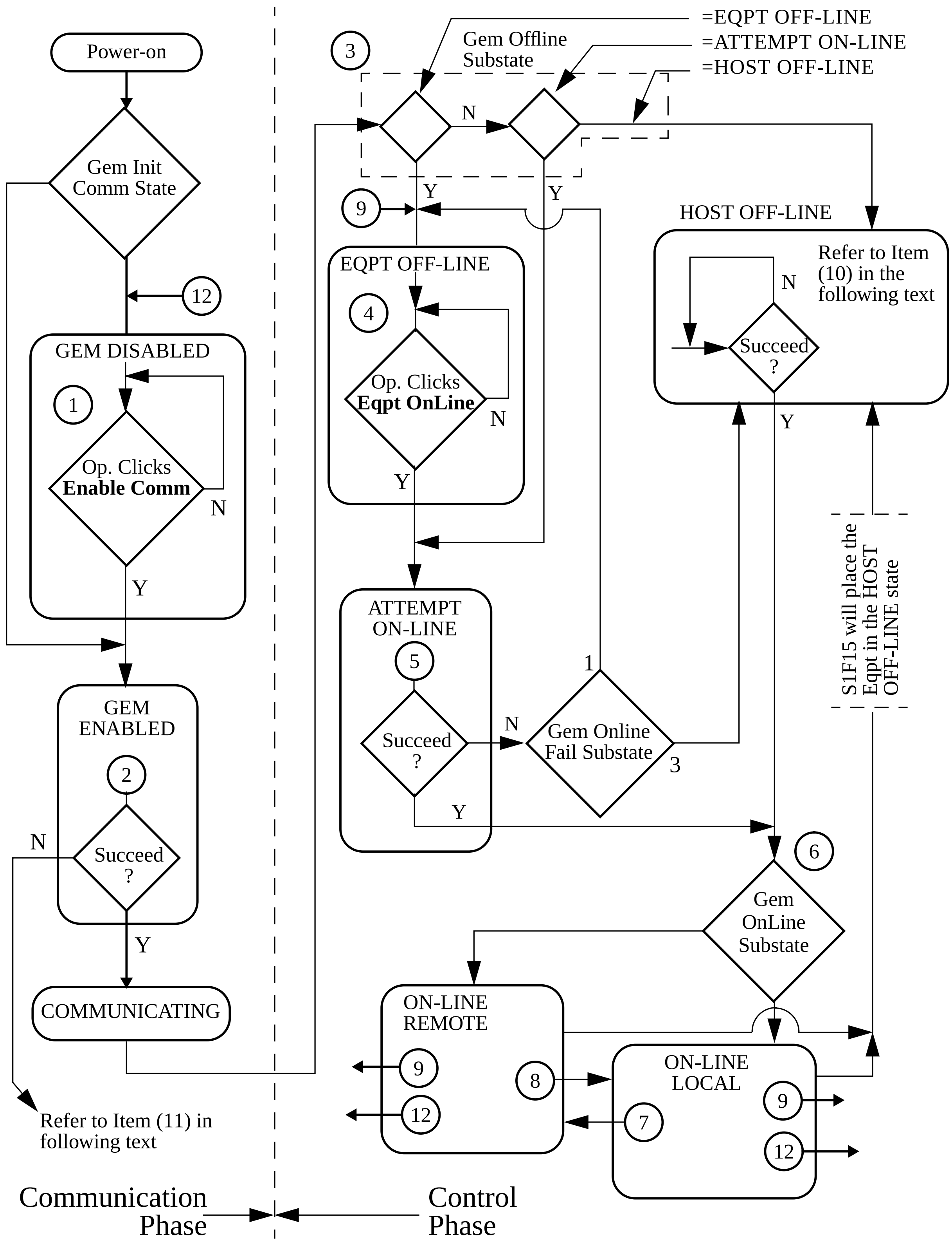

Figure 2-10. Flow Diagram for Startup

The following is the start-up sequence of events:

At power-on the equipment goes to one of two states, depending on the setting of **Gem Init Comm State**:

- GEM DISABLED
- GEM ENABLED

1. In the GEM DISABLED state, the equipment does nothing until the operator clicks the **Enable Comm** button on his display. (See Figure 2-5.) This puts the equipment in the GEM ENABLED state.
2. In the GEM ENABLED state, the Equipment sends the message S1F13 and "listens" for an S1F14 reply from the Host. Successful completion of this exchange puts the Equipment in the COMMUNICATING state. (The S1F13/F14 exchange can also be initiated by the Host.)
   Item (11) describes the possible ways in which this might fail.
3. From the COMMUNICATING state, the equipment passes immediately into the Control Phase and into one of the three states: EQPT OFF-LINE, ATTEMPT ON-LINE, HOST OFF-LINE. Which one is determined by the value programmed into **Gem Offline Substate**.
4. In the EQPT OFF-LINE state, the equipment does nothing until the operator clicks the **Equipment OnLine** button, which puts the equipment into the ATTEMPT ON-LINE state. (It is up to the operator whether the equipment even attempts to get online.)
5. In the ATTEMPT ON-LINE state, the equipment sends out an S1F1 message and "listens" for an S1F2 reply from the host. A successful completion of this pair brings the equipment to circled point (6). The attempt to get online was successful.
6. Depending on the value programmed into **GemOnLineSubstate**, the equipment passes into either the state ON-LINE LOCAL or ON-LINE REMOTE.
7. From the ON-LINE LOCAL state, the operator can move the Equipment into the ON-LINE REMOTE state by clicking the button **Remote Control**.
8. From the ON-LINE REMOTE STATE. the operator can change to the ON-LINE LOCAL state by clocking the **Local Control** button.
9. From either of the ON-LINE states, the operator can take the equipment off line by clicking the **Equipment Off-Line** button. Although this takes the equipment to an off-line condition, communications with the Host are still enabled.
   If the Host sends an S1F15 message, it puts the equipment in the HOST OFFLINE state.
10. In the HOST OFF-LINE state, the responsibility for getting the equipment on-line belongs to the host. Therefore, the host sends out the message S1F17 and "listens" for the equipment's reply S1F18.
    - If the pair completes successfully, the equipment goes to an on-line state.
    - If the pair does not complete successfully, further attempts are made.

11. The attempt to enable communications (2) might be unsuccessful for any of several reasons.
    - Equipment did not get an EOT in response to its ENQ.

      The equipment sends out its ENQ. If it does not get a responding EOT within the time limit T2 (See Section 3.5) it tries again. This it does for a number of tries equal to RTY.

      If no responding EOT was received, the equipment waits for the interval **EstabCommsTimeout** and tries again.

      In the event of continued failure, it repeats this process indefinitely or until it is reset.
    - Equipment sent its message but got no response.

      If there is no response to the message, the equipment waits for an interval equal to T3 (transaction timeout) and tries again. It continues trying for a number of tries equal to RTY.

      If no responding message was received, the equipment waits for the interval **EstabCommsTimeout** and tries again.

      In the event of continued failure, the equipment repeats this process indefinitely or until it is reset.
    - Equipment did not receive an ACK.

      The procedure is the same as for the previous case of no response.
    - Host responded with S1F14 but with COMMACK not equal to 0. (In this case, the Host is saying: “I’m willing to talk to you but not right now.”) Equipment waits for a time set by **EstabCommsTimeout** and tries again. This repeats indefinitely.
12. Operator may return the system to the DISABLED state by clicking the **Disable Comms** button.

2.6.1 Descriptions of the States

This section briefly describes the various possible states the equipment goes through. They are:

- Communication States
  - GEM DISABLED
  - GEM ENABLED
  - COMMUNICATING
- Control States
  - EQPT OFF-LINE
  - ATTEMPT ON-LINE
  - HOST OFFLINE
  - ON-LINE LOCAL
  - ON-LINE REMOTE

2.6.1.1 Communication States

GEM DISABLED No communication with the host is possible. Equipment is waiting for the operator to click the **Enable Comm** button, which causes a transition to the GEM ENABLED state.

GEM ENABLED Equipment attempts to establish communication with the host by sending S1F13. Receipt of an answering S1F14 causes a transition to the COMMUNICATING state. Alternatively, communication can be established by the host's sending S1F13 and the equipment responding with S1F14.

COMMUNICATING Upon arriving at this state, the equipment passes immediately into the Control Phase and into one of the three states belonging to that phase: EQPT OFF-LINE, ATTEMPTING ON-LINE, HOST OFF-LINE.

2.6.1.2 Control States

EQPT OFF-LINE Equipment makes no attempt to get on-line and does not respond to any similar attempts from the host.
Equipment remains in this state until operator clicks the **Equipment Online** button, which causes a transition to the ATTEMPT ON-LINE state.

ATTEMPT ONLINE Equipment attempts to get to an on-line condition by sending S1F1. Receipt of an answering S1F2 puts the equipment in one of the states: ON-LINE LOCAL or ON-LINE REMOTE.

HOST OFFLINE Getting the equipment on-line is the sole responsibility of the Host. It does this by sending S1F17. Receipt of an answering S1F18 puts the equipment into one of the on-line states.

ON-LINE LOCAL The Host can send all messages except for the following:

- Change Equipment Configuration (S2F15)
- most Send Remote Commands (S2F41); (several can be sent)

ON-LINE REMOTE The Host may send any message, including:

- Change Equipment Configuration (S2F15)
- Send Remote Commands (S2F41)

Note: The operator may issue commands to control the Equipment at any time. (This is a safety consideration.) However, when the Equipment is in REMOTE ON-LINE, the operator cannot change the equipment configuration.

Chapter 3
GEM Communication

3.1 Messages

3.1.1 Basics

Communication takes place between two parties:

- The Eaton implantation equipment (the equipment).
- The controlling computer (the host).

This communication is serial-asynchronous, based on the EIA RS-232C standard. GEM communications are also based on two additional standards:

- SEMI E4-91 (SECS I) which governs message *transfer*
- SEMI E5-0298 (SECS II) which governs message *content*.
- SEMI E-30-0298 (GEM), Generic Equipment Model.

The host directs the operations of the equipment, inquires into equipment status or results, and monitors for fault or error conditions. The equipment accepts the operating commands and reports errors, equipment status, or fault conditions.

Conversations between the two are in the form of **messages**. Any message sent must be from a pre-defined set. Each message has a specific purpose. For example, the host may inquire of the equipment as to whether it is ready and connected. Acknowledgements are sent and received. The host may send instructions; the equipment might send certain alarm or status information. Some messages can be sent only by the host; some only by the equipment; some can be sent by either.

3.1.2 Streams and Functions

The set of permissible messages is organized into groups called **streams**. These streams are designated by the letter S followed by a number, such as S1, S2, S3. Each of these is a different stream. For every stream, there are several instances of that stream which are called **functions** and are designated by the letter F followed by a number; for example: F0, F1, F2.

A message is uniquely designated by giving both its stream number and its function number, in that order. S1F1 and S3F6 are examples of message designations.

A listing and description of all of the messages are provided in Chapter 16.

Listed below are the uses of those streams used by the Eaton equipment:

- S1: Equipment Status
- S2: Equipment Control and Diagnostics
- S3: Material Status
- S4: Material Control
- S5: Exception Reporting
- S6: Data Collection
- S7: Process Program Management
- S9: System Errors
- S10: Terminal Services

These are all of the streams used by the Eaton implantation equipment. The SEMI standard defines others.

Every stream has instances called functions. In the case of S1, there are:

- S1F0, Abort transaction
- S1F1, Are you there
- S1F2, On-line data
- S1F3, Selected Equipment Status Request
- S1F4, Selected Equipment Status Data
- [others]

Note: F0 always means “Abort transaction,” no matter what the stream is.

3.1.3 Primary and Secondary Messages

Many messages occur in pairs. The first message of the pair is a **primary** message and has an odd-numbered function. A primary message could be a request for information or a request for some action. The replying message is a **secondary** message. Its function number is always one greater than that of the primary message that caused it to happen. The secondary message of a pair is an appropriate response to the primary: supplying the requested information, or acknowledging the requested action.

A primary message can be either a “stand-alone” that requires no reply or else the first message of a primary/secondary pair.

In the case of a primary/secondary pair, the primary message always has an odd F number; the secondary message always has the next sequential F number.

For example:

The host might send the primary message **S1F1 - (Are you there)** which asks if the equipment is operational and connected.

The equipment might reply with **S1F2**,"yes." (Note the sequence: S1F1, S1F2.)

3.1.4 Rules

3.1.4.1 Contention

In the event that both host and equipment attempt to send a message at the same time, the result is a situation called **contention**. It is always resolved in favor of the equipment.

3.1.4.2 Sequence and Interleaving

The normal chain of events is that one message (or pair of messages) is allowed to complete before another is sent. It is permissible for either host or equipment to send a primary message and, before having received a reply to that message, send another primary message. The term for this is **multiple open transactions.**

Section 3.1.4.2.1 and Section 3.1.4.2.2 below illustrate a case of the same events occurring on a non-interleaved and an interleaved basis.

3.1.4.2.1 Example of a Normal (non-interleaved) Sequence

1. Equipment sends the primary message S6F11.
2. Host replies with the answering secondary message S6F12 (completing the pair).
3. Host sends the primary message S2F41.
4. Equipment replies with the answering secondary message S2F42 (completing that pair).

3.1.4.2.2 Same Example, but Interleaved

It is possible for the same events to occur on an interleaved basis.

1. Equipment sends the primary message S6F11.
2. Host sends the primary message S2F41.
3. Host responds to the first primary message with S6F12 (completing the first pair).
4. Equipment responds to the second primary message with S2F42 (completing the second pair).

3.1.4.2.3 Block Interleaving.

In the above interleaved sequence, although a message pair was interrupted, the individual messages were not. The host sent a new primary message, S2F41, before replying to the original primary message S6F11. It did not do this until all the blocks of S6F11 had been received.

It is permissible for the host (but not for the equipment) to start a new message before all blocks of an incoming message have been received. Before doing this it must first send an **ENQ** and get back an **EOT**. Refer to Table 3-1 for handshake codes.

A block can never be interrupted.

3.2 Message Structure

There are three entities that make up a message:

- The basic element of a message is the **byte**, or **character**.
- A **block** consists of a 10-byte header, up to 244 data bytes, and a two-byte checksum.
- A message consists of one or more blocks, up to a maximum of 1000.

3.2.1 The Byte

In asynchronous serial communication, a byte is embedded within a START bit, a STOP bit, and an (optional) PARITY bit. In GEM communications, there is no parity bit.

The resulting 10 bits that make up the GEM byte are transmitted in the following order.

- A START bit which synchronizes the receiving end.
- 8 DATA bits (least significant bit first)
- A STOP bit which indicates the end of the byte.

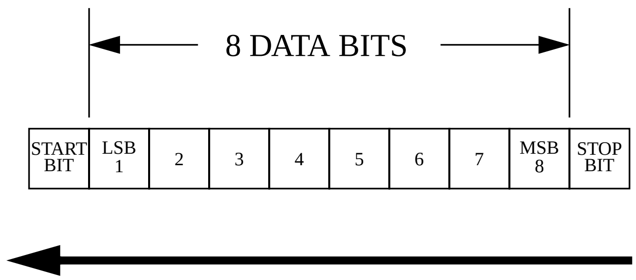

Figure 3-1. A Serial Communication Byte

All bits have the same duration equal to 1/(communication rate). For example, if the communication rate is 9600 bits/second, the width of each bit is 104.16 μsecs.

Transmission may take place in either direction but in only one direction at a given time.

Certain bytes have special meanings. These are given below.

Table 3-1. Handshake Codes

Name	Code b8b7...........b1	Function
ENQ	0000 0101	Request to Send (enquiry)
EOT	0000 0100	Ready to Receive (end of transmission)
ACK	0000 0110	Correct Reception (acknowledgement)
NAK	0001 0101	Incorrect Reception (negative acknowledgement)

Note: Before sending any message, the sending agency (either equipment or host) must first send an ENQ (Request to Send) and wait for the arrival of an answering EOT (Ready to Receive).

3.2.2 Structure of a Block

The next level of message unit is the block. As stated, a block consists of:

- A 10-byte block header
- A data area of up to 244 bytes
- A 2-byte checksum

The following figure is a diagram of a block.

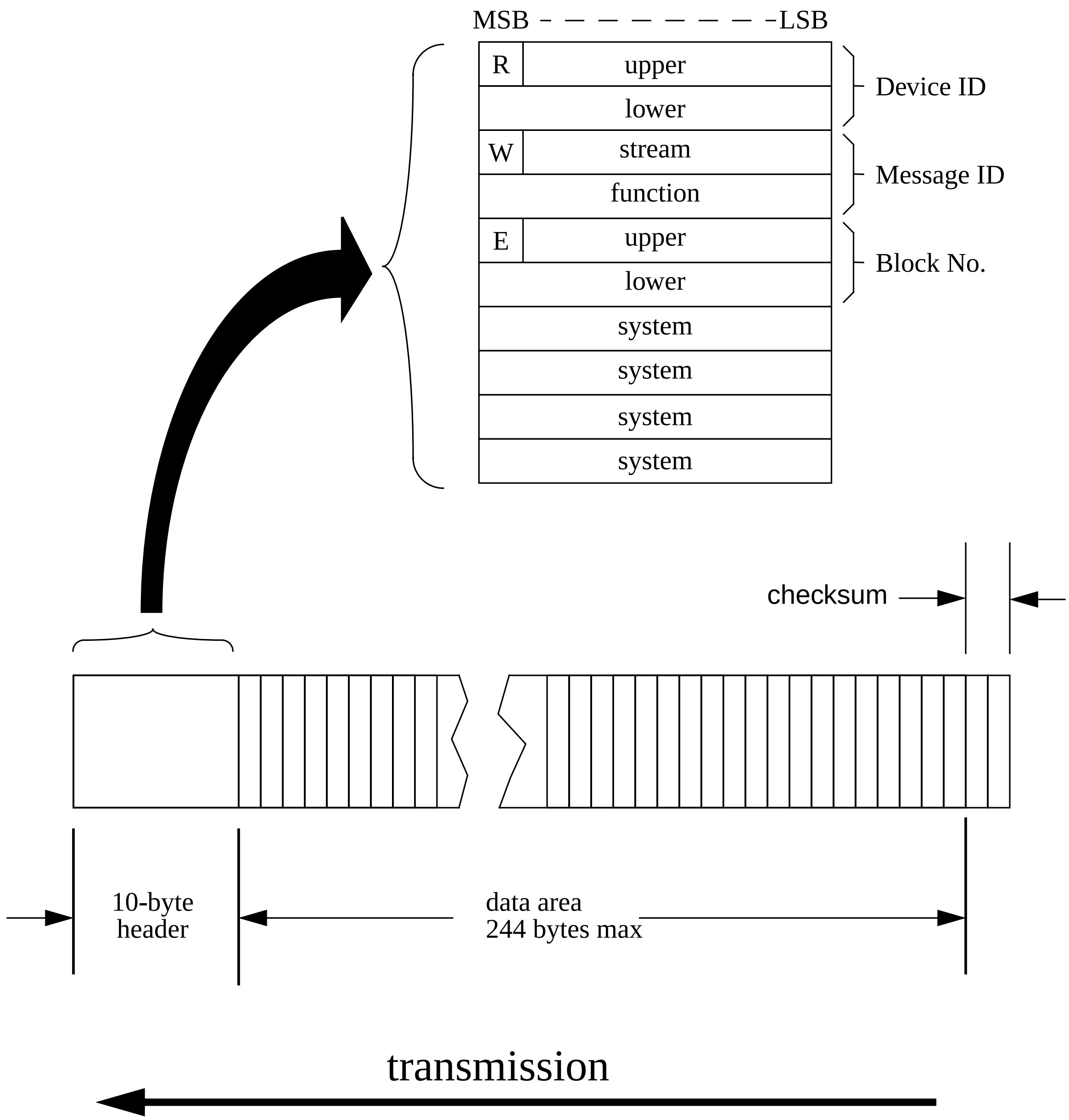

Figure 3-2. Structure of a Block

A **message** consists of one or more blocks up to a maximum of 1000.

The elements of a block are as follows:

R (reverse) bit	=0 for a host -> equipment message =1 for a equipment -> host message
Device ID	Set by the user; arbitrary
W (wait) bit	=1, reply is expected =0, no reply expected
Message ID	Upper byte is the stream number (1 for S1, 2 for S2, etc.) Lower byte is the function number (1 for F1, 2 for F2, etc.)
E (end) bit	=1, current block is the last block =0, more blocks to follow
Block No.	Multiblock message = 1 for the first block, =2 for the second block, etc. Single block message = 0 or 1. Must be one of the two but does not matter which.
System Bytes	Set by the sender of the primary message. (Refer to Section 3.1.3 for the meaning of the term primary message.) For primary messages, the system bytes generated are unique for each primary message. For secondary messages, the system bytes are copied from those of the primary message that it is replying to.

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3.3 Data Items and Lists

Refer back to Figure 3-2 which shows the structure of a block. This section describes the two things that are encoded into the data area of a block: data items and list headers.

A list header heads a list of items. Each item in the list is either a data item or may itself be a list header.

A list header is not a container of information; it is strictly an organizing device.

As a simple example of a list, consider the message **S1F2**.

```
<L[2]
   <A[6] MDLN>
   <A[6] SOFTREV>
>.
```

The first item, `L[2]`, is a list header; all others are data items. In this case, the list header announces that what follows is a list of two data items.

S5F71 is an example of lists within lists.

```
<L[2]
   <U1 0>
   <L[1]
      <L[4]
         <U4 ALID>
         <BOOLEAN ASTAT>
         <U4 ASER>
         <A[16] ‘YYYYMMDDhhmmsscc’>
      >
   >
>.
```

3.4 Encoding into the Data Block

Since different kinds of items can be placed in the data area of a block, it is necessary that each item be embedded in formatting information. First it must be determined whether the item is a data item or a list header. Once that question is answered other questions follow:

- If it is a data item, then:
  - What *kind* of data item, for example: ASCII, BINARY, BOOLEAN, 1-byte integer, 4-byte integer.
  - How *many* of them are there? The answer to this is 1 except when there are ASCII items (multiple data items that are non-ASCII are encoded as a list). Multiple data items of any type are allowed.
- If it is a list header, then it must be determined how many items are in the list.

  Lists may have the following properties:
  - The members of a list may be either data items or may be list headers. (There can be lists within lists; S5F71 shown above is an example of this.)
  - Except for ASCII data, any multiple data item is formatted as a list.

3.4.1 Data Type Format Codes

Table 3-2 below shows the codes for the various data formats.

Table 3-2. Format Codes

Bits 876543	Octal	Data Type	Symbol
000 000	00	List Header	L[ ]
001 000	10	Binary	B
001 001	11	Boolean	BOOLEAN
010 000	20	ASCII	A
010 001	21	JIS-8	J
011 000	30	8-byte integer (signed)	I8
011 001	31	1-byte integer (signed)	I1
011 010	32	2-byte integer (signed)	I2
011 100	34	4-byte integer (signed)	I4
100 000	40	8-byte floating point	F8
100 100	44	4-byte floating point	F4
101 000	50	8-byte integer (unsigned)	U8
101 001	51	1-byte integer (unsigned)	U1
101 010	52	2-byte integer (unsigned)	U2
101 100	54	4-byte integer (unsigned)	U4

For multiple-byte integer quantities, the most significant byte is sent first. For multiple-byte floating-point quantities, the byte containing the sign bit is sent first.

Note: Do not confuse a multiple-byte item (example: 8-byte integer - unsigned) with multiple data items. An 8-byte unsigned integer has 8 bytes, but it is only a single data item.

Since the encoding rules for data items and list headers are different, the two cases are discussed separately.

3.4.2 Encoding of Data Items

A group of data bytes, when placed in the data area of a block, is preceded by two parts: a **format byte** and between 1 and 3 **length bytes**.

The format byte, the length byte(s), and the data bytes all together form the encoded data item.

See Figure 3-3.

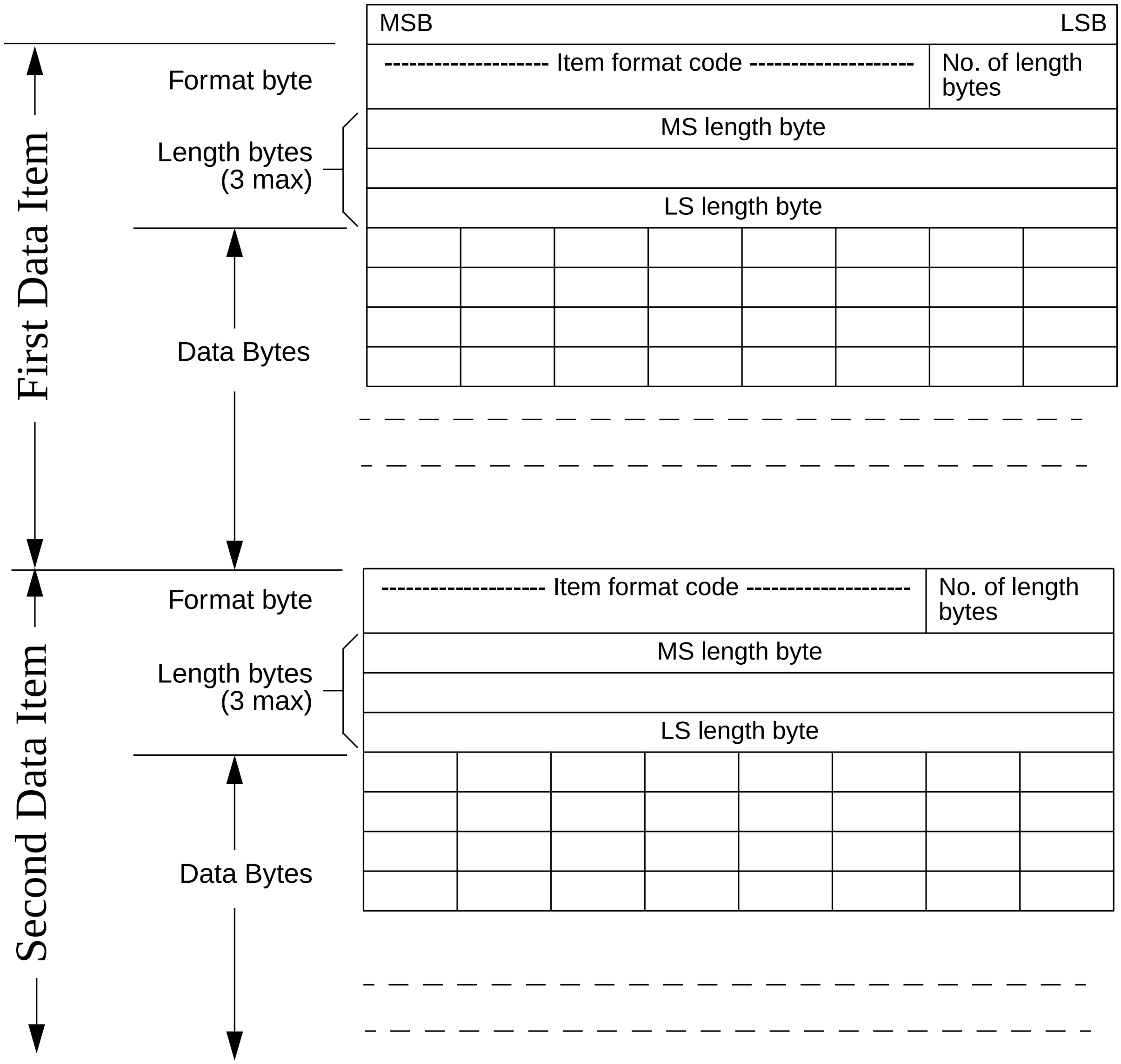

Figure 3-3. Coding of Data Items

Note: This "formatting" information is not to be confused with the 10-byte block header that is at the beginning of every block. (See Figure 3-2.) Figure 3-3 shows data items.

format byte — The upper six bits contain the format code. See Table 3-2. The lower two bits contain the *number* of length bytes, either 00, 01, or 10.

length bytes — The *number* of data bytes (data *bytes*; not data items) is placed in the length bytes, there being 1 or 2 or 3 length bytes as needed:

- If the number of data bytes is less than 256, then one length byte is sufficient.
- If the number of data bytes is between 256 and 65535, then two length bytes are necessary.
- If the number of data bytes is greater than 65535, then three length bytes are necessary.

Note: For most data types except ASCII, the number of data items (and consequently the number of length bytes) will always be 1. The coding allows for the possibility of multiple items, but this is used only in the case of ASCII data.

The following example illustrates this. Suppose that a data item consists of 200 ASCII items. Table 3-2 indicates that the format code for ASCII is 010 000. The number of bytes is 200. Since this is less than 256, only one length byte is required. Since 200 = 0xC8, the one length byte is:

- 0xC8 or, in binary, 1100 1000.

Altogether, this is:

Format byte	010 000 01
Length Byte	1100 1000
ASCII ITEMS	xxxx xxxx
	yyyy yyyy
	zzzz zzzz
	wwww wwww

Figure 3-4. Coding Example for 200 ASCII Items

Note that all of the above are just one single data item, including format byte, length bytes, and ASCII items.

Figure 3-5 shows the coding example above combined with the ten bytes of the block header.

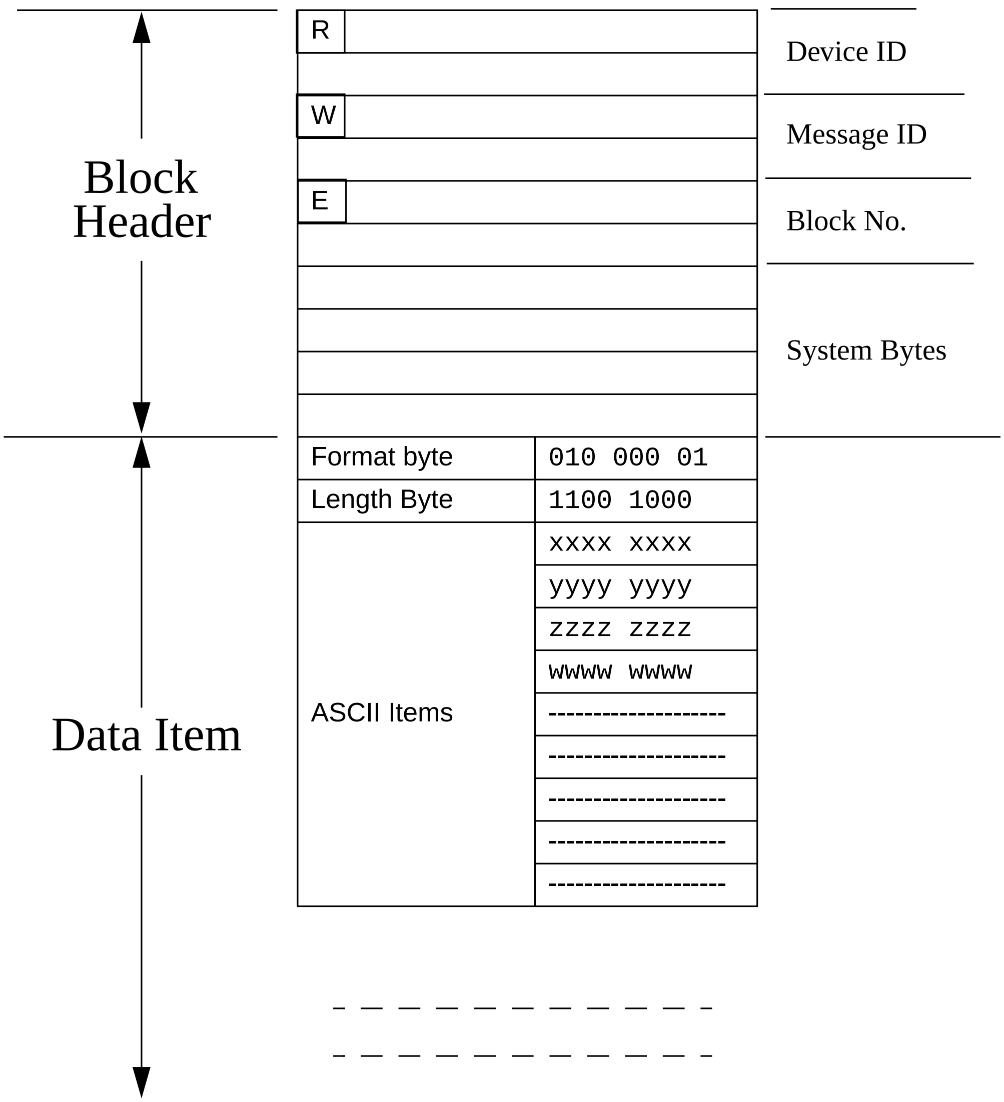

Figure 3-5. Data Item and Block Header

3.4.3 Encoding List Headers

Section 3.4.2 described the encoding of data items. This section discusses the encoding of list headers.

Keep in mind:

- The format code for a list header is 000 000.
- What is encoded into the length bytes is the number of items in the list, not the number of data bytes.

The example is a list of 3 single-byte integers.

List Header	Format byte	000 000 01
	Length byte (3 list items)	0000 0011
First Data Item	Format byte	011 001 01
	Length byte	0000 0001
	Data	xxxx xxxx
Second Data Item	Format byte	011 001 01
	Length byte	0000 0001
	Data	yyyy yyyy
Third Data Item	Format byte	011 001 01
	Length byte	0000 0001
	Data	zzzz zzzz

Figure 3-6. Encoding a List of 3 Items

3.5 Timing Considerations

Timeouts are used to detect communication failures. A timeout occurs when the time between two events exceeds a pre-determined limit. Several timing parameters are described below. Their values are given in Table 3-3.

3.5.1 T1 - Inter-character Timeout

Refer to Figure 3-2 which shows the structure of a block. T1 is the maximum permissible time between the arrival of two successive message bytes.

3.5.2 T2 - Protocol Timeout

In each of the cases below, T2 is the maximum time allowed between the two events of that case.

- Between the sending of an ENQ and subsequent receiving of an EOT. (See Section 3.2.1 for a note regarding ENQ and EOT.)
- Between the sending of an EOT and the subsequent receiving of the length byte.
- Between the sending of the second checksum byte and the subsequent receiving of any character.

3.5.3 T3 - Reply Timeout

The maximum time between the arrival of the last block of a primary message and the arrival of the first block of the responding secondary message.

3.5.4 T4 - Inter-block timeout

The maximum time between the successful receipt of one block of a multi-block message and the successful receipt of the following block.

3.5.5 RTY - Retry Limit

The maximum number of retries that is made to send a message following an initial unsuccessful attempt is called the retry limit.

Table 3-3. Timing Parameters

Parameter	Description	Default	Range/ Increment
Device ID	Specified as a value from 0 to 32767	1	0 to 32767/ 1
Baud Rate		9600	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200
T1	Inter-character timeout.	0.5 secs	0.1 to 10.0 secs/ 0.1 sec
T2	Protocol timeout.	10.0 secs	0.2 to 25.0 secs/ 0.1 sec
T3	Transaction timeout.	45 secs	1 to 120 secs/ 1 sec

Table 3-3. Timing Parameters

Parameter	Description	Default	Range/ Increment
T4	Inter-block timeout.	45 secs	1 to 120 secs/ 1 sec
RTY	Transmit failure retry limit.	3	0 to 31/ 1
Duplicate Block Detect	Duplicate Block Detect. May be enabled (ON) or disabled (OFF)	OFF	ON, OFF

3.6 Miscellaneous Data

3.6.1 Connector Pinout

Table 3-4. RS-232 Signal Connections

Pin	RS-232-C Circuit	Description
1	AA	Shield
2	BA	Data from Equipment
3	BB	Data to Equipment
7	AB	Signal Ground

3.6.2 Permissible ASCII Character Set

The following table lists the characters that are or are not accepted by Eaton equipment.

Table 3-5. Acceptable/Unacceptable Characters

<table>
<tr><td rowspan="3">Acceptable Characters</td><td>lower-case and upper-case letters</td><td>a-z, A-Z</td></tr>
<tr><td>numerals</td><td>0-9</td></tr>
<tr><td>underscore, hyphen, plus, pound</td><td>_ - + #</td></tr>
<tr><td rowspan="8">Unacceptable for Eaton eqpt.</td><td>period</td><td>.</td></tr>
<tr><td>left and right arrows</td><td>< ></td></tr>
<tr><td>vertical bar, exclamation</td><td>| !</td></tr>
<tr><td>dollar, asterisk, space</td><td>$ *</td></tr>
<tr><td>ampersand, question mark, semicolon</td><td>& ? ;</td></tr>
<tr><td>parentheses, square brackets, curly braces</td><td>( ) [ ] { }</td></tr>
<tr><td>tilde, “at”, caret, equals, colon</td><td>~ @ ^ = :</td></tr>
<tr><td>forward slash, back slash, comma</td><td>/ \ ,</td></tr>
</table>

Note: The ASCII character set is limited by the UNIX operating system.

Chapter 4
Data Item Dictionary

Table 4-1shows the meanings and codes of the various data formats used by the Eaton equipment.

Table 4-1. List of Data Formats

Format	Octal Code	Meaning
LIST	00	List Item
ASCII	20	Item is text
JIS-8	21	
I8	30	8-byte integer (signed)
I1	31	1-byte integer (signed)
I2	32	2-byte integer (signed)
I4	34	4-byte integer (signed)
BINARY	10	Individual bits have meanings
BOOL(EAN)	11	Item is two-valued
U1	51	1-byte integer (unsigned)
U2	52	2-byte integer (unsigned)
U4	54	4-byte integer (unsigned)
U8	50	8-byte integer (unsigned)
F4	44	4-byte floating-point constant
F8	40	8-byte floating-point constant

The remainder of this chapter is the Data Item Dictionary itself.

Table 4-1. Data Item Dictionary

<table>
<tr><th>Data Item</th><th>Where Used</th><th>Formats</th></tr>
<tr><td>ABS</td><td>S2F25, F26</td><td>BINARY</td></tr>
<tr><td colspan="3">Any Binary String</td></tr>
<tr><td>ACKC5</td><td>S5F2, F4</td><td>BINARY</td></tr>
<tr><td colspan="3">Acknowledge Code, 1 byte<pre>
    0 = accepted
   >0 = error, not accepted
 1-63 = reserved
</pre></td></tr>
<tr><td>ACKC6</td><td>S6F2, F4, F10, F12, F14</td><td>BINARY</td></tr>
<tr><td colspan="3">Acknowledge Code, 1 byte<pre>
    0 = accepted
   >0 = error, not accepted
 1-63 = reserved
</pre></td></tr>
<tr><td>ACKC7</td><td>S7F4, F18,</td><td>BINARY</td></tr>
<tr><td colspan="3">Acknowledge Code, 1 byte<pre>
    0 = accepted
    1 = permission not granted
    2 = length error
    3 = matrix overflow
    4 = PPID not found
    5 = mode unsupported
    5 = other error
 6-63 = reserved
</pre></td></tr>
<tr><td>ACKC10</td><td>S10F2, F4, F6, F10</td><td>BINARY</td></tr>
<tr><td colspan="3">Acknowledge Code, 1 byte<pre>
    0 = accepted for display
    1 = message will not be displayed
    2 = terminal not available
 3-63 = reserved
</pre></td></tr>
</table>

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
ALCD	S5F1, F6	BINARY

Alarm Code Byte
 	
`bit 8 = 1 means alarm set`
`bit 8 = 0 means alarm cleared`
`bit 7-1 is alarm category`
`0 = not used`
`1 = personal safety`
`2 = equipment safety`
`3 = parameter control warning`
`4 = parameter control error`
`5 = irrecoverable error`
`6 = equipment status warning`
`7 = attention flags`
`8 = data integrity`
`>8 = other categories`
`9-63 = reserved`		

ALED	S5F3	BINARY

Alarm Enable/disable Code, 1 byte
 	
`bit 8 = 1 means enable alarm`
`bit 8 = 0 means disable alarm`		

ALID	S5F1, F3, F5, F6	U4
Alarm Identification		
ALTX	S5F1. F6	ASCII
Alarm Text (40 characters max)		

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
CEED	S2F37	BOOL

Collection Event Enable/disable Code, 1 byte
`FALSE = disable`
`TRUE  = enable`		

CEID	S2F35, F37, S6F3, F8, F9, F11, F13, F15, F17	U4
Collection Event ID		
COMMACK	S1F14	BINARY

Establish Communications Acknowledge Code, 1 byte
`0 = accepted`
`1 = denied, try again`
`2-63 = reserved`		

CPACK	S2F42	BINARY

Command Parameter Acknowledge Code, 1 byte
`1 = parameter name (CPNAME)does not exist`
`2 = illegal value specified for CPVAL`
`3 = illegal format specified for CPVA`
`>3 = other equipment-specific error`
`4-63 = reserved`		

CPNAME	S2F41, F42	ASCII
Command Parameter Name		
CPVAL	S2F41	ASCII, U4
Command Parameter Value		
DATAID	S2F33. F35. F39. F45, S6F3. F5. F7. F8. F9. F11. F13. F16. F18	U4
Data ID		
DATALENGTH	S2F39, S4F25, S6F5	U4
Total bytes to be sent		

Semiconductor Equipment

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
DRACK	S2F34	BINARY

Define Report Acknowledge Code, 1 byte
`    0 = accept`
`    1 = denied, insufficient space`
`    2 = denied, invalid format`
`    3 = denied, at least one RPTID already defined`
`    4 = denied, at least one VID does not exist`
`   >4 = other errors`
` 5-63 = reserved`		

DSID	S6F3, F8, F9	U4
Data set ID		
DSPER	S2F23	ASCII
`Data sample period` `    hhmmss, 6 bytes`		
DVNAME	S6F3, F8	ASCII, U4
Data Value Name		
DVVAL	S6F3, F8, F9	BOOL, F4, U4
Data Value		
EAC	S2F16	BINARY

Equipment Acknowledge Code, 1 byte
`    0 = Acknowledge`
`    1 = Denied, At least one constant does not exist`
`    2 = Denied. Busy.`
`    3 = Denied. At least one constant is out of range`
`   >3 = Other equipment-specific error`
` 4-63 = reserved`		

ECDEF	S2F30	BOOL, F4, U4
Equipment constant default value		

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
ECID	S2F13, F15, F29, F30	U4
Equipment Constant ID		
ECMAX	S2F30	F4, U4
Equipment constant maximum value		
ECMIN	S2F30	F4, U4
Equipment constant minimum value		
ECNAME	S2F30	ASCII
Equipment constant name		
ECV	S2F14, F15	BOOL, F4, U4
Equipment Constant Value		
ERACK	S2F38	BINARY

Enable/Disable Event Report
 	
Acknowledge Code, 1 byte
 	
`0 = Accepted`
`1 = Denied, at least one CEID does not exist`
`<1 = Other errors`
`2-63 = Reserved`		

FCNID	S2F43, F44	U1
Function Identification		
GRANT	S2F2, F40	BINARY

Grant Code, 1 byte
 	
`0 = Permission Granted`
`1 = Busy, try again`
`2 = No space available`
`3 = Duplicate DATAID`
`>3 = Equipment-specific error code`
`4-63 = Reserved`		

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
GRANT6	S6F6	BINARY
Permission to send, 1 byte 0 = permission granted 1 = busy, try again 2 = not interested >2 = other errors 3-63 = reserved		
HCACK	S2F42	BINARY
Host Command Parameter Acknowledge Code, 1 byte 0 = Acknowledge, command has been performed 1 = Command does not exist 2 = Cannot perform now 3 = At least one parameter is invalid 4 = Acknowledge, command will be performed with completion signaled later by an event. 5 = Rejected. Already in desired condition 6-63 = Reserved		
LENGTH	S2F1, S7F1, F29	U4
Length (bytes) of the service program or process program		
LIMITACK	S2F46	BINARY
Acknowledge code for variable limit attribute set, 1 byte 1 = LIMITID does not exist 2 = UPPERDB > LIMITMAX 3 = LOWERDB < LIMITMIN 4 = UPPERDB < LOWERDB 5 = Illegal format specified for UPPERDB or LOWERDB 6 = ASCII value cannot be translated to numeric 7 = Duplicate limit definition for this variable >7 = Other equipment-specific error 6-63 = reserved		
LIMITID	S2F45, F46, F48	BINARY
The identifier of a specific limit in the set of limits (as defined by UPPERDB and LOWERDB) for a variable to which the corresponding limit attributes refer. 1 byte.		

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
LIMITMAX	S2F48	F4, U4
Maximum allowed value for the limit values of a specific variable. The equipment manufacturer should specify this value which would typically coincide with the maximum value of the variable being monitored. The format must match that of the referenced variable.		
LIMITMIN	S2F48	F4, U4
Minimum allowed value for the limit values of a specific variable. The equipment manufacturer should specify this value, which would typically coincide with the minimum value of the variable being monitored. The format must match that of the referenced variable.		
LOC	S3F2, F82	U1
Machine material location code. 1 byte.		
LOWERDB	S2F45, F48	F4, U4
A variable limit attribute that defines the lower boundary of the deadband of a limit. The value applies to a single limit (LIMITID) for a specified VID. Thus, UPPERDB and LOWERDB as a pair define a limit.		
LRACK	S2F36	BINARY

Link Report Acknowledge Code. 1 byte.
 	
`0 = Accepted`
`1 = Denied, insufficient space`
`2 = Denied, invalid format`
`3 = Denied, at least one CEID link already defined`
`4 = Denied, at least one CEID does not exist`
`5 = Denied, at least one RPTID does not exist`
`>5 = Other errors`
`6-63 = Reserved`		

LVACK	S2F46	BINARY

Variable limit definition acknowledge code, 1 byte. Defines the error with the limit attributes for the reference VID.
 	
`1 = Variable does not exist`
`2 = Variable has no limits capability`
`3 = Variable repeated in message`
`4 = Limit value error as described in LIMITACK`
`5-63 = Reserved`		

MDLN	S1F2, S7F22, F23, F26, F31	ASCII
Equipment Model Type, 6 bytes max. (Same data as returned by S1F2.)		

Table 4-1. Data Item Dictionary (Continued)

<table>
<tr><th>Data Item</th><th>Where Used</th><th>Formats</th></tr>
<tr><td>MF</td><td>S3F2, F81</td><td>U1</td></tr>
<tr><td colspan="3">Material format code.

1 = quantities in wafers
2 = quantities in cassette/pod
3 = quantities in die or chips
4 = quantities in boats
5 = quantities in ingots
6 = quantities in leadframes
7 = quantities in lots
8 = quantities in magazines
9 = quantities in packages
10 = quantities in plates
11 = quantities in tubes
12 = quantities in waterframes
13-63 = reserved</td></tr>
<tr><td>MHEAD</td><td>S9F1, F3, F5, F7, F11</td><td>BINARY</td></tr>
<tr><td colspan="3">SECS message block header associated with message block in error.</td></tr>
<tr><td>MID</td><td>S3F2, F82, S4F81, F83, F85, F87, F89, F91, F93, F95</td><td>BINARY</td></tr>
<tr><td colspan="3">Material ID</td></tr>
<tr><td>OFLACK</td><td>S1F16</td><td>BINARY</td></tr>
<tr><td colspan="3">Acknowledge code for OFF-LINE request

0 = OFF-LINE acknowledge
1-63 = reserved</td></tr>
<tr><td>ONLACK</td><td>S1F18</td><td>BINARY</td></tr>
<tr><td colspan="3">Acknowledge code for ON-LINE request

0 = ON-LINE Accepted
1 = ON-LINE Not Allowed
2 = Equipment Already ON-LINE
3-63 = reserved</td></tr>
<tr><td>PFCD</td><td>S6F9</td><td>BINARY</td></tr>
<tr><td colspan="3">Predefined form code, 1 byte</td></tr>
<tr><td>PPBODY</td><td>S7F3, F6</td><td>ASCII</td></tr>
<tr><td colspan="3">Process Program Body.

The process program describes to the equipment, in its own language, the actions to be taken in processing the material it receives.</td></tr>
</table>

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
PPGNT	S7F2	BINARY

Process program grant status, 1 byte.
 	
`0 = OK`
`1 = already have`
`2 = no space`
`3 = invalid PPID`
`4 = busy, try later`
`5 = will not accept`
`>5 = other error`
`6-63 = reserved`		

PPID	S7F1, F3, F5, F6, F17, F20	ASCII
Limited to a maximum of 80 bytes. The format used in the PPID will be host-dependent. For internal use of the equipment, the PPID can be treated as a unique binary pattern. If the local equipment is not prepared to display the transmitted code, the display should be in hexadecimal form. **Note: Eaton supports 16 characters.**		
PTN	S4F81, F83, F85, F87, F89, F91, F93, F95	BINARY
Material Port Number, 1 byte.		
QUA	S3F2. F82	BINARY
Quantity in format, 1 byte.		
RCMD	S2F41	ASCII
Remote command code or string		
REPGSZ	S2F23	U4
Reporting group size		
RPTID	S2F33, F35, S6F11, F13, F16	U4
Report ID		
RSDA	S6F24	BINARY

Request Spool Data Acknowledge
 	
`0 = OK`
`1 = Denied, busy try later`
`2 = Denied, spooled data does not exist`
`3-63 = reserved`		

RSDC	S6F23	U1

Request Spool Data Code
 	
`0 = Transmit spooled messages`
`1 = Purge spooled messages`
`2-63 = reserved`		

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
RSPACK	S2F44	BINARY

Reset Spooling Acknowledge
 	
`0 = Acknowledge, spooling setup accepted`
`1 = Spooling setup rejected`
`2-63 = reserved`		

SHEAD	S9F9	BINARY
Stored header related to the transaction timer		
SMPLN	S6F1	U4
Sample number		
SOFTREV	S1F2, F13, F14	ASCII
Software revision code. 6 bytes maximum.		
STIME	S6F1	ASCII
Sample time, 12 bytes. `yymmddhhmmss`		
STRACK	S2F44	BINARY

Spool Stream Acknowledge
 	
`1 = Spooling not allowed for stream (e.g. Stream 1)`
`2 = Stream unknown`
`3 = Unknown function specified for this stream`
`4 = Secondary function specified for this stream`		

STRID	S2F43, F44	U1
Stream Identification		
SV	S1F4, S6F1	BINARY, ASCII, BOOL, F4, U4
Status Variable Value		
SVID	S1F3, F11, F12, S2F23	U4
Status Variable ID. Status variables may include any parameter that can be sampled in time such as temperature or quantity of a consumable.		
SVNAME	S1F12	ASCII
Status Variable Name		
TEXT	S10F1, F3, F5, F9	BINARY, ASCII
A single line of characters		

Table 4-1. Data Item Dictionary (Continued)

Data Item	Where Used	Formats
TIAACK	S2F24	BINARY

Equipment acknowledgment code, 1 byte
 	
`0 = everything correct`
`1 = too many SVIDs`
`2 = no more traces allowed`
`3 = invalid period`
`>3 = equipment-specified error`
`4-63 = reserved`		

TIACK	S2F32	BINARY

Time Acknowledge Code, 1 byte
 	
`0 = OK`
`1 = Error, not done`
`2-63 = reserved`		

TID	S10F1, F3, F5, F7	BINARY

BIN Terminal Number, 1 byte
 	
`0 = single or main terminal`
`>0 = additional terminals at the same equipment`		

TIME	S2F18	ASCII
Time of day. 12 bytes, `yymmddhhmmss`		
TOTSMP	S2F23	ASCII
Total samples to be made		
UPPERDB	S2F45, F48	BOOL, ASCII
A variable limit attribute which defines the upper boundary of the deadband of a limit. The value applies to a single limit (LIMITID) for a specified VID. Thus, UPPERDB and LOWERDB, regarded as a pair, define a limit.		
V	S6F9, S6F11, F13, F16, F20, F22	LIST, BINARY, BOOL, U1, U2, F4, I1, I2, I4
Variable Data		
VID	S2F33, F45, F46, F47, F48, S6F13, F18, F22	U4
Variable ID		
VLAACK	S2F46	BINARY

Variable Limit Attribute Acknowledge Code, 1 byte
 	
`0 = Acknowledge, command will be performed`
`1 = Limit attribute definition error`
`2 = Cannot perform now`
`>2 = Other equipment-specific error`
`3-63 = reserved`		

Chapter 5
Variable Item Dictionary

Table 5-1shows the meanings and codes of the various variable item formats used.

Table 5-1. Variable Item Formats

Format	Octal Code	Meaning
ASCII	20	Item is text
BINARY	10	Individual bits have meanings
BOOL(EAN)	11	Item is two-valued
U1	51	1-byte integer (unsigned)
U2	52	2-byte integer (unsigned)
U4	54	4-byte integer (unsigned)
U8	50	8-byte integer (unsigned)
F4	44	4-byte floating-point constant
F8	40	8-byte floating-point constant

The rest of the chapter is the Variable Item Dictionary itself.

Item	VID	Class	Formats
AlarmID	10023	DVVAL	U4
This variable is valid only upon the setting or clearing of an alarm condition and contains the current alarm identification (ALID), regardless of whether that alarm is enabled for reporting.			
AlarmsEnabled	10024	SV	LIST
Contains the list of alarms (ALIDs) enabled for reporting (via Stream 5). Structure: L,n where n=# of alarms enabled 1. <ALID1> 2. <ALID2> .. n. <ALIDn>			

Item	VID	Class	Formats
AlarmsSet	10025	SV	LIST

Contents of this variable is a list of alarms (ALIDs) currently in the UNSAFE (alarm set) state, regardless of whether the alarms are enabled for reporting.

Structure: L,n where n=# of alarms set

```
1. <ALID1>
2. <ALID2>
..

n. <ALIDn>
```

Item	VID	Class	Formats
Clock	10028	SV	ASCII

The value of the equipment's internal clock. This is a format requirement only and does not imply a precision or accuracy.

```
Format: yyyymmddhhmmsscc
yyyy = year        0000 to 9999
  mm = month         01 to 12
  dd = day           01 to 31
  hh = hour          00 to 23
  mm = minute        00 to 59
  ss = second        00 to 59
  cc = centisecond   00 to 99
```

Item	VID	Class	Formats
ControlState	10029	SV	BINARY

The lower 6 bits of this variable indicate the current state of the equipment. When a change in any of these bits is reported, the report will give the value of the bits *following* the transition, not prior to it.

```
   1 = OFF-LINE/EQUIPMENT OFF-LINE
   2 = OFF-LINE/ATTEMPT ON-LINE
   3 = OFFLINE/HOST OFF-LLINE
   4 = ON-LINE/LOCAL
   5 = ON-LINE/REMOTE
6-63 = reserved
```

Item	VID	Class	Formats
EstablishCommunicationsTimeout	10006	ECV	U2

The length of time, in seconds, of the interval between attempts to send S1F13 when establishing communication.

<table>
<tr><th>Item</th><th>VID</th><th>Class</th><th>Formats</th></tr>
<tr><td>EventsEnabled</td><td>10031</td><td>SV</td><td>LIST</td></tr>
<tr><td colspan="4">Contains the list of events (CEIDs) enabled for reporting. (Reporting is done via Stream 6.)

Structure: L,n where n=# of events enabled

1. <CEID1>
2. <CEID2>
..
n. <CEIDn></td></tr>
<tr><td>EventLimit</td><td>10084</td><td>DVVAL</td><td>BINARY</td></tr>
<tr><td colspan="4">Used with the Limits Monitoring Capability, it contains the LIMITID of the limit reached or crossed by LimitVariable. (It is possible that several limits may be crossed in close succession.)</td></tr>
<tr><td>LimitVariable</td><td>10083</td><td>DVVAL</td><td>U4</td></tr>
<tr><td colspan="4">This variable contains the VID for the variable whose value changed monitoring zones.</td></tr>
<tr><td>MaxSpoolTransmit</td><td>10070</td><td>ECV</td><td>U4</td></tr>
<tr><td colspan="4">The maximum number of messages which the equipment will transmit from the spool in response to an S6F23 “Transmit Spooled Messages” request. If MaxSpoolTransmit is set to zero, no limit is placed on the messages sent from the spool. Multi-block inquire/grant messages are not counted in this total.</td></tr>
<tr><td>OverWriteSpool</td><td>10072</td><td>ECV</td><td>BOOL</td></tr>
<tr><td colspan="4">This tells the equipment which course of action to take in the event that the spool area becomes full. The two possible courses of action are given below.

TRUE = overwrite spooled area
FALSE = stop spooling when limits exceeded</td></tr>
<tr><td>PPChangeName</td><td>10041</td><td>DVVAL</td><td>ASCII</td></tr>
<tr><td colspan="4">The PPID which was affected upon the event of the creation, editing, or deletion of a Process Program local to the equipment.</td></tr>
<tr><td>PPChangeStatus</td><td>10042</td><td>DVVAL</td><td>U1</td></tr>
<tr><td colspan="4">The action taken on the Process Program named in PPChangeName. This variable is valid upon the event of the creation, editing, or deletion of a Process Program local to the equipment.

1 = created
2 = edited
3 = deleted
4-63 = reserved</td></tr>
</table>

Item	VID	Class	Formats
SpoolCountActual	10089	SV	U4
Used to keep a count of the messages actually contained in the equipment's spool area. Multi-block inquire/grant messages are not spooled and not included in this count.			
SpoolCountTotal	10090	SV	U4
Used to keep a count of the total number of primary messages directed to the spool, regardless of whether placed or retained in the spool. Multi-block inquire/grant messages are not spooled and not included in this count.			
SpoolFullTime	10091	SV	ASCII

Contains the timestamp from the time the spool last became full. If the spool was not filled during the last spooling period, this will contain a time value prior to the current SpoolStartTime.
`Format: yyyymmddhhmmsscc`
`yyyy = year 0000 to 9999`
`mm = month 01 to 12`
`dd = day 01 to 31`
`hh = hour 00 to 23`
`mm = minute 00 to 59`
`ss = second 00 to 59`
`cc = centisecond 00 to 99`			

TransitionType	10085	DVVAL	BINARY

Used with the Limits Monitoring capability, it defines the direction of the zone transition which has occurred.
`0 = Transition from lower to upper zone`
`1 = Transition from upper to lower zone`			

Chapter 6
Reports, Status Variables, Collection Events

WARNING: Too many reports can overload the SECS Data Link and impair system performance. Be sure to test customized reports that request large volumes of data on your equipment before starting up full production.

This chapter discusses Status Variables, Collection Events, Reports, and Limits Monitoring; and shows how they relate to one another.

- Status Variables

  Information about various aspects of the implantation process that can be gathered from the equipment and reported at any time; also items reporting the status of the GEM interface. Examples of status variables are physical measurements such as temperatures and pressures.
- Collection Events

  Events of sufficient importance to be reported to the Host, such as a change-of-state of an alarm. A collection event can have one or more reports assigned to it. If the event is enabled, the occurrence of the collection can result in the sending of any reports assigned to it.
- Reports

  A body of information sent to the Host, either spontaneously or as a result of the Host requesting it. A report is host-defined and contains information about a selected set of status variables.

Note: Although both the set of status variables and the set of collection events are fixed in advance, all reports are strictly user-defined.

6.1 Defining a Report

A report is defined by the message S2F33. The coding for this message type is reproduced here from Chapter 16, Message Summary.

S2F33 W

```
<L[2]
    <U4 DATAID>                         DATAID
    <L[n]
        <L[2]
            <U4 RPTID1>                 REPORT ID
            <L[a]
                <U4 VID1>               VARIABLE ID
                .....
                <U4 VIDa>               VARIABLE ID
            >
```

>
.....
<L[2]
<U4 RPTID$_n$> REPORT ID
<L[b]
<U4 VID$_1$> VARIABLE ID
.....
<U4 VID$_b$> VARIABLE ID
>
>
>
>.

This coding allows for the defining of as many reports as needed. For each report defined in the message, there is:

- A report ID (RPTID)
- The VIDs of all of the status variables that make up that particular report

After defining a report, you then assign it to one or more collection events. (See Section 6.1.2.)

There is a variant of this message that deletes an existing report. This is given in Chapter 16 under S2F33.

6.1.1 Collection Events

Collection events are events of sufficient importance to have their occurrences reported. Also, their occurrences cause the sending of reports assigned to them.

There are two classes of Collection Events:

- Those not associated with alarms.

  These are listed In Appendix C. For example:

```
event ALM_VAC_IN_HVAC
   ceid = 50331675
```

- Those associated with alarms.

  These are listed In Appendix A as part of the listing for the alarm they are associated with.

  Every alarm has two collection events associated with it:

  - The passage of the alarm from its OFF to its ON state
  - The passage of the alarm from its ON to its OFF state.

  For example:

```
alarm ALM_TEST_ID3
   alid = 2
   altx = "Alarm Test Message 3"
   alcd = 3
   ceon = E2_ON1
   ceoff = E2_OFF0

   event E2_ON1
     ceid = 1073741826
   event E2_OFF0
     ceid = 2147483650
```

  `event E2_ON1` is the collection event for this particular alarm going from its OFF to its ON state. Its ceid is 1073741826. There is a corresponding event `E2_OFF0`.

Collection Events are listed in Section 6.2. Unlike Appendix C, this listing includes descriptions and values.

6.1.2 Linking Reports to Collection Events

- Any number of reports can be linked to a given collection event.
- Any report can be linked to any number of collection events.

With these linkages, the occurrence of any enabled collection event results in the sending of all reports linked to it.

A possible linkage is shown in the following figure.

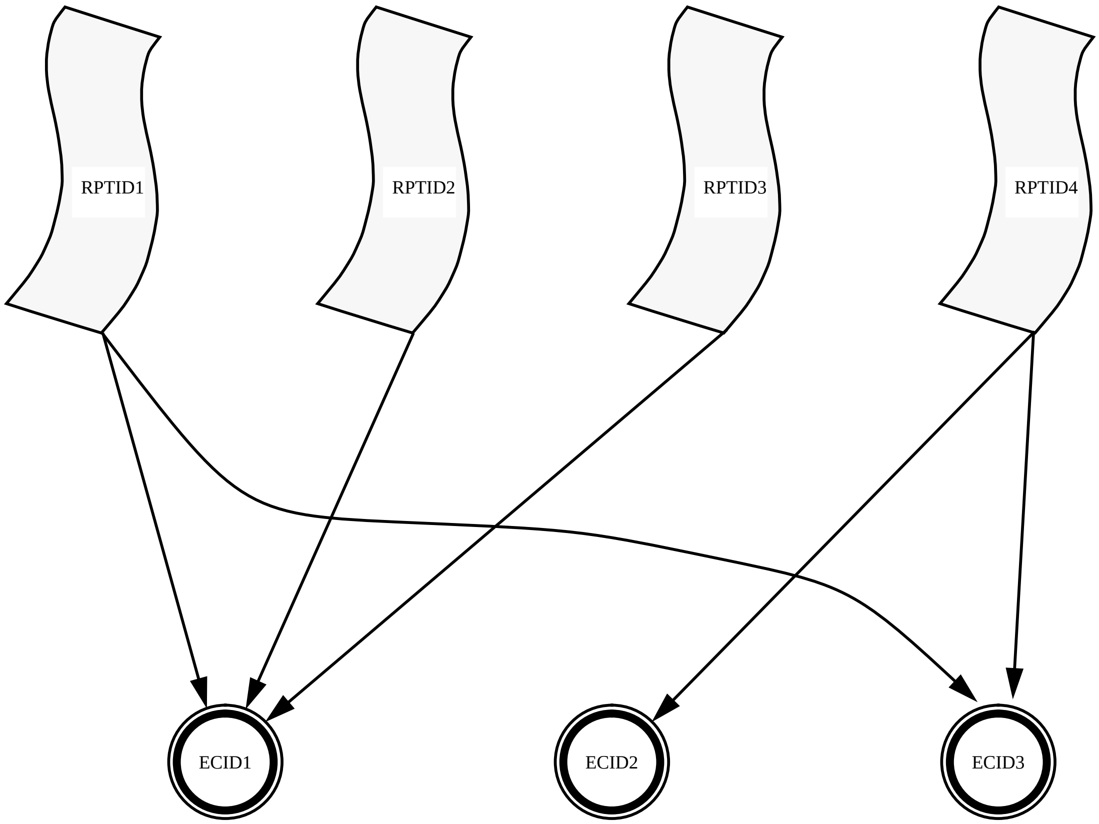

Figure 6-1. Example of Report-to-Event Linkage

For the linkages shown in Figure 6-1:

- Occurrence of event ECID1 results in the sending of reports RPTID1, RPTID2, RPTID3.
- Occurrence of event ECID2 results in the sending of report RPTID4.
- Occurrence of event ECID3 results in the sending of reports RPTID1, RPTID4.

