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# **SECS/GEM Interface Option for Fluidmove<sup>™</sup> for Windows<sup>™</sup>**

## ***Reference Manual***

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### ***Asymtek***

#### ***International Headquarters***

**2762 Loker Avenue West  
Carlsbad, CA 92008-6603  
USA**

<b>Toll Free Line:</b>	<b>1-800-ASYMTEK (1-800-279-6835)</b>
<b>Tel:</b>	<b>1-760-431-1919</b>
<b>Fax:</b>	<b>1-760-431-2678</b>
<b>E-mail:</b>	<b>info@asymtek.com</b>
<b>Website:</b>	<b>http://www.asymtek.com</b>

#### ***Technical Support***

<b>Toll Free:</b>	<b>1-800-ASYMTEK (1-800-279-6835)</b>
<b>Europe:</b>	<b>+31 43-352-4466</b>
<b>Pacific Rim:</b>	<b>1-760-431-1919</b>

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# 1. Introduction

This document describes the SECS interface provided on the GES-1993.

This document is a modification of the GW Associates GES-1993 SECS/GEM Interface document. It has been especially prepared in support for Fluidmove for Windows® (FMW). The content and structure of this document follows the original *[RefGWGEM]* document. User information and GEM interface with FMW were added.

FMW supports the GW Associates GEM subset of the SECS communication standard. Future references to the SECS/GEM interface will use only the GEM identification to acknowledge the specific approach used by FMW .

This document has numerous references to other GW Associates documents. In order to maintain clarity, these documents are referred to by the following notation:

- *[RefGWGEM] GES-1993 SECS/GEM Interface document, GW Associates, Sep-94*
- *[RefGWGEMUser ] GWGEM For Windows User's Guide (including Version 3.10 Release Notes, Revision 1.0), GW Associates, Revision 2.2, Sep-94*
- *[ RefGWGEMRef] GWGEM For Windows Reference Manual, GW Associates, Revision 2.0, Sep-94*
- *[ RefGWSECSUser ] SDR-TCP/IP For Windows User's Guide, GW Associates, Revision 1.0, Sep-95*

The interface between FMW and a host computer is explained in detail. The interface conforms to the GEM standard *[RefGWGEM]*. The GEM standard defines a standard implementation of the SECS-II communication interface for all semiconductor manufacturing equipment.

System Requirements document for FMW is also included. The majority of these requirements will be fulfilled by FMW. Other requirements (i.e. initializing ASCII configuration text files) may be met using an Operator and written procedures.

GW Associates (Software Model GEM-W-100) is used to implement approximately 90% of SECS and GEM features, with the FMW implementing the remaining equipment-specific features. *[RefGWGEMUser]*, *[RefGWGEMRef]*, and *[RefGWSECSUser ]* describe GEM-W-100 software.

## 1.1 SECS Standard

The SEMI Equipment Communication Standard (SECS) is published by Semiconductor Equipment and Materials International (SEMI). It defines a computer to computer communications interface between a unit of factory Equipment and a Host Computer.

This Equipment complies to the complete SECS-I standard (excluding the physical RS-232 hardware connection) and to the generic portions of the SECS-II standard. The equipment implements an appropriate subset of the SECS-II standard messages. The GES-1993 complies to the following versions of standards:

- E4-1991 (SECS-I)
- E5-1993 (SECS-II)

GWGEM Software is used to meet the SECS standard.

SECS default parameters will be used wherever possible; differences will be noted.



**NOTE**

There were no changes to the SEMI E4 standard for 1993.

### 1.1.1 SECS-I Clarifications

The Equipment was designed to avoid using any of the unusual features of the SECS standard, so as to simplify the job of implementing Equipment support on the Host. This section clarifies the Equipment/Host SECS interface.

FMW supports only Ethernet High Speed SECS Message Services (HSMS) in conjunction with communication drivers supplied by GW Associates. Presently, FMW does not support RS-232 interfaces.

## 1.1.2 Physical Connection

The GEM hardware interface must be a TCP/IP network card connection through a Ten-Base-T connector or BNC jack (SECS-II interface).

The following documentation is provided only as a reference for RS-232 connections (SECS-I interface) and is currently not implemented by FMW.

The RS-232 connector on the Equipment deviates from the standard SECS-I DB25F connector.

The GES-1993 provides a male 25-pin RS-232 "DB25M" connector on its backpanel as the SECS port. The following pins on the RS-232 connector are used:

Table 1-1 RS-232 Pins

Pin No.	Description
1	Shield.
2	TX Data (Equipment-to-Host).
3	RX Data (Host-to-Equipment).
4	Request to send (RTS). The Equipment raises this output signal when activating SECS. Not required by SECS standard, but you may find it useful for modem control.
7	Signal Ground.
20	Data Terminal Ready (DTR). The Equipment raises this output signal when activating SECS. This is not required by the SECS standard, but you may find it useful for modem control.

Optional SECS power pins 18 and 25 are not provided.

## 1.1.3 SECS-I Blocks Transmitted

The Equipment uses the following SECS-I conventions in the blocks it sends:

- The Device ID is present in every block, with the R-bit always set to "1".
- The Block Number is always one (0x0001) for the first block of a message.
- For Primary messages, the System Bytes are generated unique for each message. For Secondary messages, the System Bytes are replicated from the received Primary message.

#### **1.1.4 SECS-I Blocks Received**

Blocks received by the Equipment should be formatted as described above (except with the R-bit set to "0"), although the rules are more relaxed:

- If a message consists of a single block, the Block Number may be zero (0x0000) or one (0x0001).
- The Equipment is indifferent to the R-bit setting.

#### **1.1.5 Interleaved Blocks**

The GES-1993 never sends interleaved blocks to the Host. That is, the Equipment always sends all blocks of one message before sending the first block of the next message. This simplifies the job of the Host.

However, the Equipment allows the Host to send interleaved blocks, if it so chooses.

#### **1.1.6 Simultaneous Transactions**

The GES-1993 may initiate several simultaneous outstanding SECS transactions. That is, the Equipment may send a secondary primary message before the Host has sent the Reply to a previous primary message. Mainly, this occurs when the Equipment reports Alarms and Events. The Host can reduce the number of outstanding transactions initiated by the Equipment by setting Equipment Constants appropriately so that the Equipment sends no W-Bit for Stream 5 (Alarm), Stream 6 (Event), and Stream 10 (Free Text) messages.

The Equipment allows the Host to initiate at least two (2) simultaneous outstanding transactions.

## **1.2 SECS-II Clarifications**

The GES-1993 uses the following SECS-II conventions:

### **1.2.1 Data Format Types**

Where the Standards permit a choice of data item types, the choice has been made as described in section "Message Detail".

For outgoing messages, the Equipment always sends Data Items of the exact format shown. For some incoming messages, the Equipment "forgives" minor host errors. For example, the Equipment may accept a U1 Data Item where a U2 format was expected. We recommend the Host attempt to use the formats shown.

### **1.2.2 Data Item Length Bytes**

For messages sent by the Equipment, the number of length bytes in Data Items is always the minimum required to contain the Data Item length.

For messages received from the Host, the number of length bytes in Data Items can be 1, 2, or 3, provided that the length parameter can accurately be specified.

### **1.2.3 ASCII Data**

Unless otherwise specified, all ASCII data items must contain printable ASCII data - that is, characters in the range 0x20 to 0x7E.

### **1.2.4 Multi-Block Messages**

Wherever the Host is supposed to send a single-block message, this Equipment will also accept multi-block format.

The maximum size for a single SECS message is approximately 1000 blocks (256,000 bytes).

### 1.2.5 Function Zero

The Equipment sends a Reply Message using Function zero (F0) according to the requirements of the GEM Control State.

Wherever this Equipment expects a Reply message from the Host, the Host can send F0. The Equipment will instantly abort the outstanding transaction. The Equipment will not take any additional action.

## 1.3 GEM Standard

The SEMI Generic Equipment Model for Effective Factory Automation (GEM) is another document published by SEMI. The GEM standard defines some useful conventions for designing the communications interface on a unit of factory Equipment to improve operations with a Host Computer. The GES-1993 complies to the following GEM document:

- E30-1993

## 1.4 GEM Compliance

This section clarifies which GEM functions are implemented in this Equipment. See "GEM Compliance Statement" on page 7.

- The GES-1993 never sends S2F25 (Loopback Diagnostic) to the Host. It will send the appropriate S2F26 in response to an S2F25 from the Host.
- The GES-1993 never sends S9F13 (Conversation Timeout) to the Host. The Equipment can be defined as having an "infinite timeout" for conversations.
- The GES-1993 never sends S10F7 (Multi-Block Not Allowed) to the Host. It will accept incoming messages consisting of printable characters and a maximum size of 320 characters.
- The GES-1993 will accept, but does not require the Inquire/Grant transaction (S2F39/S2F40, S6F5/S6F6, S7F1/S7F2) for incoming primary multi-block messages.

GWGEM Software Model GEM-W4-100 is used by FMW to meet the SECS standard.

Table 1-2 GEM Compliance Statement

<b>FUNDAMENTAL GEM REQUIREMENTS</b>	<b>IMPLEMENTED</b>	<b>COMPLIANT</b>
State Models	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Equipment Processing States	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
S1,F13/F14 Auto Connection Scenario	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Event Notification	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
On-line Identification	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Error Messages	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Control (Operator Initiated)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Documentation	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
<b>ADDITIONAL CAPABILITIES</b>	<b>IMPLEMENTED</b>	<b>COMPLIANT</b>
Establish Communications	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Dynamic Event Report Configuration	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Variable Data Collection	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Trace Data Collection	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Status Data Collection	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Alarm Management	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Remote Control	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Equipment Constants	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Process Program Management	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Material Movement	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Equipment Terminal Services	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Clock	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Limits Monitoring	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Spooling	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Control (Host Initiated)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

## 1.5 SEMI E10 Standard

The SEMI E10 Standard is another document published by SEMI. It provides a guideline for definition and measurement of equipment reliability, availability, and maintainability (RAM). This document defines six basic Equipment States which define how equipment time is categorized.

The SECS Interface on the GES-1993 will reflect the current E10 state. These Equipment States are as defined in the following version of the standard:

- E10-1992 (Section 3, Equipment States)

FMW does not implement the E10 Standard.

## 1.6 SECS/GEM Configuration

GWGEM uses a GCD configuration file that defines support for SECS variables, ALIDs, CEIDs, the names of C-language Primary Message Handlers, application specific GWGEM Extension Routines and GEM variable Access and Management Routines([*RefGWGEMUser*] p 179 '*GCD Source File*').

The final GEM operational configuration of FMW is determined by the GWGEMEXT.DLL and GWGEMMSG.DLL supplied with FMW. The production of these program components requires an appropriate GCD configuration file, along with its resulting source and header files ( built with the GWGEM GCD Compiler/Translator ) which are compiled and linked into GWGEMEXT.DLL and GWGEMMSG.DLL([*RefGWGEMUser*] p 36 '*GCD Object File*')

## 1.6.1 SECS-I Parameters

This section provides hardware settings that apply only to the RS-232 hardware interface.



**NOTE**

FMW currently does NOT support this interface.

Table 1-3 SECS Installation Parameters

Parameter	Default	Description
Device ID	1	Specified as a value from 0 to 32767 (15 bits).
Baud Rate	9600	Allowable speeds are 110, 150, 300, 600, 1200, 2400, 4800, 9600, and 19200 Baud.
T1	0.5 Sec	Inter-character timeout. Range allowed is 0.1 to 10.0 seconds, at increments of 0.1 seconds.
T2	10.0 Sec	Protocol timeout. Range allowed is 0.2 to 25.0 seconds, at increments of 0.1 seconds.
T3	45 Sec	Transaction Timeout. Range allowed is 1 to 120 seconds, at increments of 1 second.
T4	45 Sec	Inter-Block timeout. Range allowed is 1 to 120 seconds, at increments of 1.
RTY	3	Transmit failure retry limit. Range allowed is 0 to 31, at increments of 1.
DUPLIC	Off	Duplicate Block Detect. May be Enabled (On) or Disabled (Off).

## 1.6.2 SECS-II Parameters

This section applies only to the Ethernet hardware interface defined in the SECS II standard.

There are no operator adjustable parameters involved in configuring the SECS II interface. The operating system of the Equipment computer needs to be made aware of the network connection.

### 1.6.3 GEM Configuration

This Equipment is configurable for operation with most older Host Computers which do not support the GEM message set, or support an older version of GEM.

1. Equipment Constant "CONFIGALARMS" (VID 18) selects the message the Equipment will send for Alarm Reports. "ConfigAlarms" may be 0, 1, or 2, selection S5F1, S5F71, or S5F73, respectively.
2. Equipment Constant "CONFIGCONNECT" (VID 19) selects the message the Equipment will send for Connect Request. "ConfigConnect" may be 0, 1, or 2, selecting S1F1, S1F65, or S1F13, respectively.
3. Equipment Constant "CONFIGEVENTS" (VID 20) selects which message the Equipment will send for Event Reports. If "ConfigEvents" is 0, the Equipment will send S6F9 for normal (unannotated) event reports or S6F3 for annotated event reports. If "ConfigEvents" is 1, the Equipment will send S6F11 for normal event reports or S6F13 for annotated event reports.
4. Equipment Constant "RPTYPE" (VID 16) selects whether the Equipment will send "normal" event reports (S6F9 or S6F11) or annotated event reports (S6F3 or S6F13).

RpType="False". Equipment will send "normal" event reports.

RpType="True". Equipment will send annotated event reports.

Table 1-4 GemRPTYPE

	GemConfigEvents = 0	GemConfigEvents = 1
GemRPTYPE = FALSE	S6F9	S6F11
GemRPTYPE = TRUE	S6F3	S6F13

5. For a non-GEM Host, build appropriate Report Definitions, Links, and Enables (S2F33, S2F35, S2F37) so that S6F9 or S6F3 event reports contain the desired data. See "How to Configure", below.
6. Equipment Constant "WBITS5" (VID 21) selects whether Stream 5 primary message (S5F1, S5F71, and S5F73) sent by the Equipment will have the W-bit set to "0" or "1".
7. Equipment Constant "WBITS6" (VID 22) selects whether Stream 6 primary messages (S6F1, S6F3, S6F9, S6F11, and S6F13) sent by the Equipment will have the W-bit set to "0" or "1".

8. Equipment Constant "WBITS10" (VID 23) selects whether Stream 10 primary message S10F1 sent by the Equipment will have the W-bit set to "0" or "1".
9. Equipment Constant "CONFIGSPOOL" (VID 66) configures whether the Equipment will transition to "Spool Active" state when a RTY error occurs.

The following table shows the recommended settings for compatibility with various types of Hosts. Factory (Default) settings are shown in bold.

Table 1-5 Compatibility Settings

Equipment Constant	E30-93	GEM 3.1	GEM 3.0	GEM 2.0	GEM 1.7	Non-GEM
CONFIGALARMS	<b>0</b>	2	2	2	1	0
CONFIGCONNECT	<b>2</b>	2	2	1	1	0
CONFIGEVENTS	<b>1</b>	1	1	1	1	0
RPTYPE	<b>False</b>	False	False	False	False	False or True
WBITS5	<b>1</b>	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0
WBITS6	<b>1</b>	1	1	1	1	1 or 0
WBITS10	<b>1</b>	1 or 0	1 or 0	1 or 0	1 or 0	0
CONFIGSPOOL	<b>1</b>	0	0	0	0	0

## 1.7 Terminology

The following terms are used throughout the document to refer to the various entities interfacing with the GES-1993:

Table 1-6 Terminology

<b>Equipment</b>	The GES-1993.
<b>Operator</b>	The person who physically has access to the equipment's material port(s) and control panel. This is the person who is operating the GES-1993.
<b>Host</b>	The computer which is connected to the equipment via the SECS interface
<b>ALID</b>	Equipment Alarm ID
<b>CEID</b>	Collection Event ID
<b>DV</b>	Data Variable
<b>EC</b>	Equipment Constants
<b>FMW</b>	The Fluidmove for Windows software application which controls GEM.
<b>GCD</b>	GWGEM Configuration Data (an ASCII file compiled for GWGEM)
<b>GEM</b>	Generic Equipment Model.
<b>ID</b>	Identifier, or Identification
<b>PP</b>	Process Program
<b>SECS</b>	SEMI Equipment Communications Standard
<b>SEMI</b>	Semiconductor Equipment and Materials International
<b>SV</b>	Status Variable
<b>SW</b>	Software.
<b>UFPP</b>	UnFormatted Process Program
<b>VID</b>	Variable ID

## 1.8 State Diagrams

This document uses several *Finite State Machine* diagrams to describe the current condition of the Equipment's SECS link, material handling mechanisms, and process cycle. Each Finite State Machine diagram includes a State Diagram and a complete description of the states and state transitions.

All Finite State Diagrams have been prepared in the format specified in the GEM standard. This notation is required as a fundamental part of GEM compliance and must be included in the Equipment SECS Interface Documentation. This notation is the "Statechart" notation developed by David Harel.

The following are the major characteristics of this notation as it is used in this document:

- A. Each state is represented by a rectangle with rounded corners.
- B. A collection of sub-states may be grouped into a super-state.
- C. The entity described by the diagrams will be in one and only one of the sub-states at all times.
- D. Variables representing the current state of an entity do not contain values for super-states, only the lowest sub-state is represented.
- E. State transitions are represented by single-headed arrows.
- F. Each state transition is a Collection Event, and it has a unique Collection Event ID (CEID)
- G. An arrow directly from a super-state to another state describes a Collection Event that can occur while the entity is in any one of the sub-states contained in the super-state.
- H. An arrow directly into a super-state to the **H\*** (history) symbol describes a transition to the lowest sub-state which described the entity just before the transition out of the super-state.
- I. An arrow directly into a super-state to the **C** (conditional) symbol describes a transition to a particular sub-state based on some other relevant data. The conditional data is not represented in the diagram but is described in the associated text.

## 1.9 Machine Operation and the GEM Interface

### 1.9.1 Connecting to the Host

FMW loads the GEM communications driver immediately upon startup. Once connection to the driver is established, the device enters its default communication state as set by the operator. This default state can be set via the GEM property page. The recommended selection is “Enabled”. If enabled, the Communications State Machine in the GEM driver sends the Establish Communications Request message (S1F13) every ESTABLISHCOMMUNICATIONSTIMER seconds until a reply is received from the Host. The Communication State changes to reflect this response.

Unlike other state machines, transitions in this state machine do not produce events or message reports to the Host.

In the Main Window of FMW, the GEM Status control can be seen in the lower part of the screen in a status bar display format. The COMM section displays the GEM communication state of the program. The CTRL section displays the control state of the program. The SPOOL section displays the spooling state of the program. General GEM controls are available to the user by clicking on the SECS/GEM button from the main window.

The initial (default) control state is set through the GEM property page dialog. “ONLINE/REMOTE” is recommended for this setting. This way, the host has control of the machine once the application has started and communication has been established. Refer to GEM Property Page section for further detail.

Normally, communications are established without fault, and going to the GEM setup dialog would only be used by the operator to manually go off line for maintenance reasons.

### 1.9.2 Device Identification

The Host periodically sends the Are You There message (S1F1) to the Equipment. If the communication link is operational the Equipment automatically responds with the acknowledgment message (S1F2) which contains FMW model type (MDLN) and software revision number (SOFTREV). The Host may receive more detailed information by requesting the MachineID variable from the Equipment.

### **1.9.3 Clock**

The Host updates the GEM TIME structure periodically using the Date and Time Send message (S2F31 ). FMW will update its system clock to reflect the data presented by the Host. Current values of the system time are used extensively in event logging and will be required to synchronize with comparable events logged by the Host.

### **1.9.4 Loss of Communications Link: Spooling**

Communications may be temporarily lost with the Host from time to time. GEM message responses and requests are automatically spooled to disk when this happens. When communications are restored the messages on the SPOOL file are automatically sent to the Host.

The CONFIGSPOOL variable in the gemconf.gcd file enables or disables spooling capability during program initialization. Spooling is enabled for FMW. The Host may query the SPOOLSTSATE and CONTROLSTATE variables with the Selected Equipment Status Request message (S1F3) in order to establish the success of REMOTE operations. In addition, the Host will receive spooling update messages from FMW.

The default spool state can be set through the GEM property page dialog.

### **1.9.5 Communications Error Messages**

Occasionally messages are garbled between FMW and the Host. Garbled message device Ids and streams result in FMW replying to the Host with S9F1 and S9F3 messages. Further distortion of the message results in the device ignoring the message which causes the Host to resend the message. See sections 4.93 and 4.94 for details of the message exchange.

### **1.9.6 Normal Communications**

#### ***1.9.6.1 Alarm Notification***

Alarms are reports of events which may result in production or equipment damage or events which may cause a safety hazard to workers. When an alarm state occurs, FMW initiates an alarm notification (message S5F1) to the Host. The Process State machine transfers into the Alarm-Paused state and the machine stops dispensing and retracts the dispenser apparatus from the board.

The operator will need to correct the alarm condition and guide the machine through the Paused state to the Idle State. When the machine is prepared to enter the Running state again, the operator can open the GEM control screen and send the Proceed event message to the Host to resume REMOTE operations.

The Host may poll the Equipment to receive lists of enabled or existing alarms. When the Host sends a List Alarm Data message (S5F6) the Equipment replies with a list of the current active alarms. The Host may receive a list of the currently enabled alarms with the List Enabled Alarms Request (S5F7).

### **1.9.6.2 Remote Control Operations**

Both the Host and the operator are allowed to request runtime control of FMW from each other. When the control state is Local, only the operator has the ability to command FMW, and Host run commands are rejected. Conversely, when the Host has control of FMW, the operator is limited to requesting FMW status displays and Help screens. The operator can stop, abort, or pause the process from the Run Window. Host will receive an event if the operator presses any of the buttons from the Run Window. Refer to appendix B for the list of these events.

Both the operator and the Host may request that control be turned over to the requester. Each change in the control state machine generates a notification event to the Host.

Remote run commands consist of START, STOP, PAUSE, RESUME, LOCAL, REMOTE, and ABORT.

#### **START**

This command is successful when the Control State is OnLine - REMOTE, the board is in the Dispensing position, the machine is configured for a run, and the process program has been selected. This event begins the continuous processing of substrate trays. Processing can be interrupted by STOP, PAUSE, and ABORT commands. The operator can also initiate PAUSE, and STOP commands from Run Window.

#### **STOP**

This command is successful when the Control State is OnLine - REMOTE, and the Process State is Running. It causes a halt in dispensing following completion of the current substrate cycle. The Process State changes to Idle when this command is delivered. The process program is terminated by this command. (KAM\_TODO) Further processing of the substrate tray is not possible after completing this command.

### *PAUSE*

This command is successful when the Control State is OnLine - REMOTE and the Process State is Running. It causes a halt in dispensing following completion of the current instruction. The board and the process program are retained without change. The Process State changes to Paused. Diagnostics and status checks may be performed at this time. The substrate processing may be continued in the Running State by delivering the RESUME command.

### *RESUME*

This command is successful when the Control State is OnLine - REMOTE, and the Process State is PAUSED. Processing of the substrate tray continues exactly from the PAUSED point and the current process program executes from the beginning of the next unprocessed instruction.

### *LOCAL*

This command is successful if the current Control State is OnLine -REMOTE, otherwise it is ignored. The Host may request local operation for an operator to perform maintenance or inspection of the machine. The Host may request a return to operation under its command by delivering the REMOTE command following reception of a Proceed event or sufficient time elapsing to return to remote operation.

### *REMOTE*

This command is successful if the current Control State is OnLine - LOCAL, the Process State is Idle and the configuration allows remote operation.

Return to the REMOTE state following an Alarm or Abort command without proper operator inspection and delivery of a Proceed event may return the machine to the same error state which initially caused the machine to leave the REMOTE state.

### *ABORT*

This command is successful if the current Control State is OnLine - REMOTE, the Process State is Running and the configuration allows remote operation.

This command indicates an error status which prevents further dispensing operation until the error is corrected. Dispensing is immediately stopped and the current process program is terminated. Operator intervention and maintenance is generally required in order to resume operation past this point.

#### **1.9.6.3 Material Movement**

FMW declares two material movement events. The event notifications to the Host are: Dispensing and PostDispense.

Movement of the board into the ready position for dispensing invokes the Dispensing event. Transfer of the board out of the ready position after dispensing invokes the PostDispensing event.

#### **1.9.6.4 Terminal Message Notification**

After a terminal message has been received from the host, the GEM status bar will start blinking. GEM status bar is displayed in the lower part of the screen and displays the current communication, control, and spooling state. If the user has selected the beeping option (through GEM property page/Setup page) a 1/2 second interval beep is also provided to catch the user's attention.

During run-time, the GEM status bar is covered by run screen and the SECS/GEM page is responsible for displaying the incoming terminal message.

### **1.9.7 GEM Property Page**

The GEM property page can be accessed by pressing the SECS/GEM button from the Main Window. It contains different pages for different control and setup of GEM features.

