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HP E1686A
DS1/DS3 Transceiver

User's Manual

SERIAL NUMBERS

This manual applies directly to modules with serial numbers prefixed 3432A. For additional important information about serial numbers, see Module Identification in Chapter 1.

HEWLETT PACKARD

HP Part No. E1686-90000
Microfiche Part No. E1686-90025
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DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Ltd.
Manufacturer's Address:	Queensferry Telecom Operation South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom

Declares that the product

Product Name :	DS1/DS3 Transceiver
Model Numbers:	HP E1686A
Product Options:	This declaration covers all options of the above products.

Conforms to the following Product Specifications:

Safety:	IEC 348 (1978)
EMC:	EN 55011 :1991, Group 1, Class A EN 50082-1:1992

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

The product meets the listed specifications when installed in a HP75000 series C, E1401A mainframe with all unused slots covered using single blanking plates with triple gaskets.

South Queensferry, Scotland	11/6/95	WR Pearson
Location	**Date**	**W.R.Pearson / Quality Manager**

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Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ/Standards Europe
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STATEMENT OF COMPLIANCE

This instrument has been designed and tested in accordance with IEC Publication 348, including Installation Category II and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

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Printing History

The Printing History shown below lists all Editions and Updates of this manual and the printing date(s). The first printing of the manual is Edition 1. The Edition number increments by 1 whenever the manual is revised. Updates, which are issued between Editions, contain replacement pages to correct the current Edition of the manual. Updates are numbered sequentially starting with Update 1. When a new Edition is created, it contains all the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this printing history page. Many product updates or revisions do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition or Update	Date	Part Number	Edition or Update	Date	Part Number
Edition 1	Jan 1995	E1686-90000			

Safety Symbols

	Instruction manual symbol affixed to product. Indicates that the user must refer to the manual for specific Warning or Caution information to avoid personal injury or damage to the product.		Direct current (DC)
	Indicates the field wiring terminal that must be connected to earth ground before operating the equipment - protects against electrical shock in case of fault.		Indicates hazardous voltages
	Frame or chassis ground terminal - typically connects to the equipment's metal frame.	WARNING	Calls attention to a procedure, practice, or condition that could cause bodily injury or death.
	Alternating current (AC)	CAUTION	Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

WARNINGS

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), an uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

DO NOT operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.

For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. DO NOT use repaired fuses or short-circuited fuseholders.

Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

DO NOT service or adjust alone: Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

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About this Manual

A brief outline of the content of this manual is given below.

Module Overview Provides a short description of the module.

Front-Panel Features Describes the various features on the module front-panel.

General Information Contains module identification, accessory information, reviews safety and electrostatic discharge (ESD) precautions, and provides procedures for replacing a defective module and returning it to Hewlett-Packard.

Installation Provides module installation instructions, and information about initial inspection and preparation for use. A verification procedure is also provided to check that the module is installed correctly.

Module Operation Provides a detailed module description, and describes how to operate the module using the HP ITG (HP Interactive Test Generator) software product.

Module Control Describes how to control the module using SCPI (Standard Commands for Programmable Instruments) register read and write commands, and by HP ITG control programs.

Command Reference Contains detailed information on the commands used to control the module.

Performance Tests Contains procedures which enable the electrical performance of the module to be tested to the warranted specification. The specifications in Appendix A are used as the performance standards.

Adjustments Contains procedures to adjust the variable components of the module should the module fail to meet its warranted specification.

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Specifications	Lists the operating specifications of the module.
Error Messages	Lists the error messages associated with programming/controlling the module, and provides a brief description of each error.
Using the HP E1686A in the HP 75000 Series 90 System	Describes the relationship between the elements in the Series 90 VXIbus system.
Programming using HP VEE	Describes how to control the module using HP VEE.

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Module Overview

The HP E1686A is a message-based C-size double slot VXI module which can independently transmit and receive DS3 and DS1/E1 signals. The DS3 can be channelized. The module can source and measure DS1's embedded within a DS3 as well as performing basic DS2 measurements. It can also insert and measure an E1 signal embedded in a DS3. The module can generate and detect alarms and can also error payloads and overhead bits. All appropriate frame rates, patterns, line codes and status indicators are also provided.

The module's separate DS1/E1 and DS3 ports allows independent and/or simultaneous transmit and receive operations at the two rates. For example, an M23 multiplexer can be tested by transmitting a DS1 into the multiplexer, the DS3 output from the multiplexer is applied to the module's DS3 receive port. The module then demultiplexes the DS1 from the received signal, then performs a bit error rate test.

The module also performs simultaneous independent DS1/E1 and DS3 test, that is a DS1 test can be run using the DS1 Tx and Rx ports, while a DS3 test is run using the DS3 Tx and Rx ports.

The module's DS1/E1 and DS3 transmitters and receivers operate independently of each other, that is the DS1 transmitter can be generating a signal with one frame type and pattern, while the DS1 receiver is receiving a different frame and pattern.

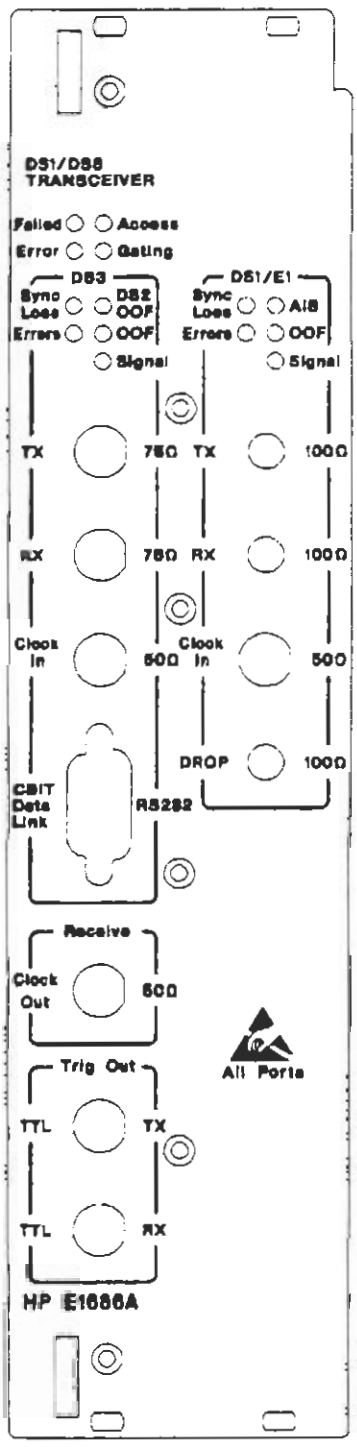
The main functions of the HP E1686A are detailed below:

- **DS3 Transmitter and Receiver** - The DS3 transmitter can be configured for desired framing, pattern, signal level, control bits and error injection. The DS3 receiver detects frame, pattern, parity, status, alarm and error events.
- **DS1 Transmitter and Receiver** - The DS1 transmitter can be configured for desired framing, pattern and error injection. The DS1 receiver detects frame, pattern, CRC 6, status, alarm and error events.
- **E1 Transmitter and Receiver** - The E1 transmitter and receiver are restricted to unframed signals only. Unframed E1 patterns can be transmitted with bit error injection, and unframed E1 patterns can be received and synchronized for bit error measurements.

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Front-Panel Features



ANNUNCIATORS

Access
This LED indicates the module is being accessed over the VXIbus backplane.

Failed
This LED indicates a failure has been detected by the command module.

Error
This LED indicates the presence of error messages in the module's SCPI command error queue. It turns OFF when all error messages have been read via the VXI control bus

Gating
This LED indicates the module is performing measurements. It flashes approximately five times per second for the duration of the measurement.

DS3 Annunciators
Sync Loss
This LED indicates that pattern synchronization is lost. Sync loss occurs if there are $\geq$240 bit errors in 1024 consecutive data bits.

Errors
This LED flashes each time an error occurs.

OOF
This LED indicates detection of a DS3 Out of Frame (OOF) condition.

Signal
This LED indicates that a valid DS3 signal is present at the DS3 RX input.

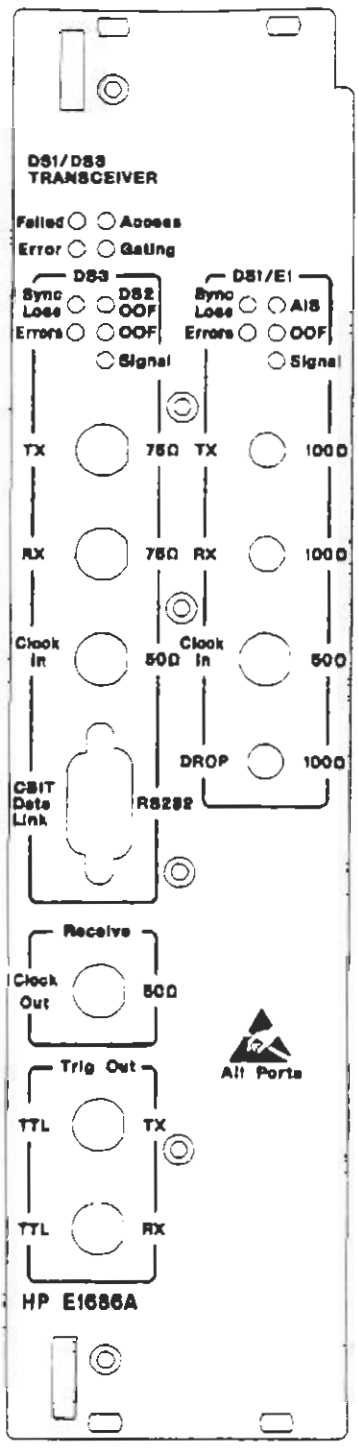
DS2 OOF
This LED indicates detection of a DS2 Out of Frame (OOF) condition.

DS1/E1 ANNUNCIATORS

Sync Loss
This LED indicates that pattern synchronization is lost. Sync loss occurs if there are $\geq$240 bit errors in 1024 consecutive data bits.

Errors
This LED flashes each time an error occurs.

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AIS
This LED indicates detection of an all ones unframed pattern. An AIS is one in which two consecutive frames contain less than three zeros.

DS1 OOF
This LED indicates detection of a DS1 Out of Frame (OOF) condition.

Signal
This LED indicates that a valid DS1/E1 signal is present at the DS1/E1 RX input.

E1686A TX/RX Ports

DS3 TX/RX Ports

TX Port This port provides a DS3 (44.736 Mb/s) data output signal. B3ZS coded for transmission to the system under test. Output levels are selectable from DSX3, high or 900 feet. The connector is BNC 75Ω to ground.

DS3 RX Port
This port accepts valid DS3, B3ZS coded data input signals.

DS3 Clock IN Port
Accepts external clock signals at 44.736MHz ±100 ppm, and levels of 1.0V to 5.0V p-p ac coupled.

CBIT Data Link Port
DS3 terminal data link drop/insert port. Interface RS-232-C (synchronous DCE). Connections are: ground,transmit data in, transmit clock out, receive data out, receive clock out.

Receive Clock Out Port
This port provides a clock signal at DS3 or DS1/E1 determined by the ITG panel selection.

DS1/E1 TX/RX PORTS

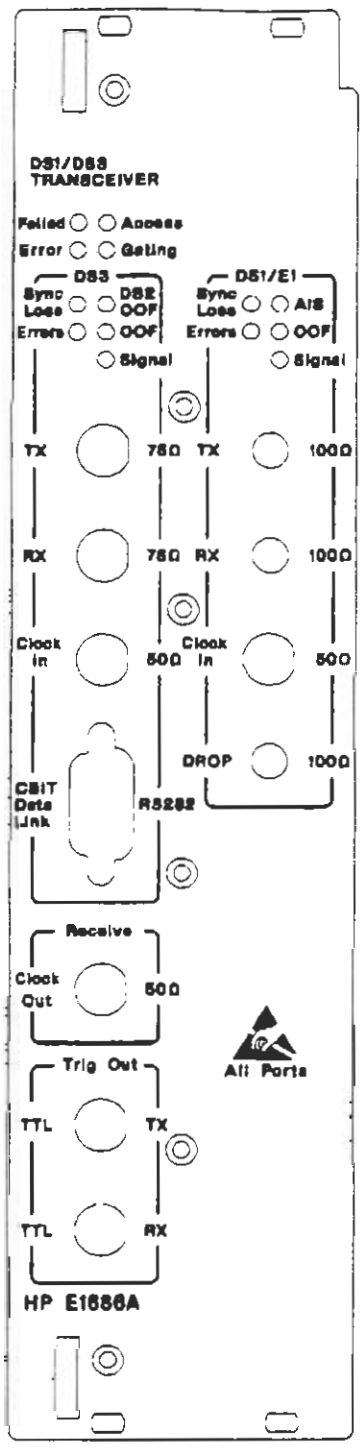
DS1/E1 TX Port

This port provides a DS1/E1 (1.544 Mb/s/2.048 MHz) data output signal for transmission to the system under test. Output level is DSX1. Line codes are: AMI, B8ZS (DS1); AMI, HDB3 (E1). The connector is Bantam 100Ω balanced.

DS1/E1 RX Port
This port accepts valid DS1/E1 coded data input signals.

DS1/E1 Clock IN Port
Accepts external clock signals at DS1/E1 rates ±100 ppm, and levels of 1.0 to 5.0V p-p ac coupled.

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Trig Out Ports

TX Trig Out Port

The trigger output can be selected from a number of different sources (see Appendix A). The output is either a pulse for momentary events or a level for continuous events.Output level is TTL compatible, 50Ω to ground.

RX Trig Out Port

The trigger output can be selected from a number of different sources (see Appendix A). The output is either a pulse for momentary events or a level for continuous events. Output level is TTL compatible, 50Ω to ground.

DROP Port

This port outputs the selected DS1/E1 channel dropped from a received DS3 signal.

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1

General Information

About this Chapter

This chapter contains general information about the HP E1686A, and comprises the following sections:

- **Module Identification**
  Explains module serial numbering for identification purposes.
- **Accessories**
  Lists the accessories supplied with the module.
- **Safety Considerations**
  Provides information about warnings and cautions in this manual.
- **ESD Precautions**
  Provides electrostatic discharge (ESD) information, and procedures to prevent ESD damage to the module.
- **Returning the Module for Service**
  Describes the service strategy, and how to obtain a replacement module using the Hewlett-Packard assembly-exchange program.
- **Storage and Shipment**
  Provides information about storing the module, and packaging for shipment.

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Module Identification

An identification label is attached to the module clamshell enclosure. The serial number on this label is in the form 0000A00000. It is in two parts: the first four digits and the letter are the serial prefix, and the last five digits are the suffix. The prefix is the same for all identical modules and changes only when a change is made to the module. The suffix, however, is assigned sequentially and is unique to each module. The contents of this manual apply to instruments with the serial prefix(es) listed under SERIAL NUMBERS on the title page.

Accessories

Accessories supplied with the module are listed below:

- "Installing Device Drivers" Installation Note (HP P/N E1401-90021)
- HP E1686A ITG Panel Disks - 2 off; part numbers are: E1686-10001 (DOS format) and E1686-10002 (LIF format).

Safety Considerations

To prevent personal injury, refer to the safety requirements provided in your Mainframe User's Manual before installing the module in the Mainframe.

Warnings and Cautions in the Manual

This manual contains WARNINGS and CAUTIONS which must be observed by the user to ensure safe operation, and retain serviceability of the module.

Warning



A WARNING calls attention to a condition or possible situation that could cause injury to the user.

Caution



A CAUTION calls attention to a condition or possible situation that could damage or destroy the product or the user's work.

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ESD Precautions

Caution

The module contains components sensitive to electrostatic discharge. To prevent component damage, carefully follow the handling precautions presented below.

The smallest static voltage most people can feel is about 3500 volts. It takes less than one tenth of that (about 300 volts) to destroy or severely damage static sensitive circuits. Often, static damage does not immediately cause a malfunction but significantly reduces the component's life. Adhering to the following precautions will reduce the risk of static discharge damage.

- Keep the module in its conductive plastic bag when not installed in the Mainframe. Save the bag for future storage of the module.
- Before handling the module, select a work area where potential static sources are minimized. Avoid working in carpeted areas and non-conductive chairs. Keep body movement to a minimum. Hewlett-Packard recommends that you use a controlled static workstation.
- Handle the module by its front-panel. Avoid touching any components or edge connectors. When you are ready to configure the module, remove it from its protective bag and lay it on top of the bag while keeping your free hand in contact with the bag. While configuring the module, keep one hand in contact with the bag. This technique maintains your body and the module at the same static potential.
- When you install the module, keep one hand in contact with the protective bag as you pick up the module with your other hand. Then, before installing the module, make contact with the metal surface of the Mainframe with your free hand to bring you, the module, and the mainframe to the same static potential. **This also applies whenever you connect/disconnect cables on the front-panel.**

Caution

The connectors on the front-panel of the module remain susceptible to ESD damage while the module is installed in the Mainframe, as indicated by the label:



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Returning the Module for Service

Servicing the module consists of verifying its operation using the operational verification tests provided in Chapter 6. These tests should be carried out on a yearly basis, or when the module is suspected faulty.

If any of the operational verification tests fail, return the module to Hewlett-Packard using the assembly-exchange program outlined below. A defective module is not customer-repairable.

If it is necessary to return the module to Hewlett-Packard, ensure the following information is sent with the module:

- Description of the problem (include error messages or specific performance data related to the problem).
- Whether the problem is constant or intermittent.
- Name and phone number of technical contact person.
- Return address.
- Model and option number of returned module.
- Full serial number of returned module.

Exchange Program

A defective module can be quickly replaced using the Hewlett-Packard assembly-exchange program. This program allows you to obtain a fully tested and guaranteed restored-exchange module at a reduced price. (The reduced price is contingent upon return of the defective module to Hewlett-Packard.)

The procedure for replacing a faulty module using the assembly-exchange program is as follows:

1. Order the replacement module through your nearest HP Sales and Service Office. A list of sales and service offices is given at the rear of this manual.

Note

Do NOT return the faulty module to Hewlett-Packard until you receive the restored-exchange module.

2. Complete the Exchange Failure Report which accompanied the restored-exchange module.
3. Return the faulty module and the Exchange Failure Report to Hewlett-Packard: re-use the special (exchange assembly) carton.

Note

Remove all accessories attached to the module before it enters the assembly-exchange program. Accessories are NOT exchangeable.

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Storage and Shipment

The module may be stored or shipped in environments within the following limits:

Temperature : −40°C to +70°C

Humidity : 95% Relative Humidity to 40°C

Altitude : Up to 4600 m (15,000 ft)

The module should also be protected from temperature extremes which may cause condensation within the clamshell enclosure.

Packaging Requirements

To prevent damage to the module during transit, original shipping or equivalent materials should be used to package the module. Containers and material identical to those used in the factory packaging are available through Hewlett-Packard offices. If the original or equivalent shipping material cannot be obtained, instructions for repackaging with commercially available materials are as follows:

1. Wrap the module in anti-static plastic to reduce the possibility of damage caused by ESD.
2. Use a double walled, corrugated cardboard carton of 90 kg (200 lb) test strength. The carton must be large enough to allow 5 to 8 cm (2 to 3 in) on all sides of the module for packing material, and strong enough to accommodate the weight of the module.
3. Surround the module with 5 to 8 cm (2 to 3 in) of packing material to protect the module and prevent it from moving in the carton.