Report-Event linkages are established using message S2F35. Its coding is reproduced below.

S2F35 W

```
<L[2]
    <U4 DATAID>                       DATAID
    <L[n]
        <L[2]
            <U4 CEID1>                Collection Event ID
            <L[a]
                <U4 RPTID1>           Report ID
                ...
                <U4 RPTIDa>           Report ID
            >
        >
        ...
        <L[2]
            <U4 CEIDn>                Collection Event ID
            <L[b]
                <U4 RPTID1>           Report ID
                ...
                <U4 RPTIDb>           Report ID
            >
        >
    >
>.
```

6.1.3 Enabling/Disabling Events

The occurrence of an enabled collection event causes all reports linked to it to be sent.

Events are enabled or disabled by the message S2F37. The coding of this message is reproduced below.

S2F37 W

```
<L[2]
    <BOOLEAN CEED>                Coll. Event Enable
    <L[n]
        <U4 CEID1>                Coll. Event ID
        ...
        <U4 CEIDn>                Coll. Event ID
    >
>.
```

CEED is set to “true” to enable events; it is set to “false” to disable events.

The Host can also enable or disable *all* CEIDs by the following special format:

S2F37 W

```
<L[2]
    <BOOLEAN CEED>                Coll. Event Enable
    <L[0]>
>.
```

6.1.4 Sending of a Report(s)

When an *enabled* collection event occurs, all reports assigned to it are sent. Those reports are embodied in the message S6F11. The coding for this message is reproduced below.

S6F11 W

```
<L [3]
    <U4 DATAID>                    DATAID
    <U4 CEID>                      Collection Event ID
    <L[n]
        <L [2]
            <U4 RPTID1>            Report ID
            <L[a]
                <V1>               Variable Value
                ...
                <Va>               Variable Value
            >
        >
        ...
        <L [2]
            <U4 RPTIDn>            Report ID
            <L[b]
                <V1>               Variable Value
                ...
                <Vb>               Variable Value
            >
        >
    >
>.
```

Note carefully the list under each RPTID. Those “V” items are not IDs; they are *values* for variables like temperatures, pressures, or voltages.

6.1.5 Reports Requested by Host

It is also possible for the Host to request a report at any time. The Host can cause a report to be sent by any of the following messages:
S6F15, S6F17, S6F19, S6F21.

6.2 Summary of Collection Events

Table 6-1. General Events

CEID	**Event** Description
1	**GemPPChangeEvent** The Equipment Operator has created, changed, or deleted a Process Program. PPCHANGESTATUS(U1) in variable 10042 is the status. PPCHANGENAME(A) in variable 10041 is the name of the Process Program. Possible states are: 1 = Change 2 = Create 3 = Delete
2	**BadDownload** The Equipment has rejected a Process Program downloaded from the Host.
335544490	**ALM_GEM_LIMITS_EXCEEDED** This event indicates that, for some variable that is subject to limits monitoring, its value has crossed a limit boundary.
335544396	**ALM_GEM_TERMINAL_DISPLAY_ACK** The Equipment Operator has acknowledged a message from the Host.
335544363	**ALM_GEM_EC_VID_CHANGE** The Equipment Operator has changed the value of an Equipment Constant. The ECID that was changed is found in variable 4563 (DB_GEM_EC_CHANGE_VID_IV).

Table 6-2. Control Finite State Description

CEID	**Event** Description
335544493	**ALM_GEM_CONTROL_STATE_REMOTE** The control state has changed. New state is in (DB_GEM_CONTROL_STATE_NEW_IV) (4553) Old state is in (DB_GEM_CONTROL_STATE_OLD_IV) (4554) Possible values for these variables are: 1: Equipment OFF 2: Attempting ON 3: Host OFF 4: ON-LINE LOCAL 5; ON-LINE REMOTE
335544492	**ALM_GEM_CONTROL_STATE_LOCAL** The control state has changed. New state is in (DB_GEM_CONTROL_STATE_NEW_IV) (4553) Old state is in (DB_GEM_CONTROL_STATE_OLD_IV) (4554) Possible values for these variables are: 1: Equipment OFF 2: Attempting ON 3: Host OFF 4: ON-LINE LOCAL 5; ON-LINE REMOTE
335544491	**ALM_GEM_CONTROL_STATE_OFFLINE** The control state has changed. New state is in (DB_GEM_CONTROL_STATE_NEW_IV) (4553) Old state is in (DB_GEM_CONTROL_STATE_OLD_IV) (4554) Possible values for these variables are: 1: Equipment OFF 2: Attempting ON 3: Host OFF 4: ON-LINE LOCAL 5; ON-LINE REMOTE

Table 6-3. Cassette Finite State Description

CEID	**Event** Description
335544366	**ALM_GEM_CASSETTE_1_STATE_CHANGE** A state transition has occurred for Port 1. New state can be found in variable 4564 (DB_GEM_ES_PORT_1_STATE_NEW_IV), and the old state in variable 4565 (DB_GEM_ES_PORT_1_STATE_OLD_IV). Possible values are: 0 = No cassette in this position 1 = Waiting to Load 2 = Loading 3 = In Process 4 = All Complete Note: There is an additional state for machines that use an AGV.
335544367	**ALM_GEM_CASSETTE_2_STATE_CHANGE** A state transition has occurred for Port 2. New state can be found in variable 4566(DB_GEM_ES_PORT_2_STATE_NEW_IV), and the old state in variable 4567 (DB_GEM_ES_PORT_2_STATE_OLD_IV). Same parameters as transitions for Port 1.
335544368	**ALM_GEM_CASSETTE_3_STATE_CHANGE** A state transition has occurred for Port 3. New state can be found in variable 4568 (DB_GEM_ES_PORT_3_STATE_NEW_IV), and the old state in variable 4569 (DB_GEM_ES_PORT_3_STATE_OLD_IV). Same Parameters as transitions for Port 1.
335544369	**ALM_GEM_CASSETTE_4_STATE_CHANGE** A state transition has occurred for Port 4. New state can be found in variable 4570 (DB_GEM_ES_PORT_4_STATE_NEW_IV), and the old state in variable 4571 (DB_GEM_ES_PORT_4_STATE_OLD_IV). Same Parameters as transitions for Port 1.

Table 6-4. Disk Finite State Description

CEID	**Event** Description
335544397	**ALM_GEM_NEW_DISK_STATE_IDLE** A state change has occurred for the Disk. The new state is IDLE. The new state is found in variable 4559 (DB_GEM_DISK_STATE_NEW_IV). The old state is represented in variable 4560 (DB_GEM_DISK_STATE_OLD_IV). The possible values for these variables are as follows: 0 = DISK_STATE_IDLE 1 = DISK_STATE_LOAD 2 = DISK_STATE_UNLOAD 3 = DISK_STATE_LOAD_UNLOAD
335544398	**ALM_GEM_NEW_DISK_STATE_LOAD** A state change has occurred for the Disk. The new state is LOAD. The new state is found in variable 4559 (DB_GEM_DISK_STATE_NEW_IV). The old state is represented in variable 4560 DB_GEM_DISK_STATE_OLD_IV). The possible values for these variables are as defined in the description for DISK_STATE_IDLE above.
335544399	**ALM_GEM_NEW_DISK_STATE_LOAD_UNLOAD** A state change has occurred for the Disk. The new state is LOAD_UNLOAD. The new state is found in variable 4559 (DB_GEM_DISK_STATE_NEW_IV). The old state is represented in variable 4560 (DB_GEMDISK_STATE_OLD_IV). The possible values for these variables are as defined in the description for DISK_STATE_IDLE above.
35544400	**ALM_GEM_NEW_DISK_STATE_UNLOAD** A state change has occurred for the Disk. The new state is UNLOAD. The new state is found in variable 4559 (DB_GEM_DISK_STATE_NEW_IV). The old state is represented in variable 4560 (DB_GEM_DISK_STATE_OLD_IV). The possible values for these variables are as defined in the description for DISK_STATE_IDLE above.

Table 6-5. E10 Finite State Description

CEID	**Event** Description
335544374	**ALM_GEM_NEW_E10_STATE_PRODUCTIVE** The E10 state as defined in SEMI E10 1993 has changed. The new state is PRODUCTIVE. This new state can be found in variable 4555 (DB_GEM_E_10_STATE_NEW_IV). The old state can be found in variable 4556 (DB_GEM_E_10_STATE_OLD_IV). The possible values are: 0 = NOT SCHEDULED 1 = PRODUCTIVE 2 = STANDBY 3 = ENGINEERING 4 = SCHEDULED_DOWNTIME 5 = UNSCHEDULED_DOWNTIME
335544373	**ALM_GEM_NEW_E10_STATE_NOT_SCHEDULED** The E10 state as defined in SEMI E10 1993 has changed. The new state is NOT SCHEDULED. This new state can be found in variable 4555 (DB_GEM_E_10_STATE_NEW_IV). The old state can be found in variable 4556 (DB_GEM_E_10_STATE_OLD_IV). The possible values are as defined in PRODUCTIVE description.
335544375	**ALM_GEM_NEW_E10_STATE_STANDBY** The E10 state as defined in SEMI E10 1993 has changed. The new state is STANDBY. This new state can be found in variable 4555 (DB_GEM_E_10_STATE_NEW_IV). The old state can be found in variable 4556 (DB_GEM_E_10_STATE_OLD_IV). The possible values are as defined in PRODUCTIVE description.
335544376	**ALM_GEM_NEW_E10_STATE_ENGINEERING** The E10 state as defined in SEMI E10 1993 has changed. The new state is ENGINEERING. This new state can be found in variable 4555 (DB_GEM_E_10_STATE_NEW_IV). The old state can be found in variable 4556 (DB_GEM_E_10_STATE_OLD_IV). The possible values are as defined in PRODUCTIVE description.
335544377	**ALM_GEM_NEW_E10_STATE_SCHEDULED_DOWNTIME** The E10 state as defined in SEMI E10 1993 has changed. The new state is SCHEDULED DOWNTIME. This new state can be found in variable 4555 (DB_GEM_E_10_STATE_NEW_IV). The old state can be found in variable 4556 (DB_GEM_E_10_STATE_OLD_IV). The possible values are as defined in PRODUCTIVE description.
335544378	**ALM_GEM_NEW_E10_STATE_UNSCHEDULED_DOWNTIME** The E10 state as defined in SEMI E10 1993 has changed. The new state is UNSCHEDULED DOWNTIME. This new state can be found in variable 4555 (DB_GEM_E_10_STATE_NEW_IV). The old state can be found in variable 4556 (DB_GEM_E_10_STATE_OLD_IV). The possible values areas defined in PRODUCTIVE description.

Table 6-6. Autotune Finite State Description

CEID	**Event** Description
335544379	**ALM_GEM_NEW_AUTOTUNE_STATE_IDLE** A state transition has occurred in the Autotune state description, the new state is IDLE. The value of the new state can be found in variable 4562 (DB_GEM_AUTOTUNE_STATE_NEW_IV), and the old state in variable 4561 (DB_GEM_AUTOTUNE_STATE_OLD_IV). The possible values are: 0 = IDLE 1 = STARTUP_ACTIVE 2 = SHUTDOWN_ACTIVE 3 = SHUTDOWN_FOR_STARTUP 4 = ERROR_HOLD 5 = OPERATOR_HOLD 6 = READY_ACTIVE 7 = TRIM_ACTIVE 8 = IMPLANT_ACTIVE 9 = AXIS_TUNE_ACTIVE 10 = STANDBY_ACTIVE
335544380	**ALM_GEM_NEW_AUTOTUNE_STATE_STARTUP_ACTIVE** New Autotune state is STARTUP_ACTIVE. See IDLE for description.
335544381	**ALM_GEM_NEW_AUTOTUNE_STATE_SHUTDOWN_ACTIVE** New Autotune state is SHUTDOWN_ACTIVE. See IDLE for description.
335544382	**ALM_GEM_NEW_AUTOTUNE_STATE_SHUTDOWN_FOR_STARTUP** New Autotune state is SHUTDOWN_FOR_STARTUP. See IDLE for description.
335544383	**ALM_GEM_NEW_AUTOTUNE_STATE_ERROR_HOLD** New Autotune state is ERROR_HOLD. See IDLE for description.
335544384	**ALM_GEM_NEW_AUTOTUNE_STATE_OPERATOR_HOLD** New Autotune state is OPERATOR_HOLD. See IDLE for description.
335544385	**ALM_GEM_NEW_AUTOTUNE_STATE_READY_ACTIVE** New Autotune state is READY_ACTIVE. See IDLE for description
335544386	**ALM_GEM_NEW_AUTOTUNE_STATE_TRIM_ACTIVE** New Autotune state is TRIM_ACTIVE. See IDLE for description.
335544387	**ALM_GEM_NEW_AUTOTUNE_STATE_IMPLANT_ACTIVE** New Autotune state is IMPLANT_ACTIVE. See IDLE for description.
335544389	**ALM_GEM_NEW_AUTOTUNE_STATE_STANDBY_ACTIVE** New Autotune state is STANDBY_ACTIVE. See IDLE for description.

Table 6-7. Implant Finite State Description

CEID	Event Description
33554439	**ALM_GEM_NEW_IMPLANT_CONTROL_STATE_IDLE** State has changed in the Implant state diagram. The new state is IMPLANT_IDLE. The value of the current state can be found in variable 4557: DB_GEM_IMPLANT_STATE_NEW_IV, and the old state in variable 4558: DB_GEM_IMPLANT_STATE_OLD_IV. Possible values are: 1 = IMPLANT_IDLE 2 = IMPLANT_IN_PROG 3 = IMPLANT_IN_HOLD 4 = IMPLANT_STARTUP 5 = IMPLANT_SHUTDOWN 6 = IMPLANT_IN_PAUSE
335544391	**ALM_GEM_NEW_IMPLANT_CONTROL_STATE_IN_PROG** New state is IMPLANT_IN_PROG. See description above.
335544392	**ALM_GEM_NEW_IMPLANT_CONTROL_STATE_IN_HOLD** New state is IMPLANT_IN_HOLD. See description above.
335544393	**ALM_GEM_NEW_IMPLANT_CONTROL_STATE_STARTUP** New state is IMPLANT_STARTUP. See description above.
335544394	**ALM_GEM_NEW_IMPLANT_CONTROL_STATE_SHUTDOWN** New state is IMPLANT_SHUTDOWN. See description above.
335544395	**ALM_GEM_NEW_IMPLANT_CONTROL_STATE_IN_PAUSE** New state is IMPLANT_IN_PAUSE. See description above.
100663321	**ALM_IC_IMPLANT_COMPLETE** Separate Event that is always sent at the end of each Implant.

Table 6-8. Implant Control Quarter Finite State Description

CEID	**Event** Description
335544401	**ALM_GEM_NEW_ICQ_STATE_1_Q** The state has changed in the Implant Control Quarter Finite State Description. The new state can be found in variable 4587 (DB_GEM_IV_ICQ_NEW_IV), and the old state in 4588 (DB_GEM_IV_ICQ_OLD_IV). Possible values for these variables are: 0 = Idle 1 = First Quarter Complete 2 = Second Quarter Complete 3 = Third Quarter Complete 4 = Fourth Quarter Complete
335544402	**ALM_GEM_NEW_ICQ_STATE_2_Q** A state change has occurred. See above for description
335544403	**ALM_GEM_NEW_ICQ_STATE_3_Q** A state change has occurred. See above for description.
335544404	**ALM_GEM_NEW_ICQ_STATE_4_Q** A state change has occurred. See above for description.
335544405	**ALM_GEM_NEW_ICQ_STATE_IDLE** A state change has occurred. See above for description.

Chapter 7
Limits Monitoring

WARNING: Excessive programming of either traces or limits monitoring could overload the SECS Data Link and impair system performance.

Note: This chapter describes the concepts of limit monitoring. The actual limit variable IDs are listed in Appendix D, "Limit Variables".

For certain variables, it is necessary to define regions in their range and to report to the Host transitions from one region to an adjacent region. Examples of such variables are temperatures and pressures. For these, three regions might be defined:

- TOO LOW
- OK
- TOO HIGH

(Any number of regions may be defined; three is commonly the case.)

Regions are established by defining boundaries between them and assigning a LimitID to each such boundary. Any crossing from one region to another generates a **collection event**.

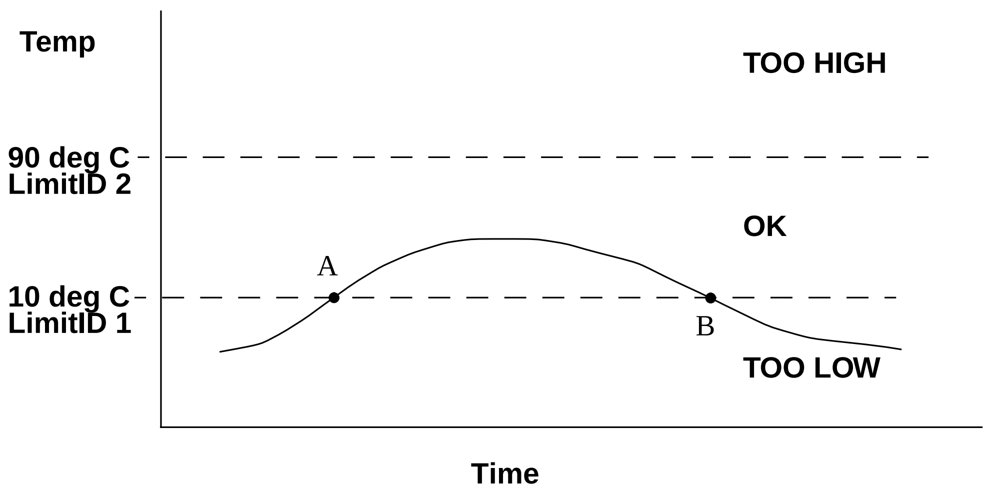

Figure 7-1. Illustration of Variable Limits

The example illustrates the case of a temperature and how it may have varied over an interval of time. The values 10 and 90 degrees C are example variables. At point A the temperature generates a collection event by passing from the TOO

LOW region to the OK region. At point B, it generates a collection event by passing from the OK region back to the TOO LOW region.

There are two additional refinements.

- LIMITMIN, LIMITMAX

  These are lower and upper bounds on the programming of limits. Any attempt to program a limit outside of these bounds produces a warning. These are built into the system; the Host does not program them. Crossing one of these limits does not generate an event.

- Deadbands

  Suppose that a variable were right at or very close to a defined limit and further suppose that there is a certain amount of noise in the system. The result would be the repeated crossing of a limit and the consequent generating of a series of meaningless collection events.

  To manage this, the single limit is replaced by a pair of closely-spaced limits termed the lower dead-band and upper dead-band.

With these refinements, our diagram becomes like that of Figure 7-2.

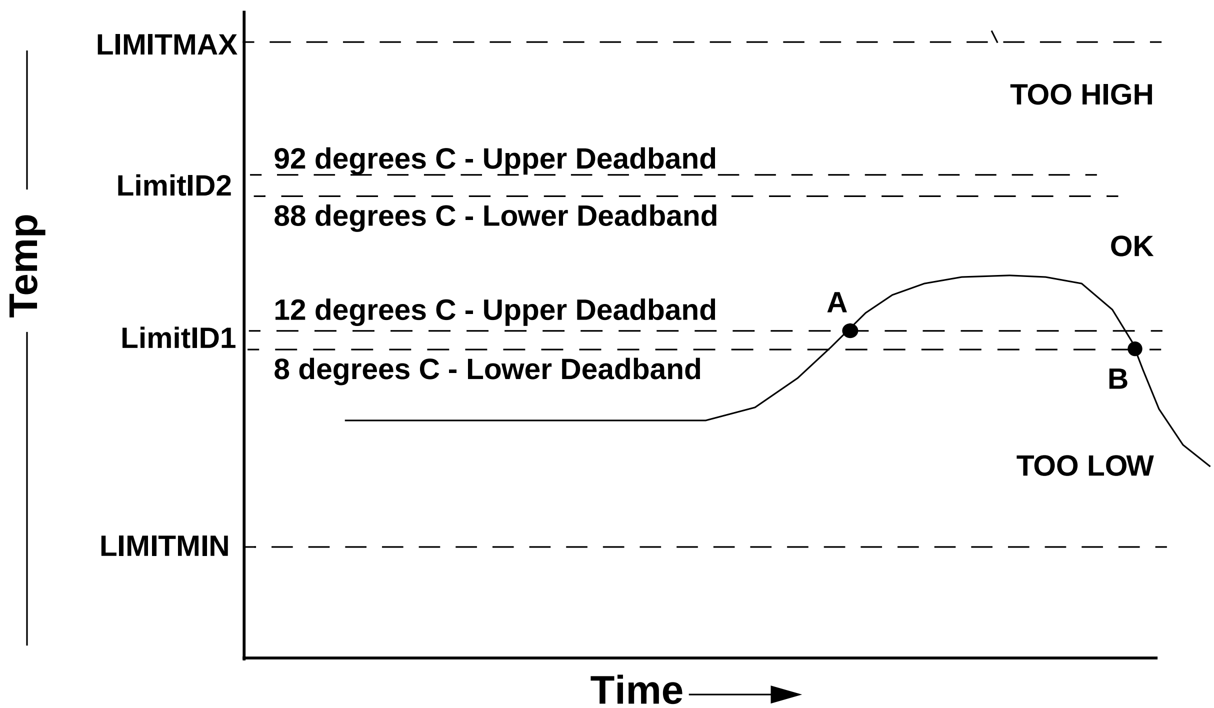

Figure 7-2. Variable LImits with Deadbands

The LIMIT ID1 of 10 degrees has been replaced by a Lower Deadband of 8 degrees and an Upper Deadband of 12 degrees. The LIMITID2 of 90 degrees has been replaced by a lower deadband of 88 degrees and an Upper Deadband of 92 degrees.

When passing from the TOO LOW to the OK region, the temperature does not generate a collection event until it crosses the 12 degree Upper Deadband at point A. When passing from the OK region back to the TOO LOW region, it does not generate a collection event until it crosses the 8 degree Lower Deadband at point B.

The same rules apply to passages between the OK and the TOO HIGH regions.

7.1 The Collection Event

For any variable subject to limits monitoring, crossing any of its defined boundaries in either direction results in the collection event ALM_GEM_LIMITS_EXCEED (CEID = 335544490. See Table 6-1).

7.2 The Associated Report

The collection event ALM_GEM_LIMITS_EXCEED states that for some variable, some limit boundary was crossed in some direction. There must be an associated report which tells the Host:

- The VID of the variable that crossed the boundary
- The LimitID of the boundary that was crossed
- A direction in which the crossing occurred (up or down)

The following steps must be performed to create the necessary report and to link it to the collection event.

1. Use the message S2F45 to define all of the limits and specify their LIMITIDs.
2. Use the message S2F33 to define the report that is to be linked to the event. Under whichever RPTID you assign, give the following three VIDs:
   - GemLimitsVID

     format: U4

     vid = 10083

     In the event of a limit crossing, this contains the vid of the variable for which the crossing occurred.
   - GemEventLimit

     format: B

     vid = 10084

     In the event of a limit crossing, this contains the limitid of the limit that was crossed.
   - GemTransType

     format: B

     vid = 10085

     In the event of a limit crossing, this contains the encoding of the direction of crossing:

     0x00 = up

     0x01 = down
3. Having defined the report, use S2F35 to link the report to the collection event.

4. Enable the event.

With the report defined and assigned to this collection event, the occurrence of the event results in the message S6F11.

Chapter 8
Alarms

When the the equipment is in operation, there are many alarm conditions that mean something in the operation has seriously deviated from what is normal, and could even imply imminent danger. A typical example is a temperature or current running outside of its pre-defined limits.

An enabled alarm is reported to the Host when it occurs, without the Host having to ask for it.

All alarms are listed in Appendix A.

8.1 Alarms Reported Spontaneously

Transactions involving alarms are supported by the Stream 5 message set. These messages are listed below:

Equipment to Host

- S5F1: Alarm Report

Host to equipment

- S5F3: Enable/disable Alarms
- S5F5: List (all) Alarms
- S5F7: List Enabled Alarms

The most important of these messages is S5F1.

S5F1 W

<L[3]	
<B[1] ALCD>	Alarm On/Off and Severity
<U4 ALID>	Alarm ID
<A[40] ALTX>	Alarm Text
>.	

Alarms are enabled or disabled by the message S5F3.

The Host may independently request the status of any alarm. (See Section 8.2.)

An alarm is always in either of two conditions:

- OFF. This is its normal, or safe, condition.
- ON. This is its alarm condition.

Two collection events are associated with each alarm. (Refer to Chapter 6 for a discussion of Collection Events.)

- The transition from the OFF to the ON condition
- The transition from the ON to the OFF condition.

A typical alarm listing is shown below.

```
alarm ALM_TEST_ID3
   alid = 2
   altx = "Alarm Test Message 3"
   alcd = 3
   ceon = E2_ON1
   ceoff = E2_OFF0

   event E2_ON1
     ceid = 1073741826
   event E2_OFF0
     ceid = 2147483650
```

This listing has the following items:

- Name of the alarm
- Alarm ID (alid)
- Alarm text (altx)
- Alarm severity code (alcd)
- Names of the two associated collection events
- IDs (ceid) of the two associated collection events

The Host can enable or disable alarms with the message S5F3. Collection events can be likewise enabled or disabled.

When an alarm occurs, the following chain of events results.

- If the alarm is enabled, its occurrence is reported by the message S5F1.
    - If the associated collection event is also enabled, a collection event report is sent in the message S6F11.
        - If one or more reports were previously linked to that collection event, then they are included in the S6F11 message.
        - If no reports were previously linked, then the S6F11 message does not contain any mention of them.
    - If the associated collection event is not enabled, then there is no S6F11 message.
- If the alarm is not enabled, then no messages of any kind are sent.

8.2 Alarms Reported by Host Request

The Host can request the status of any alarms by sending message S5F5 and listing the alarms in the message.

The Host can request the status of all alarms that are currently enabled by sending message S5F7 (no ALIDs are specified in the message).

8.3 Miscellaneous Alarm-related Messages

8.3.1 S5F8

This is used to send complete information about an alarm.

```
<L[n]
    <L [3]
        <B [1] ALCD1>              Alarm On/Off and Severity    Code
        <U4 ALID1>                 Alarm ID
        <A [40] ALTX1>     *       Alarm Text
    >
    ...
    <L [3]
        <B [1] ALCDn>              Alarm On/Off and Severity    Code
        <U4 ALIDn>                 Alarm ID
        <A [40] ALTXn>     *       Alarm Text
    >
>.
```

8.3.2 S5F71/S5F73

These are older versions of S5F1 that continue to be supported for the sake of compatibility. If you want to use either of these, your choice is determined by the setting of the Equipment Constant **GEMConfigAlarms. (**See **Table 2-1 in Chapter 2.)**

- **ConfigAlarms** = 1, use S5F71
- **ConfigAlarms** = 2, use S5F73

Chapter 9
Remote Control

9.1 ON-LINE LOCAL and ON-LINE REMOTE States

At the conclusion of the startup process the Equipment is on-line. There are two on-line states: ON-LINE LOCAL and ON-LINE REMOTE. The equipment can go into either of these two states, depending on the value set in the **GemOnLineSubstate** configuration point. A query of the support control mode variable DB_GEM_CONTROL_STATE_NEW_IV (4553) shows a value of either 4 (GemONLINELOCAL) or 5 (GemONLINEREMOTE).

From the ON-LINE LOCAL state, the operator can put the equipment in the ON-LINE REMOTE state by clicking the **Remote Control** button. Conversely, from the ON-LINE REMOTE state the operator can put the equipment in the ON-LINE LOCAL state by clocking the **Local Control** button.

In the ON-LINE REMOTE state, even when the Equipment is fully under Host control operator commands are still allowed for safety reasons. The operator can seize control from the Host by clicking the **Local Control** button on the Equipment Display Panel. This returns the Equipment to the ON-LINE LOCAL state.

9.2 Host Commands

The Equipment must be in the ON-LINE REMOTE STATE to be able to act on Host-issued commands. Such commands are issued via the S2F41 message.

In the standard interface, remote commands do not have associated parameters. The format of a standard remote command message is:

```
<L[2]
    <A ‘command_name’>
    <L[0]>
>.
```

Other formats are shown in the table where relevant.

Some remote commands listed in this table are applicable only to systems with the SMIF or AGV options.

Table 9-1 lists the possible commands that the host can send.

Table 9-1. Remote Command Table

Local, Remote	Command Description and Format
R	**R_IMPLANT** This is like the “START” command for the GSD-HE implanter. This command can only be used when the implanter is not in automatic implant mode. In automatic implant mode the implant begins after the disk is loaded and the beam has started. The R_IMPLANT command requires that the disk be loaded and the beam active. **Format:** Standard
R	**R_HOLD_IMPLANT** This command is like the “PAUSE” command for the GSD-HE implanter. It may be sent any time after the Implant State has left the Idle state. This command can be released only by the “R_RELEASE_HOST_HOLD” command. **Format:** Standard
R	**STOP** This command is the same as “R_HOLD_IMPLANT”. It may be sent anytime after the Implant State has left the Idle state. This command can be released only by R_RELEASE_HOST_HOLD command. **Format:** Standard
R	**R_RELEASE_HOST_HOLD** This command is like the “RESUME” command for the GSD-HE implanter. It can only be used to release a “R_HOLD_IMPLANT”. If any other type of holds are pending, the implant remains in a Hold state. **Format:** Standard
R	**R_ABORT_IMPLANT** This command is like the “ABORT” command for the GSD-HE implanter. It can be sent only after the implanter has been put in a hold state. This hold state can be generated by the Host or local operator. **Format:** Standard
R	**R_RESUME_EQUIP_HOLD** This command is like the “RESUME” command for the GSD-HE implanter. It is used to resume an implant that has not been put into a hold state by the Host. All hold conditions must be cleared for the implant to resume. **Format:** Standard

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
R	**R_HI_VAC** This command is used to bring the implanter to a “HI VAC” condition. The duration of the execution of this command is variable due to the unknown state of the vacuum control system when this command is issued. **Format:** Standard
R	**R_AUTO_CLEAN** This command is used to invoke the “Auto Clean” feature for the disk chamber. It can be run only during idle time. **Format:** Standard
R	**R_RESTART_ENDSTA** This command puts the endstation into the Automatic mode of operation. **Format:** Standard
R	**R_MANUAL_MODE_ENDSTA** This command puts the endstation into Manual mode of operation. **Format:** Standard
R	**R_HOLD_ENDSTA** This command puts the endstation into Hold mode. **Format:** Standard
R	**R_RESUME_ENDSTA** This command releases the endstation from a Hold state caused by an error or from the Operator or Host putting the endstation into Hold. **Format:** Standard
R	**R_SET_LOCAL** This command puts the implanter back in local control. **Format:** Standard
L, R	**MANUAL_MODE** This command supports the current AGV implementation. Sending this command puts the AGV system into Manual mode and sets communications off line. **Format:** Standard

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
L, R	**SEMI_AUTO_MODE** This command supports the current AGV implementation. Sending this command puts the AGV system into Semi-Auto mode and set communications on line local. **Format:** Standard
L, R	**FULL_AUTO_MODE** This command supports the current AGV implementation. Sending this command puts the AGV system into Full-Auto mode and set communications on line remote. **Format:** Standard
L, R	**IPR** This command supports the current AGV implementation. It is used to assign a PPID and MID to a cassette that was put onto the table in an AGV supported mode. **Format:** S2F41 W <L [2] <A ‘IPR’> <L [3] <L [2] <A “PORT”> <U4 port number> > <L [2] <A “PPID”> <A “process recipe”> > <L [2] <A “MID”> <A “material id”> > > >.

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Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
L, R	**R_BARCODE_CODES** Assigns the list of barcodes to be loaded into the Wafer Barcode Reader. **Format:** ‘S2F41’ W <L [2] <A ‘R_BARCODE_CODES’> <L [25] (could be 26 if using a 26 wafer cassette) <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> <A ‘barcode string’> > >.
L, R	**R_BARCODE_CODES_CBS** Assigns the list of barcodes to be loaded into the Wafer Barcode Reader. **Format:** Same as above

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
L, R	**R_BARCODE_LOADED** Command telling the Equipment that the Host or some other device has loaded the Wafer Barcode Reader with the list of barcodes. **Format:** Standard
L, R	**R_BARCODE_ERROR** Command telling the Equipment that the Host or some other device has had an error in loading the Wafer Barcode Reader with the list of barcodes. **Format:** Standard
R	**R_TOWER_RED_ON** Support for Turning On the Red Light in the Light Tower. This requires that the Equipment be set with the correct Light Tower Option. **Format:** Standard
R	**R_TOWER_RED_OFF** upport for Turning Off the Red Light in the Light Tower. This requires that the Equipment be set with the correct Light Tower Option. **Format:** Standard

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
L, R	**LOAD_CASSETTE** Supports the Loading of a cassette using a SMIF Arm. This requires that the Equipment has been configured for a SMIF Arm. **Format:** S2F41 W <L [2] <A ‘LOAD_CASSETTE’> <L [3] <L [2] <A “PORT”> <U4 port number> > <L [2] <A “PPID”> <A “process recipe”> > <L [2] <A “MID”> <A “material id”> > > >.

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
L, R	**UNLOAD_CASSETTE** Supports the Unloading of a cassette using a SMIF Arm. This requires that the Equipment has been configured for a SMIF Arm. **Format:** S2F41 W <L [2] <A ‘UNLOAD_CASSETTE’> <L [3] <L [2] <A “PORT”> <U4 port number> > <L [2] <A “PPID”> <A “process recipe”> > <L [2] <A “MID”> <A “material id”> > > >.
L, R	**LOCK_POD** Supports the Locking of a Pod on a SMIF Arm. This requires that the Equipment has been configured for a SMIF Arm. **Format:** Standard
L, R	**UNLOCK_POD** Supports the Unlocking of a Pod on a SMIF Arm. This requires that the Equipment has been configured for a SMIF Arm. **Format:** Standard
L, R	**SMIF_LED_BLINK_ON** Supports the Blinking of the Red Light on a SMIF Arm. This requires that the Equipment has been configured for a SMIF Arm. **Format:** Standard

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
L, R	**R_FIX_TOWER** Support for controling all the Lights in the Light Tower. This requires that the Equipment be set with the correct Light Tower Option. **Format:** S2F41 W <L [2] <A ‘R_FIX_TOWER’> <L [1 - 4] <L [2] <A “Color”> <U4 Command> > **Colors:** “RED” “GREEN” “BLUE” “YELLOW” **Command:** 0 - off 1 - blink 2 - on

Table 9-1. Remote Command Table (Continued)

Local, Remote	Command Description and Format
R	**PPSELECT** Support for the Host to remotely start up a Process Recipe on the Equipment. The Autobeam system must be in either ABS_STAT_IDLE or ABS_STAT_READY_ACTIVE. The variable DB_GEM_AUTOBEAM_STATE_NEW_IV (5208) must have one of the following values: #define ABS_STAT_IDLE 0 #define ABS_STAT_READY_ACTIVE 7 Note: If the Equipment is in the ABS_STAT_READY_ACTIVE state that could mean there are wafers loading onto the disk in preparation for an implant. If the Host were to select a new process to start up this could cause a number of problems. These could be a delay in the implant, the implant may not be done due to a wrong recipe, or there may be a bad implant. It is recommended that the Host do a PPSELECT only when the Equipment is in ABS_STAT_IDLE state. **Format:** S2F41 W <L [2] <A ‘PPSELECT’> <L [1] <L [2] <A “PPID”> <A “process recipe”> > > >.

Chapter 10
Spooling

The spool is an area of non-volatile storage set aside for the purpose of saving outgoing messages in the event of a communications breakdown. These are messages (typically, reports) that would otherwise have been sent to the Host.

When communication is restored, these saved messages are sent to the Host. The storage/retrieval is on a “first-in; first-out” basis.

For spooling to take place, it is necessary that the equipment constant **GemConfigSpool** be set to “yes.” (See Section 2.3.2, Entering Configuration Values.)

Spooling takes place for messages (of Streams other than 1) which were previously enabled for spooling by an S2F43 message from the Host. There is no spooling for Stream 1 messages.

When communication is restored, the Host indicates whether the spooled messages are to be sent or discarded by means of an S6F23 message.

S6F23 W

```
<U1 RSDC>.                       Request spool data code
```

where

RSDC=0	Spooled messages are to be sent to the Host
RSDC=1	Spooled messages are to be discarded

This chapter includes the state diagram, descriptions of the states, transitions table, descriptions of the status variables, and equipment constants involved.

10.1 Spooling State Diagram, States, and Transitions

Figure 10-1 shows a state diagram for spooling.

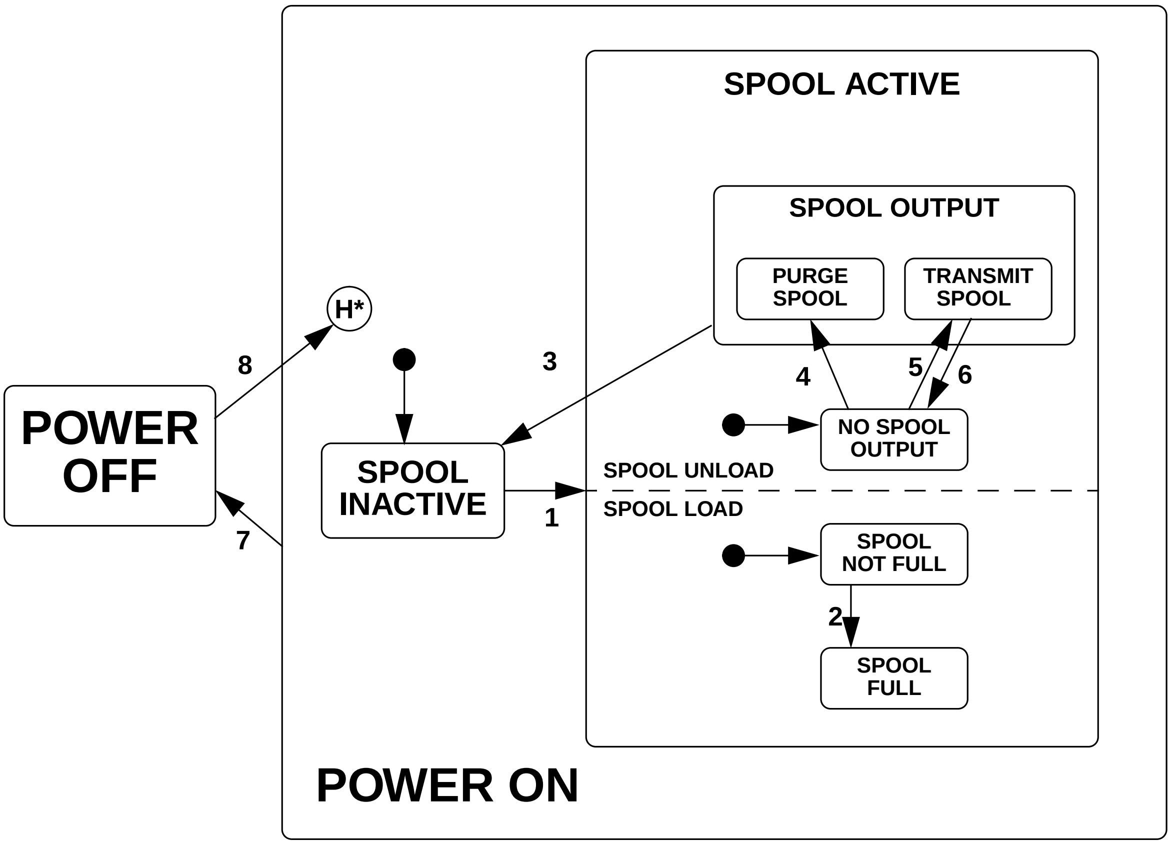

Figure 10-1. Spooling State Diagram

Section 10.1.1 describes the various states. Table 10-1 lists the possible state-to-state transitions.

10.1.1 Descriptions of the Spooling States

POWER OFF	The equipment is currently without power. This may have been a result either of a power failure or of a deliberate switching off of power. Spooling cannot take place.
POWER ON	The equipment is currently powered.
SPOOL INACTIVE	This is the normal condition. The spool area is empty and no spooling can take place.
SPOOL ACTIVE	When communication is disabled, primary messages that were previously enabled for spooling are saved on the spool for subsequent transmission to the Host when communication is restored. One attempt (and only one attempt) is made to send each generated secondary message.
SPOOL LOAD	A substate of SPOOL ACTIVE, regarding the placing of messages into the spool area. It contains the two substates: SPOOL FULL, SPOOL NOT FULL.
SPOOL NOT FULL	The default entry substate of SPOOL LOAD. Primary SECS messages are written to the spool area. For each such message placed, both of the status variables **GemSpoolCountTotal** and **GemSpoolCountActual** are incremented by 1.
SPOOL FULL	The spooling area is full. The transition from SPOOL NOT FULL to SPOOL FULL occurs on the first attempt to place a message for which there is not enough space left. The handling of this and subsequent messages to be spooled depends on the setting of **GemOverWriteSpool**. • **GemOverWriteSpool** is TRUE When a new message is to be spooled, the Equipment deletes as many of the “oldest” messages as needed to make room for the new one. **GemSpoolCountTotal** is incremented by 1. **GemSpoolCountActual** is adjusted to reflect the actual number of messages now in the spool area. • **GemOverWriteSpool** is FALSE Subsequent messages are discarded. **GemSpoolCountTotal** is incremented by 1. **GemSpoolCountActual** remains the same.
SPOOL UNLOAD	A substate of SPOOL ACTIVE. It has to do with the clearing of messages from the spool area. It contains the two substates: SPOOL OUTPUT, NO SPOOL OUTPUT. When communication is restored, the Host has two options: • Recover the spooled messages. The Host sends the message S6F23. (See TRANSMIT SPOOL.) • Discard the spooled messages. (See PURGE SPOOL.)
SPOOL OUTPUT	The recovery of spooled messages by the Host.

TRANSMIT SPOOL

The Host has chosen to recover all spooled messages. When it receives an S6F23 message, the Equipment sends the spooled messages to the Host in the order: oldest first, then next oldest, and so on. **GemSpoolCountActual** is decremented each time a spooled message is sent. There are two methods of flow control:

- Method 1

  All messages are sent until the spool area is completely cleared. For this method, **GemMaxSpoolTransmit** is set to 0. If a spooled message requires a reply, the Equipment waits for that reply before sending the next spooled message.

- Method 2

  The Equipment, instead of sending *all* of the spooled messages, sends a number of them equal to the value set into **GemMaxSpoolTransmit** and then transitions to the NO SPOOL OUTPUT state, awaiting a subsequent S6F23 command.
  It is the Host's responsibility to keep a count of the messages received.

New messages may be placed in the spool area at the same times that old ones are being transmitted to the Host. This transmitting continues even if the spool area becomes full.
If the spool area does become full, it can return to the SPOOL NOT FULL state only via the SPOOL INACTIVE state.
If the spool area is full and **GemOverWriteSpool** is TRUE, then messages which would otherwise have gone to the Host are overwritten by fresh entries into the spool area.

PURGE SPOOL

The Equipment discards all messages in the spool area. When done, it sets **GemSpoolCountActual** to zero.

NO SPOOL OUTPUT

In this state, no messages are removed from the spool.

10.1.2 Transitions Table

Table 10-1. Spooling State Transitions

#	Current State	Trigger	New State	Action	Comment
1	SPOOL INACTIVE	Communication failure detected	SPOOL ACTIVE	GemSpoolCountActual and GemSpoolCountTotal are initialized to zero. Any open transactions with the Host are aborted. GemSpoolStartTime (SV) is set to current time. Alert the operator that spooling is active.	The default state in each OR substate is entered. The message which could not be sent remains in the send queue and is dealt within Spool Active State. The collection event Spooling Activated has occurred
2	SPOOL NOT FULL	Message generated which will not fit into spool area	SPOOL FULL	GemSpoolFullTme (SV) is set to current time. Alert the operator that spool is full.	The message which would not fit into the spooling area is dealt with after the transition. No collection event is generated.
3	SPOOL OUTPUT	Spool area emptied	SPOOL INACTIVE	Spooling process disabled. Alert the operator that spooling has been terminated.	The collection event Spooling Deactivated has occurred. Transition from the OR substate Spool Load Component occurs.
4	NO SPOOL OUTPUT	S7F23 received. w/RSDC=1	PURGE SPOOL	No action	Initiates purging process. No collection event is generated since this is based on host request.
5	NO SPOOL OUTPUT	S6F23 received. w/RSDC=0	TRANSMIT SPOOL	No action	Initiates message transmission from spool. No collection event is generated since this is based on host request.
6	TRANSMIT SPOOL	Comm. failure or GemMaxSpool Transmit reached.	NO SPOOL OUTPUT	Spool transmission process suspended.	If communications failure, the event Spool Transmit Failure has occurred. No collection event generated for MaxSpoolTransmit reached.
7	POWER ON	Equipment power source discontinued	POWER OFF	No action	Spooling context has been maintained in non-volatile storage prior to this transition.
8	POWER OFF	Equipment power source restored	POWER ON	Spooling context restored from non-volatile memory.	If spooling was active prior to power-down, it shall continue. If TRANSMIT SPOOL was active at power-down, transition #6 is expected to follow since communications state is initially NOT COMMUNICATING.

10.2 Relevant Equipment Constants and Status Variables

Table 10-2. Spooling Constants and Variables

ID	Name	Comment
ecid = 10070	**GemMaxSpoolTransmit**	The maximum number of spooled messages that are to be sent to the Host in response to an S6F23 message. If **MaxSpoolTransmit** = 0, all spooled messages are to be sent.
ecid = 10072	**GemOverWriteSpool**	Indicates action to be taken if the spool becomes full. =TRUE. "Oldest" messages are removed to make room for any new messages that are to be spooled. = FALSE. New messages are discarded.
ecid = 10071	**GemConfigSpool**	Determines whether spooling is enabled or disabled. Choices are "yes" and "no." Default = "no."
vid =10089	**GemSpoolCountActual**	Keeps a count of the number of messages stored in the spool. Multi-block inquire/grant messages are not included in this count.
vid = 10090	**GemSpoolCountTotal**	Keeps a count of the total number of messages placed in the spool regardless of whether or not they are presently there. (A message may have been "bumped" from a full spool to make room for a new message.)
vid = 10091	**GemSpoolFullTime**	Contains a timestamp indicating when the spool last became full. If the spool was not filed during the last spooling period, it contains a time value prior to the current **SpoolStartTime**.
vid = 10093	**GemSpoolStartTime**	Contains the timestamp indicating when spooling was last activated.

Chapter 11
Process Program Management

11.1 Process Program Management

Processing on the GSD-HE is controlled by Process Programs. The Equipment requires selection of a Process Program for each process. Although the SECS Standard assigns a Process Program ID (PPID) to each of these, the equipment calls them **recipes** and distinguishes them by their recipe name (for example: **Standby_Ar, Standby_As**).

11.1.1 Process Program Library

The GSD-HE provides a Process Program Library, implemented as a set of ASCII files maintained on a hard disk.

11.1.2 Process Program ID

Each Process Program is identified by a unique Process Program ID (PPID). A PPID consists of from 1 to 16 ASCII characters. Upper and lower case alphabetic characters are considered distinct, and the GSD-HE distinguishes between them.

11.1.3 Process Program Editing and Management

Process Programs (or recipes) can be edited either at the Host or by an operator at the GSD-HE. In addition to this editing capability, there are means for passing recipes between Host and GSD-HE.

11.1.3.1 Host Management Capabilities

The Host can do the following:

- Edit a Process Program
- Upload a Process Program from the GSD-HE Library by using S7F5 (Process Program Request). The equipment operator can also initiate a Process Program Upload through the GSD-HE's user interface.
- Download a Process Program to the GSD-HE library by using S7F3 (Process Program Send). The Host must send S7F1 (Multi-block Inquire) to the equipment before sending a multi-block Process Program. The equipment operator can also initiate a Process Program Download through the GSD-HE's user interface.
- Delete one or more Process Programs from the GSD-HE library by using S7F17 (Process Program Delete).
- Determine which Process Programs are currently stored in the GSD-HE library by using S7F19 (Process Program Directory).

11.1.3.2 Local Editing

The Equipment Operator may modify any one of the Process Programs stored on the Equipment.

Any creation of, deletion of, or change to a process program results in sending to the Host the collection event:

```
event fixup GemPPChangeEvent
    ceid = 1
```

When this happens the Host needs to know:

- The PPID of the recipe that was changed. This information is contained in the status variable:

  status GemPPChangeName

  Format: Ascii

  vid = 10041

  name = “PPCHANGENAME”

- What sort of change it was; how the Process Program was created, deleted, or modified. This information is contained in the status variable:

  status GemPPChangeStatus

  Format Unsigned 1 byte1

  vid = 10042 name = “PPCHANGESTATUS”

  The following states or ids are used:

  PPCHANGE = 1

  PPCREATE = 2

  PPDELETE = 3

This information can come to the Host in either of two ways:

- It could have been contained in a report that was previously defined, linked to the event, and enabled.

  ```
  event fixup GemPPChangeEvent
  ```

- The Host can request this information with an S1F3 command, listing the necessary vids.

11.1.4 Current Process

There are two variables that are used to describe the current process recipe that is loaded. One is the main process recipe and the other is for the sub process if the main process is a “List” recipe. Please refer to the *Users’ Guide* for an explanation of “List” mode.

Main process recipe:

status DB_CP_PROC_NAME_SV

Format: Ascii

vid = 2595

name = “DB_CP_PROC_NAME_SV”

List or sub process:

status DB_CP_SUB_PROC_NAME_SV

Format: Ascii

vid =2596

name = “DB_CP_SUB_PROC_NAME_SV”

11.1.5 Process Program Librarian

Process Recipes are controlled by the GEM Process librarian. Only one Process Recipe can be controlled by an Operator Interface at any one time. The following messages appear when an invalid Process Recipe operation is attempted.

PROCESS: XXX is already out for editing - either an operator is editing that process recipe on a different Operator Interface or it is out at the Host. Make sure that it is returned.

PROCESS: XXX is not in the library - This process was created when GEM was not running or through a xterm editor. This process needs to be signed in by the Host. It is automatically signed in if GEM is restarted.

PROCESS: XXX was not sent to host - The process did not exist in the librarian or the communications is not On-line. Make sure the communications is On-line, and the process recipe exists.

PROCESS: XXX was not received from host - The process did not exist in the Host librarian or the communications is not On-line. Make sure the communications is On-line, and the process recipe exists at the Host.

PREVIOUS PROCESS: XXX was not signed in, please re-edit it - If an Operator leaves the Process Recipe editor without selecting either the "CANCEL" or "SAVE" button, that Recipe is still assigned to that Operator Interface. This requires the operator to re-view the process and either "CANCEL" or "SAVE" the Process Recipe. This can be done either from a viewer, "ADD CASSETTE" or from the Process Recipe editor.

11.2 Process Program Scenarios

11.2.1 Unformatted, Host-Initiated Download

Table 11-1. Host-Initiated Download

Step	SECS Message	Description
1.	H → E S7F1 W	Host requests permission to send a multi-block Process Program to the Equipment. If the Process Program is single-block, this step and the next one may be skipped.
2.	H ← E S7F2	The Equipment grants permission for the Host to send the Process Program.
3.	H → E S7F3 W	Host sends the process Program to the Equipment.
4.	H ← E S7F4	The Equipment acknowledges receipt of the Process Program. The Equipment checks the received Process Program for validity. If the process Program is valid, the Equipment stores the Process Program in its library and sends an acknowledge code of zero in this message. If the Process Program is not valid, or could not be stored in the library, the acknowledge code in this message is non-zero.

Note: In the event of a "bad" download, the following collection event results.

event fixup GemBadDownloadEvent

ceid = 2

11.2.2 Unformatted, Host-Initiated Upload

Table 11-2. Host-Initiated Upload

Step	SECS Message	Description
1.	H → E S7F5 W	Host requests a Process Program from the Equipment library.
2.	H ← E S7F5	The Equipment sends the Process Program. If the Process Program does not exist, the data portion of this message is an empty list.

11.2.3 Unformatted, Equipment-Initiated Download

Table 11-3. Equipment-Initiated Download

Step	SECS Message	Description
1.	H ← E S7F5 W	Equipment requests a Process Program.
2.	H → E S7F6	The Host sends the Process Program. If the Process Program is valid, the Equipment stores the Process Program in its library, and the scenario ends. If the data portion of S7F6 is an empty list, or if the Process Program is not valid, the Equipment does not store it in its library and the scenario continues.
3.	H ← E S6F11 W	The Equipment sets “PPChangeName” to the requested PPID and signals CEID Bad Download. Event reports as appropriate.
4.	H → E S6F12	The Host acknowledges the report.

11.2.4 Unformatted, Equipment-Initiated Upload

Table 11-4. Equipment-Initiated Upload

Step	SECS Message	Description
1.	H ← E S7F1 W	Process Program Inquire. If S7F3 is multi-block, the Equipment requests permission to send a multi-block message. If S7F3 is single-block, skip this and the following step.
2.	H → E S7F2	Process Program Grant. The Host grants permission. If PPGNT is non-zero, the scenario fails here.
3.	H ← E S7F3 W	Send Process Program. The Equipment uploads Process Program to Host.
4.	H → E S7F4	The Host acknowledges. The Equipment ignores ACKC7.

11.2.5 Host Deletes Process Program

Table 11-5. Host Deletes Process Program

Step	SECS Message	Description
1.	H → E S7F17 W	Host sends a request to delete one or more Process Programs from the Equipment's library of Process Programs.
2.	H ←E S7F18	The Equipment replies with an acknowledge code. If all specified Process Program(s) were deleted successfully, the acknowledge code is 0. If one or more of the specified Process Programs could not be deleted, the acknowledge code is non-zero.

11.2.6 Host Requests Directory

Table 11-6. Host Requests Directory

Step	SECS Message	Description
1.	H → E S7F19 W	Host requests the names (PPIDs) of all Process Programs that are stored in the Equipment's Process Program library.
2.	2.	The Equipment replies with the list of PPIDs

11.2.7 Operator Changes Process Program Library

Table 11-7. Operator Changes Process Program Library

Step	SECS Message	Description
1.		The Equipment Operator creates, changes, or deletes a Process Program in the Library.
2.	H ← E S6F11 W	The Equipment sets PPChangeStatus to “Create”, “Change”, or “Delete”, as appropriate, sets PPChangeName, and signals CEID PPChange. Event Reports as appropriate.
3.	H → E S6F12	The Host acknowledges the report.

11.3 Permissible Character Set

For a list of the acceptable and unacceptable characters, refer to Table 3-5.

Chapter 12
Material Movement

This chapter describes the characteristics of Material Movement on the GSD-HE.

This Equipment is based on batch processing architecture to maximize throughput. In the view of this Equipment, a Lot is defined as the wafers within a single cassette.Wafers from one or more cassettes may be on the disk during a given process.

The placement of cassettes onto and removal of cassettes from the endstation is performed either by a human operator or by mechanical means such as the following:

- Standard Mechanical Interface (SMIF) Arm (described inChapter 18)
- Automated Guided Vehicle (AGV) (described in Chapter 20)

This chapter is concerned only with the case where these actions are performed by a human operator.

The differences between Operator-Controlled and Host-Controlled operation are:

- Operator-controlled Mode

  In Operator-Controlled mode, the operator initiates the placing of the cassette by pushing the **ADD CASSETTE** button. The operator then places the cassette after the door has opened and the table has indexed to its correct location. The operator then pushes the **CASSETTE PLACED** button.

  In this mode, it is also the operator's responsibility to enter values for both **PPID** and **MID**.
- Host-controlled Mode

  The operator is instructed by host output messages when to place or remove a cassette. Values for PPID and MID are obtained from the chosen recipe.

Either way, the operator must physically place and remove the cassettes. The remainder of the chapter assumes host-controlled mode.

12.1 Cassete Loading and Unloading

This chapter describes the processes of loading a cassette onto the moveable table and unloading a cassette from the moveable table.

12.1.1 Cassette States

This section presents various information about the possible cassette states, the transitions of states, and the tableports on which a cassette may be placed.

- Figure 12-1 is a cassette state diagram, showing the possible states and the possible transitions between states. The page that follows Figure 12-1 describes those states.
- Table 12-1 lists the database points and vids for the old and new states of a cassette placed on a given port. Consider the first two rows of that table which are for Table Port #1. The first line tells us that the database point DB_GEM_ES_PORT_1_STATE_NEW_IV contains the new state (which could be anything from 0 to 4) for the cassette sitting on Port #1; also that its vid=4564.

  All of these database points are in Appendix B.
- Table 12-2 shows the possible cassette state transitions. It supports Figure 12-1.
- Table 12-3 is copied from Table 6-3. It gives the CEIDs for the possible state changes. For example, for the cassette sitting on Port #1, the CEID is 335544366 for any change of state.

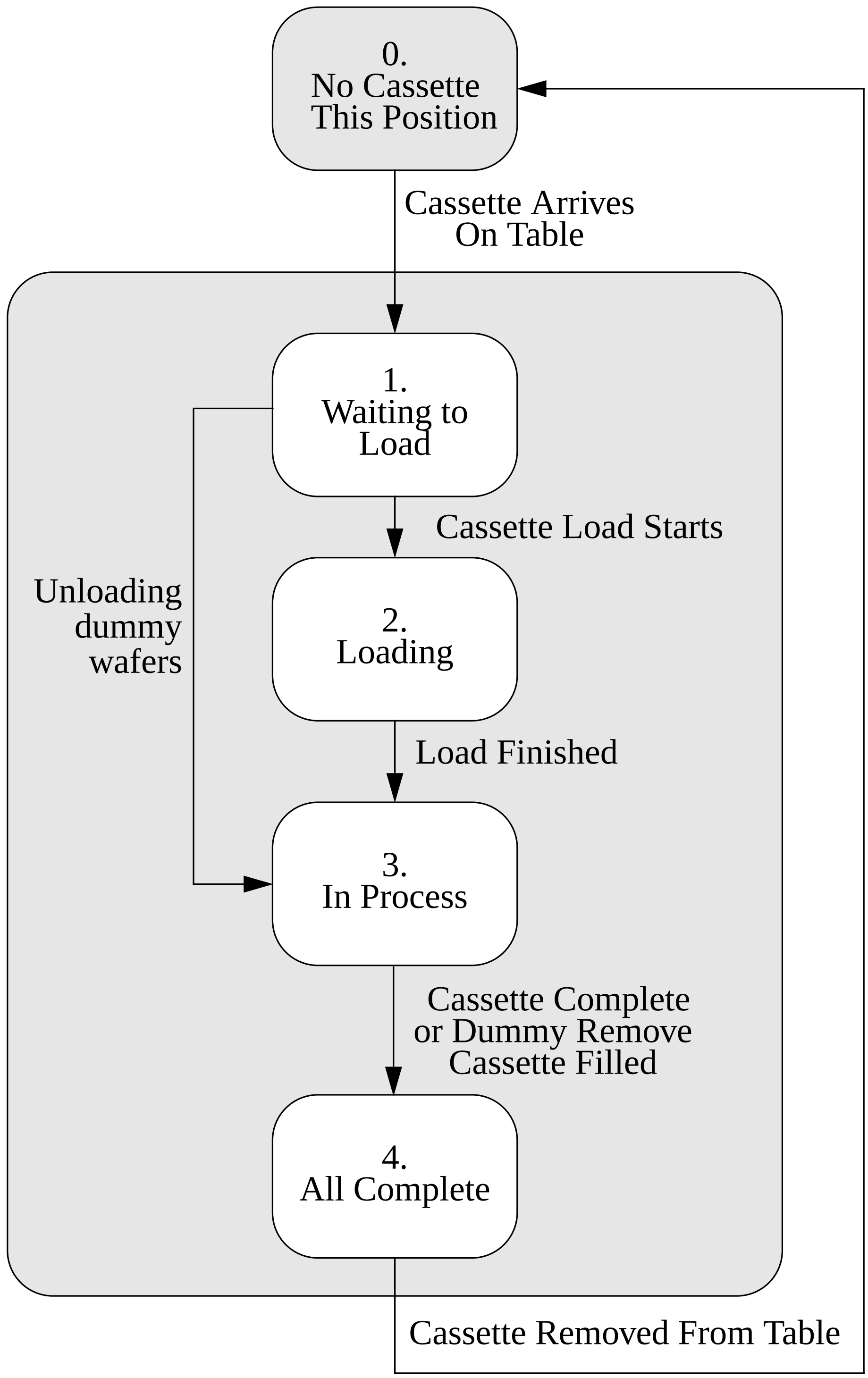

Figure 12-1. Cassette Finite State Diagram

Figure 12-1 presents the overall context by showing all of the possible cassette states.

State 0 **No cassette this position.**
There is no cassette present at this position.
DB_GEM_ES_PORT_X_STATE_NEW_IV = 0

State 1 **Waiting to load**
All wafers (dummy or real) are in the cassette. This cassette has not been touched since it was placed on the port.
DB_GEM_ES_PORT_*X*_STATE_NEW_IV = 1

State 2 **Loading**
Wafers for processing are being taken from the cassette and placed in the Equipment's input buffer.
DB_GEM_ES_PORT_*X*_STATE_NEW_IV = 2

State 3 **In process**
Wafers for Implant are either being Implanted or returned to their cassette. The cassette for Dummy wafers being added is waiting to be removed. The cassette for Dummy wafers to be removed is being filled.
DB_GEM_ES_PORT_*X*_STATE_NEW_IV = 3

State 4 **All complete**
All Implanted wafers have been returned to their cassette and the cassette is waiting to be removed. Dummy wafers for removal have been returned to their cassette and the cassette is waiting to be removed.
DB_GEM_ES_PORT_*X*_STATE_NEW_IV = 4

Table 12-1 lists the database points and vids for cassettes, depending on which port they are setting.

