



SEMI E5-92

SEMI EQUIPMENT COMMUNICATIONS STANDARD 2 MESSAGE CONTENT (SECS-II)

CONTENTS

1. Introduction

- 1.1 Intent
- 1.2 Overview
- 1.3 Application
- 1.4 Applicable Documents

2. Selected Definitions

3. The Message Transfer Protocol

- 3.1 Intent
- 3.2 Messages
- 3.3 Blocking Requirements
- 3.4 Message Header
- 3.5 The Transaction Timeout
- 3.6 Multiple Open Transaction

4. Streams and Functions

- 4.1 Streams
- 4.2 Functions
- 4.3 Stream and Function Allocation

5. Transaction and Conversation protocols

- 5.1 Intent
- 5.2 Transaction Definition
- 5.3 Transaction Level Requirements
- 5.4 Conversation Protocols

6. Data Structures

- 6.1 Intent
- 6.2 Item
- 6.3 List
- 6.4 Example Data Structures
- 6.5 Data Item Dictionary
- 6.6 Variable Item Dictionary

7. Message Detail

- 7.1 Intent
- 7.4 Stream 0 and Function 0
- 7.5 Stream 1 Equipment Status
 - S1,F0 Abort Transaction (S1F0)
 - S1,F1 Are You There Request (R)
 - S1,F2 On Line Data (D)
 - S1,F3 Selected Equipment Status Request (SSR)
 - S1,F4 Selected Equipment Status Data (SSD)
 - S1,F5 Formatted Status Request (FSR)
 - S1,F6 Formatted Status Data (FSD)
 - S1,F7 Fixed Form Request (FFR)
 - S1,F8 Fixed Form Data (FFD)
 - S1,F9 Material Transfer Status Request (TSR)
 - S1,F10 Material Transfer Status Data (TSD)
 - S1,F11 Status Variable NameList Request (SVNR)
 - S1,F12 Status Variable NameList Reply (SVNRR)
 - S1,F13 Establish Communications Request (CR)
 - S1,F14 Establish Communications Request Acknowledge (CRA)
- 7.6 Stream 2 Equipment Control and Diagnostics
 - S2,F0 Abort Transaction (S2F0)
 - S2,F1 Service Program Load Inquire (SPI)
 - S2,F2 Service Program Load Grant (SPG)
 - S2,F3 Service Program Send (SPS)
 - S2,F4 Service Program Send Acknowledge (SPA)
 - S2,F5 Service Program Load Request (SPR)
 - S2,F6 Service Program Load Data (SPD)
 - S2,F7 Service Program Run Send (CSS)
 - S2,F8 Service Program Run Acknowledge (CSA)
 - S2,F9 Service Program Results Request (SRR)
 - S2,F10 Service Program Results Data (SRD)
 - S2,F11 Service Program Directory Request (SDR)
 - S2,F12 Service Program Directory Data (SDD)
 - S2,F13 Equipment Constant Request (ECR)
 - S2,F14 Equipment Constant Data (ECD)
 - S2,F15 New Equipment Constant Send (ECS)
 - S2,F16 New Equipment Constant Acknowledge (ECA)
 - S2,F17 Date and Time Request (DTR)
 - S2,F18 Date and Time Data (DTD)



S2,F19 Reset/Initialize Send (RIS)
S2,F20 Reset Acknowledge (RIA)
S2,F21 Remote Command Send (RCS)
S2,F22 Remote Command Acknowledge (RCA)
S2,F23 Trace Initialize Send (TIS)
S2,F24 Trace Initialize Acknowledge (TIA)
S2,F25 Loopback Diagnostic Request (LDR)
S2,F26 Loopback Diagnostic Data (LDD)
S2,F27 Initiate Processing Request (IPR)
S2,F28 Initiate Processing Acknowledge (IPA)
S2,F29 Equipment Constant Namelist Request (ECNR)
S2,F30 Equipment Constant Namelist (ECN)
S2,F31 Date and Time Set Request (DTS)
S2,F32 Date and Time Set Acknowledge (DTA)
S2,F33 Define Report (DR)
S2,F34 Define Report Acknowledge (DRA)
S2,F35 Link Report/Event (LER)
S2,F36 Link Report/Event Acknowledge (LERA)
S2,F37 Enable/Disable Event Report (EDER)
S2,F38 Enable/Disable Event Report Acknowledge (EERA)
S2,F39 Multi-block Inquire (MBI)
S2,F40 Multi-block Grant (MBG)
S2,F41 Host Command Send (HCS)
S2,F42 Host Command Acknowledge (HCA)
S2,F43 Reset Spooled Data Acknowledgement Send (RSDAS)
S2,F44 Reset Spooling Acknowledge (RSA)
S2,F45 Define Variable Limit Attributes (DVLA)
S2,F46 Variable Limit Attribute Acknowledge (VLAA)
S2,F47 Variable Limit Attribute Request (VLAR)
S2,F48 Variable Limit Attribute Send (VLAS)

7.7 Stream 3 Material Status

S3,F0 Abort Transaction (S3F0)
S3,F1 Material Status Request (MSR)
S3,F2 Material Status Data (MSD)
S3,F3 Time to Completion Request (TCR)
S3,F4 Time to Completion Data (TCD)
S3,F5 Material Found Send (MFS)
S3,F6 Material Found Acknowledge (MFA)
S3,F7 Material Lost Send (MLS)
S3,F8 Material Lost Acknowledge (MLA)
S3,F9 Material ID Equate Send (IES)
S3,F10 Material ID Equate Acknowledge (IEA)
S3,F11 Material ID Request (MIDR)

S3,F12 Material ID Request Acknowledge (MIRA)
S3,F13 Material ID Send
S3,F14 Material ID Acknowledge (IEA)

7.8 Stream 4 Material Control

S4,F0 Abort Transaction (S4F0)
S4,F1 Ready to Send Material (RSN)
S4,F2 Ready to Send Acknowledge (RSA)
S4,F3 Send Material (SMN)
S4,F4 Not Used
S4,F5 Handshake Complete (HCN)
S4,F6 Not Used
S4,F7 Not Ready to Send (ABN)
S4,F8 Not Used
S4,F9 Stuck in Sender (SSN)
S4,F10 Not Used
S4,F11 Stuck in Receiver (SRN)
S4,F12 Not Used
S4,F13 Send Incomplete Timeout (SIN)
S4,F14 Not Used
S4,F15 Material Received (MRN)
S4,F16 Not Used
S4,F17 Request to Receive (RTR)
S4,F18 Request to Receive Acknowledge (RRA)

7.9 Stream 5 Exception Reporting

S5,F0 Abort Transaction (S5F0)
S5,F1 Alarm Report Send (ARS)
S5,F2 Alarm Report Acknowledge (ARA)
S5,F3 Enable/Disable Alarm Send (EAS)
S5,F4 Enable/Disable Alarm Acknowledge (FAA)
S5,F5 List Alarms Request (LAR)
S5,F6 List Alarm Data (LAD)
S5,F7 List Enabled Alarm Request
S5,F8 List Enabled Alarm Data

7.10 Stream 6 Data Collection

S6,F0 Abort Transaction (S6F0)
S6,F1 Trace Data Send (TDS)
S6,F2 Trace Data Acknowledge (TDA)
S6,F3 Discrete Variable Data Send (DVS)
S6,F4 Discrete Variable Data Acknowledge (DVA)
S6,F5 Multi-block Data Send Inquire (MBI)
S6,F6 Multi-block Grant (MBG)
S6,F7 Data Transfer Request (DDR)
S6,F8 Data Transfer Data (DDD)
S6,F9 Formatted Variable Send (FVS)
S6,F10 Formatted Variable Acknowledge (FVA)
S6,F11 Event Report Send (ERS)
S6,F12 Event Report Acknowledge (ERA)



S6,F13 Annotated Event Report Send (AERS)
S6,F14 Annotated Event Report Acknowledge (AERA)
S6,F15 Event Report Request (ERR)
S6,F16 Event Report Data (ERD)
S6,F17 Annotated Event Report Request (AERR)
S6,F18 Annotated Event Report Data (AERD)
S6,F19 Individual Report Request (IRR)
S6,F20 Individual Report Data (IRD)
S6,F21 Annotated Individual Report (AIR)
S6,F22 Annotated Individual Report Data (AIRD)
S6,F23 Request Spooled Data (RSD)
S6,F24 Request Spooled Data Acknowledgement Send (RSDAS)

7.11 Stream 7 Process Program Management

S7,F0 Abort Transaction (S7F0)
S7,F1 Process Program Load Inquire (PPI)
S7,F2 Process Program Load Grant (POG)
S7,F3 Process Program Send (PPS)
S7,F4 Process Program Acknowledge (PPA)
S7,F5 Process Program Request (PPR)
S7,F6 Process Program Data (PPD)
S7,F7 Process Program ID Request (PIR)
S7,F8 Process Program ID Data (PID)
S7,F9 M/P M Request (MMR)
S7,F10 M/P M Data (MMD)
S7,F11 M/P M Update Send (UMS)
S7,F12 M/P M Update Acknowledge (UMA)
S7,F13 Delete M/P M Entry Send (DES)
S7,F14 Delete M/P M Entry Acknowledge (DEA)
S7,F15 Matrix Mode Select Send (MMS)
S7,F16 Matrix Mode Select Acknowledge (MMA)
S7,F17 Delete Process Program Send (DPS)
S7,F18 Delete Process Program Acknowledge (DPA)
S7,F19 Current EPPD Request (RER)
S7,F20 Current EPPD Data (RED)
S7,F21 Equipment Process Capabilities Request (PCR)
S7,F22 Equipment Process Capabilities Data (PCD)
S7,F23 Formatted Process Program Send (FPS)
S7,F24 Formatted Process Program Acknowledge (FPA)
S7,F25 Formatted Process Program Request (FPR)
S7,F26 Formatted Process Program Data (FPD)
S7,F27 Process Program Verification Send (PVS)
S7,F28 Process Program Verification Acknowledge (PVA)

S7,F29 Process program Verification Inquire (PVI)
S7,F30 Process Program Verification Grant (PVG)
S7,F31 Verification Request Send (VRS)
S7,F32 Verification Request Acknowledge (VRA)
S7,F33 Process Program Available Request (PAR)
S7,F34 Process Program Availability Data (PAD)
S7,F35 Process Program for MID Request (PPMR)
S7,F36 Process Program for MID Data (PPMD)