Caution



NEVER use styrene pellets as packaging material. They do not adequately cushion the module, or prevent the module from moving in the carton. They also cause damage by generating static electricity.

If packing foam is not available, the best alternative is S.D.-240 Air Cap from Sealed Air Corporation (Commerce, California 90001). Air Cap looks like a plastic sheet with air bubbles. Wrap the module with several layers of pink (anti-static) Air Cap to protect the module, and prevent the module from moving within the carton.

4. Seal the carton with strong, nylon, adhesive tape.
5. Mark the carton "FRAGILE, HANDLE WITH CARE".
6. Retain copies of all shipping papers.
7. In any correspondence, refer to the module by model number and full serial number.

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2

Installation

About this Chapter

This chapter contains information to enable you to install the HP E1686A ready for use, and comprises the following sections:

- **Initial Inspection**
  Describes how to inspect the module for damage, how to ensure its electrical performance is correct, and who to notify if it is faulty.
- **Operating Environment**
  Reviews the module's operating temperature range and humidity.
- **Preparation for Use**
  Provides address settings and installation details, and describes the various connections to other modules prior to operation.
- **Verification**
  Describes how to check that the module is configured and installed correctly.

Initial Inspection

Warning



To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any part of the module.

Caution



This module contains components sensitive to electrostatic discharge (ESD). To prevent component damage, carefully follow the handling precautions contained in Chapter 1.

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the module has been checked mechanically and electrically. If the contents are incomplete, if there is any mechanical damage or defect, or if the module does not pass the Performance Tests, notify your local HP Sales and Service Office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the HP office. Keep the shipping materials for the carriers inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

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Operating Environment

The module may be operated at temperatures from 0°C to 55°C at altitudes up to 4600 m (15,000 ft). The module may be operated in environments up to 95% relative humidity at 40°C, but it should be protected from temperature extremes which may cause condensation within the clamshell enclosure.

To ensure adequate cooling for the module, do not obstruct the air vents in your Mainframe.

Preparation for Use

Addressing

This module is a servant to the Slot 0 Command Module. Its logical address is factory preset to 80.

The logical address is set using a series of switches. These switches are accessed through a slot in the module's clamshell enclosure, and are binary weighted. The weightings *0* (LSB) to 7 (MSB) are marked on the clamshell enclosure. If you want to change the module's logical address, ensure that the value you select does not conflict with the logical address of any other module serving the Slot 0 Command Module. The location and factory preset switch settings are shown in the following diagram:



For more details on addressing, see Appendix C.

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Module Slot Location

This module can normally be installed in any slot within a C-size VXI Mainframe. However, for further guidance refer to the installation manual supplied with your system.

Warning

To comply with the safety specifications of this module, the Mainframe must be fitted with a disconnect device to remove the power supply to the module.

Note

If your module is used as part of the HP 75000 Series 90 Modular Telecom Analyzer it must be located to the right of receiver or generator modules.

Installing, Removing and Cleaning the Module

Caution

- Review the ESD precautions in Chapter 1 before installing or removing the module.
- Do not install or remove the module while the Mainframe is powered-up. Doing so may cause irreparable damage to the module and/or Mainframe.

To install the module into the Mainframe:

1. Locate the module in the slot guides.
2. Slide the module along the guides until it just touches the connectors on the mainframe backplane.
3. Press the module firmly into the backplane connector. If there are modules in adjacent slots, care must be taken not to damage the springs located to the front left side of the module.
4. Secure the module to the Mainframe using the screws located at the top and bottom of the module.

To remove the module from the Mainframe:

1. Undo the screws located at the top and bottom of the module.
2. Extract the module from the mainframe backplane connector by simultaneously pressing up on the top "hp" logo handle, while pressing down on the bottom "VXIbus" logo handle.
3. Slide the module along the guides and out of the Mainframe.
4. Fit blanking panels (HP E1400-00202) to the Mainframe if you intend using the Analyzer without this module. Ensure the remaining modules comply with the slot location conventions, see *Module Slot Location*.

To clean the module:

- Use a soft, damp cloth to clean the front-panel and side covers.

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Mating Connectors

The mating connectors for the front-panel ports are listed below.

Port	Connector Type	Mating Connector Part Number
All Front-Panel Inputs and Outputs	BNC, 75 Ω	HP 1250-1448

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Verification

A short HP BASIC program is used to verify that the module has been correctly configured and installed. The program instructs the module to identify its manufacturer, product number, serial number, and firmware revision number.

Equipment Required

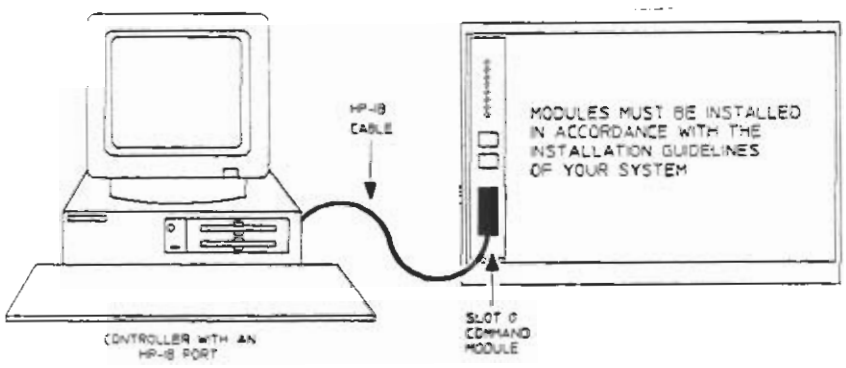
The equipment required to verify correct installation is listed below.

Mainframe	HP E1400B
Slot 0 Command Module	HP E1406A
Controller	*HP-IB compatible
HP-IB Cable	HP 10833B

* Any controller which can address HP-IB instruments using a programming language such as BASIC or C can be used. Refer to your controller's documentation for details.

Procedure

1. Ensure the Controller's HP-IB Interface Select Code is set to 7.
2. Ensure the Slot 0 Command Module's HP-IB primary address is set to 9.
3. Ensure the logical address of the module you are verifying is set to 80.
4. Connect the equipment as shown:



5. Enter the following program into the Controller:

```
10 ! Dimension module_id$
20   DIM module_id$[41]
30 ! Send identify command
40   OUTPUT 70910;"*RST;*IDN?"
50 ! Read response into controller
60   ENTER 70910;module_id$
70 ! Display response
80   PRINT module_id$
90   END
```


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6. Execute the program. A message in the following format will be displayed.

   ```
   HEWLETT-PACKARD,E1686A,0000A00000.01.00
   ```

   This indicates the module is configured and installed correctly.

   If the program fails to return the above message, check that the "Access" LED on the Slot 0 Command Module and the HP E1686A each flash once when the program runs.

   - If the "Access" LED on the HP E1686A does not light, check its logical address switch is set to 80, and that the commands in your program are exactly as those above.
   - If the "Access" LED on the Slot 0 Command Module does not light, check the settings given in the procedure above are correct, the commands in your program are exactly as those above, and that the HP-IB cable is connected properly.

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3

Module Description

About this Chapter

If you are using Windows/HP ITG or HP VEE on your controller, this chapter describes how you control the module's generate and receive functions using the HP ITG "soft-panels" facility.

The information in this chapter is organized as follows:

- **HP ITG User Interface**
  Provides a quick overview of the main features of the module's HP ITG "soft-panel". *See also note below.*
- **Transmit Operation**
  Provides information on how to set up and transmit DS3, DS1 and E1 signals, and also describes how to inject errors and alarm conditions.
- **Receive Operation**
  Provides information on how to set up and receive DS3, DS1 and E1 signals, and also describes how to measure errors and detect alarm conditions.

For an explanation of the module's indicators and connectors, refer to the page facing page 1-1 in Chapter 1.

Note

The HP E1686A can be controlled using either SCPI (Standard Commands for Controlling Instruments) commands as described in chapters 4 and 5, or the HP ITG (HP Interactive Test Generator) software product.

To support operation with HP ITG, the following disk is supplied with the module:

- E1686A Firmware Disk Rev. X.XX (HP P/N E1686-100XX)

Once loaded into a Windows®/HP ITG environment, the module can be controlled through a set of "soft-panels" that appear on the display of your controller. To display the HP E1686A panel, refer to *Loading Instruments* in Chapter 7 of the *HP Interactive Test Generator II User's Manual*.

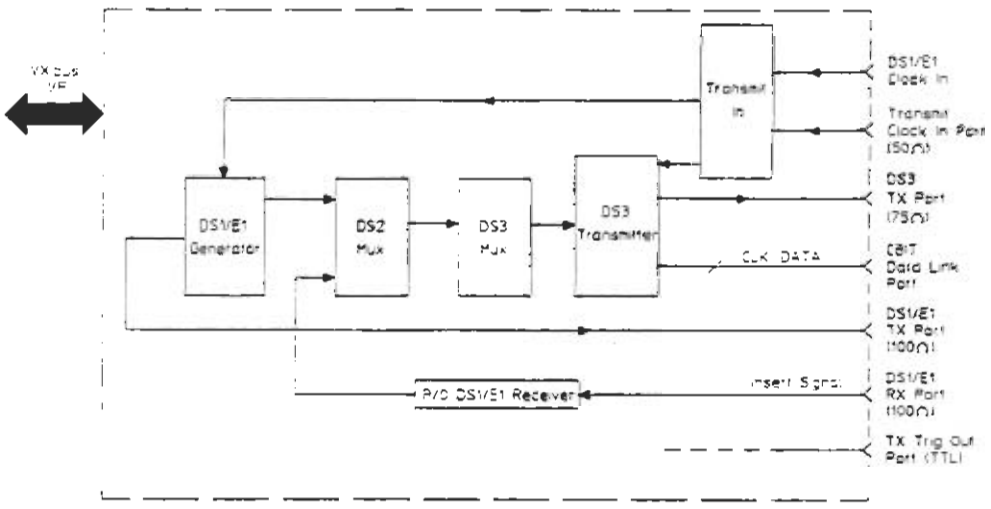
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Transmit Operation

The module's transmit functions are described in the following three sections in this chapter.

- Transmitting a DS3 Signal
- Transmitting a DS1 Signal
- Transmitting an E1 Signal

The module's transmit functions are shown in the following simplified block diagram:



DS1/DS3 Transceiver Transmit Block Diagram

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Transmitting a DS3 Signal

The DS3 transmit functions which are described in detail are listed below:

- Displaying the DS3 Transmit Parameters
- Selecting a DS3 Transmit Level
- Selecting a DS3 Frame Structure
- Selecting a DS3 Payload
- Selecting a DS3 Pattern
- Selecting a DS3 Clock Source
- Selecting a DS3 Trigger Output
- Generating a DS3 Error
- Generating a DS3 Alarm or Stressing Signal
- Generating DS2 C/Stuffing Bits
- Generating a DS2 Alarm Bit
- Generating a FEAC Code
- Generating Path Maintenance Data Link (PMDL) Bits
- Generating Data Link (DL) Bits
- Setting FEBE Bits

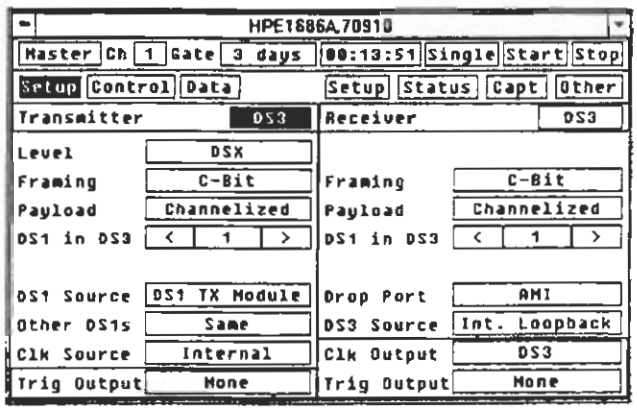
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Displaying the DS3 Transmit Parameters

If the DS3 transmit parameters are to be changed, or if you want to view them they must be displayed. Note, the module continuously transmits the DS3 signal.

To display the DS3 transmit parameters:

1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Transmitter** button to select DS3.



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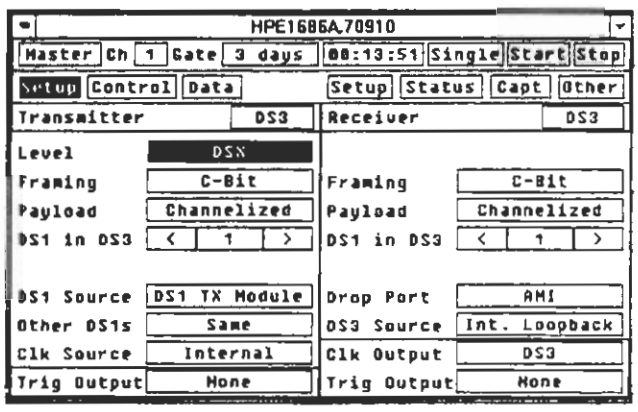
Selecting a DS3 Transmit Level

The DS3 signal is transmitted at one of the following three levels:

DSX
High
900 ft

To select a transmit level:

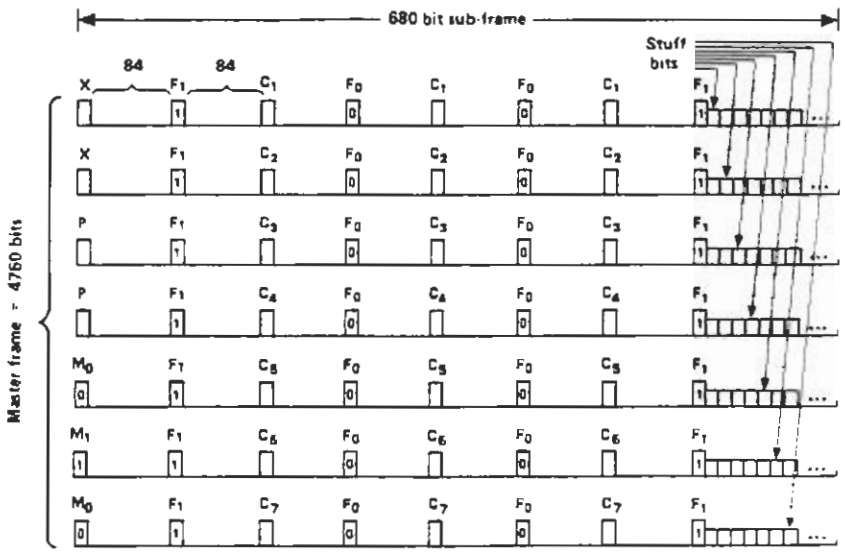
1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Level** button, then select the required level.



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Selecting a DS3 Frame Structure

The module can transmit an unframed or framed DS3 signal. The standard DS3 framing structure is shown below:



The 56 frame control bits for C-Bit and M23 DS3 frame formats are listed below:

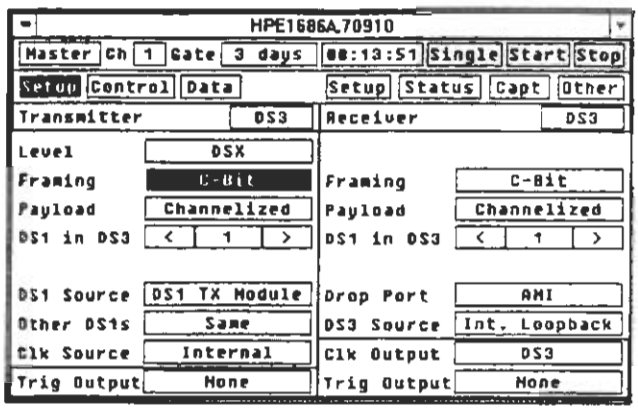
C-Bit
Frame alignment bits ($F_1F_0F_0F_1$) for each subframe: 1001
Alarm bits (X-Bits): 11 (normal) or 00 (alarm)
Multiframe alignment bits ($M_0M_1M_0$): 010
Section parity bits (P-Bits): Computed parity (11 or 00).
Far End Alarm Control (FEAC) bit : FEAC is 3rd C-Bit of subframe #1, the other two C-Bits are set to 1.
Data Link (DL) bits: 9 C-Bits of subframes #2, 6 and 7.
Path parity (CP-Bits - same value as P-Bits): 3 C-Bits of subframe #3.
Far End Block Error (FEBE) bits: 3 C-Bits of subframe #4.
Path Maintenance Data Link (PMDL) bits: 3 C-Bits of subframe #5.

M23
Frame alignment bits ($F_1F_0F_0F_1$) for each subframe: 1001
Alarm bits (X-Bits): 11 (normal) or 00 (alarm)
Multiframe alignment bits ($M_0M_1M_0$): 010
Section parity bits (P-Bits): Computed parity (11 or 00).
C-Bits: When the DS3 signal is channelized the C-Bits are used as stuffing indicator bits.

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To select a frame structure:

1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Framing** button, then select the required framing.

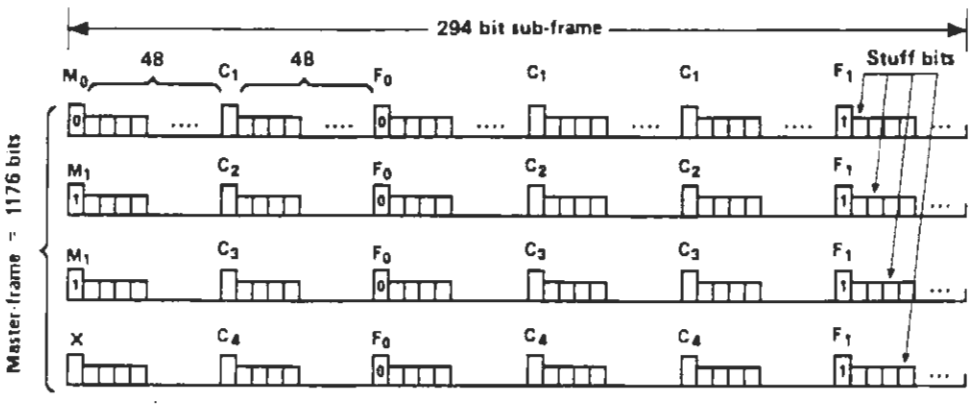


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Selecting a DS3 Payload

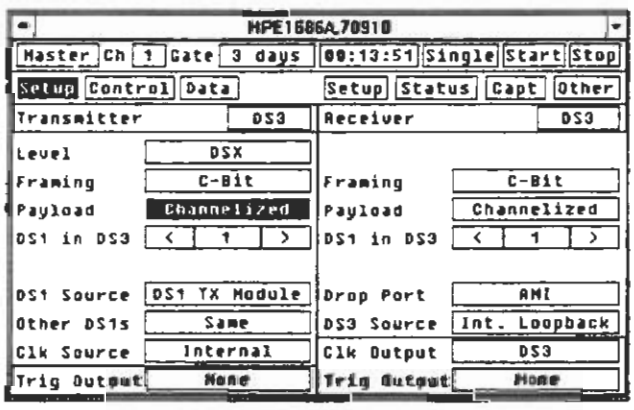
When the module is transmitting a framed DS3 signal, the payload carried can be unchannelized or channelized. If the payload is unchannelized it carries one of the patterns described in the next section. If the payload is channelized, the DS3 is structured with 7 DS2s. The DS2's contains 4 DS1s or 3 E1s which gives a total for 28 DS1 channels or 21 E1 channels in the DS3 structure.