Table 12-1. VIDs for the Various Table Ports

Ports	Database Point	vid
1	DB_GEM_ES_PORT_1_STATE_NEW_IV	4564
	DB_GEM_ES_PORT_1_STATE_OLD_IV	4565
2	DB_GEM_ES_PORT_2_STATE_NEW_IV	4566
	DB_GEM_ES_PORT_2_STATE_OLD_IV	4566
3	DB_GEM_ES_PORT_3_STATE_NEW_IV	4568
	DB_GEM_ES_PORT_3_STATE_OLD_IV	4569
4	DB_GEM_ES_PORT_4_STATE_NEW_IV	4570
	DB_GEM_ES_PORT_4_STATE_OLD_IV	4571

Table 12-2. Cassette State Transitions

#	From	Trigger	To	Actions	Description
0-1	No Cassette This Position	Cassette loaded into cassette port.	Waiting to Load	None.	All wafers are in the cassette, and none have been implanted.
1-2	Waiting to Load	Wafers removed from cassette for Disk Load	Loading	Equipment starts to take the wafers out of the cassette and place them in the buffer.	Wafers are being removed from the cassette for loading onto Disk.
2-3	Loading	All wafers have been removed from Load cassette.	In Process	None.	All wafers have been moved from the input cassette
3-4	In Process	All wafers have been Implanted	All Complete	Cassette is ready to be removed.	
4-0	All Complete	Complete cassette removed	No Cassette This Position	Waiting for next cassette.	
3-4	In Process	All dummy wafers for removal are in cassette	All Complete	Cassette is ready to be removed.	
1-3	Waiting to Load	Equipment starts to take the wafers out of the dummy buffer and place them in the cassette	In Process	Continues removing wafers from the dummy buffer	Unloading dummies

Table 12-3 shows the collection event IDs (ceid) for cassette state transitions. There is a collection event for a change-of-state for the cassette on Port 1 (no matter what that change-of-state was).

Table 12-3. Cassette Finite State Description

CEID	Event Description
335544366	**ALM_GEM_CASSETTE_1_STATE_CHANGE** A state transition has occurred for Port 1. New state can be found in variable 4564 (DB_GEM_ES_PORT_1_STATE_NEW_IV), and the old state in variable 4565 (DB_GEM_ES_PORT_1_STATE_OLD_IV). Possible values are: 0 = No cassette in this position 1 = Waiting to Load 2 = Loading 3 = In Process 4 = All Complete Note: There is an additional state for machines that use an AGV.
335544367	**ALM_GEM_CASSETTE_2_STATE_CHANGE** A state transition has occurred for Port 2. New state can be found in variable 4566 (DB_GEM_ES_PORT_2_STATE_NEW_IV), and the old state in variable 4567 (DB_GEM_ES_PORT_2_STATE_OLD_IV). Same parameters as transitions for Port 1.
335544368	**ALM_GEM_CASSETTE_3_STATE_CHANGE** A state transition has occurred for Port 3. New state can be found in variable 4568 (DB_GEM_ES_PORT_3_STATE_NEW_IV), and the old state in variable 4569 (DB_GEM_ES_PORT_3_STATE_OLD_IV). Same Parameters as transitions for Port 1.
335544369	**ALM_GEM_CASSETTE_4_STATE_CHANGE** A state transition has occurred for Port 4. New state can be found in variable 4570 (DB_GEM_ES_PORT_4_STATE_NEW_IV), and the old state in variable 4571 (DB_GEM_ES_PORT_4_STATE_OLD_IV). Same Parameters as transitions for Port 1.

12.1.2 Material Load/Unload Processes

The Host uses the following set of Stream 4 messages to control the placement of cassettes on or removal of cassettes from the moveable table.

Table 12-4. Material Movement

Message	Description
S4F81	Request to Load Product

Table 12-4. Material Movement

Message	Description
S4F83	Send Material
S4F85	Handshake Complete
S4F87	Material Ready
S4F89	Stuck in Receiver
S4F91	Product Control Error
S4F93	Abort Load / Unload
S4F95	Request to Unload Product

Section 12.1.2.1 gives a sequence diagram for the loading of a cassette.
Section 12.1.2.2 gives a sequence diagram for the unloading of a cassette.

12.1.2.1 Cassette Loading

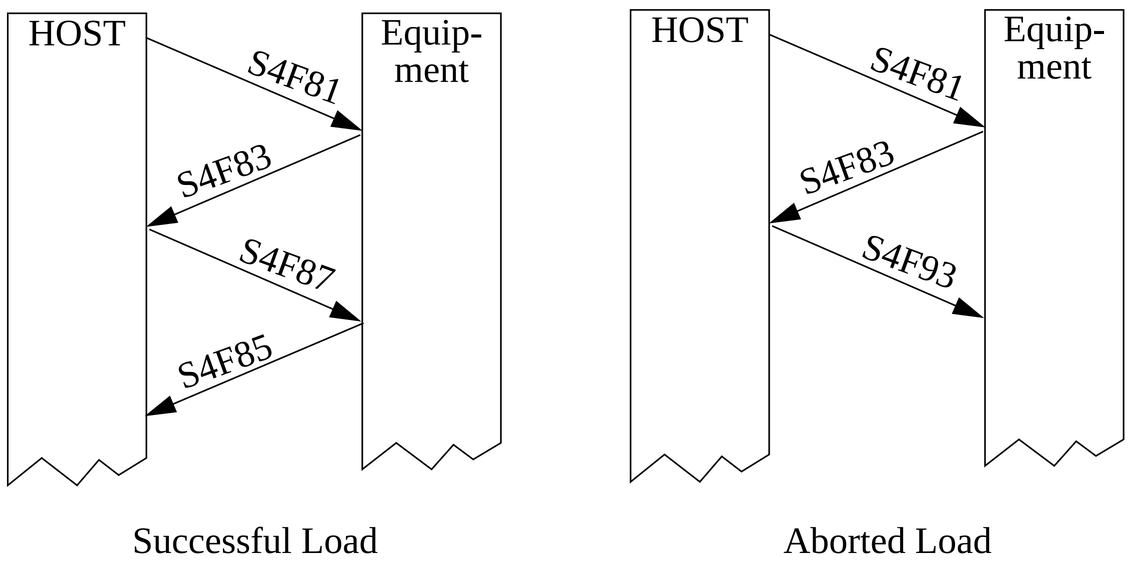

Figure 12-2. Loading Processes

S4F81 - Request to Load Product	“Load a cassette.” After the contents of the message have been verified, the cassette table moves to accept the cassette at the appropriate port.
S4F83 - Send Material	“I am ready for a cassette.” The Equipment signals the operator to place a cassette on the table. The Equipment then signals the resulting change of cassette state.
S4F87 - Material Ready	“The cassette load was successful.”
S4F85 - Handshake Complete	Completion of the handshake.

Error messages can be sent during various times in this sequence, depending on the scenario.

12.1.2.2 Cassette Unloading

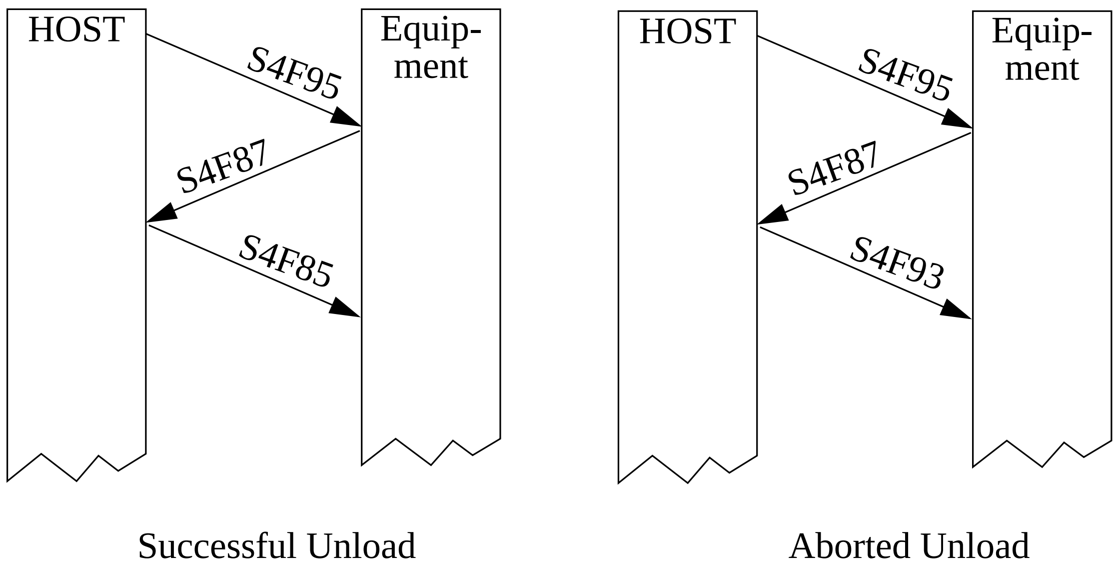

Figure 12-3. Unloading Processes

S4F95 - Request to Unload Product	"Unload a cassette." The parameters of this message are checked and verified. If they are correct, the cassette table moves to align the port with the port door, and the door opens. The Host directs the operator (or possibly some sort of robot) to remove the cassette.
S4F87 - Material Ready	"The cassette unload was successful."
S4F85 - Handshake Complete	Completion of the handshake.

Semiconductor Equipment

12.2 Material Movement Scenarios

12.2.1 Host Requests Material Status

12.2.1.1 Material Status Request

Step	SECS Message	Description
1.	H → E S3F1 W	The Host requests the status of wafers from the Equipment.
2.	H ← E S3F2	The Equipment sends status of its wafers in process.

12.2.1.2 Cassette Status Request

Step	SECS Message	Description
1.	H → E S3F81 W	The Host requests the status of the cassettes on the Equipment.
2.	H ← E S3F82	The Equipment sends status of its cassettes on cassette table.

12.2.2 Material Movement

12.2.2.1 Cassette Load

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F83	Equipment tells Host that it is ready to receive material.
3.	H → E S4F87	The Host has loaded the material, and it is now in control of the GSD-HE.
4.	H ← E S4F85	Equipment acknowledges that the transfer has completed successfully.

12.2.2.2 Cassette Unload

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette
2.	H ← E S4F87	Equipment notifies Host that it is unloading the cassette.
3.	H → E S4F85	Host acknowledges that the transfer has completed successfully.

12.2.2.3 Abort Cassette Load

Table 12-5. Abort Cassette Load

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F83	Equipment tells Host that it is ready to receive material.
3.	H → E S4F93	The Host aborts the transaction, and no material is transferred.

12.2.2.4 Abort Cassette Unload

Table 12-6. Abort Cassette Unload

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette.
2.	H ← E S4F87	Equipment notifies Host that it is unloading the cassette.
3.	H → E S4F93	Host acknowledges aborts the transfer, and no material is moved.

12.2.2.5 Cassette Load Error 1

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F91	Equipment notifies the Host that an equipment failure has occurred or an incorrect process was given.

12.2.2.6 Cassette Unload Error 1

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette.
2.	H ← E S4F91	Equipment notifies Host that an Equipment failure has occurred, and the cassette can not be unloaded.

12.2.2.7 Cassette Load Error 2

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F83	Equipment tells Host that it is ready to receive material.
3.	H → E S4F87	Host notifies Equipment that it is unloading the cassette.
4.	H ← E S4F89	Equipment notifies the Host that some material has been lost. Manual intervention is required.

12.2.2.8 Cassette Unload Error 2

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette.
2.	H ← E S4F87	Equipment notifies Host that it has successfully unloaded the cassette.
3.	H → E S4F89	Host notifies Equipment that some material has been lost. Manual intervention is required.

12.3 Error Conditions

Error messages can be sent during various times in this sequence, depending on the scenario. If the Host sends a movement command with improper parameters, or if there is an equipment failure, the Equipment replies with an S4F91 message. This message appears in the alarm box to inform the operator about the problem. It is not reported as an alarm to the Host.

Table 12-7. Material Movement Error Messages

PCE	Description	Operator Alarm
1	secs2_s4_incorrect_process	SECS WARNING S4F91: Incorrect Process from Host
2	secs2_s4_cassette_on_port	SECS WARNING S4F91: Incorrect Port from Host
3	secs2_s4_failure_table	SECS WARNING S4F91: Cassette Table Failure
4	ecs2_s4_failure_door	SECS WARNING S4F91: Cassette Table Door Failure
5	secs2_s4_wh_man_mode	SECS WARNING S4F91: Endstation in Manual Mode
6	secs2_s4_bad_msg	SECS WARNING S4F91: Bad Message from Host
7	secs2_s4_bad_mid	SECS WARNING S4F91: Bad Material ID from Host
8	secs2_s4_bad_ppid	SECS WARNING S4F91: Bad Process ID from Host
9	secs2_s4_bad_qty	SECS WARNING S4F91: Incorrect Quantity from Host
10	secs2_s4_bad_ptn	SECS WARNING S4F91: Bad Port Number from Host
11	secs2_s4_cmd_ignore	SECS WARNING S4F91: Command from Host Ignored
12	secs2_s4_cassette_not_on_port	SECS WARNING S4F91: Cassette Not On that Port
13	secs2_s4_cassette_stuck	SECS WARNING S4F91: Cassette Stuck
14	secs2_s4_load_in_progress	SECS WARNING S4F91: Unknown Error, No Command Allowed

Table 12-7. Material Movement Error Messages (Continued)

PCE	Description	Operator Alarm
15	secs2_s4_unload_in_progress	SECS WARNING S4F91: Unknown Error, No Command Allowed
16	secs2_s4_ptn_not_match	SECS WARNING S4F91: Incorrect Port from Host
17	secs2_s4_mid_not_match	SECS WARNING S4F91: Bad Material ID from Host
18	secs2_s4_ppid_not_match	SECS WARNING S4F91: Bad Process ID from Host
19	secs2_s4_qty_not_match	SECS WARNING S4F91: Incorrect Quantity from Host
33	secs2_s4_wh_lost_comm	SECS WARNING S4F91: Unable to Command Endstation
34	secs2_s4_wh_rob_hold	SECS WARNING S4F91: Robot Hold, No Command Allowed
35	secs2_s4_wh_invac_hold	SECS WARNING S4F91: In Vac Hold, No Command Allowed

Chapter 13
Equipment Terminal Services

The Host can send a text message to the equipment. S10F3 is used to send a single-line message; S10F5 is used to send a multi-line message; S10F9 is used for a broadcast message.

Any message received is acknowledged. S10F3 is acknowledged by S10F4; S10F5 is acknowledged by S10F6; S10F9 is acknowledged by S10F10. These acknowledge messages tell the Host only that its message was received by the equipment and nothing else.

If a human operator is present (not always the case) then the operator can also acknowledge the received message in a way that generates the event ALM_GEM_TERMINAL_DISPLAY_ACK. This event informs the Host that its message was received and also that a human read it (and presumably is taking appropriate action.

There is also provision for the Equipment to send a text message to the Host. A message from the Host may have up to 160 characters; a message from the Equipment may also have up to 160 characters.

13.1 Message Receiving Modes

There are two modes for receiving messages, determined by the value programmed into the configuration point **GEM Text Pop-up Enabled.** This is one of the buttons on the configuration screen. (Figure 2-4 is a partial view of that screen.)

Figure 13-1 below shows a GEM Control Screen and those areas of it that are used for text messages.

Figure 13-1. GEM Control Screen

Alarm Box — This is the display area just below the row of buttons: **Vacuum, Interlocks, Beam, End Station, Implant**, and **System**. Notification of a received message always appears in this box.

Incoming Text Field — This is the display area near the bottom of the page and to the right of the legend: "**Incoming Text Field**." The text of an incoming message appears here. The operator acknowledges this message by clicking the **Ack Message** button that is just below the legend.

Outgoing Text Field — This is the display area near the bottom of the page and to the right of the legend: "**Outgoing Text Field**." The text of an outgoing message is displayed here. The operator enters this message via the keyboard and sends it by clicking the **Send Message** button that is just below the legend.

13.1.1 GEM Text Pop-up Enabled set to “no”

Notification of an incoming message is displayed in the Alarm Box.

The message itself appears in the Incoming Text Field. The operator acknowledges the message by clicking the **Ack Message** button. This generates the collection event.

13.1.2 GEM Text Pop-up Enabled set to “yes”

Notification of an incoming message is displayed in the Alarm Box.

The message itself appears in one of two places depending on which type of screen is currently displayed.

- If the screen currently displayed is a GEM Control Screen (as in Figure 13-1) the message appears in the Incoming Text Field.
- If the screen currently displayed is anything other than a GEM Control Screen, the incoming message appears in a pop-up window. An acknowledge button appears in that same pop-up window.

13.2 Other Terminal Messaging

- If the operator has not acknowledged an existing message by the time a second message arrives, the new message is displayed and the old one discarded.
- The Host can send a message with zero-length text to clear the operator display.
- The Equipment allows the operator to send a single-block message to the Host using S10F1. The S10F2 response is ignored.

Chapter 14
Clock

The Equipment maintains two clock/calendars.

- A “GEM Timekeeper” (Host-programmable)
- A Sun-based UNIX clock (not programmable)

The Host uses the message S2F31 to sets the Equipment’s GEM Timekeeper.

There are two time formats available for this message, 12 and 16 character. The 16 character format is intended to support timestamp changes required by the year 2000. Time format is settable by the GemTime Format equipment constant (ecid 10101). The time format specified by this constant is used by all messages containing a timestamp or otherwise using the GemTime variable (10040). The GemTime Format constant can be changed by the host in an S2F15 (New Equipment Constant Send) message or by an operator setting the equipment constant in the equipment Configuration Editor. The equipment must be in remote mode in order to set the equipment constant from the host.

The two date and time formats are as follows:

S2F31 W

16-character format (year 2000-compliant):

<A ‘YYYYMMDDhhmmsscc’>.

YYYY	Year, 0000 to 9999
MM	Month, 01 to 12
DD	Day, 01 to 31
hh	Hours, 00 to 23
mm	Minutes, 00 to 59
ss	Seconds, 00 to 59
cc	centisecond, 00 to 99

12-character format:

<A ’YYMMDDhhmmss’>. TIME - Date and Time

YY	Year (last two digits), 00 to 99
MM	Month, 01 to 12
DD	Day, 01 to 31
hh	Hours, 00 to 23
mm	Minutes, 00 to 59
ss	Seconds, 00 to 59

When the Equipment receives this time/date information, it subtracts from it the corresponding time/date information of the UNIX clock and stores the resulting offset.

If the Host wants to read the Equipment's timekeeper, it sends the S2F17 message (which is header only). When the Equipment receives this message, it takes the current reading of the UNIX clock, adds to that its own stored offset, and returns the result to the Host.

Once the Host has set the Equipment's time with the S2F31 message, it can at any time ask for Equipment time with S2F17. The returned result exactly matches the Host's time.

Note: You cannot set the Sun-based UNIX clock because most processes on both the Cell Controller and User Interface use this clock. This restriction is for safety.

Chapter 15
Process States

This chapter contains state diagrams, descriptive material, and transitions tables for each of the six processes listed below.

- Cassette Finite States
- Disk Finite States
- E10 States
- Autobeam States
- Implant Finite States
- Implant Control Quarter States

Each item begins with the state diagram which is on a left-facing page. The descriptive material and transition tables for that diagram follow.

15.1 Cassette Finite States

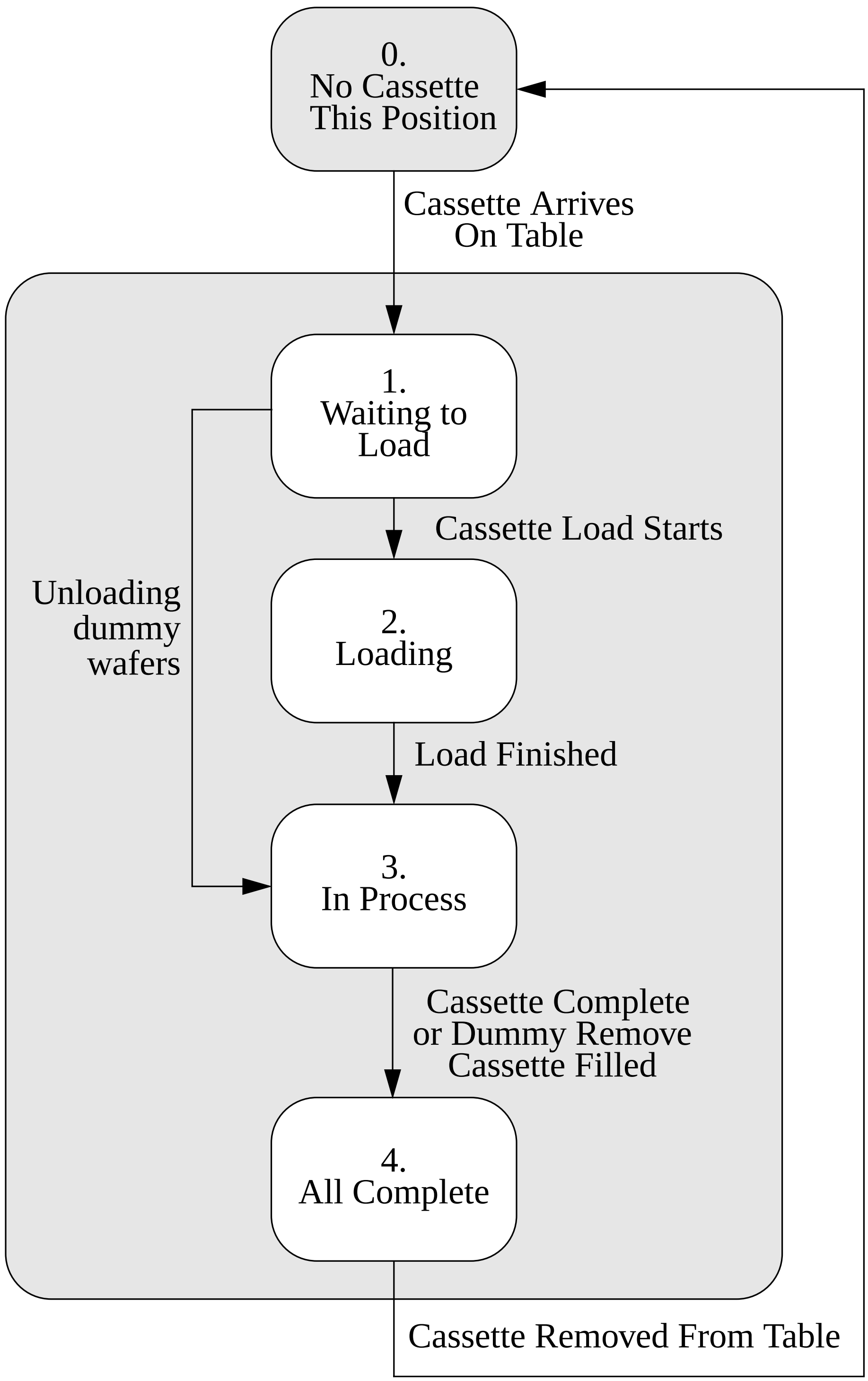

Figure 15-1. Cassette Finite State Diagram

The NV-GSD/HE may accommodate four cassettes on the cassette table. The states are described below.

Variables for cassettes which do not exist given the wafer size will contain meaningless data.

State 0 **No cassette this position.**
There is no cassette present at this position.
DB_GEM_ES_PORT_X_STATE_NEW_IV = 0

State 1 **Waiting to Load**
All wafers (dummy or real) are in the cassette. This cassette has not been touched since it was placed on the Cassette Table.
DB_GEM_ES_PORT_X_STATE_NEW_IV = 1

State 2 **Loading**
Wafers for processing are being taken from the cassette and placed in the Equipment's input buffer.
DB_GEM_ES_PORT_X_STATE_NEW_IV = 2

State 3 **In Process**
Wafers for Implant are either being Implanted or returned to their cassette. The cassette for Dummy wafers being added is waiting to be removed. The cassette for Dummy wafers to be removed is being filled.
DB_GEM_ES_PORT_X_STATE_NEW_IV = 3

State 4 **All Complete**
All Implanted wafers have been returned to their cassette and the cassette is waiting to be removed. Dummy wafers for removal have been returned to their cassette and the cassette is waiting to be removed.
DB_GEM_ES_PORT_X_STATE_NEW_IV = 4

Table 15-1 lists the database points and VIDs for the cassettes, depending on which table port they are sitting.

Table 15-1. VIDs for the Various Table Ports

Ports	Database Point	vid
1	DB_GEM_ES_PORT_1_STATE_NEW-IV	4564
	DB_GEM_ES_PORT_1_STATE_OLD-IV	4565
2	DB_GEM_ES_PORT_2_STATE_NEW-IV	4566
	DB_GEM_ES_PORT_2_STATE_OLD-IV	4567
3	DB_GEM_ES_PORT_3_STATE_NEW-IV	4568
	DB_GEM_ES_PORT_3_STATE_OLD-IV	4569
4	DB_GEM_ES_PORT_4_STATE_NEW-IV	4570
	DB_GEM_ES_PORT_4_STATE_OLD-IV	4571

Table 15-2. Cassette State Transitions

#	From	Trigger	To	Actions	Description
0-1	No Cassette This Position	Cassette loaded into cassette port.	Waiting to Load	None.	All wafers are in the cassette, and none have been implanted.
1-2	Waiting to Load	Wafers removed from cassette for Disk Load	Loading	Equipment starts to take the wafers out of the cassette and place them in the buffer.	Wafers are being removed from the cassette for loading onto Disk.
2-3	Loading	All wafers have been removed from Load cassette.	In Process	None.	All wafers have been moved from the input cassette
3-4	In Process	All wafers have been Implanted	All Complete	Cassette is ready to be removed.	
4-0	All Complete	Complete cassette removed	No Cassette This Position	Waiting for next cassette.	
3-4	In Process	All dummy wafers for removal are in cassette	All Complete	Cassette is ready to be removed.	
1-3	Waiting to Load	Eqpt starts to take the wafers out of the dummy buffer and place them in the cassette	In Process	Continues removing wafers from the dummy buffer	Unloading dummies

15.2 Disk Finite States

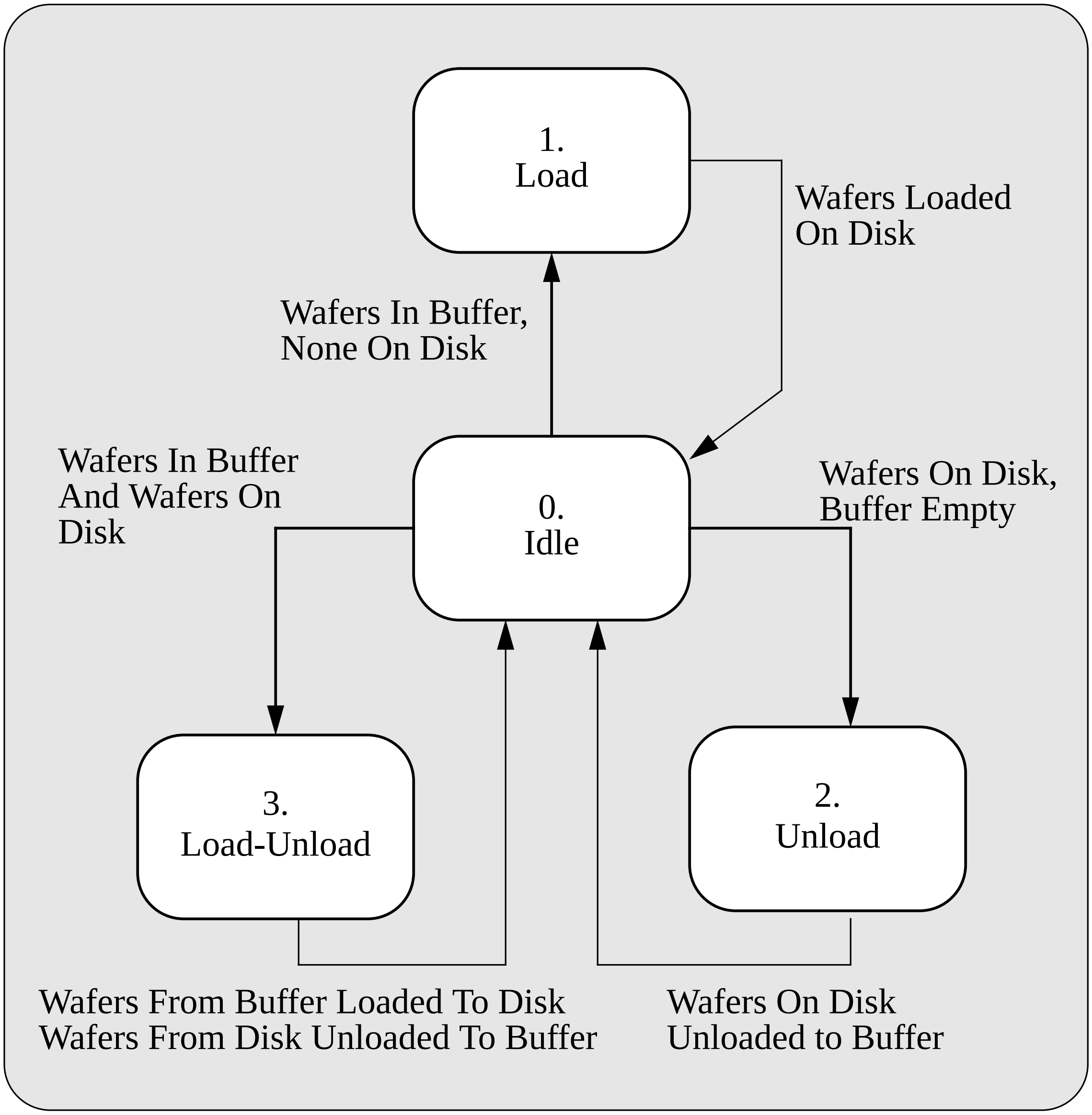

Figure 15-2. Disk Finite State Diagram

The Equipment can be in any one of the following states. The state is represented in the variable 4559, DB_GEM_DISK_STATE_NEW_IV. The old state is shown in variable 4560, DB_GEM_DISK_STATE_OLD_IV.

State 0 **Idle**

Disk is idle, awaiting the arrival of dummy or real wafers.

DB_GEM_DISK_STATE_NEW_IV = 0

State 1 **Load**

Disk is in the process of being loaded with wafers for processing.

DB_GEM_DISK_STATE_NEW_IV = 1

State 2 **Unload**

The last wafers for this lot have been processed, and are being unloaded from the disk.

DB_GEM_DISK_STATE_NEW_IV = 2

State 3 **Load-Unload**

Processed wafers are being unloaded, and wafers to process are being loaded for processing.

DB_GEM_DISK_STATE_NEW_IV = 3

Table 15-3. Disk State Transitions

#	From	Trigger	To	Actions	Description
0-1	Idle	Wafers in Load Buffer.	Load	Wafers are loaded to disk from buffer.	
1-0	Load	Wafers Loaded on Disk	Idle		
0-2	Unload	Wafer processing complete for current wafers, and there are no more wafers to process.	Unload	Wafers are unloaded.	Wafers are in the process of being unloaded to outgoing buffer and back to the cassette.
2-0	Unload	Successful completion of unloading of wafers from disk.	Idle	None.	All wafers have been removed from the disk. The disk is now ready to accept new wafers.
0-3	Load-Unload	More wafers to load after completion of processing current wafers.	Load-Unload	Wafers are concurrently loaded and unloaded.	New wafers will be processed.
3-0	Load-Unload	Wafers from Buffer loaded to Disk / Wafers from Disk Unloaded to Buffer	Idle		

15.3 E10 States

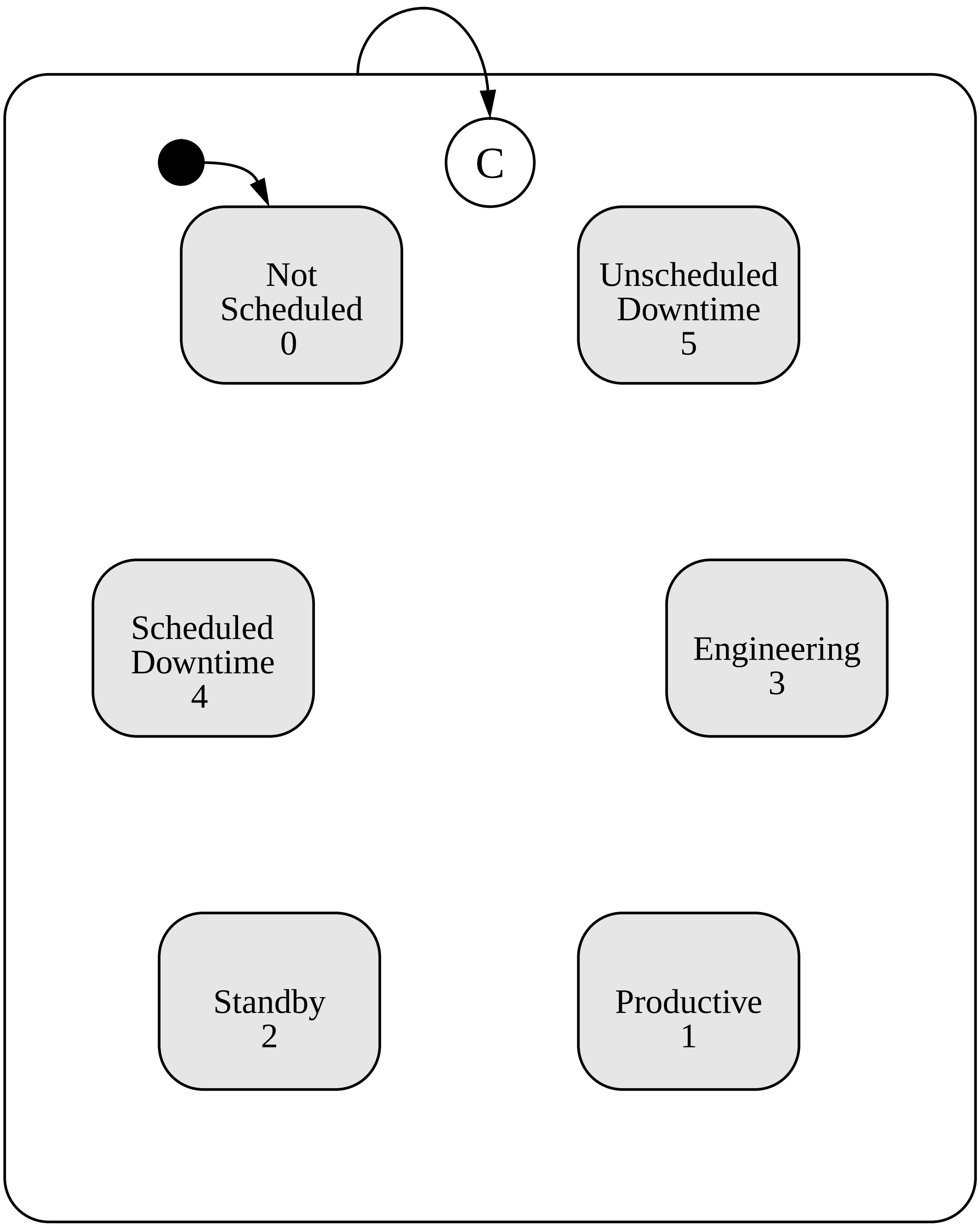

Figure 15-3. E10 State Diagram

The Equipment can be in any one of the following states. The state is represented in the variable 4555, DB_GEM_E10_STATE_NEW_IV. The old state can be found in variable 4556, DB_GEM_E10_STATE_OLD_IV.

State 0 **Not Scheduled**

This state accounts for time outside of the normal factory production schedule. This includes time when the factory itself is not operating and time when the equipment is being used for purposes other than production, engineering, or maintenance. (SEMI E10 standard)

DB_GEM_E_10_STATE_NEW_IV = 0

State 1 **Productive**

This state is the time spent by the equipment performing its intended function. This also includes time spent loading and unloading product. It is in this state when it is in MANUFACTURING state, the equipment production criteria are satisfied, and it is busy performing its intended function. (SEMI E10 standard.)

DB_GEM_E_10_STATE_NEW_IV = 1

State 2 **Standby**

This state is the time the equipment is waiting to enter the PRODUCTIVE state. The equipment enters this state automatically when it is in the MANUFACTURING superstate and the requirements for the PRODUCTIVE state do not apply. When all requirements for PRODUCTIVE are satisfied, then it transitions automatically to PRODUCTIVE. (SEMI E10 standard.)

DB_GEM_E_10_STATE_NEW_IV = 2

State 3 **Engineering**

This state is for processing and engineering purposes, such as process development or characterization. Faults that may occur in the ENGINEERING state do not trigger equipment-initiated transitions to UNSCHEDULED DOWNTIME. The equipment may also be powered off while in this state. (SEMI E10 standard.)

DB_GEM_E_10_STATE_NEW_IV = 3

State 4 **Scheduled Downtime**

This state is used for planning downtime activities. (SEMI E10 standard.)

DB_GEM_E_10_STATE_NEW_IV = 4

State 5 **Unscheduled Downtime**

This state is for unplanned downtime activities. (SEMI E10 standard.)

DB_GEM_E_10_STATE_NEW_IV = 5

15.4 Autobeam States

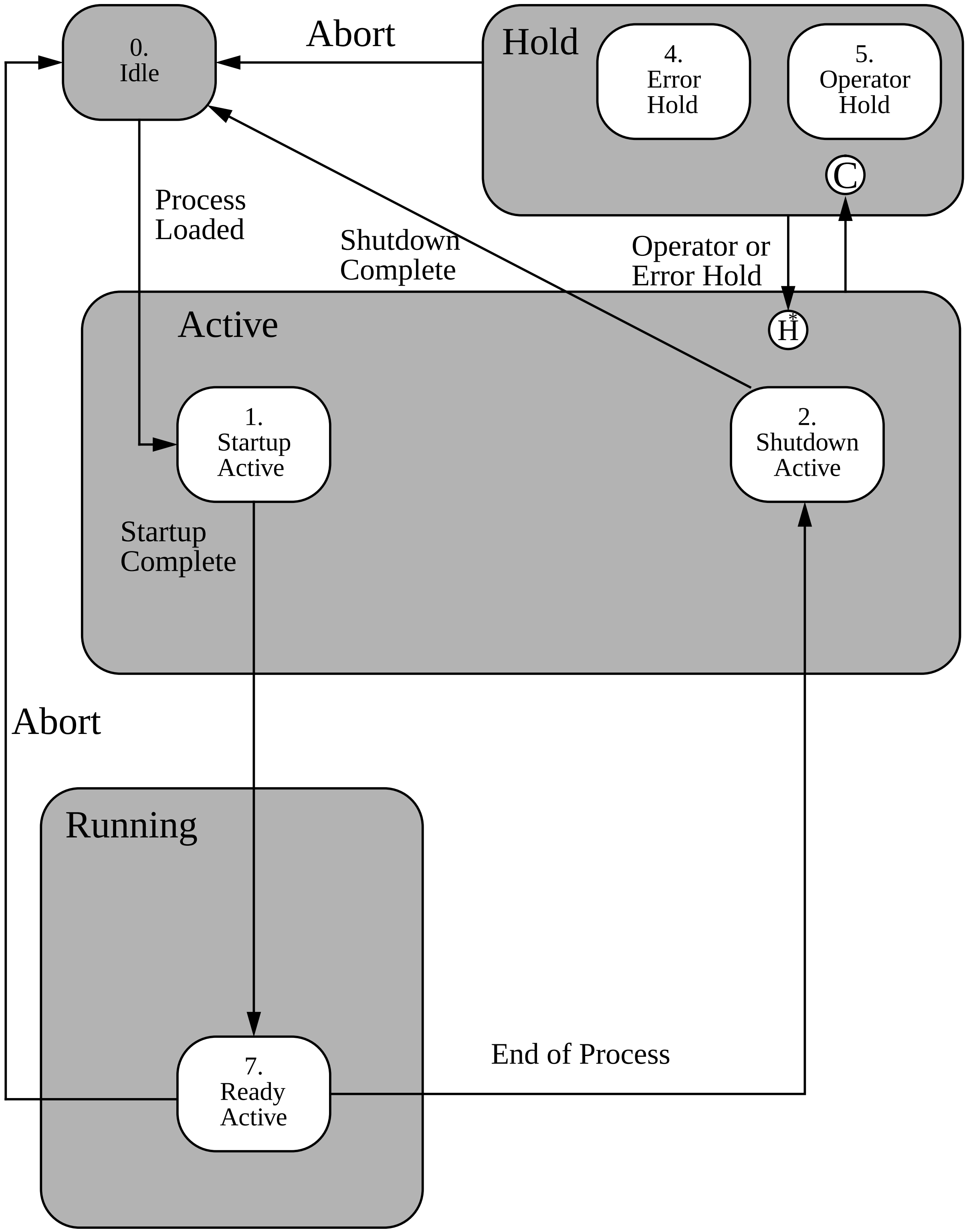

Figure 15-4. Autobeam State Diagram

The Equipment can be in any one of the following states. The state is represented in the variable 5208 DB_GEM_AUTOBEAM_STATE_NEW_IV. The old state can be found in variable 5209 DB_GEM_AUTOBEAM_STATE_OLD_IV.

State 0 **Idle**
Equipment is awaiting a process or beam is being run manually.
DB_GEM_AUTOBEAM_STATE_NEW_IV = 0

State 1 **Startup Active**
Autobeam has started upon the receipt of a process. Equipment starts to prepare for activities. DB_GEM_AUTOBEAM_STATE_NEW_IV = 1

State 2 **Shutdown Active**
Equipment is being prepared to return to default IDLE state.
DB_GEM_AUTOBEAM_STATE_NEW_IV = 2

State 4 **Error Hold**
The HOLD state has been entered as a result of an error condition. The NV-GSD/HE is awaiting operator intervention.
DB_GEM_AUTOBEAM_STATE_NEW_IV = 4

State 5 **Operator Hold**
The HOLD state has been entered as a result of an operator command. The NV-GSD/HE is awaiting operator intervention.
DB_GEM_AUTOBEAM_STATE_NEW_IV = 5

State 7 **Ready Active**
The Equipment is in ready mode.
DB_GEM_AUTOBEAM_STATE_NEW_IV = 7

Table 15-4. Autobeam State Transitions

#	From	Trigger	To	Actions	Description
0-1	Idle	Process Loaded	Startup Active	Equipment will start to prepare recipe beam.	Process has been loaded either automtically or by operator.
1-7	Startup Active	Startup complete	Ready	Beam ready	Implant can occur in this state
1-4	Startup Active	Error Detected	Error Hold	Error Detected by Autobeam Supervisor	Autobeam Supervisor has a condition that it cannot deal with.
1-5	Startup Active	Operator put Autobeam into Hold	Operator Hold	Manual Hold	Operator selected Autobeam Hold.
7-0	Ready	Operator aborts	Idle	Idle state	Operator issues Abort command
7-1	Ready	New Process Loaded	Startup Active	Equipment will start to prepare recipe beam.	Process has been loaded either automatically or by operator.
7-2	Ready	End of processing or operator command	Shutdown Active	Shutdown Active. Brings beam down.	Operator gives Shutdown Command or occurs automatically at end of process
2-0	Shutdown Active	Shutdown complete	Idle	Machine Idle	Machine at Idle state
2-4	Shutdown Active	Error Detected	Error Hold	Error detected by Autobeam Supervisor	Autobeam Supervisor has a condition that it cannot deal with
2-5	Shutdown Active	Operator put Autobeam into Hold	Operator Hold	Manual Hold	Operator selected Autobeam Hold
4-1	Error Hold	Operator selects Resume	Startup Active	Startup resumes	Error condition corrected
5-1	Operator Hold	Operator selects Resume	Startup Active	Startup resumes	Operator resumes startup

Table 15-4. Autobeam State Transitions (Continued)

#	From	Trigger	To	Actions	Description
2-0	Shutdown Active	Shutdown complete	Idle		Shutdown has been successfully completed
4-2	Error Hold	Operator selects Resume	Shutdown Active	Shutdown resumes	Operator resumes shutdown
5-2	Operator Hold	Operator selects Resume	Shutdown Active	Shutdown resumes	Operator resumes shutdown
4-0	Operator Hold	Operator Abort	Idle	Processing will return to Idle state	Machine at Idle state
5-0	Error Hold	Operator Abort	Idle	Processing will return to Idle state	Machine at Idle state

Table 15-5. Autobeam Supervisor Finite State Description

CEID	Event	Description
335544408	ALM_GEM_NEW_ AUTOBEAM_STATE_ IDLE	A state trnsition has occurred in the Autobeam state description; the new state is IDLE. The value of the new state can be found in variable 5208 (DB_GEM_ AUTOBEAM_STATE_NEW_IV). The old state can be found in variable 5209 (DB_GEM_AUTOBEAM_STATE_OLD_ IV). The possible valules are: 0 = IDLE 1 = STARTUP_ACTIVE 2 = SHUTDOWN_ACTIVE 4 = ERROR_HOLD 5 = OPERATOR_HOLD 7 = READY
335544409	ALM_GEM_NEW_ AUTOBEAM_STATE_ STARTUP_ACTIVE	New Autobeam state is STARTUP_ACTIVE. See IDLE for description.
335544410	ALM_GEM_NEW_ AUTOBEAM_STATE_ SHUTDOWN_ACTIVE	New Autobeam state is SHUTDOWN_ACTIVE. See IDLE for description.
335544411	ALM_GEM_NEW_ AUTOBEAM_STATE_ ERROR_HOLD	New Autobeam state is ERROR_HOLD. See IDLE for description.
335544412	ALM_GEM_NEW_ AUTOBEAM_STATE_ OPERATOR_HOLD	New Autobeam state is OPERATOR_HOLD. See IDLE for description.
335544413	ALM_GEM_NEW_ AUTOBEAM_STATE_ READY_ACTIVE	New Autobeam state is READY_ACTIVE. See IDLE for description.

15.5 Implant Finite States

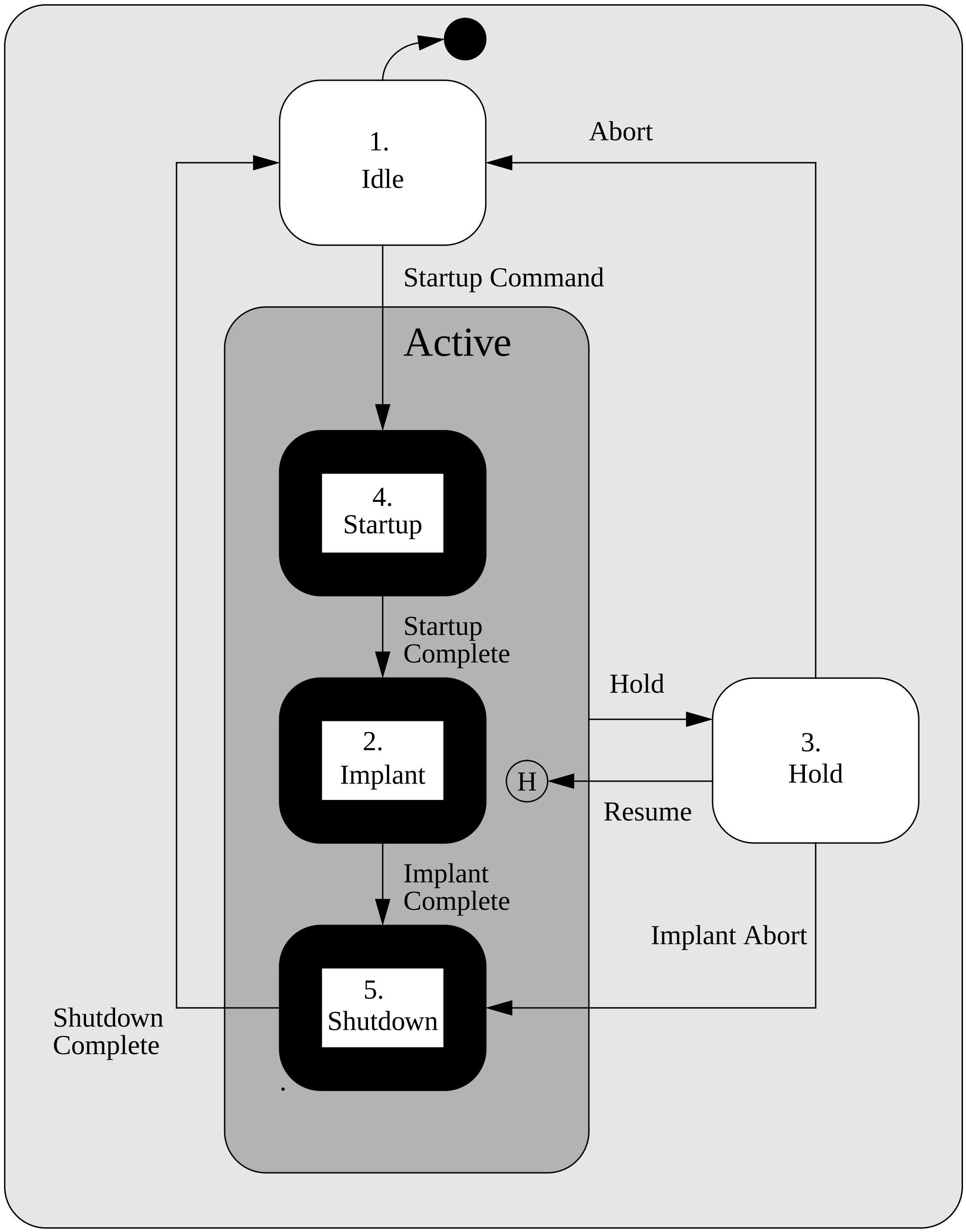

Figure 15-5. Implant Finite State Diagram

The Equipment can be in any one of the following states. The state is represented in the variable 4557, DB_GEM_IMPLANT_STATE_NEW_IV. The old state can be found in variable 4558, DB_GEM_IMPLANT_STATE_OLD_IV.

State 1 **Idle**
Implanting is not taking place, Equipment is awaiting Start-up Command.
DB_GEM_IMPLANT_STATE_NEW_IV = 1

State 2 **Implant**
Implanting is taking place on the Equipment.
DB_GEM_IMPLANT_STATE_NEW_IV = 2

State 3 **Hold**
Operator or Equipment has issued a Hold command, and the Equipment has suspended processing.
DB_GEM_IMPLANT_STATE_NEW_IV = 3

State 4 **Startup**
Necessary preparations are being performed to get the NV-GSD/HE ready for implanting.
DB_GEM_IMPLANT_STATE_NEW_IV = 4

State 5 **Shutdown**
Implant has completed or an Abort command has been issued by the Operator to halt processing and prepare to return to IDLE state.
DB_GEM_IMPLANT_STATE_NEW_IV = 5

Table 15-6. Implant State Transitions

#	From	Trigger	To	Actions	Description
1-4	Idle	Startup Command given by Operator or Equipment	Startup	Implant parameters are set up according to the recipe.	All wafers are on disk
4-2	Startup	Startup Complete	Implant	Implant is performed to wafers on disk.	
2-5	Implant	Implant Complete	Shutdown	Equipment is returned to non-implanting state.	
Active-3	Active	Hold Command given by Operator or Equipment.	Hold	Startup sequence will cease	
3-Active	Hold	Resume Command given by Operator.	H* in Active	Processing will continue at the point where it was before the Hold command was given.	
3-5	Hold	Implant Abort Command given by Operator while in Hold state	Shutdown	Implanting will cease, and Equipment will go to Shutdown.	
3-1	Hold	Abort command was given by Operator while in Hold state. Hold state was entered from Startup state.	Idle	Startup sequence is cancelled, and Equipment is returned to idle state.	

Table 15-6. Implant State Transitions (Continued)

#	From	Trigger	To	Actions	Description
5-1	Shutdown	Shutdown successfully completed.	Idle	Equipment is returned to idle state.	

15.6 Implant Control Quarter States

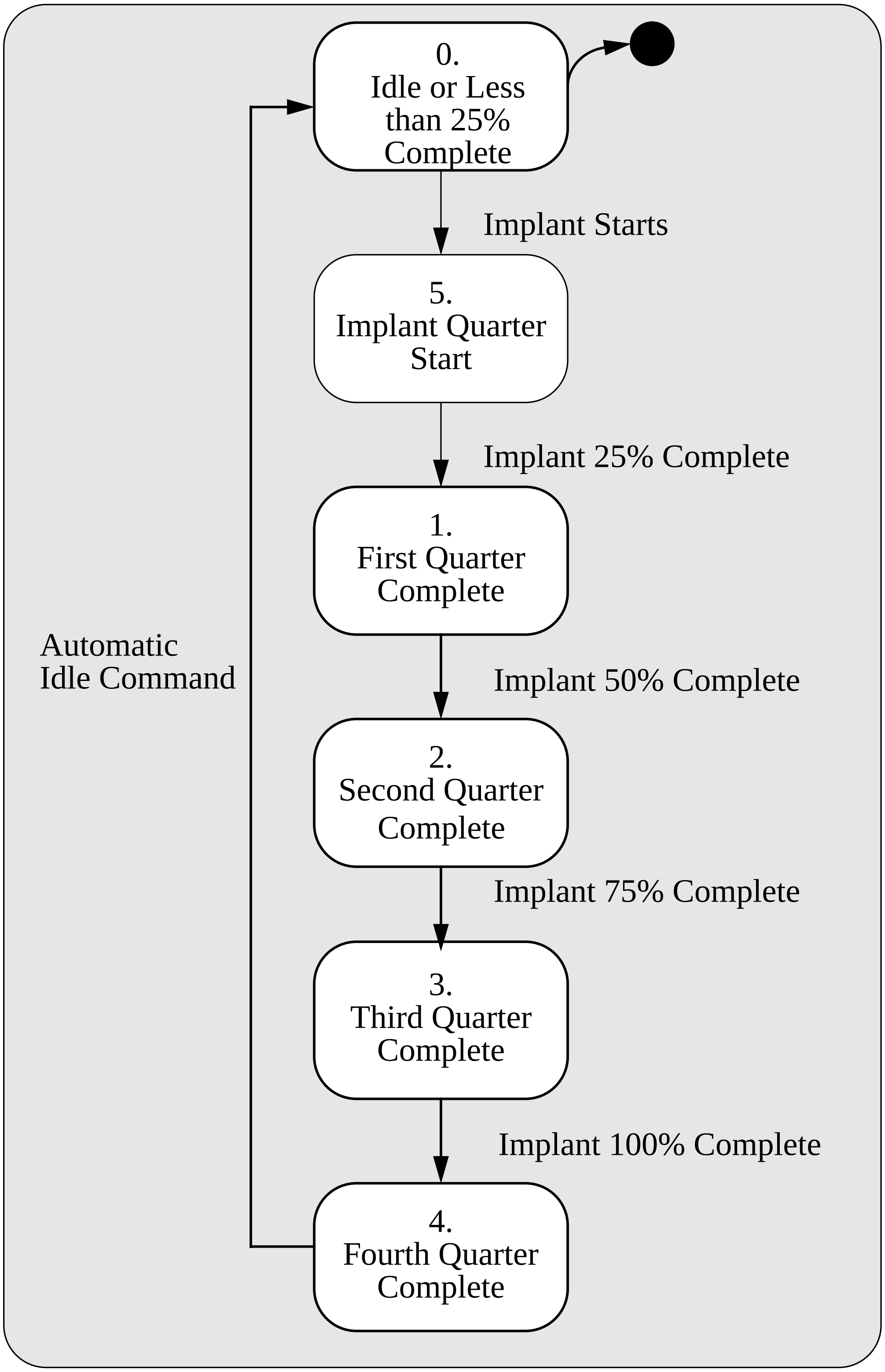

Figure 15-6. Implant Control Quarter State Diagram

The Equipment can be in any one of the following states. The state is represented in the variable 4587, DB_GEM_IV_ICQ_NEW_IV. The old state can be found in variable 4588, DB_GEM_IV_ICQ_OLD_IV.

State 0 **Idle**
No wafers are currently being processed or wafers are being processed, but less than 25% of the process is complete.
DB_GEM_IV_ICQ_NEW_IV = 0

State 1 **First Quarter Complete**
Twenty five (25) percent of the process is complete.
DB_GEM_IV_ICQ_NEW_IV = 1

State 2 **Second Quarter Complete**
Fifty (50) percent of the process is complete.
DB_GEM_IV_ICQ_NEW_IV = 2

State 3 **Third Quarter Complete**
Seventy five (75) percent of process is complete.
DB_GEM_IV_ICQ_NEW_IV = 3

State 4 **Fourth Quarter Complete**
All wafers have been successfully implanted.
DB_GEM_IV_ICQ_NEW_IV = 4

State 5 **Implant Quarter State Start**
The Implant has just started.
DB_GEM_IV_ICQ_NEW_IV = 5

Table 15-7. Implant Control Quarter State Transitions

#	From	Trigger	To	Actions
0-5	Idle	.Successful Start of the Implant	Start of the Implant	Processing Continues
5-1	First Quarter Complete	Successful completion of 25% of implant.	First Quarter Complete	Processing Continues
1-2	First Quarter Complete	Successful completion of 50% of Implant	Second Quarter Complete	Processing Continues
2-3	Second Quarter Complete	Successful Completion of 75% of Implant	Third Quarter Complete	Processing Continues
3-4	Third Quarter Complete	Successful Completion of Implant	Fourth Quarter	Processing Halts
4-0	Fourth Quarter	Idle command given by operator or automatically.	Idle or Less than 25%	Equipment will wait for next process to begin.

Chapter 16
Message Summary

This chapter provides a detailed description of each message used in communication between the host and the equipment. Refer to Chapter 3, GEM Communications, for basic information about GEM messages..

This chapter is organized as follows:

- Section 16.1, Brief Summary of Messages
    - Section 16.1.1, Host to Equipment
    - Section 16.1.2, Equipment to Host
- Section 16.2, SML Notation
- Section 16.3, SECS Message Descriptions

16.1 Message Summary

The following is a list of the messages. See Section 16.3 for detailed information about the messages.

16.1.1 Host to Equipment

Table 16-1 lists the primary SECS messages sent by the Host.

Messages marked with "R" in the R column may be sent only when the control state is **On-line Remote**. The Equipment refuses the messages when the control state is **On-line Local**.

Note: For descriptions of the various states, see Section 2.6.1, Descriptions of States, in Chapter 2, Start-up.

Messages marked with “E” in the Notes column are extensions beyond GEM. Messages marked with “N” are provided for compatibility with non-GEM or older GEM standards.

Table 16-1. Host to Equipment Messages

Primary	Reply	R	Description	Notes
S1F1	S1F2	--	Are You There	
S1F3	S1F4	--	Selected Status	
S1F11	S1F12	--	Status Variable Namelist Request	E
S1F13	S1F14	--	Connect Request	
S1F15	S1F16	-	Request OFF-LINE	
S1F17	S1F18	-	Request ON-LINE	
S1F65	S1F66	--	Connect Request	N
S2F13	S2F14	--	Equipment Constant Request	
S2F15	S2F16	R	New Equipment Constant Send	
S2F17	S2F18	--	Date and Time Request	
S2F23	S2F24	--	Trace Initialize	
S2F25	S2F26	--	Loopback Diagnostic	E
S2F29	S2F30	--	Equipment Constant Namelist Request	E
S2F31	S2F32	--	Date and Time Send	
S2F33	S2F34	--	Define Report	
S2F35	S2F36	--	Link Event Report	
S2F37	S2F38	--	Enable/Disable Event Report	
S2F39	S2F40	--	Multi-Block Inquire/Grant	
S2F41	S2F42	--	Remote Command with Parameters	
S2F43	S2F44		Reset Spooling Streams and Functions	
S2F45	S2F46		Define Variable Limit Attributes	
S2F47	S2F48		Variable Limit Attribute Request	
S3F1	S3F2	--	Material Status Request	E
S3F81	S3F82	--	Cassette Status Request	E
S4F81	Variable	--	Request to Load Product	E
S4F85	Variable	--	Handshake Complete	E
S4F87	Variable	--	Material Ready	E
S4F89	Variable	--	Stuck in Receiver	E
S4F93	Variable	--	Abort Load	E
S4F95	Variable	--	Request to Unload Product	E
S5F3	S5F4		Enable/Disable alarm Sent	
S5F5	S5F6	--	List Alarms	
S5F7	S5F8	--	List Enabled Alarms	E
S6F7	S6F8	--	Data Transfer Request	N
S6F15	S6F16	--	Request Event Report	
S6F17	S6F18	--	Request Annotated Event Report	E
S6F19	S6F20	--	Request Report	
S6F21	S6F22	--	Request Annotated Report	E
S6F23	S6F24		Request Spooled Data	
S7F1	S7F2	--	Process Program Inquire/Grant	
S7F3	S7F4	--	Unformatted Process Program Send	
S7F5	S7F6	--	Unformatted Process Program Request	

Table 16-1. Host to Equipment Messages (Continued)

Primary	Reply	R	Description	Notes
S7F17	S7F18	--	Process Program Delete	
S7F19	S7F20	--	Process Program Directory	
S10F3	S10F4	--	Terminal Display, Single	
S10F5	S10F6	--	Terminal Display, Multiple	
S10F9	S10F10	--	Broadcast	E

16.1.2 Equipment to Host

Table 16-2 lists primary SECS messages sent by the Equipment.

In the Notes column, messages marked with “E” are extensions beyond GEM. Messages marked with “N” are provided for compatibility with non-GEM or older GEM standards.

.

Table 16-2. Equipment to Host

Primary	Reply	Description	Notes
S1F1	S1F2	Are You The	
S1F13	S1F14	Connect Request	
S1F65	S1F66	Connect Request	N
S4F83	Variable	Send Material	E
S4F85	Variable	Handshake Complete	E
S4F87	Variable	Material Ready	E
S4F89	Variable	Stuck in Receiver	E
S4F91	Variable	Product Control Error	E
S5F1	S5F2	Alarm Report	N
S5F71	S5F72	Alarm Report Block Send	
S5F73	S7F74	Alarm Notification Send	
S6F1	S6F2	Trace Data Send	
S6F3	S6F4	Annotated Event Report Send	N
S6F5	S6F6	Multi-Block Data Send Inquire/Grant	
S6F9	S6F10	Event Report Send	N
S6F11	S6F12	Event Report Send	
S6F13	S6F14	Annotated Event Report Send	N
S7F1	S7F2	Process Program Inquire/Grant	
S7F3	S7F4	Unformatted Process Program Send	
S7F5	S7F6	Unformatted Process Program Request	
S9F1	--	Error, Device ID	
S9F3	--	Error, Stream	
S9F5	--	Error, Function	
S9F7	--	Error, Data	
S9F9	--	Error, Transaction Timeout	
S9F11	--	Error, Data Too Long	
S10F1	S10F2	Terminal Request	

16.2 SML Notation

Message descriptions in Section 16.3 are shown using “SECS Message Language” (SML) notation. SML is a general notation developed by GW Associates for describing SECS messages. SML is modeled on the notation used in the SECS Standards documents, but is more precise. In SML, the format for a data item is as follows:

< format [count] value >

The components are:

< > Angle Brackets. Each Data Item is enclosed within angle brackets. This notation implies that each Data Item has a Data Item Format and Data Item Length as required by SECS-II.

format Specifies the type of data. Data types can be integer (I), unsigned (U), floating point (F), or a list (L).

count The “count” specifies the number of value elements in the Data Item Value. Count is optional and, when present, is enclosed in square brackets. For String formats (ASCII, Binary, JIS-8), “count” specifies the number of characters in the string. For Numeric formats (I1, I2, I4, I8, U1, U2, U4, U8, F4, F8, BOOLEAN), “count” specifies the number of values in the array. For simple scalar numeric values, “count” is usually “1”. For LIST items, “count” specifies the number of items in the list.