#### **1.9.7.1 Control Page**

This page allows the user to change the communication state, control state, and request current date and time from host. Pressing on each button will change the state according to button's text. The current communication state, control state, and spool state is displayed in this page for user notification.

#### **1.9.7.2 Terminal Page**

The terminal page is used to display the incoming text messages from the host and also sending terminal messages to the host. The incoming message will be displayed in the upper box. The operator should acknowledge receipt of the message by pressing the "Acknowledge" button. To send a text message to host, the operator should type his message in the lower box and then press the "Send" button.

The current communication state, control state, and spool state is displayed in this page for user notification.

#### **1.9.7.3 Setup Page**

This page is used to set some user-defined parameters.

##### **1.9.7.3.1 Establish Communication Timeout**

This is the user-configurable equipment constant that defines the delay, in seconds, between attempts to send S1,F13. This value is used to initialize the CommDelay timer.

##### **1.9.7.3.2 Default Communication State**

This option allows the user define the default communication state upon FMW's startup. The valid choices are:

ENABLED: FMW will attempt to establish communication link upon start up.

DISABLED: FMW will not attempt to establish communication link upon startup.

ENABLED is recommended for this option.

#### **1.9.7.3.3 Default Control State**

This option allows the user define the default control state upon FMW's startup. The valid choices are:

OFFLINE/ATTEMPT ONLINE, OFFLINE/EQUIPMENT OFFLINE, OFFLINE/HOST OFFLINE, ONLINE/LOCAL, ONLINE/REMOTE

ONLINE/REMOTE is recommended for this option. Refer to Control State section for description of these states.

#### **1.9.7.3.4 On-line Attempt Failure Destination**

This option allows the user to select what to do if attempting to go on-line fails for any reason. The valid choices are:

OFFLINE/HOST OFFLINE, OFFLINE/EQUIPMENT OFFLINE

OFFLINE/HOST OFFLINE is recommended for this option. Refer to Control State section for description of these states.

#### **1.9.7.3.5 Beep Until Incoming Message Acknowledged**

If this option is selected, FMW will beep twice a second to notify the user of arrival an incoming terminal message from the host. The GEM status bar blinks at the same rate to catch user's attention regardless of this option being selected or not. The user should then go to the Terminal page to view and acknowledge the message.

### **1.9.8 RunWindow Interface**

The SECS/GEM page of Run Window provides user the opportunity to view incoming terminal messages and to send terminal messages to host. The incoming message will be displayed in the upper box. The operator can acknowledge receipt of the message by pressing the "Acknowledge" button. To send a text message to host, the operator should type his message in the lower box and then press the "Send" button.

The current communication state, control state, and spool state is displayed in this page for user notification.

The SECS/GEM box to the right of the screen shows the communication state of the GEM interface. If communication has not been established, a grey picture will show. A color picture will be shown as long as the communication link is established.



## 2. Message Summary

Another entry has been added to the Notes column of the following indicating FMW application involvement. See [RefGWGEMUser] Table 14 and Table 15 Host/Equipment Primary Messages.

Key for Notes Column:

- \* First line indicates FMW application requirements.
- \* E = GEM extensions.
- \* N = non-GEM or older GEM compatibility

### 2.1 Host to Equipment

This section describes primary SECS messages sent by the Host, and the associated reply messages from the Equipment.

The column headed "CState" in the table below indicates the control state the Equipment must be in to accept the message. The current value of the Equipment Control State can be found in variable CONTROLSTATE (vid 4). Possible values for this column are as follows:

Table 2-1 Control State Values

Value	State
1	Off-Line/Equipment Off-Line
2	Off-Line/Attempt On-Line
3	Off-Line/Host Off-Line
4	On-Line/Local
5	On-Line/Remote

Unlawful messages sent to the Equipment while Control State is Off-Line (1, 2, or 3) will be replied to with a SnF0 message. Thus, the Host will only ever see values of 4 or 5 for CONTROLSTATE.

Refer to [Table 122 - Host to Equipment Messages](#) in section 7 for further message detail.

In the column headed "Notes", those messages marked with "E" are extensions beyond GEM. Those messages marked with "N" are provided for non-GEM or older GEM compatibility.

Table 2-2 SECS Messages Host to Equipment

Primary	Reply	CState	Description	Notes
S1F1	S1F2	4,5	Are You There	
S1F3	S1F4	4,5	Selected Status	
S1F11	S1F12	4,5	Status Variable Namelist Request	
S1F13	S1F14	All	Connect Request	
S1F15	S1F16	4,5	Request Off-Line	
S1F17	S1F18	1,2,3	Request On-Line	
S1F65	S1F66	All	Connect Request	N
S2F13	S2F14	4,5	Equipment Constant Request	
S2F15	S2F16	4,5	New Equipment Constant Send	
S2F17	S2F18	4,5	Date and Time Request	
S2F21	S2F22	5	Remote Command	N
S2F23	S2F24	4,5	Trace Initialize	
S2F25	S2F26	4,5	Loopback Diagnostic	E
S2F27	S2F28	5	Initiate Processing Request	N
S2F29	S2F30	4,5	Equipment Constant Namelist Request	E
S2F31	S2F32	4,5	Date and Time Send	
S2F33	S2F34	4,5	Define Report	
S2F35	S2F36	4,5	Link Event Report	
S2F37	S2F38	4,5	Enable/Disable Event Report	
S2F39	S2F40	4,5	Multi-Block Inquire/Grant	
S2F41	S2F42	5	Remote Command with Parameters	
S2F43	S2F44	4,5	Reset Spooling Streams and Functions	
S2F45	S2F46	4,5	Define Variable Limits Attributes	
S2F47	S2F48	4,5	Variable Limit Attribute Request	
S5F3	S5F4	4,5	Enable/Disable Alarm	
S5F5	S5F6	4,5	List Alarms	
S5F7	S5F8	4,5	List Enabled Alarms	E
S6F15	S6F16	4,5	Request Event Report	
S6F17	S6F18	4,5	Request Annotated Event Report	E

Primary	Reply	CState	Description	Notes
S6F19	S6F20	4,5	Request Report	
S6F21	S6F22	4,5	Request Annotated Report	E
S6F23	S6F24	4,5	Request Spooled Data	
S7F1	S7F2	4,5	Process Program Inquire/Grant	
S7F3	S7F4	4,5	Unformatted Process Program Send	
S7F5	S7F6	4,5	Unformatted Process Program Request	
S7F17	S7F18	4,5	Process Program Delete	
S7F19	S7F20	4,5	Process Program Directory	
S10F3	S10F4	4,5	Terminal Display, Single	
S10F5	S10F6	4,5	Terminal Display, Multiple	
S10F9	S10F10	4,5	Broadcast	E

## 2.2 Equipment to Host

This section describes primary SECS messages sent by the Equipment, and the associated reply messages from the Host.

Refer to [Table 123 - Equipment to Host Messages](#) in section 8 for further detail.

In the column headed "Notes", those messages marked with "E" are extensions beyond GEM. Those messages marked with "N" are provided for non-GEM or older GEM compatibility.

Table 2-3 SECS Messages Equipment to Host

Primary	Reply	Description	Notes
-- (any)	SnF0	Primary rejected while Off-Line	
S1F1	S1F2	Are You There	
S1F13	S1F14	Connect Request	
S1F65	S1F66	Connect Request	N
S2F17	S2F18	Date and Time Request	
S5F1	S5F2	Alarm Report	N
S5F71	S5F72	Alarm Report Block Send	
S5F73	S7F74	Alarm Notification Send	

Primary	Reply	Description	Notes
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	

## 3. Operating Characteristics

This section describes the working characteristics of the GES-1993. It is divided into sections, and each of these sections describes a particular aspect of the GES-1993's operating characteristics.

### 3.1 Communications States

The GES-1993 represents the current state of its SECS link using a Communication Finite State Machine diagram. The purpose is to make clear how this link is initiated and terminated.

GWGEM SW maintains the GEM Communications State finite state machine (*[RefGWGEMUser]* p. 65 'Establish Communication'). However, the Communications State machine informs FMW through the user written `NoteLinkState()` function of any changes in the Communications State.

FMW is responsible for the following:

- Setting data in the GCD file (*[RefGWGEMRef]* (See page 3 – Communication').
- Configuration GCD data and the GemEnable function. (*[RefGWGEMUser]* (See page 71 'Power Up', p. 72 'Configuration').
- Providing a Process Link State Change extension routine (*[RefGWGEMRef]* **NoteLinkState**).
- GUI display of the current State( GEM Status control ).
- Handling transaction failures (*[RefGWGEMUser]* (See page 71 'Failing Transactions').

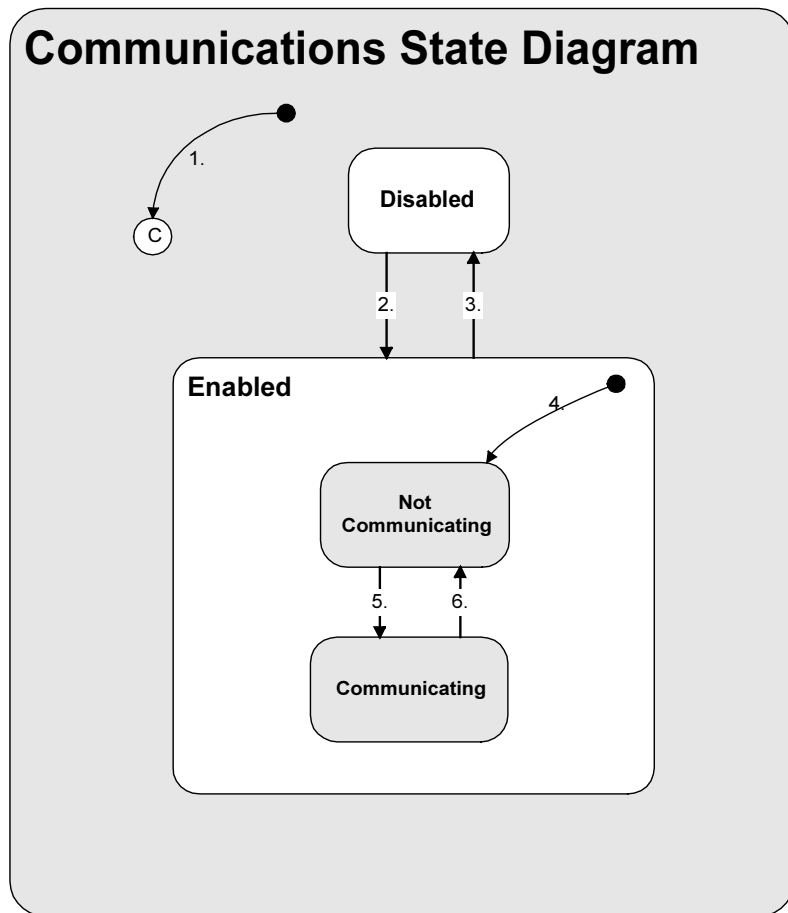
The Communications State is displayed in the GEM status bar and the SECS/GEM page of Run Window.

Initially, the `INITCOMMSTATE` variable is set to place the Equipment into the Disabled state at power up. Once FMW has completed initialization, FMW will change the Communications State to the default communication state selected by the user. The loss of communications during Running or Pausing will not affect the ability of FMW to complete operations in the Process Program. However, automatic reestablishment of the Process State may require manual intervention if FMW has changed state during the loss of communications period.

### **3.1.1 Communications Finite State Description**

The diagram on the following page explains the Communications Finite State Machine that the GES-1993 maintains.

Figure 3-1 Communication Finite State Diagram



### 3.1.1.1 State Transitions

The following transitions can occur. Transitions of the Communication Finite State Machine diagram do not cause the GES-1993 to signal any Collection Event ID (CEID), nor to send Event Reports to the Host.

Table 3-1 State Transitions

#	From	Trigger	To	Description
1	Unknown	Power-Up	Conditional	Equipment will initialize itself to either the Disabled or Enabled state, depending on the configuration of the EC INITCOMMSTATE (VID 7).
2	Disabled	Operator enables SECS link.	Enabled	Equipment will attempt to establish communications with the Host. The GES-1993 will periodically send a Connect Request at an interval dictated by the EC ESTABLISHCOMMUNICATIONS-TIMER (VID 44).
3	Enabled	Operator disables the SECS link.	Disabled	Communications are abruptly terminated. Any outstanding messages queued for send are discarded. The Equipment will not respond to a Host-initiated ENQ.
4	Disabled or Power-Up	Request has been made for the GES-1993 to start communicating.	Not Communicating	Equipment immediately attempts to establish communications with the Host. The GES-1993 will periodically send a Connect Request message at an interval dictated by the EC ESTABLISHCOMMUNICATIONS-TIMER (VID 44).
5	Not Communicating	Successful completion of Connect Request transaction.	Communicating	The Host / Equipment link is "up". Normal SECS transactions can occur.
6	Communicating	A communications failure has occurred.	Not Communicating	Equipment immediately attempts to establish communications with the Host. The GES-1993 will periodically send a Connect Request message at an interval dictated by the EC ESTABLISHCOMMUNICATIONS-TIMER (VID 44).

### **3.1.1.2 Communications States**

The current Communication State will be one of the following values. There is no Variable indicating the Communication State. The communication State is presented to the Operator on the main Operator Interface screen.

#### **3.1.1.2.1 DISABLED**

The SECS link to the Host is disabled at the GES-1993. The Equipment will send no messages to the Host. The Equipment will not respond to a Host-initiated ENQ.

#### **3.1.1.2.2 ENABLED**

When communications are Enabled, the Equipment's intention is to be in communication with the Host. Whether or no the GES-1993 is currently communicating with the Host determines which sub-state of the Enabled super-state the GES-1993 is in.

#### **3.1.1.2.3 ENABLED/COMMUNICATING**

The SECS link between the GES-1993 and the Host is operating normally.

Periodically, the Equipment will send a "Heartbeat" message S1F1 to ensure that the link is still operating. The heartbeat frequency is controlled by Equipment Constant HEARTBEAT. HEARTBEAT (VID 26) can range from 0 to 32000, with default value 30.

If the Equipment encounters a SECS-I Retry Limit (RTY) error when attempting to send a block to the Host, it discards any messages queued for send and the communication state transits to ENABLED.

#### **3.1.1.2.4 ENABLED/NOT COMMUNICATING**

The SECS link to the Host is enabled at the GES-1993, and the Equipment is attempting to determine if the link is active. The Equipment periodically sends S1F13 (Establish Communications Request).

If the connect is not successful for any reason, the Equipment will try again periodically forever. The time between attempts is controlled by the Equipment Constant ESTABLISHCOMMUNICATIONSTIMER. This variable (VID 44) can range from 0 to 32000 seconds, with default of 60 seconds.

Once the Host has responded with S1F14 (Establish Communications Acknowledge), the Communication State will change to COMMUNICATING.

The Host can also attempt to establish communications by sending S1F13. The Equipment will accept the message and respond with S1F14 and the Communication State will change to COMMUNICATING.

In ENABLED state, the GES-1993 will accept messages from the Host, but will ignore any messages except S1F13 and S1F14. The GES-1993 will respond to the S1F13 while the Communication State is ENABLED or COMMUNICATING, but it will not send S1F13 once communications have been established.

### 3.1.2 Power Up

At Power Up (or System Start), the Equipment Constant INITCOMMSTATE (vid 7) controls whether state is initialized to DISABLED or ENABLED. The factory setting is DISABLED.

### 3.1.3 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to establishing communications . For a more complete description of these variables, see "Appendix A -- Variables".

Table 3-2 Related Variables

Variable Name	VID
CONFIGCONNECT	19
INITCOMMSTATE	7
ESTABLISHCOMMUNICATIONSTIMER	44
HEARTBEAT	26
CONFIGSPOOL	66

### 3.1.4 Compatibility

If the Host intends to use the Control State Off-Line feature, CONFIGCONNECT should always be set to S1F13/14.

**S1F1/S1F2**

## 3.2 Control States

This section describes the Control characteristics of the Equipment. The Equipment may be in one of the following control states. This value is reflected in status variable CONTROLSTATE (VID 4).

Table 3-3 Control States

Value	State
1	Off-Line/Equipment Off-Line
2	Off-Line/Attempt On-Line
3	Off-Line/Host Off-Line
4	On-Line/Local
5	On-Line/Remote

GWGEM SW maintains the GEM Control State finite state machine ([RefGWGEMUser] p. 93 Remote Control).

FMW is responsible for the following ([RefGWGEMUser] p 99 ‘Other Control State Considerations’):

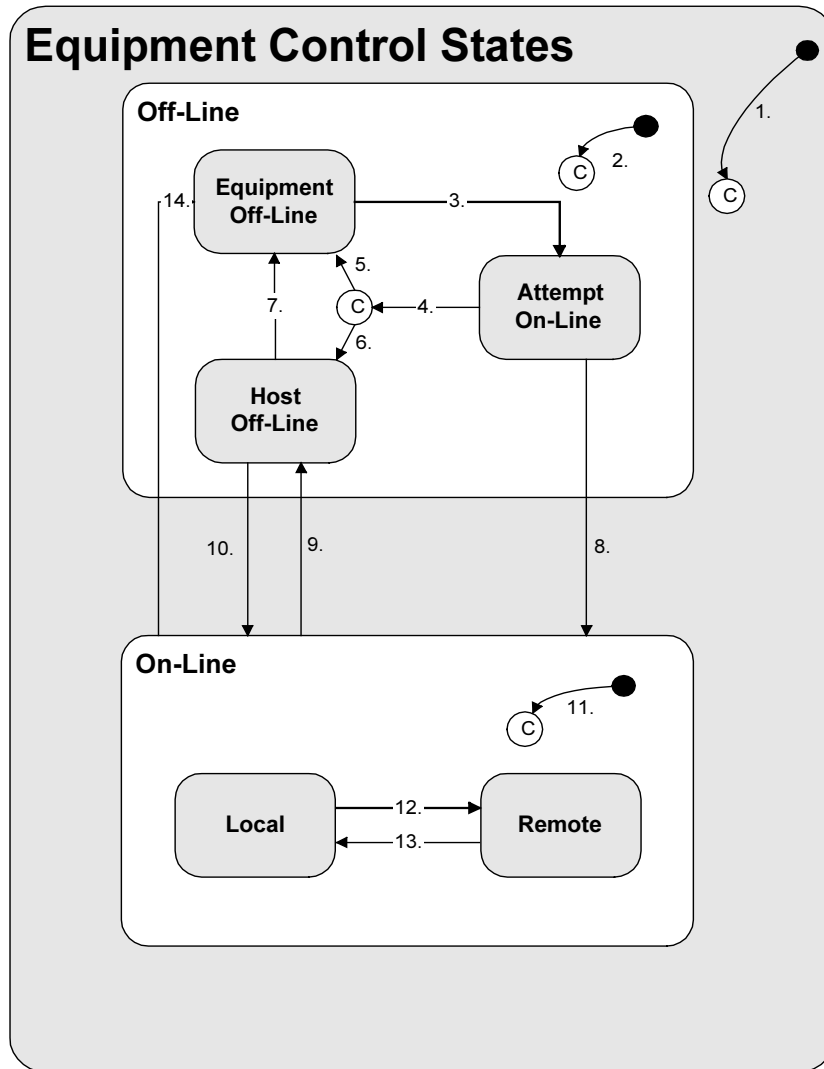
- Providing a Process Control State Change extension routine ([RefGWGEMRef] **NoteControlState**).
- GUI display of the current State.
- Provide operator commands for Go Local and Go Remote.
- When **ControlState** is LOCAL, reject remote commands appropriately.
- When **ControlState** is REMOTE, reject local commands appropriately, and call **GemNoteEvent** to signal the **OperCmd** Event.

The current Control State is displayed in the GEM status bar in lower portion of all windows except the Run Window. In Remote State configuration, teaching, and tools features are not available to the operator. This prevents the operator from interfering with Remote operations.

### **3.2.1 Control Finite State Description**

The Control State of the Equipment is illustrated in the Equipment Control State Diagram on the following page. The GES-1993 behaves differently and will accept different messages depending on its current control state. The purpose of this diagram is to make clear to the Host exactly what is happening at the Equipment. The logic for these states and transitions is the logic specified in the GEM standard.

Figure 3-2 Equipment Control State Diagram



### 3.2.1.1 Control State Transitions

Certain state transitions will cause a collection event to be signaled. If the event is enabled, this event will be sent to the Host along with the appropriate reports if appropriate. This table lists the state transitions and notes when events will be sent to the Host.

Table 3-4 Control State Transitions

#	From	Trigger	To	Description
1	Unknown	Power-Up	Conditional	This transition is made to either the Off-Line or On-Line state, depending on the EC INITCONTROLSTATE (VID 8).
2	Unknown	Power-Up	Conditional	This conditional transition is governed by the value of the OFFLINESUBSTATE EC (VID 49).
3	Equipment Off-Line	Operator requests to go On-Line	Attempt On-Line	The GES-1993 will immediately send an S1F1 to request to go On-Line.
4	Attempt On-Line	Unsuccessful On-Line request	Conditional	This transition occurred because the Host did not reply to an S1F1 with an S1F2 or because the S1F1 was not successfully sent.
5	Conditional	ONLINEFAILED Equipment Constant configured to Equipment Off-Line.	Equipment Off-Line	Equipment will allow the operator to attempt to go On-Line again.
6	Conditional	ONLINEFAILED Equipment Constant configured to Host Off-Line.	Host Off-Line	The GES-1993 will accept a Host initiated request to go On-Line by replying to the S1F17 with ONLACK = 0x00.
7	Host Off-Line	Operator requests to go Off-Line	Equipment Off-Line	A Host request to go On-Line will not be accepted.
8	Attempt On-Line	Successful On-Line request.	On-Line	The Equipment is now On-Line.
9	On-Line	Host puts the Equipment Off-Line by sending S1F15 and receiving the S1F16 with OFLACK = 0x00.	Host Off-Line	EVENT: GemControlStateOFFLINE (CEID 3). The GES-1993 will accept a Host initiated request to go On-Line by replying to the S1F17 with ONLACK = 0x00.

#	From	Trigger	To	Description
10	Host Off-Line	Successful completion of S1F17 / S1F18 transaction, with ONLACK = 0x00.	On-Line	The Equipment is now On-Line.
11	Unknown	Entry into On-Line super-state.	Conditional (Local or Remote)	EVENT: GemControlStateLOCAL (CEID 4) or GemControlStateREMOTE (CEID 5). The GES-1993 will transition to whichever state is specified in the EC ONLINE- SUBSTATE (VID 51).
12	Local	Operator or Host requests to go Remote.	Remote	EVENT: GemControlStateREMOTE (CEID 5). All documented messages will be accepted in this state, including remote commands.
13	Remote	Operator or Host requests to go Local.	Local	EVENT: GemControlStateLOCAL (CEID 4) . Remote commands will be rejected. Except for the REMOTE command.
14	On-Line	Operator requests to go Off-Line.	Equipment Off-Line.	EVENT: GemControlStateOFFLINE (CEID 3). A Host request to go On-Line will not be accepted.

### 3.2.1.2 Control States

The variable CONTROLSTATE (VID 4) represents the current control state, and will be one of the following values:

#### 3.2.1.2.1 Off-Line/EQUIPMENT OFF-LINE

The Operator has put the GES-1993 Off-Line. In this state, the Host may not put the Equipment On-Line, only the operator can attempt this from this state. Any Host-initiated primary message (except S1F13 and S1F17) will be replied to with an *S<sub>n</sub>F0* ABORT message by the Equipment. The Equipment will not send any primary messages except for S1F13 when necessary to establish communications, and the S9F1 and S9F9 messages for SECS errors.

#### 3.2.1.2.2 Off-Line/HOST OFF-LINE

While in this state, the GES-1993 will accept either the S1F17 (Go Online), or the S1F13 (Connect Request) message. When in this state, the operator has allowed the Host to put the Equipment On-Line, but the Host has not yet done so, or the Host has just put the Equipment Off-Line by sending S1F15. The Host may request for the Equipment to come On-Line by sending the S1F17 Go Online message. The Operator can not put the Equipment On-Line from this state.

The S1F13/S1F14 messages are used to maintain the Communications Finite State Machine. All messages (except S1F13 and S1F17) received will be replied to with the *S<sub>n</sub>F0* ABORT message. The Equipment will not send any primary messages except for S1F13 when necessary to establish communications, and the S9F1 and S9F9 messages for SECS errors.

#### 3.2.1.2.3 Off-Line/ATTEMPT ON-LINE

The Operator has requested that the Equipment go On-Line, causing the transition to this state. GES-1993 sends a single S1F1, indicating its desire to go On-Line. When either a transmission failure (here, T3 or RTY errors) occurs, or a successful reply to the S1F1 has been received, a transmission is made out of this state.

#### 3.2.1.2.4 On-Line/LOCAL

The local operator has control of the GES-1993. The Host can send S2F41 (Remote Command), but the Equipment will reject it with 0x40 return code. The REMOTE command sent by the Host will not be rejected by the Equipment. See "S2F42 - Remote Command Acknowledge" or "Remote Commands" for details.