The channelized payload contains one foreground channel which is user selectable, all other channels are background. The contents of the foreground channel can be provided from an external source, or internally by the module. The contents of the background channels is also user selectable.



To select a payload:

1. Select the Transmit `Setup` subpanel.
2. Click the mouse on the `Payload` button - toggles the payload selection between `channelized` and `unchannelized`.



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To select a channel structure and its contents:

1. Click the mouse on the **Transmitter** button to select DS1/E1.
2. Click the mouse on the **Mode** button, then select DS1 or E1.
3. Click the mouse on the **Transmitter** button again to select DS3.
4. Ensure the **Payload** is set to **Channelized**.
5. Select the foreground channel:

   If DS1 is selected, click the mouse on the **DS1 in DS3** button. then select a value between 1 and 28, all other channels are background.

   If E1 is selected, click the mouse on the **DS2 in DS3** and **DS2 in DS3** buttons, selecting the appropriate group (1 to 7) and tributary (1 to 3) values in turn. They define which channel is the foreground channel, all other channels are background.
6. Select the foreground channel signal source:

   If DS1 is selected, click the mouse on the **DS1 Source** button - toggles the DS1 source selection between **DS1 TX Module** and **External**.

   If E1 is selected, click the mouse on the **E1 Source** button - toggles the E1 source selection between **E1 TX Module** and **External**.

   If the module is providing the foreground channel signal, see the *Transmitting a DS1 Signal* or *Transmitting a E1 Signal* sections in this manual for selecting DS1 or E1 signal parameters.

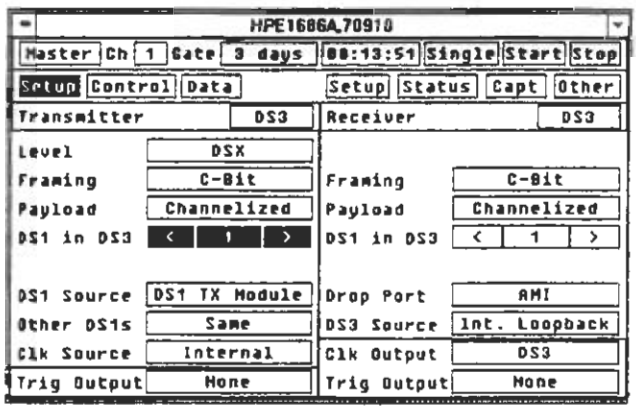
   If the signal for the foreground channel is being supplied from an external DS1 or E1 source, then the signal is applied to the module thru the receive *Rx DS1/E1* input port. The DS1/E1 receiver input parameters must match the incoming signal.

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7. Select the background channel contents:

   If DS1 is selected, click the mouse on the `Other DS1s` button, then select the data to transmitted as background payload.

   If E1 is selected, click the mouse on the `Other E1s` button, then select the data to transmitted as background payload.



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Selecting a DS3 Pattern

When the module is transmitting an unframed or unchannelized framed DS3 signal, the patterns which are available for transmisson are listed below:

PRBS15 — This PRBS 2^{15}-1 pattern can be inverted.

PRBS20 — This PRBS 2^{20}-1 pattern can be inverted.

PRBS23 — This PRBS 2^{23}-1 pattern can be inverted.

User — A 2- to 8-bit programmable pattern, with the most significant bit (left most bit) to follow the frame bit location for all lengths except 5 and 8 (that is patterns that divide evenly by 84). The default pattern is 10101010.

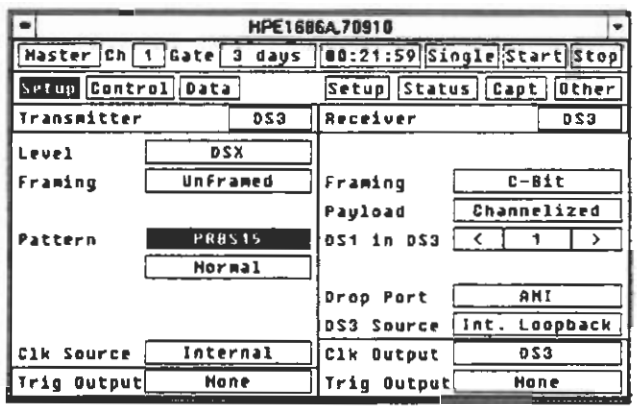
All Ones — An all ones pattern.

Idle — A frame with valid framing (F and M) bits and an information bits set to 1100.... with the 11 bits following each framing and control bit. C-Bits are set to 0 in M-subframe 3. Both X-Bits are set to 1.

To select a pattern:

1. Select the Transmit `Setup` subpanel.
2. Ensure that the `Framing` is set to `Unframed`, or if set to `Framed` ensure the `Payload` is set to `Unchannelized`.
3. Click the mouse on the `Pattern` button, then select the required pattern.

   If a PRBS pattern is selected, it can be inverted.



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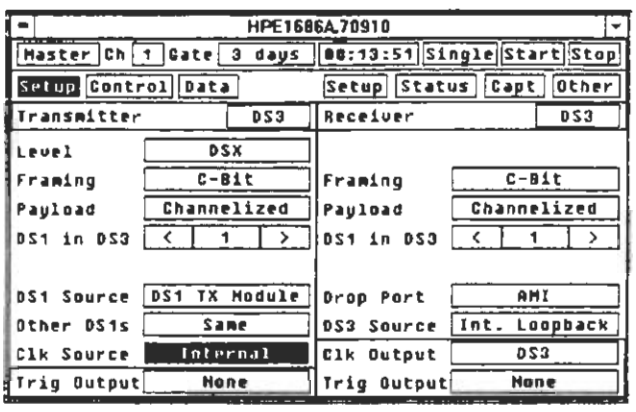
Selecting a DS3 Clock Source

The module's DS3 transmit circuits can be timed from one of the following sources:

An internal clock.
An external clock which is applied to the module thru the *DS3 Clock In* port.
A clock recovered from a data stream applied to the module's receiver (loop mode).

To select a clock source:

1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Clk Source** button, then select the required clock source.



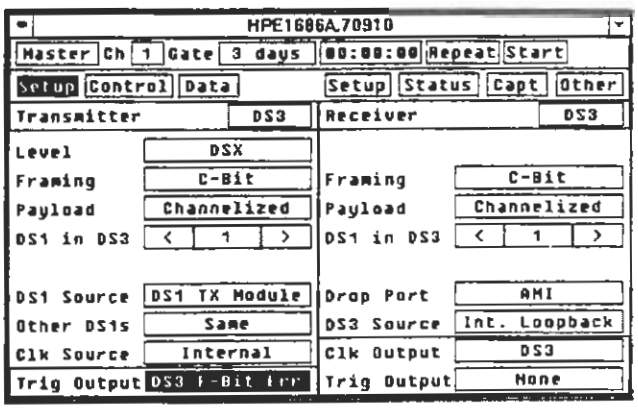
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Selecting a DS3 Transmitter Trigger Output

The transmitter can provide a trigger output pulse for various DS3 error generation and alarm conditions.

To select a trigger output:

1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Trig Output** button, then select the required DS3 trigger condition.



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Generating DS3 Errors

The DS3 error types are listed below:

Bit	Information bits are errored without erroring the parity bits. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
Bit+Parity	Information and parity bits are errored. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 in 10^{-9}.
Code (BPV)	Bipolar violations - introduces two successive ones of the same polarity that violate the line code rules. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
F-Bit Framing	Framing bits F1 and F0 are errored. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
F-Bit N in M	F-Bit errors of the form N errors in M F-Bits can be injected singly, or continuously. When injected singly, the error distribution is N errors clustered together at the beginning of the M group of bits, then a single error is placed at the M^{th} bit position. When injected continuously, the N errors are clustered into one group and occur every M bits, where N=1 to 9 and M=10 to 32.
M-Bit Framing	Framing bit M1 is errored. Between 1 and 5 consecutive frames can be errored.
FEBE	All of the FEBE bits (3 C-Bits in subframe 4) can be errored by overwriting them with 000. Errors can be injected singly or at continuous rates of 1.06 x 10^{-4} to 1.06 x 10^{-8}.
Code (EXZ)	Introduces selectable excess zeros (between 3 and 6 bits) which violate the line code rules. Errors are injected for a single duration. Note excess zeros are injected with no regard to the data being overwritten. Therefore zeros which form part of the data can be overwrittten.

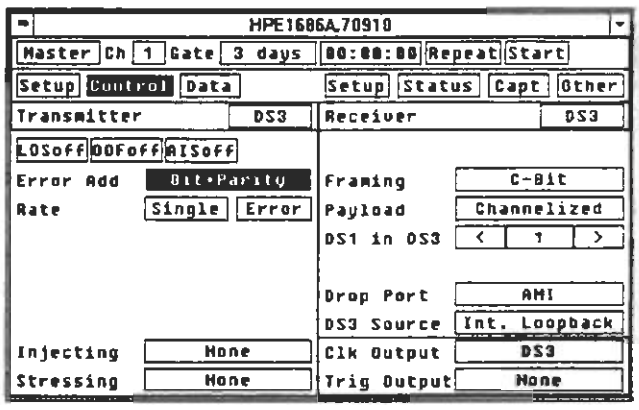
Note, the module's framing and payload configurations determine which specific error types will be available for selection.

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To select an error type and rate:

1. Select the Transmit **Control** subpanel.
2. Ensure the **Transmitter** button is displaying DS3.
3. Click the mouse on the **Error Add** button, then select the required error type.
4. Click the mouse on the **Rate** button, then select the required error rate.

   Note, depending on the error type and rate/duration selected, other associated error rate functions may be available for selection. For example, in the figure below **Period** and **% Duty** are available for selection when **Burst** is the selected error rate.



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Generating a DS3 Alarm or Stressing Signal

The module can generate the following DS3 alarms and stressing signals:

LOS — Loss of Signal - This alarm is generated using the `LOS` button on the Control subpanel, or from the Stressing subpanel when the LOS stressing duration is set to continuous. The module can also transmit a single shot stressing signal by transmitting a user selectable number of zeros, in the range 75 to 275 when the stressing duration is set to single.

AIS — Alarm Indication Signal - This alarm is generated by transmitting the AIS signal for 3 consecutive one second intervals. It is controlled using the `AIS` button on the Control subpanel, or from the Stressing subpanel when the AIS stressing duration is set to continuous. The module can also transmit a single shot stressing AIS signal by transmitting the AIS signal for 110 milliseconds when the stressing duration is set to single.

The AIS signal is a 1010.... data pattern with valid framing, the 1 follows all framing bits. All C-Bits are 0 and all X-Bits are 1.

OOF — Out of Frame - This alarm is generated using the `OOF` button on the Control subpanel, or from the Stressing subpanel. Overwrites the the 1001 framing pattern with 0000.

Special Codes — The following codes can be generated continuously, or for single-shot bursts of 110 ms while nominally transmitting any of the DS3 data patterns, see the *Selecting a DS3 Pattern* section of this chapter.

AIS excl C-Bits
Unframed 1010
Framed All Ones
Unfrm All Ones
X-Bit Toggle

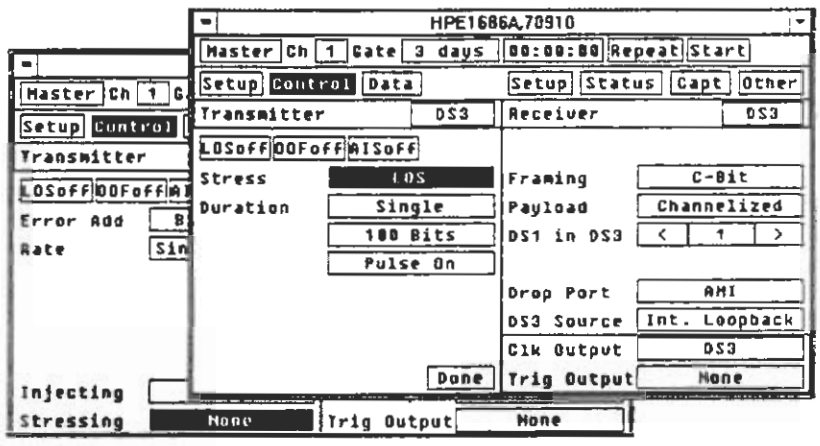
Note, for AIS excl C-Bits, Framed All Ones the signal must be framed. If X-Bit Toggle is selected, X-Bits from the steady-state valued can be inverted for 0.9, 1.0 or 1.1 seconds.

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To select an alarm or stressing signal:

1. Select the Transmit **Control** subpanel.
2. Ensure the **Transmitter** button is displaying DS3.
3. Select the **Stressing** subpanel.
4. Click the mouse on the **Stress** button, then select the required alarm type.
5. Click the mouse on the **Duration** button, then select the required duration.

   Note, when **Single** is selected, other associated stressing parameters may be available for selection. For example, in the figure below when **LOS** and **Single** are selected, the user can select the number of zeros which are to be transmitted, in the range 75 to 275. The single shot transmission is initiated by using the **Pulse On** button.



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Generating DS2 C/Stuffing Bits

When the module is transmitting a DS3 signal which is framed and channelized with a DS1 mapped DS2 structure, the DS2 C-Bits are used as DS2 stuffing indicator bits during normal operation. Under normal operation all 3 C-Bits in a given DS2 row are the same. However, the module can test special loopback codes by manipulating the DS2 C-Bits within the DS3 (which corresponds to a specific selectable DS1) by generating one of the following states:

Invert the C1 bit.
Invert the C2 bit.
Invert the C3 bit.
Invert the stuff bits from the normal state.

The normal stuff bit state can be selected from one of the following:

Stuff state is same value as the last information bit.
Stuff state is a 1.
Stuff state is a 0.

The length of time the C-Bits are inverted can be selected from one of the the following:

Continuous off/on.
Continuous off with a single burst of either 4 or 5 frames on.
Continuous on with a single burst of either 4 or 5 frames off.

Note, stuff bit control and detection is based on counting only stuffed frames.

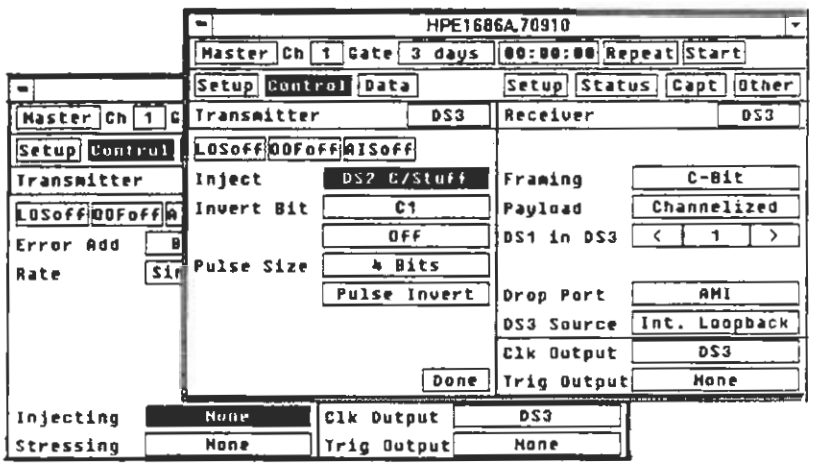
To select DS2 C/Stuffing bit :

1. Select the Transmit `Control` subpanel.
2. Ensure the `Transmitter` button is displaying `DS3`.
3. Select the `Injecting` subpanel.
4. Click the mouse on the `Inject` button, then select `DS2 C/Stuff`.
5. Click the mouse on the `Invert Bit` button, then select the required C-Bit.

   Note, other associated DS2 C/Stuff parameters are available for selection. For example, in the figure below when `C1` and `Off` (pulse inverted) are selected and the `Pulse Size` is set for 4 or 5 bits.

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6. Select the Transmit **Data** subpanel.
7. Ensure the **Transmitter** button is displaying DS3.
8. Select the **DS2 Stuff** button, then select the required normal bit stuff state.



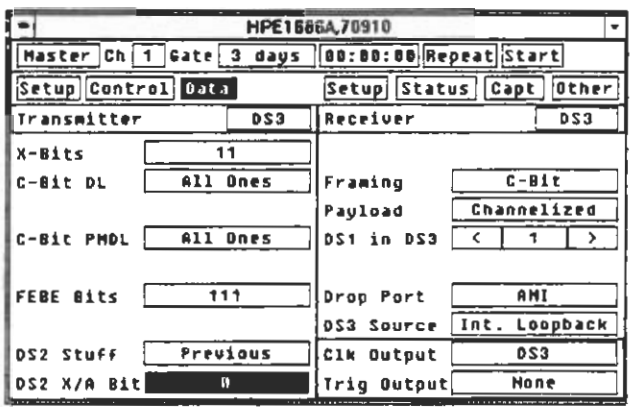
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Generating a DS2 Alarm Bit

When the module is transmitting a DS3 signal which is framed and channelized, the alarm X-Bit (DS1 mapped DS2 structure) or A-Bit (E1 mapped DS2 structure) can be set to 0 or 1.

To select DS2 alarm bit :

1. Select the Transmit `Data` subpanel.
2. Ensure the `Transmitter` button is displaying DS3.
3. Click the mouse on the `DS2 X/A Bit` button, then select `0` or `1`.



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Generating FEAC Codes

The module can generate a Far End Alarm Control (FEAC) signal when it is transmitting a DS3 signal which is C-Bit framed and channelized with a DS1 mapped DS2 structure. The FEAC signal is transmitted in the 3rd C-Bit of subframe #1.

The normal status of the FEAC bit is 1, indicating that there are no alarm, status or loop codes present. The module can transmit any of the 11 alarm/status codewords defined by ANSI T1.107a, or can transmit user defined codewords. These can be transmitted continuously, or for a burst duration of 9 or 10 codewords.

While transmitting the above steady state FEAC codes or during FEAC idle condition the user can inject special FEAC loopback code sequences. These are defined as "Action" followed by "Message". The Action choices available for selection are as follows:

Line Loopback **Activate**
Line Loopback **Deactivate**.

There are 30 Message codewords available for selection which define the line being looped.

The Action codeword is transmitted N times followed by the Message codeword N times, where N is selectable in the the range 3 to 15 (6 to 30 octets). The default length will be 10 codewords. The complete FEAC loop sequence is 12 to 60 octets long.

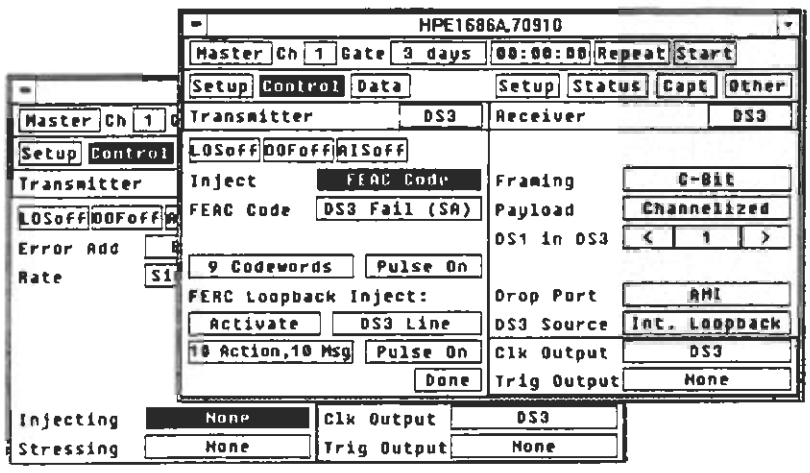
To select a FEAC codeword:

1. Select the Transmit **Control** subpanel.
2. Ensure the **Transmitter** button is displaying DS3.
3. Select the **Injecting** subpanel.
4. Click the mouse on the **Inject** button, then select **FEAC Code**.
5. Click the mouse on the **FEAC Code** button, then select the required codeword.
6. Click the mouse on the buttons below the **FEAC Code** button to select how often the codeword is to be transmitted and to initiate FEAC injection.