7.12 Stream 8 Control Program Transfer

S8,F0 Abort Transaction (S8F0)
S8,F1 Boot Program Request (BPR)
S8,F2 Boot Program Data (BPD)
S8,F3 Executive Program Request (EPR)
S8,F4 Executive Program Data (EPD)

7.13 Stream 9 System Errors

S9,F0 Abort Transaction (S9F0)
S9,F1 Unrecognized Device ID (UDN)
S9,F2 Not Used
S9,F3 Unrecognized Stream Type (USN)
S9,F4 Not Used
S9,F5 Unrecognized Function Type (UFN)
S9,F6 Not Used
S9,F7 Illegal Data (IDN)
S9,F8 Not Used
S9,F9 Transaction Timer Timeout (TTN)
S9,F10 Not Used
S9,F11 Data Too Long (DLN)
S9,F12 Not Used
S9,F13 Conversation Timeout (CTN)
S9,F14 Not Used

7.14 Stream 10 Terminal Services

S10,F0 Abort Transaction (S10F0)
S10,F1 Terminal Request (TRN)
S10,F2 Terminal Request Acknowledge (TRA)
S10,F3 Terminal Display, Single (VTN)
S10,F4 Terminal Display, Single Acknowledge (VTA)
S10,F5 Terminal Display, Multi-block (VTN)
S10,F6 Terminal Display, Multi-block Acknowledge (VMA)
S10,F7 Multi-block Not Allowed (MNN)
S10,F8 Not Used
S10,F9 Broadcast (BCN)
S10,F10 Broadcast Acknowledge (BCA)

7.15 Stream 11 Host File Services (Deleted)

7.16 Stream 12 Wafer Mapping

S12,F0 Abort Transaction (S12F0)



S12,F1 Map Set-Up Data Send (MSDS)
S12,F2 Map Set-up Data Acknowledge(MSDA)
S12,F3 Map Set-up Data Request (MSDR)
S12,F4 Map Set-up Data (MSD)
S12,F5 Map Transmit Inquire (MAPTI)
S12,F6 Map Transmit Grant (MAPTG)
S12,F7 Map Data Send Type 1 (MDSI)
S12,F8 Map Data Acknowledge Type 1 (MDAI)
S12,F9 Map Data Send Type 2 (MDS2)
S12,F10 Map Data Acknowledge Type 2 (MDA2)
S12,F11 Map Data Send Type 3 (MDS3)
S12,F12 Map Data Acknowledge 3 (MDA3)
S12,F13 Map Data Request Type 1 (MDR1)
S12,F14 Map Data Type 1 (MD1)
S12,F15 Map Data Request Type 2 (MDR2)
S12,F16 Map Data Type 2 (MD2)
S12,F17 Map Data Request Type 3 (MDR3)
S12,F18 Map Data Type 3 (MD3)
S12,F19 Map Error Report Send (MERS)
S12,F20 Not Used

7.17 Stream 13 Unformatted Data Set Transfers

S13,F0 Abort Transaction (S10F0)
S13,F1 Send Data Set Send (DSSS)
S13,F2 Send Data Set Acknowledge (DSSA)
S13,F3 Open Data Set Request (DSOR)
S13,F4 Open Data Set Data (DSOD)
S13,F5 Read Data Set Request (DSRR)
S13,F6 Read Data Set Data (DSRD)

S13F7 Close Data Set Send (DSCS)
S13,F8 Close Data Set Acknowledge (DSCA)
S13,F9 Reset Data Set Send (DSRS)
S13,F10 Reset Data Set Acknowledge (DSRA)

8.Message Documentation

8.1 Intent

8.2 Standard Form SECS-II Document

9.Units of Measure

9.1 Intent

9.2 Units Symbol

9.3 Compliance

9.4 SECS-II Units of Measure Identifiers

Application Notes

- A1. The General Node Transaction Protocol
- A2. Some Suggested Message Usage
- A3. Notes on SECS-II Data Transfers
- A4. Process Programs
- A5. Suggested Baseline SECS Equipment Implementation
- A6. Examples of Limits Monitoring
- A7. State Model Methodology



SEMI E5-92

SEMI EQUIPMENT COMMUNICATIONS STANDARD 2 MESSAGE CONTENT (SECS-II)

1. Introduction

1.1 *Intent* - The SEMI Equipment Communications Standard Part 2 (SECS-II) defines the details of the interpretation of messages exchanged between intelligent equipment and a host. This specification has been developed in cooperation with the Japan Electronic Industry Development Association Committee 12 on Equipment Communications.

1.1.1 It is the intent of this standard to be fully compatible with SEMI Equipment Communications Standard E4 (SECS-I). It is also the intent to allow for compatibility with alternative message transfer protocols. The details of the message transfer protocol requirements are contained in Section 3.

1.1.2 It is the intent of this standard to define messages to such a level of detail that some consistent host software may be constructed with only minimal knowledge of individual equipment. The equipment, in turn, may be constructed with only minimal knowledge of the host.

1.1.3 The messages defined in the standard support the most typical activities required for IC manufacturing. The standard also provides for the definition of equipment-specific messages to support those activities not covered by the standard messages. While certain activities can be handled by common software in the host, it is expected that equipment-specific host software may be required to support the full capabilities of the equipment.

1.2 *Overview* - SECS-II gives form and meaning to messages exchanged between equipment and host using a message transfer protocol, such as SECS-I.

1.2.1 SECS-II defines the method of conveying information between equipment and host in the form of messages. These messages are organized into categories of activities, called streams, which contain specific messages, called functions. A request for information and the corresponding data transmission is an example of such an activity.

1.2.2 SECS-II defines the structure of messages into entities called items and lists of items. This structure

allows for a self-describing data format to guarantee proper interpretation of the message.

1.2.3 The interchange of messages is governed by a set of rules for handling messages called the transaction protocol. The transaction protocol places some minimum requirements on any SECS-II implementation.

1.3 *Application* - SECS-II applies to equipment and hosts used in the manufacturing of semiconductor devices. Examples of the activities supported by the standard are: transfer of control programs, material movement information, measurement data, summarized test data, and alarms.

1.3.1 The minimum compliance to this standard involves meeting the few constraints outlined in Section 5. It is expected that a given piece of equipment will require only a subset of the functions described in this standard. The number of functions and the selection of functions will depend upon the equipment capabilities and requirements. For each piece of equipment, the exact format for each function provided must be documented according to the form outlined in Section 7.

1.3.2 It is assumed that the equipment will define the messages used in a particular implementation of SECS-II. It is assumed the host will support equipment implementation.

1.4 *Applicable Documents*

1.4.1 ANSI¹

X3.4-1977 Code for Information
Interchange (ASCII)

1.4.2 IEEE²

754 Standard for Binary Floating Point
Arithmetic

1.4.3 SEMI Specifications³

SEMI E4 SEMI Equipment Communications
Standard 1 -- Message Transfer (SECS-I)

SEMI E6 SEMI Facilities Interface Specification
Format

1 ANSI, 1430 Broadway, New York, NY 10018

2 IEEE Service Center, 445 Hoe Lane, Piscataway, NJ 08854

3 SEMI, 805 E. Middlefield Road, Mountain View, CA 94043



1.4.4 The Japan Electronic Industry Development Association (JEIDA) has requested that the SECS-II standard incorporate support for the JIS-8 codes for data exchange. This code would allow support for katakana characters in Japanese implementations of SECS-II.

JIS 8-bit Coded Character Set (JIS-6226) for information Interchange, Japanese Industrial Standards.

2. Selected Definitions

2.1 The following brief definitions refer to sections providing further information.

block - a physical division of a message used by the message transfer protocol. (see 3.3)

conversation - a sequence of related messages. (see 5.4)

conversation timeout - an indication that a conversation has not completed properly. (see 5.4.1)

device ID - a number between 0 and 32767 used in identifying the particular piece of equipment communicating with a host. (see 3.4.1)

equipment - the intelligent system which communicates with a host.

function - a specific message for a specific activity within a stream. (see 4.2)

host - the intelligent system which communicates with the equipment.

interpreter - the system that interprets a primary message and generates a reply when requested. (see 3.2)

item - a data element within a message. (see 6.2)

item format - a code used to identify the data type of an item. (see 4.2)

list - a group of items. (see 6.3)

message - a complete unit of communication. (see 3.2)

message header - information about the message passed by the message transfer protocol. (see 3.4)

multi-block message - a message sent in more than one block by the message transfer protocol. (see 3.3.2)

originator - the creator of a primary message. (see 3.2)

packet - a physical division of a message used by the message transfer protocol. (see 3.3)

primary message - an odd numbered message. Also, the first message of a transaction. (see 3.2, 4.2)

reply - the particular secondary message corresponding to a primary message. (see 3.2, 4.4)

secondary message - an even-numbered message. Also the second message of a transaction. (see 3.2, 4.2)

single-block message - a message sent in one block by the message transfer protocol. (see 3.3.1)

stream - a category of messages. (see 4.1)

transaction - a primary message and its associated secondary message, if any. (see 5.2)

transaction timeout - an indication from the message transfer protocol that a transaction has not completed properly. (see 3.5)

3. The Message Transfer Protocol

3.1 *Intent* - SECS-II is fully compatible with the message transfer protocol defined by SECS-I. It is the intent of this standard to allow for compatibility with alternative message transfer protocols. The purpose of this section is to define the requirements of the interaction between an application using SECS-II and the message transfer protocol. The methods used to implement these requirements are not covered as a part of this standard. The terms used in this standard are those used by SECS-I. Equivalent terms may be different for other message transfer protocols.

3.2 *Messages* - The message transfer protocol is used to send messages between equipment and host. The message transfer protocol must be capable of sending a primary message, indicating whether a reply is requested; and, if a reply is requested, it must be capable of associating the corresponding secondary message or reply message with the original primary message. The term originator will refer to the creator of the original primary message. The term interpreter will refer to the entity that interprets the primary message at its destination and generates a reply when requested.

3.3 - *Blocking Requirements* - The message transfer protocol must support the following SECS-II message blocking requirements.

3.3.1 *Single-block messages* - SECS-II requires that certain messages be sent in a single block or single packet by the message transfer protocol. Those messages defined in this standard as single-block SECS-II messages must be sent in a single-block or packet. The method used by the application software to tell the message transfer protocol that a particular message must be sent as a single block is not covered as part of this standard. For compatibility with SECS-I, the maximum length allowed for a single-block SECS-II message is 244 bytes. The minimum requirement for the message transfer protocol is to be able to send single-block SECS-II messages.