In LOCAL mode, the Equipment continues to send event and alarm reports to the Host. The Host can monitor operations, but cannot control processing. However, the Host can still exert "controls" other than S2F41 which do not directly affect processing. For example, the Host can enable/disable alarms and set the clock.

### 3.2.1.2.5 On-Line/REMOTE

The remote Host Computer has control of the GES-1993 using S2F41 (Remote Command). For details see "Remote Commands" section.

The Operator may issue the PAUSE, STOP, and ABORT commands while in Remote. These commands will generate an OperatorCommand event (CEID 4) as well as other messages attached to these activities. Refer to appendix B for further detail.

## 3.2.2 Power Up

At Power Up, the Equipment Constant INITCONTROLSTATE (VID 8) controls whether ControlState is initialized to ONLINE or OFFLINE. Within the Off-Line super-state, the Equipment Constant OFFLINESUBSTATE (VID 49) controls whether the Control State defaults to:

1. Equipment Off-Line
2. Host Off-Line
3. Attempt On-Line

If INITCONTROLSTATE (VID 8) initializes to On-Line, the variable ONLINESUBSTATE (VID 51) determines whether the default state is:

1. Local
2. Remote

When the operator changes the default control state through GEM property page dialog/Setup page, INITCONTROLSTATE gets updated. ONLINE/REMOTE is recommended for this value.

### 3.2.3 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to the Control State. For a more complete description of these variables, see "Appendix A -- Data Dictionary Variables".

Table 3-5 Control State Variables

Variable Name	VID
INITCONTROLSTATE	9
OFFLINESUBSTATE	42
ONLINEFAILED	43
ONLINESUBSTATE	44
CONTROLSTATE	28
PREVIOUSCONTROLSTATE	35

### 3.2.4 Related Events

The following lists the collection events (CEIDs) which are relevant to the Control State. For a more complete description of these events, see "Appendix B -- Collection Events" or the description in this chapter.

Table 3-6 Control State CEIDS

Collection Event	CEID
GemControlStateLOCAL	8
GemControlStateREMOTE	9
GemEquipmentOFFLINE	22

### 3.3 Process States

The processing of material at the Equipment is depicted through two Finite State Diagrams. The E10 diagram illustrates the state of the Equipment in relationship to overall factory production. The GES Process State Diagram illustrates in greater detail the processing at the GES-1993.

FMW implements a Process State Finite State Machine; GWGEM does NOT provide such a service ([*RefGWGEMUser*] p. 169 'Process State Machine').

See the Process State Diagram for a description of FMW processing state model.

FMW controls Process State machine changes in response to either operator or Host command inputs. Change of Control State from Local to Remote or vice versa is only allowed in the Idle Process State. This prevents loss of command synchronization.

The Host may command Start, Stop, Pause, Resume, Local, Remote, and Abort. The operator may command Start, Stop, Pause, Resume, Local, Remote, and Abort.

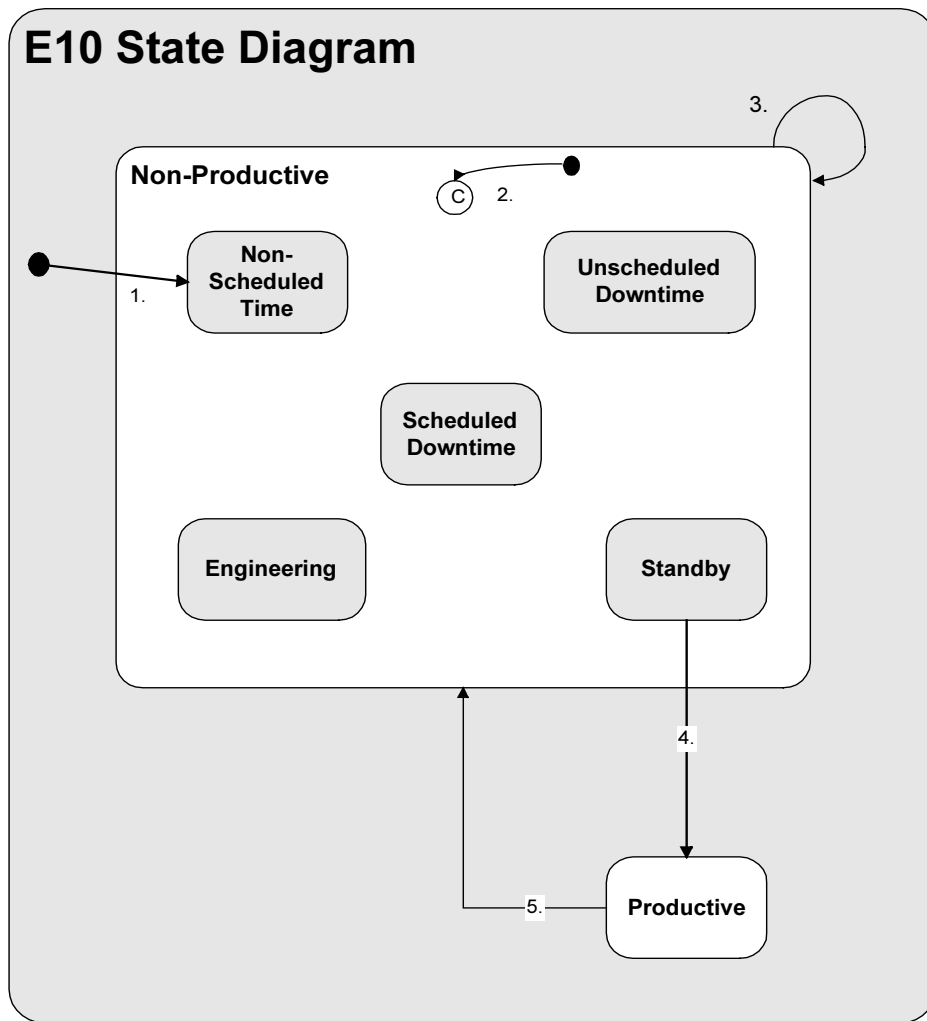
#### 3.3.1 E10 State Diagram

The E10 state diagram is implemented in the GES-1993 according to the details specified in the SEMI E10 document. The following summarizes the Equipment's implementation of the E10 standard:

The GES-1993 can transition from any state to any other state except for "Productive". The "Productive" state can only be entered from the "Standby" state. Upon startup, the Equipment is in "Non-Scheduled Time". The FMW SW does NOT implement the E10 State Machine.

The following diagram and tables depict with greater detail the Equipment's use of the E10 states.

Figure 3-3 E10 State Diagram



### 3.3.1.1 E10 STATE TRANSITIONS

Table 3-7 E10 State Transitions

#	From	Trigger	To	Description
1	Unknown	Power-Up	Non-Scheduled Time	Upon Power-Up, the Equipment defaults to this state.
2	Unknown	Operator Request	Conditional	The Operator changes states from the previous state to the new state. The conditional depends on the Operator's intentions.
3	Non-Productive	Operator Request	Non-Productive	
4	Standby	Processing of material begins.	Productive	Equipment is processing material.
5	Productive	Operator Request	Non-Productive	The Operator changes states from Productive to a new Non-Productive state. Transition will be made according to conditional transition #2.

### 3.3.1.2 E10 STATES

#### 3.3.1.2.1 Non-Productive/Non-Scheduled Time

The Equipment is not scheduled to be used in production. An Equipment operator can put the GES-1993 into this state at any time.

#### 3.3.1.2.2 Non-Productive/Unscheduled Downtime

The GES-1993 has been scheduled to be used in production, but is unable to be used because of unforeseen events. Possible reasons for transitions into this state include: 1) maintenance delay; 2) repair; 3) replacement of disposable; 4) bad input (bad boards, etc.); or 5) facilities related downtime.

#### 3.3.1.2.3 Non-Productive/Scheduled Downtime

The GES-1993 has been scheduled to be out of production so that maintenance can be performed.

#### *3.3.1.2.4 Non-Productive/Engineering*

The Equipment may be actively running boards, but these are not intended to be used in normal production. This state signifies that Engineering data is being gathered from the Equipment separate from an actual productive run.

#### *3.3.1.2.5 Non-Productive/Standby*

The Equipment is ready for production, but is awaiting resources. These resources may be in the form of physical material (boards) or in the form of information (process program, and START command).

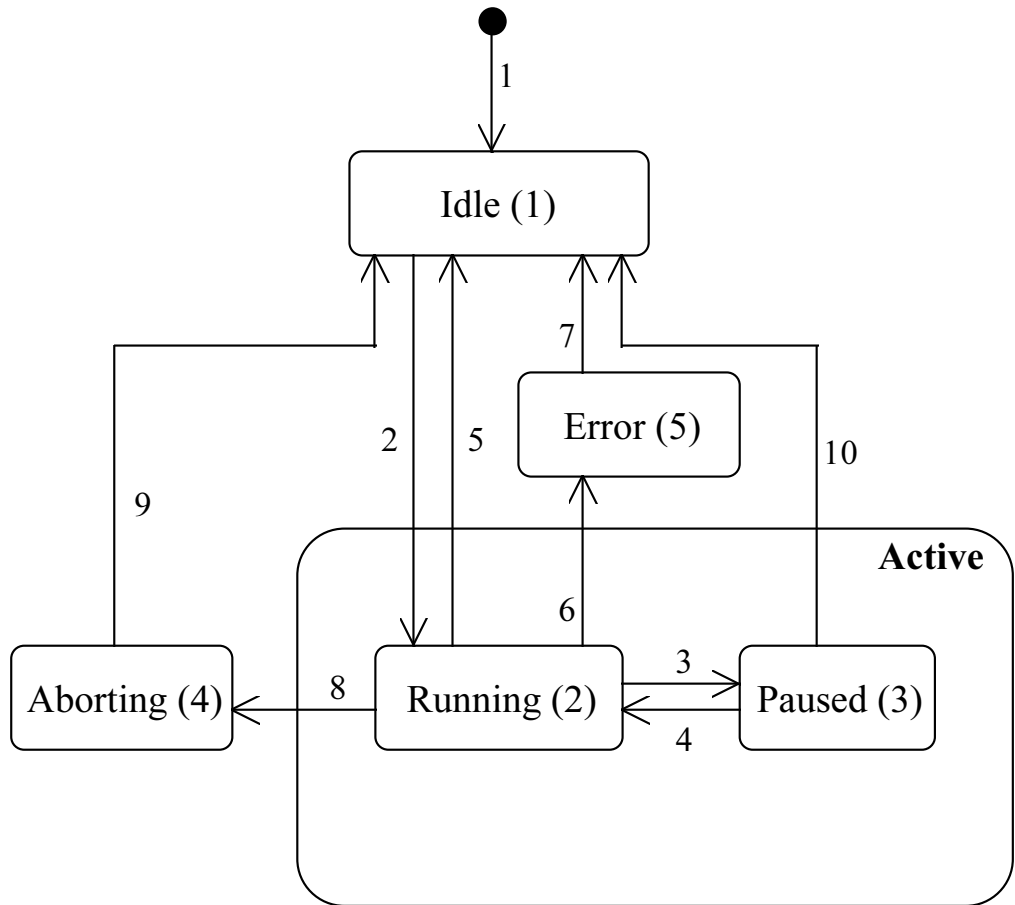
#### *3.3.1.2.6 Productive*

The Equipment is actively processing boards for use in production.

### **3.3.2 GES Process State Diagram**

This diagram depicts the working states of the GES-1993.

Figure 3-4 GES Equipment Process States



### 3.3.3 GES Process State Transitions

Table 3-8 Process State Transitions

#	From	Trigger	To	Description
1	Unknown	Power-Up	Idle	At power-up, the Equipment defaults to the IDLE state.
2	Idle	Run Command	Running	Either the Host or Operator issues a run command. This command can be issued by a remote command from the Host or by local Operator.
3	Running	Pause Command	Paused	Either the Host or Operator issues a pause command. This command can be issued by a remote command from the Host or by local Operator.
4	Paused	Unpause Command	Running	Either the Host or Operator issues a unpause command. This command can be issued by a remote command from the Host or by local Operator.
5	Running	Stop Command	Idle	Either the Host or Operator issues a stop command. This command can be issued by a remote command from the Host or by Local Operator. This command will stop processing after the current board has completed.
6	Running	Error Occurrence	Error	An error has occurred on the Equipment.
7	Error	Operator Error Acknowledge	Idle	Once the operator has acknowledged the error, the equipment will transition to the Idle state.
8	Running	Abort Command	Aborting	Either the Host or Operator issues an abort command. This command can be issued by a remote command from the Host or by Local Operator.
9	Aborting	Machine stopped	Idle	Once the machine has halted, the equipment will transition to the Idle state.
10	Paused	Stop Command	Idle	Either the Host or Operator issues a stop command. This command can be issued by a remote command from the Host or by Local Operator.

### 3.3.4 GES Process States

#### 3.3.4.1 Idle

The Equipment is initialized to this state. This state indicates that the Equipment is not dispensing on a board nor is it waiting for a board to arrive at the dispense station.

#### 3.3.4.2 Active

##### 3.3.4.2.1 Running

While in this state, the Equipment is either currently waiting for a board to arrive at the dispense station, processing a board, or unloading a processed board out of the dispense station.

##### 3.3.4.2.2 Paused

This state indicates that the Equipment is paused during the processing of a board. Processing continues on the current board when the Unpause command is issued. The transition to the Idle state can occur if the stop command is issued.

#### 3.3.4.3 Aborting

When in the Running state, upon receiving an Abort command, the Equipment will command the machine to stop all processing immediately. This state indicates that this is currently occurring. Once all processing has been halted, the transition to the Idle state will occur.

#### 3.3.4.4 Error

An error has occurred while in the Running state. A description of the error will be displayed to the user. Upon acknowledgment of the error, the Equipment will transition to the Idle state

### 3.3.5 Related Variables

The following table lists the variables (SV's, EC's, or DVVVALS) which are relevant to the Equipment processing states. For a more complete description of these variables, see "Appendix A -- Data Dictionary Variables".

Table 3-9 Equipment Processing Variables

Variable Name	VID
PREVIOUSPROCESSSTATE	36
PROCESSSTATE	37

### 3.3.6 Related Collection Events

Many of the GES-1993's collection events relate to process state changes. For a complete listing of these, see "Appendix B -- Collection Events".

## 3.4 Data Collection

Note the three types of variables: Status Variable (SV), Data Variable (DV), and Equipment Constants (EC). The Host sets only ECs. DVs are time stamped by being associated with Collection Events Ids (CEID), and will be reported by FMW in Event Reports ([*RefGWGEMUser*] p 77 'Data Collection').

FMW specifies all of the CEIDs in the GCD file, including the ones standard for GEM ([*RefGWGEMUser*] p 200 'Collection Events'). See Appendix B for a full list of the collection events managed by FMW.

### 3.4.1 Variables

The GES-1993 has a fixed set of Variables which can be read by the Host. Each Variable is identified by a unique Variable ID (VID). The Variables which exist are shown in "Appendix A -- Data Dictionary Variables".

There are three types of Variables: Status Variables, Data Variables, and Equipment Constants. The Host can read Variables of any type, but can set values only for Equipment Constants. The Host can read values for Status Variables and Equipment Constant whenever the GES-1993 is On-Line, but values for Data Variables are typically meaningful only immediately after certain Collection Events (CEIDs), and so are typically reported only in Event Reports (S6F11).

Appendix A lists all Variables for both FMW and standard GEM operations.

### 3.4.2 Are You There

The Host can send S1F1 at any time to determine if the SECS link is operational. The GES-1993 responds with S1F2, if the equipment is in the ONLINE & COMMUNICATING states. This indicates Model Number (MDLN) and Software Revision Number (SOFTREV).

GWGEM automatically provides this service.

### 3.4.3 Host Requests Status

The Host can send S1F3 when the Equipment is On-Line to read Equipment Constants from the GES-1993.

The Host can send S2F13 when the Equipment is On-Line to read Equipment Constants from the GES-1993.

For this Equipment, S1F3 and S2F13 with a list of VIDs are essentially the same. That is, either message can return Variables of any type. However, S1F3 with a zero-length list will return only VIDs of type SV, and S2F13 with a zero-length list will return only VIDs of type EC.

### 3.4.4 Setting Equipment Constants

The Equipment Operator can change the value for Equipment Constants. Once the Operator has changed an EC value, the Equipment will note the EqConstChange event . The VID for the changed EC will be reported to the Host in the variable ECIDCHANGE.

Refer to [*RefGWGEMUser*] p 105 'Equipment Constants'.

### 3.4.5 Event Reports

The GES-1993 has a fixed set of Events which can occur. Each Event is identified by a unique Collection Event ID (CEID). The CEIDs which exist are shown in "Appendix B -- Collection Events".

When an event occurs, the equipment sends the appropriate S6F11 Event Report message to the Host (if that particular event has been enabled). Event Reports are defined by the Host (S2F33) and linked to a specific CEID (S2F35).

The Equipment allows the Host to enable and disable Event Reports using S2F37. If the Host enables a CEID, for which no Event Report is defined, the Equipment will send a "null" (no data) report when the event occurs.

The Host can "force" Event Reports on the Equipment using the following Event Report Request messages:

- S6F15**            Host Requests an Event Report associated with a CEID.
- S6F17**            Host requests an Annotated Event Report associated with a CEID.
- S6F19**            Host requests an Event Report associated with a Report ID.

**S6F21** Host requests an Annotated Event Report associated with a Report ID.

GWGEM automatically processes Event Report related messages.

FMW indicates to GWGEM that an event has occurred, using **GemNoteEvent**. GWGEM handles Event Reports, and may invoke FMW Variable access functions ([*RefGWGEMUser*] p 85 'Event Reporting'). The GEM configuration file maintains the name of the event report file in the GemReportFileName Equipment Constant.

### 3.4.6 Time Driven Trace

The GES-1993 supports Time Driven Trace initiated from the Host. The Host initializes a trace using S2F23. The Equipment will send the data requested after the specified time interval has expired. The data will be sent using the S6F1 (Trace Data Send) message.

The Equipment can handle several concurrent traces. The number of concurrent traces is determined by the size of the trace data requested. The Equipment can support at least four concurrent traces to a maximum size (i.e. all variables requested).

The equipment allows Host definition of trace data to exceed the one-block limit when reported. That is, the SEMI E5 standard states that the S6F1 (Trace Data Send) message is limited to a single SECS block; but the Equipment will allow this point to be overlooked at the Host's request. If the Host does define trace data to be larger than one SECS block, then the Equipment will send the multiple blocks, not preceded by the S6F5/S6F6 Inquire/Grant scenario.

GWGEM automatically processes Time Driven Trace messages, and may also invoke FMW Variable access functions ( [ *RefGWGEMUser* ] p 86 'Time Driven Trace' ).

### 3.4.7 Limits Monitoring

The Host can define limits for various Variables on the GES-1993. When the appropriate limits transitions occur, the GES-1993 will report this occurrence by sending an event to the Host (if the event is enabled). The Host may define limits for a particular Variable through the S2F45 (Define Variable Limit Attributes). Through this message, the Host may define up to seven limits for each eligible Variable. For each limit (LIMITID), the Host defines an UPPERDB and a LOWERDB. The GES-1993 generates events when a transition across these boundaries occurs. The Host may set the rate at which the GES-1993 polls the Variables to determine if a limit has been crossed by setting the GEMLIMITSTIMER variable (VID 65).

GWGEM automatically handles Limits Monitoring. Configuration data ( limits, CEIDs, etc. ) must be set in the GCD file ( [ *RefGWGEMUser* ] ) p 165 ‘Limits Monitoring’ ).

### 3.4.7.1 Event Signaling

For any event that exists on the equipment, the event message will be sent to the Host only if the reporting for that particular event has been enabled. In this "EVENT SIGNALING" section, assume that the Host has enabled the proper reporting so that these events will be sent to the Host.

After the Host sets UPPERDB and LOWERDB values for a particular limit, the GES-1993 will send an event message when a transition occurs across these boundaries. The procedure for reporting is explained in the following chart and state chart diagram:

Figure 3-5 Limits Events Signaling

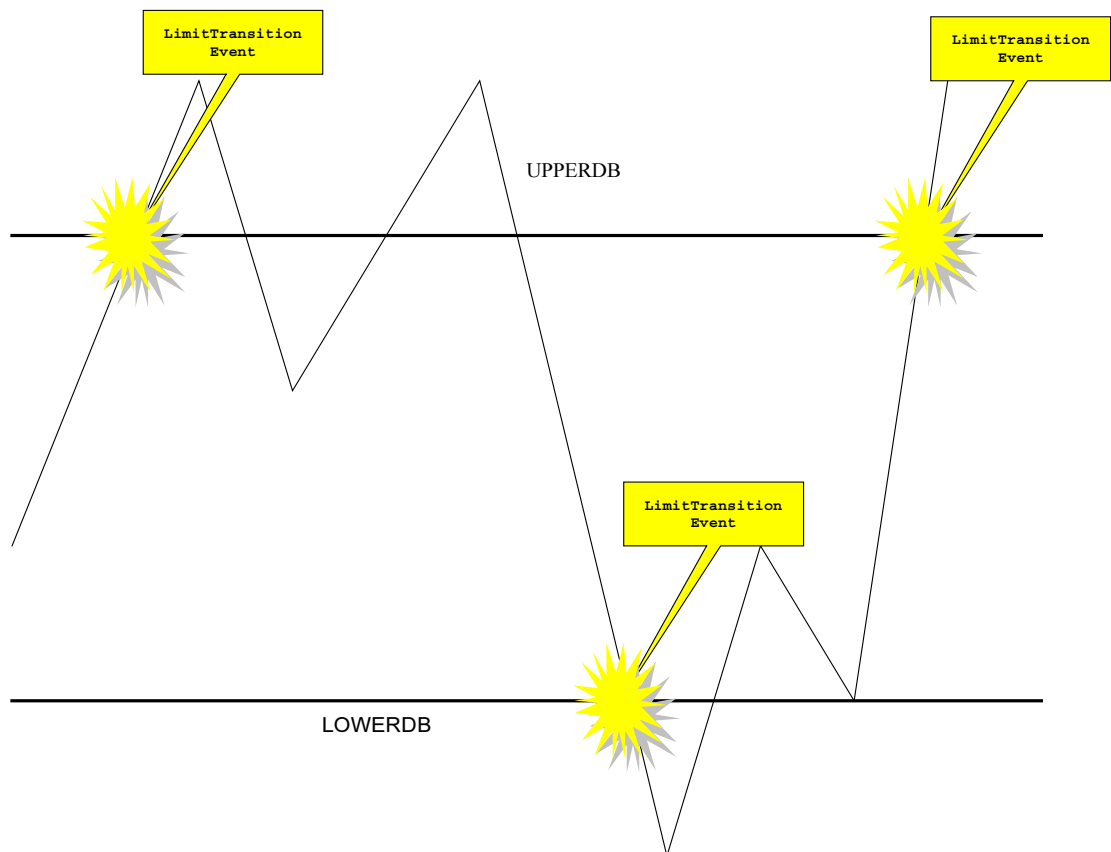
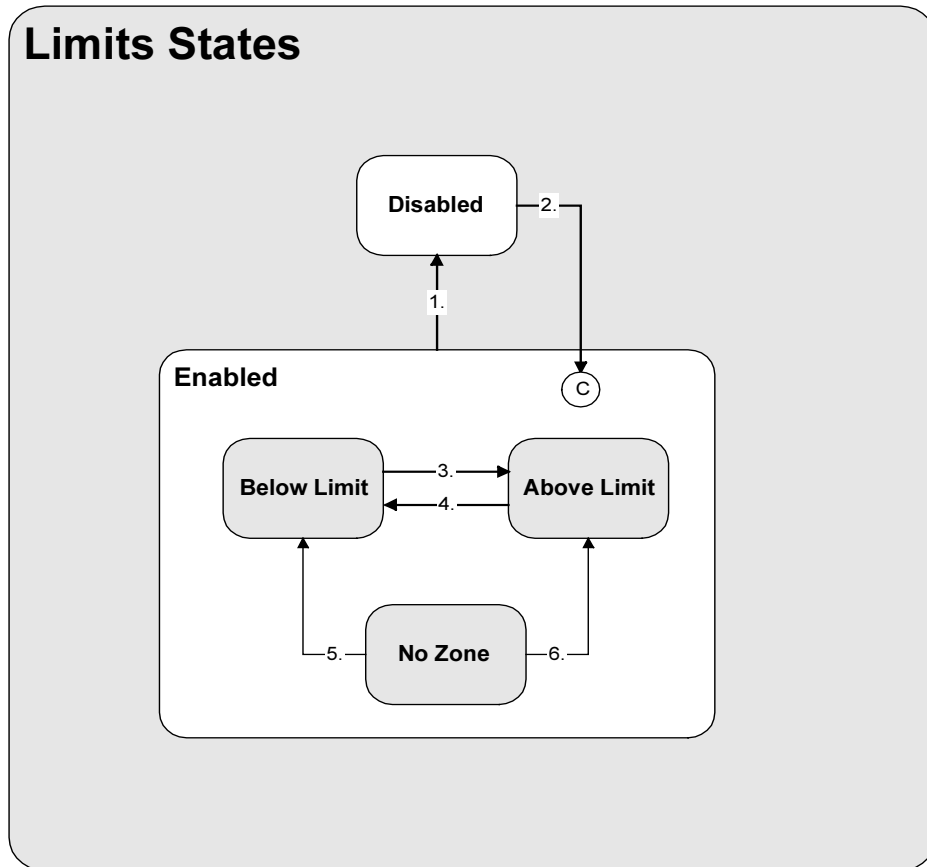


Figure 3-6 Limits State Diagram



### 3.4.8 Limits State Transitions

Table 3-10 Limits State Transitions

#	From	Trigger	To	Description
1	Enabled	Host undefines limits attributes.	Disabled	Host sends S2F45 to undefine limits.
2	Disabled	Host defines limits.	Conditional	Host sends S2F45 to define limits.
3	Below Limit	Variable changes to greater than or equal to UPPERDB.	Above Limit	Limit transition event is signaled to Host if enabled.
4	Above Limit	Variable changes to less than or equal to LOWERDB.	Below Limit	Limit transition event is signaled to Host if enabled.
5	No Zone	Variable changes to less than or equal to LOWERDB from No Zone.	Below Limit	Limit transition event is signaled to Host if enabled.
6	No Zone	Variable changes to greater than or equal to UPPERDB from No Zone.	Above Limit	Limit transition event is signaled to Host if enabled.