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To select FEAC loopback injection:

1. Click the mouse on the Action button, then select either Line loopback `Activate` or `Deactivate`.
2. Click the mouse on the Message button, then select the required line to be looped.
3. Click the mouse on the Message to Action duration button, then select the required duration.



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Generating Path Maintenance Data Link (PMDL) Bits

The module transmits the three PMDL bits (which are the three C-Bits of subframe #5) when the module is transmitting a DS3 signal that is C-Bit framed.

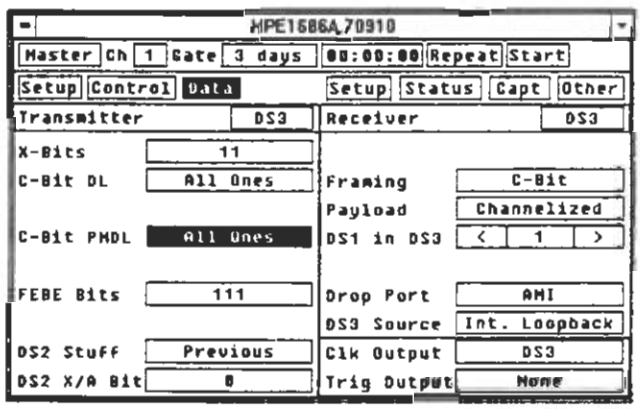
The bits can set as follows:

All Ones
User
External (thru the *C-BIT Data Link* port)

To select a PMDL bit pattern:

1. Select the Transmit `Data` subpanel.
2. Ensure the `Transmitter` button is displaying `DS3`.
3. Click the mouse on the `C-Bit PMDL` button, then select data to be transmitted.

   When User is selected, click the mouse on the button immediately below User then select the bit pattern to be transmitted.



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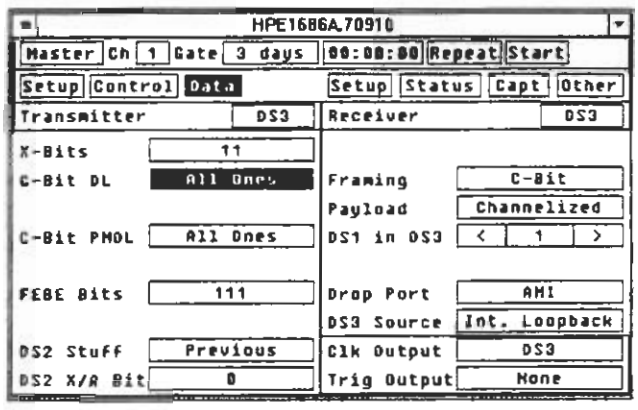
Generating Data Link (DL) Bits

The module transmits the nine DL bits (which are the three C-Bits of subframes #2, 6 and 7) when the module is transmitting a DS3 signal that is C-Bit framed with a DS1 mapped DS2 structure.

To select a DL bit pattern:

1. Select the Transmit **Data** subpanel.
2. Ensure the **Transmitter** button is displaying DS3.
3. Click the mouse on the **C-Bit DL** button, then select data to be transmitted.

   When User is selected, click the mouse on the button immediately below User then select bit pattern to be transmitted.



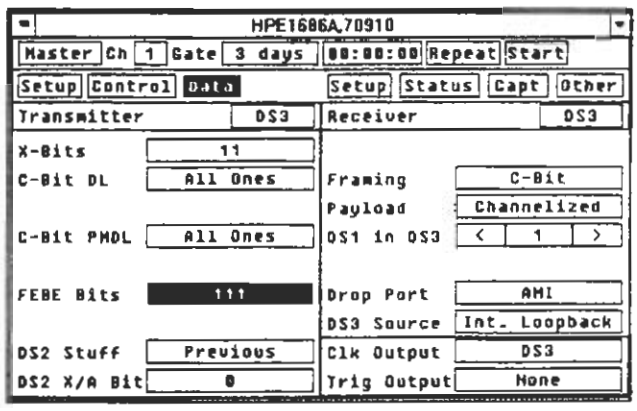
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Setting FEBE Bits

The module transmits three FEBE bits (which are the three C-Bits of subframe #4) when the module is transmitting a DS3 signal that is C-Bit framed with a DS1 mapped DS2 structure.

To select a FEBE bit pattern:

1. Select the Transmit **Data** subpanel.
2. Ensure the **Transmitter** button is displaying DS3.
3. Click the mouse on the **FEBE Bits** button, then select data to be transmitted.



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Transmitting a DS1 Signal

The DS1 transmit functions which are described in detail are listed below:

- Selecting the DS1 Signal
- Selecting a DS1 Line Code
- Selecting a DS1 Frame Structure
- Selecting a DS1 Pattern
- Selecting a DS1 Clock Source
- Selecting a DS1 Trigger Output
- Generating DS1 Errors
- Generating DS1 Alarms

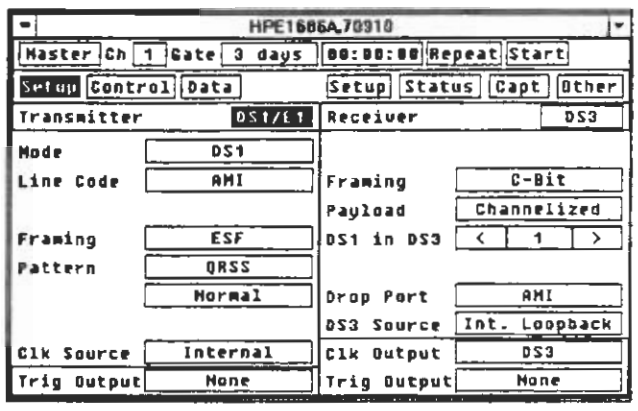
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Selecting the DS1 Signal

The module can transmit either a DS1 or E1 signal. If the DS1 signal is to be transmitted, or if you want to view or change the DS1 parameters, use the following procedure.

To select the DS1 signal:

1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Transmitter** button to select DS1/E1.
3. Click the mouse on the **Mode** button to select DS1.



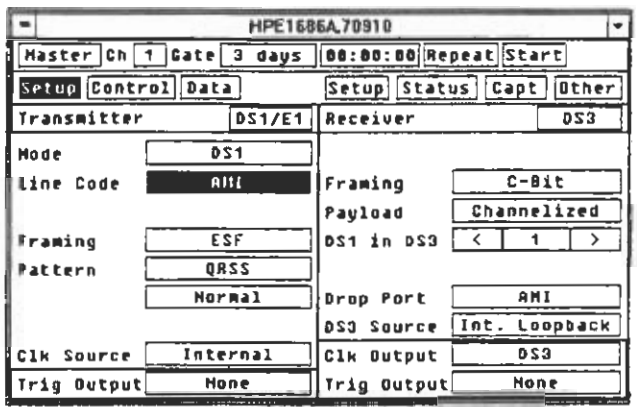
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Selecting a DS1 Line Code

The DS1 signal can be transmitted with either AMI or B8ZS line coding.

To select a line code:

1. Ensure the Transmit **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the **Line Code** button, then select the required line code.



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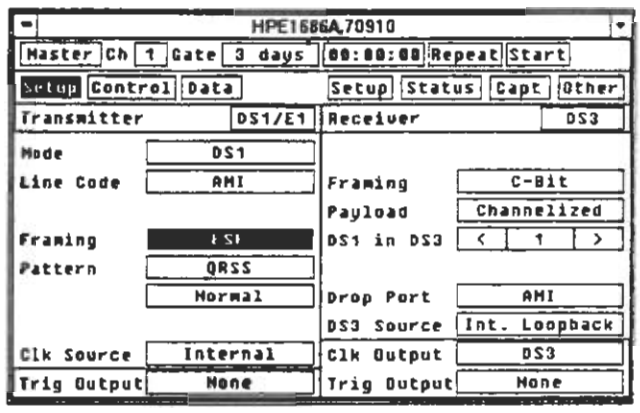
Selecting a DS1 Frame Structure

The DS1 signal can be unframed or can be framed using one of the following:

D4 (Super Frame)
ESF (Extended Super Frame)
SLC96 (Also known as TR8)

To select a frame structure:

1. Ensure the Transmit **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the **Framing** button, then select the required frame structure.



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Selecting a DS1 Pattern

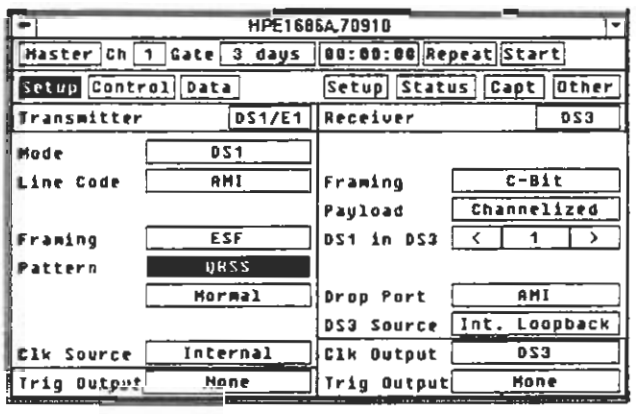
When the module is transmitting an unframed or framed DS1 signal, the patterns which are available for transmission are listed below:

QRSS	This pattern can be inverted.
PRBS15	This PRBS 2^{15}-1 pattern can be inverted.
PRBS20	This PRBS 2^{20}-1 pattern can be inverted.
PRBS23	This PRBS 2^{23}-1 pattern can be inverted.
User	A 2- to 24-bit pattern, with the most significant bit (left most bit) to follow the frame bit location for pattern lengths that divide evenly into 192.
All Ones	An all ones pattern.
3 in 24	This fills the information bits with a 12.5% ones density pattern synchronzed to the frame bit location as follows: F010001000000000000000100.
Loop Up	A 2- to 24-bit pattern. The default loop up pattern is 10000.
Loop Down	A 2- to 24-bit pattern. The default loop down pattern is 100.

To select a pattern:

1. Ensure the Transmit **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the **Pattern** button, then select the required pattern.

   If a QRSS or PRBS pattern is selected, it can be inverted.



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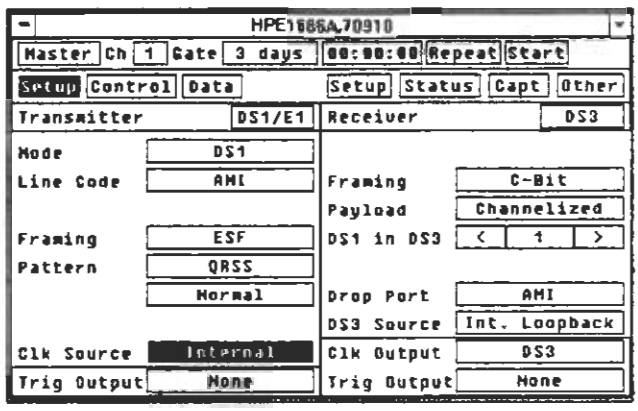
Selecting a DS1 Clock Source

The module's DS1 transmit circuits can be timed from one of the following sources:

An internal clock.
An external clock which is applied to the module thru the *DS1/E1 Clock In* port.
A clock recovered from a data stream applied to the module's receiver (loop mode).

To select a clock source:

1. Ensure the Transmit **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the **Clk Source** button, then select the required clock source.



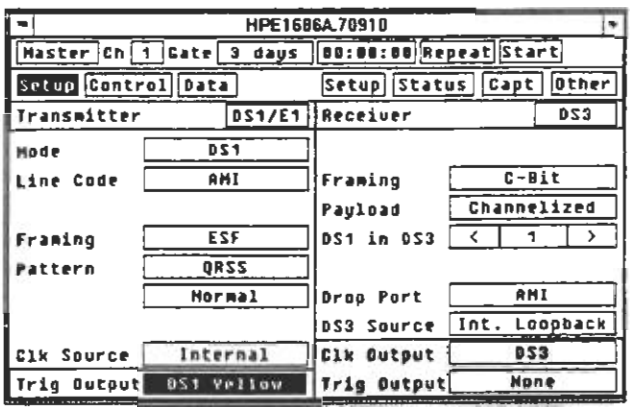
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Selecting a DS1 Transmitter Trigger Output

The transmitter can provide a trigger output pulse for various DS1 error generation and alarm conditions.

To select at trigger output:

1. Ensure the Transmit `Setup` subpanel is displaying the DS1 parameters.
2. Click the mouse on the `Trig Output` button, then select the required DS1 trigger condition.



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Generating DS1 Errors

The DS1 error types are listed below:

Bit	Information bits are errored prior to the calculation of CRC. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
Bit+Parity	The information and parity bits are errored.
Code (BPV)	Bipolar violations - introduces two successive ones of the same polarity that violate the line code rules. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
F-Bit	Framing bits are errored. If D4 or SLC96 framing are selected, the Ft bits are errored while the FPS bits are when ESF is selected. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
Code (EXZ)	Introduces selectable excess zeros (between 3 and 16 bits) which violate the line code rules. Errors are injected for a single duration.

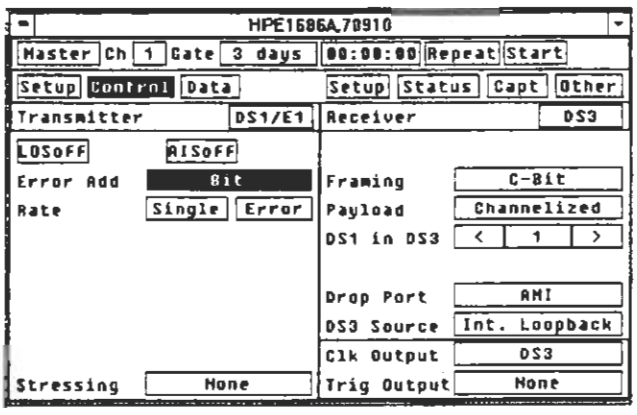
To select an error type and rate:

1. Ensure the Transmit **Setup** subpanel is displaying the DS1 parameters.
2. Select the Transmit **Control** subpanel.
3. Click the mouse on the **Error Add** button, then select the required error type.

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4. Click the mouse on the **Rate** button, then select the required error rate.

   Note, depending on the error type and rate/duration selected, other associated error rate functions may be available for selection. For example, in the figure below **Period** and **% Duty** are available for selection when **Burst** is the selected error rate.



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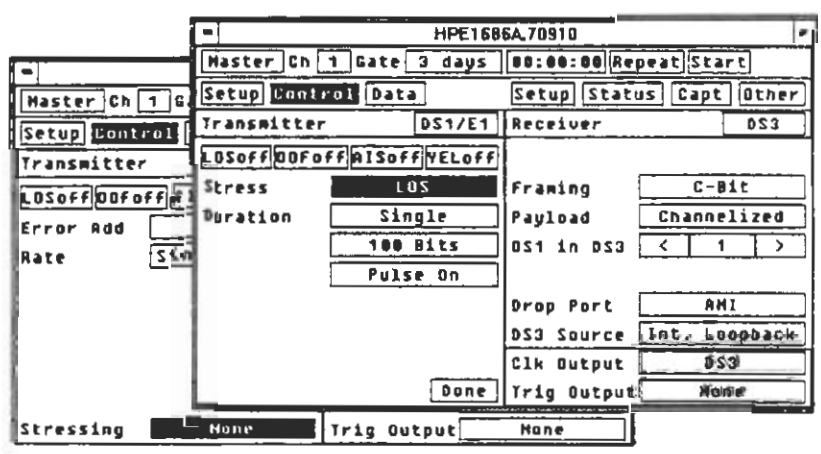
Generating a DS1 Alarm or Stressing Signal

The module can generate the following DS1 alarms and stressing signals:

LOS	This alarm is generated using the `LOS` button on the Control subpanel, or from the Stressing subpanel when the LOS stressing duration is set to continuous. The module can also transmit a single shot stressing signal by transmitting a user selectable number of zeros, in the range 75 to 275 when the stressing duration is set to single.
AIS	This alarm is generated by transmitting an all ones pattern. It is controlled using the `AIS` button on the Control subpanel, or from the Stressing subpanel.
OOF	This alarm is generated by overwriting all 1's in the frame pattern with zero.It is controlled using the `OOF` button on the Control subpanel, or from the Stressing subpanel.
Yellow	This alarm is generated by transmitting zero in bit 2 of 256 or more DS0 channels (D4/SLC96 framing), or by transmitting sixteen pattern sets of 00(hex) and FF(hex) in the Data Link channel (ESF framing).

To select an alarm or stressing signal:

1. Ensure the Transmit **`Setup`** subpanel is displaying the `DS1` parameters.
2. Select the Transmit **`Control`** subpanel.
3. Select the **`Stressing`** subpanel.
4. Click the mouse on the **`Stress`** button, then select the required alarm type.
5. If the LOS alarm is selected, click the mouse on the `Duration` button, then select the required duration.



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Transmitting an E1 Signal

The E1 transmit functions which are described in detail are listed below:

- Selecting the E1 Signal
- Selecting an E1 Line Code
- Selecting an E1 Pattern
- Selecting an E1 Clock Source
- Selecting an E1 Trigger Output
- Generating E1 Errors
- Generating E1 Alarms

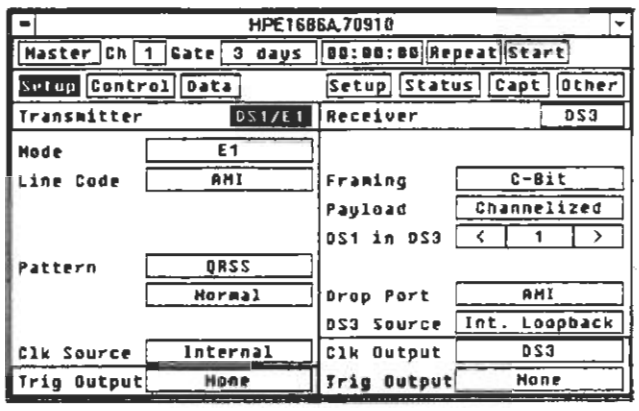
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Selecting the E1 Signal

The module can transmit either a DS1 or E1 signal. If the E1 signal is to be transmitted, or if you want to view or change the E1 parameters, use the following procedure.

To select the E1 signal:

1. Select the Transmit **Setup** subpanel.
2. Click the mouse on the **Transmitter** button to select DS1/E1.
3. Click the mouse on the **Mode** button to select E1.



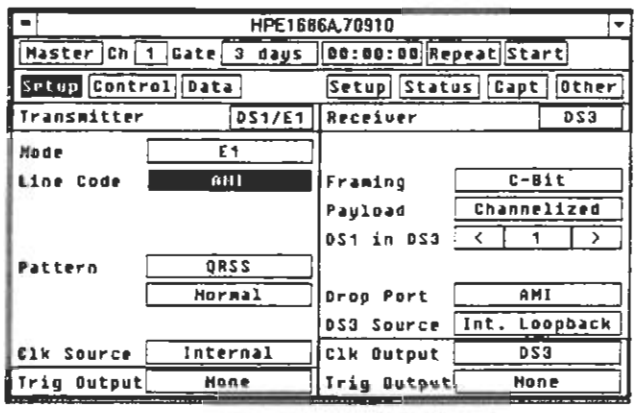
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Selecting a E1 Line Code

The E1 signal can be transmitted with either AMI or HDB3 line coding.