If “count” is omitted, then the length of the Data Item is implied by the value which follows.

value Value of a single item element. Values are shown in a notation that depends on the item type. For example, ASCII values are shown as characters enclosed in quotes, Unspecified Binary values are shown in hexadecimal.

... Ellipsis (...) is used to indicate that additional elements may occur, as for example where substructures may repeat in a List structure.

For example, a two-byte unsigned integer Data Item with an array of three values 21, 22, and 23 is represented as:

```
<U2 [3] 21 22 23>
```

Numeric values shown are considered decimal integers unless otherwise indicated. Negative values are shown with a leading minus sign “-”. Hexadecimal values are shown in C-Language convention, with a leading “0x”.

10	Decimal Ten
0x10	Hexadecimal 10
-10	Decimal Negative 10

Where a value is not fixed, the SECS variable name is used directly. For Example:

```
<A [6] SOFTREV>
```

The format of a complete message is:

```
SnFn W item.
```

The components are:

SnFn	The Stream and Function Codes; for example: S1F1.
W	The W-Bit, if set. Omitted if not set. If the W-Bit is optional, it is coded within brackets “[W]”.
item	An item that is formatted as described above.
.	A period (.) ends the message definition.

For example, the S1F3 message is described in SML as follows:

```
S1F3 W
    <L
        <U4 13>
        <U4 7>
    >.
```

16.3 SECS Message Descriptions

This section describes each message sent or understood by the Equipment.

S1F0 - Abort Transaction . . . . S,H←→E

Description: Used in lieu of an expected reply to abort a transaction, Function 0 is defined in every stream and has the same meaning in every stream.

Structure: Header only

S1F1 - Are You There Request (R) . . . . S,H←→E, reply

Description: Establishes that the Host or Equipment is on-line. A function 0 response to this message means the communication is inoperative. In the Equipment, a function 0 is equivalent to a timeout on the receive timer after issuing S1F1 to the host.

Structure: S1F1 W H←→E

Header only

Comment: The Equipment sends this message periodically as a “heartbeat” to assure itself that the communication link is still operational.

The Equipment constant **ConfigConnect** can be set to cause the Equipment to send S1F1 instead of S1F13 for a connect request.

S1F2 - On Line Data (D) . . . . S,H←→E

Description: Data signifying that the Equipment is alive.

Structure: S1F2

```
<L[2]
    <A[6] MDLN>              MDLN Model Number
    <A[6] SOFTREV>           SOFTREV Software Rev
>.
```

Exception: The host sends a zero-length list to the Equipment

S1F3 - Selected Status Request (SSR) . . . . S,H→E, reply

Description A request to the Equipment to report selected values of its status

Structure The following structure is approved for all item formats and should be used by all new implementations:

S1F3 W

<L[n]
<U4 VID$_1$>
...
<U4 VID$_n$>
>.

The following structure is included for compatibility with previous implementations and may only be used for items for format 3() an 5():

<SVID$_1$ ....SVIDn>

Exception A zero-length list (structure 1) or item (structure 2) means report all SVIDs.

Comment Host requests status from the Equipment, sending the VIDs of items it wants to know about.

Normally, only VIDs of type SV (status variables) are used. However, the Equipment also allows VIDs of type DV and EC.

If the message contains a zero-length list, then the equipment reporst all variables of type SV, in order of their VID numbers.

S1F4 - Selected Equipment Status Data (SSD) . . . . M,H←E

Description The Equipment reports the value of each SVID requested in the order requested. The host remembers the names of values requested.

Structure S1F4 W

<L[n]
<SV$_1$> Status Variable Name
....
<SVn>
>.

Exceptions If n=0, no response can be made. A zero-length returned for SVi means that SVIDi does not exist.

S1F11 - Status Variable Namelist Request (SVNR) . . . . S,H→E, reply

Description: A request to the Equipment to identify certain status variables.

Structure: S1F11 W

<L[n]
<U4 VID$_1$>
...
<U4 VID$_2$>
>.

Exception: A zero length means report all SVIDs.

Comment: Several VIDs can be specified.

Normally, only VIDS of type SV are used. Types DV and EC may also be used.

If the message contains a zero-length list, then the Equipment reports all variables of type SV in order of the VIDs.

S1F12 - Status Variable Namelist Reply (SVNRR) . . . . S,H←E, reply

Description: The Equipment reports to the host the name and units of the requested SVs.

Structure: S1F12

<L[n]	
<L[3]	
<U4 VID$_1$>	Variable ID
<A SVNAME$_1$>	Status Variable Name
<A UNITS$_1$>	Units of measure
>	
...	
<L[3]	
<U4 VID$_n$>	Variable ID
<A SVNAME$_n$>	Status Variable Name
<A UNITS$_n$>	Units of measure
>	
>.	

Comment: The Equipment returns the variable descriptions in the order requested in S1F11. If any VID specified in S1F11 is invalid, the resulting list in S1F12 has the following error format.

<L[0]>	Instead of L[3]

S1F13 - Connect Request (CR) . . . . S,H←→E, reply

Description

The purpose of this message is to provide a formal means of initializing communications at a logical application level, both on power-up and following a break in communications.

It should be the first message sent following any period where host and Equipment SECS applications are unable to communicate.

An attempt to send an Establish Communications Request (S1F13) should be repeated at programmable intervals until an Establish Communications Acknowledge (S1F14) is received within the transaction timeout period with an acknowledgment code accepting the establishment.

Structure

The Equipment sends this message using the following format.

```
S1F13 W                                  H→E
  <L[2]
    <A MDLN>
    <A SOFTREV>
  >.
```

The Host sends this message using the format:

```
S1F13 W                                  H→E
  <L[0]>.
```

Exception

The Host sends a zero-length list to the Equipment.

Comment

Either end of the link may send S1F13 as the first message of S1F13/F14 pair.

The Equipment's initialization logic always attempt to establish the link. If no reply is received from the Host, the Equipment continues to send S1F13 periodically.

S1F14 - Establish Communications Requests Acknowledge (CRA). . . . . S,H←→E

Description: Accept or deny Establish communications Request (S1F13). MDLN and SOFTREV are on-line data and are valid only if COMMACK = 0.

Structure: The Equipment sends this message using the following format:

```
S1F14                                          H←E
    <L[2]
        <B[1] 00>                              COMMACK
        <L[2]
            <A MDLN>
            <A SOFTREV>
        >
    >.
```

The Host sends this message using the following format:

```
S1F14                                          H→E
    <L[2]
        <B[1] 00>
        <L[0]>
    >.
```

Comment: Equipment always sends the value 0x00 for COMMACK

In messages received from the Host, COMMACK value 0X00 indicates acceptance of the connect request. Any other value indicates refusal.

S1F15 - Request OFF-LINE (ROFL). . . . . S,H→E,reply

Description: The Host requests that the Equipment transition to the OFF-LINE state.

Structure:

```
S1F15 W.                                       H→E
    Header only
```

S1F16 - OFF-LINE Acknowledge (OFLA) . . . . .S,H←E

Description: Acknowledge or indicate an error

Structure:

```
S1F16
    <OFLACK>.
```

S1F17 - Request ON-LINE (RONL) . . . . S,H→E,reply

Description: The Host requests that the Equipment transition to an ON-LINE state.

Structure:

```
S1F17 W.
    Header only
```

S1F18 - ON-LINE Acknowledge (ONLA) . . . . S,H←E

Description Acknowledge or indicate an error

Structure S1F18

<ONLACK>.

S1F65 - Connect Request

Description The Equipment constant **ConfigConnect** can be set to cause the Equipment to send S1F65 instead of S1F13 for a Connect Request.

Structure The Equipment Constant ConfigConnect can be set to cause the Equipment to send S1F65 instead of S1F13 for Connect Request.

The Equipment sends this message using the following format:

S1F65 W H←E

<L[2]

<A MDLN>

<A SOFTREV>

>.

The Host sends this message using the following formats:

Format 1:

S1F65 W H→E

<L[0]>.

Format 2:

S1F65 W. H→E

Comment Either end of the link may send S1F65 as the first message to establish link connection.

The Equipment's initialization logic always attempt to establish the link. If no Host acceptance reply is received, the Equipment continues to send the message at intervals.

S1F66 - Connect Request Acknowledge

Description Reply to S1F65

Structure Sent by Equipment

If the Host sends S1F65, Format 1, the Equipment replies using the following format:

```
S1F66                                   H←E
  <L[2]
    <B[1] 00>                           COMMACK
    <L[2]
      <A MDLN>
      <A SOFTREV>
    >
  >.
```

If the Host sends S1F65, Format 2, the Equipment replies using the following format:

```
S1F66                                   H←E
  <B[1] 00>.                            COMMACK
```

Sent by Host

The Host sends the message using the following format:

```
S1F66                                   H→E
  <L[2]
    <B[1] 00>
    <L[0]>
  >.
```

Alternatively, the Host may send the message in this format:

```
S1F66                                   H→E
  <B[1] 00>.                            COMMACK
```

Comment In messages received from the Host, COMMACK = 0X00 indicates acceptance of the connect request. Any other values indicate refusal. The Equipment always sends a value of 0x00 for COMMACK.

S2F13 - Equipment Constant Request (ECR) . . . . S,H→E, reply

Description: This message is used to obtain constants that are used for such things as calibration, servo gain, alarm limits, data collection mode, and other values that are changed infrequently.

Structure: S2F13 W H→E

<L[n]

<U4 $ECID_1$> Equipment Constant ID

...

<U4 $ECID_n$>

>.

Comment: Host is requesting one or more items of interest and is specifying their VIDs. Only VIDs of type EC are used.

If the message contains a zero-length list, then the Equipment reports all variables of type EC, in order of their VIDs.

For compatibility with older Host implementations, the Equipment allows the following alternative form of the message, using an array format:

S2F13 W H→E

<U4 $ECID_1$ $ECID_2$>. Equipment Constant ID

S2F14 - Equipment Constant Data (ECD) . . . . M,H←E

Description: Data response to S2F13 in the order requested.

Structure: S2F14 W

<L[n]

<ECV_1> Equipment Constant Value

...

<ECV_n> Equipment Constant Value

>.

Comment: The Equipment returns the equipment constants in the order requested by S2F13.

A zero-length ECV_i means that $ECID_i$ does not exist.

S2F15 - New Equipment Constant Send (ECS) . . . . S,H→E, reply

Description Changes one or more equipment constants.

Structure S2F15 W H→E

```
<L[n]
    <L[2]
        <U4 ECID1>          Equipment Constant ID
        <V1>
    >
    ...
    <L[2]
        <U4 ECIDn>          Equipment Constant ID
        <Vn>
    >
>.
```

Comment The Host sends new values for desired Equipment Constants. Several Equipment Constants can be specified if desired.

Only VIDs of type EC can be used in this message.

The control state must be On-line Remote.

S2F16 - New Equipment Constant Acknowledge (ECA) . . . . .S,H←E

Description Reply to S2F15. Either acknowledge that message or indicate an error. A non-zero error code tells the Equipment to make no changes in any of the ECIDs specified in the S2F15.

Structure S2F16

```
<B[1] EAC>.
```

Comment Normal completion returns a zero (0) in EAC. If any ECID or ECV in S2F15 is invalid, then EAC contains a non-zero value, and the Equipment rejects the entire S2F15. Possible EAC values are:

Table 16-3. Equipment Constant Send Acknowledge

EAC	Description
0x00	Acknowledge
0x01	Denied. At least one constant does not exist
0x02	Denied. Busy.
0x03	Denied. At least one constant is out of range
>0x03	Other equipment-specific error
0x04-0x3F	Reserved

S2F17 - Date and Time Request (DTR) . . . . S,H←→E

Description The host or the equipment can request the date and time from the other.

Structure S2F17

[Header only]

S2F18 - Date and Time Data (DTD) . . . . S,H←→E

Description The message contains the current date and time. This can be an equipment response to a host request or a host response to an equipment request. Note that there are two time formats possible; this is set by the GemTime Format equipment constant (ecid 10101). This format can be changed by the host in an S2F15 (New Equipment Constant Send) message (the equipment must be in remote mode) or by an operator setting the equipment constant in the equipment Configuration Editor.

Structure S2F18

16-character format (year 2000-compliant):

<A ‘YYYYMMDDhhmmsscc’>.

YYYY	Year, 0000 to 9999
MM	Month, 01 to 12
DD	Day, 01 to 31
hh	Hours, 00 to 23
mm	Minutes, 00 to 59
ss	Seconds, 00 to 59
cc	centisecond, 00 to 99

12-character format:

<A ‘YYMMDDhhmmss’>.

YY	Year, 00 to 99
MM	Month, 01 to 12
DD	Day, 01 to 31
hh	Hours, 00 to 23
mm	Minutes, 00 to 59
ss	Seconds, 00 to 59

Comment When the Equipment receives a valid S2F18, it sets its internal clock/calendar. If any element of the message (example: date, time) is not valid, it is not used, although the remaining valid items are.

S2F23 - Trace Initialize Send (TIS) . . . . S,H→E,reply

Description Status variables exist at all times. This function provides a way to sample a subset of those status variables as a function of time. The trace data is returned on S6F1 and is related to the original request by the TRID. Multiple trace requests may be made to equipments that allow it. If the equipment receives S2F23 with the same TRID as a trace function that is currently in progress, the equipment should terminate the old trace and then initiate the new trace. A trace function currently in progress may be terminated by S2F23 with TRID of that trace and TOTSMP=0.

Structure The following structure is approved for all item formats and should be used by all new implementations.

```
S2F23 W
  <L[5]
    <U4 TRID>               Trace ID
    <A 'hhmmss'>            DSPER - Data Sample Period
    <U4 TOTSMP>             Total number of samples
    <U4 REPGSZ>             Reporting group size
    <L[n]
      <U4 SVID1>            Status Variable ID
      ...
      <U4 SVIDn>            Status Variable ID
    >
  >.
```

For compatibility with older Host implementations, the Equipment allows the following alternative form for this message, using an array format:

```
S2F23 W
  <L[5]
    <U4 TRID>               Trace ID
    <A 'hhmmss'>            DSPER - Data Sample Period
    <U4 TOTSMP>             Total number of samples
    <U4 REPGSZ>             Reporting group size
    <U4 SVID1 SVID2...>     Status Variable ID array
  >.
```

Comment The Equipment sends trace data using S6F1.

If TRID in S2F23 matches TRID of an existing trace, the existing trace operation is canceled, and replaced by the new one.

Up to four (4) separate TRIDs can be in operation simultaneously.

The Data Sample Period (DSPER) must contain a valid hour/minute/second format (hh 0-23, mm 0-59, ss 0-59), and cannot contain 000000. The practical minimum value of DSPER is application dependent.

The Equipment sends the first S6F1 at one time period (DSPER * REPGSZ) after receiving S2F23.

If TOTSMP is zero, then S2F23 is a request to cancel an existing trace. Any trace with the specified TRID is canceled.

REPGSZ minimum value is 1. REPGSZ may not be so large that S6F1 would be a multi-block message. Typical value is 1.

Several SVIDs can be specified if desired. You must not specify so many SVIDs that S6F1 becomes a multi-block message.

Normally, only Variables of type SV are used in this message. Any VID of type DV, EC, or SV can be used.

S2F24 - Trace Initialize Acknowledge (TIA) . . . . .S,H←E

Description Acknowledge S2F23 or indicate an error

Structure S2F24

<B[1] TIAACK>. TIAACK -Trace Init. Ack. Code

Table 16-4. Trace Initialize Acknowledge

TIAACK	Description
0x0	Normal. Everything Correct
0x1	Too many SVIDs
0x2	no more traces allowed
0x3	invalid period
>0x3	equipment-specific error
0x4-0x3F	reserved

Comment The GSD-HE does not signal an error if a Host error in S2F23 causes S6F1 to be multi-block. Instead, this Equipment sends multi-block S6F1 as requested by the Host.

This Equipment does not signal an error if the Host initiates more than four (4) simultaneous traces. The maximum number of traces supported is application dependent, but is always at least 4.

S2F25 - Loopback Diagnostic Request (LDR) . . . . .S,H←→E

Description A diagnostic message for check of protocol and communication circuits. The binary string sent should be echoed back.

Structure S2F25

<B ABS>.

S2F26 - Loopback Diagnostic Data (LDD) . . . . .S,H←→E

Description The Equipment echoes back the binary data requested by message S2F25.

Structure S2F26

<B ABS>.

S2F29 - Equipment Constant Namelist Required (ECNR) . . . . S,H→E,reply

Description	This function allows the Host to retrieve basic information about what equipment constants are available in the Equipment.
Structure	S2F29 W

```
<L[n]
    <U4 ECID1>                          Equipment Constant ID
    ...
    <U4 ECIDn>                          Equipment Constant ID
>.
```

Exception	A zero-length list means: send information for all ECIDs.
Comment	The Host requests format descriptions for the specified equipment constants. Several ECIDs can be specified.

Only VIDs of type EC (i.e. equipment constants) can be used in this message.

If S2F29 contains a zero-length list, then the Equipment reports all variables of type EC, in order of their ECIDs.

S2F30 - Equipment Constant Namelist (ECN) . . . . M,H←E

Description Data Response

Structure S2F30

```
<L[n]
    <L [6]
        <U4 ECID1>          Equipment Constant ID
        <A ECNAME1>         Equipment Constant Name
        <ECMIN1>            ECV Minimum Value
        <ECMAX1>            ECV Maximum Value
        <ECDEF1>            ECV Default Value
        <A UNITS1>          Units of Measure
    >
    ...
    <L [6]
        <U4 ECIDn>          Equipment Constant ID
        <A ECNAMEn>         Equipment Constant Name
        <ECMINn>            ECV Minimum Value
        <ECMAXn>            ECV Maximum Value
        <ECDEFn>            ECV Default Value
        <A UNITSn>          Units of Measure
    >
>.
```

Comment The Equipment returns the Equipment Constant descriptions in the order requested in S2F29. If any VID specified in S2F29 is invalid, the corresponding List in S2F30 has the following error format:

```
<L[0]>                      Instead of L[6]
```

S2F31 - Date and time Set Request (DTS) . . . . S,H→E,reply

Description Useful to synchronize the Equipment time with the Host time base. Note that there are two time formats possible; this is set by the GemTime Format equipment constant (ecid 10101). This format can be changed by the host in an S2F15 (New Equipment Constant Send) message (the equipment must be in remote mode) or by an operator setting the equipment constant in the equipment Configuration Editor.

Structure S2F31 W

16-character format:

```
<A 'YYYYMMDDhhmmsscc'>.        TIME - Date and Time
```

YYYY	Year, 0000 to 9999
MM	Month, 01 to 12
DD	Day, 01 to 31
hh	Hours, 00 to 23

mm	Minutes, 00 to 59
ss	Seconds, 00 to 59
cc	centiseconds, 00 to 99

12-character format:

<A 'YYMMDDhhmmss'>.

YY	Year, 00 to 99
MM	Month, 01 to 12
DD	Day, 01 to 31
hh	Hours, 00 to 23
mm	Minutes, 00 to 59
ss	Seconds, 00 to 59

Comment: The Host commands the Equipment to set its Date and Time base to the specified value.
The Equipment sets its offset clock, but does not change the UNIX clock on the Sun.

S2F32 - Date and time Set Acknowledge (DTA) . . . . S,H←E

Description: Acknowledge the receipt of time and date.

Structure: S2F32

```
<B [1] TIACK>.          TIACK - Acknowledge Code
```

S2F33 - Define Report (DR) . . . . M,H→E,reply

Description: The Host specifies one or more Report IDs, and defines which variables are to be included in each report.

Structure: S2F33 W

```
<L[2]
    <U4 DATAID>                 DATAID
    <L[n]
        <L[2]
            <U4 RPTID1>         REPORT ID
            <L[a]
                <U4 VID1>       VARIABLE ID
                .....
                <U4 VIDa>       VARIABLE ID
            >
        >
        .....
        <L[2]
            <U4 RPTIDn>         REPORT ID
            <L[b]
                <U4 VID1>       VARIABLE ID
```

```
                    .....
                    <U4 VIDb>              VARIABLE ID
                >
            >
        >
    >.
```

Exceptions

1. A zero-length list following <DATAID> deletes all report definitions and associated links.
   (See S2F35 - Link Event/Report.)
2. A zero-length list following <RPTID> deletes report type RPTID. All CEID links to this RPTID are also deleted.

Comment

If S2F33 is multi-block, the Host may optionally send the S2F39/S2F40 Inquire/Grant Transaction before sending S2F33, but this Equipment does not require it.

The Equipment ignores DATAID.

already contains existing Report Definitions, then this message can be used to download additional definitions for RPTIDs not yet defined. The Host cannot download a new Report Definition for a RPTID for which a Report Definition already exists in the Equipment. Instead, to change a Report Definition the Host must first delete the old Report Definition and then send a new Report Definition for that RPTID.

The Host can delete selected report definitions and associated links in the Equipment by using the following specifications in S2F33:

```
...
<L [2]
        <U4 RPTID>                    *Report ID to delete
        <L[0]>
...
```

The Host can delete all report definitions and associated links in the Equipment by using the following special format.

```
S2F33 W
    <L[2]
        <U4 DATAID>
        <L[0]>
    >.
```

S2F34 - Define Report Acknowledge (DRA) . . . . S,H←E

Description Acknowledge or indicate an error. If an error condition is detected, the entire previous message is rejected. (Partial changes are not allowed.)

Structure S2F34

<B[1] DRACK>. DRACK - Acknowledge code

Comment Normally, DRACK is zero. Any non-zero DRACK indicates the Equipment has rejected the entire S2F33 message.

Table 16-5. Define Report Acknowledge

DRACK	Description
0x0	OK
0x1	Denied, insufficient space
0x2	Denied, invalid format
0x3	Denied, at last one RPTID already defined
0x4	Denied, at least one VID does not exist
>0x4	other errors
0x5-0x3F	reserved

S2F35 - Link Event Report (LER) . . . . M,H→E, reply

Description

For each of several events (each event defined by its CEID), the Host links one or more reports to that event. The subsequent occurrence of any of these events results in the sending of those reports (and *only* those reports) that were both:

- Linked to the event in question
- Enabled

See S2F37 for enabling reports.

Structure

S2F35 W

<L[2]	
<U4 DATAID>	DATAID
<L[n]	
<L[2]	
<U4 CEID$_1$>	Collection Event ID
<L[a]	
<U4 RPTID$_1$>	Report ID
...	
<U4 RPTID$_a$>	Report ID
>	
>	
...	
<L[2]	
<U4 CEID$_n$>	Collection Event ID
<L[b]	
<U4 RPTID$_1$>	Report ID
...	
<U4 RPTID$_b$>	Report ID
>	
>	
>	
>.	

Comment

The Host links Report Ids to selected Collection Event Ids. The Specified CEIDs are initialized to “disabled”. See S2F37 for enabling CEIDs.

If S2F35 is multi-block, the Host may optionally send the S2F39/S2F40 Inquire/Grant transaction before sending S2F35, but the GSD-HE does not require it.

The Equipment ignores DATAID.

Continued on next page

S2F35 - continued

The Host can eliminate all links for a CEID by sending the following format in S2F35 for that CEID:

```
...
<L [2]
        <U4 CEID>                       * Collection Event ID
        <L[0]>
        >
...
```

Exception A zero-length list following CEID deletes all report links to that event.

S2F36 - Link Event Report Acknowledge (LERA) . . . . S,H←E

Description Equipment either acknowledges the S2F35 message or reports an error. In the event of an error, the entire message is rejected. Partial changes are not allowed.

Structure S2F36

<B[1] LRACK>. LRACK - Acknowledge Code

Normally, LRACK is zero. Any non-zero LRACK indicates the Equipment has rejected the entire S2F35 message.

Table 16-6. Link Event Report Acknowledge

LRACK	Description
0x0	Accepted
0x1	Denied, insufficient space
0x2	Denied, invalid format
0x3	Denied, at least one CEID link already defined
0x4	Denied, at least one CEID does not exist
0x5	Denied, at least one RPTID does not exist
>0x5	Other errors
0x6-0x3F	Reserved

S2F37 - Enable/Disable Event Report (EDER) . . . . S,H→E,reply

Description The Host enables/disables reporting for one or more events (defined by CEID)

Structure S2F37 W

<L[2]	
<BOOLEAN CEED>	Coll. Event Enable
<L[n]	
<U4 $CEID_1$>	Coll. Event ID
...	
<U4 $CEID_n$>	Coll. Event ID
>	
>.	

Exception A zero-length list following <CEED> means *all* CEIDs.

Comment The Host enables reporting for a list of Collection Event IDs, or disables reporting for the list.

CEED is “True” to indicate Enabling, or “False” to indicate Disabling reporting for the specified CEIDs.

S2F38 - Enable/Disable Event Report Acknowledge (EERA) . . . . S,H←E

Description Acknowledge the S2F37 or indicate an error. If an error condition is detected, the entire message is rejected. Partial changes are not allowed.

Structure S2F38

<B[1] ERACK>. ERACK - Acknowledge code

Comment Normally, ERACK is zero. Any non-zero ERACK indicates the Equipment has rejected the entire S2F37 message.

Table 16-7. Enable/Disable Event Report Acknowledge

ERACK	Description
0x0	Accepted
0x1	Denied. At least one CEID does not exist.
>0x1	Other errors
0x2-0x3F	Reserved

S2F39 - Multi-block Inquire (DMBI) . . . . S,H→E,reply

Description If an S2F33, S2F35, or S2F45 message is multi-block, it must be preceded by S2F39.

Structure S2F39 W

```
<L[2]
    <U4 DATAID>           DATAID
    <U4 DATALENGTH>
>.
```

Comment The Host may send this Inquire/Grant transaction preceding any multiblock S2F33 or S2F35. For this Equipment, this Inquire/Grant is optional. The Equipment accepts it, but ignores it, commits no resources, and initiates no Conversation Timeout. The Equipment accepts multiblock S2F33 or S2F35 even if not preceded by the Inquire/Grant.

S2F40 - Multi-block Grant (DMBG). . . . . S,H←E

Description Grants permission to send a multi-block message.

Structure S2F40

<B[1] 00>. GRANT

Comment The Equipment always sends GRANT value "0."

S2F41 - Host Command Send (HCS) . . . . S,H→E,reply

Description The Host requests the Equipment to perform the specified remote command with the associated parameter(s).

Structure S2F41 W

<L[2]	
<A RCMD>	Remote command string
<L[n]	
<L[2]	
<A CPNAME$_1$>	Command parameter name
<CPVAL$_1$>	Command parameter value
>	
...	
<L[2]	
<A CPNAME$_n$>	Command parameter name
<CPVAL$_n$>	Command parameter value
>	
>	
>.	

Comment The Host sends a command with parameters to the Equipment. If a command has no parameters, S2F41 has the following format:

S2F41 [W]	H→E
<L [2]	
<A RCMD>	Remote Command String
<L>	
>.	

The GSD-HE is case sensitive when performing validity checks on the RCMD and CPNAME strings.

Note: Refer to Chapter 9, "Remote Control" for additional information about message structure.

S2F42 - Host Command Acknowledge (HCA) . . . . S,H←E

Description
Acknowledge an S2F41 command or indicate errors. If the command is not accepted due to one or more invalid parameters (for example: HCACK=3) then a list of invalid parameters is returned containing, in each case, the parameter name and the reason why it was refused.

Structure
S2F42

<L[2]	
<B[1] HCACK>	Host Command Ack. Code
<L[n]	
<L[2]	
<A CPNAME$_1$>	Name of parameter
<B[1] CPACK$_1$>	Cmd Param Ack Code
>	
...	
<L[2]	
<A CPNAME$_n$>	Name of parameter
<B[1] CPACK$_n$>	Cmd Param Ack Code
>	
>	
>.	

Exception
If there are no invalid parameters, then a list of zero length is sent in place of the L[n] list.

Comment
Normal completion returns a zero (0) in HCACK. The number of erroneous parameters “N” in S2F2 will be zero.

A non-zero value for HCACK indicates that the Equipment has rejected the Remote Command. The number of erroneous parameters “n” can be zero or greater.

Table 16-8. Remote Command Acknowledge

HCACK	Description
0x00	Acknowledge. Command has been performed.
0x01	Command does not exist
0x02	Cannot perform now.
0x03	At least one parameter is invalid.
0x04	Acknowledge. Command is performed with completion signaled later by an event.
0x05	Rejected. Already in desired condition.
0x06	No such object exists
0x07 - 0x3F	Reserved
0x40	Control State is Local. Equipment rejects command.
0x41	Incorrect Process State for this command. Equipment rejects command.

Table 16-9. Command Parameter Ack Code

CPACK	Description
0x01	Invalid parameter name (CPNAME). The CPNAME is not a valid parameter for this command.
0x02	Illegal parameter value (CPVAL). The parameter value is out of range.
0x03	Illegal format for parameter (CPVAL). The value for this parameter does not use the correct SECS-II data item type.
0x04	Illegal parameter value (CPVAL). The parameter value is out of range.

S2F43 - Reset Spooling Streams and Functions (RSSF) . . . . S,H→E,reply

Description This message allows the host to select specific streams and functions to be spooled whenever spooling is active.

Structure S2F32 W

```
<L[m]
    L[2]
        <STRID1>                Stream identification
        <L[n]
            <FCNID1>            Function identification
            ....
            <FCNIDn>            Function identification
        >
    >
    ...
    L[2]
        <STRIDm>                Stream Identification
        <L[n]
            <FCNID1>            Function identification
            ....
            <FCNIDn>            Function identification
        >
    >
>.
```

Exceptions

1. A zero-length list (m=0) turns off spooling for all streams and functions.
2. A zero-length list (n=0) turns on spooling for all functions for the associated stream.

Notes

1. Turning off spooling for all functions for a specific stream is achieved by omitting reference to the stream from this message.
2. Spooling for Stream 1 is not allowed
3. Equipment must allow Host to spool all primary messages for a stream (except Stream 1).
4. A defined list of functions for a stream in this message will replace any previously-selected functions.

S2F44 - Reset Spooling Acknowledge (RSA) . . . . M,H←E

Description — Acknowledge S2F43 or indicate an error.

Structure — S2F44

<L[2]	
<RSPACK>	Reset spooling acknowledge
L[m]	
L[3]	
<STRID$_1$>	Stream identification
<STRACK$_1$>	Spool stream acknowledge
L[n]	
<FCNID$_1$>	Function identification
...	
<FCNID$_n$>	Function identification
>	
>	
...	
L[3]	
<STRID$_m$>	Stream identification
<STRACK$_m$>	Spool stream acknowledge
L[n]	
<FCNID$_1$>	Function identification
...	
<FCNID$_n$>	Function identification
>	
>	
>	
>.	

Exceptions

1. If RSPACK=0, a zero-length list (m=0) is given, indicating no stream or functions are in error.
2. A zero-length list (n=0) indicates no functions in error for the specified stream.

S2F45 - Define Variable Limit Attributes (DVLA) . . . . M,H→E,reply

Description Specifies the upper and lower boundaries of various limits for each of several variables.

Structure S2F45 W

```
<L[2]
    <DATAID>
    <L[m]                                   m=no. of variables in this definition
        <L[2]
            <VID_1>
            <L[n]
                <L[2]
                    <LIMITID_1>
                    <L[p]                   p = 0 or 2
                        <UPPERDB_1>
                        <LOWERDB_1>
                    >
                >
                ...
                <L[2]
                    <LIMITID_n>
                    <L[p]
                        <UPPERDB_1>
                        <LOWERDB_1>
                    >
                >
            >
        >
            ...

        <L[2]
            <VID_m>
            <L[n]
                <L[2]
                    <LIMITID_1>
                    <L[p]
                        <UPPERDB_1>
                        <LOWERDB_1>
                    >
                >
                ...
                <L[2]
                    <LIMITID_n>
                    <L[p]
                        <UPPERDB_1>
                        <LOWERDB_1>
                    >
                >
            >
        >
    >
>.
```

Exceptions

1. A zero-length list (m=0) sets all limit values for all monitored

VIDs to "undefined."

2. A zero-length list (n=0) sets all limits values for that VID to "undefined."
3. A zero-length list (p=0) sets that limit to "undefined."

S2F46 - Variable Limit Attribute Acknowledge (VLAA) . . . . M,H←E

Description Acknowledge definition of variable limit attributes or report error. If DVLA is not accepted due to one or more invalid parameters (example: LIMITACK=3), then a list of invalid parameters is returned containing the variable limit attribute and reason for rejection. If an error condition is detected, the entire message is rejected. Partial changes are not allowed.

Structure S2F46

<L[2]	
<VLAACK>	
<L[m]	m=# of invalid parameters
<L[3]	
<VID$_1$>	VID that is in error
<LVACK$_1$>	reason
<L[n]	n = 0 or 2
<LIMITID$_1$>	1st limit in error for VID$_1$
<LIMITACK$_1$>	reason
>	
>	
...	
<L[3]	
<VID$_m$>	VID that is in error
<LVACK$_m$>	reason
<L[n]	n = 0 or 2
<LIMITID$_1$>	1st limit in error for VID$_m$
<LIMITACK$_1$>	reason
>	
>	
>	
>.	

Exceptions

1. A zero-length list (m=0) indicates no invalid variable limit attributes
2. A zero-length list (n=0) indicates no invalid limit values for that VID.

S2F47 - Variable Limit Attribute Request (VLAR). . . . . S,H→E,reply

Description This message allows the Host to query the Equipment for current variable limit attribute definitions.

Structure S2F47 W

<L[m] m = # of VIDs in this request
<VID_1>
...
<VID_m>
>.

Exceptions A zero-length list (m=0) requests a list of all VID values that can have variable limit attributes.

S2F48 - Variable Limit Attributes Send (VLAS) . . . . M,H←E

Description Equipment sends values of requested variable limit attribute definitions in the order requested.

Structure S2F48

<L[m] m = # of VIDS in this request
L[2]
<VID$_1$>
<L[p]} p = 0 or 4
<UNITS$_1$>
<LIMITMIN$_1$>
<LIMITMAX$_1$>
<L[n] n = # limits defined for this VID
<L[3]
<LIMITID$_1$>
<UPPERDB$_1$>
<LOWERDB$_1$>
>
...
<L[3]
<LIMITID$_n$>
<UPPERDB$_n$>
<LOWERDB$_n$>
>
>
>
>
...

L[2]
<VID$_m$>
<L[p]} p = 0 or 4
<UNITS$_m$>
<LIMITMIN$_m$>
<LIMITMAX$_m$>
<L[n] n = # limits defined for this VID
<L[3]
<LIMITID$_1$>
<UPPERDB$_1$>
<LOWERDB$_1$>
>
...
<L[3]

<LIMITID$_n$>
<UPPERDB$_n$>
<LOWERDB$_n$>
>
>
>
>
>.

Exceptions

1. A zero-length list (p=0) indicates that limits are not supported for the VID.
2. A zero-length list (n=0) means no limits are currently defined for the specified variable.

S3F1 - Material Status Request (MSR) . . . . .S,H→E

Description Host requests the Equipment to send the status of all material in process.

Structure S3F1 W

Header only

Comment This message is a part of the GSD-HE's material movement and status protocol. It is sent by the Host to generate a S3F2 from the Equipment.

S3F2 - Material Status Data (MSD) . . . . M,H←E

Description Material-in-process information is sent from the Equipment to the Host. There are m locations.

Structure S3F2

<L[2]	
<U1 MF>	Material format
<L[n]	Number of ports
<L[3]	
<U1 LOC_1>	Location 1-4, port#
<U1 QUA_1>	Quantity in cassette
<A[16] MID_1>	Material ID
>	
...	
<L[3]	
<U1 LOC_4>	Location 1-4, port#
<U1 QUA_4>	Quantity in cassette
<A[16] MID_4>	Material ID
>	
>	
>.	

Comment The value for MF (Material Format) is as defined in SEMI E5-1296. For this implementation, it is usually one (1).

The LOC data item corresponds to a specific Port Number.

QUA refers to the number of wafers in a cassette that the Host sent.

The S3F2 message contains a list of the above data items for each cassette position on the cassette table. If a cassette is empty, it is still reported, but with numerical values of zero (0x0000) and ASCII empty strings.

S3F81 - Cassette Status Request . . . . H→E

Description: This message is part of the Equipment's material movement and status protocol. It is sent by the Host to generate an S3F82 from the Equipment.

Structure: S3F81 W

Header only

S3F82 - Cassette Status Request Reply . . . . H←E

Description: Reply to S3F81.

Structure: S3F82

<L[2]	
<U1 MF>	Material format code
<L[n]	Number of ports
<L[4]	
<U1 LOC$_1$>	Location
<U1 QUA$_1$>	Quantity
<A[16] MID$_1$>	Material ID
<U1 CAS$_1$>	Cassette state
>	
...	
<L[4]	
<U1 LOC$_n$>	Location
<U1 QUA$_n$>	Quantity
<A[16] MID$_n$>	Material ID
<U1 CAS$_n$>	Cassette state
>	
>	
>.	

Comment: This message is another custom GSD-HE message. It is used to relay to the Host the status of the cassettes in process. It is sent in response to a Host S3F81.

Data items LOC, QUA, and MID are the same as above S3F2.

CAS represents the present state of the Cassette Finite State Description. (Refer to Section 15.1, Cassette Finite States.)

The S3F82 message will contain a list of the above data items for each cassette position on the cassette table. If a cassette is empty, it is still reported, but with numerical values of zero (0x0000) and ASCII empty strings.

S4F81 - Request to Load Product . . . . H→E

Structure S4F81

<L[4]

<A[16] PPID>	Process Program ID
<A[16] MID>	Material ID
<U1 QUA>	Quantity
<U1 PTN>	Port #

>.

Comment This command is used by the GSD-HE as a part of its material movement protocol. This message is sent by the Host to start the process of loading cassettes onto the Cassette Table. Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11 “Stream Four Data Items”.

S4F83 - Send Material . . . . H←E

Structure S4F83

<L[4]

<A[16] PPID>	Process Program ID
<A[16] MID>	Material ID
<U1 QUA>	Quantity
<U1 PTN>	Port #

>.

Comment After the Host has requested that material be loaded onto the GSD-HE via the S4F81 message, the Equipment responds with this message if it is ready to receive the material according to the parameters specified in the S4F81 message.

Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11, “Stream Four Data Items”.

S4F85 - Handshake Complete . . . . H←→E

Structure S4F85

<L[4]

<A[16] PPID>	Process Program ID
<A[16] MID>	Material ID
<U1 QUA>	Quantity
<U1 PTN>	Port #

>.

Comment This message is a custom Equipment message for its material movement protocol. It signals the end of a successful cassette load or unload sequence. The data items specified in this message are the same that have remained constant throughout the successful transaction.

Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11, Stream Four Data Items.

S4F87 - Material Ready . . . . H←→E

Structure S4F87

<L[4]

<A[16] PPID>	Process Program ID
<A[16] MID>	Material ID
<U1 QUA>	Quantity
<U1 PTN>	Port #

>.

Comment This message is a custom Equipment message for its material movement protocol.

- From Equipment to Host, the message indicates that the material is ready to be removed from the Equipment.
- From Host to Equipment, the message indicates that Cassettes are ready to be loaded onto the Equipment.

Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11, “Stream Four Data Items”.

S4F89 - Stuck in Receiver . . . . .H←→E

Structure S4F89

<L[4]	
<A[16] PPID>	Process Program ID
<A[16] MID>	Material ID
<U1 QUA>	Quantity
<U1 PTN>	Port #
>.	

Comment This message is another custom Equipment material movement message.

- From the Equipment to Host, it indicates that some material has become physically stuck or lost somewhere on the Equipment, making it unavailable to unload.
- From the Host to Equipment, it shows that material has become stuck or lost somewhere outside of the Equipment, and cannot be loaded onto the cassette table.

Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11, Stream 4 Data Items.

S4F91 - Product Control Error. . . . . H←E

Structure S4F91

<L[5]	
<A[16] PPID>	Process Program ID
<A[16] MID>	Material ID
<U1 QUA>	Quantity
<U1 PTN>	Port #
<U1 PCE>	Product Control Error
>.	

Comment This custom material movement message indicates that the Equipment has received a material movement command from the Host with improper parameters. Alternatively, it may also mean that an Equipment failure has occurred. The product control error that has occurred is found in variable PCE. Potential PCE values are found in Table 16-10 below.

Continued on next page.

S4F91 - cont'd

Table 16-10. Product Control Error

PCE	Description
1	secs2_s4_incorrect_process
2	secs2_s4_cassette_on_port
3	secs2_s4_failure_table
4	ecs2_s4_failure_door
5	secs2_s4_wh_man_mode
6	secs2_s4_bad_msg
7	secs2_s4_bad_mid
8	secs2_s4_bad_ppid
9	secs2_s4_bad_qty
10	secs2_s4_bad_ptn
11	secs2_s4_cmd_ignore
12	secs2_s4_cassette_not_on_port
13	secs2_s4_cassette_stuck
14	secs2_s4_load_in_progress
15	secs2_s4_unload_in_progress
16	secs2_s4_ptn_not_match
17	secs2_s4_mid_not_match
18	secs2_s4_ppid_not_match
19	secs2_s4_qty_not_match
33	secs2_s4_wh_lost_comm
34	secs2_s4_wh_rob_hold
35	secs2_s4_wh_invac_hold

Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11, Stream 4 Data Items.

S4F93 - Abort Load . . . . H→E

Structure S4F93

```
<L[4]
    <A[16] PPID>        Process Program ID
    <A[16] MID>         Material ID
    <U1 QUA>            Quantity
    <U1 PTN>            Port #
>.
```

Comment This message is an Equipment custom material movement message. When loading or unloading of cassettes has started, the Host can abort the activity by sending this message.

Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11 Stream 4 Data Items.

This message can be sent in two circumstances only:

- In place of an S4F87 during a load
- In place of an S4F93 during an unload

S4F95 - Request to Unload Product . . . . H→E

Structure S4F95

```
<L[4]
    <A[16] PPID>          Process Program ID
    <A[16] MID>           Material ID
    <U1 QUA>              Quantity
    <U1 PTN>              Port #
>.
```

Comment This message is a GSD-HE custom message for its material movement protocol. When the Host wishes to unload material from the GSD-HE, it can send this message to start that process. Descriptions of the data types PPID, MID, QUA, and PTN can be found in Table 16-11 below.

Table 16-11. Stream 4 Data Items

Data Item	Description
PPID	This <A [16]> data item contains the name of the process program associated with the material in process.
MID	<A [16]>, Material Identification Number.
QUA	<U 1> Quantity of wafers
PTN	<U 1> Port Number.

S5F1 - Alarm Report. . . . . H←E

Description

Structure S5F1 W

<L[3]
<B[1] ALCD> Alarm On/Off and Severity
<U4 ALID> Alarm ID
<A[40] ALTX> Alarm Text
>.

Comment This message is the “normal” message that the Equipment uses to report alarms. In order for this message to be used, the Equipment Constant ConfigAlarms” must be set to “0”.

The Equipment reports that an alarm condition has changed.

ALID identifies the Alarm.

The high-order bit of ALCD is “1” if this alarm is currently On (Unsafe), or “0” if it is currently Off (Safe). The low-order seven bits of ALCD contain the severity code for this alarm.

ALTX contains up to 40 bytes of Alarm Text.

Equipment Constant “WBitS5” controls whether the Equipment sends S5F1 with W-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S5F2 - Alarm Acknowledge . . . . H→E

Description

Structure S5F2

<B[1] 00>. ACKC5 - Alarm acknowledge

Comment The Host acknowledges the Alarm Report. This Equipment ignores the ACKC5.

S5F3 - Enable/Disable Alarm Send . . . . H→E

Description

Structure S5F3 W

<L[2]

<B[1] ALED> Alarm Enable/Disable Code

<U4 ALID> Alarm ID

>.

Comment The Host commands the Equipment to enable or disable (depending on ALED) reporting for the specified Alarm ID in S5F1, S5F8, S5F71, and S5F73.

Table 16-12. Enable/Disable Alarm Send

ALED	Description
0x80	Enable sending alarm.
0x00	Disable sending alarm.

The following special format can be used to enable or disable all ALIDs.

S5F3 [W] * H→E

<L [2]

<B [1] ALED> * Alarm Enable/Disable Code

U4> * Alarm ID

>.

The Host may optionally set the W-Bit to “1” in S5F3. If so, the Equipment replies with S5F4.

S5F4 - Enable/Disable Alarm Acknowledge . . . . H←E

Description

Structure S5F4

<B [1] ACKC5>. Acknowledge Code

Comment

Table 16-13. Enable/Disable Alarm Acknowledge

ACKC5	Description
0x00	Normal. Everything Correct
0x01	Invalid ALID

S5F5 - List Alarms Request . . . . H→E

Description

Structure S5F5 W

<U4 $ALID_1$ $ALID_2$ ....>. Alarm ID Array

Comment The Host requests the Equipment to send the current status of the specified Alarm IDs.

S5F6 - List Alarm Data . . . . M,H←E

Description

Structure S5F6

<L[n]	
<L [3]	
<B [1] >	ALCD - Alarm On/Off and Severity
<U4 $ALID_1$>	Alarm ID
<A [40] $ALTX_1$>	ALTX - Alarm Text
>	
...	
<L [3]	
<B [1] >	ALCD - Alarm On/Off and Severity
<U4 $ALID_n$>	Alarm ID
<A [40] $ALTX_n$>	ALTX - Alarm Text
>	
>.	

Comment The high-order bit of ALCD is “1” if this alarm is currently On (Unsafe), or “0” if it is currently Off (Safe). The low-order seven bits of ALCD contain the severity code for this alarm.

For any invalid ALID specified in S5F5, the corresponding entry in S5F6 has the following special error format:

<L [3]	
<B>	ALCD - alarm On/Off and Severity
<U4 ALID>	Alarm ID
<A>	ALTX - Alarm Text
>	

If S5F5 specified all alarms, S5F6 reports alarms in order by alarm ID.

S5F7 - List Enabled Alarms Request. . . . . H→E

Description

Structure S5F7 W

Header only

Comment The Host requests the Equipment to send the current status of all Alarm IDs which are currently enabled (See S5F3).

S5F8 - List Enabled Alarm Data . . . . M,H←E

Description

Structure S5F8

<L[n]
<L [3]
<B [1] ALCD$_1$> Alarm On/Off and Severity Code
<U4 ALID$_1$> Alarm ID
<A [40] ALTX$_1$>* Alarm Text
>
...
<L [3]
<B [1] ALCD$_n$> Alarm On/Off and Severity Code
<U4 ALID$_n$> Alarm ID
<A [40] ALTX$_n$>* Alarm Text
>
>.

Comment The high-order bit of ALCD is “1” if this alarm is currently On (Unsafe), or “0” if it is currently Off (Safe). The low-order seven bits of ALCD contain the severity code for this alarm.

S5F8 contains only those ALIDs which are currently enabled for reporting (See S5F3).

S5F8 reports alarms in order by alarm ID.

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S5F71 - Alarm Report Block Send . . . . H←E

Description

Structure S5F71 W

```
<L [2]
    <U1 0>                              ALPY Alarm Priority
    <L [1]
        <L [4]
            <U4 ALID>                   Alarm ID
            <BOOLEAN ASTAT>             T = Alarm On
                                          F = Alarm Off
            <U4 ASER>                   Alarm Serial Number
            <A [16] 'YYYYMMDDhhmmsscc'  CLOCK
        >
    >
>.
```

Comment Note: This message is provided only for compatibility with Host computers which support an older version of GEM.

The GSD-HE reports that an alarm condition has changed.

ALID identifies the Alarm.

ASTAT value is “True” (Non-zero) if this alarm is currently On (Unsafe), or “False” (Zero) if it is currently Off (Safe).

ASER (Alarm Serial Number) is assigned by the Equipment. Its value begins at “1” and is incriminated by 1 for each alarm reported.

ALPY (Alarm Priority) is always zero.

CLOCK indicates the date and time of the alarm change. Note that the time format can be 12-character or 16-character; see the S2F31 or S2F18 descriptions for more on time formats.

Equipment Constant “Wbits5” controls whether the Equipment sends S5F71 with S-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S5F72 - Alarm Report Block Acknowledge . . . . H→E

Structure S5F73 W

```
<L[0]>.
```

Comment The Host acknowledges Alarm Report. This Equipment ignores the data portion of S5F72.

S5F73 - Alarm Report Block Acknowledge. . . . . H←E

Structure	S5F73 W	
	<L [3]	
	<U4 ALID>	Alarm ID
	<BOOLEAN ASTAT>	T = Alarm On, F = Alarm Off.
	<A [16] 'YYYYMMDDhhmmsscc'>	TIMESTAMP
	>.	

Comment

Note: This message is provided only for compatibility with older Host computers which support GEM 3.1.

The Equipment reports that an alarm condition has changed.

ALID identifies the Alarm.

ASTAT value is “True” (Non-zero) if this alarm is currently On (Unsafe), or “False) (Zero) if it is currently Off (Safe).

TIMESTAMP indicates the date and time of the alarm change. Note that the time format can be 12-character or 16-character; see the S2F31 or S2F18 descriptions for more on time formats.

Equipment Constant “WBitS5” controls whether the Equipment sends S5F73 with W-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S5F74 - Alarm Notification Acknowledge . . . . H→E

Structure S5F74

<B[1] ACKC5>.

Comment The Host acknowledges Alarm Report. This Equipment ignores ACKC5.

S6F1 - Trace Data Send (TDS). . . . . S,H←E,reply

Description: This function sends samples to the Host according to the trace setup done by S2F23. Trace is a time-driven form of Equipment status.

Structure: S6F1 W

```
<L [4]
    <U4 TRID>              Trace ID
    <U4 SMPLN>             Sample Number
    <A 'yymmddhhmmss'>     STIME - Sample Date and Time
    <L[n]
        <V1>               Variable Value
        ...
        <Vn>               Variable Value
    >
>.
```

Comment: The Equipment sends time driven trace data, as previously requested by the Host using S2F23.

TRID is the Trace ID as initiated by the Host.

SMPLN is the sample number. The first sample is “1”, the next “2”, and so on. If REPGSZ is greater than 1, SMPLN is the number of the last sample contained in this S6F1.

STIME is the date and time at which this sample was taken. If REPGSZ is greater than 1, STIME is the date and time of the last sample contained in this S6F1. Note that the time format can be 12-character or 16-character; see the S2F31 or S2F18 descriptions for more on time formats.

The V's appear in the same order they were specified in S2F23.

S6F1 is normally single block. However, if the Host erroneously initiates a multiblock trace using an incorrect S2F23, S6F1 may be multi-block. The Equipment never sends an Inquire/Grant message preceding S6F1.

Equipment Constant “WBitS6” controls whether the Equipment sends S6F1 with W-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S6F2 - Trace Data Acknowledge (TDA). . . . . .S,H→E

Description: Acknowledge S6F1 or indicate an error.

Structure: S6F2

```
<B[1] 00>.                         ACKC6
```

Comment: Host acknowledges the data. Equipment ignores ACKC6.

S6F3 - Discrete Variable Data Send (DVS) . . . . M,H←E,reply

Description

Any data report which is initiated by an event, such as the completion of a measurement, rather than passage of time, is called a **discrete variable.** Some equipments may have several possible events on which to send the data. S2F15 is used to select the desired reporting events. Reports requiring only one block of data may report directly to the Host with this message. If S6F3 is multi-block, it must be preceded by the S6F5/F6 Inquire/Grant transaction.

Structure

S6F3 W

```
<L[3]
    <U4 DATAID>
    <U4 CEID>                        Collection Event ID
    <L[n]
        <L[2]
            <U4 DSID1>               = RPTID ID
            <L[m]
                <L[2]
                    <U4 DSID1>       = RPTID ID
                    <V1>             Variable Value
                >
                ...
                <L[2]
                    <U4 DSIDm>       = RPTID ID
                    <Vm>             Variable Value
                >
            >
        >
        ...
        <L[2]
            <U4 DSIDn>               = RPTID ID
            <L[m]
                <L[2]
                    <U4 DSID1>       = RPTID ID
                    <V1>             Variable Value
                >
                ...
                <L[2]
                    <U4 DSIDm>       = RPTID ID
                    <Vm>             Variable Value
                >
            >
        >
    >
```

>.

Comment Note: This message is provided only for compatibility with older Host computers which do not support GEM.

If the Equipment Constant “ConfigEvents” is set to “0”, the Equipment sends S6F3 instead of the normal S6F13 Annotated Event Report.

A Collection Event has occurred at the Equipment. The Host has enabled event reporting for this CEID (see S2F37). The Host has set the Equipment constant RpType to “True” (Annotated report format desired). The GSD-HE sends one or more Event Reports which the Host has previously linked to that CEID (see S2F35). Each report contains specific Variables which the Host has previously defined for that Report (See S2F33).

The Equipment generates a value for DATAID to uniquely identify this Conversation. If S6F3 is multiblock, the Equipment first sends the S6F5/S6F6 Inquire/Grant transaction, and DATAID in S6F3 matches DATAID in S6F5.

If the CEID is enabled, but no Reports are linked to this CEID, S6F3 has the following special format:

```
S6F3 [W]                    H←E
    <L [3]
        <U4 DATAID>         DATAID
        <U4 CEID>           Collection Event ID
        <L[0]>
    >.
```

Equipment Constant “Wbits6” controls whether the Equipment sends S6F3 with W-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S6F4 - Discrete Variable Data Acknowledge (DVA) . . . . .S,H→E

Description Acknowledge S6F3 or indicate an error.

Structure S6F4

```
<B[1] 00>.                  ACKC6
```

Comment The Host acknowledges the event report. The Equipment ignores ACKC6.

S6F5 - Multi-Block Data Send Inquire (MBI) . . . . S,H←E,reply

Description If the discrete data report --S6F3, F9, F13-- can involve more than one block, it must be preceded by this transaction.

Structure S6F5 W

<L[2]

<U4 DATAID> DATAID

<U4 DATALENGTH>

>.

Comment The Equipment sends this Inquire/Grant transaction preceding any multiblock S6F3, S6F9, S6F11, or S6F13.

The DATAID specified here appears in the following S6F3, S6F9, S6F11, S6F13.

DATALENGTH value is the total number of text bytes (excluding SECS block headers) in the following S6F3, S6F9, S6F11, or S6F13 message.

S6F6 - Multi-Block Grant (MBG). . . . . S,H→E

Description Grant permission to send

Structure S6F6

<B[1] GRANT6>. GRANT6

Comment Host grants permission for the Equipment to send a multi-block event report.

Table 16-14. Multi-Block Grant

GRANT6	Description
0x0	Normal. Permission granted.
0x1	Busy, try again
0x2	Not interested
>0x2	Other errors
0x3-0x3F	Reserved

S6F7 - Data Transfer Request (DDR) . . . .(Eaton Custom)S,H→E,reply

Description Using this message, the Host may initiate a data transfer of specified data stored in the Equipment.

Structure S6F7 W

<U1 DATAID>.

Comment This function is used to support previous versions of SECS implemented on the Equipment. The DATAID must be set to 3.

S6F8 - Data Transfer Data (DDD) . . . . (Eaton Custom)S,H←E,reply

Description This function is used to support previous versions of SECS implemented on the GSD-HE. The data in this message is a copy of the last Implant in a fixed format.