#### 3.4.8.1 Limits States

A Variable's defined limits may be in any of the following states.

##### 3.4.8.1.1 Disabled

Limits are not defined.

##### 3.4.8.1.2 Enabled

Within this super-state, a limit has been defined, and monitoring of the variable is taking place.

##### 3.4.8.1.3 No Zone

This limit has just been defined, and the value of the variable is less than UPPERDB and greater than LOWERDB. No limits transitions have occurred.

#### 3.4.8.1.4 Below Limit

The value of the variable is less than or equal to LOWERDB.

#### 3.4.8.1.5 Above Limit

The value of the variable is greater than or equal to UPPERDB.

### 3.4.9 Disk Files

The GES-1993 maintains a disk file which contains the current Equipment Constant settings. The file is updated each time the Operator or Host changes an Equipment Constant. The most recent settings for some of the Equipment Constants are read from the file when the Equipment is powered-on.

All Event Report definitions, links, and enable status as well as Limits attributes are also maintained on separate disk files.

### 3.4.10 Related Variables

The following table lists the variables (SV's, EC's, or DVVVALS) which are relevant to data collection setup and maintenance. This section does not list the variables which contain equipment-specific information. For a more complete description of specific variables, see "Appendix A -- Data Dictionary Variables".

Table 3-11 Data Collection / Setup Variables

Variable Name	VID
ECIDCHANGE	67

### 3.4.11 Related Events

The following lists the collection events (CEIDs) which are relevant to data collection. In addition to these, each variable which is eligible for limits monitoring must have a specific collection event associated with it. For a more complete description of these events, see "Appendix B -- Collection Events" or the description in this chapter.

Table 3-12 Data Collection CEIDS

Collection Event	CEID
EqConstChange	20

## 3.5 Alarm Management

The GES-1993 has a fixed set of alarm conditions which can occur. Each alarm is identified by a unique Alarm ID (ALID), and has an associated severity code (ALCD) and alarm text (ALTX). The possible alarms are shown in "Appendix C -- Alarms".

GWGEM automatically handles Alarm management.

FMW configures Alarms in the GCD file, and signals alarm state changes using **GemNoteAlarmEvent** ([ *RefGWGEMUser\_*] p 89 'Alarm Management').

FMW supports all alarms defined in Appendix C. Excess temperatures, an Interlock safety breach, a service request to refill the adhesive dispenser, and power failure are all reported to the Host as alarms. At the time of publishing this manual, only the Millennium Series systems support interlock and power failure alarms.

Temperature alarms will be activated when any of the heater channels go out of range. Host should use TempCurrent and TempNeedleCurrent SVs to determine the channel(s) responsible for activation of this alarm. Alarm Off event will be sent when all channels are within range.

### 3.5.1 Alarm States

Each alarm (ALID) can be in either of two states: CLEAR (off) or SET (on). Several alarms can be SET simultaneously. At power up, all Alarms are cleared.

### 3.5.2 Reporting

The GES-1993 reports alarms to the Host when they occur, without Host action, using the alarm report message S5F1 or configurable option, depending on CONFIGALARMS. The transition of an ALID from OFF to ON is referred to as "going on" or "leading edge", and the transition from ON to OFF as "going off" or "trailing edge". The Equipment reports both leading and trailing edge transitions.

The equipment has two CEIDs for each ALID, one for the "going on" transition and one for the "going off" transition. In addition to the Alarm Report, the Equipment sends an Event Report if the CEID associated with the alarm change is enabled. If the CEID is enabled and no report is defined, a "null" Event Report is sent. The event report for an alarm transition is sent if it is enabled, even if the reporting for the alarm is disabled.

### **3.5.3 Enable/Disable**

The Host can use S5F3 (Enable/Disable Alarms) to control which alarms the GES-1993 should report. Using S5F3, the Host can specify for each ALID whether the Equipment should report that alarm when it occurs. When an alarm transition occurs, if that ALID is enabled the Equipment will send an alarm report message to the Host. If the ALID is disabled, the Equipment will not send the alarm message. The Host can use S2F37 to enable or disable the CEIDs associated with these alarm transitions.

The GES-1993 saves Alarm Enable/Disable settings on a disk file. When the Equipment powers up, it will restore Alarm Enable/Disable settings to the same condition they had at power off.

### **3.5.4 Host Requests Alarm Status**

The Host can use S5F5 to request the GES-1993 to report all alarms which exist and the ON/OFF state for each.

The Host can use S5F7 which is similar, but which causes the Equipment to report only those alarms (ALIDs) which are Enabled, regardless of whether the alarm is ON or OFF.

### **3.5.5 Compatibility**

The GES-1993 supports the following Alarm Report message formats for older host implementations (see "1.6.3 Gem Configuration" on page 1-12).

**S5F71/S5F72**

**S5F73/S5F74**

### 3.5.6 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to alarm management. For a more complete description of these variables, see "Appendix A -- Data Dictionary Variables".

Table 3-13 Alarm Management Variables

Variable Name	VID
CONFIGALARMS	1
WBITS5	19
ALARMID	22
ALARMSENABLED	23
ALARMSSET	24
ALARMSTATE	25
ALARMSERIAL	26

### 3.5.7 Related Collection Events

Each alarm defined in GES-1993 has two unique collection events associated with it, a "Going-On" event, and a "Going-Off" event. The CEIDs are listed in "Appendix B -- Collection Events".

## 3.6 Process Program Management

Processing on the GES-1993 is controlled by Process Programs. The Equipment requires selection of a Process Program for each process. The GES-1993 supports the use of unformatted process programs.

See [RefGWGEMUser]] p 111 ‘Process Program Management’).

FMW uses proprietary ASCII and binary image files to define process programs (recipes).

GWGEM only supports Unformatted Process Programs.

FMW uses its own Process Program management vs the GWGEM’s librarian.

### 3.6.1 Equipment Management of Process Programs

The GES-1993 provides a Process Program Library, implemented as a set of binary files maintained on a hard disk. Each Process Program is identified by a unique Process Program ID (PPID). A PPID consists of from 5 to 12 ASCII characters. Upper and lower case alphabetic characters are not considered distinct, and the GES-1993 will not distinguish between them. The PPID corresponds to the 8.3 DOS file name of the recipe.

The Equipment Operator may modify any one of the Process Programs stored on the Equipment. The host will be notified via the GemPPChangeEvent Collection Event if the Operator creates, changes, or deletes a Process Program. The Equipment Operator can also select a PPID to be uploaded to the Host (S7F3), or download from the Host (S7F5).

### 3.6.2 Host Management of Process Programs

Process Programs are saved to disk on the equipment. Process Programs are typically created and updated at the GES-1993. However, the GES-1993 provides complete facilities for the Host to manage the storage and use of Process Programs. This allows the GES-1993 to operate cooperatively Host-implemented systems. The Host has the following capabilities.

The Host can upload a Process Program from the GES-1993 Library by using S7F5 (Process Program Request). The equipment operator can also initiate a Process Program Upload through the GES-1993's user interface.

The Host can download a Process Program to the GES-1993 library by using S7F3 (Process Program Send). The Host may 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 GES-1993's user interface.

The Host can delete one or more Process Programs from the GES-1993 library by using S7F17 (Process Program Delete).

The Host can determine which Process Programs are currently stored in the GES-1993 library by using S7F19 (Process Program Directory).

### 3.6.3 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to process program management. For a more complete description of these variables, see "Appendix A -- Data Dictionary Variables".

Table 3-14 Process Program Management Variables

Variable Name	VID
PPCHANGENAME	40
PPEXECNAME	32
PPCHANGESTATUS	41

### 3.6.4 Related Events

The following lists the collection events (CEIDs) which are relevant to process program management. For a more complete description of these events, see "Appendix B -- Collection Events" or the description in this chapter.

Table 3-15 Process Program Management CEIDS

Collection Event	CEID
GemPPChangeEvent	3
GemBadDownloadEvent	7

## 3.7 Remote Commands

Setup and processing at the GES-1993 can be guided by either a local operator or by a Host computer. This section describes the remote commands available to the Host.

Much of the behavior of the GES-1993 and its acceptance of remote commands is directed by requirements of the Control State. For a complete description of the Control State, please see section "Control States".

The GES-1993 will accept remote commands only when the Control State is Remote. While in the Local state, the Host can not put the Equipment into Remote, this must be done by an operator at the Equipment.

The Host has the ability to configure whether the Equipment will transition to Remote or local as a default upon entering the On-Line state from Off-Line. This is done through the GEM property page dialog, Setup page.

Once in the Remote state, the Host has the authority to issue any of these remote commands and they will not be rejected because of an invalid control state. Commands may be rejected for other reasons (trying to start a process with no material loaded, etc.).

While in Remote state, the Operator still has the ability to issue commands and change the control state. If the operator issues a command while in Remote state, the GES-1993 will send the Operator Command collection event if enabled. When the Operator "grabs" control away from the Host by changing the Control State to not Remote, the GES-1993 will send either the GemControlStateLOCAL or GemEquipmentOFFLINE event to the Host. The Host also has the ability to put the Equipment into a Local state by sending the LOCAL remote command while in Remote state. Furthermore, if the operator press any of the buttons on the Run Window (GO, PAUSE, STOP, ABORT), the host will get the corresponding events (StartCmd, PauseCmd, StopCmd, AbortCmd - refer to appendix B).

As mentioned previously, GWGEM maintains the Control State finite state machine. FMW can control going On and Off line, and can query the current and previous Control State using GWGEM functions ([*RefGWGEMUser*] p 93 'Remote Control'). The Host shall be able to order FMW to obey the following GEM commands: Start, Stop, Pause, Resume, Local, Remote, and Abort.

### 3.7.1 S2F41 Commands

The general format for remote commands using the S2F41 message is:

```
S2F41 [W] * H->E
  <L [2]
    <A RCMD> * Remote command string
    <L
      <L [2]
        <A CPNAME> * Command Parameter Name
        <CPVAL> * Command Parameter Value
      >
      ...
    >
  > .
```

The following commands may be sent by the Host to the GES-1993.

#### START

This command starts processing on the GES-1993 assuming all proper initialization has taken place and material is present.

```
S2F41 [W]
  <L [2]
    <A 'START'>
    <L>
  > .
```

#### STOP

This command will stop the processing of material at the Equipment. Boards currently in process will be completed, but no new boards will be loaded.

```
S2F41 [W]
  <L [2]
    <A 'STOP'>
    <L>
  > .
```

## PAUSE

The PAUSE command will cause the GES-1993 to complete the processing of boards currently in process, but not to start any new boards until the RESUME command has been given.

```
S2F41 [W]
  <L [2]
    <A 'PAUSE' >
    <L>
  > .
```

## RESUME

After a PAUSE command has been given, the RESUME command will continue to process new boards according to the recipe.

```
S2F41 [W]
  <L [2]
    <A 'RESUME' >
    <L>
  > .
```

## LOCAL

While the Equipment is in Remote state, the Host can put the GES-1993 into Local state by sending the LOCAL command.

```
S2F41 [W]
  <L [2]
    <A 'LOCAL' >
    <L>
  > .
```

## ABORT

The Host can abort processing at the next safe stopping point by sending the ABORT command with the AbortLevel parameter as follows.

```
S2F41 [W]
  <L [2]
    <A 'ABORT'>
    <L
      <L
        <A 'AbortLevel'>      *CPNAME
        <U1 1>                *CPVAL
      >
    >
  > .
```

### 3.7.2 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to remote control. For a more complete description of these variables, see "Appendix A -- Variables".

Table 3-16 Remote Control Variable

Variable Name	VID
ABORTLEVEL	21
PREVIOUSCOMMAND	34

### 3.7.3 Related Events

The following lists the collection events (CEIDs) which are relevant to remote control. For a more complete description of these events, see "Appendix B -- Collection Events" or the description in this chapter.

Table 3-17 Remote Control CEIDS

Collection Event	CEID
OperatorCommand	4
StartCmd	14
StopCmd	15
PauseCmd	16
ResumeCmd	17
AbortCmd	18

## 3.8 Material Movement

Material movement on the GES-1993 consists of three board holding areas: 1) The pre-processing area; 2) the post-processing area; and 3) the dispensing area. In order for processing to begin, a board must arrive from the upstream machine on the pre-processing area. The GES-1993 then takes boards pre-processing area, sends them to the dispensing area, processes them and then places them in the post-processing area. Before a new lot can be started, these boards must be removed from the dispensing area. The following diagrams depict the state transitions for the input and output ports on the GES-1993. Any state transition which occurs for the pre-processing area, PreDispense event will be sent to the Host if enabled. Any state transition which occurs for the post-processing area will trigger the PostDispense collection event.

GWGEM does not provide any support in this area. FMW provides GEM support in this area ([*RefGWGEMUser*] p 141 'Material Movement'.

### 3.8.1 Related Variables

The following table lists the variables (SV's, EC's, or DVVVALS) which are relevant to material movement. For a more complete description of these variables, see "Appendix A -- Data Dictionary Variables".

### 3.8.2 Related Collection Events

Many collection events relate directly to material movement or imply that material movement has taken place. For a more complete listing of these collection events, please see "Appendix B -- Collection Events".

## 3.9 Equipment Terminal Services

The GES-1993 supports exchange of free text messages with the Host (SECS Stream 10). This Equipment accepts the following messages from the Host, and responds accordingly if the W-Bit is set to 1:

```
S10F3      /* Single Line Data */
S10F5      /* Multi-Line Data */
S10F9      /* Broadcast      */
```

The message text will be displayed on the Equipment's CRT. Collection Event S10Ack (CEID 21) occurs once the operator has acknowledged the message and an Event Report will be sent to the Host (if enabled).

The S10F3 and S10F9 are restricted to a single TEXT data item, but S10F5 can contain multiple TEXT data items. Each TEXT data item is limited to 160 characters.

If the Operator has not acknowledged an existing message when the Host sends another message, the new message will be displayed and the old one discarded.

The Host can send a message with a 0-length text to clear the Operator text display.

Also, the Equipment allows the operator to send a single block message to the Host via S10F1. The maximum length of this text is 160 characters. The S10F2 response from the Host is ignored.

See [*RefGWGEMUser*] p 143 'Equipment Terminal Services'.

FMW provides functionality to create data (typed in by the Operator) and send it to the Host using GemTerminalReq. Operator can enter his message through the GEM property page dialog (terminal page), or via SECS/GEM page of Run Window. The message will be sent when the operator presses the Send button on screen.

FMW provides a Terminal Display to display text received from the Host. FMW will implement a finite state machine for this functionality, as described in [*RefGWGEMUser*] p 145 'Equipment Terminal - Finite State Machine'.

FMW notifies the operator that a text message has arrived from the Host by blinking the GEM status bar at lower portion of screen. If the beep option has been selected a beep once every half a second will be used to catch operator's attention. The operator can then view the incoming message through GEM property page dialog (terminal page). He can also view the message from the SECS/GEM page of Run Window. In the same locations, there are provisions for the operator to send a message to host.

### 3.10 Error Messages

The GES-1993 provides standard Stream 9 messages to report SECS-I errors. See 5.7 SECS Error Messages on page 5-19 for detailed description of these messages:

<b>S9F1</b>	Unrecognized Device ID
<b>S9F3</b>	Unrecognized Stream
<b>S9F5</b>	Unrecognized Function
<b>S9F7</b>	Invalid Data
<b>S9F9</b>	Transaction Timeout
<b>S9F11</b>	Data Too Long

GWGEM together with GW SDR perform error handling.

FMW can reject a Primary Message received from the Host as incorrectly formatted for SECS-II (invalid data, or data too long); see [*RefGWGEMUser*] p 150 'S9F7 and S9F11'.

### 3.11 Clock

The GES-1993 contains Clock/Calendar hardware, by which it knows the current date and time.

The Host can send S2F31 to set the Equipment's Clock/Calendar hardware.

The Host can send S2F17 to read the Equipment's Clock/Calendar hardware.

The Operator can initiate a Date/Time request from the Host. This is done through the GEM property page dialog (control page). The Equipment will send S2F17 to the Host and will set its clock according to the data in the S2F18 reply.

### 3.11.1 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to material movement. For a more complete description of these variables, see "Appendix A -- Variables".

Table 3-18 Material Movement Variables

Variable Name	VID
CLOCK	27

GWGEM provides automated handling of synchronization of Equipment to Host Date and Time ([*RefGWGEMUser*] p 163 'Clock').

FMW can synchronize with the Host using **GemHostTimeReq**. When time update messages from the Host are not arriving, a time update request to the Host shall be made approximately once per hour until the Host resumes time update messages.

GWGEM automatically updates FMW's clock hardware.

### 3.12 Spooling

When the SECS link between the Host and the GES-1993 goes down (RTY error on the Equipment side), the GES-1993 will spool appropriate messages so that the Host can read them once the link comes back up (after a successful Connect Request transaction).

The Host can set spooling attributes on the GES-1993 by setting certain Equipment Constants with the S2F15/16 transaction.

The Host can define streams and functions of messages to be spooled through the S2F43/44 transaction. Stream one (S1Fx) messages are not eligible for spooling. The Host can also disable spooling for messages through this S2F43/44 transaction. Stream 9 messages are not spooled.

The Host may read spooled messages or purge the Equipment's spool through the S6F23/24 transaction.

When the SECS link between the Host and the Equipment goes down, the Equipment will 'spool' (buffer) messages until the link is restored.

GWGEM maintains the Spooling finite state machine ([*RefGWGEMUser*] p 153 'Spooling').

Spooling configuration is done in the GCD file.

GWGEM provides variables, events, and a log file for spooling.

The device is informed of Spooling State changes by the NoteSpoolState() function in the extension DLL.

### 3.12.1 A Word of Caution

If the Host does not intend to use the spooling features of the Equipment, the Equipment Constant ConfigSpool should be set to zero. Setting this EC to zero disables the spooling feature. If this is not set to zero, and the Host does not support spooling, the SECS connection with the Equipment will be crippled. This happens because of the following:

1. When spooling becomes active (transmission error), the Equipment will not send non-stream 1 primary messages to the Host. That is, it will not send, events, alarms, process programs, terminal display, etc.
2. When spooling becomes active, the ONLY way to deactivate it is to read or delete the spool from the Host. In complying with the GEM standard, the Equipment does not have the ability to reset its spooling state.
3. Therefore, if your Host does not support spooling and spooling becomes active, you will never again receive non stream 1 messages from the Equipment. If this occurs, you will need to use a Host simulator such as SECSIM to delete the spool.

If the Host does not intend to use the spooling features of the GES-1993, CONFIGSPOOL should be set to zero. This will disable the spooling feature and the Equipment will never transition to Spool Active state. After a transition is made to Spool Active, the only way to get out of the state is to read or purge the spool.

### 3.12.2 Spooling Sequence

Messages are sent to the spool only if the Host has enabled these messages for spooling. This precondition will not be repeated throughout this section. Assume that the messages referred to in this section have been enabled for spooling.

While spooling is active, the Host may initiate primary messages and the GES-1993 will respond, if it is in the COMMUNICAING state.

### 3.12.2.1 Spooling Starts

When a transmission failure occurs, the first message sent to the spool is the event message GemSpoolingActivated. The next message sent to the spool is the message which caused the communications failure. The following table depicts the activity at the GES-1993 when spooling starts.

Table 3-19 Spooling Activity

#	Equipment Send Sequence	Spool Sequence	Description
1	S5F1 (Alarm Report 1)	S6F11 (Spool Activated Event Report)	Equipment attempts to send an alarm report to the Host, but experiences a transmit failure. The GemSpoolingActivated event (CEID 23) is sent to the spool. Variable GEMSPPOOLSTARTTIME (VID 57) is updated.
2		S5F1 (Alarm Report 1)	The Alarm Report message is sent to the spool.
3	S6F11 (Event Report 1)	S6F11 (Event Report 1)	The Equipment generates an event report and it is sent to the spool.
4	S5F1 (Alarm Report 2)	S5F1 (Alarm Report 2)	The Equipment generates an alarm report and it is sent to the spool.

### 3.12.2.2 Equipment Spools Messages

While spooling messages, the Equipment will increment the GEMSPPOOLCOUNTRACTUAL and GEMSPPOOLCOUNTTOTAL status variables for each message spooled. Messages which require an inquire/grant scenario are spooled along with the inquire message as a single message. That is, if a multi-block S6F11 (Event Report) message is being sent to the Host and spooling is active, the S6F5 (inquire) as well as the S6F1 are sent to the spool and GEMSPPOOLCOUNTTOTAL and GEMSPPOOLCOUNTRACTUAL are incremented by one.

The GES-1993 maintains two Equipment Constants which effect the spooling of messages. The first is CONFIGSPOOL. If this is set to zero, then spooling will never become active. If it is set to one, spooling will become active when a transmission failure occurs.

The EC OVERWRITESPOOL determines if the Equipment should over-write the oldest messages with new ones when the spool becomes full. If OVERWRITESPOOL is TRUE, old messages will be over-written with new ones. If FALSE, new messages will be discarded when the spool is full.

### **3.12.2.3 Host Reads Spooled Data**

The Host can read spooled messages by sending the S6F23 message. Upon receipt of this message, the Equipment will reply and attempt to send spooled messages. Messages are sent in order of oldest to newest, with no priority given to a particular kind of message. The EC MAXSPOOLTRANSMIT determines the maximum number of spooled messages which are sent per S6F23 message received from the Host. If zero, all spooled messages are sent, if any other number, that number of messages are sent.