3.3.2 Multi-Block Messages - For compatibility with SECS-I, SECS-II messages that are longer than 244 bytes are referred to as multi-block messages. Also, certain SECS-II messages are allowed to be multi-block messages even if they otherwise meet the single-block length requirements. Certain older implementations may impose application-specific requirements on block sizes for certain incoming messages. Beginning with the 1988 revision of the standard, new applications may not impose application-specific requirements on incoming block sizes. Applications implemented before 1988 may impose such requirements.

3.4 Message Header - The message transfer protocol must provide the following information, called the message header, with every message. Only the content of the message header is defined by this standard. The exact format of the message header passed between the application and the message transfer protocol is not covered as part of this standard.

NOTE: In SECS-I, this information is contained in the 10-byte header of each block of a message.

3.4.1 Device ID - The message transfer protocol must be capable of identifying the device ID (0-32767) which indicates the source or destination of a message.

3.4.2 Stream and Function - The message transfer protocol must be capable of identifying to SECS-II a minimum 15-bit message identification code. In SECS-II, messages are identified by a stream code (0-127, 7 bits) and a function code (0-255, 8 bits). Each combination of stream and function represents a distinct message identification.

3.4.3 Reply Requested - The message transfer protocol must be capable of identifying whether a reply is requested to a primary message.

3.5 The Transaction Timeout - It is presumed that the message transfer protocol will notify SECS-II in the event of failure to receive an expected reply message within a specified transaction timeout period.

NOTE: In SECS-I, a transaction timeout occurs if either the reply timeout (T3) is exceeded before the first block of a reply message is received or if the inter-block timeout (T4) is exceeded before an expected block of a multi-block message is received.

3.6 Multiple Open Transactions - This standard allows, but does not require, the support of more than one concurrent open transaction.

4. Streams and Functions

4.1 Streams - A stream is a category of messages intended to support similar or related activities.

4.2 Functions - A function is a specific message for a specific activity within a stream. All the functions used in SECS-II will follow a numbering convention corresponding to primary and secondary message pairs. All primary messages will be given an odd-numbered function code. The reply message function code is determined by adding one to the primary message function code. The even-numbered function following a primary message which requests no reply is reserved and is not to be used. Function code 0 is reserved in all streams for aborting transactions as described in Section 7.4.

4.3 Stream and Function Allocation - Some of the stream and function code combinations are reserved for this standard while others are available for user definition. The stream and function codes reserved for this standard are as follows:

In Stream 0, Functions 0-255.

In Streams 1-63, Functions 0-63.

In Streams 64-127, Function 0.

The stream and function codes available for use definition are as follows:

In Streams 1-63, Functions 64-255.

In Streams 64-127, Functions 1-255.

4.3.1 The stream and function code assignment can also be represented by the diagram shown in Figure 1.

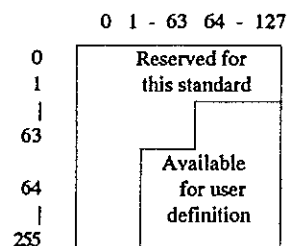


Figure 1

Stream and Function Allocation

4.3.2 The reserved codes assigned by this standard are listed in Section 7. It is recognized that there will be user needs beyond the specific definitions given in this standard. In these situations, the streams and functions reserved for user definition should be used subject to the guidelines for minimum compliance outlined in Section 5.



5. Transaction and Conversation Protocols

5.1 Intent - For an implementation to be in compliance with SECS-II it must meet the minimum transaction requirements outlined in this section. The conversation protocols serve to further define the use and interaction between transactions.

5.2 Transaction Definition - A transaction forms the basis for all information exchanges in SECS-II. A transaction consists of either a primary message for which no reply is requested, or a primary message which requests a reply together with its corresponding secondary message. Secondary messages cannot request a reply.

5.3 Transaction Level Requirements - The following are the requirements to comply with the SECS-II protocol at the transaction level:

1. Respond to S1,F1 with S1,F2 as described in Section 7.5.
2. For any received message that cannot be processed by the equipment, send the appropriate error message on Stream 9. As described in Section 7.13, S9,F1, F3, F5, F7, or F11 are possible.
3. Format any other supported messages according to Section 7.
4. Upon detection of a transaction timeout at the equipment, send S9,F9 to the host.
5. Upon receipt of function 0 as a reply to a primary message, terminate the related transaction. No error message should be sent to the host by the equipment.

5.4 Conversation Protocols - A conversation is a series of one or more related transactions used to complete a specific task. A conversation should include all transactions necessary to accomplish the task and leave both the originator and interpreter free of resource commitments at its conclusion.

5.4.1 Conversation Timeout - A conversation timeout is used to indicate that a conversation has not completed properly. A conversation timeout is application-dependent, and the methods used for detecting conversation timeouts are not covered as part of this standard. A conversation timeout will terminate further action on the conversation, and will allow for the clearing of any committed resources. Upon detection of a conversation timeout at the equipment, S9,F13 should be sent to the host.

5.4.2 Types of Conversations - There are seven types of conversations which characterize all information exchanges in SECS-II:

1. A primary message with no reply is the simplest conversation. This message must be a single-block SEC-II message. The originator must assume that the interpreter responds to the message. This conversation is used where the originator can do nothing if the message is rejected.
2. If the interpreter has data that the originator wants, the data are requested with a primary message and the data returned to the originator as a reply message. It is assumed that the originator requesting the data is prepared to receive the amount of data returned. This is the request/data conversation.
3. If the originator wishes to send data in a single-block SECS-II message to the interpreter, then the originator sends the data and expects an acknowledgment from the interpreter. This is the send/acknowledge conversation.
4. If the originator has a multi-block SECS-II message to send for a particular exchange, then the originator must receive permission from the interpreter prior to sending the data. The first transaction requests permission to send, and the interpreter either grants or denies permission. If permission is granted, the originator sends the data and the interpreter replies appropriately. This is the inquire/grant/send/ acknowledge conversation. Between the inquire and the send, the interpreter may commit some resources in preparation for the data. Consequently, a conversation timeout may be set by the interpreter at a time dependent upon the application, at which time the interpreter will free its resources and send an S9,F13 error message to the originator. Note that under the definition of S9,F13 in this standard, only the equipment should generate an error message to the host under these conditions.
5. There is a conversation related to the transfer of unformatted data sets between equipment and host. This conversation is described in detail in Stream 13. (see Section 7.17)
6. There is a conversation related to the handling of material between equipment. This conversation is described in detail in Stream 4. (see Section 7.8)
7. The originator may request information from the interpreter which requires some time to obtain; e.g. operator input is required. The first transaction requests the information and the interpreter responds in 1 of 3 ways: 1) the



information is returned, 2) the interpreter indicates that the information cannot or will not be obtained, or 3) the interpreter indicates that the information will be obtained and returned in a subsequent transaction, as specified for this conversation. For case number 3, the interpreter will initiate the subsequent transaction when the information is available.

Case 3 is the request/acknowledge/send/acknowledge transaction.

The originator of the request/acknowledge/send/acknowledge conversation may commit some resources in anticipation of the send/acknowledge transaction. Consequently, a conversation timeout may be set by the originator at a time dependent on the application. On timeout, the originator will free its resources and restart the conversation with the 'request', or send an S9 F13 error message. Note that under the definition of S9 F13 in this standard, only the equipment should generate an error message to the host under these conditions.

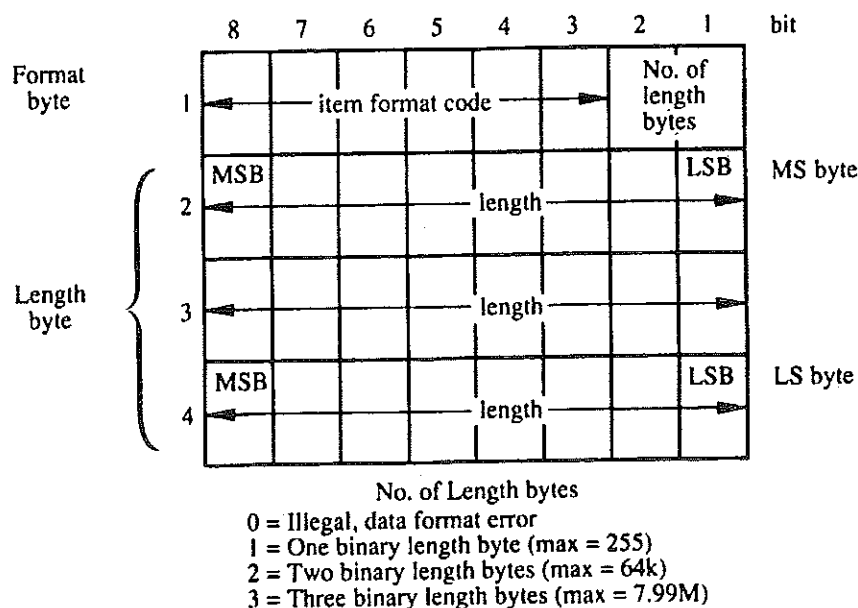
5.4.3 The key words, request, data, send, acknowledge, inquire, and grant are used in the function names as an aid to understanding the relationship between the messages and the conversation. Single message transactions do not use these words.

6. Data Structures

6.1 *Intent* - All information transmitted according to this standard will be formatted using two data structures, items and lists. These data structures define the logical divisions of the message, as distinct from the physical divisions of the message transfer protocol. They are intended to provide a self-describing internal structure to messages passed between equipment and host.

6.2 *Item* - An item is an information packet which has a length and format defined by the first 2, 3, or 4 bytes of the item. These first bytes are called the item header (IH). The item header consists of the format byte and the length byte(s) as shown in Figure 2. Bits one and two of the item header tell how many of the following bytes refer to the length of the item. This feature allows for long items without requiring the byte overhead for shorter items. The item length refers to the number of bytes following the item header, called the item body (IB), which is the actual data of the item. The item length refers only to the item body not including the item header, so the actual number of bytes in the message for one item is the item length plus 2, 3, or 4 bytes for the item header. All bytes in the item body are in the format specified in the format byte.

6.2.1 A zero length in the format byte is illegal and produces an error. A zero length in the item length bytes has a special meaning as defined in the detailed message definitions.



Length refers to the number of bytes except in a list format where it refers to the number of elements (items or lists) in the list.