To select a line code:

1. Ensure the Transmit **Setup** subpanel is displaying the E1 parameters.
2. Click the mouse on the **Line Code** button, then select the required line code.



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Selecting a E1 Pattern

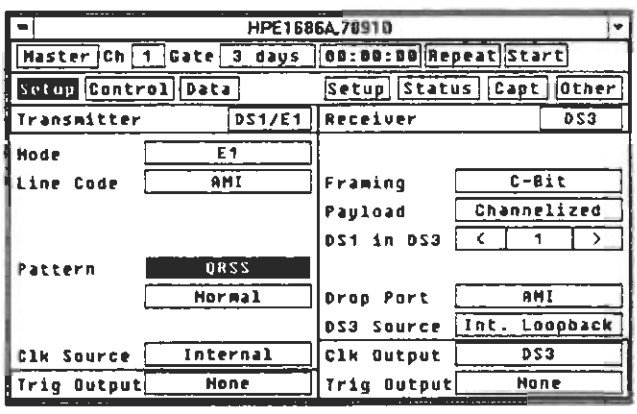
When the module is transmitting E1 signal, the patterns which are available for transmisson are listed below:

QRSS	This pattern can be inverted.
PRBS15	This PRBS 2^{15}-1 pattern can be inverted.
PRBS20	This PRBS 2^{20}-1 pattern can be inverted.
PRBS23	This PRBS 2^{23}-1 pattern can be inverted.
User	A 2- to 24-bit pattern. The default 24-bit pattern is 1010.....
All Ones	An all ones pattern.
3 in 24	This fills the information bits with a 12.5% ones density pattern synchronized to the frame bit location as follows: 010001000000000000000100.

To select a pattern:

1. Ensure the Transmit **Setup** subpanel is displaying the E1 parameters.
2. Click the mouse on the **Pattern** button, then select the required pattern.

   If a PRBS pattern is selected, it can be inverted.



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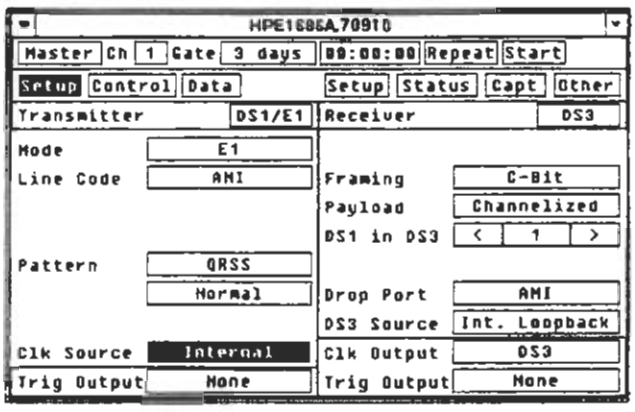
Selecting a E1 Clock Source

The module's E1 transmit circuits can be timed from one of the following sources:

An internal clock.
An external clock which is applied to the module thru the *DS1/E1 Clock In* port.
A clock recovered from a data stream applied to the module's receiver (loop mode).

To select a clock source:

1. Ensure the Transmit `Setup` subpanel is displaying the `E1` parameters.
2. Click the mouse on the `Clk Source` button, then select the required clock source.



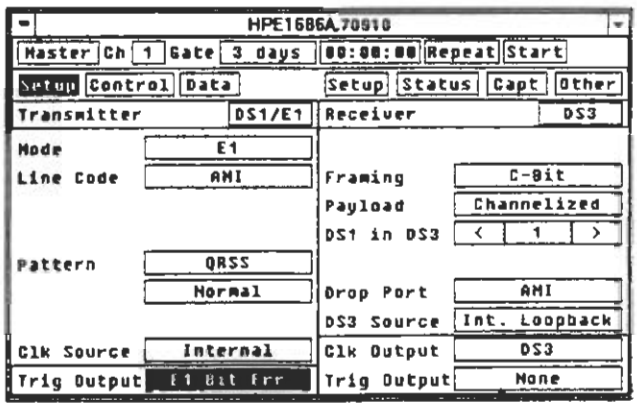
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Selecting a E1 Transmitter Trigger Output

The transmitter can provide a trigger output pulse for various DS1 error generation and alarm conditions.

To select a trigger output:

1. Ensure the Transmit **Setup** subpanel is displaying the E1 parameters.
2. Click the mouse on the **Trig Output** button, then select the required E1 trigger condition.



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Generating E1 Errors

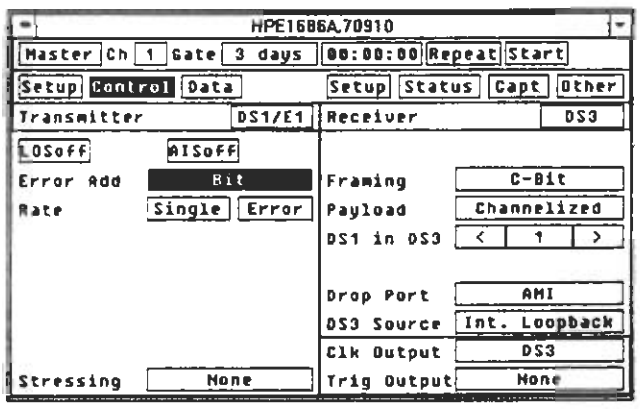
The E1 error types are listed below:

Bit	Information bits are errored. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1.1 X 10^{-2} to 0.9 X 10^{-9}.
Code (BPV)	Bipolar violations - introduces two successive ones of the same polarity that violate the line code rules. Errors can be injected singly, in bursts, the user specifies the burst rate (period) and duration (% duty), or at a specific rate from 1 X 10^{-2} to 0.9 X 10^{-9}.
Code (EXZ)	Introduces selectable excess zeros (between 3 and 16 bits) which violate the line code rules. Errors are injected for a single duration.

To select an error type and rate:

1. Ensure the Transmit **Setup** subpanel is displaying the E1 parameters.
2. Select the Transmit **Control** subpanel.
3. Click the mouse on the **Error Add** button, then select the required error type.
4. Click the mouse on the **Rate** button, then select the required error rate.

   Note, depending on the error type and rate/duration selected, other associated error rate functions may be available for selection. For example, in the figure below **Period** and **% Duty** are available for selection when **Burst** is the selected error rate.



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Generating E1 Alarm or Stressing Signal

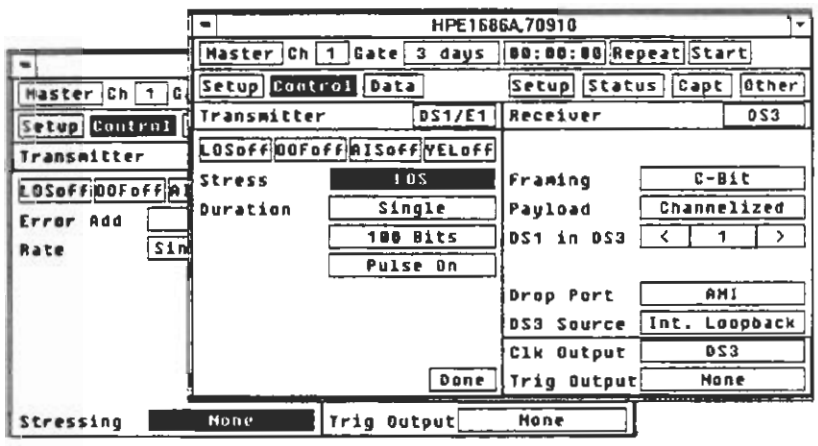
The module can generate the following E1 alarms and stressing signals:

LOS — This alarm is generated using the LOS button on the Control subpanel, or from the Stressing subpanel when the LOS stressing duration is set to continuous. The module can also transmit a single shot stressing signal by transmitting a user selectable number of zeros, in the range 75 to 275 when the stressing duration is set to single.

AIS — This alarm is generated by transmitting an all ones pattern. It is controlled using the AIS button on the Control subpanel, or from the Stressing subpanel.

To select an alarm or stressing signal:

1. Ensure the Transmit **Setup** subpanel is displaying the E1 parameters.
2. Select the Transmit **Control** subpanel.
3. Select the **Stressing** subpanel.
4. Click the mouse on the **Stress** button, then select the required alarm type.
5. If the LOS alarm is selected, click the mouse on the **duration** button, then select the required duration.



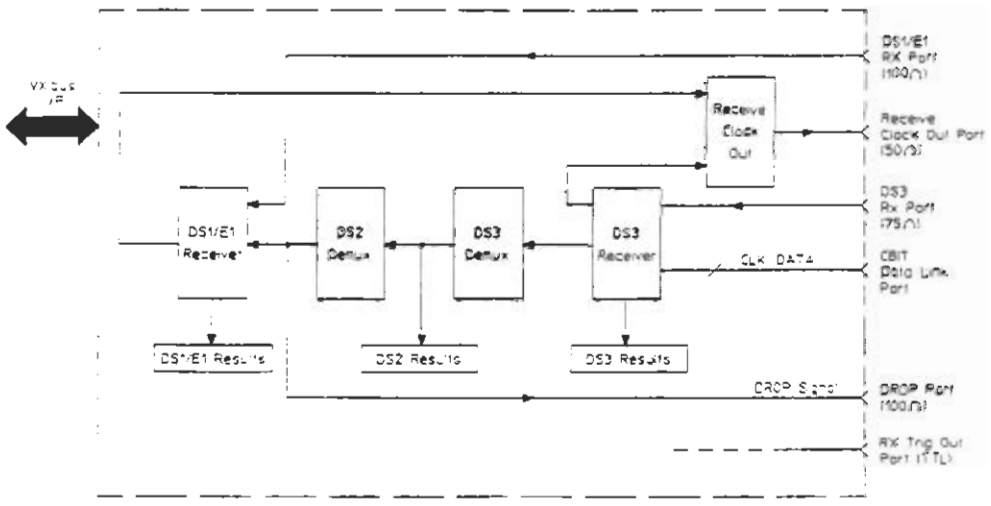
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Receive Operation

The module's receive functions are described in the following three sections in this chapter.

- Receiving a DS3 Signal
- Receiving a DS1 Signal
- Receiving an E1 Signal

The module's receive functions are shown in the following simplified block diagram:



DS1/DS3 Transceiver Receive Block Diagram

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Receiving a DS3 Signal

The DS3 receive functions which will be described in detail are listed below:

- Displaying the DS3 Receive Parameters
- Selecting a DS3 Frame Structure
- Selecting a DS3 Payload
- Selecting a DS3 Pattern
- Selecting a DS3 Source
- Selecting a DS3 Clock Output
- Selecting a DS3 Receive Trigger Output
- Making a Measurement
- Monitoring DS3 Errors
- Measuring the DS3 Signal Level
- Monitoring DS3 Alarms and Status Indicators
- Monitoring DS2 Alarms
- Capturing X-Bits, FEAC Codes or C-Bits
- Detecting Special Codes, DS2 C/Stuff Bits and FEAC Loopback Codes

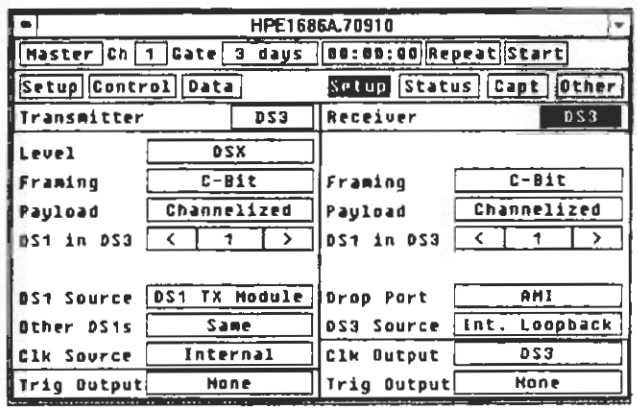
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Displaying the DS3 Receive Parameters

If the DS3 receive parameters are to be changed, or if you want to view them they must be displayed.

To display the DS3 receive parameters:

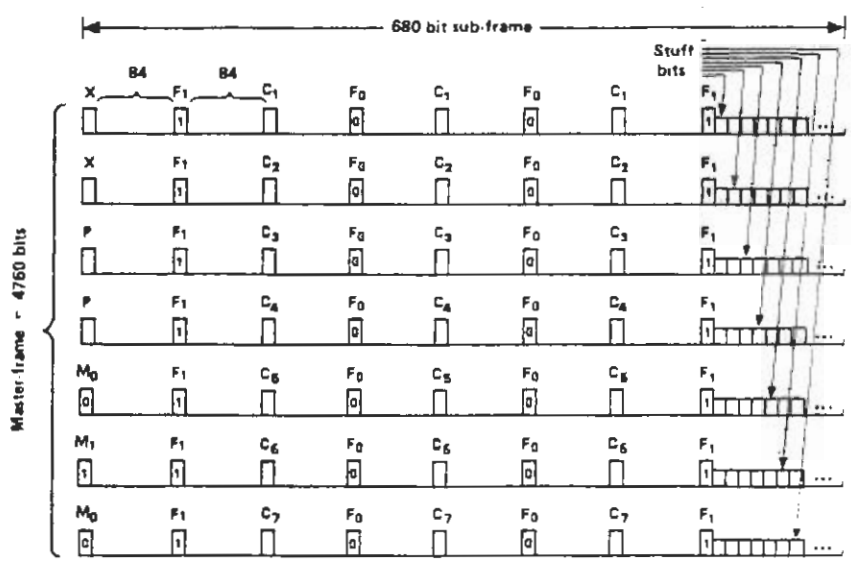
1. Select the Receive **Setup** subpanel.
2. Click the mouse on the **Receiver** button to select DS3.



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Selecting a DS3 Frame Structure

The module can receive an unframed or framed DS3 signal. The standard DS3 framing structure is shown below:



The 56 frame control bits for the C-Bit and M23 DS3 frame formats are listed below:

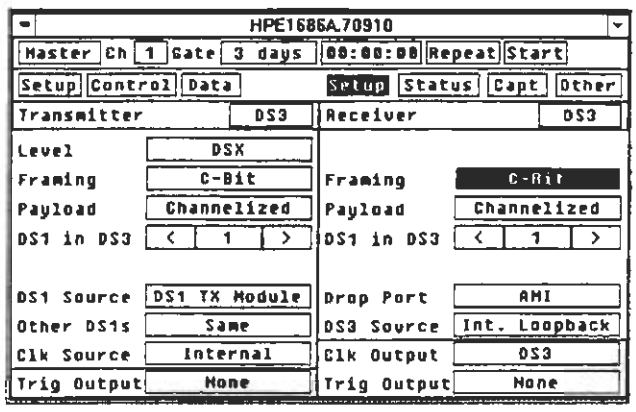
C-Bit
Frame alignment bits ($F_1F_0F_0F_1$) for each subframe: 1001
Alarm bits (X-Bits): 11 (normal) or 00 (alarm)
Multiframe alignment bits ($M_0M_1M_0$): 010
Section parity bits (P-Bits): Computed parity (11 or 00).
Far End Alarm Control (FEAC) bit : FEAC is 3rd C-Bit of subframe #1, the other two C-Bits are set to 1.
Data Link (DL) bits: 9 C-Bits of subframes #2, 6 and 7.
Path parity (CP-Bits - same value as P-Bits): 3 C-Bits of subframe #3.
Far End Block Error (FEBE) bits: 3 C-Bits of subframe #4.
Path Maintenance Data Link (PMDL) bits: 3 C-Bits of subframe #5.

M23
Frame alignment bits ($F_1F_0F_0F_1$) for each subframe: 1001
Alarm bits (X-Bits): 11 (normal) or 00 (alarm)
Multiframe alignment bits ($M_0M_1M_0$): 010
Section parity bits (P-Bits): Computed parity (11 or 00).
C-Bits: When the DS3 signal is channelized the C-Bits are used as stuffing indicator bits.

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To select a frame structure:

1. Ensure the Receive **Setup** subpanel is displaying the DS3 parameters.
2. Click the mouse on the **Framing** button, then select the required framing.

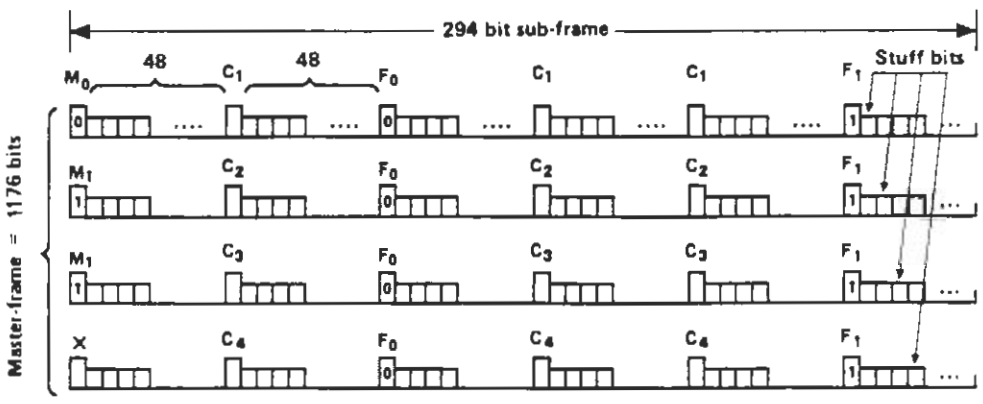


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Selecting a DS3 Payload

When the module is receiving a framed DS3 signal, the payload carried can be unchannelized or channelized. If the payload is unchannelized it can carry one of the patterns described in the next section. If the payload is channelized, the DS3 is structured with 7 DS2s. The DS2's contains 4 DS1s or 3 E1s which gives a total for 28 DS1 channels or 21 E1 channels in the DS3 structure.

The contents of one of the DS1 or E1 channels (selected by the user) can be demultiplexed (dropped) from a channelized DS3 signal and analyzed by the DS1/E1 receiver, or applied to an external analyzer for further analysis thru the *Drop* port.



To select a payload:

1. Ensure the Receive **Setup** subpanel is displaying the DS3 parameters.
2. Click the mouse on the Payload button, then select the required payload (channelized or unchannelized).

To drop a channel from the DS3 signal:

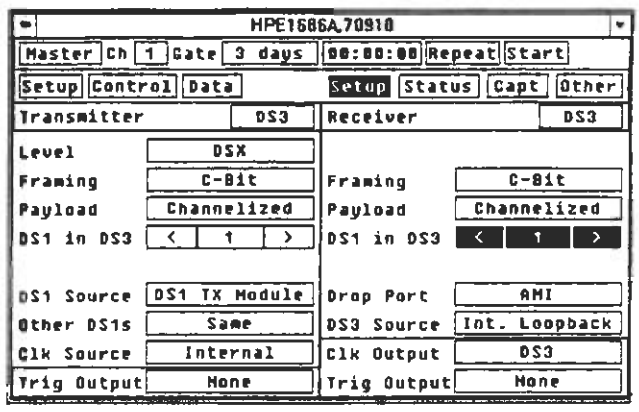
1. Ensure the Payload is set to Channelized.
2. Click the mouse on the Receiver button to select DS1/E1.
3. Click the mouse on the Mode button, then select DS1 or E1.
4. Click the mouse on the Receiver button again to select DS3.
5. Select the channel to be dropped:

   If DS1 is selected, click the mouse on the DS1 in DS3 button, then select a value between 1 and 28.