Structure S6F8

```
<L [3]
    <U1 DATAID>                         DATAID is always 3
    <U1 CEID>                           CEID is always 2



        <L [2]
            <U1 DSID>                   DSID is always 4 for
                                          list.
            <L [9]
                <L [2]
                    <A [4]'Date'>
                    <A [9]'DD-MMM-YY'>
                >
                <L [2]
                    <A [4]'Time'>
                    <A [8]'HH:MM:SS'>
                >
                <L [2]
                    <A [8]'Batch ID'>
                    <A [16] Batch ID>
                >
                <L [2]
                    <A [10]'Wafer size'>
                    <A [16] Wafer size>
                >
                <L [2]
                    <A [14]'Estimated time'>
                    <A [8]'HH:MM:SS'>
                >
                <L [2]
                    <A [11]'Actual time'>
                    <A [8]'HH:MM:SS'>
                >
                <L [2]
                    <A [13]'Interruptions'>
                    <U2 Interruptions>
                >
```

```
            <L [2]
                <A [16]'Percent complete'>
                <F4 Percent complete>
            >
            <L [2]
                <A [9]'HYT Count'>
                <I4 Hyt count >
            >
        >
    >


    <L [2]
        <U1 DSID>                      DSID is always 5 for
                                          this list.
        <L [9]
            <L [2]
                <A [14]'Process recipe'>
                <A [16] Process recipe>
            >
            <L [2]
                <A [4]'Dose'>
                <F4 Dose>
            >
            <L [2]
                <A [11]'Trim Factor'>
                <F4 Trim Factor>
            >
            <L [2]
                <A [19]'B.L. Pressure Comp.'>
                <F4 B.L. Pressure Comp.>
            >
            <L [2]
                <A [19]'E.S. Pressure Comp.'>
                <F4 E.S. Pressure Comp.>
            >
            <L [2]
                <A [18]'Implant Start Prs.'>
                <F4 Implant Start Prs.>
            >
            <L [2]
                <A [17]'Implant Stop Prs.'>
                <F4 Implant Stop Prs.>
```

```
            >
            <L [2]
                <A [10]'Ion charge'>
                <I1 Ion charge>
            >
            <L [2]
                <A [11]'Beam Height'>
                <I4 Beam Height>
            >
        >
    >

    <L [2]
        <U1 DSID>                       DSID is always 6 for
                                          this list.
        <L [1]
            <L [2]
                <A [17]'Material Tracking'>
                <A [] Material Tracking>
            >
        >
    >


    <L [2]
        <U1 DSID>                       DSID is always 7 for
                                          this list.
        <L [136]
```

This is the first implant quarter. (DSID=7)
The L[136] list extends over approximately
10 pages.

```
            <L [2]
                <A [17]'Total energy avg.'>
                <F4 Total energy avg.>
            >
            <L [2]
                <A [8]'AMU avg.'>
                <F4 AMU avg.>
            >
            <L [2]
                <A [17]'Beam current avg.'>
                <F4 Beam current avg.>
            >
```

```
<L [2]
    <A [17]'Preset scans avg.'>
    <I2 Preset scans avg.>
>
<L [2]
    <A [16]'G1 Pressure avg.'>* Source Pressure
    <F4 G1 Pressure avg>
>
<L [2]
    <A [16]'G2 Pressure avg.'>*N/A to GSD-HE
    <F4 G2 Pressure avg.>
>
<L [2]
    <A [16]'G3 Pressure avg.'>* Beamline Pressure
    <F4 G3 Pressure avg.>
>
<L [2]
    <A [16]'G4 Pressure avg.'>* Chamber Pressure
    <F4 4 Pressure avg.>
>

<L [2]
    <A [16]'Arc Current avg.'>
    <F4 Arc Current avg.>
>
<L [2]
    <A [16]'Arc Voltage avg.'>
    <F4 Arc Voltage avg.>
>
<L [2]
    <A [21]'Filament Current avg.'>
    <F4 Filament Current avg.>
>
<L [2]
    <A [21]'Filament Voltage avg.'>
    <F4 Filament Voltage avg.>
>
<L [2]
    <A [23]'Extraction Current avg.'>
    <F4 Extraction Current avg.>
>
<L [2]
    <A [23]'Extraction Voltage avg.'>
```

```
    <F4 Extraction Voltage avg.>
>
<L [2]
    <A [21]'Vap #1 Oven Temp avg.'>
    <F4 Vap #1 Oven Temp avg.>
>
<L [2]
    <A [23]'Vap #1 Heater Temp avg.'>
    <F4 Vap #1 Heater Temp avg.>
>
<L [2]
    <A [21]'Vap #2 Oven Temp avg.'>
    <F4 Vap #2 Oven Temp avg.>
>
<L [2]
    <A [23]'Vap #2 Heater Temp avg.'>
    <F4 Vap #2 Heater Temp avg.>
>
<L [2]
    <A [21]'Gas Leak Valve 1 avg.'>
    <F4 Gas Leak Valve 1 avg.'>
>
<L [2]
    <A [21]'Gas Leak Valve 2 avg.'>
    <F4 Gas Leak Valve 2 avg.>
>
<L [2]
    <A [21]'Gas Leak Valve 3 avg.'>
    <F4 Gas Leak Valve 3 avg.>
>
<L [2]
    <A [21]'Gas Leak Valve 4 avg.'>
    <F4 Gas Leak Valve 4 avg.>
>
<L [2]
    <A [16]'Extr Axis 1 avg.'>
    <F4 Extr Axis 1 avg.>
>
<L [2]
    <A [16]'Extr Axis 2 avg.'>
    <F4 Extr Axis 2 avg.>
>
<L [2]
```

```
    <A [16]'Extr Axis 3 avg.'>
    <F4 Extr Axis 3 avg>
 >
<L [2]
    <A [20]'Extr Suppress I avg.'>
    <F4 Extr Suppress I avg.>
>
<L [2]
    <A [20]'Extr Suppress V avg.'>
    <F4 Extr Suppress V avg.>
>
<L [2]
    <A [20]'Source Magnet I avg.'>
    <F4 Source Magnet I avg.>
>
<L [2]
    <A [22]'Analyzer Magnet I avg.'>
    <F4 Analyzer Magnet I avg.>
>
<L [2]
    <A [23]'Post Accel Current avg.'>
    <F4 Post Accel Current avg.>
>
<L [2]
    <A [23]'Post Accel Voltage avg.'>
    <F4 Post Accel Voltage avg.>
>
<L [2]
    <A [22]'Post Accel Axis 3 avg.'>
    <F4 Post Accel Axis 3 avg.>
>
<L [2]
    <A [23]'Post Accel Suppr I avg.'>
    <F4 Post Accel Suppr I avg.>
>
<L [2]
    <A [23]'Post Accel Suppr V avg.'>
    <F4 Post Accel Suppr V avg.>
>
<L [2]
    <A [17]'ES Primary I avg.'>
    <F4 ES Primary I avg.>
>
```

```
<L [2]
    <A [19]'ES Secondary I avg.'>
    <F4 ES Secondary I avg.>
>
<L [2]
    <A [14]'ES Disk I avg.'>
    <F4 ES Disk I avg.>
>
<L [2]
    <A [14]'ES Bias V avg.'>
    <F4 ES Bias V avg.>
>
<L [2]
    <A [15]'ES MFC Gas avg.'>
    <F4 ES MFC Gas avg.>
>
<L [2]
    <A [23]'ES Charge POS Peek avg.'>
    <F4 ES Charge POS Peek avg.>
>
<L [2]
    <A [23]'ES Charge NEG Peek avg.'>
    <F4 ES Charge NEG Peek avg.>
>
<L [2]
    <A [17]'Ext Gap Axis avg.'>
    <F4 Ext Gap Axis avg.>
>
<L [2]
    <A [18]'Extr Supp I 2 avg.'>
    <F4 Extr Supp I 2 avg.>
>
<L [2]
    <A [18]'Extr Supp V 2 avg.'>
    <F4 Extr Supp V 2 avg.>
>
<L [2]
    <A [25]'Beamguide Gas On/Off avg.'>
    <BOOLEAN Beamguide Gas On/Off avg.>
>
<L [2]
    <A [25]'Magnetic Quad On/Off avg.'>
    <BOOLEAN Magnetic Quad On/Off avg.>
```

```
>
<L [2]
     <A [16]'Exit Quad I avg.'>
     <F4 Exit Quad I avg.>
>
<L [2]
     <A [15]'Gas #1 MFC avg.'>
     <F4 Gas #1 MFC avg.>
>
<L [2]
     <A [15]'Gas #2 MFC avg.'>
     <F4 Gas #2 MFC avg.>
>
<L [2]
     <A [15]'Gas #3 MFC avg.'>
     <F4 Gas #3 MFC avg.>
>
<L [2]
     <A [15]'Gas #4 MFC avg.'>
     <F4 Gas #4 MFC avg>
>
<L [2]
     <A [19]'Tilt Angle Deg avg.'>
     <F4 >Tilt Angle Deg avg.
>
<L [2]
     <A [20]'Twist Angle Deg avg.'>
     <F4 Twist Angle Deg avg.>
>
<L [2]
     <A [20]'Ihc Arc Voltage avg.'>
     <F4 Ihc Arc Voltage avg>
>
<L [2]
     <A [25]'Ihc Filament Current avg.'>
     <F4 Ihc Filament Current avg>
>
<L [2]
     <A [24]'Ihc Cathode Voltage avg.'>
     <F4 Ihc Cathode Voltage avg>
>
<L [2]
     <A [24]'Ihc Cathode Current avg.'>
```

```
    <F4 Ihc Cathode Current avg>
>
<L [2]
    <A [25]'E-Stat Quad Pos Volt avg.'>
    <F4 E-Stat Quad Pos Volt avg>
>
<L [2]
    <A [25]'E-Stat Quad Neg Volt avg.'>
    <F4 E-Stat Quad Neg Volt avg>
>
<L [2]
    <A [25]'E-Stat Quad Pos Curr avg.'>
    <F4 E-Stat Quad Pos Curr avg>
>
<L [2]
    <A [25]'E-Stat Quad Neg Curr avg.'>
    <F4 E-Stat Quad Neg Curr avg>
>
<L [2]
    <A [19]'Fem Hall Probe avg.'>
    <F4 Fem Hall Probe avg>
>
<L [2]
    <A [22]'Fem Mag 1 Current avg.'>
    <F4 Fem Mag 1 Current avg>
>
<L [2]
    <A [22]'Fem Mag 2 Current avg.'>
    <F4 Fem Mag 2 Current avg>
>
<L [2]
    <A [14]'Spare #12 avg.'>
    <BOOLEAN Spare #12 avg.>
>
<L [2]
    <A [14]'Estimated Time'>
    <I2 Estimated Time'>
>
<L [2]
    <A [11]'Actual Time'>
    <I2 Actual Time>
>
<L [2]
```

```
    <A [12]’Interruption’>
    <I2 Interruption>
>
<L [2]
    <A [21]’Total energy std.dev.’>
    <F4 Total energy std.dev.>
>
<L [2]
    <A [12]’AMU std.dev.’>
    <F4 AMU std.dev.>
>
<L [2]
    <A [21]’Beam current std.dev.’>
    <F4 Beam current std.dev.>
>
<L [2]
    <A [21]’Preset scans std.dev.’>
    <I2 Preset scans std.dev.>
>
<L [2]
    <A [20]’G1 Pressure std.dev.’>* Source Pressure
    <F4 G1 Pressure std.dev>
>
<L [2]
    <A [20]’G2 Pressure std.dev.’> *N/A to GSD-HE
    <F4 G2 Pressure std.dev.>
>
<L [2]
    <A [20]’G3 Pressure std.dev.’>* Beamline Pressure
    <F4 G3 Pressure std.dev.>
>

<L [2]
    <A [20]’G4 Pressure std.dev.’>* Chamber Pressure
    <F4 4 Pressure std.dev.>
>
<L [2]
    <A [20]’Arc Current std.dev.’>
    <F4 Arc Current std.dev.>
>
<L [2]
```

```
    <A [20]’Arc Voltage std.dev.’>
    <F4 Arc Voltage std.dev.>
>
<L [2]
    <A [25]’Filament Current std.dev.’>
    <F4 Filament Current std.dev.>
>
<L [2]
    <A [25]’Filament Voltage std.dev.’>
    <F4 Filament Voltage std.dev.>
>
<L [2]
    <A [27]’Extraction Current std.dev.’>
    <F4 Extraction Current std.dev.>
>
<L [2]
    <A [27]’Extraction Voltage std.dev.’>
    <F4 Extraction Voltage std.dev.>
>
<L [2]
    <A [25]’Vap #1 Oven Temp std.dev.’>
    <F4 Vap #1 Oven Temp std.dev.>
>
<L [2]
    <A [27]’Vap #1 Heater Temp std.dev.’>
    <F4 Vap #1 Heater Temp std.dev.>
>
<L [2]
    <A [25]’Vap #2 Oven Temp std.dev.’>
    <F4 Vap #2 Oven Temp std.dev.>
>
<L [2]
    <A [27]’Vap #2 Heater Temp std.dev.’>
    <F4 Vap #2 Heater Temp std.dev.>
>
<L [2]
    <A [25]’Gas Leak Valve 1 std.dev.’>
    <F4 Gas Leak Valve 1 std.dev.’>
>
<L [2]
    <A [25]’Gas Leak Valve 2 std.dev.’>
    <F4 Gas Leak Valve 2 std.dev.>
>
```

```
<L [2]
    <A [25]’Gas Leak Valve 3 std.dev.’>
    <F4 Gas Leak Valve 3 std.dev.>
>
<L [2]
    <A [25]’Gas Leak Valve 4 std.dev.’>
    <F4 Gas Leak Valve 4 std.dev.>
>
<L [2]
    <A [20]’Extr Axis 1 std.dev.’>
    <F4 Extr Axis 1 std.dev.>
>
<L [2]
    <A [20]’Extr Axis 2 std.dev.’>
    <F4 Extr Axis 2 std.dev.>
>
<L [2]
    <A [20]’Extr Axis 3 std.dev.’>
    <F4 Extr Axis 3 std.dev>
 >
<L [2]
    <A [24]’Extr Suppress I std.dev.’>
    <F4 Extr Suppress I std.dev.>
>
<L [2]
    <A [24]’Extr Suppress V std.dev.’>
    <F4 Extr Suppress V std.dev.>
>
<L [2]
    <A [24]’Source Magnet I std.dev.’>
    <F4 Source Magnet I std.dev.>
>
<L [2]
    <A [26]’Analyzer Magnet I std.dev.’>
    <F4 Analyzer Magnet I std.dev.>
>
<L [2]
    <A [27]’Post Accel Current std.dev.’>
    <F4 Post Accel Current std.dev.>
>
<L [2]
    <A [27]’Post Accel Voltage std.dev.’>
    <F4 Post Accel Voltage std.dev.>
```

```
>
<L [2]
    <A [26]'Post Accel Axis 3 std.dev.'>
    <F4 Post Accel Axis 3 std.dev.>
>
<L [2]
    <A [27]'Post Accel Suppr I std.dev.'>
    <F4 Post Accel Suppr I std.dev.>
>
<L [2]
    <A [27]'Post Accel Suppr V std.dev.'>
    <F4 Post Accel Suppr V std.dev.>
>
<L [2]
    <A [21]'ES Primary I std.dev.'>
    <F4 ES Primary I std.dev.>
>
<L [2]
    <A [23]'ES Secondary I std.dev.'>
    <F4 ES Secondary I std.dev.>
>
<L [2]
    <A [18]'ES Disk I std.dev.'>
    <F4 ES Disk I std.dev.>
>
<L [2]
    <A [18]'ES Bias V std.dev.'>
    <F4 ES Bias V std.dev.>
>
<L [2]
    <A [19]'ES MFC Gas std.dev.'>
    <F4 ES MFC Gas std.dev.>
>
<L [2]
    <A [27]'ES Charge POS Peek std.dev.'>
    <F4 ES Charge POS Peek std.dev.>
>
<L [2]
    <A [27]'ES Charge NEG Peek std.dev.'>
    <F4 ES Charge NEG Peek std.dev.>
>
<L [2]
    <A [21]'Ext Gap Axis std.dev.'>
```

```
    <F4 Ext Gap Axis std.dev.>
>
<L [2]
    <A [22]'Extr Supp I 2 std.dev.'>
    <F4 Extr Supp I 2 std.dev.>
>
<L [2]
    <A [22]'Extr Supp V 2 std.dev.'>
    <F4 Extr Supp V 2 std.dev.>
>
<L [2]
    <A [29]'Beamguide Gas On/Off std.dev.'>
    <BOOLEAN Beamguide Gas On/Off std.dev.>
>
<L [2]
    <A [29]'Magnetic Quad On/Off std.dev.'>
    <BOOLEAN Magnetic Quad On/Off std.dev.>
>
<L [2]
    <A [20]'Exit Quad I std.dev.'>
    <F4 Exit Quad I std.dev.>
>
<L [2]
    <A [19]'Gas #1 MFC std.dev.'>
    <F4 Gas #1 MFC std.dev.>
>
<L [2]
    <A [19]'Gas #2 MFC std.dev.'>
    <F4 Gas #2 MFC std.dev.>
>
<L [2]
    <A [19]'Gas #3 MFC std.dev.'>
    <F4 Gas #3 MFC std.dev.>
>
<L [2]
    <A [19]'Gas #4 MFC std.dev.'>
    <F4 Gas #4 MFC std.dev>
>
<L [2]
    <A [23]'Tilt Angle Deg std.dev.'>
    <F4 >Tilt Angle Deg std.dev.
>
<L [2]
```

```
    <A [24]'Twist Angle Deg std.dev.'>
    <F4 Twist Angle Deg std.dev.>
>
<L [2]
    <A [24]'Ihc Arc Voltage std.dev.'>
    <F4 Ihc Arc Voltage std.dev.>
>
<L [2]
    <A [29]'Ihc Filament Current std.dev.'>
    <F4 Ihc Filament Current std.dev.>
>
<L [2]
    <A [28]'Ihc Cathode Voltage std.dev.'>
    <F4 Ihc Cathode Voltage std.dev.>
>
<L [2]
    <A [28]'Ihc Cathode Current std.dev.'>
    <F4 Ihc Cathode Current std.dev.>
>
<L [2]
    <A [29]'E-Stat Quad Pos Volt std.dev.'>
    <F4 E-Stat Quad Pos Volt std.dev.>
>
<L [2]
    <A [29]'E-Stat Quad Neg Volt std.dev.'>
    <F4 E-Stat Quad Neg Volt std.dev.>
>
<L [2]
    <A [29]'E-Stat Quad Pos Curr std.dev.'>
    <F4 E-Stat Quad Pos Curr std.dev.>
>
<L [2]
    <A [29]'E-Stat Quad Neg Curr std.dev.'>
    <F4 E-Stat Quad Neg Curr std.dev.>
>
<L [2]
    <A [23]'Fem Hall Probe std.dev.'>
    <F4 Fem Hall Probe std.dev.>
>
<L [2]
    <A [26]'Fem Mag 1 Current std.dev.'>
    <F4 Fem Mag 1 Current std.dev.>
>
```

```
        <L [2]
            <A [26]'Fem Mag 2 Current std.dev.'>
            <F4 Fem Mag 2 Current std.dev. >
        >
        <L [2]
            <A [18]'Spare #12 std.dev.'>
            <BOOLEAN Spare #12 std.dev.>
        >
        <L [2]
            <A [18]'Estimated Time'>
            <I2 Estimated Time'>
        >
        <L [2]
            <A [15]'Actual Time'>
            <I2 Actual Time>
        >
        <L [2]
            <A [16]'Interruption'>
            <I2 Interruption>
        >
    >                       End of L[136] list.
>

<L [2]
    <U1 DSID>                         DSID is always 8 for
                                        this list.
    <L [136]
```

This is the second implant quarter. (DSID=8)
The L[136] list is exactly the same as the
L[136] list for the first quarter (DSID=7)

```
        ●
        ●
        ●
    >
>


<L [2]
    <U1 DSID>                         DSID is always 9 for
                                        this list.
    <L [136]
```

This is the third implant quarter. (DSID=9) The L[136] list is exactly the same as the previous two L[136] lists.

●
●
●

>

>

<L [2]

<U1 DSID> DSID is always 10 for this list.

<L [136]

This is the fourth implant quarter. (DSID=10) The L[136] list is exactly the same as the previous three L[136] lists.

●
●
●

>

>

>

>. End of message

Comment All Values that are set to a Negative One (-1) are items that are not configured for this type of machine. There are no Standard Deviation for items such as Spares, Estimated Time, and Actual Time. For all BOOLEAN values TRUE is OUT and FALSE is IN.

The DATAID for this message will always be a 3 (Implant Data Log).

The CEID for this message will always be a 2 (End of Implant).

Table 16-15. DSID Table for S6F8

DSID	Description
0x4	Implant Summary
0x5	Process Summary
0x6	Material Summary
0x7	Implant Data Quarter 1
0x8	Implant Data Quarter 2
0x9	Implant Data Quarter 3
0xA	Implant Data Quarter 4

Exception A zero-length item returned means the requested data cannot be sent.

S6F9 - Formatted Variable Send (FVS) . . . . M,H←E,reply

Description The same function as S6F3 except that the DVNAMEs are supplied from a predefined form that is known to the Host. Thus, the data are more compact. If S6F9 is multi-block, it must be preceded by the S6F5/F6 Inquire/Grant transaction.

Structure S6F9 W

```
<L[4]
    <PFCD>
    <DATAID>
    <CEID>
    <L[n]
        <L[2]
            <DSID1>
            L[m]
                <DVVAL1>
                ...
                <DVVALm>
            >
        >
        ...
        <L[2]
            <DSIDn>
            L[m]
                <DVVAL1>
                ...
                <DVVALm>
            >
        >
    >
>.
```

Comment Note: This message is provided only for compatibility with older Host computers which do not support GEM.

A Collection Event has occurred at the Equipment. The Host has enabled event reporting for this CEID (see S2F37). The Host has set the Equipment Constant RpType to “False” (normal report format desired). The Equipment sends one or more Event Reports which the Host has previously linked to that CEID (see S2F35). Each report contains specific Variables which the Host has previously defined for that Report (see S2F33).

PCFD is always zero.

The Equipment generates a value for DATAID to uniquely identify this Conversation. If S6F9 is multiblock, the Equipment first sends the S6F5/S6F6 Inquire/Grant transaction, and the DATAID in S6F9 matches

DATAID in S6F5.

If the CEID is enabled, but no Reports are linked to this CEID, S6F9 has the following special format:

```
S6F9 [W]                 H←E
  <L [4]
    <B [1] 00>           PFCD
    <U4 DATAID>          DATAID
    <U4 CEID>            Collection Event ID
    <L[0]>
    >.
```

Equipment Constant “WBitS6” controls whether the Equipment sends S6F9 with W-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S6F9 - Event Report (ASCII) . . . . (Eaton Custom) . . . . H←E

Description This function is used to support previous versions of SECS implemented on the Equipment. The data in this message is a copy of the last Implant in an ASCII format. This message is activated only when the configuration point "SECS IDL File Format" is set to either ASCII File or to ASCII AND BINARY.

Structure S6F9

```
<L[4]
    <B PFCD>                              Always 3 (ASCII File)
    <U1 DATAID>                           Always 3 (Implant Data
                                              Log)
    <U1 CEID)                             Always 2
    <L[1]
        <L[2]
            <U1 DSID>                     Always 3 (Entire implant
                                              data log)
            <L[1]
                <A[] ASCII Implant Data Log>
            >
        >
    >
>.
```

Comment Note: The length of the ASCII implant data log can be two bytes long.

Semiconductor Equipment

S6F9 - Event Report (Formatted Data Values) . . . .(Eaton Custom) . . . . H←E

Description

This function is used to support previous versions of SECS implemented on the Equipment. The data in this message is a copy of the last implant in Formatted Data Values. This message is activated only when the configuration point "SECS IDL File format" is set to either BINARY File or ASCII-and-BINARY.

Structure

S6F9

```
<L [4]
    <B PFCD>            PFCD always 4 (Binary File)
    <U1 DATAID>         DATAID is always 3 at this point
                                    (Implant Data Log)
    <U1 CEID>           CEID is always 2 at this point
    <L [7]

        <L [2]
            <U1 DSID>       DSID is always 4 for this list
                                    (Implant Summary)
            <L [9]
                <A [9] Date -'DD-MMM-YY'>
                <A [8] Time -'HH:MM:SS'>
                <A [16] Batch ID>
                <A [16] Wafer size>
                <A [8] Estimated time -'HH:MM:SS'>
                <A [8] Actual time -'HH:MM:SS'>
                <U2 Interruptions>
                <F4 Percent complete>
                <I4 Hyt count >
            >
        >

        <L [2]
            <U1 DSID>               DSID is always 5 for this list
            <L [9]
                <A [16] Process recipe>
                <F4 Dose>
                <F4 Trim Factor>
                <F4 B.L. Pressure Comp.>
                <F4 E.S. Pressure Comp.>
                <F4 Implant Start Prs.>
                <F4 Implant Stop Prs.>
                <I1 Ion charge>
                <I4 Beam Height>
            >
```

>

<L [2]
<U1 DSID> DSID is always 6 for this list
<L [1]
<A [] Material Tracking>
>
>
<L [2]
<U1 DSID> DSID is always 7 for this list.
<L [136]

This is the first quarter (DSID=7) implant.
The L[136] list extends over 3 pages.

<F4 Total energy avg.>
<F4 AMU avg.>
<F4 Beam current avg.>
<I2 Preset scans avg.>
<F4 G1 Pressure avg>* Source Pressure
<F4 G2 Pressure avg.>* N/A to GSD-HE
<F4 G3 Pressure avg.>* Beamline Pressure
<F4 4 Pressure avg.>* Chamber Pressure
<F4 Arc Current avg.>
<F4 Arc Voltage avg.>
<F4 Filament Current avg.>
<F4 Filament Voltage avg.>
<F4 Extraction Current avg.>
<F4 Extraction Voltage avg.>
<F4 Vap #1 Oven Temp avg.>
<F4 Vap #1 Heater Temp avg.>
<F4 Vap #2 Oven Temp avg.>
<F4 Vap #2 Heater Temp avg.>
<F4 Gas Leak Valve 1 avg.’>
<F4 Gas Leak Valve 2 avg.>
<F4 Gas Leak Valve 3 avg.>
<F4 Gas Leak Valve 4 avg.>
<F4 Extr Axis 1 avg.>
<F4 Extr Axis 2 avg.>
<F4 Extr Axis 3 avg>
<F4 Extr Suppress I avg.>
<F4 Extr Suppress V avg.>
<F4 Source Magnet I avg.>

<F4 Analyzer Magnet I avg.>
<F4 Post Accel Current avg.>
<F4 Post Accel Voltage avg.>
<F4 Post Accel Axis 3 avg.>
<F4 Post Accel Suppr I avg.>
<F4 Post Accel Suppr V avg.>
<F4 ES Primary I avg.>
<F4 ES Secondary I avg.>
<F4 ES Disk I avg.>
<F4 ES Bias V avg.>
<F4 ES MFC Gas avg.>
<F4 ES Charge POS Peek avg.>
<F4 ES Charge NEG Peek avg.>
<F4 Ext Gap Axis avg.>
<F4 Extr Supp I 2 avg.>
<F4 Extr Supp V 2 avg.>
<BOOLEAN Beamguide Gas On/Off avg.>
<BOOLEAN Magnetic Quad On/Off avg.>
<F4 Exit Quad I avg.>
<F4 Gas #1 MFC avg.>
<F4 Gas #2 MFC avg.>
<F4 Gas #3 MFC avg.>
<F4 Gas #4 MFC avg>
<F4 >Tilt Angle Deg avg.
<F4 Twist Angle Deg avg.>
<F4 Ihc Arc Voltage avg.>
<F4 Ihc Filament Current avg.>
<F4 Ihc Cathode Voltage avg.>
<F4 Ihc Cathode Current avg.>
<F4 E-Stat Quad Pos Volt avg.>
<F4 E-Stat Quad Neg Volt avg.>
<F4 E-Stat Quad Pos Curr avg.>
<F4 E-Stat Quad Neg Curr avg.>
<F4 Fem Hall Probe avg.>
<F4 Fem Mag 1 Current avg.>
<F4 Fem Mag 2 Current avg.>
<BOOLEAN Spare #12 avg.>
<I2 Estimated Time'>
<I2 Actual Time>
<I2 Interruption>
<F4 Total energy std.dev.>
<F4 AMU std.dev.>
<F4 Beam current std.dev.>

<I2 Preset scans std.dev.>
<F4 G1 Pressure std.dev>
<F4 G2 Pressure std.dev.>
<F4 G3 Pressure std.dev.>
<F4 4 Pressure std.dev.>
<F4 Arc Current std.dev.>
<F4 Arc Voltage std.dev.>
<F4 Filament Current std.dev.>
<F4 Filament Voltage std.dev.>
<F4 Extraction Current std.dev.>
<F4 Extraction Voltage std.dev.>
<F4 Vap #1 Oven Temp std.dev.>
<F4 Vap #1 Heater Temp std.dev.>
<F4 Vap #2 Oven Temp std.dev.>
<F4 Vap #2 Heater Temp std.dev.>
<F4 Gas Leak Valve 1 std.dev.’>
<F4 Gas Leak Valve 2 std.dev.>
<F4 Gas Leak Valve 3 std.dev.>
<F4 Gas Leak Valve 4 std.dev.>
<F4 Extr Axis 1 std.dev.>
<F4 Extr Axis 2 std.dev.>
<F4 Extr Axis 3 std.dev>
<F4 Extr Suppress I std.dev.>
<F4 Extr Suppress V std.dev.>
<F4 Source Magnet I std.dev.>
<F4 Analyzer Magnet I std.dev.>
<F4 Post Accel Current std.dev.>
<F4 Post Accel Voltage std.dev.>
<F4 Post Accel Axis 3 std.dev.>
<F4 Post Accel Suppr I std.dev.>
<F4 Post Accel Suppr V std.dev.>
<F4 ES Primary I std.dev.>
<F4 ES Secondary I std.dev.>
<F4 ES Disk I std.dev.>
<F4 ES Bias V std.dev.>
<F4 ES MFC Gas std.dev.>
<F4 ES Charge POS Peek std.dev.>
<F4 ES Charge NEG Peek std.dev.>
<F4 Ext Gap Axis std.dev.>
<F4 Extr Supp I 2 std.dev.>
<F4 Extr Supp V 2 std.dev.>
<BOOLEAN Beamguide Gas On/Off std.dev.>
<BOOLEAN Magnetic Quad On/Off std.dev.>

<F4 Exit Quad I std.dev.>
<F4 Gas #1 MFC std.dev.>
<F4 Gas #2 MFC std.dev.>
<F4 Gas #3 MFC std.dev.>
<F4 Gas #4 MFC std.dev>
<F4 >Tilt Angle Deg std.dev.
<F4 Twist Angle Deg std.dev.>
<F4 Ihc Arc Voltage std.dev.>
<F4 Ihc Filament Current std.dev.>
<F4 Ihc Cathode Voltage std.dev.>
<F4 Ihc Cathode Current std.dev.>
<F4 E-Stat Quad Pos Volt std.dev.>
<F4 E-Stat Quad Neg Volt std.dev.>
<F4 E-Stat Quad Pos Curr std.dev.>
<F4 E-Stat Quad Neg Curr std.dev.>
<F4 Fem Hall Probe std.dev.>
<F4 Fem Mag 1 Current std.dev.>
<F4 Fem Mag 2 Current std.dev. >
<BOOLEAN Spare #12 std.dev.>
<I2 Estimated Time'>
<I2 Actual Time>
<I2 Interruption>
> End of L[136] list
> End of L[2] list

<L [2]
<U1 DSID> DSID is always 8 for this list.
<L [136]
●

This is the second implant quarter (DSID=8). The L[136] list is exactly the same as the L[136] list for the first quarter (DSID=7).

●
●
>
>

<L [2]
<U1 DSID> DSID is always 9 for this list
<L [136]

This is the third implant quarter (DSID=9). The L[136] list is exactly the same as the previous two L[136] lists.

●
●
●

>

>

<L [2]

<U1 DSID> DSID is always 10 for this list.

<L [136]

This is the fourth implant quarter (DSID=10). The L[136] list is exactly the same as the three previous L[136] lists.

●
●
●

>

> Close L[2] list

> Close L[7] list

>. Completion of message

All Values that are set to a Negative One (-1) are items that are not configured for this type of machine. There are no Standard Deviation for items such as Spares, Estimated Time, and Actual Time. For all BOOLEAN values TRUE is OUT and FALSE is IN.

The DATAID for this message is always a 3 (Implant Data Log).

The CEID for this message is always a 2 (End of Implant).

Table 16-16. DSID Table for S6F9

DSID	Description
4	Implant Summary
5	Process Summary
6	Material Summary
7	Implant Data Quarter 1
8	Implant Data Quarter 2
9	Implant Data Quarter 3
10	Implant Data Quarter 4

S6F9 - Event Report Cassette Table Log (CTL) - ASCII . . . . H←E

Description

A log of the cassettes at each table position for the time when processing is complete and the wafers are returned to the cassette. The data contained in the message is the material data and the wafer map summary. For each wafer in a cassette, the report includes: original slot position, final slot position, status.

This message is sent in ASCII format and is sent only when the configuration point
Secs CTL File Format has been set to either **ASCII** or
ASCII & BINARY.

Structure

```
S6F9
  <L[4]
    <B PFCD>                      PFCD 6 Cassette TableLog in
                                       ASCII format
    <U4 DATAID>                   DATAID always 4 (Cassette
                                       Table Log)
    <U4 CEID>                     CEID ALWAYS 123
    <L[1]
      <L[2]
        <U4 DSID>                 DSID always 20
        <A[ ] ASCII Table Log>
      >
    >
  >.
```

S6F9 - Event Report Cassette Table Log (CTL) - Binary . . . . H←E

Description A log of the cassettes at each table position for the time when processing is complete and the wafers are returned to the cassette. The data contained in the message is the material data and the wafer map summary. For each wafer in a cassette, the report includes: original slot position, final slot position, status.

This message is sent in Binary format and is sent only when the configuration point **Secs CTL File Format** has been set to either **ASCII** or **ASCII & BINARY.**

Possible states:

0 - empty
1 - raw
2 - partial
3 - implanted
4 - unknown

Structure S6F9

```
<L[4]
    <B PFCD>                PFCD 5 Cassette Table Log in binary
                                 format
    <U4 DATAID>             DATAID always 4 (Cassette Table Log)
    <U4 CEID>               CEID always 123
    <L[2]
        <U4 DSID>           DSID always 20
        <L[8]
            <A[ ] date>         16 chars max
            <A[ ] time>         16 chars max
            <A[ ] machine ID>   16 chars max
            <A[ ] material ID>  16 chars max
            <A[ ] process ID>   16 chars max
            <A[ ] wafer size>   16 chars max
            <U1 table position> position on the table (1 - 4
            <L[26]
                <L[4]               first wafer
                    <U1 final slot number>
                    <U1 original slot number>
                    <U1 state>
                    <A[ ] wafer ID>     ID from barcode reader
                >
                |
                |
                |
                |
                <L[4]               last wafer
```


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```
                    <U1 final slot number>
                    <U1 original slot number>
                    <U1 state>
                    <A[ ] wafer ID>      ID from barcode reader
                  >
                >
              >
            >
          >.
```

S6F10 - Formatted Variable Acknowledge (FVA). . . . . .S,H→E

Description Acknowledge S6F9 or indicate an error.

Structure S6F10

```
<B[1] 00>.                         ACKC6
```

Comment The Host acknowledges the Event Report. The Equipment ignores ACKC6.

S6F11 - Event Report Send (ERS) . . . . M,H←E,reply

Description: The Equipment sends a defined, linked, and enabled group of reports to the Host upon the occurrence of an event (CEID).

If S6F11 is multiblock, it must be preceded by the S6F5/F6 Inquire/Grant transaction.

Structure: S6F11 W

<L [3]	
<U4 DATAID>	DATAID
<U4 CEID>	Collection Event ID
<L[n]	
<L [2]	
<U4 $RPTID_1$>	Report ID
<L[a]	
<V_1>	Variable Value
...	
<V_a>	Variable Value
>	
>	
...	
<L [2]	
<U4 $RPTID_n$>	Report ID
<L[b]	
<V_1>	Variable Value
...	
<V_b>	Variable Value
>	
>	
>	
>.	

Exceptions: If there are no reports linked to the event, a ’null’ report is assumed.

Comment: This message is the “normal” message that the Equipment uses to report events. In order for this message to be used, the Equipment Constant “ConfigEvents” must be set to “1”.

A Collection Event has occurred at the Equipment. The Host has enabled event reporting for this CEID (see S2F37). The Host has set the Equipment Constant RpType to “False” (normal report format desired). The Equipment sends one or more Event Reports which the Host has previously linked to that CEID (see S2F35). Each report contains specific Variables which the Host has previously defined for that Report (see S2F33).

S6F11 - continued

The Equipment generates a value for DATAID to uniquely identify this Conversation. If S6F11 is multiblock, the Equipment first sends the S6F5/S6F6 Inquire/Grant transaction, and the DATAID in S6F11 will match DATAID in S6F5.

If the CEID is enabled, but no Reports are linked to this CEID, S6F11 has the following special format:

<L [3]	
<U4 DATAID>	DATAID
<U4 CEID>	Collection Event ID
<L>	
>.	

S6F12 - Event Report Acknowledge (ERA) . . . . .S,H→E

Description — Acknowledge S6F11 or indicate an error

Structure — S6F12

<B[1] 00>. ACKC6

Comment — The Host acknowledges the Event Report. The Equipment ignores ACKC6.

S6F13 - Annotated Event Report Send (AERS) . . . . M,H←E,reply

Description This message is the same as SS6F11 except that VIDs are sent with data.

Structure S6F13 W

```
<L [3]
    <U4 DATAID>                         DATAID
    <U4 CEID>                           Collection Event ID
    <L[a]
        <L [2]
            <U4 RPTID1>                 Report ID
            <L[b]
                <L [2]
                    <U4 VID1>           Variable ID
                    <V1>                Variable value
                >
                ...
                <L [2]
                    <U4 VIDb>
                    <Vb>
                >
            >
        >
        ...
        <L [2]
            <U4 RPTIDa>                 Report ID
            <L[c]
                <L [2]
                    <U4 VID1>
                    <V1>
                >
                ...
                <L [2]
                    <U4 VIDc>
                    <Vc>
                >
            >
        >
    >
>.
```

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S6F13 - continued

A Collection Event has occurred at the Equipment. The Host has enabled event reporting for this CEID (see S2F37). The Host has set the Equipment Constant RpType to “True” (Annotated report format desired). The Equipment Constant ConfigEvents has been set to 1. The Equipment sends one or more Event Reports which the Host has previously linked to that CEID (see S2F35). Each report contains specific Variables which the Host has previously defined for that Report (see S2F33).

The Equipment generates a value for DATAID to uniquely identify this Conversation. If S6F11 is multiblock, the Equipment first sends the S6F5/S6F6 Inquire/Grant transaction, and the DATAID in S6F11 matches DATAID in S6F5.

If the CEID is enabled, but no Reports are linked to this CEID, S6F11 has the following special format:

S6F13 W H←E

```
<L [3]
    <U4 DATAID>          DATAID
    <U4 CEID>            Collection Event ID
    <L[0]>
>.
```

S6F14 - Annotated Event Report Acknowledge (AERA). . . . . S,H→E

Description Acknowledge S6F13 or indicate an error.

Structure S6F14

```
<B[1] 00>.                              ACKC6
```

Comment The Host acknowledges the Event Report. The Equipment ignores ACKC6.

S6F15 - Event Report Request (ERR). . . . . S,H→E,reply

Description The Host demands a specified report group from the Equipment

Structure S6F15 W

```
<U4 CEID>.                              Collection Event ID
```

S6F16 - Event Report Data (ERD) . . . . M,H←E

Description Equipment sends to the Host reports linked to a given CEID

Structure S6F16

<L [3]	
<U4 DATAID>	DATAID
<U4 CEID>	Collection Event ID
<L[n]	
<L [2]	
<U4 RPTID$_1$>	Report ID
<L[a]	
<V$_1$>	Variable Value
...	
<V$_a$>	Variable Value
>	
>	
...	
<L [2]	
<U4 RPTID$_n$>	Report ID
<L[b]	
<V$_1$>	Variable Value
...	
<V$_b$>	Variable Value
>	
>	
>	
>.	

Comment The Equipment sends one or more Event Reports that the Host has previously linked to that CEID (see S2F35). Each report contains specific Variables that the Host has previously defined for that Report (see S2F33).

This message occurs whether or not the Host has enabled event reporting for this CEID (see S2F37), and regardless of how the Host has set the Equipment Constant RpType (report format).

The Equipment generates a meaningless value for DATAID.

CEID contains the CEID specified in S6F15.

Continued on next page

S6F16 - continued

If the CEID specified in S6F15 is invalid, or if no reports are linked to this CEID, this message has the following special format:

S6F16 H←E, Multiblock

<L [3]

<U4 DATAID> DATAID

<U4 CEID> Collection Event ID

<L[0]>

>.

S6F17 - Annotated Event Report Request (AERR) . . . . S,H→E,reply

Description Same as S6F15 but requests *annotated* reports

Structure S6F17 W

<U4 CEID>. Collection Event ID

Comment The Host sends the CEID of interest, requesting annotated format reports.

S6F18 - Annotated Event Reports Data (AERD). . . . . M,H←E

Description Equipment sends annotated reports linked to a given CEID

Structure S6F18

```
<L [3]
    <U4 DATAID>                         DATAID
    <U4 CEID>                           Collection Event ID
    <L[a]
        <L [2]
            <U4 RPTID1>                 Report ID
            <L[b]
                <L [2]
                    <U4 VID1>           Variable ID
                    <V1>                Variable value
                >
                ...
                <L [2]
                    <U4 VIDb>
                    <Vb>
                >
            >
        >
        ...
        <L [2]
            <U4 RPTIDa>                 Report ID
            <L[c]
                <L [2]
                    <U4 VID1>
                    <V1>
                >
                ...
                <L [2]
                    <U4 VIDc>
                    <Vc>
                >
            >
        >
    >
>.
```

Continued on next page

S6F18 - continued

The Equipment sends one or more Event Reports that the Host has previously linked to that CEID (see S2F35). Each report contains specific Variables that the Host has previously defined for that Report (see S2F33).

This message occurs whether or not the Host has enabled event reporting for this CEID (see S2F37), and regardless of how the Host has set up the Equipment Constant RpType (report format).

The Equipment generates a meaningless value for DATAID.

CEID contains the CEID specified in S6F17.

If the CEID specified in S6F17 is invalid, or if no reports are linked to this CEID, this message has the following format:

S6F18 H←E, Multiblock

```
<L [3]
    <U4 DATAID>                  DATAID
    <U4 CEID>                    Collection Event ID
    <L[0]>
>.
```

S6F19 - Individual Report Request (IRR) . . . . S,H→E,reply

Description The Host requests from the Equipment a report for the specified RPTID

Structure S6F19 W

```
U4 RPTID>.                       Report ID
```

S6F20 - Individual Report Data (IRD) . . . . M,H←E

Description Equipment sends the report requested by S6F19.

Structure S6F20

```
<L[n]
    <V1>
    ...
    <Vn>
>.
```

Comment If no report is defined for the RPTID in S6F19, S6F20 has the following special error format:

S6F20

```
<L[0]>.
```

S6F21 - Annotated Individual Report Request (AIRR). . . . . S,H→E,reply

Description The Host requests from the Equipment an annotated report for the specified RPTID.

Structure S6F21 W

```
<U4 RPTID>.                          Report ID
```

S6F22 - Annotated Individual Report Data (AIRD) . . . . M,H←E

Description Equipment sends the report requested in S6F21.

Structure S6F22

```
<L[n]
    <L [2]
        <U4 VID1>      * VID - Variable ID
        <V1>
    >
    ...
    <L [2]
        <U4 VIDn>      * VID - Variable ID
        <Vn>
    >
>.
```

Comment If no Report is defined for the RPTID in S6F21, S6F22 has the following special error format:

S6F22

```
<L[0]>.
```

S6F23 - Request Spooled Data (RSD) . . . . S,H→E,reply

Description The Host requests either the sending or the deleting of messages currently spooled by the equipment

Structure S6F23 W

```
<U1 RSDC>.                          Request spool data code
```

where

RSDC = 0 Spooled messages are to be sent to the Host

RSDC = 1 Spooled messages are to be discarded

S6F24 - Request Spooled Data Acknowledgment Send (RSDAS) . . . . S,H←E

Description Equipment acknowledges the request in S6F23 and answers with the appropriate acknowledge code.

Structure S6F24

```
<BINARY RSDA>.                      Request spool data acknowledge
```

S7F1 - Process Program Load Inquire (PPI) . . . . S,H←→E,reply

Description

This message is the first part of a Multiblock Inquire/Grant transaction preliminary to sending S7F3.

- For a planned Equipment-to-Host transfer, this inquiry is required.
- For a planned Host-to-Equipment transfer, it is optional. The Equipment accepts it but ignores it.

Structure

S7F1

```
<L[2]
    <A PPID>                          Process Program ID
    <U4 LENGTH>                       Length of text
>.
```

S7F2 - Process Program Load Grant (PPG). . . . . S,H←→E

Description

This message is the reply to the Multiblock Inquire/Grant transaction that was initiated by S7F1.

Structure

S7F2

```
<B[1] 00>.                            PPGNT
```

Comment

- Host-to-Equipment transfer.
  Host need not wait on a grant.
- Equipment-to-Host transfer
  - PPGNT = 0 means permission granted
  - PPGNT not equal to 0 means permission not granted

The Process Program may be either a Load Recipe, Process Recipe, or Parameter Table.

When the Host sends S7F2, the Equipment interprets PPGNT as follows:

Table 16-17. Process Program Load Grant

PPGNT	Description
0x00	Normal. The Equipment sends S7F3.
0x01	already have
0x02	no space
0x03	invalid PPID
0x04	busy, try again
0x05	will not accept
>0x05	other error
0x06 - 0x3F	reserved

S7F3 - Process Program Send (PPS) . . . . M,H←→E,reply

Description This message sends the program. If S7F3 is multiblock, it must be preceded by the S7F1/F2 Inquire/Grant transaction.

Structure S7F3

```
<L [2]
    <A PPID>                PPID - Process Program ID
    <A PPBODY>              PPBODY - Process Program Body
>.
```

Comment Send an Unformatted Process Program. Before sending a multi-block S7F3, the Equipment always first sends the S7F1/S7F2 Inquire/Grant transaction. The Host may send S7F1/S7F2 before sending S7F3. The Equipment accepts it, but does not require it.

S7F4 - Process Program Acknowledge (PPA) . . . . S,H←→E

Description Acknowledge S7F3 or indicate an error

Structure S7F4

```
<B [1] ACKC7>.              ACKC7
```

Comment The Receiver acknowledges the receipt of the Process Program. If the transfer succeeds, ACKC7 will contain 0x00, and the Receiver stores the new Process Program into its library. Any previous Process Program with the same PPID is deleted. Any non-zero ACKC7 indicates refusal of the Process Program.

The Process Program may be either a Load Recipe, Process Recipe, or Parameter Table.

When the Equipment sends S7F4, ACKC7 may contain the following codes. Any non-zero code indicates that S7F3 has not changed the Equipment Library.

Table 16-18. Process Program Acknowledge

ACKC7	Description
0x00	Accepted
0x01	Permission Not Granted.
0x02	length error
0x03	matrix overflow
0x04	PPID not found
0x05	mode unsupported
0x05	other error
0x06 - 0x3F	Reserved
0x40	Process Program Format Error.
0x41	Process Program Data Error (Verify Failed)

When the Host sends S7F4, the Equipment interprets ACKC7 as follows:

Table 16-19. Process Program Acknowledge

ACKC7	Description
0x00	Normal.
Other	Refusal. The upload operation fails

S7F5 - Process Program Request (PPR). . . . . .S,H←→E,reply

Description: Request the other end of the link to send a specified Process Program from its library. The Process Program may be either a Load Recipe, Process Recipe, or Parameter Table.

Structure: S7F5 W

```
<A PPID>.                          Process Program ID
```

S7F6 - Process Program Data (PPD). . . . . M,H←→E

Description: Sends the Process Program requested by S7F5

Structure: S7F6

```
<L [2]
    <A PPID>                       Process Program ID
    <A PPBODY>                     PPBODY - Process Program Body
>.
```

Comment: If the specified PPID is not found in the library, S7F6 has the following special format:

S7F6 H←>E

```
<L[0]>.
```

If the Equipment receives S7F6 and cannot store the Process Program in its library, the CEID Bad Download is signalled, with PPChangeName set to the PPID of the requested Process Program. This occurs if the received S7F6 is of the special “not found” form, if the S7F6 message is not in the expected format, or if an error is detected in PPBODY (for example, a parameter out of range). See S7F3 for a description of PPBODY.

S7F17 - Delete Process Program Send (DPS) . . . . S,H→E,reply

Description: The Host deletes one or more Process Programs from the Equipment library.

Structure: S7F17 W

```
<L[n]
    <A PPID1>                      Process Program ID
    ...
    <A PPIDn>                      Process Program ID
>.
```

Comment: If S7F17 contains a zero-length List, the entire library is deleted.

S7F18 - Delete Process Program Acknowledge (DPS) . . . . S,H←E,reply

Description Acknowledge S7F17 or indicate an error

Structure S7F18

```
<B [1] ACKC7>.              ACKC7 - Acknowledge Code
```

Comment

S7F19 - Current EPPD Request (RER) . . . . S,H→E,reply

Description Host requests a directory of the Process Programs currently in the Equipment library.

Structure S7F19 W

Header only

S7F20 - Current EPPD Data (RED) . . . . M,H←E

Description Equipment sends a directory of its Process Program Library. If the library is empty, the list will be of zero length.

Structure S7F20

```
<L[n]
    <A PPID1>                  Process Program ID
    ...
    <A PPIDn>                  Process Program ID
>.
```

S9F1 - Unrecognized Device ID (UDN) . . . . S,H←E

Description The device ID in the block header of the received message did not match any device ID known to the Host.

Structure S9F1

```
<B [10] MHEAD>.                  MHEAD - Header of bad msg
```

S9F3 - Unrecognized Stream type (USN) . . . . S,H←E

Description The Equipment did not recognize the stream type in the message block header.

Structure S9F3

```
<B [10] MHEAD>.                  MHEAD - Header of bad msg
```

S9F5 - Unrecognized Function Type (UFN) . . . . S,H←E

Description The Equipment did not recognize the function type in the message block header.

Structure S9F5

```
<B [10] MHEAD>.                  MHEAD - Header of bad msg
```

S9F7 - Illegal Data (IDN) . . . . S,H←E

Description Although the Equipment recognized the stream and function, it was unable to interpret the associated data format.

Structure S9F7

```
<B [10] MHEAD>.                  MHEAD - Header of bad msg
```

S9F9 - Transaction Timer Timeout (TTN) . . . . S,H←E

Description A receive timer has timed out; therefore, the transaction has been aborted. The Host must respond appropriately to keep the system operational.

Structure S9F9

```
<B[10] SHEAD>.                   SHEAD - stored header
```

S9F11 - Data Too Long (DLN). . . . . S,H←E

Description Equipment has been sent more data than it can handle.

Structure S9F11

```
<B [10] MHEAD>.                  MHEAD - Header of bad msg
```

S10F1 - Terminal Request (TRN). . . . . S,H←E,reply

Description Equipment sends a terminal text message to the Host

Structure S10F1 W

```
<L [2]
    <B [1] TID>                 Terminal ID
    <A [160] TEXT>              Message Text
>.
```

Comment Equipment may send the following values for TID:

Table 16-20. Terminal Request

TID	Description
0x00	Always sent.

Equipment Constant “WBitS10” controls whether the Equipment sends S10F1 with W-Bit “1” (Reply Expected) or “0” (No Reply Expected).

S10F2 - Terminal Request Acknowledge (TRA). . . . . .S,H→E

Description Acknowledge S10F1 or indicate an error.

Structure S10F2

```
<B [1] ACKC10>.                 Acknowledge Code
```

Comment The Host may send the following values for ACKC10:

Table 16-21. Terminal Request Acknowledge

ACKC10	Description
0x00	Accepted for display
0x01	Message will not be displayed
0x02	Terminal not available
0x03-0x3F	Reserved

S10F3 - Terminal Display, Single (VTN). . . . . S,H→E,reply

Description Data to be displayed

Structure S10F3 W

```
<L [2]
    <B [1] TID>                    Terminal ID
    <A [160] TEXT>                 Message Text
>.
```

Comment The Host sends to the Equipment. The Equipment interprets TID as follows:

Table 16-22. Terminal Display, Single

TID	Description
Any	Equipment displays the text on its CRT.

The Host may optionally set the W-Bit to “1” in S10F3. If so, the Equipment replies with S10F4.

S10F4 - Terminal Display, Single Acknowledge (VTA). . . . . S,H←E

Description Acknowledge S10F3 or indicate an error.

Structure S10F4

```
<B [1] ACKC10>.                Acknowledge Code
```

Comment This Equipment may send the following values for ACKC10:

Table 16-23. Terminal Display, Single Acknowledge

ACKC10	Description
0x00	Accepted for display
0x01	Message will not be displayed
0x02	Terminal not available
0x03-0x3F	Reserved

S10F5 - Terminal Display, Multi-block (VTN) . . . . .M,H→E,reply

Description Data to be displayed on the Equipment's terminal

Structure S10F5 W

```
<L [2]
    <B [1] TID>                       Terminal ID
    <L[1]
        <A [160] TEXT>                Message Text
    >
>.
```

The Host sends text to the Equipment. The Equipment interprets TID as follows:

Table 16-24. Terminal Display, Multiblock

TID	Description
Any	Equipment displays the text on its CRT

The Host may optionally set the W-Bit to “1” in S10F5. If so, the Equipment replies with S10F6.

S10F6 - Terminal Display, Multi-block Acknowledge (VMA) . . . . S,H←E

Description Acknowledge S10F5 or indicate an error.

Structure S10F6

```
<B [1] ACKC10>.                  Acknowledge Code
```

Comment This Equipment may send the following values for ACKC10:

Table 16-25. Terminal Display, Multiblock Acknowledge

ACKC10	Description
0x00	Accepted for display
0x01	Message will not be displayed
0x02	Terminal not available
0x03-0x3F	Reserved

S10F9 - Broadcast (BCN) . . . . S,H→E

Description This function is similar to S10F3 except that TID need not be specified. Upon receiving the message, the Equipment directs it to all of its Operator Interfaces.

Structure S10F9 W

```
<A [160] TEXT>.                      Message Text
```

Comment The Host sends text to the Equipment. The Equipment displays the text on its CRT.

The Host may optionally set the W-Bit to “1” in S10F9. If so, the Equipment replies with S10F10.

S10F10 - Broadcast Acknowledge (BCA). . . . . .S,H←E

Description Acknowledge S10F9 or indicate an error.

Structure S10F10