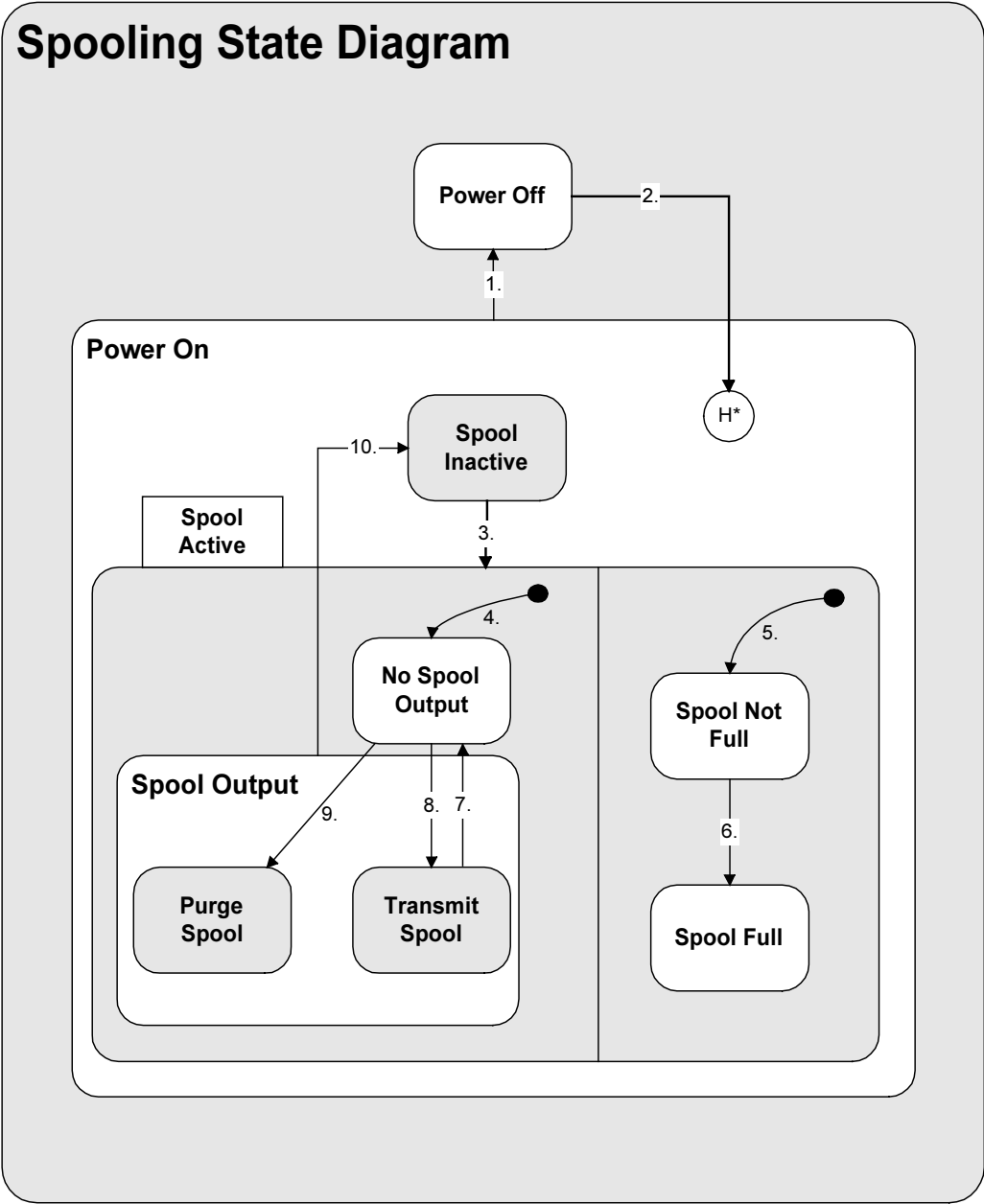
During the de-spooling of messages, the Equipment maintains only one outstanding Equipment-Initiated transaction. The equipment will wait for either a reply to the primary or a T3 timeout before starting another transaction. If the de-spooled message requires an inquire/grant scenario, the Equipment will initiate this transaction first. If the Host accepts the inquire, the message is sent. If not, then the Equipment removes the message from the spool and discards it.

If a transmission failure occurs while attempting to send the spool, the event GemSpoolTransmitFailure is sent to the spool and spooling will remain active. While the spool is active, any new (spoolable) messages generated by the Equipment are also sent to the spool.

When the spool has been completely transmitted, the event GemSpoolingDeactivated is sent to the Host.

Instead of reading spooled messages, the Host can purge the spool by sending S6F23 with RSDC = 1. For details, please see section "S6F23 -- Request Spooled Data".

Figure 3-7 Spooling State Diagram



### 3.12.3 Spooling State Transitions

Table 3-20 Spooling State Transitions

#	From	Trigger	To	Description
1	Power On	Equipment shutdown	Power Off	The Equipment may power off at any time.
2	Power Off	Equipment Startup	History* (Power On)	Equipment re-boots after a shutdown. Spooling will continue according to its state when the equipment was powered off.
3	Spool Inactive	GES-1993 experiences a transmission failure and the variable GemConfigSpool (VID 66) is set to "1" (enabled).	Spool Active	GES-1993 will now start spooling any messages which have been defined by the Host.. If the Host does not wish to implement Spooling, the EC GemConfigSpool should be set to "0" and the spool state will never become active.
4	Default	Entry into Spool Active	No Spool Output	No spooled messages are being read by the Host.
5	Default	Entry into Spool Active	Spool Not Full	The spool file has not yet filled up.
6	Spool Not Full	The Equipment's spool has reached capacity.	Spool Full	The Equipment will start to either discard new messages destined for the spool or overwrite the beginning of the spool, depending on the setting of GemOverWriteSpool (VID 67).
7	Transmit Spool	The Equipment has de-spoiled some messages, but not all have been sent to the Host.	No Spool Output	No spooled messages are being read by the Host.
8	No Spool Output	The Host has requested spooled messages to be sent by sending S6F23.	Transmit Spool	The GES-1993 will send messages according to the setting of GemMaxSpoolTransmit (VID 52) If GemMaxSpoolTransmit is zero, all messages will be sent, otherwise only the number of messages specified in this variable will be sent.
9	No Spool Output	The Host requests the GES-1993 to purge its spool.	Purge Spool	GES-1993 will delete its spool.
10	Spool Output	Entire spool has either been read or purged by the Host.	Spool Inactive	GES-1993 will continue normal SECS communicating.

## **3.12.4 Spool States**

### **3.12.4.1 Power Off**

The GES-1993 is completely shut down.

### **3.12.4.2 Power On**

The GES-1993 is "on" and in a stable state.

#### *3.12.4.2.1 Spool Inactive*

Spooling is not activated. This is either because GemConfigSpool is "0" (disabled) in which case, spooling will never be active, or because while GemConfigSpool is enabled ("1"), a RTY error has not occurred. In this state, no messages are sent to the spool. The Host may define or un-define messages eligible for spooling should the link go down.

#### *3.12.4.2.2 Spool Active*

While GemConfigSpool is "enabled" ("1"), the GES-1993 has experienced a transmission failure (RTY error). Upon entry into this state, the first message sent to the spool is the GemSpoolingActivated event, assuming that this event is enabled and that spooling for the particular stream and function have been enabled. This message will enter the spool even before the message which originally caused the RTY error.

##### *Spool Not Full*

The file containing the spooled messages has not reached its capacity.

##### *Spool Full*

The file containing the spooled messages has reached its capacity.

##### *No Spool Output*

In this state, the Host is not reading or purging the GES-1993's spool.

##### *Spool Output*

This super-state contains the two sub-states in which the Equipment's spool is either being read or purged by the Host.

##### *Purge Spool*

The GES-1993 is purging its spool, erasing all spooled messages.

##### *Transmit Spool*

The GES-1993 is transmitting spooled messages to the Host.

### 3.12.5 Related Variables

The following table lists the variables (SV's, EC's, or DVVALS) which are relevant to spooling. For a more complete description of these variables, see "Appendix A -- Variables".

Table 3-21 Spooling Variables

Variable Name	VID
MAXSPOOLTRANSMIT	46
SPOOLCOUNTACTUAL	48
SPOOLCOUNTTOTAL	49
SPOOLFULLTIME	50
SPOOLLOADSUBSTATE	51
SPOOLSTARTTIME	52
SPOOLSTATE	53
SPOOLUNLOADSUBSTATE	54
OVERWRITESPOOL	62
CONFIGSPOOL	63

### 3.12.6 Related Events

The following lists the collection events (CEIDs) which are relevant to spooling. For a more complete description of these events, see "Appendix B -- Collection Events" or the description in this chapter.

Table 3-22 Spooling CEIDS

Collection Event	CEID
GemSpoolingActivated	23
GemSpoolingDeactivated	24
GemSpoolTransmitFailure	25

## 4. SECS Message Detail

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

### 4.1 SML Notation

Message descriptions are shown using "SECS Message Language" (SML) notation. SML is a general notation developed by GW Associates for describing SECS messages. SML is similar to the notation used in the SECS Standards documents, but SML is a more precise and regular notation. In SML, the format for a data item is as follows:

```
< type [ count ] value >
```

The components are:

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

#### **type**

This specifies the SECS-II Data Item format. It will have one of the following values:

A	ASCII
B	Binary
J	JIS-8
I1, I2, I4, I8	Signed Integers
U1, U2, U4, U8	Unsigned Integers
F4, F8	Floating Point
BOOLEAN	True/False

#### **count**

Count of the element values that make up the item. If present, the count is enclosed within square brackets "[ ]". The count may be omitted, in which case the square brackets are also omitted.

The "count" specifies the number of value elements in the Data Item Value. 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. The "count" can range between known limits. It may be specified as minimum and maximum "counts", separated by two dots. (For example, [0..40]).

**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 additional elements may occur, as for example where substructures may repeat in a List structure.

As an 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 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 .



## 4.5 S1F3 - Selected Status Request

```
S1F3 W                                * H-> E

<L
  <U4 VID>                            * Variable ID
  . . .
  > .
```

The Host requests status from the GES-1993. The Host sends the VID's of interest. Several VID's can be specified if desired.

Normally, only VID's of class SV (i.e. Status Variables) are used in this message. However, the GES-1993 allows the Host to use any VID of class DV, EC, or SV.

If S1F3 contains a zero-length list, then the GES-1993 will report all variables of class SV, in order by VID.

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

```
S1F4 W                                * H->E

  <U4 VID...>.
```

## 4.6 S1F4 - Selected Status Data

```
S1F4 W                                * H<-E  
  
<L  
    <V>                                * Status Variable Value  
    ...  
> .
```

The Equipment returns the Variable Values in the order requested by S1F3. If any VID specified in S1F3 is invalid, the corresponding V in S1F4 has the following error format:

```
<L>                                * V for Invalid VID
```

## 4.7 S1F11 - Status Variable Namelist Request

```
S1F11 W                                * H->E  
  
<L  
    <U4 VID>                            * Status Variable ID  
    ...  
> .
```

The Host format descriptions for the specified Variables. Several VID's can be specified if desired.

Normally, only VID's of class SV (i.e. Status Variables) are used in this message. However, any VID of class DV, EC, or SV can be used.

If S1F11 contains a zero-length list, then the Equipment will report all variables of class SV, in order by VID.

```
S1F11 W                                * H->E  
  
<L> .
```

## 4.8 S1F12 - Status Variable Namelist Reply

```
S1F12                                * H<-E

<L
  <L [3]
    <U4 VID>                          * Variable ID
    <A SVNAME>                        * Status Variable Name
    <A UNITS>                          * Units of Measure
    . . .
  > .
```

The Equipment returns the Variable descriptions in order requested in S1F11. If any VID specified in S1F11 is invalid, the corresponding List in S1F12 has the following error format:

```
<L>                                * Instead of L [3]
```

## 4.9 S1F13 - Connect Request

The Equipment sends this message using the following format.

```
S1F13 W                                * H<-E

<L
  <A MDLN>
  <A SOFTREV>
  > .
```

The Host sends this message using the following format.

```
S1F13 W                                * H->E

<L> .
```

Either end of the link may send S1F13 as the first message to establish connection of the link.

Under the GES-1993's initialization logic, the Equipment will always attempt to establish the link. If no Host acceptance reply is received, the Equipment sends this message periodically.

## 4.10 S1F14 - Connect Request Acknowledge

The Equipment sends this message using the following format:

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

The Host sends this message using the following format:

```
S1F14                                * H->E
<L
  <B [1] 00>                          * COMMACK
  <L>
  > .
```

The 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.

## 4.11 S1F15 - Request Off-Line

```
S1F15 W .                             * H->E
```

Host requests the Equipment to go Off-Line.

## 4.12 S1F16 - Off-Line Acknowledge

S1F16 \* H <- E

<B [1] 0x00> . \* OFLACK

Equipment Control State transits to Host Off-Line and sends this message in response to S1F15 primary. OFLACK is always zero.

## 4.13 S1F17 - Request On-Line

S1F17 W . \* H -> E

Host requests the Equipment to go On-Line.

## 4.14 S1F18 - On-Line Acknowledge

S1F18 \* H <- E

<B [1] ONLACK> .

Equipment responds to S1F17 primary in an attempt to go On-Line. Data item ONLACK indicates the success or failure of the attempt.

Table 4-1 On-Line Acknowledge

ONLACK	Description
0x00	OK. Equipment On-Line transition successful. Equipment Control State transits to either Local or Remote while On-Line as guided by the EC "GemOnlineSubstate".
0x01	On-Line not allowed.
0x02	Equipment already On-Line.

## 4.15 S1F65 - Connect Request



### **NOTE**

This message is provided only for compatibility with Host computers which support an older version of GEM.

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  
    <A MDLN>  
    <A SOFTREV>  
    > .
```

Format 1: The Host sends this message using the following format:

```
S1F65 W                               * H->E  
  
<L> .
```

Format 2: The Equipment also accepts the following form of this message:

```
S1F65 W .                               * H->E
```

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

Under the GES-1993's initialization logic, the Equipment will always attempt to establish the link. If no Host acceptance reply is received, the Equipment sends this message periodically.

## 4.16 S1F66 - Connect Request Acknowledge



### NOTE

This message is provided only for compatibility with Host computers which support an older version of GEM.

If the Host sends S1F65, Format 1, the Equipment replies S1F66 using the following format.

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

If the Host sends S1F65, format 2, the Equipment replies S1F66 using the following format.

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

The Host sends this message using the following format.

```
S1F66                                * H->E
<L
  <B [1] 00>
  <L>
> .
```

The Equipment also accepts the following form of this message.

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

The 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 values indicates refusal.

## 4.17 S2F13 - Equipment Constant Request

```
S2F13 W                                * H->E  
  
<L  
    <U4 VID>                            * Equipment Constant ID  
    . . .  
> .
```

The Host requests the VIDs of interest. Several VIDs can be specified if desired.

Normally, only VIDs of class EC (i.e. Equipment Constants) are used in this message. However, any VID of class DV, EC, or SV can be used.

If S2F13 contains a zero-length list, then the Equipment will report all variables of class EC, in order by VID.

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

```
S2F13 W                                * H->E  
    <U4 VID VID ...> .                  * Equipment Constant ID
```

## 4.18 S2F14 - Equipment Constant Data

```
S2F14                                * H<-E, Multiblock  
  
<L  
    <V>                                  * Equipment Constant Value  
    . . .  
> .
```

The Equipment returns the Equipment Constants in the order requested in S2F13. If any VID specified in S2F13 is invalid, the corresponding V in S2F14 has the following error format:

```
<L>                                * V for Invalid VID
```

## 4.19 S2F15 - New Equipment Constant Send

```
S2F15 W                                * H->E  
  
<L  
  <L [2]  
    <U4 VID>                            * Equipment Constant ID  
    <V>  
    >  
  ...  
> .
```

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

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

## 4.20 S2F16 - Equipment Constant Send Acknowledge

```
S2F16                                * H<-E  
<B [1] EAC> .                        * Equipment Acknowledge Code
```

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.

Table 4-2 EAC Values

EAC	Description
0x00	OK
0x01	At least one ECID invalid
0x03	At least one ECV out of range

## 4.21 S2F17 - Date and Time Request

S2F17 W . \* H<->E

The Host may send this message at any time to determine the Date and Time base that the GES-1993 is currently using.

The GES-1993 sends this message at the request of the operator.

## 4.22 S2F18 - Date and Time Data

S2F18 \* H<->E

\* TIME - Date and Time

<A 'YYMMDDhhmmss' > . \* If TIMEFORMAT = 0

- OR -

<A 'YYYYMMDDhhmmsscc' > . \* If TIMEFORMAT = 1

This message contains the current Date and Time.

**YY** Year (last two digits), 00 to 99 (TIMEFORMAT = 0)

**YYYY** Year (all four digits) (TIMEFORMAT = 1)

**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 (TIMEFORMAT = 1)

When the Equipment receives a good S2F18, it sets its internal clock/calendar. When receiving S2F18, the Equipment will discard an invalid date or time. For example, if the date is good but the time is bad, the Equipment sets its date but not its time.

## 4.23 S2F23 - Trace Initialize Send

```
S2F23 W                                * H->E

<L [5]
  <U4 TRID>                             * Trace ID
  <A 'hhmmss' >                         * DSPER - Data Sample Period
  <U4 TOTSMP>                            * Total Number of Samples
  <U4 REPGSZ>                             * Reporting Group Size
  <L
    <U4 SVID>                             * Status Variable ID
    . . .
  >
> .
```

The Host requests the Equipment to initiate a time driven trace operation.

The Equipment will send 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.

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

The Equipment will send 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 class SV are used in this message. However, any VID of class DV, EC, or SV can be used.

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

```

S2F23 W                                     * H->E

<L [5]
  <U4 TRID>                                * Trace ID
  <A 'hhmmss'>                             * DSPER - Data Sample
Period
  <U4 TOTSMP>                              * Total Number of Samples
  <U4 REPGSZ>                               * Reporting Group Size
  <U4 SVID SVID ...>                       * Status Variable ID array
  > .

```

## 4.24 S2F24 - Trace Initialize Acknowledge

```

S2F24                                     * H<-E
  <B [1] TIAACK> .                       * TIAACK - Trace Init. Ack.
Code

```

Table 4-3 Trace Initialize Acknowledge

TIAACK	Description
0x00	Normal. Everything Correct
0x03	Invalid period. DSPER is incorrect. The Equipment does not start the trace.

The GES-1993 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 depends on the size of the trace data, but is always at least 4.

## 4.25 S2F25 - Diagnostic Loopback Request

```
S2F25 W                               * H->E
  <B ABS> .                             * ABS - Any Binary String
```

The Host sends an arbitrary binary string to test operation of the link.

The Equipment never sends this message to the Host.

## 4.26 S2F26 - Diagnostic Loopback Data

```
S2F26                               * H<-E
  <B ABS> .                             * ABS - Any Binary String
```

The Equipment "echoes" back the binary data from the Host's S2F25.

## 4.27 S2F27 - Initiate Process Request

```
S2F27 [W]                               * H->E
  <L [3]
    <B LOC>                               * Location (always '0')
    <A [1..12] PPID>                       * Process Program ID
    <L [1]
      <A [1..16] MID>                     * Lot ID
    >
  > .
```

The Host sends this command to initiate a new lot for processing.

The GES-1993 ignores case when performing validity checks on the PPID string.

The Host may optionally set the W-Bit to "1" in S2F27. If so, the Equipment replies with S2F28.

PPID is the DOS 8.3 file name for the recipe. It should include the extension (RCP).



## 4.29 S2F29 - Equipment Constant Namelist Request

```
S2F29 W * H->E
<L
  <U4 VID> * Equipment Constant ID
  ...
  > .
```

The Host requests format descriptions for the specified Equipment Constants. Several VIDs can be specified if desired.

Only VIDs of class EC (i.e. Equipment Constants) can be used in this message.

If S2F29 contains a zero-length list, then the Equipment will report all variables of class EC, in order by VID.

## 4.30 S2F30 - Equipment Constant Namelist Reply

```
S2F30 * H<-E, Multiblock
<L
  <L [6]
    <U4 VID> * Equipment Constant ID
    <A ECNAME> * Equipment Constant Name
    <ECMIN> * ECV Minimum Value
    <ECMAX> * ECV Maximum Value
    <ECDEF> * ECV Default Value
    <A UNITS> * Units of Measure
  >
  ...
  > .
```

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> * Instead of L [6]
```

## 4.31 S2F31 - Date and Time Send

S2F31 W \* H->E  
\* TIME - Date and Time  
<A 'YYMMDDhhmmss'> . \* If TIMEFORMAT = 0  
- OR -  
<A 'YYYYMMDDhhmmsscc'> . \* If TIMEFORMAT = 1

The Host commands the Equipment to set its Date and Time base to the specified value.

When the Equipment receives a good S2F31, it sets its internal clock/calendar. When receiving S2F31, the Equipment will discard an invalid date or time. For example, if the date is good but the time is bad, the Equipment sets its date but not its time.

## 4.32 S2F32 - Date and Time Acknowledge

S2F32 \* H<-E  
<B [1] TIACK> . \* TIACK - Acknowledge Code

Table 4-5 TIACK

TIACK	Description
0x00	Normal. Everything correct.
0x01	Invalid Date and/or Time.

### 4.33 S2F33 - Define Report

```
S2F33 W                                * H->E, Multiblock

<L [2]
  <U4 DATAID>                          * DATAID
  <L
    <L [2]
      <U4 RPTID>                          * Report ID
      <L
        <U4 VID>                          * Variable ID
        ...
      >
    >
  ...
  >
> .
```

The Host specifies one or more Report IDs, and defines which Variables should be included in each report.

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.

If the GES-1993 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>
  ...
```

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

```
S2F33 W * H->E
<L [2]
  <U4 DATAID> * DATAID
  <L>
  > .
```

#### 4.34 S2F34 - Define Report Acknowledge

```
S2F34 * H<-E
  <B [1] DRACK> . * DRACK - Acknowledge Code
```

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

Table 4-6 DRACK Values

DRACK	Description
0x00	OK
0x02	Denied. Invalid format.
0x03	Denied. At least one RPTID already defined.
0x04	Denied. At least one VID does not exist.

## 4.35 S2F35 - Link Event Report

```
S2F35 W                                * H->E, Multiblock
<L [2]
  <U4 DATAID>                          * DATAID
  <L
    <L [2]
      <U4 CEID>                          * Collection Event ID
      <L
        <U4 RPTID>                      * Report ID
        ...
      >
    >
  ...
  >
> .
```

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 GES-1993 does not require it.

The Equipment ignores DATAID.

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>
  >
  ...
```

## 4.36 S2F36 - Link Event Report Acknowledge

S2F36

<B [1] LRACK> .

\* H<-E

\* LRACK - Acknowledge Code

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

Table 4-7 LRACK Values

LRACK	Description
0x00	OK
0x02	Denied. Invalid format.
0x03	Denied. At least one CEID link already defined
0x04	Denied. At least one CEID does not exist.
0x05	Denied. At least one RPTID does not exist.
Other	Equipment has rejected the S2F35 message

## 4.37 S2F37 - Enable/Disable Event Report

```

S2F37 W                                * H<-E
<L [2]
  <BOOLEAN CEED>                        * Coll. Event Enable
  <L
    <U4 CEID>                            * Collection Event ID
    ...
  >
> .

```

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.

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

```

S2F37 W                                * H->E
<L [2]
  <BOOLEAN CEED>                        * Coll. Event Enable
  <L>
  > .

```

## 4.38 S2F38 - Enable/Disable Event Report Acknowledge

```

S2F38                                * H<-E
<B [1] ERACK> .                       * ERACK - Acknowledge Code

```

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

Table 4-8 ERACK Values

ERACK	Description
0x00	OK
0x01	Denied. At least one CEID does not exist.

## 4.39 S2F39 - Multi-Block Inquire

S2F39 W \* H->E  
<L [2]  
    <U4 DATAID> \* DATAID  
    <U4 DATALENGTH>  
    > .

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.

## 4.40 S2F40 - Multi-Block Grant

S2F40 \* H<-E  
    <B [1] 00> . \* GRANT

The Equipment always sends GRANT value "0".

## 4.41 S2F41 - Remote Command with Parameters

```

S2F41 [W]                                * H->E

<L [2]
  <A RCMD>                                * Remote command string
  <L
    <L [2]
      <A CPNAME>                          * Command Parameter Name
      <CPVAL>                             * Command Parameter Value
    >
  >
> .

```

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 GES-1993 ignores case when performing validity checks on the RCMD and CPNAME strings. The ASCII strings described below may be sent in any combination of upper and lower case characters.

RCMD String	Function
"START"	Start a Process Program
"STOP"	Stop a running Process Program
"ABORT"	Abort a running Process Program
"PAUSE"	Pause a running Process Program
"RESUME"	Resume a paused Process Program
"REMOTE"	Switch equipment to remote state
"LOCAL"	Switch equipment to local state

The Host may optionally set the W-Bit to "1" in S2F41. If so, the Equipment replies with S2F42.

## 4.42 S2F42 - Remote Command Acknowledge

```

S2F42                                     * H<-E
<L [2]
  <B [1] H<ACK>                           * Host Command Ack. Code
  <L [n]
    <L [2]
      <A CPNAME>                           * name of parameter
      <B [1] C<ACK>                         * Cmd Param Ack Code
    >
    . . .
  >
> .
  
```

Normal completion returns a zero (0) in H<ACK>. The number of erroneous parameters "N" in S2F42 will be zero.

A non-zero value for H<ACK> indicates that the Equipment has rejected the Remote Command. The number of erroneous parameters "n" can be zero or greater.

Table 4-9 H<ACK> Values

H<ACK>	Description
0x00	OK. All normal.
0x01	Invalid command. Equipment rejects command
0x02	Cannot perform now. Equipment rejects command. FMW is not in Run Window screen.
0x03	At least one parameter is invalid. Equipment rejects the command.
0x40	Control State is Local. Equipment rejects command.
0x41	Incorrect Process State for this command. Equipment rejects command.
0x42	Process Program contains an invalid format. Unable to load program.

Table 4-10 CPACK Values

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.
0x40	Duplicate parameter name. This parameter name occurred at least twice in the S2F41 command.

## 4.43 S2F43 - Reset Spooling Streams and Functions

```
S2F43 W                                * H -> E

<L
  <L [2]
    <U1 STRID>                          * Message Stream
    <L
      <U1 FCNID>                        * Message Function
      ...
    >
  >
  ...
> .
```

The Host sends message to specify which messages the Equipment should spool in the event of a communications loss. When this message is received by the Equipment, all previous definitions of messages to spool are replaced.

The following version of S2F43 will enable spooling for all messages within the specified stream:

```
S2F43 W                                * H -> E

<L
  <L [2]
    <U1 STRID>                          * Message Stream
    <L>
  >
  ...
> .
```

To disable spooling of all messages, the following version of S2F43 may be used.

```
S2F43 W                                * H -> E

<L>.
```

Spooling is not allowed for even-numbered function messages (replies) or stream one messages.