   If E1 is selected, click the mouse on the E1 in DS2 and DS2 in DS3 buttons, then select the appropriate group (1 to 7) and tributary (1 to 3) values in turn.

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6. Click the mouse on the **Drop Port** button, then select the required line code.



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Selecting a DS3 Pattern

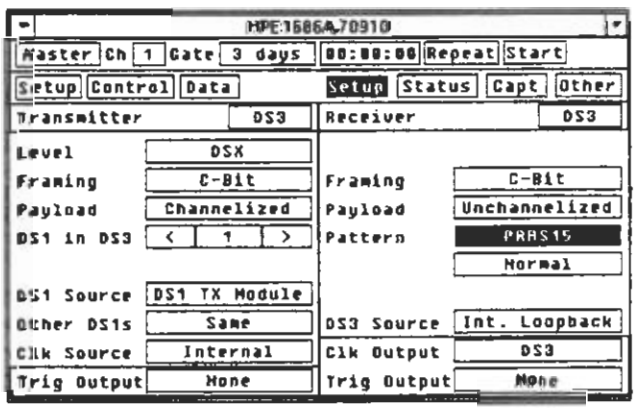
When the module is receiving an unframed or unchannelized framed DS3 signal, the patterns which can be received are listed below:

PRBS15	This PRBS 2^{15}-1 pattern can be inverted.
PRBS20	This PRBS 2^{20}-1 pattern can be inverted.
PRBS23	This PRBS 2^{23}-1 pattern can be inverted.
User	A 2- to 8-bit programmable pattern, with the most significant bit (left most bit) to follow the frame bit location for all lengths except 5 and 8 (that is patterns that divide evenly by 84). The default pattern is 10101010.
All Ones	An all ones pattern.
Idle	A frame with valid framing (F and M) bits and information bits set to 1100.... with the 11 pattern following on after each framing and control bit. C-Bits are set to 0 in M-subframe 3. Both X-Bits are set to 1.

To select a pattern:

1. Ensure the Receive **Setup** subpanel is displaying the DS3 parameters.
2. Ensure that the **Framing** is set to **Unframed**, or if set to **Framed** ensure the **Payload** is set to **Unchannelized**.
3. Click the mouse on the **Pattern** button, then select the required pattern.

   If a PRBS pattern is selected, it can be inverted.



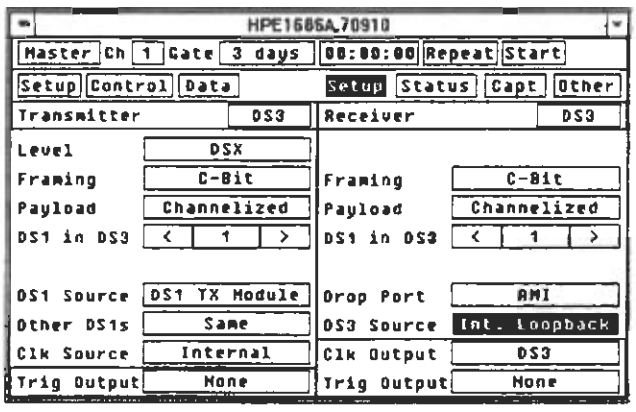
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Selecting a DS3 Source

The DS3 signal is applied to the module thru the *DS3 Rx* port (external source), or it can be looped to the receiver from the module's DS3 transmit section.

To select a DS3 source:

1. Ensure the Receive **Setup** subpanel is displaying the DS3 parameters.
2. Click the mouse on the DS3 Source button to toggle the DS3 source between Int. Loopback and External.



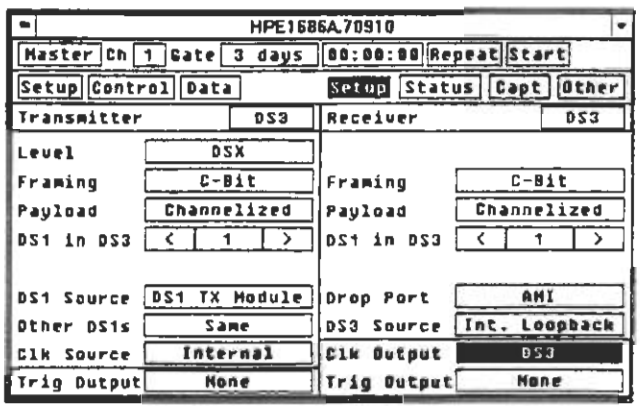
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Selecting a DS3 Clock Output

The module's receiver recovers a clock from the incoming signal and makes it available at the *Clock Out* port.

To select a DS3 clock output:

1. Select the Receive **Setup** subpanel.
2. Click the mouse on the `Clk Output` button, then select `DS3`.



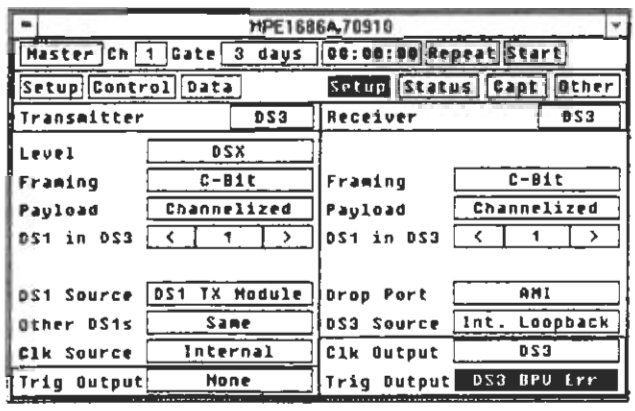
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Selecting a DS3 Receiver Trigger Output

The receiver can provide a trigger output pulse for various DS3 error generation and alarm conditions.

To select a trigger output:

1. Select the Receive `Setup` subpanel.
2. Click the mouse on the `Trig Output` button, then select the required DS3 trigger condition.



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Making a Measurement

The module's measurement control bar at the top of the panel allows the user to:

- Control measurement gating using either the module's soft-panel or the gating facilities of another source.
- Select a trigger source on the VXI backplane to be used for gating.
- Set the gating period for a single or repeated measurement.
- Stop or start a measurement.

The functions associated with the measurement gating control bar are described in the following table.

The functions associated with control bar are described below:

- **Master/Slave**
  Select **Master** if the module is to control one of the four trigger sources on the VXIbus backplane which are used for measurement gating. When selected, the user can specify the trigger channel, gating period, single or repeated measurements and can start and stop measurements.

  Select **Slave** if one of the four trigger channels on the VXIbus backplane is to be used as the trigger source to control the measurement gating in the module. When selected, you can specify the trigger channel, single or repeated measurements, and you can start/stop measurements.

  To start measurement gating with master and slave modules, click the mouse on the slave(s) **Start** button, then on the master **Start** button.

  To stop measurement gating with master and slave modules, click the mouse on the slave(s) **Stop** button, then on the master **Stop** button.

- **Channel**
  Allows the user to select one of the four possible trigger sources on the VXIbus backplane for gating in either **Master** or **Slave** mode. All four channels are gated simultaneously. You can increment or decrement the channel displayed by clicking the mouse on the > or < buttons.

- **Gating Period**
  Sets the measurement gating period from 1 second up to 3 days. The gating period can only be set when the module is in the Stop state. The periods available for selection are:
  1 second, 10 seconds, 1 minute, 5 minutes, 1 hour, 5 hours, 24 hours and 3 days (default). If you ckick the mouse on the Gate button when gating is active, the elapsed time for the current gating interval is displayed.

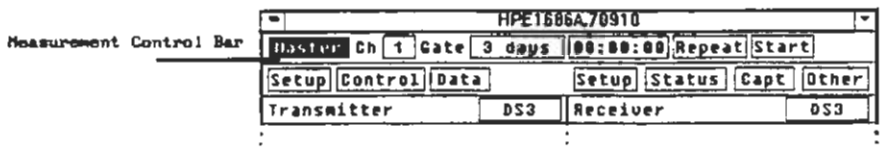
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- **Measurement Time**
  The elapsed time since the start of the measurement is displayed in the `Timer` field in the form `hh:mm:ss`, where `hh`=hours, `mm`=minutes, and `ss`=seconds.

- **Repeat/Single**
  Allows the user to make a single measurement, or allows the measurement to automatically restart at the end of each gating period.

- **Start/Stop (Continue)**
  Starts and stops a measurement, or, having stopped a measurement allows you to continue.

  When `Start` is selected, the `Stop` button is displayed indicating a measurement is being made. When `Stop` is selected, the `Stop` button changes to `Cont` indicating the module is in an idle state.



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Monitoring DS3 Errors

The DS3 error types which can be measured are listed below:

- **Alarm Error Seconds**
  The number of seconds that either a LOS (Sig Loss), AIS, Sync loss or OOF condition exists.

- **Bit Errors**
  Bit errors can be measured on an unframed, or framed and unchannelized DS3 signal. The results can be displayed in one of three ways:

Count	The number of information (payload) bits received in error.
Ratio	Average Ratio - The ratio of the number of bit errors to the total number of information bits transmitted during the elapsed test time.
Seconds	Bit Error Seconds (ES) - The number of seconds in which the bit error count is greater than zero.

- **Section Parity (P-Bit) Errors**
  P-Bit errors can be measured on framed DS3 signals. The results can be displayed in one of three ways:

Count	The number of P-Bits received in error.
Ratio	Average Ratio - The ratio of the number of P-Bit errors to the total number of information bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the P-Bit error count is greater than zero.

- **Path Parity (CP-Bit) Errors**
  CP-Bit errors are measured on C-Bit framed DS3 signals. The results can be displayed in one of three ways:

Count	The number of CP-Bits received in error.
Ratio	Average Ratio - The ratio of the number of CP-Bit errors to the total number of information bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the CP-Bit error count is greater than zero.

- **Frame (F-Bit) Errors**
  F-Bit errors are measured on framed DS3 signals. The results can be displayed in one of three ways:

Count	The number of F_1 and F_0 bits received in error.
Ratio	Average Ratio - The ratio of the number of F-Bit errors to the total number of F-Bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the F-Bit error count is greater than zero.

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- **FEBE Errors**
  FEBE errors are measured on framed DS3 signals. The results can be displayed in one of three ways:

Count	The number of FEBE triads which are not equal to 111.
Ratio	Average Ratio - The ratio of the number of FEBE errors to the total number of information bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the FEBE error count is greater than zero.

- **Frame and Multiframe (F-Bit and M-Bit) Errors**
  F-Bit and M-Bit errors are measured on framed DS3 signals. The results can be displayed in one of three ways:

Count	The number of frames which contain one or more F-Bits (F_1, F_0) and/or M-Bits (M_1, M_0) in error.
Ratio	Average Ratio - The ratio of the number of frames which contain one or more F-Bits and/or M-Bits in error to the total number of frames tranmitted.
Seconds	Error Seconds (ES) - The number of seconds in which the combined F-Bit and M-Bit error count is greater than zero.

- **Code (BPV and EXZ) Errors**
  Code errors are measured on all DS3 signals. The results can be displayed in one of three ways:

Count	The combined count of bipolar violations (BPV) and excess zeros (EXZ) received that were not part of a valid B3ZS code.
Ratio	Average Ratio - The ratio of the number of code errors to the total number of DS3 bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the combined code error count is greater than zero.

Having run a measurement (see *Making a Measurement* section) or during a measurement, error results are available on the **Status** subpanel - use the **Next** and **Previous** buttons to access all DS3 error results.

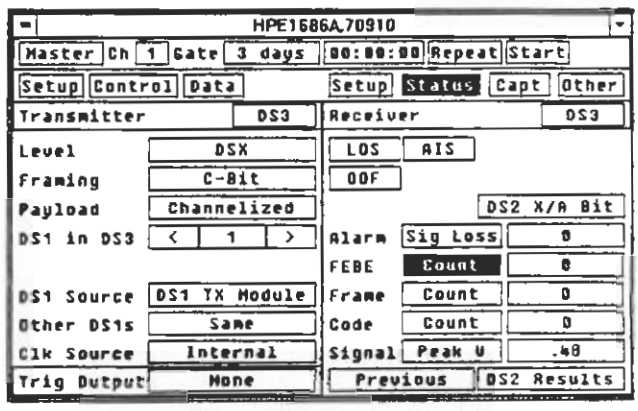
The following procedure shows you how to view FEBE errors but is applicable to all error types.

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To monitor FEBE error results:

1. Select the Receive **Status** subpanel.
2. Ensure the **Receiver** button is displaying DS3.
3. Click the mouse on the **Next** or **Previous** button (if required) to display the FEBE errors.
4. Click the mouse on the left **FEBE** button, then select the required error analysis - **Count**, **Ratio** or **Seconds**.
5. Click the mouse on the right **FEBE** button to update the error measurement result.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Measuring the DS3 Signal Level

The module can measure the DS3 signal level, and display the result in the following two ways:

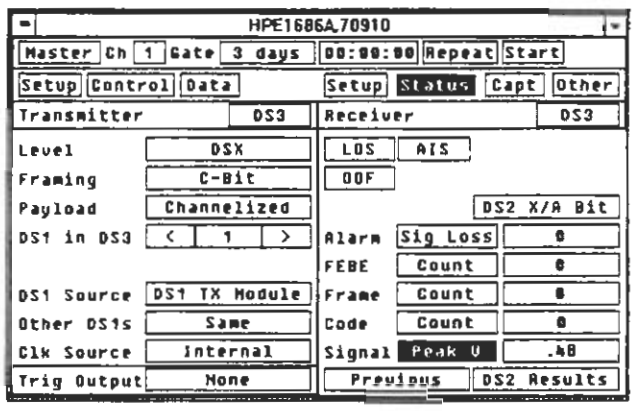
Peak V — The peak voltage of the received signal, measured in volts with an accuracy of 5%.

dBDSX — The received signal level referenced to a DSX-3 signal (0.48V), measured in dB with an accuracy of 1 dB.

To measure the signal level:

1. Select the Receive **Status** subpanel.
2. Ensure the **Receiver** button is displaying **DS3**.
3. Click the mouse on the **Next/Previous** button to display **Previous**.
4. Click the mouse on the left **Signal** button, then select the required signal level analysis.
5. Click the mouse on the right **Signal** button to update the level measurement result.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Monitoring DS3 Alarms and Status Indicators

The module can detect the following DS3 alarms and status conditions:

LOS — Loss of Signal - This alarm occurs when the module detects 160 ±32 consecutive pulse positions with no pulses of either +ve or -ve polarity in the incoming signal. The LOS condition is terminated when at least ten pulses are detected in 32 consecutive bit periods.

OOF — Out of Frame - This alarm occurs when the module fails to detect F-Sync and/or M-Sync frame synchronization. The DS3 receiver maintains F-Bit synchronization during very error rate conditions. For example, at 1 in 10^2 bit error rate the mean time to loose frame synchronization is 1000 hours. The framer can tolerate 1020 bit bursts with 100% errors before losing frame synchronization.

The criteria for losing M-Bit synchronization is two M-Group errors out of three successive M-Groups. An M-Group error is when the M_0, M_1, M_0 sequence does not equal 0, 1, 0.

AIS — DS3 Alarm Indication Signal - This alarm occurs when the AIS signal is present for three consecutive one second intervals. This condition is detected in the presence of a random error rate of 1 in 10^3. The DS3 AIS signal is defined as a 1010.... data pattern with valid framing. the 1 follows the framing bit. All C-Bits are zero, and the X-Bits are one. the ability to disable the C-Bits equal to zero is also provided.

Sync — Pattern Sync Loss - This status indicator only appears on the display when the payload is unframed or unchannelized. This alarm occurs when data pattern synchronization is not achieved, or when the received data pattern does not correspond to the internally generated reference. To achieve synchronization requires 64 consecutive error free comparisons of the received data to the internally generated reference pattern. To lose pattern synchronization requires 240 bit errors out of 1024 consecutive data bits.

The following status indicators only appear on the subpanel when the status condition becomes active.

X-Bit — DS3 X-Bit - When both X-Bits are zero, the X-Bit status becomes active. In addition, the state of both X-Bits will be detected and are independently available.

Idle — Idle Channel Signal - This is a signal which has valid M-frame and M-subframe alignment and P-Bit parity. The information bits are set to a 1100.... sequence, starting with 11 after each framing control bit. The C-Bits are set to zero

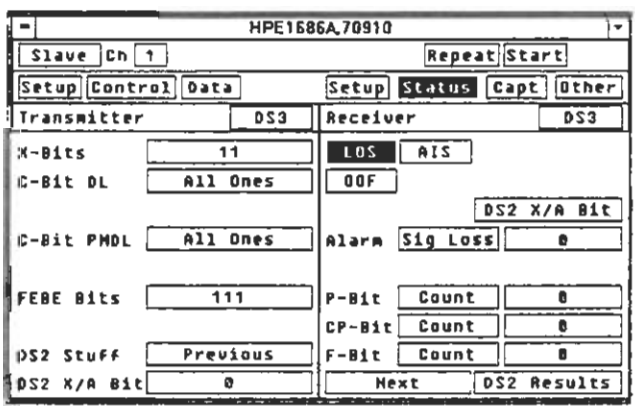
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	in M-subframe #3. The X-Bits XX are 11. An Idle Channel Signal condition is detected in the presence of a random error rate of 1 in 10^3.
M23	This alarm appears on the subpanel when the receiver is set to C-Bit framing and a M23 signal is applied to the Rx input.
C-BIT	This alarm appears on the subpanel when the receiver is set to M23 framing and a C-BIT signal is applied to the Rx input.
DS2 Condition Summary	If DS3 channelized, reports most important DS2 condition present. (This is a summary of the DS2 **Results** subpanel.)

To monitor alarm or status indicators:

1. Select the Receive **Status** subpanel.
2. Ensure the Receiver button is displaying DS3.
3. Click the mouse on the appropriate alarm or status button to update the display.

   If the HP ITG "automatic update" function is active. the display is automatically updated.



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Monitoring DS2 Alarms

The module can detect the following DS2 alarms when the incoming DS3 signal is channelized:

LOS Loss of Signal - 192 consecutive zeros.

OOF Loss of Frame - No valid F- and/or M-Bits.

AIS Alarm Indication Signal - All ones, unframed.

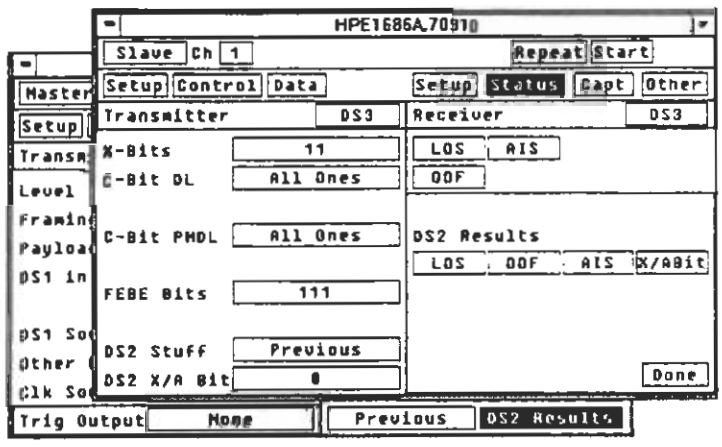
X-Bit Alarm Bit - For DS1 mapped DS2 (active when set high).