Figure 2
Item and List Header



6.2.2 Bits 3 through 8 of the format byte of the item header define the format of the data which follows. Of the 64 possible formats, fifteen are defined as shown in Table 1. Format code 0 is called a list and is defined in E5 6.3. The remaining 14 item formats define unspecified binary, code 10 (octal); Boolean, code 11 (octal); ASCII character strings, code 20 (octal); JIS-8 character strings, code 21 (octal) signed integer, codes 30, 31, 32, 34 (octal); floating point, codes 40, 44 (octal); and unsigned integer, codes 50, 51, 52, 54 (octal). These formats are used for groups of data which have the same representation in order to save repeated item headers. Signed integers will be two's complement values. Floating point numbers will conform to the IEEE standard 754. Boolean values will be byte quantities, with zero being equivalent to false, and non-zero being equivalent to true.

6.3 List - A list is an ordered set of elements, where an element can be either an item (6.2) or a list. The list header (LH) has the same form as an item header with format type 0. However, the length bytes refer to the number of elements in the list rather than to the number of bytes. The list structure allows grouping items of related information which may have different formats into a useful structure.

6.3.1 A zero-length in the format byte is illegal and produces an error. A zero-length in the list length bytes has a special meaning, which is defined in the detailed message definitions.

Table 1
Item Format Codes

Format Code Binary Bit 876543	Octal	Meaning The data after the heading has the following form
000000	00	LIST (length in elements)
001000	10	Binary
001001	11	Boolean
010000	20	ASCII ¹
010001	21	JIS-8
011000	30	8-byte integer (signed) ²
011001	31	1-byte integer (signed)
011010	32	2-byte integer (signed) ²
001110	34	4-byte integer (signed) ²
100000	40	8-byte floating point ³
100100	44	4-byte floating point ³
101000	50	8-byte integer (unsigned) ²
101001	51	1-byte integer (unsigned)
101010	52	2-byte integer (unsigned) ²
101100	54	4-byte integer (unsigned) ²

¹ Non-printing characters are equipment specific.

² Most significant byte sent first.

³ IEEE 754. The byte containing the sign bit is sent first.

NOTE - Changes in integer format codes may conflict with earlier implementations.



6.4 *Example Data Structures* - The data structures for different types of items are illustrated in the following examples:

(a) An item contains one binary code 10101010.
bit
87654321

00100001 Item, binary, 1 length byte
00000001 1 byte long
10101010 data byte

(b) An item contains three ASCII characters ABC.
01000001 Item ASCII, 1 length byte
00000011 Three bytes long
01000001 ASCII A
01000010 ASCII B
01000011 ASCII C

(c) An item contains three binary numbers in 2-byte signed integer form.

01101001 Item, 2-byte integers

00000110 6 bytes total (6/2=3 integers)

xxxxxxx MSByte number x
xxxxxxx LSByte number x
yyyyyyyy MSByte number y
yyyyyyyy LSByte number y
zzzzzzzz MSByte number z
zzzzzzzz LSByte number z

(d) An item contains one 4-byte IEEE floating point number.

10010001 Item, 4-byte floating point
00000100 4 bytes (4/4=1 number)
ffffff Floating point number
ffffff in IEEE 754
ffffff

(e) A message is sent from device 66 telling the host that the temperature at point T1 has exceeded a preset process limit. The message ID is stream 5, function 1, and the data consists of a list of three items. The first item is a code for the alarm set and the alarm category code. The second item is the equipment-specific alarm number for this alarm, e.g. 17. The third item is a string of text giving a brief description of the alarm, e.g. "T1 HIGH." No reply is requested. The complete message including the header is as follows:

10000000	R=1 (to the host)
00101010	Device Code=66
00000101	Stream 5, W=0
00000001	Function 1
10000000	E=1
00000001	Block 1
00000000	System bytes=0
00000000	
00000000	
00000001	List
00000011	3 Elements
00100001	Binary Item next byte length
00000001	1 byte long
10000100	Alarm set, category 4
01100101	Item, 1-byte integer, next byte length
00000001	1 byte long
00010001	Alarm 17
01000001	Item, ASCII, next byte length
00000111	7 characters
01010100	ASCII T
00110001	ASCII I
00100000	ASCII space
01001000	ASCII H
01001001	ASCII I
01000111	ASCII G
01001000	ASCII H

The entire message contains 17 bytes of data, 1 byte length (not shown), 10 bytes of header, and 2 bytes checksum (not shown) for a total of 30 bytes. At 9600 baud transmission, the message would be sent in 31 milliseconds.



6.5 Data Item Dictionary

This section defines the data items used in the standard SECS-II messages described in Section 7, Message Detail.

Name: A unique mnemonic name for this data item. This name is used in message definitions.

Format: The allowable item format codes which can be used for this standard data item. Item format codes are shown in octal, as described in Table 1, Item Format Codes. The notation "30" indicates any of the signed integer formats (30, 31, 32, 34). The notation "40" indicates any of the floating point formats (40, 44). The notation "50" indicates any of the unsigned integer formats (50, 51, 52, 54). The notation "0" indicates that a list with user-defined structure may be used. Where more than one format is shown, a given implementation can use any of the formats specified.

Description: A description of the data item, with the meanings of specific values.

Where Used: The standard messages in which this data item appears.

ABS Format: 10
Any binary string
Where Used: S2F25, F26

ACDS Format: 32, 52
After Command Codes
Vector of all command codes which defined command must succeed within the same block.

Where Used: S7F22

ACKC3 Format: 10
Acknowledge code, 1 byte
0 = accepted
>0 = error, not accepted
1-63 reserved

Where Used: S3F6, F8, F10

ACKC5 Format: 10
Acknowledge code, 1 byte
0 = accepted
>0 = error, not accepted
1-63 reserved

Where Used: S5F2, F4

ACKC6 Format: 10
Acknowledge code, 1 byte
0 = accepted and done
>0 = error, not done
1-63 reserved

Where used: S6F2, F4, F10, F12, S6, F14



ACKC7

Format: 10

Acknowledge code, 1 byte

- 0 = Accepted
- 1 = Permission not granted
- 2 = Length error
- 3 = Matrix overflow
- 4 = PPID not found
- 5 = Mode unsupported
- >5 = Other error
- 6-63 reserved

Where Used: S7F4, F12, F14, F16, F18, F24, F32

ACKC7A

Format: 31, 51

Acknowledge Code, 1 byte

- 0 = Accepted
- 1 = MDLN is inconsistent
- 2 = SOFTREV is inconsistent
- 3 = Invalid CCODE
- 4 = Invalid PPARM value
- 5 = Other error (described by ERRW7)
- 6-63 reserved.

Where Used: S7F27

ACKC10

Format: 10

Acknowledge Code, 1 byte

- 0 = Accepted for display
- 1 = Message will not be displayed
- 2 = Terminal not available
- 3 - 63 = Reserved

Where Used: S10F2, S10F4, S10F6, S10F10

ACKC13

Format: 10

Return code for secondary messages 1 byte.

- 0 = O.K.
- 1 = ERROR: Try later
- 2 = ERROR: Unknown Data Set Name
- 3 = ERROR: Illegal Checkpoint value
- 4 = ERROR: Too many open Data Sets
- 5 = ERROR: Data set open too many times
- 6 = ERROR: No open Data Set
- 7 = ERROR: Cannot continue
- 8 = ERROR: End of Data
- 9 = ERROR: Handle in Use
- >10 = ERROR: Pending Transaction
- 11-127 reserved

Where Used: S13F2, F4, F6, F8



ALCD

Format: 10

Alarm code byte

- bit 8 = 1 means alarm set
- bit 8 = 0 means alarm cleared
- bits 7 - 1 is alarm category code
- 0 = not used
- 1 = Personal safety
- 2 = Equipment safety
- 3 = Parameter control warning
- 4 = Parameter control error
- 5 = Irrecoverable error
- 6 = Equipment status warning
- 7 = Attention flags
- 8 = Data integrity
- >8 = other categories
- 9-63 reserved.

Where used: S5F1, F6

ALED

Format: 10

Alarm enable/disable code, 1 byte

- bit 8 = 1 means enable alarm
- bit 8 = 0 means disable alarm

Where Used: S5F3

ALID

Format: 3(),5()

Alarm identification

Where Used: S5F1, F3, F5, F6

ALTX

Format: 20

Alarm text limited to 40 characters

Where Used: S5F1, F6

BCDS

Format: 32, 52

Before Command Codes.

Vector of all command codes which defined command must precede within the same block.

Where Used: S7F22

BCEQU

Format: 20,51

Bin code equivalents

Array of all codes that are to be processed. Must be the same format as BINLT and NULBC. Zero length indicates all codes be sent.

Where Used: S12F3, S12F4



BINLT

Format: 20, 51

The Bin List

Is an array of bin values. Format must be the same as used in NULBC and BCEQU.

Where Used: S12F7, F9, F11, F14, F16, F18

BLKDEF

Format: 31, 51

Block Definition

Blocks define the range for before/after code checking (specified by BCDS, IBCDS, NBCDS, ACDS, IACDS, and NACDS). BLKDEF specifies whether the command being defined starts a block (+1), terminates a block (-1) or is within the body of a block (0). All other values are invalid. The outermost block of a process program is implicit, and is bounded by the first and last command of the process program. Before/after checks for a particular command are performed with all other commands in the same block and at the same nesting level. For the purpose of before/after checking, a set of commands making up a block is considered to be a single body command of its containing block. This command has the before/after restrictions of the start block command which begins the block.

Where Used: S7F22

BPD

Format: 10

Boot program Data

Where Used: S8F2

BYTMAX

Format: 3(),5()

Byte Maximum

Maximum length of process program. A value of zero indicates no limit. Negative values are invalid.

Where Used: S7F22

CCODE

Format: 32, 52

Command Code.

Each command code corresponds to a unique process operation the machine is capable of performing.

Where Used: S7F22, F23, F26, F31

CEED

Format: 11

Collection event enable/disable code, 1 byte

FALSE = Disable

TRUE = Enable

Where Used: S2F37



CEID
Collected event ID

Format: 20, 3(), 5()

Where Used: S2F35, F37, S6F3, F8, F9, F11, F13, F15, F17, F35

CKPNT
Checkpoint as defined by the sending system

Format: 54

Where used: S13F3, S13F6

CMDA
Command acknowledge code

Format: 31, 51

- 0 = completed or done
- 1 = command does not exist
- 2 = cannot perform now
- >2 = other equipment-specific error
- 3-63 reserved.

Where Used: S2F22, F28

CMDMAX
Command Maximum

Format: 3(), 5()

Maximum number of commands to be allowed in a process program. A value of zero indicates no limit. Negative values are invalid.

Where Used: S7F22

CNAME
Command Name = 16 characters

Format: 20

Text string unique among other CNAMEs in PCD which describes the processing done by the equipment for the corresponding CCODE.