## 4.44 S2F44 - Reset Spooling Acknowledge

The S2F44 message has two forms, depending on the return code in RSPACK. If there are no errors in S2F43, the format of S2F44 is as follows.

```
S2F44                                * H <- E

<L [2]
  <B [1] 00>                          * RSPACK
  <L>
> .
```

If S2F43 contains any errors, the Equipment will discard the entire S2F43, and return error information in S2F44, as follows:

```
S2F44                                * H <- E

<L [2]
  <B [1] 01>                          * RSPACK
  <L
    <L [3]
      <U1 STRID>                       * Msg String
      <B STRACK>                       * Stream Ack Code
      <L
        <U1 FCNID>                     * Msg Function
        ...
      >
    >
  ...
> .
```

The RSPACK code indicates whether the Equipment accepted the S2F43 message:

Table 4-11 RSPACK Values

RSPACK	Description
0x00	Acknowledge, spooling setup accepted.
0x01	Spooling setup rejected. At least one message requested as spool-able could not be made so.

When errors exist in the request to set some messages as spool-able, the Equipment will return codes explaining the nature of the error. These codes are found in the STRACK data item.

Table 4-12 STRACK Values

STRACK	Description
0x01	Spooling not allowed for this stream. Spooling is never allowed for stream one.
0x04	Requested message is a secondary message and therefore ineligible for spooling

#### 4.45 S2F45 - Define Variable Limits Attributes

```

S2F45 W                               * H -> E

<L [2]
  <U4 DATAID>
  <L
    <L [2]
      <U4 VID>                          * Variable ID
      <L
        <L [2]
          <B [1] LIMITID>
          <L [2]
            <UPPERDB>
            <LOWERDB>
          >
        >
      >
    >
    ...
  >
  ...
> .

```

With this message, the Host defines a set of limits for a single variable or a series of variables.

DATAID may be any value, and is ignored by the Equipment.

VID must specify the Variable ID of a Variable for which Limits Monitoring is allowed.

LIMITID must be between 0x01 and 0x07. It specifies one of the seven allowable limits for the variable.

UPPERDB and LOWERDB must match the value format of the specified variable

The Host may undefine all limits for all VIDs:

```
S2F45 W * H -> E
```

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

The Host may undefine all limits for a specific VID:

```
S2F45 W * H -> E
```

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

The Host may undefine a specific limit for a specific VID:

```
S2F45 W * H -> E
<L [2]
  <U4 DATAID>
  <L
    <L [2]
      <U4 VID>
      <L
        <L [2]
          <B [1] LIMITID>
          <L>
        >
      >
    ...
  >
  ...
> .
```

## 4.46 S2F46 - Variable Limit Attribute Acknowledge

This message acknowledges the successful setting of limits as defined in the Host-generated S2F45.

```
S4F46                                * H <- E

<L [2]
  <B [1]                                * VLAACK
  <L>
> .
```

If any of the limits proposed in S4F45 are invalid, all limits for all variables in this message are rejected. The following message is sent in the event of an error:

```
S4F46                                * H <- E

<L [2]
  <B [1] VLAACK>
  <L
    <L [3]
      <U4 VID>
      <B [1] 0x00>                    * LVACK
      <L [2]
        <B [1] LIMITID>
        <B [1] LIMITACK>
      >
    >
    ...
  >
> .
```

Data item VLAACK reports to the Host the status of the request to define limits for the requested variables.

Table 4-13 VLAACK Values

VLAACK	Description
0x00	OK. Limits successfully defined.
0x01	Limit attribute definition error.

The LVACK data item gives information to the Host about the status of setting a specific variable when the request to set it is unsuccessful.

Table 4-14 LVACK Values

LIMIT-ACK	Description
0x01	Requested variable does not exist.
0x02	Variable is not eligible for limits definition.
0x03	Requested variable was repeated in request message.
0x04	Error in setting limit due to reason specified in LIMITACK.

The LIMITACK data item indicates the status of an attempt to set an individual limit for a variable.

Table 4-15 VLACK Values

VLACK	Description
0x01	LIMITID does not exist.
0x02	Requested UPPERDB is greater than LIMITMAX.
0x03	Requested LOWERDB is lower than LIMITMIN.
0x04	UPPERDB < LOWERDB
0x05	Illegal format specified for UPPERDB or LOWERDB.

## 4.47 S2F47 - Variable Limit Attribute Request

```
S2F47 W                                * H-> E  
  
<L  
    <U4 VID>                            * Requested Variable ID  
    ...  
> .
```

The Host sends this message to the Equipment to request the limits attributes for specific variables. The Host may request the limits attributes for all defined variables with the following message.

```
S2F47 W                                * H -> E  
  
<L> .
```

In response to this message, the Equipment reports all limits attributes for all variables. If a variable is eligible for limits monitoring, but does not have any limits defined, it is not reported.

## 4.48 S2F48 - Variable Limit Attributes Send

```

S2F48                                     * H <- E

<L
  <L [2]
    <U4 VID>                               * Variable ID
    <L [4]
      <A UNITS>                             * Units of Measure
      <LIMITMIN>                            * Minimum Limit
      <LIMITMAX>                            * Maximum Limit
      <L
        <L [3]
          <B [1] LIMITID> * Limit ID
          <UPPERDB> * Upper Deadband
          <LOWERDB> * Lower Deadband
        >
        ...
      >
    >
  >
  ...
> .

```

The Equipment sends this message in response to a Host S2F47 and reports the characteristics of limits for specified variables. In response to a request from the Host for all limits for all variables, only variables with limits defined are reported. If the Host requests specific variables which are not eligible for limits monitoring, the following message will be reported for that variable:

```

S2F48                                     * H <- E

<L
  <L [2]
    <U4 VID>                               * Variable ID
    <L>                                     * Not eligible for
Limits
  >
  ...
> .

```

If the Host requests the limits for a specific variable which is eligible for limits monitoring but does not have any limits defined, this variable will be reported as follows:

```
S2F48                                * H <- E

<L
  <L [2]
    <U4 VID>                          * Variable ID
    <L [4]
      <A UNITS>                        * Units of Measure
      <LIMITMIN>                       * Minimum Limit
      <LIMITMAX>                       * Maximum Limit
      <L>                              * No Limits Defined
    >
  >
  ...
> .
```

#### 4.49 S5F1 - Alarm Report

```
S5F1 [W]                              * H<-E

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

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".

If the Equipment Constant "ConfigAlarms" is set to "0", the Equipment sends S5F1 instead of the normal S5F73 Alarm Notification Send.

The equipment reports that an alarm condition has changed.

ALID identifies the Alarm.

The high-order bit of ALCD will be "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. See "Appendix C" for a table of possible Alarms which can occur.

Equipment Constant "WBitS5" controls whether the Equipment sends S5F1 with W-Bit "1" (Reply Expected) or "0" (No Reply Expected).

## 4.50 S5F2 - Alarm Acknowledge

S5F2 \* H->E  
 <B [1] 00> . \* ACK5 - Alarm Acknowledge

The Host acknowledges the Alarm Report. This Equipment ignores the ACKC5.

## 4.51 S5F3 - Enable/Disable Alarm Send

S5F3 [W] \* H->E  
 <L [2]  
 Code <B [1] ALED> \* ALED - Alarm Enable/Disable  
 <U4 ALID> \* ALID - Alarm ID  
 > .

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 4-16 ALED Values

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]
Code <B [1] ALED> * ALED - Alarm Enable/Disable
      <U4> * ALID - Alarm ID
      > .

```

The Host may optionally set the W-Bit to "1" in S5F3. If so, the GES-1993 replies with S5F4.

## 4.52 S5F4 - Enable/Disable Alarm Acknowledge

```

S5F4 * H<-E
<B [1] ACKC5> . * ACKC5 - Acknowledge Code

```

Table 4-17 ACKC5 Values

ACKC5	Description
0x00	Normal. Everything Correct
0x01	Invalid ALID.

## 4.53 S5F5 - List Alarms Request

```

S5F5 W * H->E
<U4 ALID ...> . * Alarm ID Array

```

The Host requests the Equipment to send the current status of the specified Alarm IDs.

The Host can use the following special format to request the status of all Alarm IDs:

```

S5F5 W
      <U4> . * ALID

```

## 4.54 S5F6 - List Alarm Data

```
S5F6                                * H<-E, Multiblock

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

The high-order bit of ALCD will be "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:

```
Code  <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.

## 4.55 S5F7 - List Enabled Alarms Request

```
S5F7 W .                                * H->E
```

The Host requests the Equipment to send the current status of all Alarm IDs which are currently enabled (See S5F3).

## 4.56 S5F8 - List Enabled Alarm Data

S5F8 \* H<-E, Multiblock

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

The high-order bit of ALCD will be "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.

## 4.57 S5F71 - Alarm Report Block Send

```
S5F71 [W]                                * H<-E
<L [2]
  <U1 0>                                  * ALPY Alarm Priority
  <L [1]
    <L [4]
      <U4 ALID>                            * ALID - Alarm ID
      <BOOLEAN ASTAT>                     * T = Alarm On
                                           * F = Alarm Off
      <U4 ASER>                            * ASER Alarm Serial Number
      <A [16] 'YYYYMMDDhhmmsscc'>        * CLOCK
    >
  > .
```



### **NOTE**

This message is provided only for compatibility with Host computers which support an older version of GEM.

If the Equipment Constant "ConfigAlarms" is set to "1", the Equipment sends S5F71 instead of the normal S5F1 Alarm Notification Send.

The GES-1993 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 incremented by 1 for each alarm reported.

ALPY (Alarm Priority) is always zero.

CLOCK indicates the date and time of the alarm change.

Equipment Constant "Wbits5" controls whether the Equipment sends S5F71 with w-bit= "1" (Reply Expected) or "0" (No Reply Expected).

## 4.58 S5F72 - Alarm Report Block Acknowledge

S5F72 \* H->E  
<L> .

The Host acknowledges Alarm Report. This Equipment ignores the data portion of S5F72.

## 4.59 S5F73 - Alarm Report Block Acknowledge

S5F73 [W] \* H<-E  
<L [3]  
    <U4 ALID> \* ALID - Alarm ID  
    <BOOLEAN ASTAT> \* T = Alarm On,  
                            F = Alarm Off.  
    <A [16] 'YYYYMMDDhhmmsscc' > \* TIMESTAMP  
    > .



### **NOTE**

This message is provided only for compatibility with older Host computers which support GEM 3.1. (See section 2.7.2, "Gem Configuration".)

In order for this message to be used, the Equipment Constant "ConfigAlarms" must be set to "2".

The GES-1993 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.

Equipment Constant "WBitS5" controls whether the Equipment sends S5F73 with W-Bit "1" (Reply Expected) or "0" (No Reply Expected).

## 4.60 S5F74 - Alarm Notification Acknowledge

S5F74 \* H->E  
<B [1] ACK5> .

The Host acknowledges Alarm Report. This Equipment ignores ACKC5.

## 4.61 S6F1 - Trace Data Send

```
S6F1 [W] * H<-E
<L [4]
  <U4 TRID> * Trace ID
  <U4 SMPLN> * Sample Number
              * STIME - Sample Date/Time
  <A 'YYMMDDhhmmss' > * If TIMEFORMAT = 0
                    - OR -
  <A 'YYYYMMDDhhmmsscc' > * If TIMEFORMAT = 1
  <L
    <V> * Variable Value
    . . .
    >
  >.
```

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.

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).

## 4.62 S6F2 - Trace Data Acknowledge

```
S6F2 * H->E
  <B [1] 00> . * ACKC6
```

The Host acknowledges the data. The Equipment ignores ACKC6.

## 4.63 S6F3 - Annotated Event Report

```
S6F3 [W]                                * H<-E, Multiblock

<L [3]
  <U4 DATAID>                          * DATAID
  <U4 CEID>                              * Collection Event ID
  <L
    <L [2]
      <U4 DSID> * DSID=RPTID Report ID
      <L
        <U4 VID> * Variable ID
        <V>     * Variable Value
      >
      ...
    >
  >
  ...
> .
```



### **NOTE**

This message is provided only for compatibility with older Host computers which do not support GEM. (See section 2.7.2, "Gem Configuration".)

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 GES-1993 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 will match 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>
  > .
```

Equipment Constant "Wbits6" controls whether the Equipment sends S6F3 with W-Bit "1" (Reply Expected) or "0" (No Reply Expected).

#### 4.64 S6F4 - Annotated Event Report Acknowledge

```
S6F4 * H->E
  <B [1] 00> . * ACKC6
```

The Host acknowledges the Event Report. The Equipment ignores ACKC6.

#### 4.65 S6F5 - Multi-Block Data Send Inquire

```
S6F5 W * H<-E

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

The Equipment sends this Inquire/Grant transaction preceding any multiblock S6F3, S6F9, S6F11, or S6F13.

The DATAID specified here will appear 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.

## 4.66 S6F6 - Multi-Block Grant

S6F6 \* H->E  
<B [1] GRANT6> . \* GRANT6

The Host grants permission for the Equipment to send a multi-block event report..

Table 4-18 Multi-Block Event Values

GRANT6	Description
0x00	Normal. Permission granted.
Other	Permission not granted. The Equipment will not send the following S6F3, S6F9, S6F11, or S6F13, and will discard the data.

## 4.67 S6F9 - Event Report

```
S6F9 [W]                                * H<-E, Multiblock

<L [4]
  <B [1] 00>                             * PFCF
  <U4 DATAID>                            * DATAID
  <U4 CEID>                                * Collection Event ID
  <L
    <L [2]
      <U4 DSID>                            * DSID=RPTID Report ID
      <L
        <V>                                * Variable Value
        ...
      >
    >
  ...
  > .
```



### **NOTE**

This message is provided only for compatibility with older Host computers which do not support GEM. (See section 2.7.2, "Gem Configuration".)

If the Equipment Constant "ConfigEvents" is set to "0", the Equipment sends S6F9 instead of the normal S6F11 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 "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).

PFCF 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 will match 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>                             * PFCB
  <U4 DATAID>                           * DATAID
  <U4 CEID>                               * Collection Event ID
  <L>
  > .
```

Equipment Constant "WBitS6" controls whether the Equipment sends S6F9 with W-Bit "1" (Reply Expected) or "0" (No Reply Expected).

#### 4.68 S6F10 - Event Report Acknowledge

```
S6F10                                     * H->E
  <B [1] 00> .                            * ACKC6
```

The Host acknowledges the Event Report. The Equipment ignores ACKC6.

## 4.69 S6F11 - Event Report Send

```
S6F11 W * H<-E
<L [3]
  <U4 DATAID> * DATAID
  <U4 CEID> * Collection Event ID
  <L
    <L [2]
      <U4 RPTID> * Report ID
      <L
        <V> * Variable Value
        ...
      >
    >
  ...
  >
> .
```

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).

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:

```
S6F11 W * H<-E
<L [3]
  <U4 DATAID> * DATAID
  <U4 CEID> * Collection Event ID
  <L>
  > .
```

## 4.70 S6F12 - Event Report Acknowledge

```
S6F12                                * H->E
<B [1] 00> .                          * ACKC6
```

The Host acknowledges the Event Report. The Equipment ignores ACKC6.

## 4.71 S6F13 - Annotated Event Report Send

```
S6F13 W                                * H<-E, Multiblock
<L [3]
  <U4 DATAID>                          * DATAID
  <U4 CEID>                              * Collection Event ID
  <L
    <L [2]
      <U4 RPTID>                          * Report ID
      <L
        <L [2]
          <U4 VID>                        * Variable ID
          <V>                              * Variable Value
        >
        ...
      >
    >
  ...
  >
> .
```



### **NOTE**

This message is provided only for compatibility with older Host computers which support older versions of GEM. (See section 2.7.2, "Gem Configuration".)

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 will match 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>
  > .
```

#### 4.72 S6F14 - Annotated Event Report Acknowledge

```
S6F14                                * H->E
  <B [1] 00> .                       * ACKC6
```

The Host acknowledges the Event Report. The Equipment ignore ACKC6.

#### 4.73 S6F15 - Event Report Request

```
S6F15 W                                * H->E
  <U4 CEID> .                          * Collection Event ID
```

The Host sends the CEID of interest, requesting normal format reports.

## 4.74 S6F16 - Event Report Data

```
S6F16                                * H<-E, Multiblock

<L [3]
  <U4 DATAID>                        * DATAID
  <U4 CEID>                            * Collection Event ID
  <L
    <L [2]
      <U4 RPTID>                       * Report ID
      <L
        <V>                            * Variable Value
        ...
      >
    >
  ...
  >
> .
```

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).

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.

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>
  > .
```

## 4.75 S6F17 - Annotated Event Report Request

```
S6F17 W                                * H->E
<U4 CEID> .                             * Collection Event ID
```

The Host sends the CEID of interest, requesting annotated format reports.

## 4.76 S6F18 - Annotated Event Report Data

```
S6F18                                    * H<-E
<L [3]
  <U4 DATAID>                            * DATAID
  <U4 CEID>                                * Collection Event ID
  <L
    <L [2]
      <U4 RPTID>                            * Report ID
      <L
        <L [2]
          <U4 VID>                          * Variable ID
          <V>                               * Variable Value
        >
      ...
    >
  >
  ...
> .
```

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).

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>
  > .
```

#### 4.77 S6F19 - Request Report Request

```
S6F19 W                                * H->E
  <U4 RPTID> .                          * Report ID
```

The Host requests a Report for the specified RPTID.

#### 4.78 S6F20 - Request Report Data

```
S6F20                                * H<-E, Multiblock

<L
  <V>
  ...
  > .
```

The Equipment sends the Report.

If no report is defined for the RPTID in S6F19, S6F20 has the following special error format:

```
S6F20                                * H<-E

<L> .
```



## 4.81 S6F23 - Request Spooled Data

S6F23 W \* H -> E  
<U1 RSDC> .

The Host sends this message to start the transfer of spooled messages from the Equipment to the Host, or to delete the contents of the spool file, depending on the value of RSDC.

When the Host requests the spooled messages (RSDC is zero), the Equipment will send messages according to EC "MaxSpoolTransmit". All messages are sent from oldest to newest, and once the message is successfully sent, it is removed from the spool. If MaxSpoolTransmit is zero, all messages will be sent one at a time until the last message has been delivered. If MaxSpoolTransmit is set to a non-zero value, the Equipment will send the lesser of MaxSpoolTransmit or messages left in spool. If in this case the Equipment sends MaxSpoolTransmit messages, and messages remain in the spool, the Equipment will wait for another S6F23 to deliver the next messages.

If the Host sends S6F23 with RSDC set to one, this will be interpreted by the Equipment as a request to purge the spool.

Table 4-19 RSDC

RSDC	Description
0	Transmit spooled messages.
1	Purge spooled messages

## 4.82 S6F24 - Request Spooled Data Acknowledge

S6F24 \* H<- E  
 <B [1] RSDA> .

Equipment acknowledges the Host's request to either purge spooled messages or send spooled messages to the Host.

Table 4-20 RSDA Values

RSDA	Description
0x00	Normal. Equipment will start to send spooled data or optionally purge the spool. Action performed will depend on value for RSDC in S6F23.
0x02	Denied. Spooled data does not exist.

## 4.83 S7F1 - Process Program Load Inquire

S7F1 W \* H<->E  
 <L [2]  
 <A PPID> \* Process Program ID  
 <U4 LENGTH> \* Length of text  
 > .

PPID should be in the DOS 8.3 file name format and should include the extension RCP.

The Sender requests permission to send a Process Program. The Process Program may be either a Load Recipe, Process Recipe, or Parameter Table.

The Equipment always sends this Inquire/Grant transaction before sending any multi-block S7F3. LENGTH specifies the number of bytes in the following S7F3 message, excluding SECS-I block-length bytes, block headers, and checksums.

For Host-to-Equipment transfers, this Inquire/Grant is optional. The Equipment accepts it, but ignores it, commits no resources, and initiates no Conversation timeout. The Equipment will accept a multi-block S7F3 even if not preceded by the Inquire/Grant.



## 4.85 S7F3 - Process Program Send

S7F3 W \* H<->E, Multiblock

<L [2]

<A PPID> \* PPID - Process Program ID

<A PPBODY> \* PPBODY - Process Program Body

PPID should be in DOS 8.3 file name format and should include the extension RCP.

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.

## 4.86 S7F4 - Process Program Acknowledge

S7F4 \* H<->E

<B [1] ACKC7> . \* ACKC7

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.

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 4-23 S7F4 ACKC7 Values

ACKC7	Description
0x00	Normal. Process Program Accepted and stored into Library.
0x01	Permission Not Granted. Insufficient space in Library.
0x40	Process Program Format Error.
0x41	Process Program Data Error (Verify Failed).

When the Host sends S7F4, the Equipment interprets ACKC7 as follows:

Table 4-24 S7F4 ACKC7 Interpretations

ACKC7	Description
0x00	Normal.
Other	Refusal. The upload operation fails.

## 4.87 S7F5 - Process Program Request

S7F5 W \* H<->E  
<A PPID> . \* Process Program ID

PPID should be in DOS 8.3 file name format and should include the extension RCP.

Request the other end of the link to send a specified Process Program from its library.

## 4.88 S7F6 - Process Program Data

S7F6 \* H<->E, Multiblock  
<L [2]  
<A PPID> \* Process Program ID  
<A PPBODY> \* PPBODY - Process Program Body

PPID should be in DOS 8.3 file name format and should include the extension RCP.

Send the requested Process Program.

If the specified PPID is not found in the library, S7F6 has the following special format:

S7F6 \* H<->E  
<L> .

If the Equipment receives S7F6 and cannot store the Process Program in its library, the CEID BadDownload 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).

## 4.89 S7F17 - Process Program Delete

```
S7F17 W                               * H->E
<L
  <A PPID>                             * Process Program ID
  . . .
  > .
```

PPID should be in DOS 8.3 file name format and should include the extension RCP.

The Host deletes one or more Process Programs from the Equipment library.

If S7F17 contains a zero-length List, the entire library is deleted.

## 4.90 S7F18 - Process Program Delete Acknowledge

```
S7F18                               * H<-E
<B [1] ACKC7> .                     * ACKC7 - Acknowledge Code
```

The Equipment acknowledges the Process Program delete.

Table 4-25 S7F18 ACKC7 Values

ACKC7	Description
0x00	Normal. All specified PPIDs have been deleted.
0x04	Error: At least one specified PPID was not found. However, correct PPIDs have been deleted from the Equipment Library

## 4.91 S7F19 - Process Program Directory Request

S7F19 W . \* H->E

PPIDs returned to host will be in DOS 8.3 file name format and will include the extension RCP.

The Host requests a directory of the Process Programs currently in the Equipment library.

## 4.92 S7F20 - Process Program Directory

S7F20 \* H<-E

```
<L
  <A PPID> * Process Program ID
  . . .
  > .
```

The Equipment sends a directory of its Process Program library. If the library is empty, the list will be zero length.

## 4.93 S9F1 - Unrecognized Device ID

S9F1 \* H<-E  
<B [10] MHEAD> . \* MHEAD - Header of bad msg

## 4.94 S9F3 - Unrecognized Stream

S9F3 \* H<-E  
<B [10] MHEAD> . \* MHEAD - Header of bad msg

## 4.95 S9F5 - Unrecognized Function

S9F5 \* H<-E  
<B [10] MHEAD> . \* MHEAD - Header of bad msg









## 5. SECS Scenarios

Unless otherwise noted in this section, the Communications State is "Communicating" and the Control state is either "On-Line/Local" or "On-Line/Remote".

### 5.1 Equipment Communications

#### 5.1.1 Equipment Establishes Communications

Assumption: Equipment's Communication state is "Enabled/Not Communicating".

Table 5-1 SECS Messages Equipment Establishes Communications

Step	SECS Message	Description
1.	H <- E S1F13 W	Equipment attempts to send Establish Communications Request.
2.		If the send is not successful, or if no reply is received from the Host, wait "ESTABLISHCOMMUNICATIONSTIMER" seconds, 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.

### 5.1.2 Host Establishes Communications

Assumption: Equipment's Communication state is either "Enabled/Not Communicating" or "Enabled/Communicating".

Table 5-2 SECS Messages Host Establishes Communications

Step	SECS Message	Description
1.	H -> E S1F13 W	Host sends Establish Communications Request.
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.

### 5.1.3 Simultaneous Establish Communications

Assumption: Equipment's Communication state is "Enabled/Not Communicating".

Table 5-3 SECS Messages 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.

## 5.1.4 Losing Connection, Re-Connecting

Table 5-4 SECS Messages 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. Spooling will become Active if enabled.
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.

## 5.1.5 Heartbeat

Table 5-5 SECS Messages 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.

## 5.2 Data Collection

### 5.2.1 Host Initializes Event Reporting

Table 5-6 SECS Messages 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 will make 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.
10.	H <- E S2F16	The Equipment acknowledges
11.	H -> E S2F37 W	Enable Event Reports. The Host enables reporting for desired Collection Events.
12.	H <- E S2F38	The Equipment acknowledges. From this point on, the Equipment will report events as they occur.