A-Bit Alarm Bit - For E1 mapped DS2 (active when set high).

To monitor DS2 alarms:

1. Select the Receive **Status** subpanel.
2. Ensure the Receiver button is displaying DS3.
3. Click the mouse on the DS2 Results button.
4. Click the mouse on the appropriate alarm or status button to update the display.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



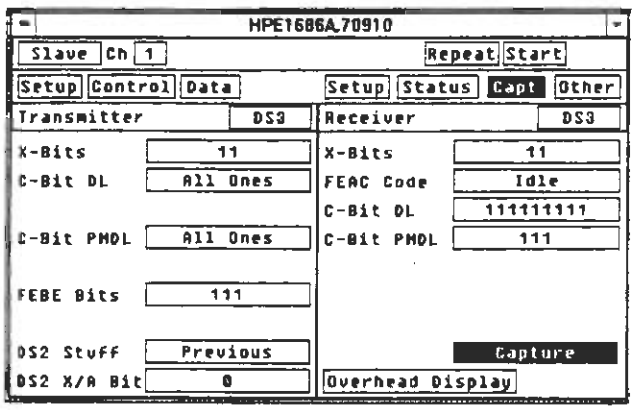
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Capturing X-Bits, FEAC Codes or C-Bits

The module can capture X-Bits, FEAC codes, C-Bit DL or C-Bit PMDL when the incoming DS3 signal is C-Bit framed, only X-Bits can be captured if the framing is M23.

To capture X-Bits, FEAC Codes or C-Bits (DL, PMDL):

1. Select the Receive **Capt** subpanel.
2. Ensure the Receiver button is displaying DS3.
3. Click the mouse on the Capture button.



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Detecting Special Code, DS2 C/Stuff Bits and FEAC Loopback Codes

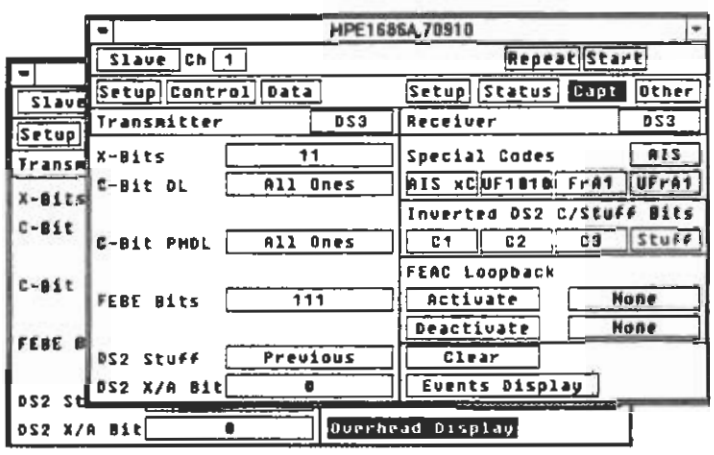
The module can automatically detect any of the following:

- **Special Codes**
  Detects the following codes if they are present: AIS, AIS excl C-Bits, Unframed 1010, Framed all ones and Unframed all ones.
- **Inverted DS2 C/Stuff Bits**
  Detects inverted DS2 C1, C2 and C3 bits and inverted DS2 stuff bits. Note, the stuff bit detection is relative to the DS2 stuff state selected on the DS3 Transmit **DATA** subpanel.
- **FEAC Loopback**
  Detects the FEAC loopback codes. The codes are detected if the activate/deactivate octect is transmitted ten times, followed immediately by ten repitions of the two-octect DS3 or DS1 line codeword.

When any of above conditions are detected, the appropriate display latched flags are set. These flags can only be cleared by using the **Clear** button.

To detect special codes, inverted DS2 C/Stuff bits and FEAC loopcodes:

1. Select the Receive **Capt** subpanel.
2. Ensure the **Receiver** button is displaying **DS3**.
3. Click the mouse on the **Overhead Display** subpanel to display the Special Codes, Inverted DS2 C/Stuff bits and FEAC Loopback.
4. Click the mouse on the **Clear** button to clear the display flags.



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Receiving a DS1 Signal

The DS1 receive functions which will be described in detail are listed below:

- Displaying the DS1 Receive Parameter
- Selecting a DS1 Line Code
- Selecting a DS1 Frame Structure
- Selecting a DS1 Pattern
- Selecting a DS1 Source
- Selecting a DS1 Clock Source
- Selecting a DS1 Trigger Output
- Monitoring DS1 Errors
- Measuring the DS1 Signal Level
- Monitoring DS1 Alarms

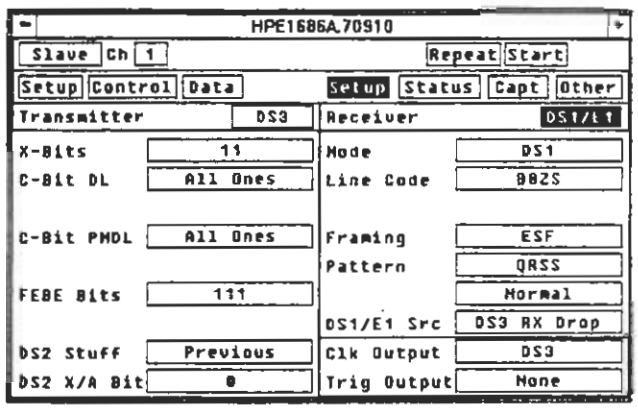
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Displaying the DS1 Receive Parameters

If the DS1 receive parameters are to be changed, or if you want to view them they must be displayed.

To display the DS1 receive parameters:

1. Select the Receive **Setup** subpanel.
2. Click the mouse on the `Receiver` button to select `DS1/E1`.
3. Click the mouse on the `Mode` button to select `DS1`.



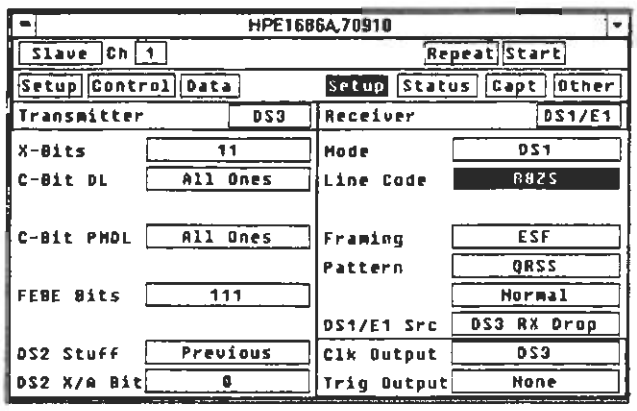
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Selecting a DS1 Line Code

The module can be configured for incoming DS1 signals with AMI or B8ZS line coding.

To select a line code:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the **Line Code** button, then select the required line code.



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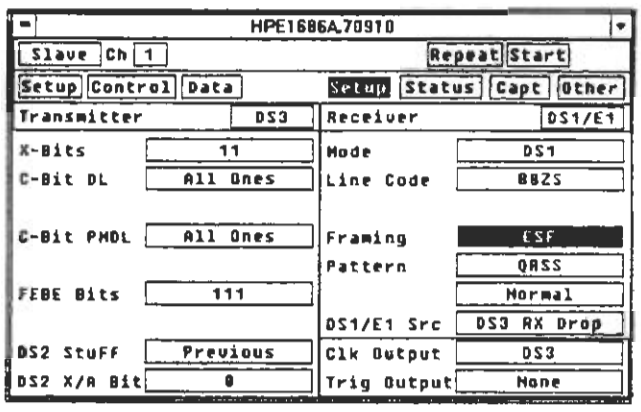
Selecting a DS1 Frame Structure

The module can monitor DS1 signals which are unframed or framed as listed below:

D4 (Super Frame)
ESF (Extended Super Frame)
SLC96 (Also known as TR8)

To select a frame structure:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the **Framing** button, then select the required frame structure.



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Selecting a DS1 Pattern

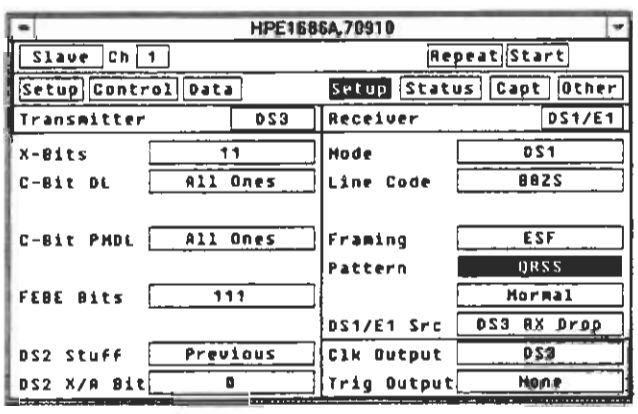
When the module is monitoring a DS1 signal the patterns which can be received are listed below:

QRSS	This pattern can be inverted.
PRBS15	This PRBS 2^{15}-1 pattern can be inverted.
PRBS20	This PRBS 2^{20}-1 pattern can be inverted.
PRBS23	This PRBS 2^{23}-1 pattern can be inverted.
User	A 2- to 24-bit pattern, with the most significant bit (left most bit) to follow the frame bit location for pattern lengths that divide evenly into 192.
All Ones	An all ones pattern.
3 in 24	This fills the information bits with a 12.5% ones density pattern synchronzed to the frame bit location as follows: F010001000000000000000100.
Loop Up	A 2- to 24-bit pattern. The default loop up pattern is 10000.
Loop Down	A 2- to 24-bit pattern. The default loop up pattern is 100.

To select a pattern:

1. Ensure the Receive `Setup` subpanel is displaying the `DS1` parameters.
2. Click the mouse on the `Pattern` button, then select the required pattern.

   If a QRSS or PRBS pattern is selected, it can be inverted.



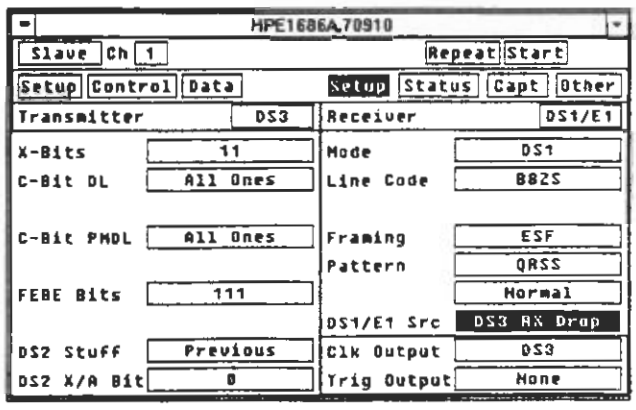
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Selecting a DS1 Source

The DS1 signal is applied to the module thru the *DS1/E1 Rx* port (external source), or it can be looped to the receiver from the module's DS1 transmit section, or it can be dropped from a channelized DS3 signal.

To select a DS1 source:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the DS1/E1 Src button to select the required source.



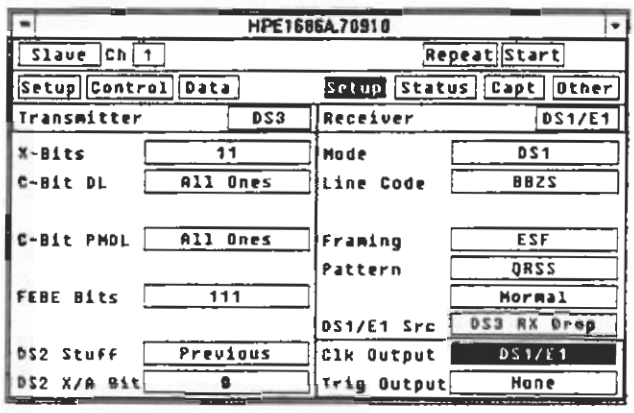
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Selecting a DS1 Clock Output

The module's receiver recovers a clock from the incoming signal and makes it available at the *Clock Out* port.

To select a DS1 clock output:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the Clk Source button, then select DS1/E1.



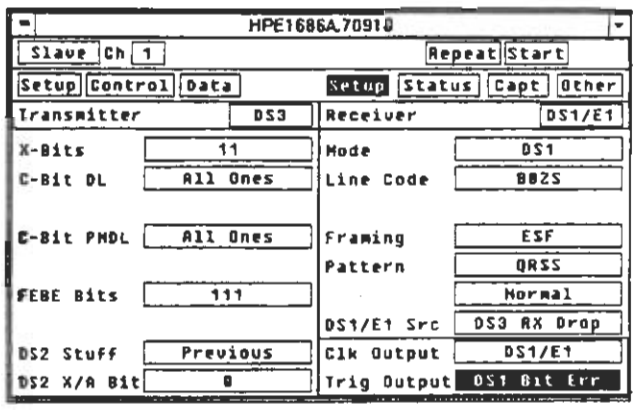
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Selecting a DS1 Receiver Trigger Output

The module's receiver can provide a trigger output pulse for various DS1 error generation and alarm conditions.

To select at trigger output:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Click the mouse on the Trig Output button, then select the required DS1 trigger condition.



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Monitoring DS1 Errors

The DS1 error types which can be measured are listed below:

- **Alarm Error Seconds**
  The number of seconds that either a LOS (Sig Loss), Sync (Pattern Sync Loss), AIS, Yellow, OOF or COFA condition exists.
- **Bit Errors**
  These results can be displayed in one of three ways:

Count	The number of information (payload) bits received in error.
Ratio	Average Ratio - The ratio of the number of bit errors to the total number of information bits received during the elapsed test time.
Seconds	Bit Error Seconds (ES) - The number of seconds in which the bit error count is greater than zero.

- **CRC-6 Errors**
  These results can be displayed in one of three ways:

Count	The number of CRC-6 frames received in error (only valid for ESF framing).
Ratio	Average Ratio - The ratio of the number of CRC-6 errors to the total number of information bits received during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the CRC-6 error count is greater than zero.

- **Frame (F_t- or F_s-Bit) Errors**
  These results can be displayed in one of three ways:

Count	The number of F_t and F_s bits (for Superframe framing), FPS bits (for Extended Superframe framing) and F_t bits (with SLC96 framing) received in error.
Ratio	Average Ratio - The ratio of the number of framing bit errors to the total number of frame bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the frame error count is greater than zero.

- **Code (BPV and EXZ) Errors**
  These results can be displayed in one of three ways:

Count	The combined count of bipolar violations (BPV) and excess zeros (EXZ) received that were not part of a valid B8ZS code.
Ratio	Average Ratio - The ratio of the number of code errors to the total number of DS1 bits transmitted during the elapsed test time.
Seconds	Error Seconds (ES) - The number of seconds in which the combined code error count is greater than zero.

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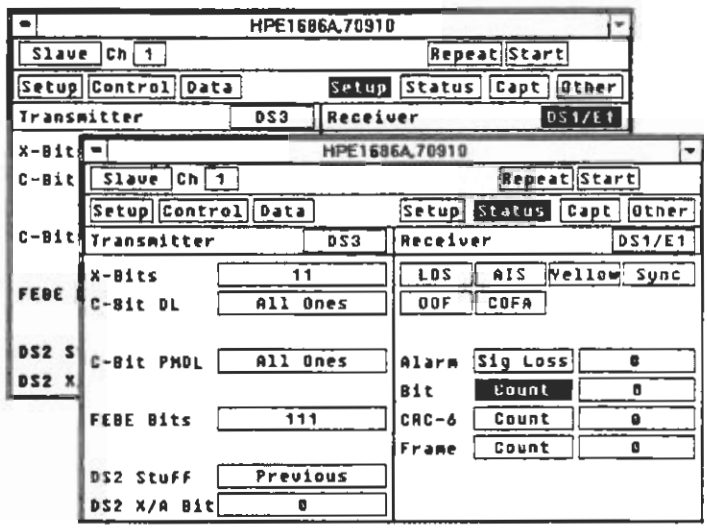
Having run a measurement (see *Making a Measurement* section) or during a measurement, error results are available on the **Status** subpanel.

The following procedure shows you how to view bit errors but is applicable to all error types.

To monitor bit error results:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Select the Receive **Status** subpanel.
3. Click the mouse on the left **Bit** button, then select the required error analysis - **Count**, **Ratio** or **Seconds**.
4. Click the mouse on the right **Bit** button to update the error measurement result.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Measuring the DS1 Signal Level

The DS1 signal level can be measured when it is applied to the module from an external source. The level result can be displayed in the following two ways:

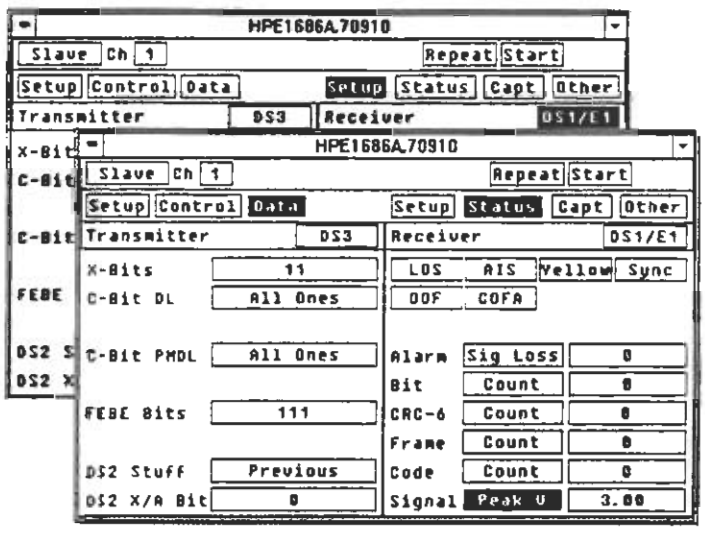
Peak V — The peak voltage of the received signal, measured in volts with an accuracy of 5%.

dBDSX — The received signal level referenced to a DSX signal (3V), measured with an accuracy of 1 dB.

To measure the signal level:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Ensure the DS1/E1 Src is set to **External**.
3. Select the Receive **Status** subpanel.
4. Click the mouse on the left **Signal** button, then select the required signal level analysis.
5. Click the mouse on the right **Signal** button to update the level measurement result.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Monitoring DS1 Alarms

The module can detect the following DS1 alarms conditions:

LOS — Loss of Signal - This alarm occurs when the module detects 175 consecutive pulse positions with no pulses of either +ve or -ve polarity in the incoming signal. The LOS condition is terminated when a 12.5% ones density is detected.

OOF — Out of Frame - This alarm occurs when the module detects two out of four framing bits in error. F_t and F_s bits are tested for OOF in D4 framing, FPS bits are tested in ESF framing, and F_t bits in SLC96 framing.

Sync — Pattern Sync Loss - This alarm occurs when data pattern synchronization is not achieved or the received data pattern does not correspond to the internally generated reference. To achieve synchronization requires 64 consecutive error free comparisons of the received data to the internally generated reference pattern. To lose pattern synchronization requires 240 bit errors out of 1024 consecutive data bits.

AIS — DS1 Alarm Indication Signal - This alarm occurs when an all ones unframed pattern is detected. An all ones pattern is detected if two consecutive frames contain less than three zeros.

Yellow — Yellow Alarm - This alarm occurs when bit 2 of 256 or more consecutive DS0 channels were zero in D4 framing, or when 16 pattern sets of 00 (hex) and FF (hex) are received on the facility data link channel in ESF framing.