Where Used: S7F22

COLCT
Column count in die increments.

Format: 5()

Where Used: S12F1, F4



COMMACK

Format: 10

Establish Communications Acknowledge Code, 1 byte

- 0 = Accepted
- 1 = Denied, Try Again
- 2-63 = Reserved

Where Used: S1F13,F14

CPACK

Format: 10

Command Parameter Acknowledge Code, 1 byte

- 1 = Parameter Name (CPNAME) does not exist
- 2 = Illegal Value specified for CPVAL
- 3 = Illegal Format specified for CPVAL
- >3 = Other equipment-specific error
- 4-63 reserved

Where Used: S2F42

CPNAME

Format: 20, 3(), 5()

Command Parameter Name

Where Used: S2F41,42

CPVAL

Format: 10, 11, 20,21, 3(),5()

Command Parameter Value

Where Used: S2F41

CSAACK

Format: 10

Equipment Acknowledgement code, 1 byte

- 0 = everything correct
- 1 = busy
- 2 = invalid SPID
- 3 = invalid data
- >3 = equipment-specific error
- 4-63 reserved

Where Used: S2F8

DATAID

Format: 20, 30, 50

Data ID

Where Used: S2F33, 35, 37, S6F3, F5, F7, F8, F9

DATALENGTH

Format: 3(),5()

Total bytes to be sent

Where Used: S2F39, S6F5



DATLC

Format: 51

Data location

Location of invalid data, represented in bytes, measured from the start of the message in question, excluding all header bytes.

Where Used: S12F19

DRACK

Format: 10

Define Report Acknowledge Code, 1 byte

- 0 = Accepted
- 1 = Denied. Insufficient space
- 2 = Denied. Invalid format
- 3 = Denied. At least one RPTID already defined
- 4 = Denied. At least one VID does not exist
- >4 = Other errors
- 5-63 = Reserved

Where used: S2F34

DSID

Format: 20, 3(), 5()

Data set ID

Where Used: S6F3, F8, F9

DSNAME

Format: 20

The name of the Data Set.

The minimum length is zero. The maximum is 50 characters.

Where Used: S13F1, F2, F3, F4

DSPER

Format: 20

Data sample period

hhmmss, 6 bytes

Where Used: S2F23

DUTMS

Format: 20

Die Units of Measure.

Use units description per E5 Section 9.

Where Used: S12F1, F4

DVNAME

Format: 3(), 20, 5()

Data value name

Where Used: S6F3, F8



DVVAL
Data value

Format: 10, 11, 20, 21, 3(), 4(), 5()

Where Used: S6F3, F8, F9, F11, F16

EAC

Format: 10

Equipment acknowledge code, 1 byte

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

Where Used: S2F16

ECDEF

Format: 10, 11, 20, 21, 3(), 4(), 5()

Equipment constant default value

Where Used: S2F30

ECID

Format: 3(), 20, 5()

Equipment Constant ID

Where Used: S2F13, F15, F29, F30

ECMAX

Format: 10, 11, 20, 21, 3(), 4(), 5()

Equipment constant maximum value

Where Used: S2F30

ECMIN

Format: 10, 11, 20, 21, 3(), 4(), 5()

Equipment constant minimum value

Where Used: S2F30

ECNAME

Format: 20

Equipment constant name

Where Used: S2F30

ECV

Format: 10, 11, 20, 21, 3(), 4(), 5()

Equipment Constant Value

Where Used: S2F14, F15



EDID Format: 10,3(),20,5()
Expected data Identification

Three possible responses.

MEXP	EDID	EDID
S02F03, <SPID>	A[6]	
S03F13, <PTN>	B[1]	
S07F03, <PPID>	A[16], B[16]	

Where Used: S9F13

EMID Format: 10, 20
Equivalent material ID (16 bytes maximum)

Where Used: S3F9

EPD Format: 10
Executive program data

Where Used: S8F4

ERACK Format: 10
Enable/Disable Event Report
Acknowledge Code, 1 byte
0 = Accepted
1 = Denied. At least one CEID does not exist
<1 = Other Errors
2-63 = reserved.

ERRW7 Format: 20
Text string describing error found in process program

Where Used: S7F27

FCNID Format: 51
Function Identification

Where Used: S2,F43/F44

FFROT Format: 52
Film Frame Rotation

In degrees from the bottom CW. (Bottom equals zero degrees) Zero length indicates not used.

Where Used: S12F1, F3



FILDAT

Format: 10, 20

Data from the Data Set.

The maximum length is the RECLen from Open Data Set Data.

Where Used: S13F6

FNLOC

Format: 52

Flat/Notch Location

In degrees from the bottom CW. (Bottom equals zero degrees). Zero length indicates not used.

Where Used: S12F1, F3, F4

FRMLEN

Format: 3(),5()

Formatted Process Program Length

If greater than zero, indicates PPID is available as a formatted process program and its length in bytes. If zero, the PPID is not available as a formatted process program. Negative values are invalid.

Where Used: S7F34

GRANT

Format: 10

Grant code, 1 byte

- 0 = positive response, load OK
- 1 = busy, try again
- 2 = no space
- 3 = duplicate name
- >3 = equipment specific error code
- 4-63 reserved

Where Used: S2F2, F40

GRANT6

Format: 10

Permission to send, 1 byte

- 0 = Permission granted
- 1 = Busy, try again
- 2 = Not interested
- >2 = Other errors
- 3-63 reserved.

Where Used: S6F6

GRNT1

Format: 10

Grant code, 1 byte

- 0 = Positive response, transfer ok
- 1 = Busy, try again
- 2 = No space
- 3 = Map too large
- 4 = Duplicate ID
- 5 = Material ID not found
- 6 = Unknown map format
- >6 = Error
- 7-63 reserved

Where Used: S12F6

HANDLE

Format: 3(), 5()

Logical unit or channel.

Where used: S13F3, F4, F5, F6, F7, F8

HCACK

Format: 10

Host Command Parameter Acknowledge Code, 1 byte

- 0 = Acknowledge, command has been performed
- 1 = Command does not exist
- 2 = Cannot perform now
- 3 = At least one parameter is invalid
- 4 = Acknowledge, command will be performed with completion signalled later by an event.
- 5-63 Reserved

Where Used: S2F42

IACDS

Format: 32, 52

Immediately After Command Codes

Vector of all command codes which defined command must immediately succeed within the same block.

Where Used: S7F22

IBCDS

Format: 32, 52

Immediately Before Command Codes

Vector of all command codes which defined command must immediately precede within the same block.

Where Used: S7F22



IDTYP

Format: 10

Id type

- 0 = Wafer ID
- 1 = Wafer Cassette ID
- 2 = Film Frame ID
- >2 = Error
- 3-63 Reserved

Where Used: S12F1, F3, F4, F5, F7, F9, F11, F13, F14, F15, F16, F17, F18

LENGTH

Format: 3(),5()

Length of the service program or process program in bytes

Where Used: S2F1; S7F1, F29

LIMITACK

Format:10

Acknowledgment code for variable limit attribute set, 1 byte.

- 1 = LIMITID does not exist.
- 2 = UPPERDB > LIMITMAX.
- 3 = LOWERDB < LIMITMIN.
- 4 = UPPERDB < LOWERDB.
- 5 = Illegal format specified for UPPERDB or LOWERDB.
- 6 = ASCII value cannot be translated to numeric.
- 7 = Duplicate limit definition for this variable.
- >7 = Other equipment-specific error
- 8-63 Reserved

Where used: S2,F46

LIMITID

Format: 10

The identifier of a specific limit in the set of limits (as defined by UPPERDB and LOWERDB) for a variable to which the corresponding limit attributes refer, 1 byte.

Where used: S2,F45/F86

LIMITMAX

Format:11,20,30,40,50

The maximum allowed value for the limit values of a specific variable. The equipment manufacturer should specify this value, which would typically coincide with the maximum value of the variable being monitored. The format must match that of the referenced variable.

Where used: S2,F48

LIMITMIN

Format:11,20,30,40,50

The minimum allowed value for the limit values of a specific variable. The equipment manufacturer should specify this value, which would typically coincide with the minimum value of the variable being monitored. The format must match that of the referenced variable.

Where used: S2,F48



LLIM

Lower limit for numeric value

Format: 3(),4(),5()

Where Used: S7F22

LOC

Machine material location code, 1 byte

Format: 10

Where Used: S2F27, S3F2

LOWERDB

A variable limit attribute which defines the lower boundary of the deadband of a limit. The value applies to a single limit (LIMITID) for a specified VID. Thus, UPPERDB and LOWERDB as a pair define a limit.

Format: 11,20,30,40,50

Where used: S2,F45/F86

LRACK

Link Report Acknowledge Code, 1 byte

Format: 10

- 0 = Accepted
- 1 = Denied. Insufficient space
- 2 = Denied. Invalid format
- 3 = Denied. At least one CEID link already defined
- 4 = Denied. At least one CEID does not exist
- 5 = Denied. At least one RPTID does not exist
- >5 = Other errors
- 6-63 = reserved

Where used: S2F36

LVACK

Variable limit definition acknowledge code, 1 byte. Defines the error with the limit attributes for the referenced VID.

Format: 10

- 1 = Variable does not exist.
- 2 = Variable has no limits capability.
- 3 = Variable repeated in message.
- 4 = Limit value error as described in LIMITACK.
- 5-63 Reserved.

Where used: S2,F46

MAPER

Map Error

Format: 10

- 0 = ID not found
- 1 = Invalid Data
- 2 = Format error
- >2 = Invalid error
- 3-63 Reserved.

Where Used: S12F19



MAPFT

Format: 10

Map data format type

- 0 = Row format
- 1 = Array format
- 2 = Coordinate format
- >2 = Error
- 3-63 reserved

Where Used: S12F3, F5

MDACK

Format: 10

Map data acknowledge

- 0 = Map received
- 1 = Format error
- 2 = No ID match
- 3 = Abort/discard map.
- >3 = Error
- 4-63 reserved

Where Used: S12F8, F10, F12

MDLN

Format: 20

Equipment Model Type, 6 bytes max

Same data as returned by S1,F2

Where Used: S1F2; S7F22, F23, F26, F31

MEXP

Format: 20

Message expected in the form SxxFyy where x is stream and y is function.