```
    <B [1] ACKC10>.                  Acknowledge Code
```

Comment This Equipment may send the following values for ACKC10:

Table 16-26. Broadcast Acknowledge

ACKC10	Description
0x00	Accepted for display
0x01	Message will not be displayed
0x02	Terminal not available
0x03-0x3F	Reserved

Chapter 17
SECS Scenarios

17.1 Equipment Communications

Refer to Chapter 2 for information about configuration and startup.

17.1.1 Equipment Establishes Communications

Assumption: Equipment's Communication state is “Enabled/Not Communicating”.

Table 17-1. Equipment Establishes Communications

Step	SECS Message	Description
1.	H ← E S1F13 W	Equipment attempts to send Establish Communications Request. Refer to Figure 2-10. This occurs in the **GEM ENABLED** state.
2.		If the send is not successful, or if no reply is received from the Host, wait **GEM Est CommDelay** seconds (see Table 2-1), then go to step 1.
3.	H → E S1F14	The Host responds with Establish Communications Acknowledge. If COMMACK in this message is non-zero, wait “EstablishCommunicationsTimer” seconds, then go to step 1. If COMMACK is zero, proceed to the next step.
4.		Communications is successfully established. The Equipment changes its communication state to Communicating. Normal SECS message processing begins.

17.1.2 Host Establishes Communications

Assumption: Equipment's Communication state is either “Enabled/Not Communicating” or “Enabled/Communicating”.

Table 17-2. Host Establishes Communications

Step	SECS Message	Description
1.	H → E S1F13 W	Host sends Establish Communications Request. Refer to Figure 2-10. This occurs in the **GEM ENABLED** state.
2.	H ← E S1F14	The Equipment responds with Establish Communications Acknowledge, with COMMACK set to zero. After this message is successfully sent, communications is established. If the current communication state is “Not Communicating”, the Equipment changes its communication state to “Communicating”. If the state is “Communicating”, no change in communication state occurs. In either case, subsequently received messages are processed normally.

17.1.3 Communications Established Simultaneously

Assumption: Equipment's Communication state is “Enabled/Not Communicating”.

Table 17-3. Simultaneous Establish Communications

Step	SECS Message	Description
1.	H ←E S1F13 W	Equipment sends Establish Communications Request.
2.	H → E S1F13 W	Host sends Establish communications Request.
3.	H ← E S1F14	The Equipment responds with Establish Communications Acknowledge, with COMMACK set to zero. After this message is successfully sent, communications is established. The Equipment changes its communication state to Communicating.
4.	H → E S1F14	The Host responds with Establish Communications Acknowledge, with COMMACK set to zero. This step could occur before step 3, in which case communications would be established at this step.

17.1.4 Losing Connection, Re-Connecting

Table 17-4. Losing Connection, Re-Connecting

Step	SECS Message	Description
1.	H ← E SxFy	Any Message. The Equipment encounters SECS block transmission errors while attempting to send a message to the Host, and reaches its Retry Limit (RTY). The Equipment considers the SECS link as disconnected
2.	H ←E S1F13 W	Connect Request. The Equipment attempts to re-establish the link.
3.		If the send is not successful, or if no reply is received from the Host, the Equipment waits for “EstablishCommunicationsTimer” seconds and then goes back to step 2.
4.	H → E S1F14	The Host acknowledges, sending COMMACK of “0”. The link is now re-connected.

17.1.5 Heartbeat

Table 17-5. Heartbeat

Step	SECS Message	Description
1.	H ← E S1F1 W	Are You There. The Equipment sends this message periodically to determine if the SECS link is still intact.
2.	H → E S1F2	On Line Data. The Host replies. The Equipment knows that the link is still intact.

17.2 Control - Operator Initiated Scenarios

17.2.1 Host Accepts ON-Line

Table 17-6. Host Accepts ON-Line

Step	SECS Message	Description
1.	H ← E S1F1 W	Equipment requests On-Line. Refer to Figure 2-10. This occurs in the **EQPT OFF-LINE** state when the operator clicks the **Equipment Online** button. See Figure 2-6.
2.	H → E S1F2	Host grants On-Line.
3.	H ← E S6F11 W	Event, Control State to Local or Remote.
4.	H → E S6F12	The Host acknowledges the report.

17.2.2 Host Denies ON-Line

Table 17-7. Host Denies ON-Line

Step	SECS Message	Description
1.	H ← E S1F1 W	Equipment requests On-Line
2.	H → E S1F0	Host denies On-Line.

17.2.3 Operator Sets Off-Line

Table 17-8. Operator Sets Off-Line

Step	SECS Message	Description
1.	H ← E S6F11 W	Event, Control State to Off-Line. Refer to Figure 2-10. This could occur from either the **ON-LINE REMOTE** or from the **ON-LINE LOCAL** state. It results when the operator clicks the **Equipment Offline** button. See Figure 2-7.
2.	H → E S6F12	The Host acknowledges the report.

17.2.4 Operator Sets Remote

Table 17-9. Operator Sets Remote

Step	SECS Message	Description
1.	H ← E S6F11 W	Event, Control State to Remote. Refer to Figure 2-10. This occurs while in the **ON-LINE LOCAL** state. Operator clicks the **Remote Control** button.
2.	H → E S6F12	The Host acknowledges the report.

17.2.5 Operator Sets Local

Table 17-10. Operator Sets Local

Step	SECS Message	Description
1.	H ← E S6F11 W	Event, Control State to Local. Refer to Figure 2-10. This occurs while in the **ON-LINE REMOTE** state. Operator clicks the **Local Control** button.
2.	H → E S6F12	The Host acknowledges the report.

17.3 Control - Host Initiated Scenario

17.3.1 Host Sets Off-Line, Accepted

Table 17-11. Host Sets Off-Line, Accepted

Step	SECS Message	Description
1.	H → E S1F15 W	Host Requests Off-Line. Equipment is Off-Line. Refer to Figure 2-10. This could occur from either the **ON-LINE REMOTE** or from the **ON-LINE LOCAL** state. The result is to move the equipment to the **HOST OFF-LINE** state.
2.	H ← E S1F16	Equipment Accepts
3.	H ← E S6F11 W	Event, Control State to Off-Line
4.	H → E S6F12	The Host acknowledges the report.

17.3.2 Host Sets Off-Line, Rejected

Table 17-12. Host Sets Off-Line, Rejected

Step	SECS Message	Description
1.	H → E S1F15 W	Host Requests Off-Line. Equipment is Off-Line.
2.	H ← E S1F0	Equipment Rejects.

17.3.3 Host Sets On-Line, Accepted

Table 17-13. Host Sets ON-Line, Accepted

Step	SECS Message	Description
1.	H → E S1F17 W	Host Requests On-Line. Refer to Figure 2-10. This occurs when the equipment is in the **HOST OFF-LINE** state. The result, if successful, moves the equipment to one of the **ON-LINE** states.
2.	H ← E S1F18	Equipment Accepts
3.	H ← E S6F11 W	Event, Control State to Local / Remote
4.	H → E S6F12	The Host acknowledges the report.

17.3.4 Host Sets On-Line, Rejected

Table 17-14. Host Sets On-Line, Rejected

Step	SECS Message	Description
1.	H → E S1F17 W	Host Requests On-Line.
2.	H ← E S1F18	If Equipment is not Host Off-Line. Equipment Rejects

17.4 Data Collection

Refer to Chapter 6, Reports.

17.4.1 Host Initializes Event Reporting

Table 17-15. Host Initializes Event Reporting

Step	SECS Message	Description
1.	H → E S2F37 W	Disable Event Reports. The Host disables reporting for all Collection Events. S2F37 W <L [2] <BOOLEAN F> <L> >.
2.	H ← E S2F38	The Equipment acknowledges. Temporarily, the Equipment makes no event reports.
3.	H →E S2F33 W	Define Report. The Host erases all previous Report definitions and Links: S2F33 W <L [2] <U4 DATAID> <L> >.
4.	H ← E S2F34	The Equipment acknowledges.
5.	H → E S2F33 W	Define Report. The Host sends Report Definitions.
6.	H ←E S2F34	The Equipment Acknowledges.
7.	H → E S2F35 W	Link Events/Reports. The Host links reports to the desired Collection Events. Linked Reports are initially “disabled
8.	H ← E S2F36	The Equipment acknowledges
9.	H → E S2F15 W	Equipment Constant Send. The Host sets Equipment constant RpType to indicate whether Event Reports should be in Normal or Annotated format (see Figure 2-1, GEM Report Type).
10.	H ← E S2F16	The Equipment acknowledges
11.	H → E S2F37 W	Enable Event Reports. The Host enables reporting for desired Collection Events.

Table 17-15. Host Initializes Event Reporting (Continued)

Step	SECS Message	Description
12.	H ← E S2F38	The Equipment acknowledges. From this point on, the Equipment reports events as they occur.

17.4.2 Equipment Reports Event

Table 17-16. Equipment Reports Event

Step	SECS Message	Description
1.		The Equipment recognizes that an event has occurred. The Host has enabled reporting for the CEID, and possibly has defined one or more Reports and linked them to the CEID. The Equipment Constant RpType is set to “False”, requesting normal reports.
2.	H ← E S6F5 W	Inquire. If S6F13 is multi-block, the Equipment first sends this Inquire to request permission. If S6F13 is single-block, skip this and the next step.
3.	H →E S6F6	Grant. The Host grants permission to send multi-block event report. If GRANT6 is non-zero, this scenario fails here, and the event data is discarded.
4.	H ← E S6F11 W	The Equipment sends Event reports for the CEID that occurred
5.	H → E S6F12	The Host acknowledges the report.

17.4.3 Equipment Reports Annotated Event

Table 17-17. Equipment Reports Annotated Event

Step	SECS Message	Description
1.		The Equipment recognizes that an event has occurred. The Host has enabled reporting for the CEID, and possibly has defined one or more Reports and linked them to the CEID. The Equipment Constant RpType is set to “True”, requesting Annotated reports.
2.	H ← E S6F5 W	Inquire. If S6F13 is multi-block, the Equipment first sends this Inquire to request permission. If S6F13 is single-block, skip this and the next step.

Table 17-17. Equipment Reports Annotated Event

Step	SECS Message	Description
3.	H → E S6F6	Grant. The Host grants permission to send multi-block event report. If GRANT6 is non-zero, this scenario fails here, and the event data is discarded
4.	H ← E S6F13 W	The Equipment sends annotated event reports for the CEID that occurred.
5.	H → E S6F14	The Host acknowledges the report.

Note: In all other scenarios in which event reports occur, the Events or Annotated Events are shown in abbreviated form (S6F11/S6F12 only). The complete Event Report Scenarios are shown here.

17.4.4 Host Initiates Trace

Table 17-18. Host Initiates Trace

Step	SECS Message	Description
1.	H → E S2F23 W	The Host initiates a trace.
2.	H ← E S2F24	The Equipment acknowledges the trace request. If the data in S2F23 is not valid, the acknowledge code in this message is non-zero and the scenario ends. Otherwise, the following steps are done “TOTSMP” times, where TOTSMP is the total number of samples to be done.
3.		The Equipment waits “DSPER” (data sample period). While waiting, the Equipment continues to operate normally, responding to any SECS messages that may be received. After the wait is finished, the values of the variable(s) to be traced are obtained and saved. If “REPGSZ” samples have been saved, or if this is the last sample, do the following steps.
4.	H ← E S6F1 W	The Equipment sends trace data.
5.	H → E S6F2	If the S6F1 has its W-bit set to 1, the Host acknowledges the trace data.
6.		If this is the last sample, the Equipment terminates this trace and the scenario ends. Otherwise, go back to the beginning of step 3.

17.4.5 Host Terminates Trace

Assumption: The Host started a Trace report as in the above scenario.

Table 17-19. Host Terminates Trace

Step	SECS Message	Description
1.	H → E S2F23 W	The Host initiates a trace, with the same trace ID as the currently running trace, and with TOTSMP (number of samples) set to “0”.
2.	H ← E S2F24	The Equipment acknowledges the trace request. If the data in S2F23 is valid, the Equipment terminates the trace.
3.		If the Equipment has saved trace data that has not yet been sent to the Host, it discards the saved data.

17.4.6 Host Requests Status

Table 17-20. Host Requests Status

Step	SECS Message	Description
1.	H → E S1F3 W	Discrete Variable Request. The Host requests the VIDs of interest.
2.	H ← E S1F4	he Equipment sends the Variable values.

17.4.7 Host Requests Report by CEID

Table 17-21. Host Requests Report by CEID

Step	SECS Message	Description
1.	H → E S6F15 W	Request Event Report. The Host requests a report for the specified CEID. In this way, the host requests the Equipment to “pretend that the specified CEID has occurred.
2.	H ← E S6F16	The Equipment sends reports linked to that CEID.

17.4.8 Host Requests Annotated Report by CEID

Table 17-22. Host Requests Annotated Report by CEID

Step	SECS Message	Description
1.	H → E S6F17 W	Request Annotated Event Report. The Host requests a report for the specified CEID. In this way, the host requests the Equipment to “pretend” that the specified CEID has occurred.
2.	H ← E S6F18	The Equipment sends annotated reports linked to that CEID.

17.4.9 Host Requests Report by RPTID

Table 17-23. Host Requests Report by RPTID

Step	SECS Message	Description
1.	H → E S6F19 W	Request Report. The Host requests a report for the specified RPTID.
2.	H ← E S6F20	The Equipment sends the report.

17.4.10 Host Requests Annotated Report by RPTID

Table 17-24. Host Requests Annotated Report by RPTID

Step	SECS Message	Description
1.	H → E S6F21 W	Request Annotated Report. The Host requests an annotated report for the specified RPTID.
2.	H ← E S6F22	The Equipment sends the annotated report.

17.4.11 Are You There

Table 17-25. Are You There

Step	SECS Message	Description
1.	H → E S1F1 W	Are You There. The Host sends this simple message.
2.	H ←E S1F2	The Equipment reports its MDLN and SOFTREV.

17.4.12 Host Reads Equipment Constants

Table 17-26. Host Reads Equipment Constants

Step	SECS Message	Description
1.	H → E S2F13 W	Host requests the values of one or more Equipment Constants.
2.	H ← E S2F14	The Equipment responds with the values of the requested Equipment Constants.

17.4.13 Host Sets Equipment Constants

Table 17-27. Host Sets Equipment Constants

Step	SECS Message	Description
1.	H → E S2F15 W	Host sends new values for one or more Equipment Constants.
2.	H ← E S2F16	If all new values are valid, the Equipment saves the new values and sends this message with an acknowledge code of “0”. If one or more new values are not valid, no Equipment Constants are changed and the acknowledge code in this message is non-zero.

17.5 Material Status

17.5.1 Material Status Request

Table 17-28. Material Status Request

Step	SECS Message	Description
1	H → E S3F1 W	Host request Device to send Material Status
2	H ← E S3F2	The Equipment replies with the Material Status.

17.5.2 Cassette Status Request

Table 17-29. Cassette Status Request

Step	SECS Message	Description
1	H → E S3F81 W	Host request Device to send Cassette Status.
2	H ← E S3F82	The Equipment replies with the Cassette Status.

17.6 Alarms

Refer to Chapter 8, Alarms and to Appendix A.

17.6.1 Equipment Reports Alarm

Table 17-30. Equipment Reports Alarm

Step	SECS Message	Description
1.	H ← E S5F1 [W]	If reporting for this alarm ID is disabled, skip this and the following step. Otherwise send the alarm. The Equipment Constant WBitS5 determines whether the W-bit is 0 or 1 in this message.
2.	H → E S5F2	If the W-bit in S5F1 is 1, the Host acknowledges the alarm report. Otherwise, skip this step.
3.	H ← E S6F11 W	If the event ID associated with this alarm state is enabled, send the event report. Otherwise, the scenario ends.
4.	H → E S6F12	The Host acknowledges the event report.

17.6.2 Host Enables/Disables Alarms

Table 17-31. Host Enables/Disables Alarms

Step	SECS Message	Description
1.	H → E S5F3 [W]	The Host specifies ALIDs to be enabled or disabled.
2.	H ← E S5F4	The Host specifies ALIDs to be enabled or disabled.

17.6.3 Host Requests Alarms

Table 17-32. Host Requests Alarms

Step	SECS Message	Description
1.	H → E S5F5 W	The Host requests whether specified ALIDs are “on” or “off”.
2.	H ← E S5F6	The Equipment sends Alarm status.

17.6.4 Alarm Report (GEM, Ver 3.1 Compatibility)

Note: This scenario is provided only for compatibility with Host computers which support GEM, Ver 3.1.

Table 17-33. Alarm Report (GEM, Ver 3.1 Compatibility)

Step	SECS Message	Description
1.		The Equipment Constant ConfigAlarms is set to 0 for non-GEM compatibility. The Equipment recognizes that an alarm condition has gone “on” (has become Unsafe).
2.	H ← E S5F73 [W]	The Equipment reports the Alarm going on. The high-order bit of ALCD is “1”.
3.	H → E S5F74	If the W-bit of S5F74 is 1, the Host acknowledges the Alarm.
4.		The Equipment recognizes that the alarm condition has gone “off” (has become Safe).
5.	H ← E S5F73 [W]	The Equipment reports the Alarm going off. The high-order bit of ALCD is “0”.
6.	H → E S5F74	If the W-bit in S5F74 is 1, the host acknowledges the Alarm.

17.6.5 Alarm Report (GEM, Ver 1.7 Compatibility)

Table 17-34. Alarm Report (GEM, Ver 1.7 Compatibility)

Step	SECS Message	Description
1.		The Equipment Constant ConfigAlarms is set to 1 for GEM, Ver 1.7 compatibility. The Equipment recognizes that an alarm condition has gone “on” (that has become Unsafe).
2.	H ← E S5F71 [W]	The Equipment reports the Alarm going on. The high-order bit of ALCD is “1”.
3.	H → E S5F72	If the W-bit in S5F71 is 1, the Host acknowledges the Alarm.
4.		The Equipment recognizes that the alarm condition has gone “off” (that has become Safe).
5.	H ← E S5F71 [W]	The Equipment reports the Alarm going off. The high-order bit of ALCD is “0”.
6.	H → E S5F72	If the W-bit in S5F71 is 1, the Host acknowledges the Alarm.

17.7 Remote Control

Refer to Chapter 9, Remote Control.

17.7.1 Host Sends Remote Command

Assumption: Control State is Remote

Table 17-35. Remote Command

Step	SECS Message	Description
1.	H → E S2F41 [W]	The Host sends the command. The W-bit in this message bay be either 0 or 1.
2.	H ← E S2F42	If the W-bit was 1, the Equipment acknowledges the command. If the Equipment cannot perform the command, the acknowledge code in this message is non-zero. If the command can be completed “immediately”, the command is performed and the acknowledge code in this message is 0. Otherwise, if the command takes a significant amount of time to complete, the acknowledge code is 4. Successful completion of a command may trigger one or more events.

17.7.2 Equipment Rejects Host Command

Assumption: Control State is Local

Table 17-36. Equipment Rejects Host Command

Step	Step	Description
1.	H → E S2F41 [W]	The Host sends the command. The W-bit in this message may be either 0 or 1.
2.	H ← E S2F42	If the W-bit in S2F41 is 1, the Equipment acknowledges the command. The acknowledge code in this message is 64 (Control State is incorrect). If the W-bit is 0, this message is not sent. In either case, the Equipment does not perform the command.

17.7.3 Go Remote, Operator-Initiated

Table 17-37. Go Remote, Operator-Initiated

Step	SECS Message	Description
1.		ControlState is Local. The Equipment operator switches the Equipment to Remote Control by clicking the Remote Control button on the Operator’s Display Panel (see Figure 2-7).
2.	H ← E S6F11 W	The Equipment signals CEID GoingRemote. Event Reports as appropriate.
3.	H → E S6F12	The Host acknowledges the report.

17.7.4 Go Local, Operator-Initiated

Table 17-38. Go Local, Operator-Initiated

Step	SECS Message	Description
1.		ControlState is Remote. The Equipment operator switches the Equipment to Local Control by clicking the Local Control button on the Operator’s Display Panel (see Figure 2-7).
2.	H ← E S6F11 W	The Equipment signals CEID GoingLocal. Event Reports as appropriate.
3.	H → E S6F12	The Host acknowledges the report.

17.7.5 Go Local, Host-Initiated

Table 17-39. Go Local, Host-Initiated

Step	SECS Message	Description
1.		ControlState is Remote.
2.	H → E S2F41 [W]	Remote Command (GO LOCAL). The Host commands the Equipment to go into Local Control.
3.	H ←E S2F42	If the W-bit in S2F41 is 1, the Equipment acknowledges the command. HCACK is zero.

Table 17-39. Go Local, Host-Initiated

Step	SECS Message	Description
4.	H ← E S6F11 W	The Equipment signals CEID GoingLocal. Event Reports as appropriate.
5.	H → E S6F12	The Host acknowledges the report.

17.7.6 Operator Command, Successful

Table 17-40. Operator Command, Successful

Step	SECS Message	Description
1.		ControlState is Local. The operator issues a front-panel INITIATE PROCESS command. The Equipment performs the command.
2.	H ← E S6F11 W	ControlState is Local. The operator issues a front-panel INITIATE PROCESS command. The Equipment performs the command.
3.	H → E S6F12	The Host acknowledges the report.

17.8 Process Program Management

Refer to Chapter 11, Process Program Management.

17.8.1 Unformatted, Host-Initiated Download

Table 17-41. Host-Initiated Download

Step	SECS Message	Description
1.	H → E S7F1 W	Host requests permission to send a multi-block Process Program to the Equipment. If the Process Program is single-block, this step and the next one may be skipped.
2.	H ← E S7F2	The Equipment grants permission for the Host to send the Process Program.
3.	H → E S7F3 W	Host sends the process Program to the Equipment.
4.	H ← E S7F4	The Equipment acknowledges receipt of the Process Program. The Equipment checks the received Process Program for validity. If the process Program is valid, the Equipment stores the Process Program in its library and sends an acknowledge code of zero in this message. If the Process Program is not valid, or could not be stored in the library, the acknowledge code in this message is non-zero.

17.8.2 Unformatted, Host-Initiated Upload

Table 17-42. Host-Initiated Upload

Step	SECS Message	Description
1.	H → E S7F5 W	Host requests a Process Program from the Equipment library.
2.	H ← E S7F5	The Equipment sends the Process Program. If the Process Program does not exist, the data portion of this message is an empty list.

17.8.3 Unformatted, Equipment-Initiated Download

Table 17-43. Equipment-Initiated Download

Step	SECS Message	Description
1.	H ← E S7F5 W	Equipment requests a Process Program.
2.	H → E S7F6	The Host sends the Process Program. If the Process Program is valid, the Equipment stores the Process Program in its library, and the scenario ends. If the data portion of S7F6 is an empty list, or if the Process Program is not valid, the Equipment does not store it in its library and the scenario continues.
3.	H ← E S6F11 W	The Equipment sets “PPChangeName” to the requested PPID and signals CEID Bad Download. Event reports as appropriate.
4.	H → E S6F12	The Host acknowledges the report.

17.8.4 Unformatted, Equipment-Initiated Upload

Table 17-44. Equipment-Initiated Upload

Step	SECS Message	Description
1.	H ← E S7F1 W	Process Program Inquire. If S7F3 is multi-block, the Equipment requests permission to send a multi-block message. If S7F3 is single-block, skip this and the following step.
2.	H → E S7F2	Process Program Grant. The Host grants permission. If PPGNT is non-zero, the scenario fails here.
3.	H ← E S7F3 W	Send Process Program. The Equipment uploads Process Program to Host.
4.	H → E S7F4	The Host acknowledges. The Equipment ignores ACKC7.

17.8.5 Host Deletes Process Program

Table 17-45. Host Deletes Process Program

Step	SECS Message	Description
1.	H → E S7F17 W	Host sends a request to delete one or more Process Programs from the Equipment's library of Process Programs.
2.	H ← E S7F18	The Equipment replies with an acknowledge code. If all specified Process Program(s) were deleted successfully, the acknowledge code is 0. If one or more of the specified Process Programs could not be deleted, the acknowledge code is non-zero.

17.8.6 Host Requests Directory

Table 17-46. Host Requests Directory

Step	SECS Message	Description
1.	H → E S7F19 W	Host requests the names (PPIDs) of all Process Programs that are stored in the Equipment's Process Program library.
2.	2.	The Equipment replies with the list of PPIDs

17.8.7 Operator Changes Process Program Library

Table 17-47. Operator Changes Process Program Library

Step	SECS Message	Description
1.		The Equipment Operator creates, changes, or deletes a Process Program in the Library.
2.	H ← E S6F11 W	The Equipment sets PPChangeStatus to “Create”, “Change”, or “Delete”, as appropriate, sets PPChangeName, and signals CEID PPChange. Event Reports as appropriate.
3.	H → E S6F12	The Host acknowledges the report.

17.9 Limits Monitoring

Refer to Chapter 7, Limits Monitoring.

17.9.1 Host Defines Limit Attributes

Table 17-48. Host Defines Limit Attributes

Step	SECS Message	Description
1.	H → E S2F39 W	Host sends mutli-block inquire if necessary
2.	H ← E S2F40	Equiptment replies with grant
3.	H → E S2F45 W	Host defines new variable limit attributes
4.	H ← E S2F46	Equipment acknowledges Host request.

17.9.2 Host Queries Equipment for Current Limits

Table 17-49. Host Queries Equipment for Current Limits

Step	SECS Message	Description
1.	H → E S2F47 W	Host queries equipment for current variable Limit Attribute definitions
2.	H ← E S2F48	Equipment returns report containing requested variable limit attribute values.

17.10 Spooling

Refer to Chapter 10, Spooling.

17.10.1 Host Defines Messages to be Spooled

Table 17-50. Host Defines Messages to be Spooled

Step	SECS Message	Description
1.	H → E S2F43 W	Host defines messages to be spooled
2.	H ← E S2F44	Equipment acknowledges setup

17.10.2 Host Defines Max Spool Messages

Table 17-51. Host Defines Max Spool Messages

Step	SECS Message	Description
1.	H → E S2F15W	Host defines the maxinum number of messages to send in response to a S6F23 message
2.	H ← E S2F16	Equipment acknowledges Equipment Configuration change. Note: Machine must be in Remote Control.
3.	H ← E S6F11 W	Configuration Event
4.	H → E S6F12	Host Acknowledges Report.

17.10.3 Host Requests Spooled Data, Max Transmit = 0

Table 17-52. Host Requests Spooled Data, Max Transmit = 0

Step	SECS Message	Description
1.	H → E S1F3 W	Host request data for Max Transmit Variable.
2.	H ← E S1F4	Equipment sends data
3.	H → E S6F23W	Host Requests spooled data.
4.	H ← E S6F24	Request Spooled Data acknowledged
5. ... N	H ← E W H → E	The appropiate Streams and Functions are used to transmit the spooled data to the Host.
N + 1	H ← E S6F11	Equipment sends Spooling Deactivated event report.
N +2	H → E S6F12	Event Acknowledge

17.10.4 Host Requests Spooled Data, Max Transmit > 0

Table 17-53. Host Requests Spooled Data, Max Transmit > 0

Step	SECS Message	Description
1.	H → E S1F3 W	Host request data for Max Transmit Variable.
2.	H ← E S1F4	Equipment sends data
3.	H → E S6F23W	Host Requests spooled data.
4.	H ← E S6F24	Request Spooled Data acknowledged
5. ... N	H ← E W H → E	The appropiate Streams and Functions are used to transmit the spooled data to the Host.
		Max Transmit has been reached. The Host requests additional messages if necessary.
N + 1	H → E S6F23W	Host Requests spooled data
N + 2	H ← E S6F24	Request Spooled Data acknowledged
N	H ←E W H → E	The appropiate Streams and Functions are used to transmit the spooled data to the Host.
From Equipment	H ← E S6F11	Equipment sends Spooling Deactivated event report.
From Host	H → E S6F12	Event Acknowledge

17.11 Equipment Terminal Communications

Refer to Chapter 13, Equipment Terminal Services.

17.11.1 Host to Equipment, Single Line

Table 17-54. Host to Equipment, Single Line Terminal Communications

Step	SECS Message	Description
1.		The Host has data to display at the Equipment's front panel.
2.	H → E S10F3 [W]	Terminal Display. The Host sends text. The Equipment displays the text on its front panel.
3.	H ←ES10F4	If the W-bit in S10F3 is 1, the Equipment acknowledges.
4.		The Operator acknowledges that he/she has read the message.
5.	H ← E S6F11 W	The Equipment signals CEID HostMsgAck. Event Reports as appropriate.
6.	H → E S6F12	The Host acknowledges the report.

17.11.2 Host to Equipment, Multi-Line

Table 17-55. Multi-Line Terminal Communications

Step	SECS Message	Description
1.		The Host has a multi-line data to display at the Equipment front panel.
2.	H → E S10F5 [W]	Terminal Display Multiple. The Host sends text. The Equipment displays the text on its front panel.
3.	H ← ES10F6	If W-bit in S10F5 is 1, the Equipment acknowledges.
4.		The Operator acknowledges that he/she has read the message.
5.	H ← E S10F11 W	The Equipment signals CEID HostMsgAck. Event Reports as appropriate.
6.	H → E S6F12	The Host acknowledges the report.

17.11.3 Equipment Sends Text to Host

Table 17-56. Equipment Sends Text to Host

Step	SECS Message	Description
1.		The Equipment operator enters data to send to the Host.
2.	H ← E S10F1 [W]	Equipment sends text to Host. The W-bit in this message may be either 0 or 1. The Host displays the message for the operator.
3.	H → E S10F2	If the W-bit in S10F1 is 1, the Host acknowledges the text message.

17.12 Error Messages

17.12.1 Unrecognized Device ID

Table 17-57. Unrecognized Device ID

Step	SECS Message	Description
1.	H → E SnFn [W]	Host sends a message with a bad Device ID in the header. The W-bit can be either 0 or 1.
2.	H ← E S9F1	Equipment replies with “Unrecognized Device ID”.

17.12.2 Unrecognized Stream

Table 17-58. Unrecognized Stream

Step	SECS Message	Description
1.	H → E SnFn [W]	Host sends a primary message with a stream number that the Equipment does not support. The W-bit can be either 0 or 1.
2.	H ← E S9F3	Equipment replies with “Unrecognized Stream”.

17.12.3 Unrecognized Function

Table 17-59. Unrecognized Function

Step	SECS Message	Description
1.	H → E SnFn [W]	Host sends a primary message with a stream number for which the Equipment recognizes some messages, but with a function number that the Equipment does not support for that stream. The W-bit can be either 0 or 1.
2.	H ← E S9F5	Equipment replies with “Unrecognized Function”.

17.12.4 Illegal Data Format

Table 17-60. Illegal Data Format

Step	SECS Message	Description
1.	H → E SnFn [W]	Host sends a message with a stream and function that the Equipment recognizes, but with a data format that is incorrect. The W-bit can be either 0 or 1.
2.	H ← E S9F7	

17.12.5 Data Too Long

Table 17-61. Data Too Long

Step	SECS Message	Description
1.	H → E SnFn [W]	Host sends a message with a stream and function that the Equipment recognizes, but contains more data than expected. The W-bit can be either 0 or 1.
2.	H ← E S9F11	Equipment replies with “Data Too Long”. If the erroneous message is a primary with the W-bit set to 1, then in come cases the Equipment will reply with the usual secondary response with an appropriate error code, instead of S9F11. If the erroneous message is a secondary, the Equipment makes no reply at all.

17.13 Clock

The GEM Timekeeper clock on the Equipment is programmable by the Host (the UNIX clock is not). Refer to Chapter 14, Clock.

17.13.1 Host Sets Date and Time

Table 17-62. Host Sets Date and Time

Step	SECS Message	Description
1.	H → E S2F31 W	Date and Time Send. The Host sends a new Date and Time to the Equipment.
2.	H ← E S2F32	The Equipment sets its Clock/Calendar hardware and acknowledges the command.

17.13.2 Host Requests Date and Time

Table 17-63. Host Requests Date and Time

Step	SECS Message	Description
1.	H → E S2F17 W	Date and Time Request. The Host requests Date and Time from the Equipment.
2.	H ← E S2F18	The Equipment sends its Date and Time.

17.14 Host Requests Material Status

17.14.1 Material Status Request

Table 17-64. Material Status Request

Step	SECS Message	Description
1.	H → E S3F1 W	The Host requests the status of wafers from the Equipment.
2.	H ← E S3F2	The Equipment sends status of its wafers in process.

17.14.2 Cassette Status Request

Table 17-65. Cassette Status Request

Step	SECS Message	Description
1.	H → E S3F81 W	The Host requests the status of the cassettes on the Equipment.
2.	H ← E S3F82	The Equipment sends status of its cassettes on the cassette table.

17.15 Material Movement

Refer to Chapter 12, Material Movement.

17.15.1 Cassette Load

Table 17-66. Cassette Load

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F83	Equipment tells Host that it is ready to receive material.
3.	H → E S4F87	The Host has loaded the material, and it is now in control of the GSD-HE.
4.	H ← E S4F85	Equipment acknowledges that the transfer has completed successfully.

17.15.2 Cassette Unload

Table 17-67. Cassette Unload

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette
2.	H ← E S4F87	Equipment notifies Host that it will start to unload the cassette.
3.	H → E S4F85	Host acknowledges that the transfer has completed successfully.

17.15.3 Abort Cassette Load

Table 17-68. Abort Cassette Load

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F83	Equipment tells Host that it is ready to receive material.
3.	H → E S4F93	The Host aborts the transaction, and no material is transferred.

17.15.4 Abort Cassette Unload

Table 17-69. Abort Cassette Unload

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette.
2.	H ← E S4F87	Equipment notifies Host that it is starting to unload the cassette.
3.	H → E S4F93	Host acknowledges aborts the transfer, and no material is moved.

17.15.5 Cassette Load Error 1

Table 17-70. Cassette Load Error 1

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F91	Equipment notifies the Host that an equipment failure has occurred or an incorrect process was given.

17.15.6 Cassette Unload Error 1

Table 17-71. Cassette Unload Error 1

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette.
2.	H ← E S4F91	Equipment notifies Host that an Equipment failure has occurred, and the cassette can not be unloaded.

17.15.7 Cassette Load Error 2

Table 17-72. Cassette Load Error 2

Step	SECS Message	Description
1.	H → E S4F81	Host notifies Equipment of request to load cassette.
2.	H ← E S4F83	Equipment tells Host that it is ready to receive material.
3.	H → E S4F87	Host notifies Equipment that it is starting to unload the cassette.
4.	H ← E S4F89	Equipment notifies the Host that some material has been lost. Manual intervention is required.

17.15.8 Cassette Unload Error 2

Table 17-73. Cassette Unload Error 2

Step	SECS Message	Description
1.	H → E S4F95	Host sends request to unload cassette.
2.	H ←E S4F87	Equipment notifies Host that it has successfully unloaded the cassette.
3.	H → E S4F89	Host notifies Equipment that some material has been lost. Manual intervention is required.

Chapter 18
The SMIF Option

18.1 SMIF Basics

The Standard Mechanical Interface (SMIF) Arm is an optional attachment that mechanically loads and unloads cassettes. Use of a SMIF Arm makes it possible to operate in an environment that does not require Clean Room standards.

This chapter provides the Host programmer with the additional information needed to program for connection to those Equipments that include a SMIF arm.

Eaton documents describing the mechanical connection and cabling of the SMIF arm are not normally given to users but are available on request.

18.1.1 Descriptions of Terms

Chapter 1 includes descriptions of the basic terms involved in wafer handling: **wafer, cassette, table, port, door**.This chapter introduces a new term: **pod**. A pod is a sealed container that holds a cassette during the time it is transported to and from the SMIF Arm.

18.1.2 Cassette Handling

The addition of a SMIF arm to the material movement mechanism automates the handling of cassettes on the equipment. Figure 18-1illustrates the SMIF arm in relation to the Robot arm and moveable table. Note that the SMIF Arm is permanently positioned in alignment with the Robot Arm. The table travels back and forth but both the Robot and the SMIF remain fixed.

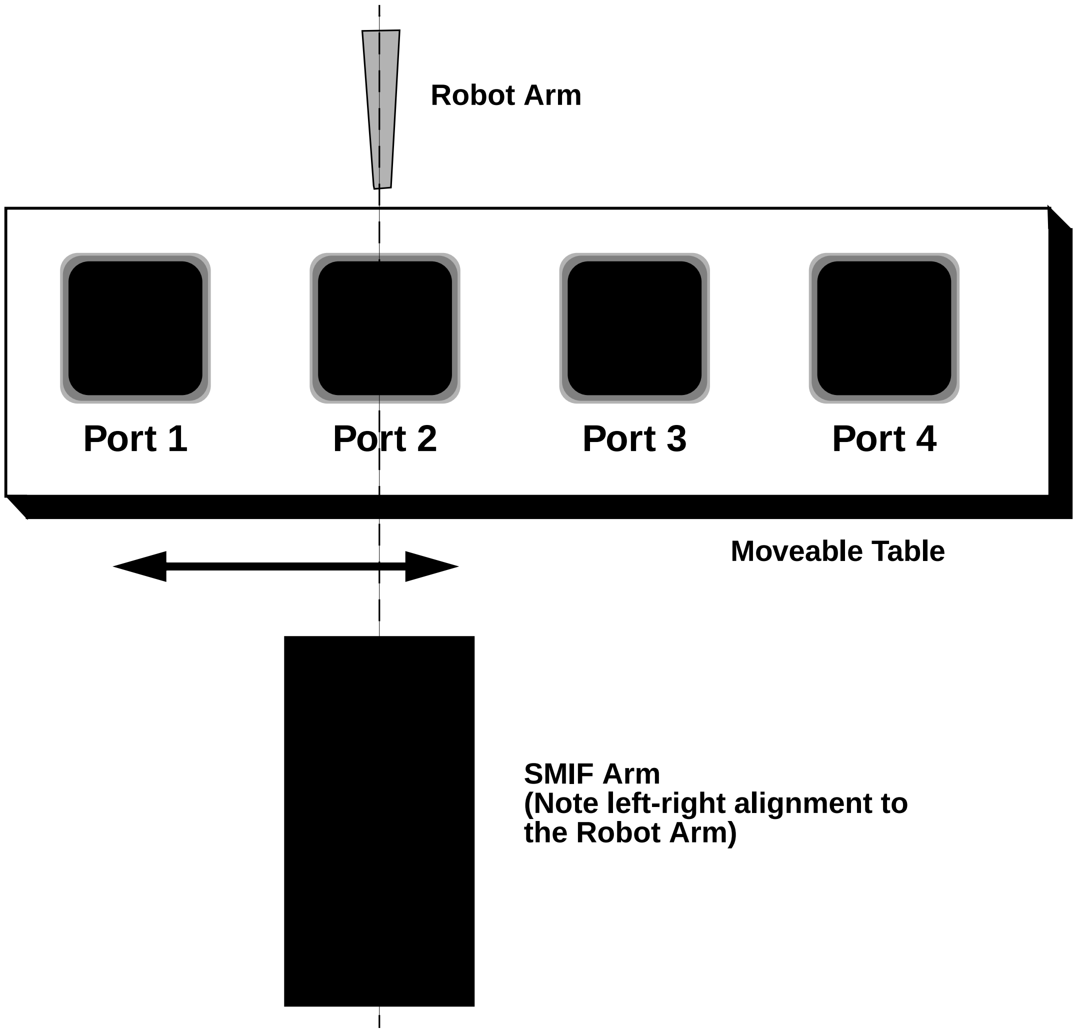


Figure 18-1. SMIF Arm Location

When the configuration includes a SMIF arm, silicon wafers are loaded into the implanter via the following procedure.

1. A cassette containing silicon wafers to be processed is placed in a sealed container called a **pod.** The pod protects the wafers within from exposure while the pod is transported to the work station.
2. The operator places the pod on the SMIF arm.
3. The operator or program selects a port on the moveable table.
4. The SMIF Arm mechanism lifts the cassette out of its pod and places it in

the port. The table positions itself to align that port to the SMIF arm.

The wafers are then moved one by one onto the implanter disk via the Robot arm, as described in Chapter 1.

18.2 Options and Connections

SMIF arms are available in three different models from the two vendors ASYST and Jenoptic:

- ASYST LPT 2200
- ASYST ARM 2200
- Jenoptic ERGOSPEED 3800

The ASYST ARM 2200 offers an optional accessory called the **Smart Arm Movement (SAM)**. This option includes a “Smart Tag” in which information about the wafers can be stored and later read. The ASYST Arm 2200 is the only model that offers this option.

The SMIF has an RS-232 connection to the Equipment through which it can receive commands via the Equipment. Figure 18-2 shows the connections between Host, Equipment, and the SMIF. When the SMIF includes the SAM option, connection from the Equipment is made via the SAM.

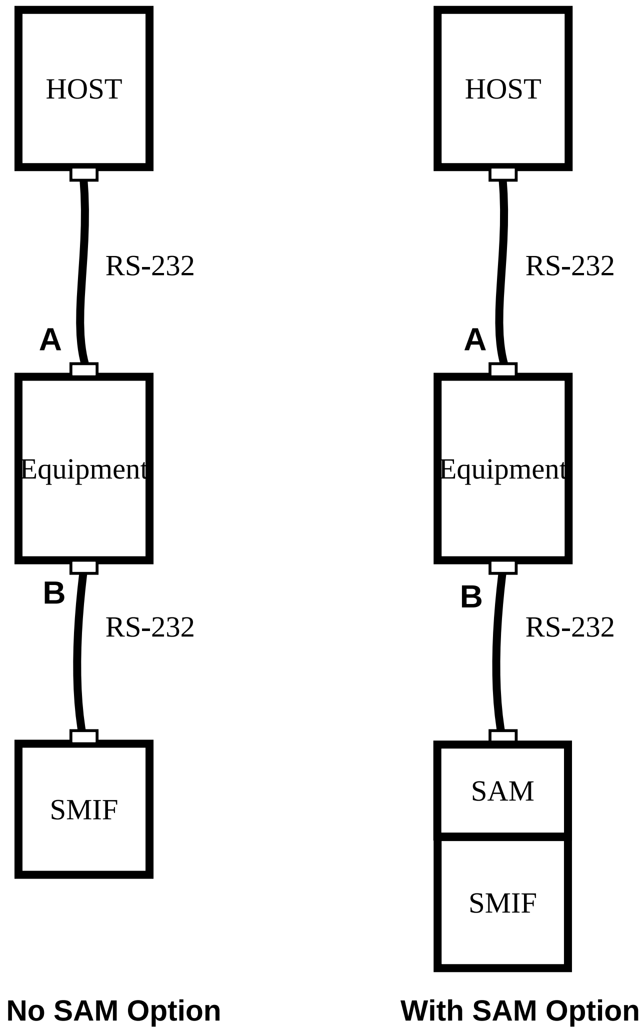


Figure 18-2. Serial Connections with a SMIF Arm

Figure 18-3 shows in greater detail the components that make up the Equipment and how it makes connection to the SMIF. The A and B connections in Figure 18-3 correspond to those in Figure 18-2.

On the rear panel of the Cell Controller are 16 fiber-optic connectors (which can be expanded to 32). A pair of fiber-optic cables (one for receive; the other for transmit) joins one of these connectors to an RS-232 TO FIBER-OPTIC CONVERTER. From there, connection is made to the SMIF by RS-232 cables.

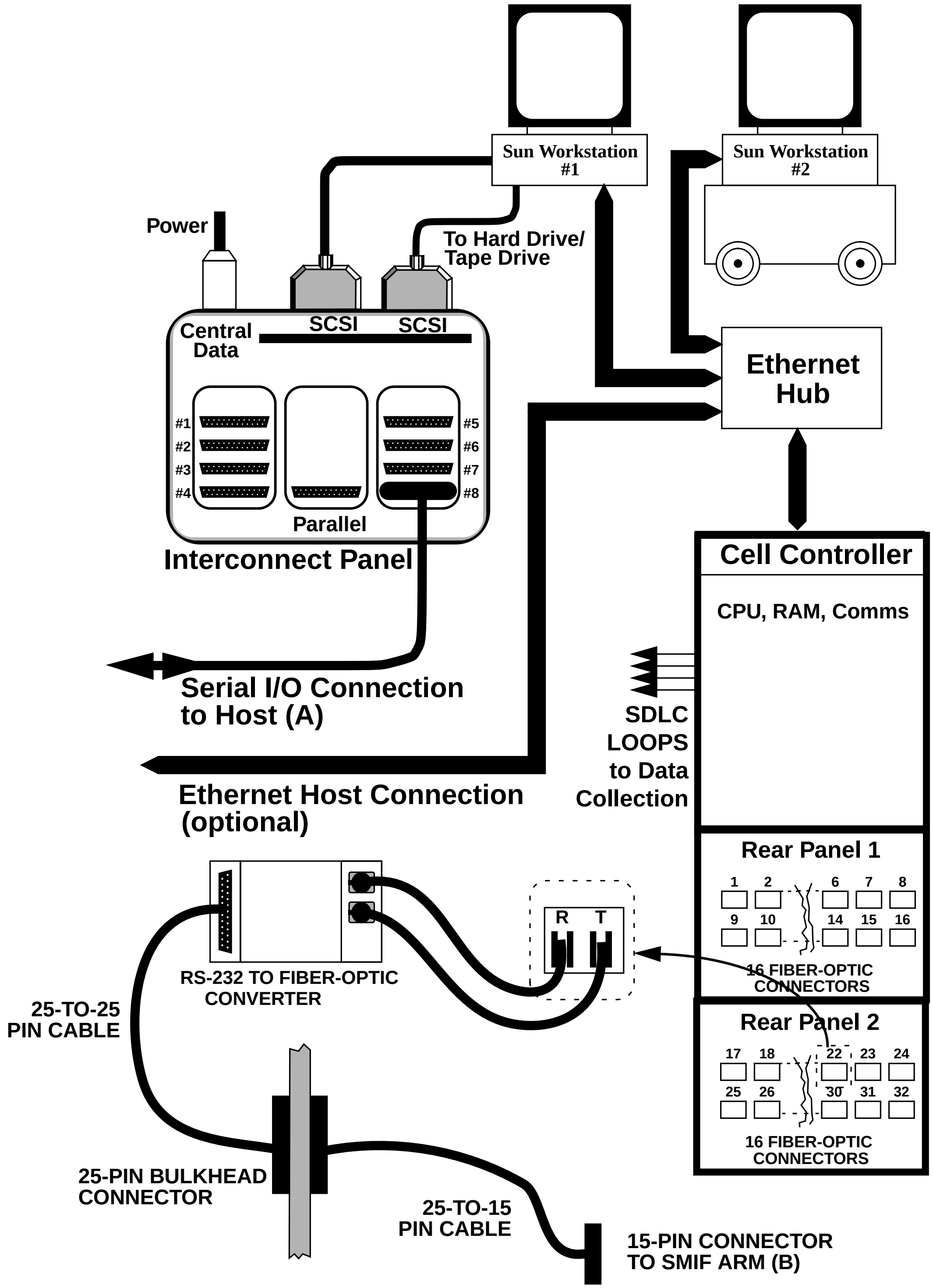


Figure 18-3. Component Details of the Equipment

18.3 Operating Modes

There are three operating modes:

Host-controlled: The Host sends control messages to the SMIF by way of its serial link to the Equipment. The Equipment, upon receiving the message and recognizing that it pertains to the SMIF, does either of the following:

- Pass it along as received
- Interpret it into a message that the SMIF can understand.

Equipment-controlled: Equipment sends control messages to the SMIF over the serial link that connects them. (See Figure 18-2.) There is no contact between the Host and the SMIF.

The Equipment. may carry on a conversation with the Host (over the Host-Equipment serial line) at the same time it is having a conversation with the SMIF (over the Equipment-SMIF serial line).

Operator-controlled: This mode is also called “standalone.” There is no communication with the SMIF. The operator alone controls things by selecting buttons on the control screens. This is discussed further in Section 18.10, Operator-controlled Mode.

Semiconductor Equipment

18.4 Configuration Screens

Chapter 2, Configuration and Startup, explained how to use the configuration screens to set values of equipment constants such as Baud Rate and timeouts. If you are not familiar with this material, review it now.

When there is a SMIF option, additional values must be entered. The method is the same.

1. Log in to the system. The Main Menu screen is displayed (shown in Figure 2-2).
2. Select **Supervisor:Configuration Editor** from the menu bar at the top.
3. The Configuration Points menu is displayed:

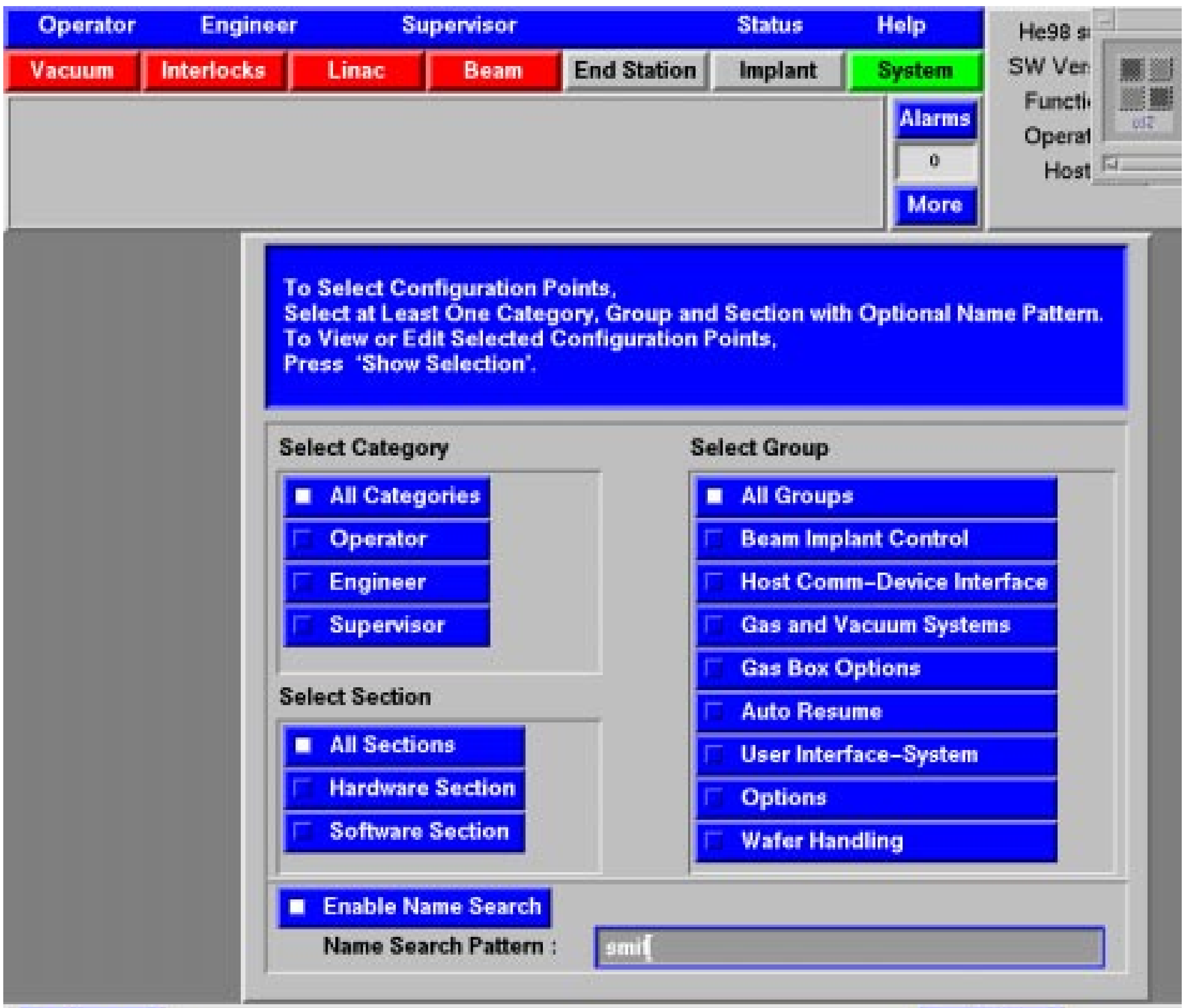


Figure 18-4. Menu Choices for SMIF Configuration Points

4. Select the options shown. (Example: **Select Category -- All Categories**.) Type the word “smif” in the **Name Search Pattern** field. Select the **Enable Name Search** button. The SMIF Configuration Points screen is shown in Figure 18-5.

Figure 18-5. SMIF-related Configuration Points

18.4.1 Hardware Points

Note: Those points for which a vid is listed (example: SMIF Arm Present) are accessible by the Host. Those for which a vid is *not* listed are not accessible by the Host.

Table 18-1. Hardware Points

SMIF Arm Present -- vid = 2822
Choices: ASYST SECS, ASYST PIO, Jenoptic SECS, Jenoptic PIO
Default Choice: No
Comment
SMIF SAM Present -- vid = 2820
Choices: yes, no
Default Choice: No
Comment: This is available with the ASYST SMIF but not with the Jenoptic SMIF.
SMIF - Pod Cass. Sensor Present
Choices: CF_NO, CF_YES
Default Choice: **CF_NO**
Comment:
SMIF Arm Pre-Load Enable
Choices: yes, no
Default Choice: no
Comment:
SMIF Arm Pre-Unload Enable
Choices: yes, no
Default Choices: **no**
Comment:

18.4.2 Software Points

Table 18-2. Software Points

Enable SMIF SECS Host Pass Thru
Choices: yes, no
Default Choice: yes
Comment
SMIF Arm SECS Device Id -- vid = 2823
Choices: 1-65535
Default Choice: 356
Comment
SMIF SAM SECS Device Id -- vid = 2821
Choices: 2-253
Default Choice: 100
Comment:
SMIF Arm Load/Unload Command Timeout
Choices: 40-360 secs
Default Choice: 120
Comment:
SMIF Arm Home Command Timeout
Choices: 30-270 secs
Default Choice: 90
Comment:
SMIF Arm Abort Command Timeout
Choices: 10-90 secs
Default Choice: 30
Comment:
SMIF Arm Pod Command Timeout
Choices: 5-45 secs
Default Choice: 15
Comment:

18.5 SMIF Messages

Chapter 16, Message Summary, describes the messages used by both Host and Equipment. The SMIF Arm option involves the use of different messages and different uses of familiar ones. There are two sub-sections:

- Section 18.5.1, S2F41
- Section 18.5.2, The Tag Message Group: S4F101 to S4F104.

18.5.1 S2F41 - Host Command Send

This message is described in Chapter 16. Use of a SMIF Arm involves different commands being substituted for the “RCMD.”

First, the general form of a remote command is copied here from Chapter 16, Messages Summary.

S2F41 - Host Command Send (HCS) . . . . S,H→E,reply

Description The Host requests the Equipment to perform the specified remote command with the associated parameter(s).

Structure S2F41 W

```
<L[2]
    <A RCMD>                      Remote command string
    <L[n]
        <L[2]
            <A CPNAME1>           Command parameter name
            <CPVAL1>              Command parameter value
        >
        ...
        <L[2]
            <A CPNAMEn>           Command parameter name
            <CPVALn>              Command parameter value
        >
    >
>.
```

Several classes of remote commands are available for use with a SMIF Arm. In each case, the programmer must substitute the command name for RCMD and fill in any parameters if required.

18.5.1.1 Load/unload cassette

```
S2F41 W
    <L[2]
        <A “LOAD_CASSETTE”>                 Or “UNLOAD_CASSETTE”
        <L[3]
            <L[2]
                <A “PORT”>
                <U4 port number>
            >
            <L[2]
                <A “PPID”>
                <A [name of recipe]>
            >
            L[2]
                <A “MID”>
                <A [name of material]>
            >

        >
    >.
```

18.5.1.2 Lock/unlock Pod

```
S2F41 W
    <L[2]
        <A “LOCK_POD”>                      Or “UNLOCK_POD”
        <L>
    >.
```

18.5.1.3 Led Blink

```
S2F41 W
    <L[2]
        <A “SMIF_LED_BLINK_ON”>
        <L>
    >.
```

18.5.2 The Tag Messages Group

For those SMIF installations that have a SAM option, there are commands to read from and write to the tag that is mounted on the pod.

They are:

- S4F101. Hosts requests Equipment to read a tag.
- S4F102. Equipment replies with the tag data.
- S4F103. Host sends data to be written to a tag.
- S4F104. Equipment acknowledges the command.

Section 18.9, Host-Controlled Operation, gives a good example of the use of one of these commands. The Host sends the Equipment an S4F101 message to read the tag. The Equipment passes the same message on to the SAM/SMIF, which then reads the tag and returns the data to the Equipment with an S4F102 message. The Equipment then passes this same S4F102 message back to the Host.

18.5.2.1 S4F101 - Tag Read Request

Form Codes 1,2,4,5,6

```
S4F101 W      H→E
    <L [3]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
    >.
```

Form Codes 3

```
S4F101 W
    <L [4]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <A FILEID>              * Ascii 12 bytes
    >.
```

18.5.2.2 S4F102 - Tag Read Data

Form Code 1

```
S4F102
    <L [5]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 ACK1>
        <L [2]
            <A LOTID>           * Ascii 16 bytes
            <U2 PRIORITY>
        >
    >.
```

Form Code 2

```
S4F102
    <L [5]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 ACK1>
        <L [n]                  * number of non blank messages
            <A LCDMES1>             * Ascii 16bytes
            <A LCDMES n>            * Ascii 16 bytes
        >
    >.
```

Form Code 3

```
S4F102
    <L [5]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 ACK1>
        <L [2]
            <A FILEID>          * Ascii 12 bytes
            <B FILEDATA>          * Binary Bites
        >
    >.
```

Form Code 4

```
S4F102
    <L [6]
        <U2 DEVID>
        <U1 TATAGGLOC>
        <U1 FMCODE>
        <U1 ACK1>
        <U1 NFILES>
        <L [n]                  * Based on N files
            <L [2]
                <A FILEID>      * Ascii 12 bytes
                <B FILEDATA>      * Binary Bites
            >
            <L [2]              * n implementation
                <A FILEID>      * Ascii 12 bytes
                <B FILEDATA>      * Binary Bites
            >
        >
    >.
```

Form Code 5

```
S4F102
    <L [7]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 ACK1>
        <U1 NFILES>
        <U2 FRESP>
        <L [n]                  * Based on N files
            <L [3]
                <A FILEID>      * Ascii 12 bytes
                <U1 FSIZE>
                <A FDATE>        * Ascii bytes
            >
            <L [3]              * n implementation
                <A FILEID>      * Ascii 12 bytes
                <U1 FSIZE>
                <A FDATE>        * Ascii bytes
            >
        >
    >.
```

Form Code 6

```
S4F102
    <L [11]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 ACK1>
        <U1 BAT_STAT>
        <U1 RAM_SIZE>
        <U2 TGSW_DAT>
        <A TAG_SER>                 * Ascii 12 bytes
        <A BCHG_DAT>                * Ascii 8 bytes
        <A BCHG_TIM>                * Ascii 8 bytes
        <U1 L_SFTEST>
    >.
```

18.5.2.3 S4F103 - Tag Write Data

Form Code 1

```
S4F103
    <L [4]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <L [2]
            <A LOTID>               * Ascii 16 bytes
            <U2 PRIORITY>
        >
    >.
```

Form Code 2

```
S4F103
    <L [4]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <L [n]                      * number of non blank messages
            <A LCDMES1>             * Ascii 16 bytes
            <A LCDMES n>            * Ascii 16 bytes
        >
    >.
```

Form Code 3

```
S4F103
    <L [5]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 FILOVWT>
        <L [2]
            <A FILEID>              * Ascii 12 bytes
            <B FILEDATA>            * Binary Bites
        >
    >
```

Form Code 7

```
S4F103
    <L [4]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <A FILEID>                    * Ascii 12 bytes
    >
```

Form Code 8

```
S4F103
    <L [3]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
    >.
```

Form Code 9

```
S4F103
    <L [6]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <A TAG_SER>                   * Ascii 12 bytes
        <A BCHG_DAT>                  * Ascii 8 bytes
        <A BCHG_TIM>                  * Ascii 8 bytes
    >.
```

Form Code 10

```
S4F103
    <L [4]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <L [n]                        * Based on N files
            <L [3]
                <A FILEID>            * Ascii 12 bytes
                <U1 FILOVWT>
                <B FILEDATA>          * Binary Bites
            >
    >.
```

18.5.2.4 S4F104 - Tag Write Acknowledge

```
S4F104
    <L [4]
        <U2 DEVID>
        <U1 TAGLOC>
        <U1 FMCODE>
        <U1 ACK1>
    >.
```

18.6 Alarms

The following is a list of the SMIF-related alarms that may occur.

```
alarm ALM_SMIF_ALARMS
     alid = 453050368
     altx = “SMIF-Arm Alarm Class”

alarm ALM_SMIF_ALM_LOAD_COLLISION
     alid = 453050369
     altx = “SMIF-Arm Load Error - Collision”

alarm ALM_SMIF_ALM_USER_ABORT
     alid = 453050370
     altx = “SMIF-Arm Load Error - Aborted by User”

alarm ALM_SMIF_ALM_LOAD_BAD_SQUAT
     alid = 453050371
     altx = “SMIF-Arm Load Error - Improper Squat”

alarm ALM_SMIF_ALM_LOAD_BAD_SEATING
     alid = 453050372
     altx = “SMIF-Arm Load Error - Improper Wafer Sea”

alarm ALM_SMIF_ALM_LOAD_BAD_SENSOR
     alid = 453050373
     altx = “SMIF-Arm Load Error - Bad Wafer Sensor”

alarm ALM_SMIF_ALM_LOAD_BAD_DOOR
     alid = 453050374
     altx = “SMIF-Arm Load Error - Port Door not Leve”

alarm ALM_SMIF_ALM_LOAD_ABNRML_ABORT
     alid = 453050375
     altx = “SMIF-Arm Load Error - Abnormal Abort”

alarm ALM_SMIF_ALM_LOAD_ARM_NOT_HOME
     alid = 453050376
     altx = “SMIF-Arm Load Error - ARM not Home/Illeg”

alarm ALM_SMIF_ALM_LOAD_CASS_GONE
     alid = 453050377
     altx = “SMIF-Arm Load Error - Cassette not Prese”

alarm ALM_SMIF_ALM_LOAD_POD_REMOVED
     alid = 453050378
     altx = “SMIF-Arm Load Error - Pod Removed”

alarm ALM_SMIF_ALM_UNLOAD_COLLISION
     alid = 453050379
     altx = “SMIF-Arm Unload Error - Collision”

alarm ALM_SMIF_ALM_UNLOAD_USER_ABORT
     alid = 453050380
     altx = “SMIF-Arm Unload Error - Aborted by User”

alarm ALM_SMIF_ALM_UNLOAD_BAD_SQUAT
     alid = 453050381
     altx = “SMIF-Arm Unload Error - Improper Squat”
```

```
alarm ALM_SMIF_ALM_UNLOAD_BAD_SEATING
     alid = 453050382
     altx = "SMIF-Arm Unload Error - Improper Wafer S"

alarm ALM_SMIF_ALM_UNLOAD_BAD_SENSOR
     alid = 453050383
     altx = "SMIF-Arm Unload Error - Bad Wafer Sensor"

alarm ALM_SMIF_ALM_UNLOAD_BAD_DOOR
     alid = 453050384
     altx = "SMIF-Arm Unload Error - Port Door not Le"

alarm ALM_SMIF_ALM_UNLOAD_ABNRML_ABORT
     alid = 453050385
     altx = "SMIF-Arm Unload Error - Abnormal Abort"

alarm ALM_SMIF_ALM_UNLOAD_ARM_NOT_HOME
     alid = 453050386
     altx = "SMIF-Arm Unload Error - ARM not Home/Ill"

alarm ALM_SMIF_ALM_UNLOAD_CASS_GONE
     alid = 453050387
     altx = "SMIF-Arm Unload Error - Cassette not Pre"

alarm ALM_SMIF_ALM_UNLOAD_POD_REMOVED
     alid = 453050388
     altx = "SMIF-Arm Unload Error - Pod Removed

alarm ALM_SMIF_ALM_HOME_COLLISION
     alid = 453050389
     altx = "SMIF-Arm Home Error - Collision"

alarm ALM_SMIF_ALM_HOME_USER_ABORT
     alid = 453050390
     altx = "SMIF-Arm Home Error - Aborted by User"

alarm ALM_SMIF_ALM_HOME_BAD_SQUAT
     alid = 453050391
     altx = "SMIF-Arm Home Error - Improper Squat"

alarm ALM_SMIF_ALM_HOME_BAD_SEATING
     alid = 453050392
     altx = "SMIF-Arm Home Error - Improper Wafer Sea"

alarm ALM_SMIF_ALM_HOME_BAD_SENSOR
     alid = 453050393
     altx = "SMIF-Arm Home Error - Bad Wafer Sensor"

alarm ALM_SMIF_ALM_HOME_BAD_DOOR
     alid = 453050394
     altx = "SMIF-Arm Home Error - Port Door not Leve"

alarm ALM_SMIF_ALM_HOME_ABNRML_ABORT
     alid = 453050395
     altx = "SMIF-Arm Home Error - Abnormal Abort"

alarm ALM_SMIF_ALM_HOME_ARM_NOT_HOME
     alid = 453050396
     altx = "SMIF-Arm Home Error - ARM not Home/Illeg"
```

```
alarm ALM_SMIF_ALM_HOME_CASS_GONE
     alid = 453050397
     altx = “SMIF-Arm Home Error - Cassette not Prese”

alarm ALM_SMIF_ALM_HOME_POD_REMOVED
     alid = 453050398
     altx = “SMIF-Arm Home Error - Pod Removed”

alarm ALM_SMIF_BAD_CMD_DENIED
     alid = 453050399
     altx = “SMIF-Arm Bad Command - Denied”

alarm ALM_SMIF_BAD_CMD_CANNOT_PERFORM_NOW
     alid = 453050400
     altx = “SMIF-Arm Bad Command - Can not Perform N”

alarm ALM_SMIF_BAD_CMD_ARM_IN_MANUAL_MODE
     alid = 453050401
     altx = “SMIF-Arm Bad Command - Arm in Manual Mod”

alarm ALM_SMIF_BAD_CMD_NO_POD_IN_PLACE
     alid = 453050402
     altx = “SMIF-Arm Bad Command - No Pod in Place”

alarm ALM_SMIF_BAD_CMD_HOST_NOT_READY
     alid = 453050403
     altx = “SMIF-Arm Bad Command - Host not Ready”

alarm ALM_SMIF_BAD_CMD_LIMIT
     alid = 453050404
     altx = “SMIF-Arm Bad Command - Limit not Reached”

alarm ALM_SMIF_BAD_CMD_ALREADY_THERE
     alid = 453050405
     altx = “SMIF-Arm Bad Command - ARM/ALU Already i”

alarm ALM_SMIF_ALM_PRE_LOAD_COLLISION
     alid = 453050406
     altx = “SMIF-Arm Pre-Load Error - Collision”

alarm ALM_SMIF_ALM_PRE_LOAD_USER_ABORT
     alid = 453050407
     altx = “SMIF-Arm Pre-Load Error - Aborted by Use”

alarm ALM_SMIF_ALM_PRE_LOAD_BAD_SQUAT
     alid = 453050408
     altx = “SMIF-Arm Pre-Load Error - Improper Squat”

alarm ALM_SMIF_ALM_PRE_LOAD_BAD_SEATING
     alid = 453050409
     altx = “SMIF-Arm Pre-Load Error - Improper Wafer”

alarm ALM_SMIF_ALM_PRE_LOAD_BAD_SENSOR
     alid = 453050410
     altx = “SMIF-Arm Pre-Load Error - Bad Wafer Sens”

alarm ALM_SMIF_ALM_PRE_LOAD_BAD_DOOR
     alid = 453050411
     altx = “SMIF-Arm Pre-Load Error - Port Door not “
```

```
alarm ALM_SMIF_ALM_PRE_LOAD_ABNRML_ABORT
     alid = 453050412
     altx = “SMIF-Arm Pre-Load Error - Abnormal Abort”

alarm ALM_SMIF_ALM_PRE_LOAD_ARM_NOT_HOME
     alid = 453050413
     altx = “SMIF-Arm Pre-Load Error - ARM not Home/I”

alarm ALM_SMIF_ALM_PRE_LOAD_CASS_GONE
     alid = 453050414
     altx = “SMIF-Arm Pre-Load Error - Cassette not P”

alarm ALM_SMIF_ALM_PRE_LOAD_POD_REMOVED
     alid = 453050415
     altx = “SMIF-Arm Pre-Load Error - Pod Removed”

alarm ALM_SMIF_ALM_PRE_UNLOAD_COLLISION
     alid = 453050416
     altx = “SMIF-Arm Pre-Unload Error - Collision”

alarm ALM_SMIF_ALM_PRE_UNLOAD_USER_ABORT
     alid = 453050417
     altx = “SMIF-Arm Pre-Unload Error - Aborted by U”

alarm ALM_SMIF_ALM_PRE_UNLOAD_BAD_SQUAT
     alid = 453050418
     altx = “SMIF-Arm Pre-Unload Error - Improper Squ”

alarm ALM_SMIF_ALM_PRE_UNLOAD_BAD_SEATING
     alid = 453050419
     altx = “SMIF-Arm Pre-Unload Error - Improper Waf”

alarm ALM_SMIF_ALM_PRE_UNLOAD_BAD_SENSOR
     alid = 453050420
     altx = “SMIF-Arm Pre-Unload Error - Bad Wafer Se”

alarm ALM_SMIF_ALM_PRE_UNLOAD_BAD_DOOR
     alid = 453050421
     altx = “SMIF-Arm Pre-Unload Error - Port Door no”

alarm ALM_SMIF_ALM_PRE_UNLOAD_ABNRML_ABORT
     alid = 453050422
     altx = “SMIF-Arm Pre-Unload Error - Abnormal Abo”

alarm ALM_SMIF_ALM_PRE_UNLOAD_ARM_NOT_HOME
     alid = 453050423
     altx = “SMIF-Arm Pre-Unload Error - ARM not Home”

alarm ALM_SMIF_ALM_PRE_UNLOAD_CASS_GONE
     alid = 453050424
     altx = “SMIF-Arm Pre-Unload Error - Cassette not”

alarm ALM_SMIF_ALM_PRE_UNLOAD_POD_REMOVED
     alid = 453050425
     altx = “SMIF-Arm Pre-Unload Error - Pod Removed”

alarm ALM_SMIF_GENERAL
     alid = 453115904
     altx = “SMIF-Arm General Class”
```

```
alarm ALM_SMIF_ERROR_HOME_SHUTTLE_NOT_READY
     alid = 453115905
     altx = “SMIF-Arm Home Error - Shuttle Table not “

alarm ALM_SMIF_ERROR_LOAD_SHUTTLE_NOT_READY
     alid = 453115906
     altx = “SMIF-Arm Load Error - Shuttle Table not “

alarm ALM_SMIF_ERROR_LOAD_CASS_NOT_UNLATCHED
     alid = 453115907
     altx = “SMIF-Arm Load Error - Cassette Latch not”

alarm ALM_SMIF_ERROR_UNLOAD_SHUTTLE_NOT_READY
     alid = 453115908
     altx = “SMIF-Arm Unload Error - Shuttle Table no”

alarm ALM_SMIF_ERROR_UNLOAD_CASS_NOT_UNLATCHED
     alid = 453115909
     altx = “SMIF-Arm Unload Error - Cassette Latch n”

alarm ALM_SMIF_STAT_ARM_IN_HOME_POS
     alid = 453115910
     altx = “SMIF-Arm in Home Position”

alarm ALM_SMIF_STAT_ARM_NOT_IN_HOME_POS
     alid = 453115911
     altx = “SMIF-Arm Not in Home Position”

alarm ALM_SMIF_SMART_TAG_CONTENTS
     alid = 453115912
     altx = “SMIF-Arm Pod Lotid [] Priority []”

alarm ALM_SMIF_STAT_PING_TIMEOUT
     alid = 453115913
     altx = “SECS Timeout with SMIF-Arm, Stream Funct”

alarm ALM_SMIF_ARM_MODEL_INFO
     alid = 453115914
     altx = “SMIF-Arm model [] Software Rev []”

alarm ALM_SMIF_SAM_MODEL_INFO
     alid = 453115915
     altx = “SMIF SAM model [] Software Rev []”

alarm ALM_SMIF_ARM_PUT_INTO_REMOTE
     alid = 453115916
     altx = “SMIF-Arm Event - Put SMIF-Arm into Remot”

alarm ALM_SMIF_ARM_CANNOT_PUTINTO_REMOTE
     alid = 453115917
     altx = “SMIF-Arm Event - Can not Put into Remote”

alarm ALM_SMIF_ARM_DISABLED_ALL_BUTTONS
     alid = 453115918
     altx = “SMIF-Arm Event - Disabled All Buttons”

alarm ALM_SMIF_ARM_CANNOT_DIABLE_BUTTONS
    alid = 453115919
     altx = “SMIF-Arm Event - Can not Disable All But”
```

```
alarm ALM_SMIF_ARM_BLINK_POD
     alid = 453115920
     altx = “SMIF-Arm Event - Blink Pod LED”

alarm ALM_SMIF_ARM_POD_LOCK_START
     alid = 453115921
     altx = “SMIF-Arm Event - Pod Lock Started”

alarm ALM_SMIF_ARM_POD_LOCK_COMPLETE
     alid = 453115922
     altx = “SMIF-Arm Event - Pod Lock Complete”

alarm ALM_SMIF_ARM_POD_LOCK_FAILED
     alid = 453115923
     altx = “SMIF-Arm Event - Pod Lock Failed”

alarm ALM_SMIF_ARM_POD_UNLOCK_START
     alid = 453115924
     altx = “SMIF-Arm Event - Pod Unlock Started”

alarm ALM_SMIF_ARM_POD_UNLOCK_COMPLETE
     alid = 453115925
     altx = “SMIF-Arm Event - Pod Unlock Complete”

alarm ALM_SMIF_ARM_POD_UNLOCK_FAILED
     alid = 453115926
     altx = “SMIF-Arm Event - Pod Unlock Failed”

alarm ALM_SMIF_ARM_ABORTED
     alid = 453115927
     altx = “SMIF-Arm Alarm - Arm Function Aborted”

alarm ALM_SMIF_PLEASE_HOME
     alid = 453115928
     altx = “Home SMIF-Arm, then retry SMIF operation”

alarm ALM_SMIF_PLEASE_HOME_MANUALLY
     alid = 453115929
     altx = “*Manually* Home SMIF-Arm, then renter Au”

alarm ALM_SMIF_NO_AUTO_IF_SMIF_IN_MANUAL
     alid = 453115930
     altx = “Cannot perform Auto SMIF Function, SMIF “

alarm ALM_SMIF_ERROR_NO_CASS_IN_POD_CANT_LOAD
     alid = 453115931
     altx = “SMIF-Arm Load Error - There is no Casset”

alarm ALM_SMIF_ERROR_CASS_IN_POD_CANT_UNLOAD
     alid = 453115932
     altx = “SMIF-Arm Unload Error - There is a Casse”

alarm ALM_SMIF_NO_FUNCTIONS_TO_ABORT
     alid = 453115933
     altx = “SMIF - no automatic operations to abort”

alarm ALM_SMIF_PRE_LOAD_NOT_CONFIGURED
     alid = 453115934
     altx = “SMIF-Arm cannot Pre-Load, not Configured”
```

```
alarm ALM_SMIF_PRE_UNLOAD_NOT_CONFIGURED
     alid = 453115935
     altx = “SMIF-Arm cannot Pre-Unload, not Configur”

alarm ALM_WH_SMIF_COMM_DOWN
     alid = 494665730
     altx = “SMIF DI communication down, cannot execu”
```

18.7 Events

The following is a list of SMIF-related events that may occur.

```
ALM_SMIF_EVENT_POD_REMOVED = 452984833
 SMIF-Arm Event - Pod Remove

ALM_SMIF_EVENT_POD_PLCED = 452984834
 SMIF-Arm Event - Pod Place

ALM_SMIF_EVENT_ENTER_AUTO = 452984835
 SMIF-Arm Event - Automatic Mode Entered

ALM_SMIF_EVENT_ENTER_MANUAL = 452984836
 SMIF-Arm Event - Manual Mode Entered

ALM_SMIF_EVENT_POWERED_UP = 452984837
 SMIF-Arm Event - Arm Powered Up

ALM_SMIF_EVENT_LOAD_START = 452984838
 SMIF-Arm Event - Load Started

ALM_SMIF_EVENT_LOAD_DONE = 452984839
 SMIF-Arm Event - Load Complete

ALM_SMIF_EVENT_LOAD_ABORT = 452984840
 SMIF-Arm Event - Load Aborted

ALM_SMIF_EVENT_UNLOAD_START = 452984841
 SMIF-Arm Event - Unload Started

ALM_SMIF_EVENT_UNLOAD_END = 452984842
 SMIF-Arm Event - Unload Complete

ALM_SMIF_EVENT_UNLOAD_ABORT =452984843
 SMIF-Arm Event - Unload Aborted

ALM_SMIF_EVENT_HOME_START = 452984844
 SMIF-Arm Event - Home Started
>
ALM_SMIF_EVENT_HOME_DONE =452984845
 SMIF-Arm Event - Home Completed

ALM_SMIF_EVENT_CASS_REL_ON_TABLE = 452984846
 SMIF-Arm Event - Cassette Released on Table

ALM_SMIF_EVENT_HOME_ABORT = 452984847
 SMIF-Arm Event - Home Aborted
```

```
ALM_SMIF_EVENT_PORT_LOCKED = 452984848
 SMIF-Arm Event - Pod Port Locked

ALM_SMIF_EVENT_PORT_UNLOCKED = 452984849
 SMIF-Arm Event - Pod Port Unlocked

ALM_SMIF_EVENT_PRE_LOAD_START = 452984861
 SMIF-Arm Event - Pre-Load Started

ALM_SMIF_EVENT_PRE_LOAD_DONE = 452984862
 SMIF-Arm Event - Pre-Load Done

ALM_SMIF_EVENT_PRE_LOAD_ABORT = 452984863
 SMIF-Arm Event - Pre-Load Aborted

ALM_SMIF_EVENT_PRE_UNLOAD_START =   452984864
 SMIF-Arm Event - Pre-Unload Started

ALM_SMIF_EVENT_PRE_UNLOAD_DONE = 452984865
 SMIF-Arm Event - Pre-Unload Completed

ALM_SMIF_EVENT_PRE_UNLOAD_ABORT = 452984866
 SMIF-Arm Event - Pre-Unload Aborted
```

18.8 Database Points

This section lists the database points the Host must access in order to ascertain the status of the SMIF arm.