## 5.2.2 Equipment Reports Event

Table 5-7 SECS Messages 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 will be multi-block, the Equipment first sends this Inquire to request permission. If S6F11 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.

## 5.2.3 Equipment Reports Annotated Event

Table 5-8 SECS Messages 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 will be 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 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.

## 5.2.4 Host Initiates Trace

Table 5-9 SECS Messages 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, etc. 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.

## 5.2.5 Host Terminates Trace

Assumption: The Host started a Trace report as in the above scenario.

Table 5-10 SECS Messages 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.

## 5.2.6 Host Requests Status

Table 5-11 SECS Messages 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	The Equipment sends the Variable values.

## 5.2.7 Host Defines Limits

Table 5-12 SECS Messages Host Defines Limits

Step	SECS Message	Description
1.	H -> E S2F45 W	Host defines new variable limits attributes.
2.	H <- E S2F46	Equipment accepts new limits definitions, and responds with VLAACK = 0x00.

## 5.2.8 Host Queries Defined Limits

Table 5-13 SECS Messages Host Queries Defined Limits

Step	SECS Message	Description
1.	H -> E S2F47 W	Host requests listing of defined limits. This request may be for limits of individual variables listed in this message, or if this message is an empty list, all limits will be replied.
2.	H <- E S2F48	Equipment sends limits values as required.

## 5.2.9 Host Requests Report by CEID

Table 5-14 SECS Messages 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.

### 5.2.10 Host Requests Annotated Report by CEID

Table 5-15 SECS Messages 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.

### 5.2.11 Host Requests Report by RPTID

Table 5-16 SECS Messages 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.

### 5.2.12 Host Requests Annotated Report by RPTID

Table 5-17 SECS Messages 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.

### 5.2.13 Are You There

Table 5-18 SECS Messages 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.

## 5.2.14 Host Reads Equipment Constants

Table 5-19 SECS Messages 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.

## 5.2.15 Host Sets Equipment Constants

Table 5-20 SECS Messages 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.

## 5.3 Alarms

### 5.3.1 Equipment Reports Alarm

Table 5-21 SECS Messages 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.

### 5.3.2 Host Enables/Disables Alarms

Table 5-22 SECS Messages 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	If the W-bit in S5F3 is 1, the Equipment acknowledges.

### 5.3.3 Host Requests Alarms

Table 5-23 SECS Messages 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.

### 5.3.4 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 5-24 SECS Messages Alarm Report (GEM, Ver 3.1 Compatibility)

Step	SECS Message	Description
1.		The Equipment Constant ConfigAlarms is set to 2 for non-GEM compatibility. The Equipment recognizes that an alarm condition has gone "on" (i.e. 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" (i.e. 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.

### 5.3.5 Alarm Report (GEM, Ver 1.7 Compatibility)



**NOTE**

This scenario is provided only for compatibility with Host computers which support GEM, Ver 1.7.

Table 5-25 SECS Messages 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" (i.e. 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" (i.e. 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.

## 5.4 Control State

### 5.4.1 Host Sends On-Line Command

Assumption: Control State is "Host Off-Line". Variable GemControlState = 3.

Table 5-26 SECS Messages Host Sends On-Line Command

Step	SECS Message	Description
1.	H -> E S1F17 W	Host instructs the Equipment to go "On-Line".
2.	H <- E S1F18	Equipment responds to successful On-Line transition with ONLACK=0. Control state transits to either Local or Remonte as guided by EC GemOnlineSubstate.
3.	H <- E S6F11 W	The Equipment signals CEID GemControlState LOCAL or GemControlState REMOTE.
4.	H -> E S6F12	The Host acknowledges the event.

### 5.4.2 Host Sends Off-Line Command

Assumption: Control State is "On-Line".

Table 5-27 SECS Messages Host Sends Off-Line Command

Step	SECS Message	Description
1.	H -> E S1F15 W	Host instructs the Equipment to go "Off-Line".
2.	H <- E S1F16	Equipment Control State transitions to "Host Off-Line" (GemControlState = 3) and responds to primary. OFLACK = 0.

### 5.4.3 Host Sends Remote Command

Assumption: Control State is On-Line and Remote.

Table 5-28 SECS Messages Host Sends Remote Command

Step	SECS Message	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 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.

### 5.4.4 Equipment Rejects Host Command

Assumption: Control State is Local and On-Line

Table 5-29 SECS Messages Equipment Rejects Host Command

Step	SECS Message	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.

### 5.4.5 Go Remote, Operator-Initiated

Table 5-30 SECS Messages Go Remote, Operator-Initiated

Step	SECS Message	Description
1.		ControlState is Local. The Equipment operator switches the Equipment to Remote Control.
2.	H <- E S6F11 W	The Equipment signals CEID GemControlState REMOTE. Event Reports as appropriate.
3.	H -> E S6F12	The Host acknowledges the report.

### 5.4.6 Go Local, Operator-Initiated

Table 5-31 SECS Messages Go Local, Operator-Initiated

Step	SECS Message	Description
1.		ControlState is Remote. The Equipment operator switches the Equipment to Local Control.
2.	H <- E S6F11 W	The Equipment signals CEID GemControlState LOCAL. Event Reports as appropriate.
3.	H -> E S6F12	The Host acknowledges the report.

### 5.4.7 Go Local, Host-Initiated

Table 5-32 SECS Messages 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.
4.	H <- E S6F11 W	The Equipment signals CEID GemControlState LOCAL. Event Reports as appropriate.
5.	H -> E S6F12	The Host acknowledges the report.

## 5.4.8 Operator Command, Successful

Table 5-33 SECS Messages 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	The Equipment signals CEID LotStart. Event Reports as appropriate.
3.	H -> E S6F12	The Host acknowledges the report.

## 5.5 Process Program Management

### 5.5.1 Unformatted, Host-Initiated Download

Table 5-34 SECS Messages Unformatted, 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.

### 5.5.2 Unformatted, Host-Initiated Upload

Table 5-35 SECS Messages Unformatted, 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.

### 5.5.3 Unformatted, Equipment-Initiated Download

Table 5-36 SECS Messages Unformatted, 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 GemBadDownloadEvent. Event reports as appropriate.
4.	H -> E S6F12	The Host acknowledges the report.

### 5.5.4 Unformatted, Equipment-Initiated Upload

Table 5-37 SECS Messages Unformatted, 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.

### 5.5.5 Host Deletes Process Program

Table 5-38 SECS Messages 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.

### 5.5.6 Host Requests Directory

Table 5-39 SECS Messages 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.	H <- E S7F20	The Equipment replies with the list of PPIDs.

### 5.5.7 Operator Changes Process Program Library

Table 5-40 SECS Messages 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 GemPPChangeEvent. Event Reports as appropriate.
3.	H -> E S6F12	The Host acknowledges the report.

## 5.6 Equipment Terminal Communications

### 5.6.1 Host to Equipment, Single Line

Table 5-41 SECS Messages Host to Equipment, Single Line

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 <- E S10F4	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 S10Ack. Event Reports as appropriate.
6.	H -> E S6F12	The Host acknowledges the report.

### 5.6.2 Host to Equipment, Multi-Line

Table 5-42 SECS Messages Host to Equipment, Multi-Line

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 <- E S10F6	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.

## 5.6.3 Equipment Sends Text to Host

Table 5-43 SECS Messages 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.

## 5.7 Error Messages

### 5.7.1 Unrecognized Device ID

Table 5-44 SECS Messages 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".

### 5.7.2 Unrecognized Stream

Table 5-45 SECS Messages 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".

### 5.7.3 Unrecognized Function

Table 5-46 SECS Messages 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".

### 5.7.4 Illegal Data Format

Table 5-47 SECS Messages 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	

### 5.7.5 Data Too Long

Table 5-48 SECS Messages 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 some 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.

## 5.8 Clock

### 5.8.1 Host Sets Date and Time

Table 5-49 SECS Messages 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.

### 5.8.2 Host Requests Date and Time

Table 5-50 SECS Messages 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.

### 5.8.3 Equipment Requests Date and Time

Table 5-51 SECS Messages Equipment Requests Date and Time

Step	SECS Message	Description
1.	H <- E S2F17 W	Date and Time Request. The Equipment requests Date and Time from the Host.
2.	H -> E S2F18	The Host sends its Date and Time. The Equipment sets its Clock/Calendar hardware according to the contents of this message.

## 5.9 Spooling

For all of the spooling scenarios, spooling is meaningful only when Control State (CONTROLSTATE = 4 or 5) is "On-Line". When CONTROLSTATE is "Off-Line" (CONTROLSTATE = 1, 2, or 3), Equipment sends only stream one primaries and SnF0 secondaries, neither of which are eligible for spooling.

### 5.9.1 Host Enables Spooling of Messages

Table 5-52 SECS Messages Host Enables Spooling of Messages

Step	SECS Message	Description
1.	H -> E S2F43 W	<p>Host requests that messages be eligible for spooling using the following message:</p> <pre> S2F43 W          * H -&gt; E &lt;L   &lt;L [2]     &lt;U1 STRID&gt;   * Msg Stream   &lt;L     &lt;U1 FCNID&gt;  * Msg Fcn   ...   &gt;   ...   &gt; . </pre>
2.	H <- E S2F44	<p>The Equipment enables spooling for the messages requested by the Host. Response has RSPACK set to zero as follows:</p> <pre> S2F44 &lt;L [2]   &lt;B [1] 00&gt;   * RSPACK &lt;L&gt;   &gt; . </pre>

## 5.9.2 Messages Spooled and Transmitted

Assumption: Spool State is "Spool Inactive".

Table 5-53 SECS Messages Spooled and Transmitted

Step	SECS Message	Description
1.	H <- E SnFn	Equipment attempts to send any message to the Host.
2.		After failure to deliver message, the Equipment assumes that the link is down, and will start to spool all messages marked for spooling. The first message spooled is the collection event "SpoolActivated".
3.	H <- E S1F13 W	Equipment attempts to establish communications. This message will repeat every "EstablishCommunicationsTimer" seconds until successful.
4.	H -> E S1F14	Communications established. Communications state transits to "Communicating". If COMMACK is not zero, communications are not established and scenario proceeds at step 3.
5.	H -> E S6F23 W	Host requests that Equipment begin despooling messages. RSDC is zero in this message.
6.	H <- E S6F24	Equipment indicates that it will start to send spooled messages with return code RSDA = 0x00.
7.		Equipment will start to despool messages. This process is single-threaded. That is, when Equipment sends a de-spooled message with the W-bit set to "1", Equipment must be receive the Host reply before the Equipment will send next despooled message. If EC "MaxSpoolTransmit" is zero, all messages will be transmitted. If it is set to another number, this number of messages will be sent. The Equipment will await the next S6F23 to send the next messages.
8.	H <- E S6F11 W	The Equipment signals CEID GemSpoolActivated. This was the first message in the spool if it was not over-written.
9.	H -> E S6F12	Host acknowledges the start of the spool transfer.
10.		Equipment will de-spool messages one at a time from oldest to youngest until one of the following criteria is met: 1) All messages have been transmitted (go to step 13); or 2) When "MaxSpoolTransmit" is not zero, and the messages transmitted has reached MaxSpoolTransmit limit (go to step 11).  Some spooled messages (usually multi-block) consist of a SECS conversation of type "Inquire, Grant, Send, Acknowledge". During de-spool, if the Host rejects the Inquire, the multi-block message is removed from the spool and not transmitted. Despooling continues.

Step	SECS Message	Description
11.	H -> E S6F23 W	The Host requests that the Equipment continue de-spooling messages.
12.	H <- E S6F24	Equipment indicates that it will start to send spooled messages with return code RSDA = 0x00. Go to step 10.
13.	H <- E S6F11 W	Equipment notifies the Host that sending of spooled messages has been completed by sending CEID GemSpooling Deactivated.
14.	H -> E S6F12	Host acknowledges that the spool has been cleared and is deactivated.

### 5.9.3 Host Purges Spool

Assumption: spool state is "Spool Active"

*Table 5-54 SECS Messages Host Purges Spool*

Step	SECS Message	Description
1.	H -> E S6F23 W	Host sends S2F23, requesting that spool be discarded with RSDC set to one.
2.	H <- E S6F24	Equipment deletes spooled data and returns RSDA code zero.

## 6. Machine Variable Definitions

The following data variables are collected by the Host to support intelligent communications with the Equipment.

There are three categories of data variables listed here.

Status Variables

Data Variables

Equipment Constants

Each variable is given a header line with its associated ID value and its name. The storage type and the definition of the variable are listed below in smaller type. Variables listed in the header in capital letters are GEM standards. The others belong to FMW. Refer to *[RefGWGEMRef]* to find the detailed definitions of each of the GEM standard variables.

All variables are listed in alphabetical order.

### Status Variables

Table 6-1 Status Variables

Variable Name	ID	Storage Type	Description
ABORTLEVEL	21	U1	The abort level of the most recent ABORT command.
ALARMID	22	U4	This variable contains the ID of the last alarm to be reported to the Host.
ALARMSENABLED	23	List	This variable contains the list of the currently enabled alarms. See the reference for its structure.
ALARMSERIAL	26	U4	The sequence number( count ) of the most recent alarm change( going on or going off). This number starts at zero at power-up and increments by one for each following alarm transition.
ALARMSSET	24	List	This variable contains the list of alarms which are currently set.
ALARMSTATE	25	U1	The state of the current alarm. Non zero values indicate the alarm is set.
BoardCount	106	U4	The number of boards processed since the Power On event or since the last Process entry into the Running state.
CameraXFieldMils	700	U2	The size in mils of the X coordinate axis field of view seen by the camera.

Variable Name	ID	Storage Type	Description
CameraYFieldMils	701	U2	The size in mils of the Y coordinate axis field of view seen by the camera.
CLOCK	27	A[16]	The current value of the clock accurate to hundredths of a second. The format is: YYYYMMDDHHmmsscc.  This format is always the same, regardless of TIMEFORMAT.
CONTROLSTATE	28	U1	This is the value indicating the current Control State Machine state.  1 OffLine/Equipment OffLine 2 OffLine/Attempt OnLine 3 OffLine/Host OffLine 4 OnLine/Local 5 OnLine/Remote
DeviceID	115	A[12]	The SECS Device ID.
EventLogFilename	104	A[12]	The name of the file holding the event log.
EVENTSENABLED	30	List	This is the list of events which are enabled for reporting to the Host.
FluidFileName	300	A[12]	The name of the data file holding the dispensing fluid data. Fluid files have the ".flu" extension.
FluidLotNumber	301	A[20]	The lot number of the dispensing fluid.
FluidThawTime	302	A[14]	The time stamp, in the YYYYMMDDhhmmss format, at which the fluid was removed from the refrigerator and began to warm up.
MachineID	102	A[20]	The model number and serial number of the Asymtek machine. See Appendix A for the format.
MDLN	31	A[6]	This is the model designation for this machine.
PPDirectory	103	A[30]	The directory path of the Process Programs on the hard disk.
PPEXECNAME	32	A[0..8]	This is the currently selected Process Program ID number.
PREVIOUSCEID	33	U4	This is the latest event ID to be sent to the Host.
PREVIOUSCOMMAND	34	A[0..9]	The latest remote command received from the Host.

Variable Name	ID	Storage Type	Description
PREVIOUSCONTROLSTATE	35	U1	The previous Control State for the Equipment. The values are: 1 Off-Line / Equipment Off-Line 2 Off-Line /Attempt On-Line 3 Off-Line/Host Off-Line 4 On-Line Local, 5 On-Line Remote.
PREVIOUSPROCESSSTATE	36	U1	The previous Process State for the Equipment. The values for this state can be found in Appendix A.
PROCESSSTATE	37	U1	The current Process State for the Equipment. The values for this state can be found in Appendix A.
ProductionStartTime	105	A[14]	The time stamp at which the last production run began. See Appendix A for the format.
RunMode	110	U1	The specific type of runtime operation being conducted; dry run, production run, passthrough, or prototype test run.
SOFTREV	38	A[6]	The software revision number in ASCII code.
SoftwareID	101	A[20]	FMW name and version code.
SPOOLCOUNTACTUAL	48	U4	A count of the number of messages actually present on the spool disk, adjusted for any messages which have been overwritten or discarded.
SPOOLCOUNTTOTAL	49	U4	A count of the number of messages the equipment attempted to write to the spool disk. This number includes messages actually present on the spool disk, and any messages which may have been overwritten or discarded.
SPOOLFULLTIME	50	A[16]	The date and time at which the Spool file became full. The format is : YYYYMMDDhhmmsscc.
SPOOLLOADSUBSTATE	51	U4	The current state within the SPOOL LOAD super-state. 1 - Spool Active, 2 - Spool Inactive.
SPOOLSTARTTIME	52	A[16]	See description of CLOCK variable for this format.
SPOOLSTATE	53	U4	The current Spool State within the POWER ON super-state. 3 - Purge Spool 4 - Transmit Spool 5 - No Spool output.

Variable Name	ID	Storage Type	Description
SPOOLUNLOADSUBSTATE	54	U4	The current Spool State within the SPOOLUNLOAD super-state. 6 - Spool not full 7 - Spool full.
TempNeedleCurrent	207	U2	This is the temperature at the needle heater.
TempCurrent	205	List	The actual temperatures for each heater zone in deg. C. See Appendix A for this list format.
TempTimeOut	204	U2	The warning time limit in seconds for the heaters to heat the substrate to the desired temperature band.
TIME	39	A[12]	The current time accurate to the second. The format is YYMMDDhhmmss.  This format is always the same, regardless of TIMEFORMAT.

## Data Variables

Table 6-2 Data Variables

Variable Name	ID	Storage Type	Description
ALARMTEXT	1000	A[0..40]	The Alarm Text ( ALTX ) for the most recent alarm transition.
ALARMSEVERITYCODE	1001	B[1]	The Severity Code (the low order seven bits ) of the most recent alarm transition.
BoardCycleTime	114	U2	The number of seconds required to complete dispensing an entire board of substrates.
ConveyorSpeed	500	F4	The conveyor belt speed during board transfer between dispensing positions. The units are in./sec.
ECIDCHANGE	46	U4	The ID of the last event to be reported to the Host.
FlowRate	400	F4	The most current fluid flow rate in mg. per second.
FlowRateMax	402	F4	The maximum flow rate in mg./sec. allowed during this run.
FlowRateMin	401	F4	The minimum flow rate in mg./sec. allowed during this run.
NumFailedBoards	107	U4	The number of boards failed since PwrUp or since the Process State machine entered the Running state..
PPCHANGENAME	40	A[0..8]	The PPID of the Process Program most recently changed.
PPCHANGESTATUS	41	U1	The last action performed on the Process Program. 1 - Created, 2 - Changed, 3 - Deleted

## Equipment Constants

Table 6-3 Equipment Constants

Variable Name	ID	Storage Type	Description
CONFIGALARMS	1	U1	This EC determines the type of alarm message which is sent following an alarm. 0 - S5F1, 1 - S5F71, 2 - S5F73.
CONFIGCONNECT	2	U1	The EC which determines which message type the Equipment uses for Connection Request. 0 - S1F1, 1 - S1F65, 2 - S1F13
CONFIGEVENTS	3	U1	The EC which determines the choice of event report message. 0 - S6F9 or S6F3, 1 - S6F11 or S6F13.
CONFIGSPOOL	63	U4	This variable defines the current Spooling State: 0 Disabled, 1 Enabled.
DEVICENAME	29	A[20]	This is the name chosen by the Host in its references to the machine.
ESTABLISHCOMMUNICATIONSTIMER	6	U2	The delay in seconds between each attempt to reestablish communications.
INITCOMMSTATE	8	U1	Indicates whether Host communications should be enabled in the initial Communications State entered following Power Up. The two assignable values are: 1 - Enable Host Communications, 2 - Disable
INITCONTROLSTATE	9	U1	The initial Control State to be entered following Power Up. The two values are: 1 - Offline, 2 - Online.
HEARTBEAT	10	U2	The time in seconds between each S1F1( Are You There? ) Message sent to the Host. These messages are sent to confirm that the communications link between the Host and the Equipment is still valid during light message traffic.
MAXSPOOLTRANSMIT	46	U4	This is the largest number of messages that may be read from the Spool file during a single read. This limits the number of messages sent to the Host in response to the S6F23 message and helps to prevent clogging of the communications link during a link recovery after a long communications failure.
MeasFlowEnabled	601	BOOL	This Boolean flag indicates whether periodic flow rate calibration operations are enabled. 1 - Enabled, 0 - Disabled

Variable Name	ID	Storage Type	Description
OFFLINESUBSTATE	42	U1	This variable determines the Control State that the Equipment enters when it enters the OffLine super-state. The allowable values are: 1 - Equipment Offline, 2 - Attempt Online, 3 - Host Offline.
ONLINEFAILED	43	U1	This variable controls the entry state resulting from a failed attempt to go Online. The two values are: 1 - Equipment Offline, 3 - Host Offline.
ONLINESUBSTATE	44	U1	This variable controls the entry state resulting from a successful attempt to go Online. The two values are: 4 - Online - Local, 5 - Online - Remote.
OVERWRITESPOOL	62	BOOL	This variable enables overwriting the Spool when it becomes full.
PurgeEnabled	600	BOOL	The state of periodic purging operations. 1 - Enabled, 0 - Disabled
RPTYPE	17	BOOL	This variable enables the Equipment to send annotated reports to the Host on request.
TempNeedleTarget	206	U2	The needle temperature set point.
TempTooCool	202	List	The low temperature limit for acceptable control. The format for the list is found in Appendix A.
TempTooHot	201	List	The high temperature limit for acceptable control. The format for the list is found in Appendix A.
TempZoneSetpoints	200	List	The desired temperatures for each heater zone in deg. C. The format for the list is found in Appendix A.
VisionFailures	112	U4	The number of vision system failures counted by the FMW SW since the Power On event or latest Process Program change. The Host may clear this variable to measure failures during a run.
WBITS10	18	U1	This variable determines the default state of the W bit for all messages in stream 10 sent from the Equipment to the Host.
WBITS5	19	U1	This variable determines the default state of the W bit for all messages in stream 5 sent from the Equipment to the Host.
WBITS6	20	U1	This variable determines the default state of the W bit for all messages in stream 6 sent from the Equipment to the Host.



## 7. Host to Equipment Messages

The \*\* signifies FMW primary message handlers.

The \* signifies FMW secondary message handlers.

Table 7-1 Host to Equipment Messages

Primary	Reply	Cstate	Description	Notes
S1F1	S1F2	4,5	Are You There	None
S1F3	S1F4	4,5	Selected Status	Possible variable access
S1F11	S1F12	4,5	Status Variable Namelist Request	None
S1F13	S1F14	All	Connect Request	None
S1F15	S1F16*	4,5	Request Off-Line	None
S1F17	S1F18*	1,2,3	Request On-Line	None
S1F65	S1F66*	All	Connect Request	None, N
S2F13	S2F14	4,5	Equipment Constant Request	Possible variable access (only if non-ECs requested)
S2F15	S2F16*	4,5	New Equipment Constant Send	Possible EC validation routines. EC-Changed processing routine Disk write occurs
S2F17	S2F18*	4,5	Date and Time Request	None
S2F21	S2F22	5	Remote Command	Primary message handler N ( for Non GEM Hosts )
S2F23	S2F24	4,5	Trace Initialize	None
S2F25	S2F26	4,5	Loopback Diagnostic	None E
S2F27	S2F28*	5	Initiate Processing Request	Primary Message Handler N
S2F29**	S2F30	4,5	Equipment Constant Namelist Request	None E
S2F31	S2F32	4,5	Date and Time Send	None
S2F33	S2F34	4,5	Define Report	None. Disk write occurs

Primary	Reply	Cstate	Description	Notes
S2F35	S2F36	4,5	Link Event Report	None. Disk write occurs
S2F37	S2F38	4,5	Enable/Disable Event Report	None. Disk write occurs
S2F39	S2F40	4,5	Multi-Block Inquire/Grant	None
S2F41**	S2F42*	5	Remote Command with Parameters	Primary Message Handler
S2F43	S2F44	4,5	Reset Spooling Streams and Functions	None
S2F45	S2F46	4,5	Define Variable Limits Attributes	None
S2F47	S2F48	4,5	Variable Limit Attribute Request	None
S5F3	S5F4	4,5	Enable/Disable Alarm	None Disk write occurs
S5F5**	S5F6*	4,5	List Alarms	None
S5F7	S5F8*	4,5	List Enabled Alarms	None E
S6F15	S6F16	4,5	Request Event Report	Possible variable access routines.
S6F17	S6F18	4,5	Request Annotated Event Report	Possible variable access routines. E
S6F19	S6F20	4,5	Request Report	Possible variable access routines.
S6F21	S6F22	4,5	Request Annotated Report	Possible variable access routines. E
S6F23	S6F24	4,5	Request Spooled Data	None
S7F1	S7F2	4,5	Process Program Inquire/Grant	None
S7F3	S7F4	4,5	Unformatted Process Program Send	UFPP verify Disk write occurs
S7F5**	S7F6*	4,5	Unformatted Process Program Request	None Disk read occurs
S7F17**	S7F18	4,5	Process Program Delete	None Disk write occurs

Primary	Reply	Cstate	Description	Notes
S7F19	S7F20*	4,5	Process Program Directory	None Disk read occurs
S10F3**	S10F4	4,5	Terminal Display, Single	Terminal display
S10F5**	S10F6	4,5	Terminal Display, Multiple	Terminal display
S10F9**	S10F10	4,5	Broadcast	Terminal display E



## 8. Equipment to Host Messages

The \*\* signifies FMW primary message handlers.