Where Used: S9F13



MF

Format: 10, 20

Material format code 1 byte by Format 10

Items with format 10 will be encoded as follows:

- 1 = quantities in wafers
- 2 = quantities in cassette
- 3 = quantities in die or chips
- 4 = quantities in boats
- 5 = quantities in ingots
- 6 = quantities in leadframes
- 7 = quantities in lots
- 8 = quantities in magazines
- 9 = quantities in packages
- 10 = quantities in plates
- 11 = quantities in tubes
- 12 = quantities in waferframes

13-63 reserved

Items with format 20 will be a unit identifier for one of the special SECS generic units, as specified in Section 9

Where Used: S3F2, F4, F5, F7

MHEAD

Format: 10

SECS message block header associated with message block in error

Where Used: S9F1, F3, F5, F7, F11

MID

Format: 10, 20

Material ID

16 Characters maximum

Where Used: S2F27; S3F2, F4, F7, F9, F12, F13; S4F1, F3, F5, F7, F9, F11, F13, F15, F17; S7F7, F8, F10, F11, F13, F35, F36; S12F1, F3, F4, F5, F7, F9, F11, F13, F14, F15, F16, F17, F18.

MIDAC

Format: 10

Material ID Acknowledge Code, 1 byte

- 0 = accepted
- 1 = invalid port number
- 2 = material is not present at identified port
- >2 = error
- 3-63 reserved

Where Used: S3F14



MIDRA

Format: 10

Material ID Request Acknowledge, 1 byte

- 0 = acknowledge, MID follows
- 1 = acknowledge, will not send MID
- 2 = acknowledge, will send MID later in S3F13
- 3-63 reserved

Where Used: S3F12

MLCL

Format: 5()

Message length

Defined by message size in (bytes).

Where Used: S12F4, F5

MMODE

Format: 10

matrix mode select, 1 byte

- 1 = Host source mode
Use S7F7 and F8 to define the process program to be used.
- 2 = Local source mode
Use the matrix defined by S7F9, F10, F11 and F13 to define the process program to be used. The equipment will initialize to local source mode at power up. The equipment will default to local source mode from host source mode in the event of loss of communication with the host.
- 3 = Host immediate mode
Use the current process program for all material unless changed by S7F1-F4. The timing of the mode change is equipment specific

Where Used: S7F15

NACDS

Format: 32, 52

Not After Command Codes

Vector of all command codes which defined command may not succeed within the same block

Where Used: S7F22

NBCDS

Format: 32, 52

Not Before Command Codes

Vector of all command codes which defined command may not precede within the same block

Where Used: S7F22



NULBC

Format: 20, 51

Null bin code value.

This value is the bin code value that is used for no die at a location. (For X/Y coordinate format the ASCII value is a value with "n" length. For all other map formats, ASCII is a single byte per bin with "n" length per item thus the total number of bins is the length, i.e. length "n" = 10 for ASCII format is 10 single byte bin codes.) The format used must be the same as the one used for BINLT and BCEQU. Zero length indicates not used.

Where Used: S12F1, F3, F4

ORLOC

Format: 10

Origin Location

implicit value of (0,0)

0 = Center die of wafer

(Determined by:

$$\frac{\text{row or column count} + 1}{2}$$

truncated)

1 = Upper right

2 = Upper left

3 = Lower left

4 = Lower right

>4 = Error

5-63 reserved

Zero length indicates not available

Where Used: S12F1, F3, F4

PDFLT

Format: 11,20,3(),4(),5()

Parameter Default Value

Specifies default value and data type of parameter. If no defaults are provided, item data length will be zero. For numeric or Boolean data, the default item may be a multi-varied vector if the parameter itself can be a vector.

If RQPAR is false:

Position of data in a default item is significant. When obtaining a default value to be used in the Nth position of a vector parameter, the value is obtained from the Nth position of the default item. If the default item has L entries, no default value will be provided for the L+1,...,PMAX parameter entries.

If RQPAR is true:

The length of the default vector (L) specifies the minimum number of entries which must be entered for the parameter. If > PMAX, only PMAX entries are required.

Where Used: S7F22



PFCD

Format: 10

Predefined form code, 1 byte

Where Used: S6F9

PMAX

Format: 3(), 5()

Parameter Count Maximum

Maximum amount of data to be accepted by the host for this parameter. When a conflict arises between value of PMAX and length of PDFLT, PMAX takes precedence.

For numeric and Boolean parameters:

PMAX < 0 is invalid.

PMAX = 0 specifies there is no upper bound

PMAX = 1 specifies a single value is expected

PMAX > 1 specifies a vector of values is expected with a maximum of PMAX entries

For string parameters:

PMAX < 0 is invalid

PMAX = 0 specifies there is no upper bound

PMAX > 0 maximum length of parameter string

Where Used: S7F22

PNAME

Format: 20

Parameter Name <= 16 characters

Text string identifying the parameter value expected by its parent process command.

Where Used: S7F22

PPARM

Format: 11,20,3(),4(),5()

Process Parameter

Numeric or Boolean SECS data item, single or multiple value, or text string which provides information required to complete the process command to which the parameter refers.

Where Used: S7F23, F26, F31

PPBODY

Format: 10,20,3(),5()

Process program body

The process program describes to the equipment, in its own language, the actions to be taken in processing the material it receives.

Where Used: S7F3, F6, F36



PPGNT

Format: 10

Process program grant status, 1 byte

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

Where Used: S7F2, F30

PPID

Format: 10, 20

Process program ID.

Limited to 16 bytes.

The format used in the PPID will be host dependent. For internal use of the equipment, the PPID can be treated as a unique binary pattern. If the local equipment is not prepared to display the transmitted code, the display should be in hexadecimal form.

Where Used: S2F27; S7F1, F3, F5, F6, F8, F10, F11, F13, F17, F20 F23, F25 F26, F27, F31, F33, F34, F36, S9F13

PRAXI

Format: 10

Process axis.

- 0 = Rows (X-axis), top, increasing.
- 1 = Rows (X-axis), top, decreasing
- 2 = Rows (X-axis), bottom, increasing
- 3 = Rows (X-axis), bottom, decreasing
- 4 = Columns (Y-axis), left, increasing
- 5 = Columns (Y-axis), left, decreasing
- 6 = Columns (Y-axis), right, increasing
- 7 = Columns (Y-axis), right, decreasing
- >7 = Error
- 8-63 reserved

Where Used: S12F1, F3



PRDCT Format: 5()
Process Die Count
(Number of die to be processed or number of die which have been processed.) Zero length indicates not used.

Where Used: S12F1, F4

PTN Format: 10
Material Port number, 1 byte

Where Used: S4F1, F3, F5, F7, F9, F11, F13, F15, F17

QUA Format: 10
Quantity in format, 1 byte

Where Used: S3F2, F4, F5, F7

RAC Format: 31, 51
Reset acknowledge, 1 byte
0 = reset to be done
1 = reset denied
>1 = other errors
2-63 reserved

Where Used: S2F20

RCMD Format: 20, 31, 51
Remote command code or string

Where Used: S2F21, F41

READLN Format: 3(), 5()
Maximum length to read

Where Used: S13F5

RECLN Format: 3(), 5()
Maximum length of a Discrete record.

Where Used: S13F4

REFP Format: 3()
Reference Point

Where used: S12F1, F4



REPGSZ Format: 20,3(),5()
Reporting group size

Where Used: S2F23

RESC Format: 31, 51
Resolution code for numeric data
1 - Absolute. Value may be specified to nearest increment of RESV.
2 - Significant Digits. Value may be specified with no more significant digits than RESV allows.

Where Used: S7F22

RESV Format: 3(),4(),5()
Resolution value for numeric data.
If RESC = 1 then RESV contains smallest increment allowed for parameter.

Where Used: S7F22

RIC Format: 31, 51
Reset code, 1 byte
0 = not used
1 = power up reset
>1 other reset conditions
2-63 reserved

Where Used: S2F19

ROWCT Format: 5()
Row count in die increments.

Where Used: S12F1, F4

RPSEL Format: 51
Reference Point Select.
(number of reference point from 0-n).

Where Used: S12F1, F4

RPTID Format: 20, 3(), 5()
Report ID

Where Used: S2F33, F35; S6F11, F13, F16



RQCMD

Format: 11

Required Command.

True - Command must be specified

False - Command is optional

Where Used: S7F22

RQPAR

Format: 11

Required Parameter

True - Parameter must be specified

False - Parameter is optional

Where Used: S7F22

RRACK

Format: 10

Request to Receive Acknowledge code, 1 byte

0 = acknowledge, OK (note that 'OK' differs from 'ready')

1 = invalid port number

2 = requested material is not at identified port

3 = busy. Try again

4 = sender does not have permission to perform this operation

5-63 reserved

Where Used: S4F18

RSACK

Format: 10

Ready to Send Acknowledge code, 1 byte

0 = acknowledge, OK (note that 'OK' differs from 'ready')

1 = invalid port number

2 = port is already occupied

3 = busy, unable to move material at this time. Try again

4 = receiver does not have permission to perform this operation

5-63 reserved

Where Used: S4F2

RSDA

Format: 10

Request Spool Data Acknowledge

0 = OK

1 = Denied, busy try later

2 = Denied, spooled data does not exist

3-63 = Reserved

Where Used: S6,F24



RSDC

Format: 51

Request Spool Data Code

- 0 = Transmit Spooled Messages
- 1 = Purge Spooled Messages
- 2-63 = Reserved

Where Used: S6,F23

RSINF

Format: 3()

Starting location for row or column. This item consists of 3 values (x,y, direction). If direction value is "-", it equals decreasing direction. If the value is "+", it equals increasing direction. Direction must be a non-zero value.

Where Used: S12F7, F14

RSPACK

Format: 10

Reset Spooling Acknowledge

- 0 = Acknowledge, spooling setup accepted
- 1 = Spooling setup rejected.
- 2- 63 = Reserved.

Where Used: S2,F44

RTYPE

Format: 3(),5()

Type of record.

- 0 = Stream
- 1 = Discrete
- 2-63 reserved

Where Used: S13F4

SDACK

Format: 10

Map set-up data acknowledge.

- 0 = Received data
- >0 = Error
- 1-63 reserved

Where Used: S12F2

SDBIN

Format: 10

Send bin information flag.

- 0 = Send bin information
- 1 = Don't send bin information
- >1 = Error
- 2-63 reserved

Where Used: S12F17



SEQNUM Format: 3(),5()
Command Number
Value which identifies a unique process program command by its position in the list of commands relative to the first. For the first command of the process program, SEQNUM is 1.