```
status DB_CF_SMIF_SAM_PRESENT_IV
   vid = 2820
   name = “DB_CF_SMIF_SAM_PRESENT_IV”
     Indicates whether the machine is configured for a Smart
     Arm Master (SAM)
        0 = no
        1 = yes

status DB_CF_SMIF_SAM_SECS_DEVID_IV
   vid = 2821
   name = “DB_CF_SMIF_SAM_SECS_DEVID_IV”
     Contains the SECS device Id of the SMIF SAM unit (if
     present).

status DB_CF_SMIF_ARM_PRESENT_IV
   vid = 2822
   name = “DB_CF_SMIF_ARM_PRESENT_IV”
     Indicates whether the machine is configured for a SMIF
     Arm.
        0 = NO SMIF Arm
        1 = yes, Asyst SMIF Arm, serial SECS interface
        3 = yes, Jenoptik SMIF Arm, serial SECS interface
      257 = yes, Asyst SMIF Arm, parallel I/O interface
      259 = yes, Jenoptik SMIF Arm, parallel I/O interface

status DB_CF_SMIF_ARM_SECS_DEVID_IV
   vid = 2823
   name = “DB_CF_SMIF_ARM_SECS_DEVID_IV”
     Contains the device ID of the SMIF Arm.

status DB_SMIF_CASSETTE_POD_EMPTY_TSR
   vid = 1082
   name = “DB_SMIF_CASSETTE_POD_EMPTY_TSR”
     Indicates whether the pod on the SMIF Arm has a cassette
     in it. (Valid only when a cassette sensor is present.
     DB_CF_SMIF_POD_CASSETTE_SENSOR_PRESENT = 1)
        0 = cassette in pod
        1 = no cassette in pod

status DB_CF_SMIF_POD_CASSETTE_SENSOR_PRESENT_IV
   vid = 2888
   name = “DB_CF_SMIF_POD_CASSETTE_SENSOR_PRESENT_IV”
     Indicates whether the Equipment has a pod sensor
     installed.
        0 = A pod cassette sensor is not installed
        1 = A pod cassette sensor is installed

status DB_CF_SMIF_ARM_PRE_LOAD_ENABLE_IV
   vid = 2881
   name = “DB_CF_SMIF_ARM_PRE_LOAD_ENABLE_IV”
     Indicates whether the SMIF Arm is capable of using the
     Pre-load routine. (This routine enables the SMIF Arm to
     pre-position the cassette to be loaded to the pre-load
     position.)
        0 = SMIF Arm does not have pre-load capability
        1 = SMIF Arm does have pre-load capability
```

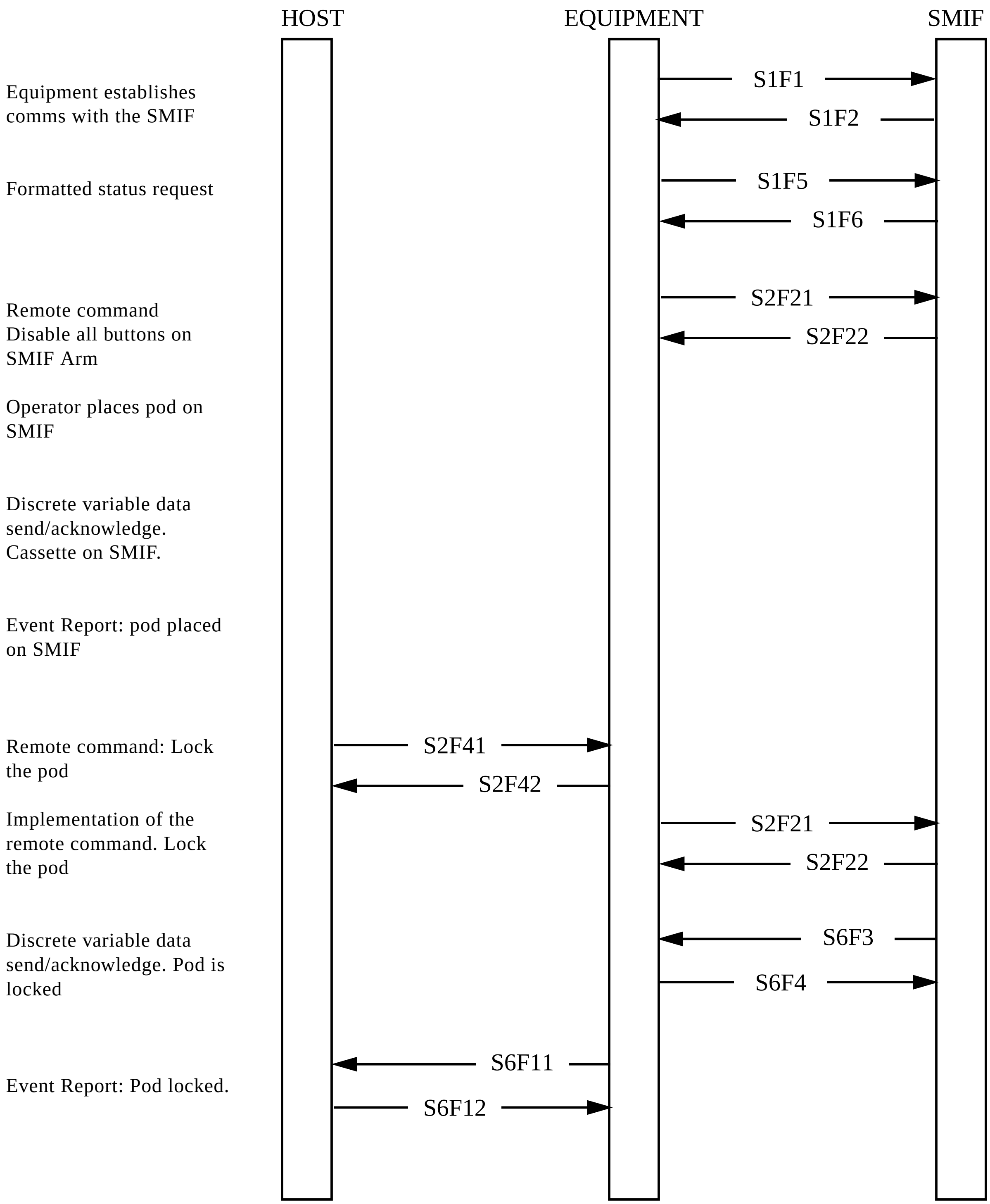
```
status DB_CF_SMIF_ARM_PRE_UNLOAD_ENABLE_IV
   vid = 2890
   name = "DB_CF_SMIF_ARM_PRE_UNLOAD_ENABLE_IV"
     Indicates whether the SMIF Arm is capable of using the
     Pre-unload routine. (This enables the SMIF Arm to
     pre-position the cassette to the pre-unload position.)
        0 = SMIF Arm does not have pre-unload capability
        1 = SMIF Arm does have pre-unload capability

status DB_CF_SMIF_SECS_HOST_PASS_THRU_ENABLE_IV
   vid = 2891
   name = "DB_CF_SMIF_SECS_HOST_PASS_THRU_ENABLE_IV"
     Indicates whether the command to load/unload a cassette
     will come from the Host or from the Equipment.
        0 = Equipment commands the SMIF Arm to load/unload a
            cassette
        1 = Host commands the SMIF Arm to load/unload a cas-
            sette

status DB_CF_SMIF_POD_CASSETTE_STATUS_IV
   vid = 3547
   name = "DB_CF_SMIF_POD_CASSETTE_STATUS_IV"
     Indicates whether there is a pod on the SMIF Arm.
        1 = Pod on SMIF Arm
        2 = No pod on SMIF Arm

status DB_SMIF_ARM_STATUS_IV
   vid = 4013
   name = "DB_CF_SMIF_ARM_STATUS_IV"
     Indicates status of the SMIF Arm.
        0x0000000 - Idle
        0x1100001 - Pre-loading
        0x1100100 - Pre-load
        0x0000001 - Loading
        0x1000001 - Loading (safe)
        0x1100002 - Pre-unloading
        0x1100200 - Pre-unload
        0x0000002 - Unloading
        0x1000002 - Unloading (safe)
        0x0000004 - Homing
        0x1000004 - Homing (safe)
        0x1000008 - Home
        0x0000010 - Collided
        0x1000010 - Collided (safe)
        0x0000020 - Lost
        0x1000020 - Lost (safe)
        0x1000040 - Locking pod
        0x1000080 - Unlocking pod
        0x2000000 - Manual
        0x0000007 - Moving (used in PIO mode)
```

18.9 Host-Controlled Operation



A Tag Read Request is possible for users who have the SAM Option

Remote command. Load the cassette command: port, mid, and ppid parameters are passed.

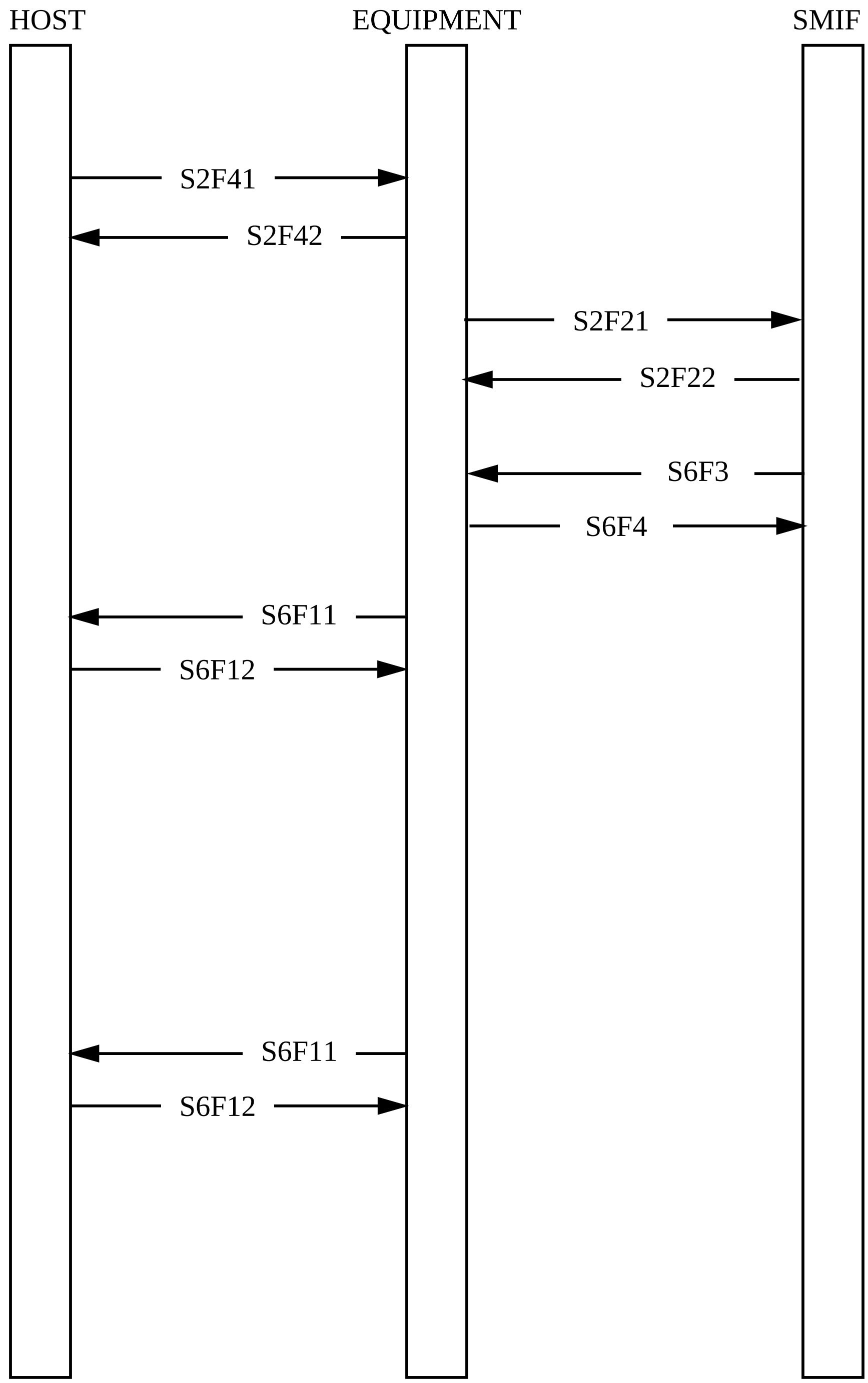
Implementation. Load the cassette.

Cassette has been loaded.

Event Report. Change of cassette state.

Wafers are processed and returned to the cassette

Event Report. Change of cassette state.



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Remote command. Remove the cassette command: port, mid, and ppid parameters are passedls .

NOTE: For the cassette to be removed and placed on the SMIF Arm, there has to be an empty and locked pod on the SMIF Arm.

Implementation of the remote command. Remove the cassette.

Cassette has been removed.

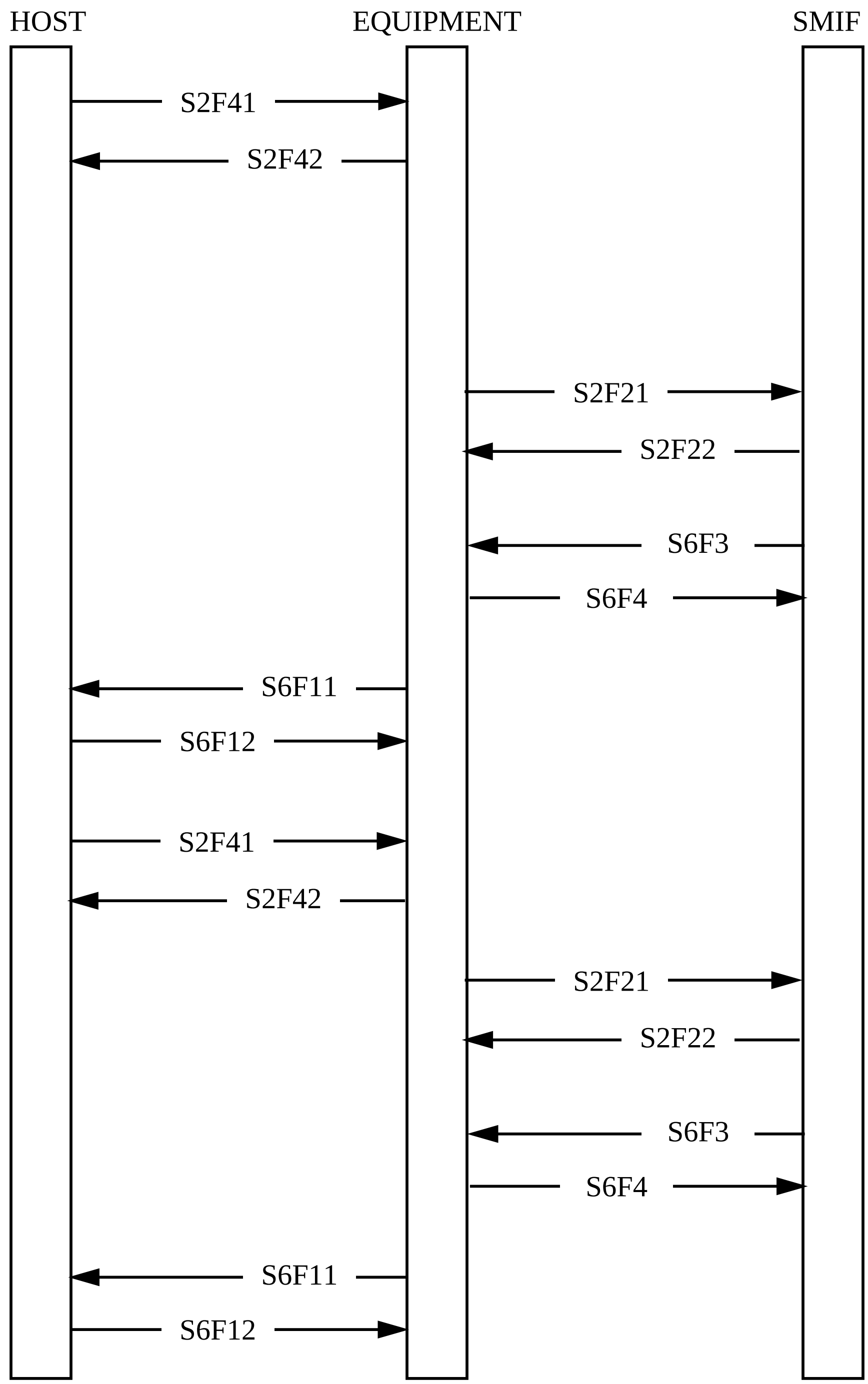
Event Report. Change of cassette state

Remote command. Unlock the pod.

Implementation of the remote command. Unlock the pod.

The pod is unlocked.

Event Report. Pod unlocked.



18.10 Operator-controlled Mode

18.10.1 Loading Cassettes

The operator performs the following steps to load a cassette from the SMIF Arm onto the table. (The configuration point **Implant Mode** must be set to Automatic.)

1. Select **Operator:Automatic Implant**. The Automatic Implant screen is displayed, with the SMIF button appearing in the lower right corner (when a SMIF is configured).

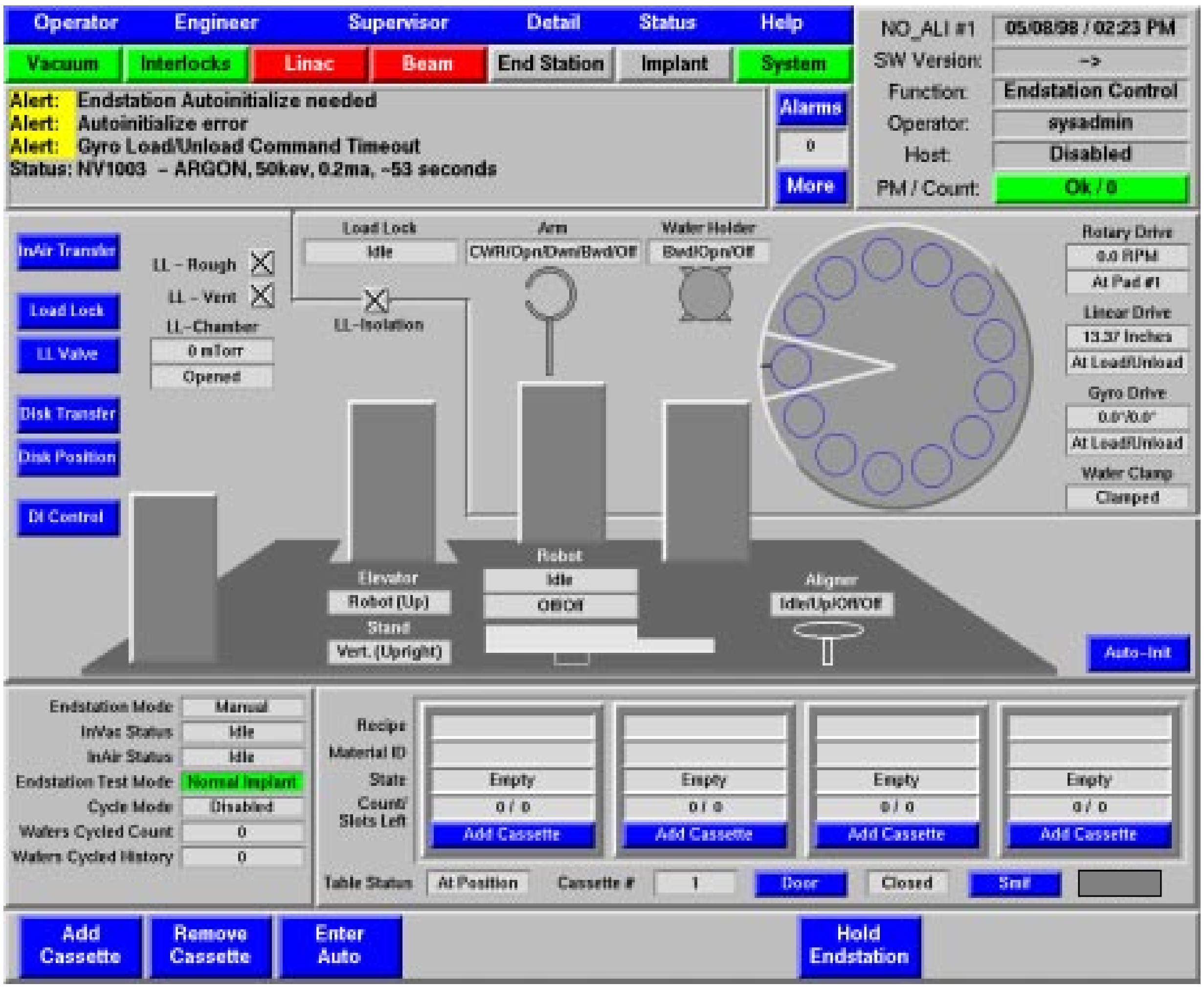


Figure 18-6. Automatic Implant Screen with SMIF Option

2. Click the **Add Cassette** button in the lower-left corner. This causes the next available port to be selected. The Add Cassette window is displayed (Figure 18-7).

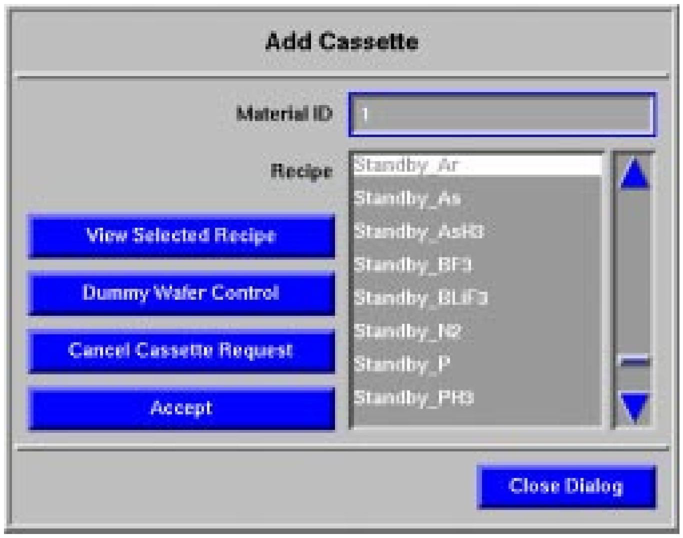


Figure 18-7. Entry of Material ID and Recipe

3. Scroll to the desired recipe for this implant operation via the scroll bar on the right. Enter the appropriate number in the **Material Id** field and click **Accept**. Then click **Confirm**.
4. The port on which the cassette is to be placed must be moved into alignment with the robot arm, if it is not currently at that position. Once the table is positioned, the SMIF places its pod containing the cassette onto that port.
5. The extraction and processing of wafers begins.

18.10.2 Unloading Cassettes

In Figure 18-6, note that each of the four ports has five status fields, one above the other: **Recipe, Material Id, State, Count, Slots Left.**

When processing is complete, the **State** field for the active port indicates the port status. The cassette is removed as follows.

1. Operator clicks the **Remove Cassette** button.
2. If necessary, the table moves to bring the port bearing the completed cassette into alignment with the robot arm.
3. The SMIF unloads the cassette.
4. The SMIF Arm removes the cassette from its port.

18.10.3 SMIF Control Panel

The SMIF Control panel is available to manually control the SMIF from the Operator Interface screen. It duplicates the control functions on the panel on the SMIF, and can be used to re-initialize SMIF operations or manually home the arm. To access this panel, click the SMIF button on the Automatic Implant screen. The SMIF Control pop-up panel appears.

Figure 18-8. SMIF Control Panel

These buttons have the following functions:

- Pre Load -- positions the pod and SMIF arm prior to a Load operation, while the endstation is still in motion from another operation. This function is valid only on Asyst 2200 SMIFs, and must be configured.
- Pre Unload - positions the pod and SMIF arm prior to an Unload operation, while the endstation is still in motion from another operation. This function is valid only on Asyst 2200 SMIFs only, and must be configured.
- Load - halts endstation while SMIF arm loads port.
- Unload - halts endstation while SMIF arm unloads port.
- Home - returns SMIF arm to home position.
- Abort - abrupt stop of SMIF arm operation.
- Pod Lock - locks pod on minienvironment transport.
- Pod Unlock - unlocks pod on minienvironment transport.
- Close Dialog - closes SMIF Conrol panel.

Note: The SMIF must be taught the specific points (Teach Points) required for load and unload operations prior to use. This should be performed during the installation and system configuration phase. Refer to the installation manual by the SMIF vendor.

Chapter 19
Implant Completion and Custom Implant Data Log

19.1 Implant Completion

Two different message reports describing the results of an implant process are available to the Host upon the completion of the process.

- S6F8

  This message is sent to the Host as a reply to an S6F7 request. S6F8 is annotated. This means that for each data item reported, the value of the item is preceded by its name. In contrast, the message S6F9 (see below) is not annotated.
- S6F9

  This message is sent without Host request at the end of an implantation process, providing that certain choices were selected on the Configuration Screen. (The message is not annotated.)

  Refer to Table 2-1 in Chapter 2 and note particularly the item **SECS IDL File Format**. The possible choices for this item are:
  - None

    With this choice, no S6F9 message is sent
  - ASCII File

    S6F9 is sent in ASCII format
  - Binary

    S6F9 is sent in binary format
  - ASCII and binary

    Both ASCII and binary messages are sent

19.1.1 Implant Data Log (IDL)

The results of an implant process can also be viewed by the operator at their screen. To view this, select **Operator:Implant Data Log** from the menu**.**

19.2 Custom Implant Data Log

The S6F8 message is a lengthy full report; some users may prefer to receive a report that is shorter and custom-tailored to their needs.

This remainder of this chapter describes how to customize an implant data log.

19.2.1 Procedure

Chapter 6, Reports, Status Variables, Collection Events, gives the general procedure for generating reports.

1. Define a report using message S2F33. (See Section 6.1.)
2. Link the report to some collection event, using S2F35. (See Section 6.1.2.)
3. Enable that event using S2F37. (See Section 6.1.3.)

Follow the same procedure to create a custom data log.

This chapter includes lists of all the database points you might want to include in your customized report: all those points that are valid at the end of an implant. These points are listed alphabetically in Section 19.2.2.

Note: This list includes all of the possible points that could be included in a report. Depending on the configuration of your particular machine, some of them may not be supported.

Step (2) in the above procedure instructs you to link your report to some collection event. The event to which you link your report is:

```
event ALM_IC_IDL_DATABASE_LOADED
    ceid = 100925509
```

19.2.2 Database Points - Listed Alphabetically

All wafer parameters have the following format:

20 characters - dsmmmmmmmmmmmmmmmmcs,
where

- ds = disk slot number
- mmmmmmmmmmmmmmmm = material id, 16 characters
- cs = cassette slot

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```
status DB_IDL_ACCEL_AXIS_AVG_AV
    Comment:Post Accel Axis 3 Average
    Format: Four (4) byte Floating point
    vid = 6532
    name = “DB_IDL_ACCEL_AXIS_AVG_AV”

status DB_IDL_ACCEL_AXIS_STD_AV
    Comment:Post Accel Axis 3
    Format: Four (4) byte Floating point
    vid = 6533
    name = “DB_IDL_ACCEL_AXIS_STD_AV”

status DB_IDL_ACCEL_CURRENT_AVG_AV
    Comment:Post Accel Current (mA) Average
    Format: Four (4) byte Floating point
    vid = 6528
    name = “DB_IDL_ACCEL_CURRENT_AVG_AV”

status DB_IDL_ACCEL_CURRENT_STD_AV
    Comment:Post Accel Current (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6529
    name = “DB_IDL_ACCEL_CURRENT_STD_AV”

status DB_IDL_ACCEL_SUPP_CURRENT_AVG_AV
    Comment:Post Accel Suppr I (mA) Average
    Format: Four (4) byte Floating point
    vid = 6534
    name = “DB_IDL_ACCEL_SUPP_CURRENT_AVG_AV”

status DB_IDL_ACCEL_SUPP_CURRENT_STD_AV
    Comment:Post Accel Suppr I (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6535
    name = “DB_IDL_ACCEL_SUPP_CURRENT_STD_AV”

status DB_IDL_ACCEL_SUPP_VOLTAGE_AVG_AV
    Comment:Post Accel Suppr V (kV) Average
    Format: Four (4) byte Floating point
    vid = 6536
    name = “DB_IDL_ACCEL_SUPP_VOLTAGE_AVG_AV”

status DB_IDL_ACCEL_SUPP_VOLTAGE_STD_AV
    Comment:Post Accel Suppr V (kV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6537
    name = “DB_IDL_ACCEL_SUPP_VOLTAGE_STD_AV”
```

```
status DB_IDL_ACCEL_VOLTAGE_AVG_AV
    Comment:Post Accel Voltage (kV) Average
    Format: Four (4) byte Floating point
    vid = 6530
    name = “DB_IDL_ACCEL_VOLTAGE_AVG_AV”

status DB_IDL_ACCEL_VOLTAGE_STD_AV
    Comment:Post Accel Voltage (kV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6531
    name = “DB_IDL_ACCEL_VOLTAGE_STD_AV”

status DB_IDL_AMU_AVG_AV
    Comment:AMU Average
    Format: Four (4) byte Floating point
    vid = 6442
    name = “DB_IDL_AMU_AVG_AV”

status DB_IDL_AMU_STD_AV
    Comment:AMU Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6443
    name = “DB_IDL_AMU_STD_AV”

status DB_IDL_ANAL_MAG_CURRENT_AVG_AV
    Comment:Analyzer Magnet I (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6524
    name = “DB_IDL_ANAL_MAG_CURRENT_AVG_AV”

status DB_IDL_ANAL_MAG_CURRENT_STD_AV
    Comment:Analyzer Magnet I (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6525
    name = “DB_IDL_ANAL_MAG_CURRENT_STD_AV”

status DB_IDL_ARC_CURRENT_AVG_AV
    Comment:Arc Current (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6452
    name = “DB_IDL_ARC_CURRENT_AVG_AV”

status DB_IDL_ARC_CURRENT_STD_AV
    Comment:Arc Current (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6453
    name = “DB_IDL_ARC_CURRENT_STD_AV”
```

```
status DB_IDL_ARC_VOLTAGE_AVG_AV
    Comment:Arc Voltage (Volts) Average
    Format: Four (4) byte Floating point
    vid = 6454
    name = “DB_IDL_ARC_VOLTAGE_AVG_AV”

status DB_IDL_ARC_VOLTAGE_STD_AV
    Comment:Arc Voltage (Volts) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6455
    name = “DB_IDL_ARC_VOLTAGE_STD_AV”

status DB_IDL_BEAMGUIDE_GAS_ON_AVG_TSV
    Comment:Beamguide Gas Average
    Format: Binary (Boolean type)
    vid = 6514
    name = “DB_IDL_BEAMGUIDE_GAS_ON_AVG_TSV”

status DB_IDL_BEAMGUIDE_GAS_ON_STD_TSV
    Comment:Beamguide Gas Standard Deviation
    Format: Binary (Boolean type)
    vid = 6515
    name = “DB_IDL_BEAMGUIDE_GAS_ON_STD_TSV”

status DB_IDL_BEAMLINE_TRANS_AVG_AV
    Comment:Beamline Transmission Average
    Format: Four (4) byte Floating point
    vid = 6582
    name = “DB_IDL_BEAMLINE_TRANS_AVG_AV”

status DB_IDL_BEAMLINE_TRANS_STD_AV
    Comment:Beamline Transmission Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6583
    name = “DB_IDL_BEAMLINE_TRANS_STD_AV”

status DB_IDL_BEAM_AVG_AV
    Comment:Beam current(A) Average
    Format: Four (4) byte Floating point
    vid = 6444
    name = “DB_IDL_BEAM_AVG_AV”

status DB_IDL_BEAM_STD_AV
    Comment:Beam current(A) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6445
    name = “DB_IDL_BEAM_STD_AV”
```

```
status DB_IDL_BL_PRESS_AVG_AV
    Comment:Beamline Pressure (Torr) Average
    Format: Four (4) byte Floating point
    vid = 6448
    name = “DB_IDL_BL_PRESS_AVG_AV”

status DB_IDL_BL_PRESS_COMP_AV
    Comment:Beam Line Pressure Compensation
    Format: Four (4) byte Floating point
    vid = 6396
    name = “DB_IDL_BL_PRESS_COMP_AV”

status DB_IDL_BL_PRESS_STD_AV
    Comment:Beamline Pressure (Torr) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6449
    name = “DB_IDL_BL_PRESS_STD_AV”

status DB_IDL_CATHODE_CURRENT_AVG_AV
    Comment:Cathode Current (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6464
    name = “DB_IDL_CATHODE_CURRENT_AVG_AV”

status DB_IDL_CATHODE_CURRENT_STD_AV
    Comment:Cathode Current (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6465
    name = “DB_IDL_CATHODE_CURRENT_STD_AV”

status DB_IDL_CATHODE_VOLTAGE_AVG_AV
    Comment:Cathode Voltage (Volts) Average
    Format: Four (4) byte Floating point
    vid = 6466
    name = “DB_IDL_CATHODE_VOLTAGE_AVG_AV”

status DB_IDL_CATHODE_VOLTAGE_STD_AV
    Comment:Cathode Voltage (Volts) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6467
    name = “DB_IDL_CATHODE_VOLTAGE_STD_AV”

status DB_IDL_CHAM_PRESS_AVG_AV
    Comment:Chamber Pressure (Torr) Average
    Format: Four (4) byte Floating point
    vid = 6450
    name = “DB_IDL_CHAM_PRESS_AVG_AV”
```

```
status DB_IDL_CHAM_PRESS_STD_AV
    Comment:Chamber Pressure (Torr) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6451
    name = “DB_IDL_CHAM_PRESS_STD_AV”

status DB_IDL_DATE_SV
    Comment:Date
    Format: Ascii
    vid = 6403
    name = “DB_IDL_DATE_SV”

status DB_IDL_DOSE_AV
    Comment:Dose (Ions/cm2)
    Format: Four (4) byte Floating point
    vid = 6394
    name = “DB_IDL_DOSE_AV”

status DB_IDL_DOSE_BEAM_HEIGHT_IV
    Comment:Beam Height
    Format: Four (4) byte integer (unsigned)
    vid = 6401
    name = “DB_IDL_DOSE_BEAM_HEIGHT_IV”

status DB_IDL_DOSE_TRIM_AV
    Comment:Dose Trim Factor
    Format: Four (4) byte Floating point
    vid = 6395
    name = “DB_IDL_DOSE_TRIM_AV”

status DB_IDL_DUMMY_AV
    Comment:
    Format: Four (4) byte Floating point
    vid = 6052
    name = “DB_IDL_DUMMY_AV”

status DB_IDL_DUMMY_IV
    Comment:
    Format: Four (4) byte integer (unsigned)
    vid = 6053
    name = “DB_IDL_DUMMY_IV”

status DB_IDL_DUMMY_TSV
    Comment:
    Format: Binary (Boolean type)
    vid = 6054
    name = “DB_IDL_DUMMY_TSV”
```

```
status DB_IDL_EL_SH_APERTURE_VOLTAGE_AVG_AV
    Comment:El.Sh. Bias Voltage(kV) Average
    Format: Four (4) byte Floating point
    vid = 6566
    name = “DB_IDL_EL_SH_APERTURE_VOLTAGE_AVG_AV”

status DB_IDL_EL_SH_APERTURE_VOLTAGE_STD_AV
    Comment:El.Sh. Bias Voltage(kV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6567
    name = “DB_IDL_EL_SH_APERTURE_VOLTAGE_STD_AV”

status DB_IDL_EL_SH_CHARGE_MONITOR_NEG_PEAK_VOLTAGE_AVG_AV
    Comment:Charge Mon Neg Peak(volts) Average
    Format: Four (4) byte Floating point
    vid = 6572
    name = “DB_IDL_EL_SH_CHARGE_MONITOR_NEG_PEAK_VOLTAGE_AVG_AV”

status DB_IDL_EL_SH_CHARGE_MONITOR_NEG_PEAK_VOLTAGE_STD_AV
    Comment:Charge Mon Neg Peak(volts) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6573
    name = “DB_IDL_EL_SH_CHARGE_MONITOR_NEG_PEAK_VOLTAGE_STD_AV”

status DB_IDL_EL_SH_CHARGE_MONITOR_POS_PEAK_VOLTAGE_AVG_AV
    Comment:Charge Mon Pos Peak(volts) Average
    Format: Four (4) byte Floating point
    vid = 6570
    name = “DB_IDL_EL_SH_CHARGE_MONITOR_POS_PEAK_VOLTAGE_AVG_AV”

status DB_IDL_EL_SH_CHARGE_MONITOR_POS_PEAK_VOLTAGE_STD_AV
    Comment:Charge Mon Pos Peak(volts) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6571
    name = “DB_IDL_EL_SH_CHARGE_MONITOR_POS_PEAK_VOLTAGE_STD_AV”

status DB_IDL_EL_SH_DISK_CURRENT_AVG_AV
    Comment:Disk Current (mA) Average
    Format: Four (4) byte Floating point
    vid = 6560
    name = “DB_IDL_EL_SH_DISK_CURRENT_AVG_AV”

status DB_IDL_EL_SH_DISK_CURRENT_STD_AV
    Comment:Disk Current (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6561
    name = “DB_IDL_EL_SH_DISK_CURRENT_STD_AV”
```

```
status DB_IDL_EL_SH_GAS_FLOW_1MFC_AVG_AV
    Comment:El.Sh. MFC Gas Flow(sccm) Average
    Format: Four (4) byte Floating point
    vid = 6568
    name = “DB_IDL_EL_SH_GAS_FLOW_1MFC_AVG_AV”

status DB_IDL_EL_SH_GAS_FLOW_1MFC_STD_AV
    Comment:El.Sh. MFC Gas Flow(sccm) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6569
    name = “DB_IDL_EL_SH_GAS_FLOW_1MFC_STD_AV”

status DB_IDL_EL_SH_ON_AVE_TSV
    Comment:Elec. Shower On/Off Average
    Format: Binary (Boolean type)
    vid = 6556
    name = “DB_IDL_EL_SH_ON_AVE_TSV”

status DB_IDL_EL_SH_ON_STD_TSV
    Comment:Elec. Shower On/Off Standard Deviation
    Format: Binary (Boolean type)
    vid = 6557
    name = “DB_IDL_EL_SH_ON_STD_TSV”

status DB_IDL_EL_SH_PRI_CURRENT_AVG_AV
    Comment:ES Primary I (mA) Average
    Format: Four (4) byte Floating point
    vid = 6538
    name = “DB_IDL_EL_SH_PRI_CURRENT_AVG_AV”

status DB_IDL_EL_SH_PRI_CURRENT_STD_AV
    Comment:ES Primary I (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6539
    name = “DB_IDL_EL_SH_PRI_CURRENT_STD_AV”

status DB_IDL_EL_SH_SEC_CURRENT_AVG_AV
    Comment:ES Secondary I (mA) Average
    Format: Four (4) byte Floating point
    vid = 6558
    name = “DB_IDL_EL_SH_SEC_CURRENT_AVG_AV”

status DB_IDL_EL_SH_SEC_CURRENT_STD_AV
    Comment:ES Secondary I (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6559
    name = “DB_IDL_EL_SH_SEC_CURRENT_STD_AV”
```

```
status DB_IDL_ES_PRESS_COMP_AV
    Comment:Endstation Pressure Compensation
    Format: Four (4) byte Floating point
    vid = 6397
    name = “DB_IDL_ES_PRESS_COMP_AV”

status DB_IDL_EXIT_QUADRUPOLE_CURRENT_AVG_AV
    Comment:Exit Quadrupole I (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6516
    name = “DB_IDL_EXIT_QUADRUPOLE_CURRENT_AVG_AV”


status DB_IDL_EXIT_QUADRUPOLE_CURRENT_STD_AV
    Comment:Exit Quadrupole I (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6517
    name = “DB_IDL_EXIT_QUADRUPOLE_CURRENT_STD_AV”


status DB_IDL_EXTR_AXIS_1_AVG_AV
    Comment:Extr Axis 1 Average
    Format: Four (4) byte Floating point
    vid = 6492
    name = “DB_IDL_EXTR_AXIS_1_AVG_AV”


status DB_IDL_EXTR_AXIS_1_STD_AV
    Comment:Extr Axis 1 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6493
    name = “DB_IDL_EXTR_AXIS_1_STD_AV”


status DB_IDL_EXTR_AXIS_2_AVG_AV
    Comment:Extr Axis 2 Average
    Format: Four (4) byte Floating point
    vid = 6494
    name = “DB_IDL_EXTR_AXIS_2_AVG_AV”


status DB_IDL_EXTR_AXIS_2_STD_AV
    Comment:Extr Axis 2 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6495
    name = “DB_IDL_EXTR_AXIS_2_STD_AV”
```

```
status DB_IDL_EXTR_AXIS_3_AVG_AV
    Comment:Extr Axis 3 Average
    Format: Four (4) byte Floating point
    vid = 6496
    name = “DB_IDL_EXTR_AXIS_3_AVG_AV”


status DB_IDL_EXTR_AXIS_3_STD_AV
    Comment:Extr Axis 3 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6497
    name = “DB_IDL_EXTR_AXIS_3_STD_AV”


status DB_IDL_EXTR_CURRENT_AVG_AV
    Comment:Extraction Current (mA) Average
    Format: Four (4) byte Floating point
    vid = 6468
    name = “DB_IDL_EXTR_CURRENT_AVG_AV”


status DB_IDL_EXTR_CURRENT_STD_AV
    Comment:Extraction Current (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6469
    name = “DB_IDL_EXTR_CURRENT_STD_AV”


status DB_IDL_EXTR_SUPP_CURRENT_2_AVG_AV
    Comment:Extr Suppress I-2 (mA) Average
    Format: Four (4) byte Floating point
    vid = 6510
    name = “DB_IDL_EXTR_SUPP_CURRENT_2_AVG_AV”


status DB_IDL_EXTR_SUPP_CURRENT_2_STD_AV
    Comment:Extr Suppress I-2 (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6511
    name = “DB_IDL_EXTR_SUPP_CURRENT_2_STD_AV”


status DB_IDL_EXTR_SUPP_CURRENT_AVG_AV
    Comment:Extr Suppress I (mA) Average
    Format: Four (4) byte Floating point
    vid = 6506
    name = “DB_IDL_EXTR_SUPP_CURRENT_AVG_AV”
```

```
status DB_IDL_EXTR_SUPP_CURRENT_STD_AV
    Comment:Extr Suppress I (mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6507
    name = “DB_IDL_EXTR_SUPP_CURRENT_STD_AV”

status DB_IDL_EXTR_SUPP_VOLTAGE_2_AVG_AV
    Comment:Extr Suppress V-2 (kV) Average
    Format: Four (4) byte Floating point
    vid = 6512
    name = “DB_IDL_EXTR_SUPP_VOLTAGE_2_AVG_AV”

status DB_IDL_EXTR_SUPP_VOLTAGE_2_STD_AV
    Comment:Extr Suppress V-2 (kV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6513
    name = “DB_IDL_EXTR_SUPP_VOLTAGE_2_STD_AV”

status DB_IDL_EXTR_SUPP_VOLTAGE_AVG_AV
    Comment:Extr Suppress V (kV) Average
    Format: Four (4) byte Floating point
    vid = 6508
    name = “DB_IDL_EXTR_SUPP_VOLTAGE_AVG_AV”

status DB_IDL_EXTR_SUPP_VOLTAGE_STD_AV
    Comment:Extr Suppress V (kV) Standard Deviatio
    Format: Four (4) byte Floating point
    vid = 6509
    name = “DB_IDL_EXTR_SUPP_VOLTAGE_STD_AV”

status DB_IDL_EXTR_VOLTAGE_AVG_AV
    Comment:Extraction Voltage (kV) Average
    Format: Four (4) byte Floating point
    vid = 6470
    name = “DB_IDL_EXTR_VOLTAGE_AVG_AV”

status DB_IDL_EXTR_VOLTAGE_STD_AV
    Comment:Extraction Voltage (kV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6471
    name = “DB_IDL_EXTR_VOLTAGE_STD_AV”
```

```
status DB_IDL_FIL_CURRENT_AVG_AV
    Comment:Filament Current (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6456
    name = “DB_IDL_FIL_CURRENT_AVG_AV”


status DB_IDL_FIL_CURRENT_STD_AV
    Comment:Filament Current (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6457
    name = “DB_IDL_FIL_CURRENT_STD_AV”


status DB_IDL_FIL_VOLTAGE_AVG_AV
    Comment:Filament Voltage (Volts) Average
    Format: Four (4) byte Floating point
    vid = 6458
    name = “DB_IDL_FIL_VOLTAGE_AVG_AV”


status DB_IDL_FIL_VOLTAGE_STD_AV
    Comment:Filament Voltage (Volts) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6459
    name = “DB_IDL_FIL_VOLTAGE_STD_AV”


status DB_IDL_GAS1_VALVE_INDEX_AVG_AV
    Comment:Gas Leak Valve 1 Average
    Format: Four (4) byte Floating point
    vid = 6484
    name = “DB_IDL_GAS1_VALVE_INDEX_AVG_AV”

status DB_IDL_GAS1_VALVE_INDEX_STD_AV
    Comment:Gas Leak Valve 1 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6485
    name = “DB_IDL_GAS1_VALVE_INDEX_STD_AV”


status DB_IDL_GAS2_VALVE_INDEX_AVG_AV
    Comment:Gas Leak Valve 2 Average
    Format: Four (4) byte Floating point
    vid = 6486
    name = “DB_IDL_GAS2_VALVE_INDEX_AVG_AV”
```

```
status DB_IDL_GAS2_VALVE_INDEX_STD_AV
    Comment:Gas Leak Valve 2 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6487
    name = “DB_IDL_GAS2_VALVE_INDEX_STD_AV”


status DB_IDL_GAS3_VALVE_INDEX_AVG_AV
    Comment:Gas Leak Valve 3 Average
    Format: Four (4) byte Floating point
    vid = 6488
    name = “DB_IDL_GAS3_VALVE_INDEX_AVG_AV”


status DB_IDL_GAS3_VALVE_INDEX_STD_AV
    Comment:Gas Leak Valve 3 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6489
    name = “DB_IDL_GAS3_VALVE_INDEX_STD_AV”


status DB_IDL_GAS4_VALVE_INDEX_AVG_AV
    Comment:Gas Leak Valve 4 Average
    Format: Four (4) byte Floating point
    vid = 6490
    name = “DB_IDL_GAS4_VALVE_INDEX_AVG_AV”


status DB_IDL_GAS4_VALVE_INDEX_STD_AV
    Comment:Gas Leak Valve 4 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6491
    name = “DB_IDL_GAS4_VALVE_INDEX_STD_AV”


status DB_IDL_HALL_AVG_AV
    Comment:AMU Hall Probe (Gauss) Average
    Format: Four (4) byte Floating point
    vid = 6526
    name = “DB_IDL_HALL_AVG_AV”


status DB_IDL_HALL_STD_AV
    Comment:AMU Hall Probe (Gauss) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6527
    name = “DB_IDL_HALL_STD_AV”
```

```
status DB_IDL_HYT_LOOP_CURRENT_AVG_IV
    Comment:HYT Laser Current (mA) Average
    Format: Four (4) byte integer (unsigned)
    vid = 6578
    name = “DB_IDL_HYT_LOOP_CURRENT_AVG_IV”

status DB_IDL_HYT_LOOP_CURRENT_STD_IV
    Comment:HYT Laser Current (mA) Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6579
    name = “DB_IDL_HYT_LOOP_CURRENT_STD_IV”

status DB_IDL_HYT_STR_LIGHT_CURRENT_AVG_IV
    Comment:HYT Stray Light Average
    Format: Four (4) byte integer (unsigned)
    vid = 6580
    name = “DB_IDL_HYT_STR_LIGHT_CURRENT_AVG_IV”

status DB_IDL_HYT_STR_LIGHT_CURRENT_STD_IV
    Comment:HYT Stray Light Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6581
    name = “DB_IDL_HYT_STR_LIGHT_CURRENT_STD_IV”

status DB_IDL_HYT_TOTAL_CT_AVG_IV
    Comment:HYT Particle Counts Average
    Format: Four (4) byte integer (unsigned)
    vid = 6576
    name = “DB_IDL_HYT_TOTAL_CT_AVG_IV”

status DB_IDL_HYT_TOTAL_CT_STD_IV
    Comment:HYT Particle Counts Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6577
    name = “DB_IDL_HYT_TOTAL_CT_STD_IV”

status DB_IDL_IHC_ARC_VOLTAGE_AVG_AV
    Comment:Arc Voltage (Volts) Average
    Format: Four (4) byte Floating point
    vid = 6460
    name = “DB_IDL_IHC_ARC_VOLTAGE_AVG_AV”
```

```
status DB_IDL_IHC_ARC_VOLTAGE_STD_AV
    Comment:Arc Voltage (Volts) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6461
    name = “DB_IDL_IHC_ARC_VOLTAGE_STD_AV”

status DB_IDL_IHC_FIL_CURRENT_AVG_AV
    Comment:Filament Current (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6462
    name = “DB_IDL_IHC_FIL_CURRENT_AVG_AV”

status DB_IDL_IHC_FIL_CURRENT_STD_AV
    Comment:Filament Current (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6463
    name = “DB_IDL_IHC_FIL_CURRENT_STD_AV”

status DB_IDL_IMPLANT_ANGLE_TILT_AVG_AV
    Comment:Tilt Angle (degrees) Average
    Format: Four (4) byte Floating point
    vid = 6562
    name = “DB_IDL_IMPLANT_ANGLE_TILT_AVG_AV”

status DB_IDL_IMPLANT_ANGLE_TILT_STD_AV
    Comment:Tilt Angle (degrees) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6563
    name = “DB_IDL_IMPLANT_ANGLE_TILT_STD_AV”

status DB_IDL_IMPLANT_ANGLE_TWIST_AVG_AV
    Comment:Twist Angle (degrees) Average
    Format: Four (4) byte Floating point
    vid = 6564
    name = “DB_IDL_IMPLANT_ANGLE_TWIST_AVG_AV”

status DB_IDL_IMPLANT_ANGLE_TWIST_STD_AV
    Comment:Twist Angle (degrees) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6565
    name = “DB_IDL_IMPLANT_ANGLE_TWIST_STD_AV”
```

```
status DB_IDL_IMP_INTERRUPT_AVG_IV
    Comment:Interruptions Average
    Format: Four (4) byte integer (unsigned)
    vid = 6544
    name = “DB_IDL_IMP_INTERRUPT_AVG_IV”

status DB_IDL_IMP_INTERRUPT_IV
    Comment:Interruptions
    Format: Four (4) byte integer (unsigned)
    vid = 6413
    name = “DB_IDL_IMP_INTERRUPT_IV”

status DB_IDL_IMP_INTERRUPT_STD_IV
    Comment:Interruptions Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6545
    name = “DB_IDL_IMP_INTERRUPT_STD_IV”

status DB_IDL_IMP_LAST_DARK_AVG_IV
    Comment:Dark Current Average
    Format: Four (4) byte integer (unsigned)
    vid = 6574
    name = “DB_IDL_IMP_LAST_DARK_AVG_IV”

status DB_IDL_IMP_LAST_DARK_STD_IV
    Comment:Dark Current Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6575
    name = “DB_IDL_IMP_LAST_DARK_STD_IV”

status DB_IDL_IMP_SCANS_AVG_IV
    Comment:Scans Average
    Format: Four (4) byte integer (unsigned)
    vid = 6411
    name = “DB_IDL_IMP_SCANS_AVG_IV”

status DB_IDL_IMP_SCANS_STD_IV
    Comment:Scans Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6412
    name = “DB_IDL_IMP_SCANS_STD_IV”
```

```
status DB_IDL_IMP_TIME_ACTUAL_AVG_IV
    Comment:Actual Time Average
    Format: Four (4) byte integer (unsigned)
    vid = 6542
    name = "DB_IDL_IMP_TIME_ACTUAL_AVG_IV"

status DB_IDL_IMP_TIME_ACTUAL_ESTIMATE_AVG_AV
    Comment:Actual/Estimated Time Average
    Format: Four (4) byte Floating point
    vid = 6584
    name = "DB_IDL_IMP_TIME_ACTUAL_ESTIMATE_AVG_AV"

status DB_IDL_IMP_TIME_ACTUAL_ESTIMATE_STD_AV
    Comment:Actual/Estimated Time Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6585
    name = "DB_IDL_IMP_TIME_ACTUAL_ESTIMATE_STD_AV"

status DB_IDL_IMP_TIME_ACTUAL_STD_IV
    Comment:Actual Time Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6543
    name = "DB_IDL_IMP_TIME_ACTUAL_STD_IV"

status DB_IDL_IMP_TIME_ACTUAL_SV
    Comment:Actual time
    Format: Ascii
    vid = 6407
    name = "DB_IDL_IMP_TIME_ACTUAL_SV"

status DB_IDL_IMP_TIME_ESTIMATE_AVG_IV
    Comment:Estimated Time Average
    Format: Four (4) byte integer (unsigned)
    vid = 6540
    name = "DB_IDL_IMP_TIME_ESTIMATE_AVG_IV"

status DB_IDL_IMP_TIME_ESTIMATE_STD_IV
    Comment:Estimated Time Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6541
    name = "DB_IDL_IMP_TIME_ESTIMATE_STD_IV"
```

```
status DB_IDL_IMP_TIME_ESTIMATE_SV
    Comment:Estimated time
    Format: Ascii
    vid = 6406
    name = "DB_IDL_IMP_TIME_ESTIMATE_SV"


status DB_IDL_ION_CHARGE_IV
    Comment:Ion charge
    Format: Four (4) byte integer (unsigned)
    vid = 6400
    name = "DB_IDL_ION_CHARGE_IV"


status DB_IDL_MACHINE_ID_SV
    Comment:Machine ID
    Format: Ascii
    vid = 6404
    name = "DB_IDL_MACHINE_ID_SV"


status DB_IDL_MAG_QUADRUPOLE_IN_AVG_TSV
    Comment:Magnetic Quadrupole Average
    Format: Binary (Boolean type)
    vid = 6554
    name = "DB_IDL_MAG_QUADRUPOLE_IN_AVG_TSV"


status DB_IDL_MAG_QUADRUPOLE_IN_STD_TSV
    Comment:Magnetic Quadrupole Standard Deviation
    Format: Binary (Boolean type)
    vid = 6555
    name = "DB_IDL_MAG_QUADRUPOLE_IN_STD_TSV"


status DB_IDL_MFC_GAS1_VALVE_INDEX_AVG_AV
    Comment:Gas #1 MFC (sccm) Average
    Format: Four (4) byte Floating point
    vid = 6546
    name = "DB_IDL_MFC_GAS1_VALVE_INDEX_AVG_AV"


status DB_IDL_MFC_GAS1_VALVE_INDEX_STD_AV
    Comment:Gas #1 MFC (sccm) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6547
    name = "DB_IDL_MFC_GAS1_VALVE_INDEX_STD_AV"
```

```
status DB_IDL_MFC_GAS2_VALVE_INDEX_AVG_AV
    Comment:Gas #2 MFC (sccm) Average
    Format: Four (4) byte Floating point
    vid = 6548
    name = "DB_IDL_MFC_GAS2_VALVE_INDEX_AVG_AV"

status DB_IDL_MFC_GAS2_VALVE_INDEX_STD_AV
    Comment:Gas #2 MFC (sccm) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6549
    name = "DB_IDL_MFC_GAS2_VALVE_INDEX_STD_AV"

status DB_IDL_MFC_GAS3_VALVE_INDEX_AVG_AV
    Comment:Gas #3 MFC (sccm) Average
    Format: Four (4) byte Floating point
    vid = 6550
    name = "DB_IDL_MFC_GAS3_VALVE_INDEX_AVG_AV"

status DB_IDL_MFC_GAS3_VALVE_INDEX_STD_AV
    Comment:Gas #3 MFC (sccm) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6551
    name = "DB_IDL_MFC_GAS3_VALVE_INDEX_STD_AV"

status DB_IDL_MFC_GAS4_VALVE_INDEX_AVG_AV
    Comment:Gas #4 MFC (sccm) Average
    Format: Four (4) byte Floating point
    vid = 6552
    name = "DB_IDL_MFC_GAS4_VALVE_INDEX_AVG_AV"

status DB_IDL_MFC_GAS4_VALVE_INDEX_STD_AV
    Comment:Gas #4 MFC (sccm) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6553
    name = "DB_IDL_MFC_GAS4_VALVE_INDEX_STD_AV"

status DB_IDL_PLSM_APERTURE_VOLTAGE_AVG_AV
    Comment:Pl.Sh. Aper Voltage(kV) Average
    Format: Four (4) byte Floating point
    vid = 6600
    name = "DB_IDL_PLSM_APERTURE_VOLTAGE_AVG_AV"
```

```
status DB_IDL_PLSM_APERTURE_VOLTAGE_STD_AV
    Comment:Pl.Sh. Aper Voltage(kV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6601
    name = “DB_IDL_PLSM_APERTURE_VOLTAGE_STD_AV”


status DB_IDL_PLSM_ARC_CURRENT_AVG_AV
    Comment:Pl.Sh. Arc Current (A) Average
    Format: Four (4) byte Floating point
    vid = 6594
    name = “DB_IDL_PLSM_ARC_CURRENT_AVG_AV”


status DB_IDL_PLSM_ARC_CURRENT_STD_AV
    Comment:Pl.Sh. Arc Current (A) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6595
    name = “DB_IDL_PLSM_ARC_CURRENT_STD_AV”


status DB_IDL_PLSM_ARC_VOLTAGE_AVG_AV
    Comment:Pl.Sh. Arc Voltage (V) Average
    Format: Four (4) byte Floating point
    vid = 6592
    name = “DB_IDL_PLSM_ARC_VOLTAGE_AVG_AV”


status DB_IDL_PLSM_ARC_VOLTAGE_STD_AV
    Comment:Pl.Sh. Arc Voltage (V) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6593
    name = “DB_IDL_PLSM_ARC_VOLTAGE_STD_AV”


status DB_IDL_PLSM_BIAS_CURRENT_AVG_AV
    Comment:Pl.Sh. Extr Current(mA) Average
    Format: Four (4) byte Floating point
    vid = 6590
    name = “DB_IDL_PLSM_BIAS_CURRENT_AVG_AV”


status DB_IDL_PLSM_BIAS_CURRENT_STD_AV
    Comment:Pl.Sh. Extr Current(mA) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6591
    name = “DB_IDL_PLSM_BIAS_CURRENT_STD_AV”
```

```
status DB_IDL_PLSM_BIAS_VOLTAGE_AVG_AV
    Comment:Pl.Sh. Extr Voltage(V) Average
    Format: Four (4) byte Floating point
    vid = 6588
    name = “DB_IDL_PLSM_BIAS_VOLTAGE_AVG_AV”

status DB_IDL_PLSM_BIAS_VOLTAGE_STD_AV
    Comment:Pl.Sh. Extr Voltage(V) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6589
    name = “DB_IDL_PLSM_BIAS_VOLTAGE_STD_AV”

status DB_IDL_PLSM_FIL_CURRENT_AVG_AV
    Comment:Pl.Sh. Fil Current (A) Average
    Format: Four (4) byte Floating point
    vid = 6598
    name = “DB_IDL_PLSM_FIL_CURRENT_AVG_AV”

status DB_IDL_PLSM_FIL_CURRENT_STD_AV
    Comment:Pl.Sh. Fil Current (A) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6599
    name = “DB_IDL_PLSM_FIL_CURRENT_STD_AV”

status DB_IDL_PLSM_FIL_VOLTAGE_AVG_AV
    Comment:Pl.Sh. Fil Voltage (V) Average
    Format: Four (4) byte Floating point
    vid = 6596
    name = “DB_IDL_PLSM_FIL_VOLTAGE_AVG_AV”

status DB_IDL_PLSM_FIL_VOLTAGE_STD_AV
    Comment:Pl.Sh. Fil Voltage (V) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6597
    name = “DB_IDL_PLSM_FIL_VOLTAGE_STD_AV”

status DB_IDL_PLSM_GAS_FLOW_MFC_AVG_AV
    Comment:Pl.Sh. Gas Flow MFC(sccm) Average
    Format: Four (4) byte Floating point
    vid = 6586
    name = “DB_IDL_PLSM_GAS_FLOW_MFC_AVG_AV”
```

```
status DB_IDL_PLSM_GAS_FLOW_MFC_STD_AV
    Comment:Pl.Sh. Gas Flow MFC(sccm) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6587
    name = “DB_IDL_PLSM_GAS_FLOW_MFC_STD_AV”

status DB_IDL_PROC_NAME_SV
    Comment:Process name for Implant
    Format: Ascii
    vid = 6392
    name = “DB_IDL_PROC_NAME_SV”

status DB_IDL_PROFILE_QUAD_CURRENT_AVG_AV
    Comment:Profile Quadrupole I (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6518
    name = “DB_IDL_PROFILE_QUAD_CURRENT_AVG_AV”

status DB_IDL_PROFILE_QUAD_CURRENT_STD_AV
    Comment:Profile Quadrupole I (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6519
    name = “DB_IDL_PROFILE_QUAD_CURRENT_STD_AV”

status DB_IDL_RATIO_ACT_EST_TIME_AV
    Comment:Ratio of Actual time to Estimated time
    Format: Four (4) byte Floating point
    vid = 6408
    name = “DB_IDL_RATIO_ACT_EST_TIME_AV”

status DB_IDL_SEN_EXTR_AXIS_1_AVG_AV
    Comment:Extr Axis 1 Average
    Format: Four (4) byte Floating point
    vid = 6500
    name = “DB_IDL_SEN_EXTR_AXIS_1_AVG_AV”

status DB_IDL_SEN_EXTR_AXIS_1_STD_AV
    Comment:Extr Axis 1 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6501
    name = “DB_IDL_SEN_EXTR_AXIS_1_STD_AV”
```

```
status DB_IDL_SEN_EXTR_AXIS_2_AVG_AV
    Comment:Extr Axis 2 Average
    Format: Four (4) byte Floating point
    vid = 6502
    name = “DB_IDL_SEN_EXTR_AXIS_2_AVG_AV”


status DB_IDL_SEN_EXTR_AXIS_2_STD_AV
    Comment:Extr Axis 2 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6503
    name = “DB_IDL_SEN_EXTR_AXIS_2_STD_AV”


status DB_IDL_SEN_EXTR_AXIS_3_AVG_AV
    Comment:Extr Axis 3 Average
    Format: Four (4) byte Floating point
    vid = 6504
    name = “DB_IDL_SEN_EXTR_AXIS_3_AVG_AV”


status DB_IDL_SEN_EXTR_AXIS_3_STD_AV
    Comment:Extr Axis 3 Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6505
    name = “DB_IDL_SEN_EXTR_AXIS_3_STD_AV”


status DB_IDL_SNAPS_IV
    Comment:Snapshots (80, 20 per quarter)
    Format: Four (4) byte integer (unsigned)
    vid = 6414
    name = “DB_IDL_SNAPS_IV”


status DB_IDL_SRC_PRESS_AVG_AV
    Comment:Source Pressure (Torr) Average
    Format: Four (4) byte Floating point
    vid = 6446
    name = “DB_IDL_SRC_PRESS_AVG_AV”


status DB_IDL_SRC_PRESS_STD_AV
    Comment:Source Pressure (Torr) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6447
    name = “DB_IDL_SRC_PRESS_STD_AV”
```

```
status DB_IDL_START_PRESS_AV
    Comment:Implant Start Pressure
    Format: Four (4) byte Floating point
    vid = 6398
    name = “DB_IDL_START_PRESS_AV”

status DB_IDL_STOP_PRESS_AV
    Comment:Implant Stop Pressure
    Format: Four (4) byte Floating point
    vid = 6399
    name = “DB_IDL_STOP_PRESS_AV”

status DB_IDL_SUB_PROC_NAME_SV
    Comment:Sub Process name for Implant
    Format: Ascii
    vid = 6393
    name = “DB_IDL_SUB_PROC_NAME_SV”

status DB_IDL_SUM_PRESET_SCANS_AVG_IV
    Comment:Preset Scans Average
    Format: Four (4) byte integer (unsigned)
    vid = 6409
    name = “DB_IDL_SUM_PRESET_SCANS_AVG_IV”

status DB_IDL_SUM_PRESET_SCANS_STD_IV
    Comment:Preset Scans Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6410
    name = “DB_IDL_SUM_PRESET_SCANS_STD_IV”

status DB_IDL_S_MAG_CURRENT_AVG_AV
    Comment:Source Magnet I (Amps) Average
    Format: Four (4) byte Floating point
    vid = 6522
    name = “DB_IDL_S_MAG_CURRENT_AVG_AV”

status DB_IDL_S_MAG_CURRENT_STD_AV
    Comment:Source Magnet I (Amps) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6523
    name = “DB_IDL_S_MAG_CURRENT_STD_AV”
```

```
status DB_IDL_TIME_SV
    Comment:Time
    Format: Ascii
    vid = 6402
    name = “DB_IDL_TIME_SV”

status DB_IDL_TOTAL_ENERGY_AVG_AV
    Comment:Total energy (keV) Average
    Format: Four (4) byte Floating point
    vid = 6440
    name = “DB_IDL_TOTAL_ENERGY_AVG_AV”

status DB_IDL_TOTAL_ENERGY_STD_AV
    Comment:Total energy (keV) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6441
    name = “DB_IDL_TOTAL_ENERGY_STD_AV”

status DB_IDL_VAE_GAP_AXIS_AVG_AV
    Comment:Extr Gap Axis Average
    Format: Four (4) byte Floating point
    vid = 6498
    name = “DB_IDL_VAE_GAP_AXIS_AVG_AV”

status DB_IDL_VAE_GAP_AXIS_STD_AV
    Comment:Extr Gap Axis Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6499
    name = “DB_IDL_VAE_GAP_AXIS_STD_AV”

status DB_IDL_VAP1_HEATER_TEMP_AVG_AV
    Comment:Vap #1 Heater Temp (DegC) Average
    Format: Four (4) byte Floating point
    vid = 6474
    name = “DB_IDL_VAP1_HEATER_TEMP_AVG_AV”

status DB_IDL_VAP1_HEATER_TEMP_CMD_AVG_AV
    Comment:Vap #1 Heater Set (DegC) Average
    Format: Four (4) byte Floating point
    vid = 6476
    name = “DB_IDL_VAP1_HEATER_TEMP_CMD_AVG_AV”
```

```
status DB_IDL_VAP1_HEATER_TEMP_CMD_STD_AV
    Comment:Vap #1 Heater Set (DegC) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6477
    name = “DB_IDL_VAP1_HEATER_TEMP_CMD_STD_AV”


status DB_IDL_VAP1_HEATER_TEMP_STD_AV
    Comment:Vap #1 Heater Temp (DegC) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6475
    name = “DB_IDL_VAP1_HEATER_TEMP_STD_AV”


status DB_IDL_VAP1_OVEN_TEMP_AVG_AV
    Comment:Vap #1 Oven Temp (DegC) Average
    Format: Four (4) byte Floating point
    vid = 6472
    name = “DB_IDL_VAP1_OVEN_TEMP_AVG_AV”


status DB_IDL_VAP1_OVEN_TEMP_STD_AV
    Comment:Vap #1 Oven Temp (DegC) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6473
    name = “DB_IDL_VAP1_OVEN_TEMP_STD_AV”


status DB_IDL_VAP2_HEATER_TEMP_AVG_AV
    Comment:Vap #2 Heater Temp (DegC) Average
    Format: Four (4) byte Floating point
    vid = 6480
    name = “DB_IDL_VAP2_HEATER_TEMP_AVG_AV”


status DB_IDL_VAP2_HEATER_TEMP_CMD_AVG_AV
    Comment:Vap #2 Heater Set (DegC) Average
    Format: Four (4) byte Floating point
    vid = 6482
    name = “DB_IDL_VAP2_HEATER_TEMP_CMD_AVG_AV”


status DB_IDL_VAP2_HEATER_TEMP_CMD_STD_AV
    Comment:Vap #2 Heater Set (DegC) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6483
    name = “DB_IDL_VAP2_HEATER_TEMP_CMD_STD_AV”
```

```
status DB_IDL_VAP2_HEATER_TEMP_STD_AV
    Comment:Vap #2 Heater Temp (DegC) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6481
    name = “DB_IDL_VAP2_HEATER_TEMP_STD_AV”

status DB_IDL_VAP2_OVEN_TEMP_AVG_AV
    Comment:Vap #2 Oven Temp (DegC) Average
    Format: Four (4) byte Floating point
    vid = 6478
    name = “DB_IDL_VAP2_OVEN_TEMP_AVG_AV”

status DB_IDL_VAP2_OVEN_TEMP_STD_AV
    Comment:Vap #2 Oven Temp (DegC) Standard Deviation
    Format: Four (4) byte Floating point
    vid = 6479
    name = “DB_IDL_VAP2_OVEN_TEMP_STD_AV”

status DB_IDL_VARIABLE_RESOLVE_APERTURE_POS_RBK_AVG_IV
    Comment:Variable Resolve Aperture Average
    Format: Four (4) byte integer (unsigned)
    vid = 6520
    name = “DB_IDL_VARIABLE_RESOLVE_APERTURE_POS_RBK_AVG_IV”

status DB_IDL_VARIABLE_RESOLVE_APERTURE_POS_RBK_STD_IV
    Comment:Variable Resolve Aperture Standard Deviation
    Format: Four (4) byte integer (unsigned)
    vid = 6521
    name = “DB_IDL_VARIABLE_RESOLVE_APERTURE_POS_RBK_STD_IV”

status DB_IDL_WAFER10_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6424
    name = “DB_IDL_WAFER10_PARAMETERS_SV”

status DB_IDL_WAFER11_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6425
    name = “DB_IDL_WAFER11_PARAMETERS_SV”
```

```
status DB_IDL_WAFER12_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6426
    name = "DB_IDL_WAFER12_PARAMETERS_SV"

status DB_IDL_WAFER13_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6427
    name = "DB_IDL_WAFER13_PARAMETERS_SV"

status DB_IDL_WAFER14_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6428
    name = "DB_IDL_WAFER14_PARAMETERS_SV"

status DB_IDL_WAFER15_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6429
    name = "DB_IDL_WAFER15_PARAMETERS_SV"

status DB_IDL_WAFER16_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6430
    name = "DB_IDL_WAFER16_PARAMETERS_SV"

status DB_IDL_WAFER17_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6431
    name = "DB_IDL_WAFER17_PARAMETERS_SV"

status DB_IDL_WAFER18_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6432
    name = "DB_IDL_WAFER18_PARAMETERS_SV"
```

```
status DB_IDL_WAFER19_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6433
    name = “DB_IDL_WAFER19_PARAMETERS_SV”


status DB_IDL_WAFER1_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6415
    name = “DB_IDL_WAFER1_PARAMETERS_SV”


status DB_IDL_WAFER20_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6434
    name = “DB_IDL_WAFER20_PARAMETERS_SV”


status DB_IDL_WAFER21_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6435
    name = “DB_IDL_WAFER21_PARAMETERS_SV”


status DB_IDL_WAFER22_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6436
    name = “DB_IDL_WAFER22_PARAMETERS_SV”


status DB_IDL_WAFER23_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6437
    name = “DB_IDL_WAFER23_PARAMETERS_SV”


status DB_IDL_WAFER24_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6438
    name = “DB_IDL_WAFER24_PARAMETERS_SV”
```

```
status DB_IDL_WAFER25_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6439
    name = “DB_IDL_WAFER25_PARAMETERS_SV”


status DB_IDL_WAFER2_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6416
    name = “DB_IDL_WAFER2_PARAMETERS_SV”


status DB_IDL_WAFER3_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6417
    name = “DB_IDL_WAFER3_PARAMETERS_SV”


status DB_IDL_WAFER4_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6418
    name = “DB_IDL_WAFER4_PARAMETERS_SV”


status DB_IDL_WAFER5_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6419
    name = “DB_IDL_WAFER5_PARAMETERS_SV”


status DB_IDL_WAFER6_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6420
    name = “DB_IDL_WAFER6_PARAMETERS_SV”


status DB_IDL_WAFER7_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6421
    name = “DB_IDL_WAFER7_PARAMETERS_SV”
```

```
status DB_IDL_WAFER8_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6422
    name = "DB_IDL_WAFER8_PARAMETERS_SV"


status DB_IDL_WAFER9_PARAMETERS_SV
    Comment:20 characters
    Format: Ascii
    vid = 6423
    name = "DB_IDL_WAFER9_PARAMETERS_SV"


status DB_IDL_WAFER_SIZE_SV
    Comment:Wafer size
    Format: Ascii
    vid = 6405
    name = "DB_IDL_WAFER_SIZE_SV"
```