The \* signifies FMW secondary message handlers.

Table 8-1 Equipment to Host Messages

Primary	Reply	Description	Notes
-- (any)	SnF0	Primary rejected while Off-Line	None
S1F1	S1F2	Are You There	None (heartbeat) GemGoAOnline (Attempt Online)
S1F13	S1F14	Connect Request	None
S1F65	S1F66	Connect Request	None N
S2F17	S2F18	Date and Time Request	GemHostTimeReq
S5F1	S5F2*	Alarm Report	GemNoteAlarmEvent N
S5F71	S5F72	Alarm Report Block Send	GemNoteAlarmEvent
S5F73	S7F74	Alarm Notification Send	GemNoteAlarmEvent
S6F1	S6F2	Trace Data Send	Possible variable access routines
S6F3	S6F4	Annotated Event Report Send	GemNoteEvent Possible variable access routines N
S6F5	S6F6	Multi-Block Data Send Inquire/Grant	None
S6F9	S6F10	Event Report Send	GemNoteEvent Possible variable access routines N
S6F11	S6F12	Event Report Send	GemNoteEvent Possible variable access routines

Primary	Reply	Description	Notes
S6F13	S6F14	Annotated Event Report Send	GemNoteEvent Possible variable access routines N
S7F1	S7F2	Process Program Inquire/Grant	GemUFPPSend or GEMFPPSend
S7F3	S7F4*	Unformatted Process Program Send	GemUFPPSend Disk Read occurs
S7F5	S7F6	Unformatted Process Program Request	GemUFPPLoad UFPPVerify Disk write occurs
S9F1	--	Error, Device ID	None
S9F3	--	Error, Stream	None
S9F5	--	Error, Function	None
S9F7	--	Error, Data	None
S9F9	--	Error, Transaction Timeout	None
S9F11	--	Error, Data Too Long	None
S9F13	--	Error, Conversation timeout	Sent by application only if required
S10F1	S10F2	Terminal Request	GemTerminalRequest
S13F1	S13F2	Send Data Set Send	GemDSNameSend

## 9. Appendix A -- Data Dictionary Variables

This is a summary explanation of the machine variables of section 7 sorted by ID number and containing details of the content of each variable.

The data formats are as follows:

A[nn]	ASCII text of length nn. Where two numbers are indicated, they specify a range of acceptable lengths.
Bool	A boolean flag indicating TRUE or FALSE.
F4,F8	A floating point number in four bytes.
I1,I2,I4,I8	Signed integers of the indicated length in bytes.
U1,U2,U4,U8	Unsigned integers of the indicated length in bytes.
List	An array of similar structures or primitive elements, as above. The list format is specified in the description field.

Table 9-1 Data Dictionary Variables

VID	Class	Format	Name and Description
1	EC	U1	CONFIGALARMS. An EC which controls which Alarm Report message this Equipment will send. 0 = S5F1 default 1 = S5F71 2 = S5F73
2	EC	U1	CONFIGCONNECT. An EC which controls which SECS message this Equipment will use for Connect Request. 0 = S1F1 1 = S1F65 2 = S1F13 default
3	EC	U1	CONFIGEVENTS. An EC which controls some aspects of the Event Reports sent by this Equipment. 0 = S6F9 or S6F3 1 = S6F11 or S6F13 default
5	EC	A[0..22]	DEVICENAME. The Host can change this EC to define a meaningful name for the equipment.

VID	Class	Format	Name and Description
6	EC	U2	ESTABLISHCOMMUNICATIONSTIMER. Time in seconds of how long the equipment will delay after an unsuccessful Connect Request before sending another. Valid values are 0-32000.
8	EC	U1	INITCOMMSTATE. Initial (power-up) Communications State. 0 = Disabled 1 = Enabled
9	EC	U1	INITCONTROLSTATE. Initial (power-up) control super-state. 1 = Off-Line 2 = On-Line
10	EC	U2	HEARTBEAT. The time in seconds that the Equipment will delay before sending S1F1 to test the link. Units are seconds. Valid values are 0-3200 (a setting of zero will disable the heartbeat).
17	EC	BOOL	RPTYPE. This EC controls some aspects of the format of Event Reports sent by this Equipment. FALSE = Normal Event Reports TRUE = Annotated Event Reports
18	EC	U1	WBITS10. An EC which controls the W-Bit setting used when sending S10F1. 0 = W-Bit not set 1 = W-Bit set
19	EC	U1	WBITS5. An EC which controls the W-Bit setting used when sending Alarm Reports (S5F1, S5F71, or S5F73). 0 = W-Bit not set 1 = W-Bit set
20	EC	U1	WBITS6. An EC which controls the W-Bit setting used when sending stream six messages (events, trace) 0 = W-Bit not set 1 = W-Bit set
21	SV	U1	ABORTLEVEL. The AbortLevel of the most recent ABORT command.
22	SV	U4	ALARMID. The ALID of the most recent Alarm transition.
23	SV	List	ALARMSENABLED. A list of all Alarms which are currently enabled. Format as follows: <L,n 1.<U4 ALID> ... n.<U4 ALID> >

VID	Class	Format	Name and Description
24	SV	List	ALARMSSET. A list of all Alarms which are currently in the SET (on) state. Format as follows: <L 1.<U4 ALID> ... n.<U4 ALID> >
25	SV	U1	ALARMSTATE. The Alarm State now in effect for the most recently transitioned alarm. 0 = Alarm transitioned OFF 1 = Alarm transitioned ON
26	SV	U4	ALARMSERIAL. The sequence number of the most recent alarm change (going on or going off). This number starts at zero at power-up and increments by one for each alarm transition which occurs.
27	SV	A[16]	CLOCK. The Equipment's current Date and Time in the following format: YYYYMMDDhhmmsscc. YYYY = year from 0000 to 9999 MM = month from 01 to 12 DD = day from 01 to 31 hh = hours from 00 to 23 mm = minutes from 00 to 59 ss = seconds from 00 to 59 cc = centiseconds from 00 to 99
28	SV	U4	CONTROLSTATE. The current Control State. 1 = Off-Line/Equipment Off-Line 2 = Off-Line/Attempt On-Line 3 = Off-Line/Host Off-Line 4 = On-Line/Local 5 = On-Line/Remote
30	SV	List	EVENTSENABLED. A list of all Events which are currently enabled. Format as follows: <L,n 1.<U4 CEID> ... n.<U4 CEID> >
31	SV	A[6]	MDLN. Model number. "FMW " The format is a one to six letter left justified acronym with blank fill on the right.
32	SV	A[0..12]	PPEXECNAME. The PPID of the currently selected Process Program. This PPID is the DOS 8.3 file name of the recipe. It includes the extension RCP.
33	SV	U4	PREVIOUSCEID. The CEID of the most recent Collection event which has occurred.

VID	Class	Format	Name and Description
34	SV	A[0..9]	PREVIOUSCOMMAND. The name of the most recent command.
35	SV	U1	PREVIOUSCONTROLSTATE. The Control State in effect before the most recent transition to the current Control State. 1 = Off-Line/Equipment Off-Line 2 = Off-Line/Attempt On-Line 3 = Off-Line/Host Off-Line 4 = On-Line/Local 5 = On-Line/Remote
36	SV	U1	PREVIOUSPROCESSSTATE. The Process State in effect before the most recent transition to the current Process State. 0 = Idle (Boot-up) 1 = Idle 2 = Running 3 = Paused 4 = Aborting 5 = Error
37	SV	U1	PROCESSSTATE. The current Process State. 0 = Idle (Boot-up) 1 = Idle 2 = Running 3 = Paused 4 = Aborting 5 = Error
38	SV	A[6]	SOFTREV. Software revision number with Major and minor parts. Example: "1.02 " The revision is in <u>M</u> ajor and <u>m</u> inor format with a period separating the parts.
39	SV	A[12]	TIME. The Equipment's current date and time in the following format: YYMMDDHHMMSS. YY = year from 00 to 99 MM = month from 01 to 12 DD = day from 01 to 31 hh = hours from 00 to 59 mm = minutes from 00 to 59 ss = seconds from 00 to 59

VID	Class	Format	Name and Description
40	DV	A[0..12]	PPCHANGENAME. PPID of the Process Program most recently created, changed, or deleted. This variable is the DOS 8.3 file name of the recipe changed. It includes the extension RCP.
41	DV	U1	PPCHANGESTATUS. The action (create, change, delete) taken on a Process Program 1 = Created 2 = Changed 3 = Deleted
42	EC	U1	OFFLINESUBSTATE. The default (power-up) offline substate of the Control State Model. 1 = Equipment Off-Line 2 = Attempt On-Line 3 = Host Off-Line
43	EC	U1	ONLINEFAILED. The default Control State transition when Attempt On-Line fails. 1 = Equipment Off-Line 2 = Host Off-Line
44	EC	U1	ONLINESUBSTATE. The default (power-up) online substate of the Control State Model. 4 = Local 5 = Remote
46	EC	U4	MAXSPOOLTRANSMIT. The maximum number of spooled messages the equipment will send each time the Host reads the spool. A setting of zero indicates that all spooled messages should be sent. Refer to the description of S6F23 in the "SECS Message Detail" section for further information.
48	SV	U4	SPOOLCOUNTACTUAL. A count of the number of messages actually present on the spool disk, adjusted for any messages which have been overwritten or otherwise discarded.
49	SV	U4	SPOOLCOUNTTOTAL. A count of the number of messages the equipment attempted to write to the spool disk. This number includes messages actually present on the spool disk, and also any messages which may have been overwritten or otherwise discarded.
50	SV	A[16]	SPOOLFULLTIME. The date and time at which the spool file became full. Format is: YYYYMMDDhhmmsscc. See description of CLOCK variable above for format details.

VID	Class	Format	Name and Description
51	SV	U4	SPOOLLOADSUBSTATE. The current state within the SPOOL LOAD super-state. 6 = Spool Not Full 7 = Spool Full
52	SV	A[16]	SPOOLSTARTTIME. The date and time at which the first message was written to the current spool file. Format is: YYYYMMDDhhmmsscc. See description of CLOCK variable above for format details.
53	SV	U4	SPOOLSTATE. The current spool state within the POWER ON super-state. 1 = Spool Active 2 = Spool Inactive
54	SV	U4	SPOOLUNLOADSUBSTATE. The current spool state within the SPOOL UNLOAD super-state. 3 = Purge Spool 4 = Transmit Spool 5 = No Spool Output
61	EC	BOOL	Internal to the Equipment. The Host should not access this variable.
62	EC	BOOL	OVERWRITESPOOL. This EC determines the action to be taken by the Equipment when the Spool file reaches its capacity. TRUE = Overwrite Spool FALSE = Do Not Overwrite Spool
63	EC	U4	CONFIGSPOOL. This EC determines whether spooling is enabled or disabled for this Equipment. 0 = Disabled 1 = Enabled
67	DV	U4	ECIDCHANGE. The VID of the Equipment Constant most recently changed by the Operator.
71	EC	U1	TIMEFORMAT. Determines whether STIME is sent in 12-byte or 16-byte format. 0 = 12-byte data format 1 = 16-byte data format
101	SV	A[20]	SoftwareID. The FMW SW name and version code. The software name format is: "FMW <u>M</u> . <u>mm</u> A - 7ltrSuf". The version is in <u>M</u> ajor and <u>m</u> inor format with a period separating the parts. Up to seven letters in an alphanumeric suffix follow the capitol A and hyphen in the name as shown. Spaces pack any remaining space to the right of the software ID.

VID	Class	Format	Name and Description
102	SV	A[30]	MachineID. The machines Model number and Serial number. The MachineID format is: "Model SNXXXXX ". The Model field is fixed at twenty characters. The Serial Number field is fixed at ten characters and contains up to five characters in the serial number. Spaces pack any remaining space to the right of both fields.
103	SV	A[30]	PPDirectory. The directory path holding the Process Programs. The format is: "vol:\dir1[\dir2[\dir3]]". Brackets indicate optional directory levels. The volume indicator is a single letter.
104	SV	A[12]	EventLogFilename. The name of the file holding the event records log. The DOS 8.3 file name format is used. There are up to eight characters reserved for the name and up to three characters for the extension. The name and extension are thus separated by a period: "name.ext". The file name is left justified within the character string and spaces pack any remaining space to the right of the file name.
105	SV	A[14]	ProductionStartTime. The time stamp when production started. The format is: YYYYMMDDhhmmss. Similar to the TIME(39) variable format. YYYY = year from 0000 to 9999 MM = month from 01 to 12 DD = day from 01 to 31 hh = hours from 00 to 59 mm = minutes from 00 to 59 ss = seconds from 00 to 59
106	SV	U4	BoardCount. The number of boards processed since the Power On event or since the last Process entry into the Running state.
107	DV	U4	NumFailedBoards. The number of boards failed during this run.
110	SV	U1	RunMode. The various types of run operations: 0 – Standby 1 – Production Dry 2 – Production Wet 3 – Passthrough 4 – Manual Wet 5 – Manual Dry 6 – Not Ready 7 – Invalid
112	EC	U4	VisionFailures. The count of vision system failures counted by the FMW SW since the Power On event or since the last change of Process Programs. The Host may clear this variable to measure failures during a run.
114	DV	U2	BoardCycleTime. The time in seconds needed to complete dispensing a board.
115	SV	A[12]	Device ID. The SECS Device ID.

VID	Class	Format	Name and Description
300	SV	A[12]	FluidFileName1. This is the name of the file containing the dispensing fluid data for Valve1. The file extension is ".flu". The DOS 8.3 file name format is used. There are up to eight characters reserved for the name and up to three characters for the extension. The name and extension are thus separated by a period: "name.ext". The file name is left justified within the character string, and spaces pack any remaining space to the right of the file name.
301	SV	A[20]	FluidLotNumber1. This is the dispensing fluid lot number recorded by the operator when the syringe was reloaded. The format is a twenty character ASCII alphanumeric string containing the lot number from the fluid syringe. The number is left justified and blanks fill the remaining space.
302	SV	A[14]	FluidThawTime1. This is the time stamp in the YYYYMMDDhhmmss format, at which the fluid was removed from the refrigerator and began to warm up. Similar to the TIME(39) variable format.  YYYY = year from 0000 to 9999 MM = month from 01 to 12 DD = day from 01 to 31 hh = hours from 00 to 59 mm = minutes from 00 to 59 ss = seconds from 00 to 59
303	SV	A[12]	FluidFileName2. This is the name of the file containing the dispensing fluid data for Valve 2. See FluidFileName1 for a detailed description.
304	SV	A[20]	FluidLotNumber2. This is the dispensing fluid lot number for Valve 2. See FluidLotNumber1 for a detailed description.
305	SV	A[14]	FluidThawTime2. This is the time stamp for the fluid for Valve 2. See FluidThawTime1 for a detailed description.
400	DV	F8	FlowRate1. The most current fluid flow rate for Valve 1 in mg./sec.
401	DV	F8	FlowRateMin1. The minimum flow rate for Valve 1 in mg./sec. allowed during this run.
402	DV	F8	FlowRateMax1. The maximum flow rate for Valve 1 in mg./sec. allowed during this run.
403	DV	F8	FlowRate2. The most current fluid flow rate for Valve 2 in mg/sec.
404	DV	F8	FlowRateMin2. The minimum flow rate for Valve 2 in mg./sec. allowed during this run.
405	DV	F8	FlowRateMax2. The maximum flow rate for Valve 2 in mg./sec. allowed during this run.
500	DV	F4	ConveyorSpeed1. This is the Conveyor 1 belt speed in in./sec. when it is moving a board to the next dispensing position.

VID	Class	Format	Name and Description
501	DV	F4	ConveyorSpeed2. This is the Conveyor 2 belt speed in in./sec. when it is moving a board to the next dispensing position.
600	EC	Bool	PurgeEnabled1. This Boolean flag indicates whether periodic purging operations are enabled for Valve 1.
601	EC	Bool	MeasFlowEnabled1. This Boolean flag indicates whether periodic flow rate calibration operations are enabled for Valve 1.
602	EC	Bool	PurgeEnabled2. This Boolean flag indicates whether periodic purging operations are enabled for Valve 2.
603	EC	Bool	MeasFlowEnabled2. This Boolean flag indicates whether periodic flow rate calibration operations are enabled for Valve 2.
700	SV	U2	CameraXFieldMils. The size in mils of the X coordinate axis field of view seen by the camera.
701	SV	U2	CameraYFieldMils. The size in mils of the Y coordinate axis field of view seen by the camera.
1000	DV	A[0-40]	ALARMTEXT. The Alarm Text (ALTX) for the most recently transitioned Alarm.
1001	DV	Bool	ALARMSEVERITYCODE. The Severity Code (ALCD low-order 7 bits) for the most recently transitioned alarm.
1002	DV	U2	FMWMostRecentError. The error code of the most recent FMW Error.



## 10. Appendix B -- Collection Events

The following collection events exist at the Equipment.

Table 10-1 CEID

CEID	Name	Description
Note: 1 - 65 are standard GEM		
1	ControlStateChange	This event is triggered when there is a change in control state.
2	ProcessStateChange	This event is triggered when there is a change in process state.
3	GemPPChangeEvent	This event is triggered when the operator creates, changes, or deletes a process program.
4	OperatorCommand	Sent whenever the operator attempts to control the machine while in the Online - REMOTE state.
5	AbortStarted	This event is triggered when an abort request was acknowledged and the abort process begins.
6	AbortCompleted	This event is triggered when the abort process is complete.
7	GemBadDownloadEvent	After the host downloads a recipe to the equipment upon the equipment's request, the equipment checks the recipe for accuracy. If the process program is invalid, this event is triggered.
8	GemControlStateLOCAL	Sent when Control State changes to LOCAL.
9	GemControlStateREMOTE	Sent when Control State changes to REMOTE.
14	StartCmd	Sent when the operator clicks the GO button from Teach Window or Run Window.
15	StopCmd	Sent when the operator clicks the STOP button from Teach Window or Run Window.
16	PauseCmd	Sent when the operator clicks the PAUSE button from Teach Window or Run Window and the equipment is in RUNNING state.
17	ResumeCmd	Sent when the operator clicks the PAUSE button from Teach Window or Run Window and the equipment is in PAUSED state.
18	AbortCmd	Sent when the operator clicks the ABORT button from Teach Window or Run Window.

CEID	Name	Description
20	EqConstChange	Sent to the Host when the operator changes an Equipment Constant.
21	S10Ack	Sent to acknowledge the reception of a Host text message.
22	GemEquipmentOFFLINE	Sent when Control State changes to Off-Line.
23	GemSpoolingActivated	Sent when Equipment attempts to send a primary message to the Host and gets a transmit failure while Spooling is enabled.
24	GemSpoolingDeactivated	Sent after the entire spool file has been read by the Host.
25	GemSpoolTransmitFailure	Send if a transmission failure occurs during the period in which the Host is reading the Spooling file.
<b>Board handling</b>		
2001	BoardAtDispenseLoc1	The board is at the dispensing location for Conveyor 1 and ready for dispensing.
2002	DispensingDone1	Dispensing is completed for Conveyor 1. The board is ready to leave the dispensing location.
2003	BoardAtDispenseLoc2	The board is at the dispensing location for Conveyor 2 and ready for dispensing.
2004	DispensingDone2	Dispensing is completed for Conveyor 2. The board is ready to leave the dispensing location.
<b>File handling</b>		
3001	NewProgramLoaded	A new program is loaded.
3002	NewFluidFileLoaded1	A new fluid parameter file for Valve 1 is loaded.
3003	NewHeaterFileLoaded	A new heater parameter file is loaded.
3004	FluidParametersModified1	The fluid parameters for Valve 1 have been changed by an operator.
3005	FluidParametersSaved1	The fluid parameters for Valve 1 have been saved onto the local mass storage.
3008	ConveyorCodeDownloaded1	A new conveyor control code has been downloaded into the Conveyor 1 controller.
3009	NewFluidFileLoaded2	A new fluid parameter file for Valve 2 is loaded by an operator.
3010	FluidParametersModified2	The fluid parameters for Valve 2 have been changed by an operator.
3011	FluidParametersSaved2	The fluid parameters for Valve 2 have been saved onto the local mass storage.

<b>CEID</b>	<b>Name</b>	<b>Description</b>
3012	ConveyorCodeDownloaded2	A new conveyor control code has been downloaded into the Conveyor 2 controller.
<b>Setup</b>		
4001	PromptedSetupStarted	An operator has initiated the Prompted Setup process.
4002	PromptedSetupCompleted	The Prompted Setup Process is completed.
4003	FindNeedleXYZ	An automatic needle XYZ calibration has been performed.
4004	ManualMeasureFlowRate1	A flow rate measurement for Valve 1 has been initiated by an operator.
4005	ManualPurgeNeedle1	A needle purging of Valve 1 has been initiated by an operator.
4006	OperationLevelChanged	The system operation level has been changed.
4007	PasswordsModified	The system operation level passwords have been modified.
4008	ManualMeasureFlowRate2	A flow rate measurement for Valve 2 has been initiated by an operator.
4009	ManualPurgeNeedle2	A needle purging of Valve 2 has been initiated by an operator.
<b>Run Time</b>		
5001	HeaterMonitorTimeout	The heaters at the dispensing location failed to reach the specified temperature range within the timeout period.
5002	HeaterMonitorSkipped	The operator has selected to skip the temperature monitoring and proceed to dispensing.
5003	HeaterMonitorAborted	The operator has selected to abort the temperature monitoring and aborted the run.
5004	PeriodicPurge1	A periodical purging of the needle for Valve 1 has been performed.
5005	PeriodicFlowrateMeasurement 1	A periodical flow rate measurement for Valve 1 has been performed.
5006	PotLifeWarning1	The pot life of the dispensing material for Valve 1 has reached a warning level.
5007	PotLifeExpire1	The pot life of the dispensing material for Valve 1 has expired.
5008	AwaitingRecoveryCommand	The system has queried the operator to recover the previous run.
5009	OperatorAckedTerminalMsg	The operator acknowledged a terminal message.

<b>CEID</b>	<b>Name</b>	<b>Description</b>
5010	PeriodicPurge2	A periodical purging of the needle for Valve 2 has been performed.
5011	PeriodicFlowrateMeasurement2	A periodical flow rate measurement for Valve 2 has been performed.
5012	PotLifeWarning2	The pot life of the dispensing material for Valve 2 has reached a warning level.
5013	PotLifeExpire2	The pot life of the dispensing material for Valve 2 has expired.
<b>Errors</b>		
9000	FMWError	An FMW Error has occurred. Use status variable FMWMostRecentError (1002) to retrieve the error code.
9001	FMWErrorCleared	An FMW Error has been acknowledged by the operator and the message cleared.

# 11. Appendix C -- Alarms

Table 11-1 Alarms

ALID	ALCD	ALTX	Description	ON CEID	OFF CEID
2	3	Temperature Low	Current Temp < setpoint - band	63	62
3	3	Temperature High	Current Temp > setpoint + band.	65	64
101	7	Interlock Open	The Equipment door is open creating a safety hazard.	101	100
103	15	Dispenser Empty	The adhesive dispenser needs refilling.	103	102
105	30	AC Power Loss	The Equipment is stopped and the computer will fail in a few minutes if power is not restored.	105	104

Since the number of alarms which FMW reports to SECS/GEM is constantly growing, each individual alarm will not be listed here. The alarm section of the GWGEM GCD file is automatically generated from the FMW source code using a custom software tool. The format for each alarm is described below:

- ALID** Alarm ID. This number is the same as the resource identification number used by FMW.
- ALCD** Alarm Severity Code. The low-order 7-bits of ALCD specifies the severity code. The high-order bit (bit-8) shows the current alarm state (1=SET, 0=CLEAR). Currently all FMW errors have a default severity code of 64.
- ALTX** Alarm Text. This is the actual string sent to the Host in the Alarm Report (S5F1) and is a truncated version (first 40 characters) of the resource item used by FMW.
- ON CEID** This is the Collection Event that is signaled when the alarm state changes from CLEAR to SET ("going-on"). For all of the FMW errors the event is **FMWError**.
- OFF CEID** This is the Collection Event that is signaled when the alarm state changes from SET to CLEAR ("going-off"). For all of the FMW errors the event is **FMWErrorCleared**.