Where Used: S7F27

SFCD Format: 10
Status form code, 1 byte

Where Used: S1F5

SHEAD Format: 10
Stored header related to the transaction timer

Where Used: S9F9

SMPLN Format: 3(),5()
Sample number

Where Used: S6F1

SOFTREV Format: 20
Software revision code 6 bytes maximum

Where Used: S1F2, F13, F14; S7F22, F23, F26, F31

SPAACK Format: 10
Equipment acknowledgement code, 1 byte
0 = everything correct
1 = Invalid data
>1 = equipment-specific error
2-63 reserved

Where Used: S2F4

SPD Format: 10
Service program data

Where Used: S2F3, F6

SPID Format: 20
Service program ID, 6 characters

Where Used: S2F1, S2F5, F7, F9, S2F12, S9F13



SPR

Service program results

Device dependent

Format: Device Dependent

Where Used: S2F10

STEMP

Format: 20

String template. ASCII text string acceptable to equipment as a parameter value. A data string matches a template string if the data string is at least as long as the template and each character of the data string matches the corresponding character of the template. A null list indicates all user data is acceptable to the machine.

Where Used: S7F22

STIME

Format: 20

Sample time, 12 bytes

yymmddhhmmss

Where Used: S6F1

STRACK

Format: 10

Spool Stream Acknowledge

- 1 = Spooling not allowed for stream (i.e. Stream 1).
- 2 = Stream unknown.
- 3 = Unknown function specified for this stream.
- 4 = Secondary function specified for this stream.

Note: Error codes 1 - 4 shown in order of precedence for reporting. Code 0 not used.

Where Used: S6,F24

STRID

Format: 51

Stream Identification

Where Used: S2,F43/F44

STRP

Format: 3()

Starting position in die coordinate position. must be in (X,Y) order.

Where Used: S12F9, F16

SV

Format: 10, 11, 20, 21,3(),4(),5()

Status variable value

Where Used: S1F4, S6F1



SVID

Format: 20, 3(), 5()

Status variable ID

Status variables may include any parameter that can be sampled in time such as temperature or quantity of a consumable.

Where Used: S1F3, F11, F12; S2F23

SVNAME

Format: 20

Status Variable Name

Where Used: S1F12

TEXT

Format: 10,20,3(),5()

A single line of characters.

Where Used: S10F1, F3, F5, F9

TIAACK

Format: 10

Equipment acknowledgement code, 1 byte

- 0 = everything correct
- 1 = too many SVIDs
- 2 = no more traces allowed
- 3 = invalid period
- >3 = equipment specific error
- 4-63 reserved

Where Used: S2F24

TIACK

Format: 10

Time Acknowledge Code, 1 Byte

- 0 = OK
- 1 = Error, not done
- 2-63 = Reserved.

Where Used: S2F32

TID

Format: 10

Terminal number, 1 byte

- 0 = single or main terminal
- >0 = additional terminals at the same equipment

Where Used: S10F1, F3, F5, F7



TIME Format: 20
Time of day, 12 bytes yymmddhhmmss

Where Used: S2F18

TOTSMP Format: 20,3(), 5()
Total samples to be made

Where Used: S2F23

TRID Format: 20, 3(), 5()
Trace request ID

Where Used: S2F23, S6F1

TSIP Format: 10
Transfer status of input port, 1 byte
1 = Idle state
2 = Prep state
3 = Track on state
4 = Stuck in Receiver state
5-63 reserved

Where Used: S1F10

TSOP Format: 10
Transfer status of output port, 1 byte
1 = Idle state
2 = Prep state
3 = Track on state
4 = Stuck in Sender state
5 = Completion state
6-63 reserved

Where Used: S1F10



TTC
Time to completion

Format: 3(),5()

Where Used: S3F4

ULIM
Upper limit for numeric value.

Format: 3(),4(),5()

Where Used: S7F22

UNFLEN
Unformatted Process Program Length

Format: 3(),5()

If greater than zero, indicates PPID is available as an unformatted process program and its length in bytes. If zero, the PPID is not available as an unformatted process program. Negative values are invalid.

Where Used: S7F34

UNITS
Units Identifier

Format: 20

As allowed by E5 section 9

Where Used: S1F12, S2F30, S7F22

UPPERDB

Format: 11,20,3(),4(),5()

A variable limit attribute which defines the upper boundary of the deadband of a limit. The value applies to a single limit (LIMITID) for a specified VID. Thus, UPPERDB and LOWERDB as a pair define a limit.

Where used: S2,F45/F86

V
Variable data

Format: 0, 10, 11, 20, 21, 3(), 4(), 5()

Where Used: S6F11, F13, F16

VID
Variable ID

Format: 20, 3(), 5()

Where Used: S2F33; S6F13



VLAACK

Format: 10

Variable Limit Attribute Acknowledge Code, 1 byte

- 0 = Acknowledge, command will be performed
- 1 = Limit attribute definition error
- 2 = Cannot perform now
- >2 = Other equipment-specific error
- 3-63 Reserved

Where Used: S2,F46

XDIES

Format: 4(),5()

X-axis die size (index)

Where Used: S12F1, F4

XYPOS

Format: 3()

X and Y Coordinate Position. Must be in (X,Y) order

Where Used: S12F11, F18

YDIES

Format: 4(),5()

Y-axis die size (index)

Where Used: S12F1, F4

6.6 Variable Item Dictionary

This section defines variable data items which are available to the Host for data collection purposes.

Name: A unique mnemonic name for this variable data item. This name is provided for reference only.

Class: The data type classification (SV, ECV or DVVAL) of the item. Status values (SV's) always contain valid information, while data values (DVVAL's) may only be valid upon the occurrence of a particular event. All equipment constants (ECV's) are settable by the Host.

Format: The allowable item format codes which can be used for this variable data item. ...as in Data Item Dictionary...

Description: A description of the variable data item, with the meanings of specific values. Also, specify validity for item of class DVVAL.



AlarmsEnabled

Format: 0

Class: SV

Contains the list of alarms (ALIDs) enabled for reporting (via Stream 5).

Structure: L,n n= # of alarms enabled

1. <ALID1>

.

.

n. <ALIDn>

AlarmsSet

Format: 0

Class: SV

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

Structure: L,n n= # of alarms set

1. <ALID1>

.

.

n. <ALIDn>

CLOCK

Format: 20

Class: SV

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

Format: YYYYMMDDhhmmsscc

YYYY = Year 0000 to 9999

MM = Month 01 to 12

DD = Day 01 to 31

hh = Hour 00 to 23

mm = Minute 00 to 59

ss = Second 00 to 59

cc = Centisecond 00 to 99

Where used:

ControlState

Format: 51

Class: SV

The current control state of the equipment. This variable is always available.

0 = Local

1 = Remote

2-63 = Reserved

EstablishCommunicationsTimeout

Format: 52

Class: ECV

The length of time, in seconds, of the interval between attempts to send S1,F13 when establishing communications.



EventsEnabled Format: 0

Class: SV

Contains the list of events(CEIDs) enabled for reporting (via Stream 6).

Structure: L,n n= # of events enabled

1. <CEID1>

.

.

n. <CEIDn>

EventLimit Format: 0,10,11,20,21,30,40,50

Class: DVVAL

Used with the Limits Monitoring capability, it contains the LIMITID of the limit reached or crossed by LimitVariable. Since multiple zone transitions for a variable may occur simultaneously (e.g. due to identical limit definitions or a slow data sampling rate), EventLimit has been defined to allow for a list of LIMITIDs.

LimitVariable Format: 50

Class: DVVAL

This variable contains the VID for the variable whose value changed monitoring zones.

MaxSpoolTransmit Format: 54

Class: ECV

The maximum number of messages which the equipment will transmit from the spool in response to an S6,F23 "Transmit Spooled Messages" request. If MaxSpoolTransmit is set to zero, no limit is placed on the messages sent from the spool. Multi-block inquire/grant messages are not counted in this total.

OverWriteSpool Format: 11

Class: ECV

This Equipment Constant is used to indicate to the equipment either to overwrite data in the spool area or to stop spooling whenever the spool area limits are exceeded.

= TRUE to overwrite spooled data

= FALSE to stop spooling when limits exceeded

PPChangeName Format: 10, 20

Class: DVVAL

The PPID which was affected upon the event of the creation, editing, or deletion of a Process Program local to the equipment.

PPChangeStatus Format: 51

Class: DVVAL

The action taken on the Process Program named in PPChangeName. This variable is valid upon the event of the creation, editing, or deletion of a Process Program local to the equipment.

1 = Created

2 = Edited

3 = Deleted

4-63 = Reserved

PPExecName Format: 0,10, 20

Class: SV

The PPID(s) of the currently selected Process Program(s). The selection of a new Process Program updates this variable. If multiple Process Programs can be selected then this variable is a list of PPIDs.



PreviousProcessState Format: 51
Class: SV
The previous processing state of the equipment, before the most recent process state change.
0-63 = Reserved

ProcessState Format: 51
Class: SV
The current processing state of the equipment.
0-63 = Reserved

SpoolCountActual Format: 50
Class: SV
Used to keep a count of the messages actually contained in the equipment's spool area. Multi-block inquire/grant messages are not spooled and not included in this count.

SpoolCountTotal Format: 50
Class: SV
Used to keep a count of the total number of primary messages directed to the spool, regardless of whether placed or retained in the spool. Multi-block inquire/grant messages are not spooled and not included in this count.

SpoolFullTime Format: 20
Class: SV
Contains the timestamp from the time the spool last became full. If the spool was not filled during the last spooling period, this will contain a time value prior to the current SpoolStartTime.
Format: YYYYMMDDHHMMSSCC
YYYY = Year 0000 to 9999
MM = Month 01 to 12
DD = Day 01 to 31
HH = Hour 00 to 23
MM = Minute 00 to 59
SS = Second 00 to 59
CC = Centisecond 00 to 99

SpoolStartTime Format: 0,10,11,20,21,30,40,50
Class: SV
Contains the timestamp from the time spooling last became active.
Format: YYYYMMDDHHMMSSCC
YYYY = Year 0000 to 9999
MM = Month 01 to 12
DD = Day 01 to 31
HH = Hour 00 to 23
MM = Minute 00 to 59
SS = Second 00 to 59
CC = Centisecond 00 to 99

TransitionType Format: 10
Class: DVVAL
Used with the Limits Monitoring capability, it defines the direction of the zone transition which has occurred.
0 = Transition from lower to upper zone.
1 = Transition from upper to lower zone.