Chapter 20
Automated Guided Vehicles

20.1 General Remarks

The Automated Guided Vehicle (AGV) provides another mechanical means of placing a cassette onto the moveable table or removing a cassette from the moveable table. Unlike a SMIF Arm, which is permanently bolted to the Equipment and can serve only that Equipment, an AGV is a moving vehicle that can be directed to different points on the factory floor by radio signals. These signals may originate from a Host computer or from a human agent such as a stocker or dispatcher. When a job is to be processed at a particular implanter, an AGV bearing a cassette is directed to that implanter and correctly positioned. Upon command, it places the cassette on the selected port of the moveable table. The AGV is then free for assignment to a different job at another implanter.

When the wafers have been processed they are placed back in the cassette (still sitting on the same port) and a call is made for an AGV to come and remove the completed cassette. Any AGV on the floor may be summoned.

AGVs have a capability called **Exchange**, described in Section 20.1.1.

20.1.1 Exchange

An AGV with the Exchange feature can remove a completed cassette from a port and place another cassette in the port for processing. AGVs able to handle two cassettes are required for Exchange. The Exchange capability is available only in the Extended E mode and requires a special S4F67 prep message.

Note: Extended E Mode is one of the choices that can be made under the configuration point Extended SECS Mode. See Section 20.2.

20.1.2 Operating Modes

The three AGV operating modes are as follows:

- Manual Mode

  AGV operation is entirely under operator control; it has no communication with the Host. The operator both loads and unloads cassettes via the Operator Interface (OI) and also supplies both the PPID and the MID. In Manual Mode, the Equipment is in the **GEM DISABLED** (offline) state.
- Semi-automatic Mode.

  AGV operation is under control of the Host. The Equipment is in the **ON-LINE LOCAL** state. The operator loads/unloads cassettes via the OI but does not supply either the PPID or the MID. The OI sends the add request to the AGV task instead of to the IMPLANT_CONTROL task. The AGV task positions the table and opens the door.

  Cassettes must be loaded by hand in this mode.
- Automatic Mode

  AGV operation is fully under control of the Host. There is no operator involvement. The Equipment is in the **ON-LINE REMOTE** state. Use of an AGV is required in this mode (and only in this mode).

The control mode can be selected from the Operator Interface via the Detail selection.

The current and previous operating mode is located in the two database points:

- DB_GEM_CONTROL_STATE_NEW_IV contains the current control state.
- DB_GEM_CONTROL_STATE_OLD_IV contains the previous control state.

Loading and unloading sequences for each of the three modes are described in Section 20.7, Load, Unload, Processing Scenarios.

20.1.3 Connections

The only electrical link between the implanter and the AGV is a 7-channel optical, parallel I/O (PIO). This link is not operative until the AGV has been brought to an implanter and accurately positioned. Accurate positioning is necessary to point the optical transmitters in the AGV directly at the optical receptors in the equipment.

Figure 20-1 shows internal details of the implanter and its PIO link to an AGV.

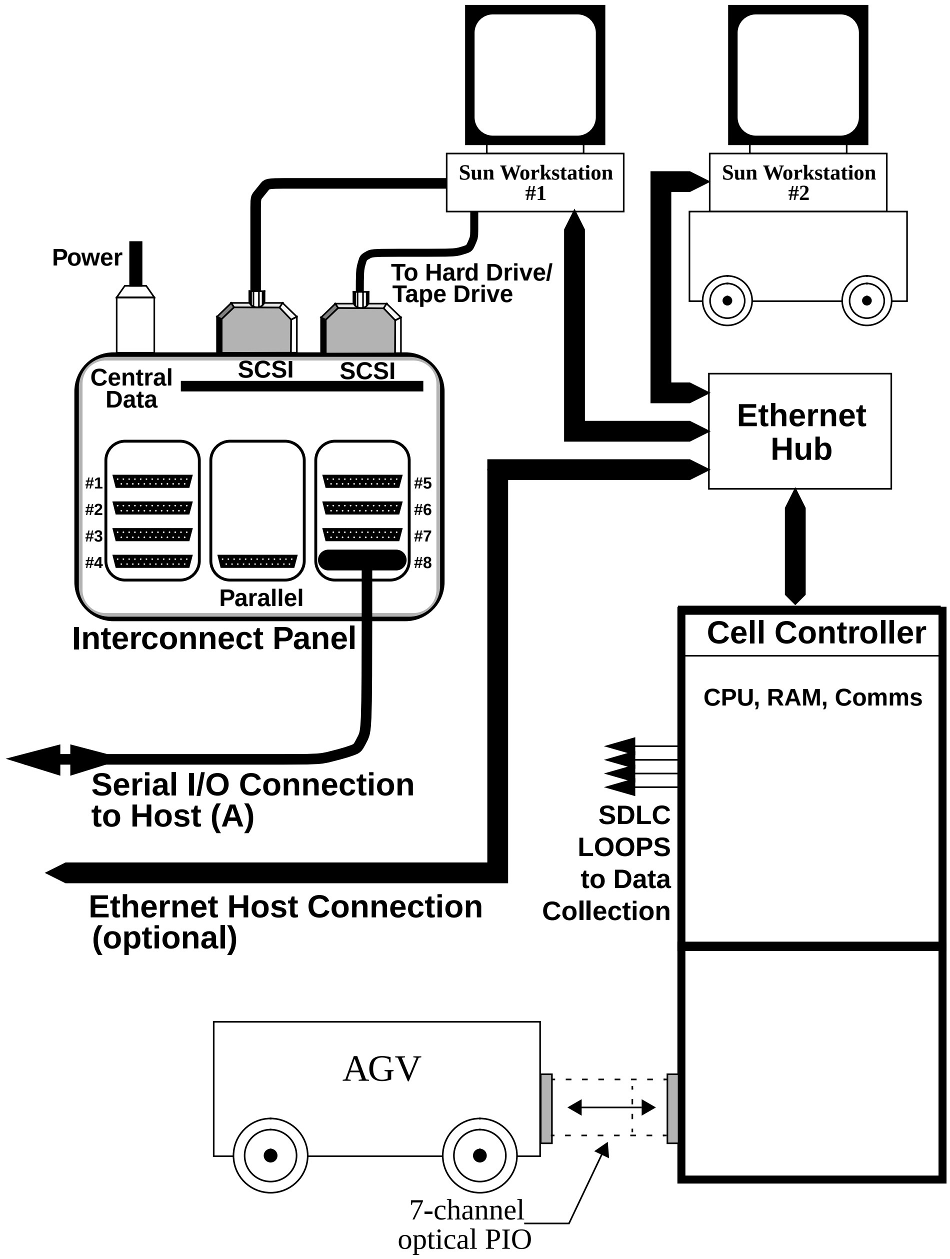


Figure 20-1. Implanter Details and Link to an AGV

Details of the PIO are given in Section 20.8, Parallel I/O.

20.2 Configuration Points

When there is an AGV option, additional values must be entered for configuration and startup. The method is the same as the procedure described in Chapter 2.

1. Login to the system. The Main Menu screen is displayed (Figure 2-2).
2. Select **Supervisor:Configuration Editor** from the menu bar. The Configuration Editor screen is displayed (Figure 2-3).
3. Select the following choices on that screen:

   Select Category: **All Categories**

   Select Section: **Software Section**

   Select Group: **Host Comm - Device Interface**

   Enable Name Search: deselect

   Click **Show Selection**. The Configuration Points screen is displayed.

4. Verify (or enter) the standard host communication configuration values, shown in the following table. The GEM Extended Mode and GEM E30 Version configuration points must be set as shown specifically for AGV communication:

Table 20-1. Host Communication Configuration for AGV

Configuration Point	Value
SECS Protocol Type	GEM Standard
GEM Config Alarms	S5 F1
GEM Config Connect	S1 F13
GEM Config Events	S6 F11/13
GEM Init Comm State	Disabled
GEM Init Control State	Offline
GEM Report Type	Normal
GEM Extended Mode	Extended D, E, F
Limits Monitor Interval	10
GEM Off-line Substate	Equipment Off-line
GEM Off-line Fail Substate	Equipment Off-line
GEM On-line Substate	On-line Local
GEM E30 Version	E30-92
AGV Present	Yes

   This GEM E30-92 version differs from the E30-95 version given in Table 2-2.

5. Select **Supervisor:Configuration Editor** from the menu bar again and click on the following:

   Select Category: **All Categories**

   Select Section: **All Sections**

Select Group: **All Groups**

Enable Name Search: select

Name Search Pattern: Type **"AGV"**

Click **Show Selection**. The AGV Configuration Points screen is displayed.

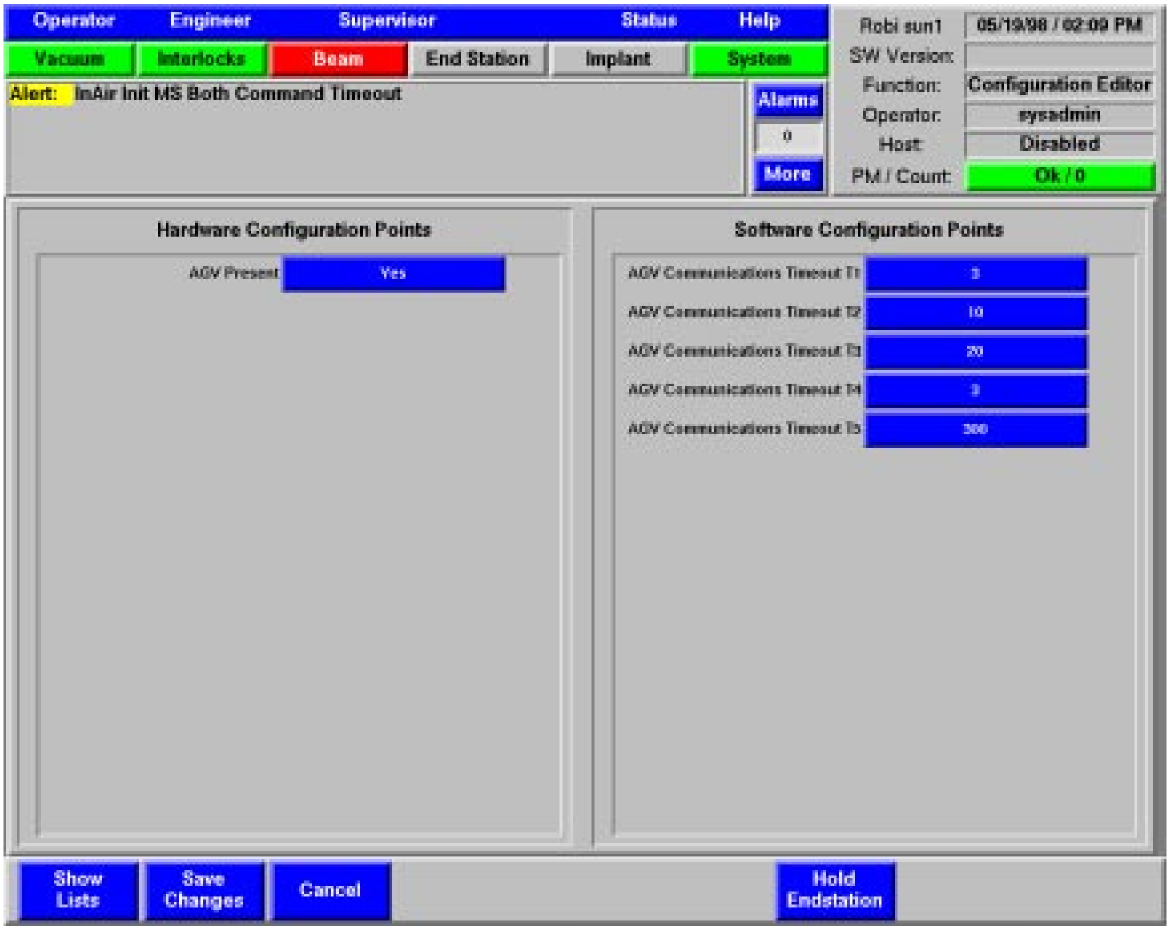


Figure 20-2. AGV Configuration Points Screen

6. Enter values for the following configuration points:
   - Enter "**yes**" for **AGV PRESENT** in the Hardware Configuration Points area (left side of the screen).
   - Enter values based on Table 20-2 below for the five AGV timeout parameters (AGV COMMUNICATIONS TIMEOUT #1 through #5) in the Software Configuration Points area (right side of the screen).

Table 20-2. AGV Timeout Parameters

Timeout Parameter	Min/max Range	Default Value
AGV Comms Timeout T1	1/600 secs	3 secs
AGV Comms Timeout T2	1/600 secs	10 sec

Semiconductor Equipment

Table 20-2. AGV Timeout Parameters

Timeout Parameter	Min/max Range	Default Value
AGV Comms Timeout T3	1/600 secs	20 secs
AGV Comms Timeout T4	1/600 secs	3 secs
AGV Comms Timeout T5	1/600 secs	300 secs

7. Select **Supervisor:Configuration Editor** again.
8. Select Endstation. On the Endstation screen choose **Detail:Show AGV Mode.** Then choose: **MANUAL, SEMI-AUTOMATIC,** or **AUTOMATIC.** This sets the GEM Online state (offline, on-line local, or on-line remote) and the control state (local or remote).
9. After you have entered all values, verify the following conditions:
   - The vacuum system is in the safe state (click the Vacuum button; then Detail: Vacuum Safe State).
   - The endstation is empty of wafers (indicated on the Endstation display graphics).
10. Reset the system.
   a) Reboot the Primary Sun.
   b) When the red window appears on the Primary Sun, then reboot the cell by pressing the red **RESET** button on the VME card.

   The reboot takes several minutes.

20.3 AGV Messages

Chapter 16 gave the coding for all messages normally used. For the AGV option, there are additional messages that may be used and special ways of coding common messages.

Three different messages are discussed:

- S2F41 in Section 20.3.1
- S2F42 in Section 20.3.2
- S4F67 in Section 20.3.3.

20.3.1 S2F41 - Remote Command (Initiate Process Request)

The general form of this message is described in Chapter 16. When an AGV is used, IPR (Initiate Process Request) is substituted for RCMD to begin the processing.

The message coding for this situation is as follows:

S2F41 W H→E

```
<L[2]
    <A IPR>                                 Initiate Process Request
    <L[3]
        <L[2]
            <A "PORT">
            <U4 port number>
        >
        <L[2]
            <A "PPID"
            <A PPID>
        >
        <L[2]
            <A "MID">
            <A MID>
        >
    >
>.
```

20.3.2 S2F42 - Remote Command Acknowledge

S2F42 H←E

```
<L[1]
    <B[1] HCACK>
>.
```

Table 20-3. Possible Values for HCACK

HCACK	Description
0x00	OK. All normal
0x01	Invalid command. Rejected.
0x02	Cannot perform now. Rejected.
0x03	At least one parameter is invalid. Rejected.
0x04	Acknowledge. Command will be performed with completion signaled later by an event.
0x05	Rejected. Already in desired condition.
0x06	No such object exists.
0x07 - 0x3F	Reserved.

20.3.3 S4F67 Request to Load/Unload/Exchange

The Host sends a message to prepare the Equipment for a Load, an Unload, or an Exchange.

S4F67 W H→E

```
<L[3]
    <B[1] PTN>        Port Number
    <B[1] PST>        Post Status
    <A[16] MID>       Material ID
>.
```

PST = 1, Load Request

PST = 2, Unload Request

PST = 3, Exchange Request

This message is used only in Extended E Mode.

20.4 AGV Collection Events

Some collection events have to do with cassette changes-of-state, others with changes in the sensor state, and still others like load and unload requests.

Information about these collection events is presented in two successive tables. Both tables contain similar information presented in different ways:

- Table 20-4 lists the collection events in order of their ceid.
- Table 20-5 lists the collection events organized by table port: first the events for Port #1, then for Port #2, and so on. Also, Table 20-5 contains detailed information not found in Table 20-4.

Note: Events marked with an asterisk (*) are valid only when the Extended SECS Mode is set to Extended E. (Refer to Section 20.2, Item 7.)

Table 20-4. AGV Collection Events by CEID

CEID	PORT	Collection Event
335544366	1	ALM_GEM_CASSETTE_1_STATE_CHANGE
335544367	2	ALM_GEM_CASSETTE_2_STATE_CHANGE
335544368	3	ALM_GEM_CASSETTE_3_STATE_CHANGE
335544369	4	ALM_GEM_CASSETTE_4_STATE_CHANGE
335544414	1	ALM_GEM_CASSETTE_1_POSITION_LOAD_REQ
335544415		ALM_GEM_CASSETTE_1_POSITION_UNLOAD_REQ
335544416	2	ALM_GEM_CASSETTE_2_POSITION_LOAD_REQ
335544417		ALM_GEM_CASSETTE_2_POSITION_UNLOAD_REQ
335544418	3	ALM_GEM_CASSETTE_3_POSITION_LOAD_REQ
335544419		ALM_GEM_CASSETTE_3_POSITION_UNLOAD_REQ
335544420	4	ALM_GEM_CASSETTE_4_POSITION_LOAD_REQ
335544421		ALM_GEM_CASSETTE_4_POSITION_UNLOAD_REQ
335544422	1	ALM_GEM_CASSETTE_1_POSITION_LOAD_COMPLETE
335544423		ALM_GEM_CASSETTE_1_POSITION_UNLOAD_COMPLETE
335544424		ALM_GEM_CASSETTE_1_POSITION_EXCHANGE_COMPLETE
335544425	2	ALM_GEM_CASSETTE_2_POSITION_LOAD_COMPLETE
335544426		ALM_GEM_CASSETTE_2_POSITION_UNLOAD_COMPLETE
335544427		ALM_GEM_CASSETTE_2_POSITION_EXCHANGE_COMPLETE
335544428	3	ALM_GEM_CASSETTE_3_POSITION_LOAD_COMPLETE
335544429		ALM_GEM_CASSETTE_3_POSITION_UNLOAD_COMPLETE
335544430		ALM_GEM_CASSETTE_3_POSITION_EXCHANGE_COMPLETE
335544431	4	ALM_GEM_CASSETTE_4_POSITION_LOAD_COMPLETE
335544432		ALM_GEM_CASSETTE_4_POSITION_UNLOAD_COMPLETE
335544433		ALM_GEM_CASSETTE_4_POSITION_EXCHANGE_COMPLETE
335544442	1	ALM_GEM_CASSETTE_1_TABLE_SENSOR_TRUE
335544443		ALM_GEM_CASSETTE_1_TABLE_SENSOR_FALSE
335544444	2	ALM_GEM_CASSETTE_2_TABLE_SENSOR_TRUE
335544445		ALM_GEM_CASSETTE_2_TABLE_SENSOR_FALSE
335544446	3	ALM_GEM_CASSETTE_3_TABLE_SENSOR_TRUE
335544447		ALM_GEM_CASSETTE_3_TABLE_SENSOR_FALSE
335544448	4	ALM_GEM_CASSETTE_4_TABLE_SENSOR_TRUE
335544449		ALM_GEM_CASSETTE_4_TABLE_SENSOR_FALSE

Table 20-5. AGV Collection Events by Port

Port	Sensor IDs	Sensor States
1	**ALM_GEM_CASSETTE_1_POSITION_LOAD_REQ** **ceid = 335544414**	Table 1 load request (MIR)
	ALM_GEM_CASSETTE_1_POSITION_UNLOAD_REQ **ceid = 335544415**	Table 1 unload request (MOR)
	ALM_GEM_CASSETTE_1_LOAD_COMPLETE **ceid = 335544422**	Table 1 load complete (MIC)
	ALM_GEM_CASSETTE_1_UNLOAD_COMPLETE **ceid = 335544423**	Table 1 unload complete (MOC)
	ALM_GEM_CASSETTE_1_EXCHANGE_COMPLETE **ceid = 335544424**	Table 1 exchange complete
	ALM_GEM_CASSETTE_1_TABLE_SENSOR_TRUE* **ceid = 335544442** (See Table 20-6 for sensor values)	The Table 1 sensor has transitioned from the False to the True state
	ALM_GEM_CASSETTE_1_TABLE_SENSOR_FALSE*c **eid = 335544443**	The Table 1 sensor has transitioned from the True to the False state
	ALM_GEM_CASSETTE_1_STATE_CHANGE **ceid = 335544366** New state: DB_GEM_ES_PORT_1_STATE_NEW_IV vid = 4564 Old state: DB_GEM_ES_PORT_1_STATE_OLD_IV vid = 4565	0 = No cassette 1 = Waiting to load 2 = Loading 3 = In process 4 = All complete 5 = Pending
2	**ALM_GEM_CASSETTE_2_POSITION_LOAD_REQ** **ceid = 335544416**	Table 2 load request (MIR)
	ALM_GEM_CASSETTE_2_POSITION_UNLOAD_REQ **ceid = 335544417**	Table 2 unload request (MOR)
	ALM_GEM_CASSETTE_2_LOAD_COMPLETE **ceid = 335544425**	Table 2 load complete (MIC)
	ALM_GEM_CASSETTE_2_UNLOAD_COMPLETE **ceid = 335544426**	Table 2 unload complete (MOC)
	ALM_GEM_CASSETTE_2_EXCHANGE_COMPLETE **ceid = 335544427**	Table 2 exchange complete
	ALM_GEM_CASSETTE_2_TABLE_SENSOR_TRUE* **ceid = 335544444**	The Table 2 sensor has transitioned from the False to the True state
	ALM_GEM_CASSETTE_2_TABLE_SENSOR_FALSE* **ceid = 335544445**	The Table 2 sensor has transitioned from the True to the False state
	ALM_GEM_CASSETTE_2_STATE_CHANGE **ceid = 335544367** New state: DB_GEM_ES_PORT_2_STATE_NEW_IV vid = 4566 Old state: DB_GEM_ES_PORT_2_STATE_OLD_IV vid = 4567	0 = No cassette 1 = Waiting to load 2 = Loading 3 = In process 4 = All complete 5 = Pending

Table 20-5. AGV Collection Events by Port (Continued)

Port	Sensor IDs	Sensor States
3	**ALM_GEM_CASSETTE_3_POSITION_LOAD_REQ** **ceid = 335544418**	Table 3 load request (MIR)
	ALM_GEM_CASSETTE_3_POSITION_UNLOAD_REQ **ceid = 335544419**	Table 3 unload request (MOR)
	ALM_GEM_CASSETTE_3_LOAD_COMPLETE **ceid = 335544428**	Table 3 load complete (MIC)
	ALM_GEM_CASSETTE_3_UNLOAD_COMPLETE **ceid = 335544429**	Table 3 unload complete (MOC)
	ALM_GEM_CASSETTE_3_EXCHANGE_COMPLETE **ceid = 335544430**	Table 3 exchange complete
	ALM_GEM_CASSETTE_3_TABLE_SENSOR_TRUE* **ceid = 335544446**	The Table 3 sensor has transitioned from the False to the True state
	ALM_GEM_CASSETTE_3_TABLE_SENSOR_FALSE* **ceid = 335544447**	The Table 3 sensor has transitioned from the True to the False state
	ALM_GEM_CASSETTE_3_STATE_CHANGE **ceid = 335544368** New state: DB_GEM_ES_PORT_3_STATE_NEW_IV vid = 4568 Old state: DB_GEM_ES_PORT_3_STATE_OLD_IV vid = 4569	0 = No cassette 1 = Waiting to load 2 = Loading 3 = In process 4 = All complete 5 = Pending
4	**ALM_GEM_CASSETTE_4_POSITION_LOAD_REQ** **ceid = 335544420**	Table 4 load request (MIR)
	ALM_GEM_CASSETTE_4_POSITION_UNLOAD_REQ **ceid = 335544421**	Table 4 unload request (MOR)
	ALM_GEM_CASSETTE_4_LOAD_COMPLETE **ceid = 335544431**	Table 4 load complete (MIC)
	ALM_GEM_CASSETTE_4_UNLOAD_COMPLETE **ceid = 335544432**	Table 4 unload complete (MOC)
	ALM_GEM_CASSETTE_4_EXCHANGE_COMPLETE **ceid = 335544433**	Table 4 exchange complete
	ALM_GEM_CASSETTE_4_TABLE_SENSOR_TRUE* **ceid = 335544448**	The Table 4 sensor has transitioned from the False to the True state
	ALM_GEM_CASSETTE_4_TABLE_SENSOR_FALSE* **ceid = 335544449**	The Table 4 sensor has transitioned from the True to the False state
	ALM_GEM_CASSETTE_4_STATE_CHANGE **ceid = 335544369** New state: DB_GEM_ES_PORT_4_STATE_NEW_IV vid = 4570 Old state: DB_GEM_ES_PORT_4_STATE_OLD_IV vid = 4571	0 = No cassette 1 = Waiting to load 2 = Loading 3 = In process 4 = All complete 5 = Pending

The table sensor states are:

- TRUE. A cassette is currently sitting on this port.
- FALSE. There is currently no cassette on this port.

These values are found in the following database points:

Table 20-6. Port Sensor Values

Port	VID	Database Point
1	2141	DB_ES_TABL1_SENSE_TSR
2	2142	DB_ES_TABL2_SENSE_TSR
3	2143	DB_ES_TABL3_SENSE_TSR
2	2144	DB_ES_TABL4_SENSE_TSR

20.5 Cassette State Transitions

Refer to Figure 15-1, Cassette Finite State Diagram. This is the state diagram for operation without either a SMIF Arm or an AGV. Operation with an AGV requires a new state: **PENDING**. This state means that a cassette has been placed on the moveable table but that the Host must supply both a PPID and an MID before loading can begin.

Figure 20-3 shows the state diagram of Figure 15-1 modified to include this new state.

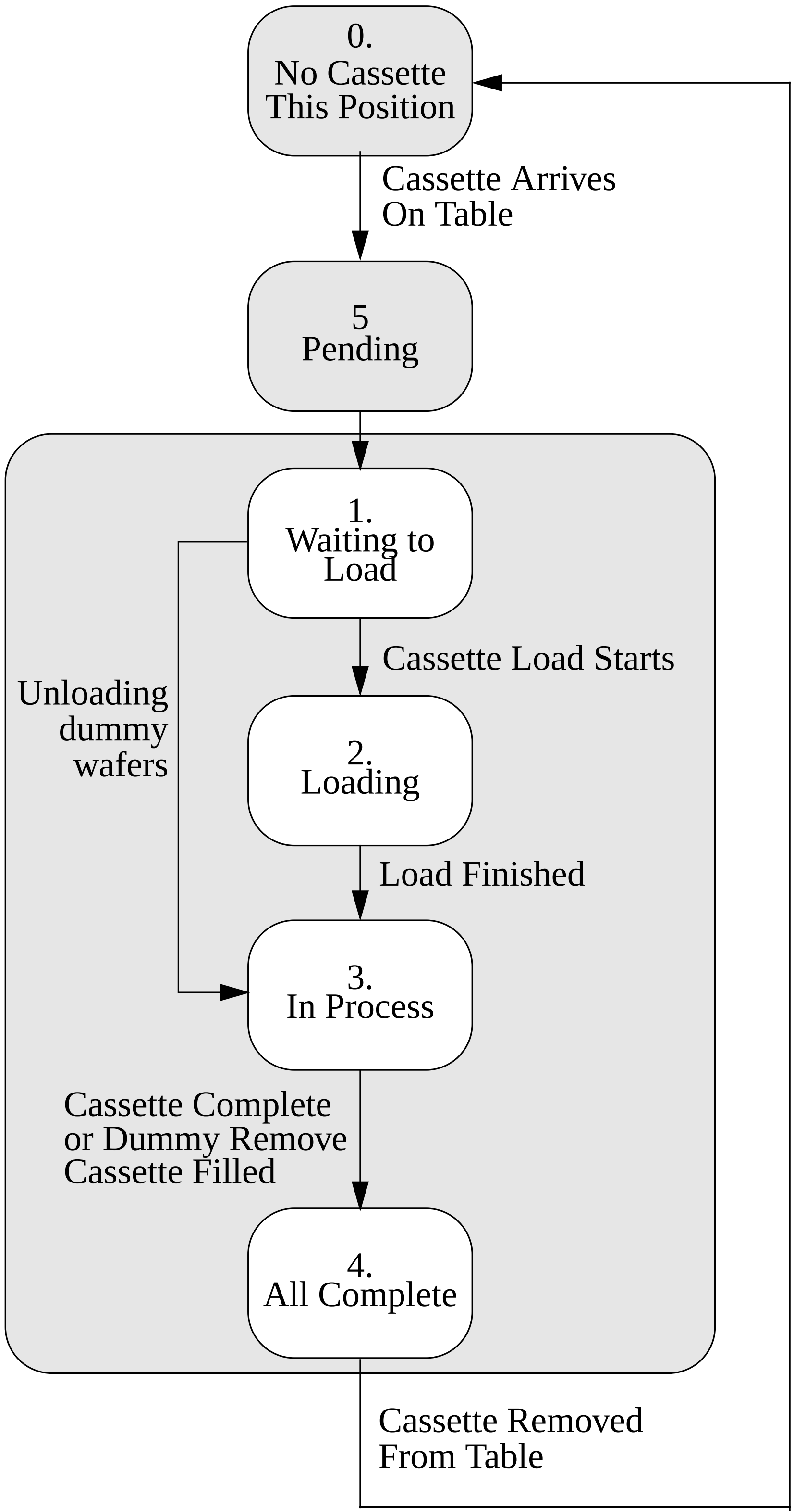


Figure 20-3. Cassette State Diagram Modified to Include PENDING State

Table 20-7. Cassette State Transitions

#	From	Trigger	To	Actions	Description
0-5	No Cassette This Position	Cassette loaded into cassette port	Pending	Cassette loaded in semi-automatic or in full-automatic	
5-1	Pending	PPID and MID assigned to cassette	Waiting to load	none	All wafers are in the cassette and none have been implanted
1-2	Waiting to Load	Wafers removed from cassette for Disk Load	Loading	Equipment starts to take the wafers out of the cassette and place them in the buffer.	Wafers are being removed from the cassette for loading onto Disk.
2-3	Loading	All wafers have been removed from Load cassette.	In Process	None.	All wafers have been moved from the input cassette
3-4	In Process	All wafers have been Implanted	All Complete	Cassette is ready to be removed.	
4-0	All Complete	Complete cassette removed	No Cassette This Position	Waiting for next cassette.	
0-5	No Cassette This Position	A cassette for removal of dummies is added	Pending	Cassette loaded in semi-automatic or in full-automatic	
3-4	In Process	All dummy wafers for removal are in cassette	All Complete	Cassette is ready to be removed.	
1-3	Waiting to load	Equipment starts to take the wafers out of the dummy buffer and place them in the cassette	In Process	Continues removing wafers from the dummy buffer	**Unloading dummies**

20.6 Alarms

```
ALM_GEM_AGV_NOT_CONFIGURED, alid = 335544450
altx = “Not configured for AGV, reject S4F67”

ALM_GEM_AGV_BAD_PORT, alid = 335544452
altx = “Host Cmd Bad Port #, reject S2F67”

ALM_GEM_AGV_BAD_CMD, alid = 335544453
altx = “Host Cmd Bad, reject S2F67”

ALM_GEM_AGV_BAD_PORT_HOST, alid = 335544454
altx = “Host Cmd Bad Port #, reject S2F41”

ALM_GEM_AGV_BAD_PPID, alid = 335544455
altx = “Host Cmd Bad PPID, reject S2F41”

ALM_GEM_AGV_NO_PEND_CASS, alid = 335544456
altx = “Host Cmd, No Cass Pending, reject S2F41”

ALM_AGV_HW_NOT_PRESENT, alid = 503316480
altx = “Can Not Read AGV. Check Hardware or Deco”

ALM_AGV_EXT_SECS_NOT_CONFIGED, alid = 503316482
altx = “AGV Transmitting: Extended Secs Mode not”

ALM_AGV_BAD_PORT, alid = 503316484
altx = “AGV Specified Invalid Port Number “

ALM_AGV_PORT_MISMATCH, alid = 503316485
altx = “AGV Port that doesn’t match Port by Host”

ALM_AGV_HOST_UNLOAD_EMPTY, alid = 503316486
altx = “Host Requested Unload of an Empty Casset”

ALM_AGV_HOST_EXCH_EMPTY, alid = 503316487
altx = “Host Requested Exchange of an Empty Cass”

ALM_AGV_HOST_LOAD_FULL, alid = 503316488
altx = “Host Requested Load to Port : Cassette P”

ALM_AGV_PORT_STATE, alid = 503316489
altx = “AGV Specified Port . Not Ready for Trans”

ALM_AGV_HOST_LD_LD, alid = 503316490
altx = “AGV Req. Load to before Prev. Load to Co”

ALM_AGV_HOST_LD_EX, alid = 503316491
altx = “AGV Req. Load to before Prev. Exch to Co”

ALM_AGV_HOST_LD_UN, alid = 503316492
altx = “AGV Req. Load to before Prev. Unld to Co”
```

```
ALM_AGV_HOST_BAD_PORT, alid = 503316493
altx = “Host Request Bad Port “

ALM_AGV_HOST_UN_LD, alid = 503316494
altx = “AGV Req. Unld to before Prev. Load to Co”

ALM_AGV_HOST_UN_EX, alid = 503316495
altx = “AGV Req. Unld to before Prev. Exch to Co”

ALM_AGV_HOST_UN_UN, alid = 503316496
altx = “AGV Req. Unld to before Prev. Unld to Co”

ALM_AGV_HOST_EX_LD, alid = 503316497
altx = “AGV Req. Exch to before Prev. Load to Co”

ALM_AGV_HOST_EX_EX, alid = 503316498
altx = “AGV Req. Exch to before Prev. Exch to Co”

ALM_AGV_HOST_EX_UN, alid = 503316499
altx = “AGV Req. Exch to before Prev. Unld to Co”

ALM_AGV_OPEN_FAILED, alid = 503316500
altx = “AGV Open of Serial Port Failed”

ALM_AGV_SETTING_PARITY_ERROR, alid = 503316501
altx = “AGV Failed to Set Parity on Serial Port”

ALM_AGV_SETTING_BAUD_ERROR, alid = 503316502
altx = “AGV Failed to Setting Baud Rate on Seria”

ALM_AGV_TABLE_FAILED, alid = 503316503
altx = “AGV: Table Move Failed, Can’t complete A”

ALM_AGV_WRONG_TABLE_POS, alid = 503316504
altx = “AGV: Table not positioned where requeste”

ALM_AGV_TABLE_NEVER_REPLY, alid = 503316505
altx = “AGV: Table Never Responded to Request. A”

ALM_AGV_NOT_CONFIGURED, alid = 503316506
altx = “Host sending PREP messages but AGV not C”

ALM_AGV_LINK_LOST_DURING, alid = 503316507
altx = “AGV: Lost I/R Link with AGV During Trans”

ALM_AGV_T1_TIMEOUT, alid = 503316509
altx = “Timeout Waiting for TR_REQ”

ALM_AGV_T2_TIMEOUT, alid = 503316510
altx = “Timeout Waiting for BUSY ON”

ALM_AGV_T3_TIMEOUT, alid = 503316512
altx = “Timeout Waiting for BUSY OFF”
```

```
ALM_AGV_T4_TIMEOUT, alid = 503316513
altx = “Timeout Waiting for COMPT ON”

ALM_AGV_T4_OFF_TIMEOUT, alid = 503316514
altx = “Timeout Waiting for COMPT OFF”

ALM_AGV_VALID_TIMEOUT, alid = 503316515
altx = “Timeout Waiting for VALID during Exchang”
```

20.7 Load, Unload, Processing Scenarios

This sections describes the steps that take place in each of the three modes: Manual, Semi-automatic, Full-automatic.

20.7.1 Manual Mode

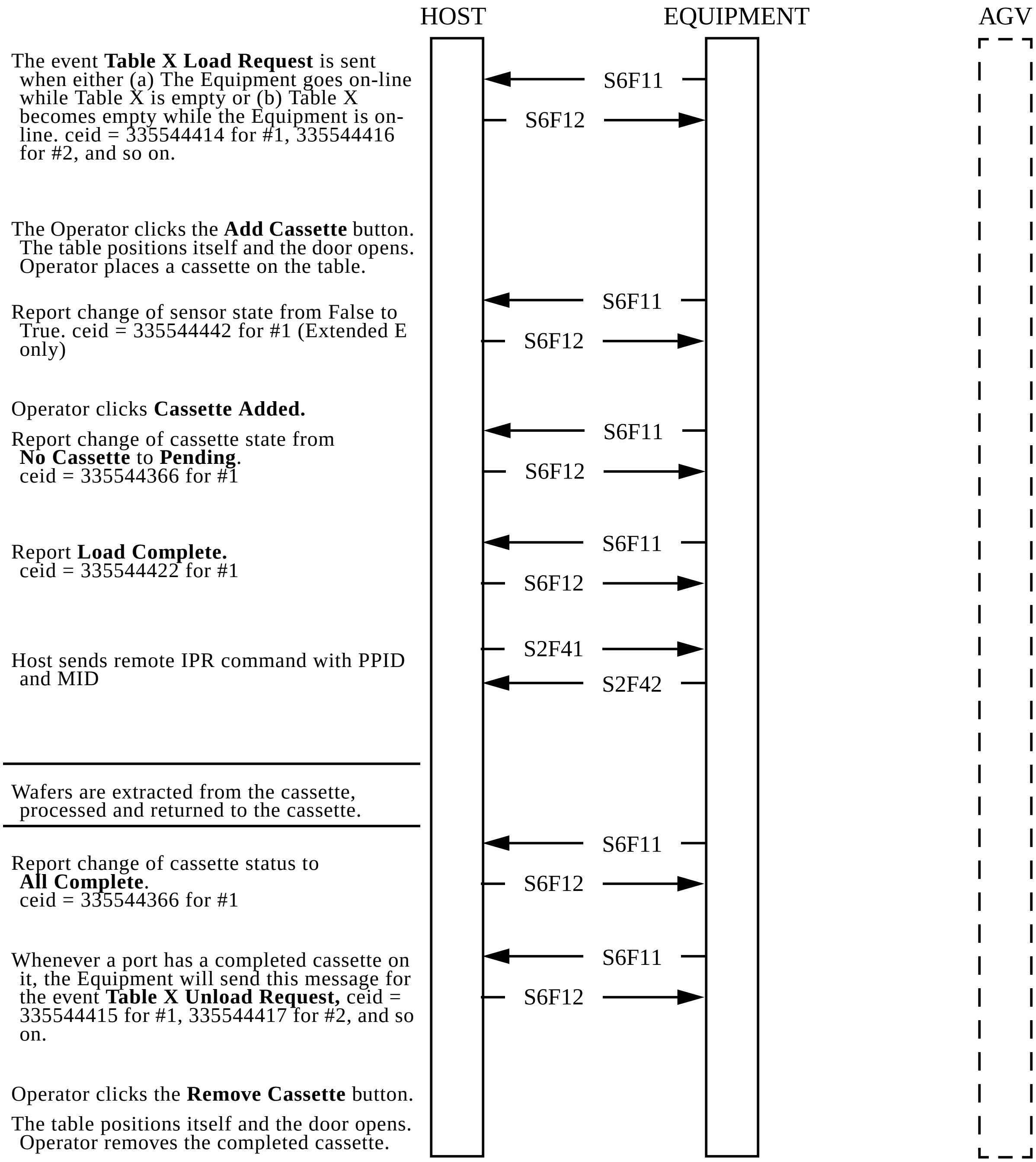
Processing in this mode takes place when the system is in the **GEM DISABLED** state. There is no communication with the Host and the AGV is not used. The operator both loads and unloads the cassettes by hand and also performs the necessary control functions at the Operator Interface.

The steps of manual mode operation are as follows: (refer to Figure 2-2, Main Menu screen).

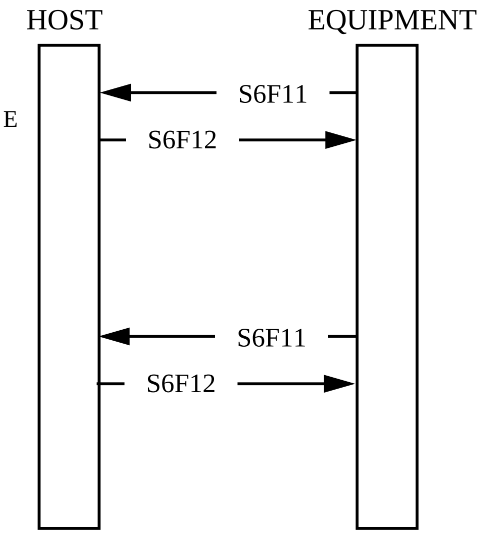
1. Click the **Add Cassette** button in the lower-left corner. At the prompt, enter both the **PPID** and the **MID** for the job to be processed.
2. The door opens and the table is positioned to the correct port.
3. Place the cassette on that port, then click **Cassette Added**.
4. Near the lower-left corner of your Endstation screen is a 7-element status display. The bottom item in this display is **AGV Mode**. As the loading process proceeds, its progress is displayed here: **idle, loading, unloading.** Error messages are also displayed here.
5. The wafers are extracted from the cassette, processing takes place, and the wafers are eventually replaced into the cassette.
6. Notice in the lower right-hand part of Figure 2-2 the status display for each of the four ports (#1 through #4 going from left to right). For each port there are five status items. One of these is **State**.
   When the **State** value for the active port changes to **Complete**, click the **Remove Cassette** button.
7. When the door opens and the table positions itself, remove the cassette.
8. Click **Cassette Removed**.
9. Unloading proceeds and its status is displayed.

20.7.2 Semi-automatic Mode

The system is in the ON-LINE LOCAL state. Cassettes are placed or removed manually but under direction of the Host. The AGV is not used in this mode.



Semiconductor Equipment



Report change of sensor state from True to False. ceid = 335544443 for #1 (Extended E only)

Operator clicks **Cassette Removed**. Door closes. Table repositions.

Report change of cassette state to **No Cassette.** ceid = 335544366 for #1

Return to starting point.

20.7.3 Full Automatic Mode

The event **Table X Load Request** is sent when either (a) The Equipment goes on-line while Table X is empty or (b) Table X becomes empty while the Equipment is on-line. ceid = 335544414 for #1, 335544416 for #2, and so on.

Used as a “Prep” message for the Extended E Mode

An AGV is summoned to bring a fresh cassette for Port X. It does so and announces its arrival. The door opens and the table is positioned. The AGV places its cassette.

Report change of sensor state from False to True. ceid = 335544442 for #1. (Extended E only)

Report change of cassette state from **No Cassette** to **Pending**.
ceid = 335544366 for #1

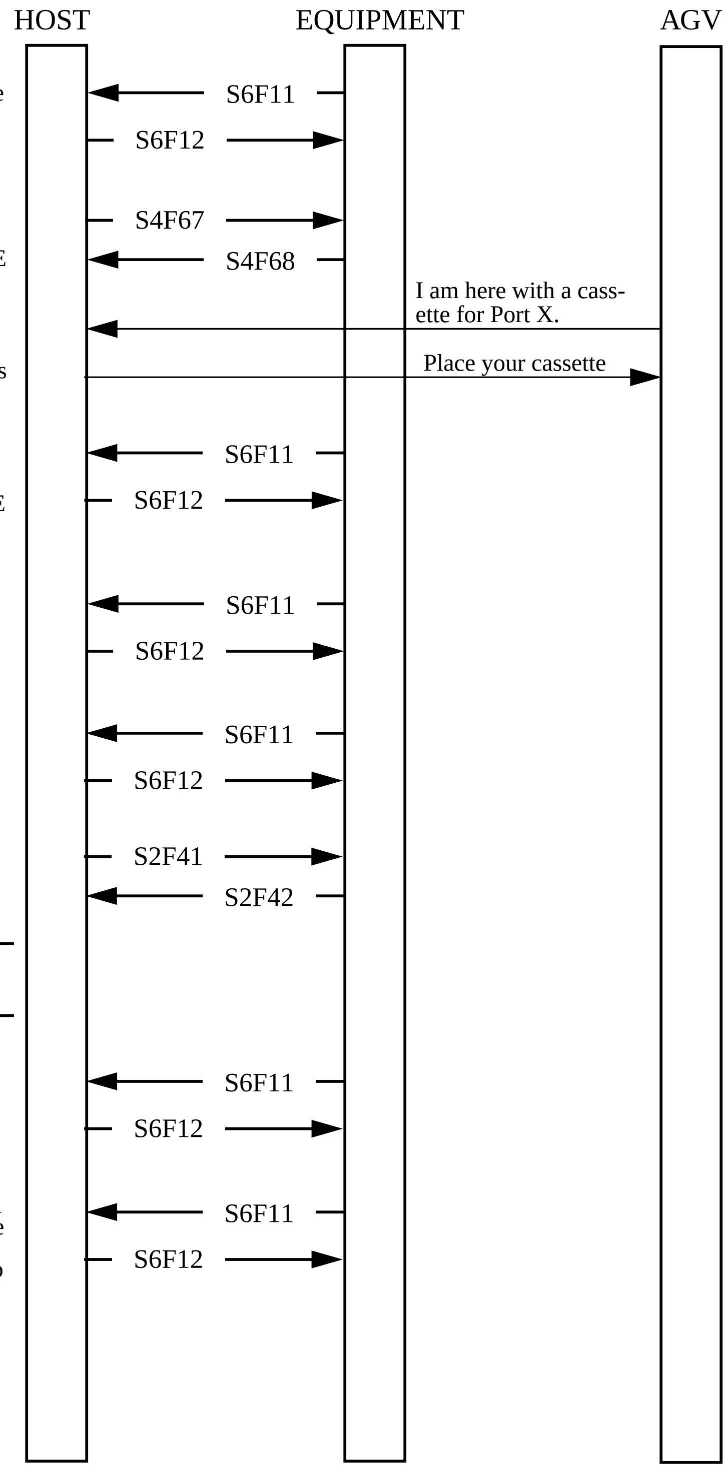
Report **Load Complete.**
ceid = 335544422 for #1

Host sends remote IPR command with PPID and MID

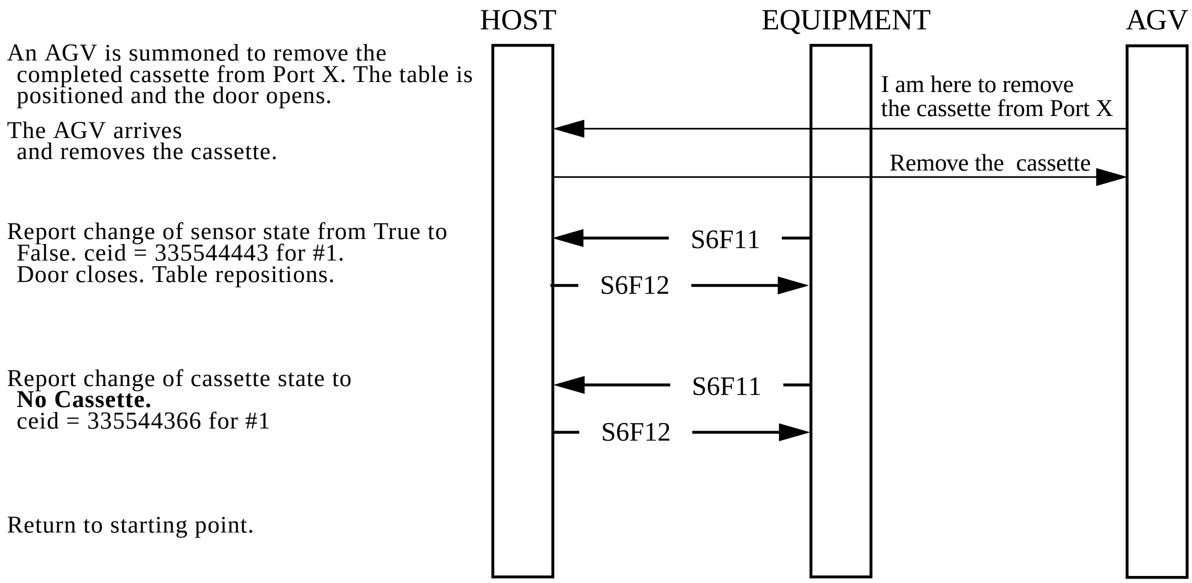
Wafers are extracted from the cassette, processed and returned to the cassette.

Report change of cassette status to **All Complete**.
ceid - 335544366 for #1

Whenever a port has a completed cassette on it, the Equipment sends this message for the event Table X Unload Request, ceid = 335544415 for #1, 335544417 for #2 and so on.



EATON Semiconductor Equipment



20.8 Parallel I/O

An AGV is summoned to come to an implanter either for the purpose of placing a fresh cassette or for removing a processed cassette. This activity requires a dialog between the AGV and the implanter: “Are you ready?” “Yes, I am ready.” “Did I place successfully.” “Yes, you did.”.

Such messages are passed back and forth through a 7-channel, parallel optical link. Figure 20-4 shows the link in more detail.

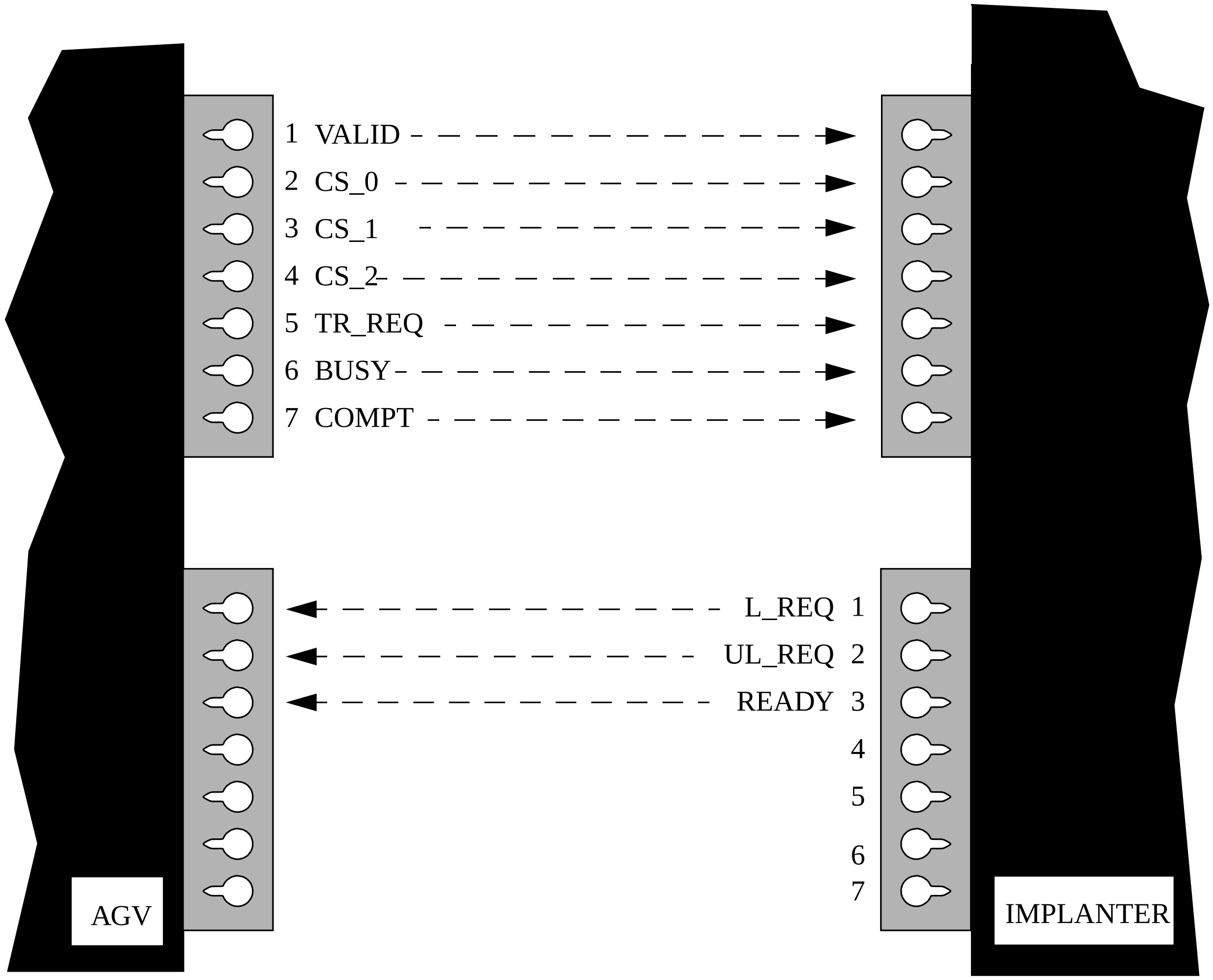


Figure 20-4. Parallel I/O

AGV→ IMPLANTER Signals

- VALID, CS_0, CS_1, CS_2, TR_REQ, BUSY, COMPT

IMPLANTER → AGV Signals

- L_REQ, UL_REQ, READY

CS_0-CS_2 These three bits encode the number of the port upon which a cassette is to be placed or from which a cassette is to be removed.

Table 20-8. Port # Encoding

CS_0	CS_1	CS_2	Port
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4

VALID This bit validates the three CS bits.

- VALID = 1, CS bits are valid
- VALID = 0, CS bits are ignored

TR_REQ, BUSY, COMPT, L_REQ, UL_REQ, READY These six bits form the handshake involved in either placing or removing a cassette

You can display the current states of these seven bits by clicking the **AGV** button in the lower-right region of the display.

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Note: An X may stand for any of the four possible table positions: 1, 2, 3, or 4.

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B

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