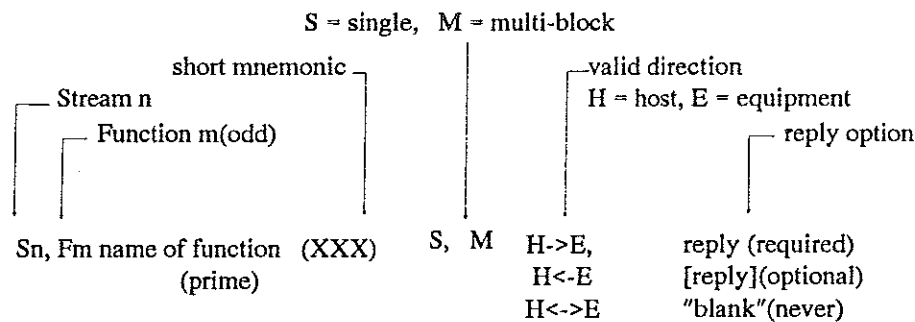


7. Message Detail

7.1 *Intent* - This section defines a number of specific functions in different streams which can be used as a basis for communication between host and equipment. The functions are defined in the form of transaction message pairs according to the transaction level requirements specified in Section 5.

7.2 The functions are described in a standard form which involves specification of the number, name, single or multiple block, direction of communication, nature of reply required, description, variable definition, and the detailed structure of the message in terms of lists and items. Double lines separate streams and single lines separate transactions to aid readability.

7.3 The abbreviations used in each transaction are as follows:



Description: A description of the action generated by the function.

Structure:

Detailed structure showing lists and defined items. Lists are denoted by a capital L followed by the length separated by a comma. The individual elements in the list are numbered on separate lines. Nested lists are indented to emphasize the structure. The detailed form of the items is given in the define section at the beginning of the transaction. The symbols "<" and ">" are used to enclose each item in the structure definition and imply that there is an item header.

Exception:

Special cases in the structure that have a different meaning.

Sn,Fm+1 Name of function
(secondary)

(same structure as above
except never with reply)

7.4 Stream 0 and Function 0 - Stream 0 is always defined as not used since a 0 is the most likely error. No functions are defined in stream 0.

7.4.1 Function 0 exists in all streams and has the same special meaning in each stream. A function 0 message closes a transaction, so that the originator will not have to

wait for a transaction timeout to proceed. Function 0 is sent in lieu of the expected secondary message when the interpreter cannot, because of a transmission error or some other reason, respond with the expected reply. It is not a requirement that the interpreter send function 0 to close a transaction.

7.5 Stream 1 Equipment Status - This stream provides a means for exchanging information about the status of the equipment, including its current mode, depletion of various consumable items, and the status of transfer operations.

7.5.1 Establish Communications State Model - The state model to be used for formally establishing communications in a SECS-I environment, shown in Figure S1.1, is based on the following set of assumptions:

1. The length of the interval between attempts to send the Establish Communications Request (CR) is a user-configurable constant, called **EstablishCommunicationsTimeout**, in units of seconds. An internal timer called **CommDelay** is used to control the actual time interval.
2. The **CommDelay** timer is initialized to begin timing, and time remaining is equal to the value in the constant **EstablishCommunicationsTimeout**. The **CommDelay** timer expires when it times out, and time remaining is zero.
3. A communications failure occurs in a SECS-I environment when, and only when, the RTY limit is exceeded.
4. A connection transaction failure occurs when attempting to establish communications and is

either a communications failure, a T3 transaction timeout while attempting to receive, receipt of a CRA with **COMMACK** not set to 0, or receipt of S1,F0 in response to CR.

5. The T3 timer begins after receiving ACK to the last block of a Primary message. A T3 timeout indicates the first block of the Reply was not correctly received within the T3 Timeout limit.
6. A communications link is established in a SECS-I environment following the first successful completion of any one S1,F13/ S1,F14 transaction where **COMMACK** = 0.
7. A transition from one state to another state is triggered by an event. An action occurs immediately following the transition into the new state (which may be the same state) and is not repeated within that state without a new transition.
8. For simplicity of description, to send means to "begin the process of attempting to send" a message rather than the successful completion of the transmission.
9. The state model for establishing communications is shown in Figure S1.1. The Table S1.1 describes transitions. Labels on the transitions in Figure S1.1 show the event that triggers each transition.

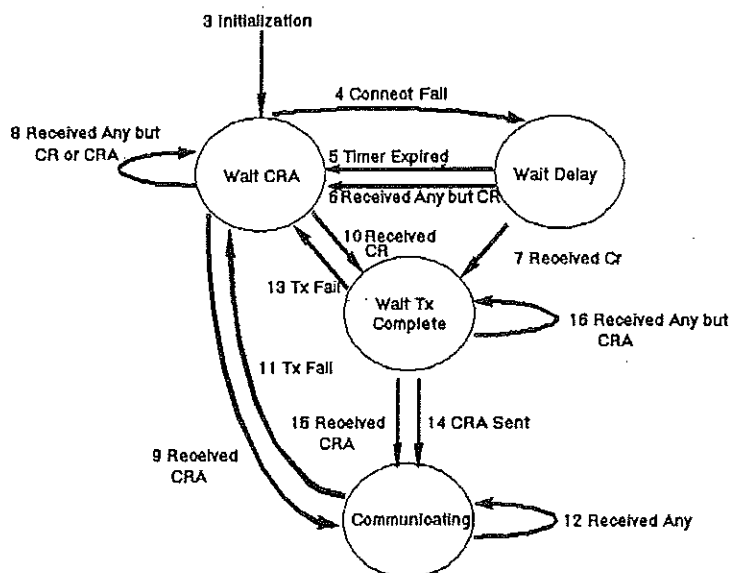


Figure S1.1
Establish Communications State Model



10. Communications States are as follows:

Wait CRA Wait for S1,F14 (CRA) from Host. May receive S1,F13 (CR) from Host.

Wait Delay Wait interval before retrying to establish communications. May receive S1,F13 (CR) from Host.

Wait Tx Complete Wait for the successful transmission of S1,F14 (CRA) to Host.

Communicating Communications have been formally established. May receive any message from the Host, including S1,F13 (CR).

Table S1.1
Table of Transitions

#	Current State	Trigger	New State	Action	Comment
3	(init)	Powerup, initialization.	Wait CRA	Initialize communications. Set CommDelay timer "expired". Send CR.	Also triggered by switch from state of "communications disabled".
4	Wait CRA	Connection Transaction failure (see assumption 4).	Wait Delay	Initialize CommDelay timer.	Do not send error message. Wait for timer to expire.
5	Wait Delay	CommDelay timer expired.	Wait CRA	Send CR.	Wait for CRA. May receive CR from Host.
6	Wait Delay	Received a message other than CR.	Wait CRA	Discard message. No reply. Set CommDelay timer "expired". Send CR.	Communications may now be "up".
7	Wait Delay	Received CR.	Wait Tx Complete	Send CRA with COMMACK = 0.	Equipment received CR and has not sent CR.
8	Wait CRA	Received a message other than CR or CRA.	Wait CRA	Discard message. No reply.	Continue to wait for CRA.
9	Wait CRA	Received CRA with COMMACK = 0.	Communicating	None.	Communications established. Normal path.
10	Wait CRA	Received CR.	Wait Tx Complete	Send CRA with COMMACK = 0.	Equipment sent CR and Host sends CR (connect collision).
11	Communicating	Communications failure (see assumption 3).	Wait CRA	Dequeue all messages queued to send. Set CommDelay timer "expired". Send CR.	

Table S1.1 (continued)
Table of Transitions

#	Current State	Trigger	New State	Action	Comment
12	Communicating	Received any message.	Communicating	If CR received, send CRA with COMMACK = 0.	Normal Communications.
13	Wait Tx Complete	Communications failure.	Wait CRA	Discard all messages queued to send. Set CommDelay timer "expired". Send CR.	Equipment attempt to send CRA failed.
14	Wait Tx Complete	CRA transmission completed successfully.	Communicating	None.	Normal path to completion. Communications established.
15	Wait Tx Complete	Received CRA with COMMACK = 0.	Communicating	None.	In some implementations, it is not possible to receive a message once the attempt to send begins.
16	Wait Tx Complete	Received a message other than CRA.	Wait Tx Complete	Discard message. No reply.	In some implementations, it is not possible to receive a message once the attempt to send begins.



S1,F0 Abort Transaction (S1F0)

S,H<->E

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

Structure: Header only

S1,F1 Are You There Request (R)

S,H<->E,reply

Description: Establishes if the equipment is on line. A function 0 response to this message means the communication is inoperative. In the equipment, a function 0 is equivalent to a timeout on the receive timer after issuing S1,F1 to the host.

Structure: Header only

S1,F2 On Line Data (D)

S,H<->E

Description: Data signifying that the equipment is alive.

Structure: L,2
1. <MDLN>
2. <SOFTREV>

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



S1,F3 Selected Equipment Status Request (SSR)

S,H->E,reply

Description: A request to the equipment to report selected values of its status.

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

L,n
1. <SVID₁>
.
.
n. <SVID_n>

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

<SVID₁, . . . , SVID_n>

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

S1,F4 Selected Equipment Status Data (SSD)

M,H<-E

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

Structure: L,n
1. <SV₁>
.
.
n. <SV_n>

Exceptions: If n =0, no response can be made. A zero length returned for SV_i means that SVID_i does not exist.

S1,F5 Formatted Status Request (FSR)

S,H->E,reply

Description: A request for the equipment to report the status according to a predefined fixed format.

Structure: <SFCD>

S1,F6 Formatted Status Data (FSD)

M,H<-E

Description: The equipment reports the value of status variables according to the SFCD.

Structure: Depends upon the structure specified by the status form.

Exception: A zero length item means that no report can be made.



S1,F7 Fixed Form Request (FFR)

S,H->E,reply

Description: A request for the form used in S1F6.

Structure: <SFCD>

S1,F8 Fixed Form Data (FFD)

M,H<-E

Description: The form is returned with the name of each value and the corresponding data format item having a zero length as a two element list in the place of each single item to be returned in S1F6.

Structure: Depends upon the form being specified.

Exception: A zero length item means the form is unavailable.

S1,F9 Material Transfer Status Request (TSR)

S,H->E,reply

Description: A request to report the status of all material ports to the host.

Structure: Header only

S1,F10 Material Transfer Status Data (TSD)

M,H<-E

Description: The equipment reports to the host the transfer status of all material ports.

Structure: L,2

1. <TSIP₁, . . . , TSIP_n>
2. <TSOP₁, . . . , TSOP_n>

Exception: A zero-length item means there are no such ports. A zero length list means there are no ports.