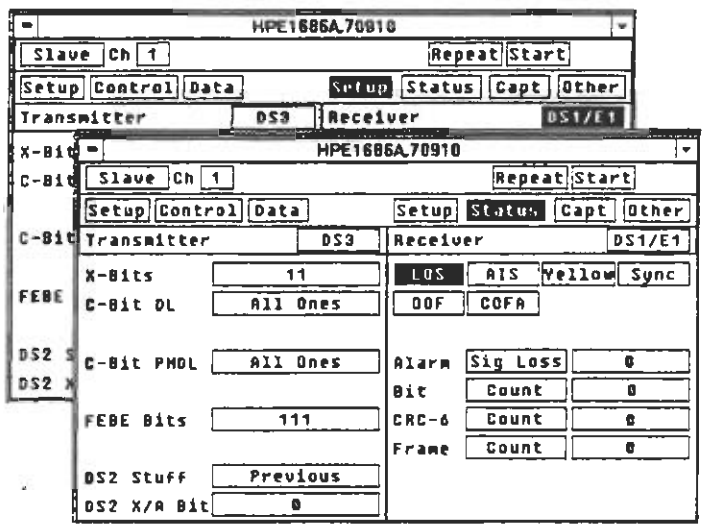
COFA — Change of Frame Alignment - This alarm occurs when the framer resynchronizes to a new frame or multiframe alignment after an OOF condition.

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To monitor alarm:

1. Ensure the Receive **Setup** subpanel is displaying the DS1 parameters.
2. Select the Receive **Status** subpanel.
3. Click the mouse on the appropriate alarm button to update the display.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Receiving an E1 Signal

The E1 receive functions which will be described in detail are listed below:

- Displaying the E1 Receive Parameters
- Selecting an E1 Line Code
- Selecting an DS1 Pattern
- Selecting an E1 Source
- Selecting an E1 Clock Source
- Selecting an E1 Trigger Output
- Monitoring E1 Errors
- Measuring the E1 Signal Level
- Monitoring E1 Alarms

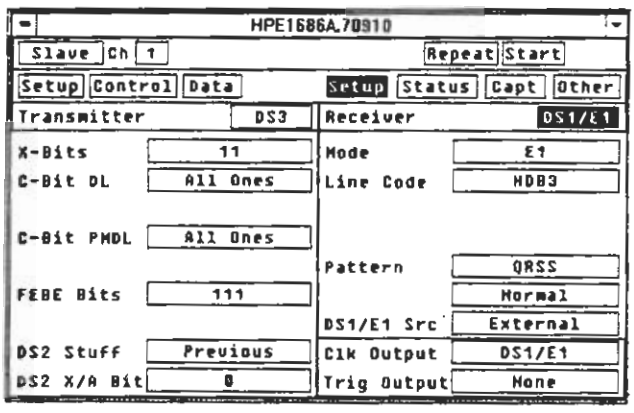
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Displaying the E1 Receive Parameters

If the E1 receive parameters are to be changed, or if you want to view them they must be displayed.

To display the E1 receive parameters:

1. Select the Receive **Setup** subpanel.
2. Ensure the **Receiver** button is displaying **DS1/E1**.
3. Click the mouse on the **Mode** button to select **E1**.



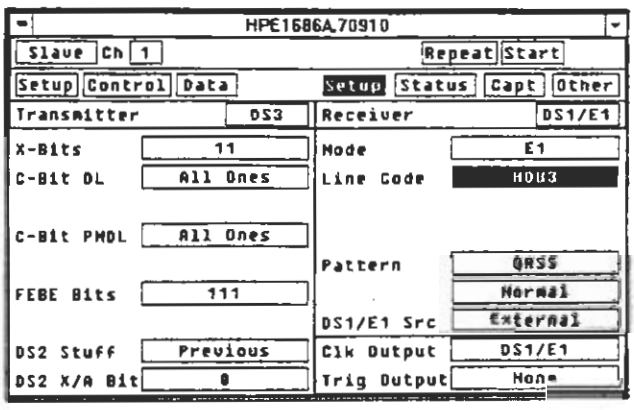
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Selecting an E1 Line Code

The module can be configured for incoming E1 signals with AMI or HDB3 line coding.

To select a line code:

1. Ensure the Receive **Setup** subpanel is displaying the E1 parameters.
2. Click the mouse on the Line Code button, then select the required line code.



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Selecting an E1 Pattern

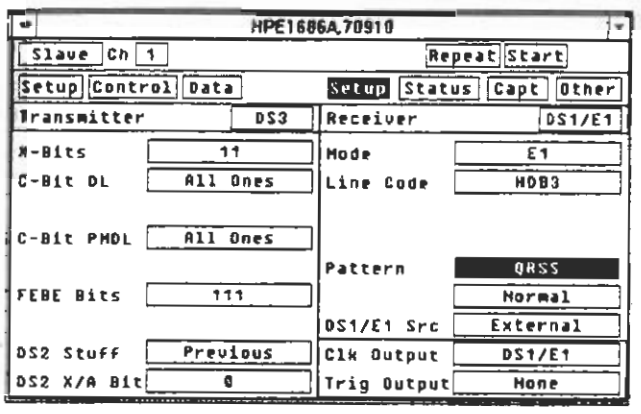
When the module is monitoring an E1 signal the patterns which can be received are listed below:

QRSS	This pattern can be inverted.
PRBS15	This PRBS 2^{15}-1 pattern can be inverted.
PRBS20	This PRBS 2^{20}-1 pattern can be inverted.
PRBS23	This PRBS 2^{23}-1 pattern can be inverted.
User	A 2- to 24-bit pattern.
All Ones	An all ones pattern.
3 in 24	This fills the information bits with a 12.5% ones density pattern.

To select a pattern:

1. Ensure the Receive **Setup** subpanel is displaying the E1 parameters.
2. Click the mouse on the **Pattern** button, then select the required pattern.

   If a QRSS or PRBS pattern is selected, it can be inverted.



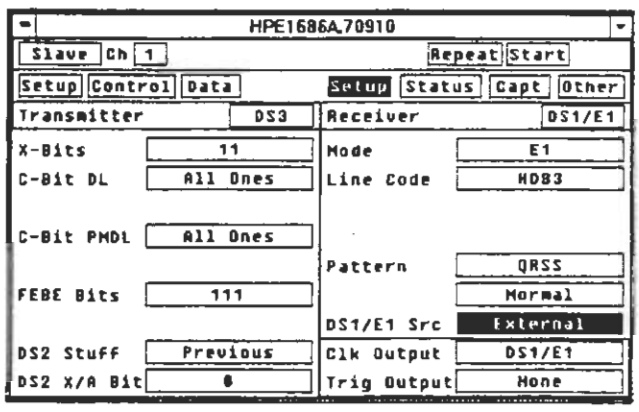
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Selecting a E1 Source

The E1 signal is applied to the module thru the *DS1/E1 Rx* port (external source), or it can be looped to the receiver from the module's E1 transmit section, or it can be dropped from a channelized DS3 signal.

To select a DS1 source:

1. Ensure the Receive **Setup** subpanel is displaying the E1 parameters.
2. Click the mouse on the **DS1/E1 Src** button to select the required source.



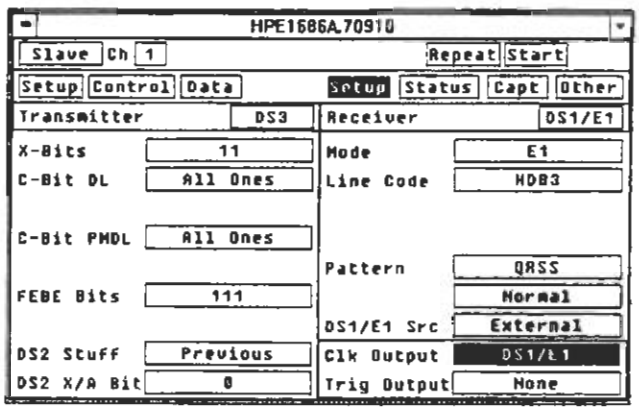
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Selecting an E1 Clock Output

The module's receiver recovers a clock from the incoming signal and makes it available at the *Clock Out* port.

To select a E1 clock output:

1. Select the Receive `Setup` subpanel.
2. Click the mouse on the `Clk Source` button, then select `DS1/E1`.



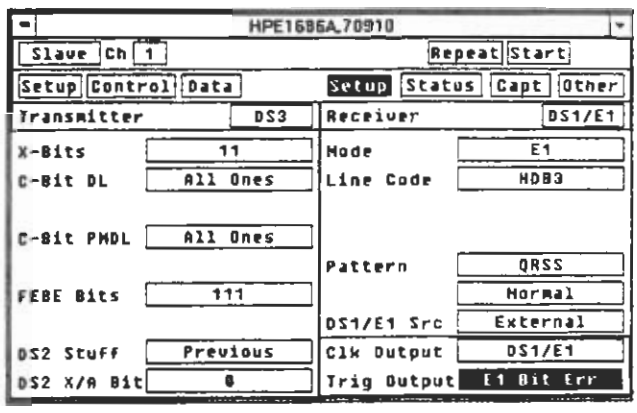
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Selecting a E1 Receiver Trigger Output

The module's receiver can provide a trigger output pulse for various E1 error generation and alarm conditions.

To select at trigger output:

1. Select the Receive **Setup** subpanel.
2. Click the mouse on the **Trig Output** button, then select the required E1 trigger condition.



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Monitoring E1 Errors

The DS1 error types which can be measured are listed below:

- **Alarm Error Seconds**
  The number of seconds that either a LOS (Sig Loss), Sync Loss(Pattern Sync Loss) and or AIS condition exists.
- **Bit Errors**
  These results can be displayed in one of three ways:

Count	The number of information (payload) bits received in error.
Ratio	Average Ratio - The ratio of the number of bit errors to the total number of information bits received during the elapsed test time.
Seconds	Bit Error Seconds (ES) - The number of seconds in which the bit error count is greater than zero.

Having run a measurement (see *Making a Measurement* section) or during a measurement, error results are available on the **Status** subpanel.

The following procedure shows you how to view bit errors but is applicable to all error types.

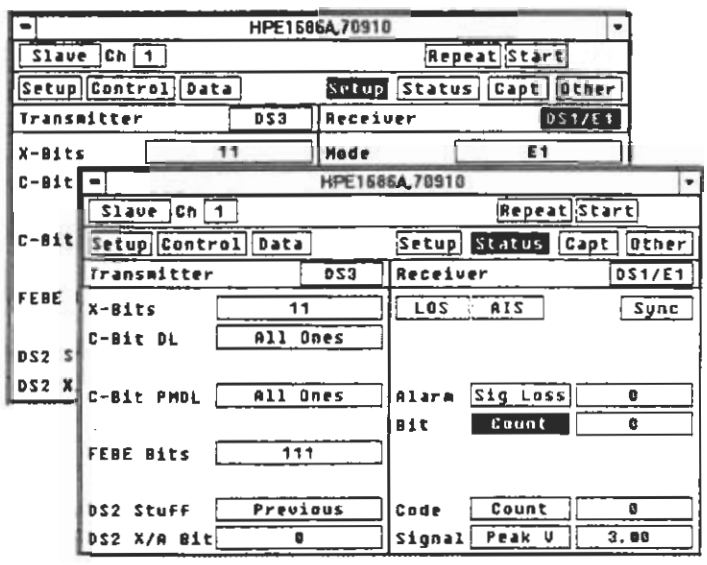
To monitor bit error results:

1. Ensure the Receive **Setup** subpanel is displaying the **E1** parameters.
2. Select the Receive **Status** subpanel.
3. Click the mouse on the left **Bit** button, then select the required error analysis - **Count**, **Ratio** or **Seconds**.

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4. Click the mouse on the right Bit button to update the error measurement result.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Measuring the E1 Signal Level

The E1 signal level can be measured when it is applied to the module from an external source. The level result can be displayed in the following two ways:

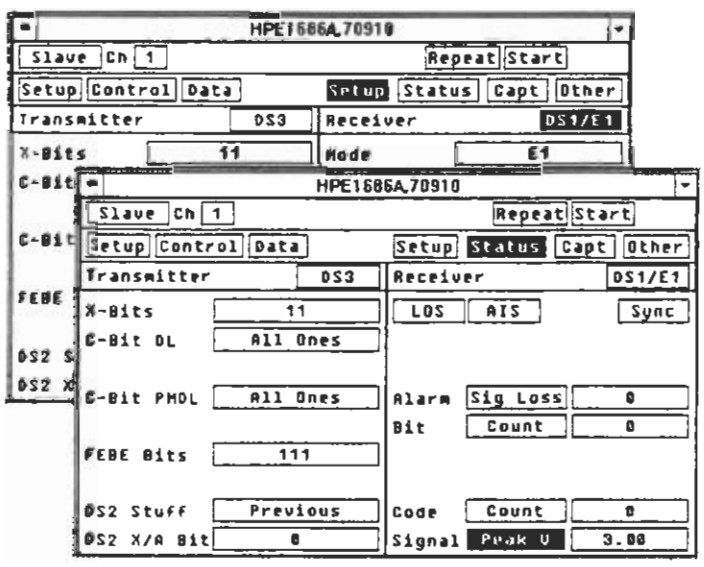
Peak V — The peak voltage of the received signal, measured in volts with an accuracy of 5%.

dBDSX — The received signal level referenced to a DSX signal (3V), measured with an accuracy of 1 dB.

To measure the signal level:

1. Ensure the Receive **Setup** subpanel is displaying the E1 parameters.
2. Ensure the **DS1/E1 Src** is set to **External**.
3. Select the Receive **Status** subpanel.
4. Click the mouse on the left **Signal** button, then select the required signal level analysis.
5. Click the mouse on the right **Signal** button to update the level measurement result.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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Monitoring E1 Alarms

The module can detect the following E1 alarms conditions:

LOS — Loss of Signal - This alarm occurs when the module detects 175 consecutive pulse positions with no pulses of either +ve or -ve polarity in the incoming signal. The LOS condition is terminated when a 12.5% ones density s detected.

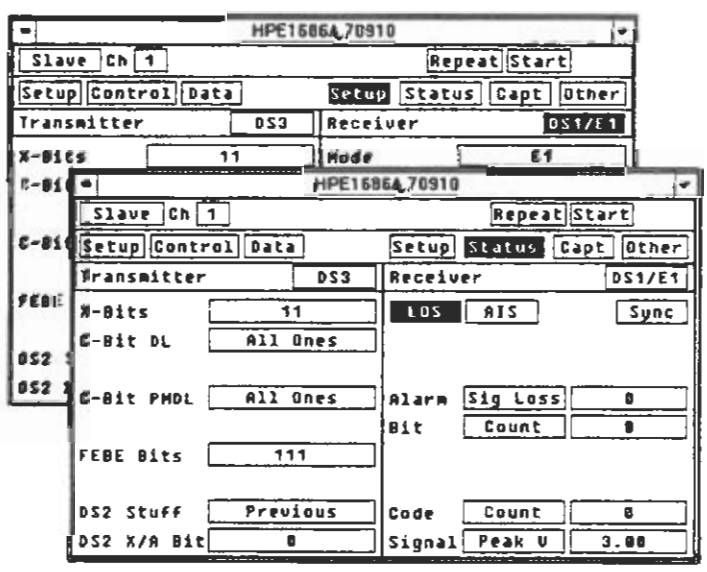
Sync — Pattern Sync Loss - This alarm occurs when data pattern synchronization is not achieved or the received data pattern does not correspond to the internally generated reference. To achieve synchronization requires 64 consecutive error free comparisons of the received data to the internally generated reference pattern. To lose pattern synchronization requires 240 bit errors out of 1024 consecutive data bits.

AIS — E1 Alarm Indication Signal - This alarm occurs when an all ones unframed pattern is detected. An all ones pattern is detected if 256 bits contain less than three zeros.

To monitor alarm:

1. Ensure the Receive **Setup** subpanel is displaying the E1 parameters.
2. Select the Receive **Status** subpanel.
3. Click the mouse on the appropriate alarm button to update the display.

   If the HP ITG "automatic update" function is active, the display is automatically updated.



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4

Module Control

About this Chapter

This chapter describes how to control the HP E1686A using the HP ITG and HP VEE software products, and by programs using HP ITG/HP VEE component drivers and SCPI commands.

The information is organized as follows:

- **Controlling the Module Using SCPI Commands**
  Describes how to control your module using the SCPI (Standard Commands for Programming Instruments) commands given in Chapter 3, *Command Reference*.
- **Controlling the Module using HP ITG**
  Describes how to control your module using the Microsoft® Windows™/HP ITG (HP Interactive Test Generator) environment. This section provides a quick overview of the main features of the HP ITG user interface and module's HP ITG soft-panel, and describes how you can use the code generated by your interactions with the module's HP ITG soft-panel to create control programs. This section also lists the components and associated values required to generate instrument-control code.
- **Controlling the Module using HP VEE**
  Describes how to control your module using HP VEE (HP Visual Engineering Environment). This section also lists the components and associated values required to generate instrument-control code when creating control programs.

Note



For additional information on programming using HP VEE, refer to *Appendix D*.

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Controlling the Module Using SCPI Commands

Module functions, such as signal routing, input rate selection and transition detection, are activated using SCPI commands. By combining these SCPI commands with the programming language of your workstation or computer, you can write programs for many test applications.

You can also use IEEE 488.2 common commands, which perform functions such as reset, self-test, and query status, in your programs.

For detailed information on the SCPI commands associated with each module function, refer to Chapter 5, *Command Reference*. This chapter also contains information on the IEEE 488.2 common commands.

Note

If you are unsure which SCPI command is required to enable a particular function and you have HP ITG capability, activate the `Bus Traffic To Files` facility on the HP ITG `Options` menu. In this mode all the SCPI commands that correspond to an alteration to the module's control-panel configuration are automatically recorded to the module's *(model no.)*`.out` file, located in the HPITG2\USER directory. By setting up the required module condition and accessing the file, you will be able to identify the appropriate command. For further information, refer to the HP ITG online Help system.

Command Structure

For programming, SCPI commands are combined with HP BASIC "OUTPUT" and "ENTER" commands. The command structures are:

Output Command: `OUTPUT 70910;"OUTP:TEL:DS3:LEV<level>"`
(The SCPI command is enclosed in quotes.)

Enter Command: `ENTER 70910;variable`

The "OUTPUT" command sends the module control command from the controller. The "ENTER" command reads the module response into the controller.

Both commands take a numeric address which specifies the destination of the SCPI command. The address used to communicate with the HP E1686A is 70910, where:

- The 7 represents the switch setting of the controller's interface select code.
- The 09 represents the switch setting of the Slot 0 Command module's HP-IB primary address.
- The 10 represents the HP-IB secondary address value which is derived by dividing the logical address switch setting on the module by 8. For further information on switch settings, refer to Chapter 2, *Preparation for Use*.

For further information on switch configurations of other modules, refer to Chapter 2, *Installation*, in the relevant User's Manuals.

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Controlling the Module Using HP ITG

This section describes how to generate and receive test signals using the HP ITG "soft-panels" facility. HP ITG is compatible with Microsoft Windows based user-interface software running on an MS-DOS based computer.

To support operation with HP ITG, the HP E1685B Panel Disk is supplied with the module.

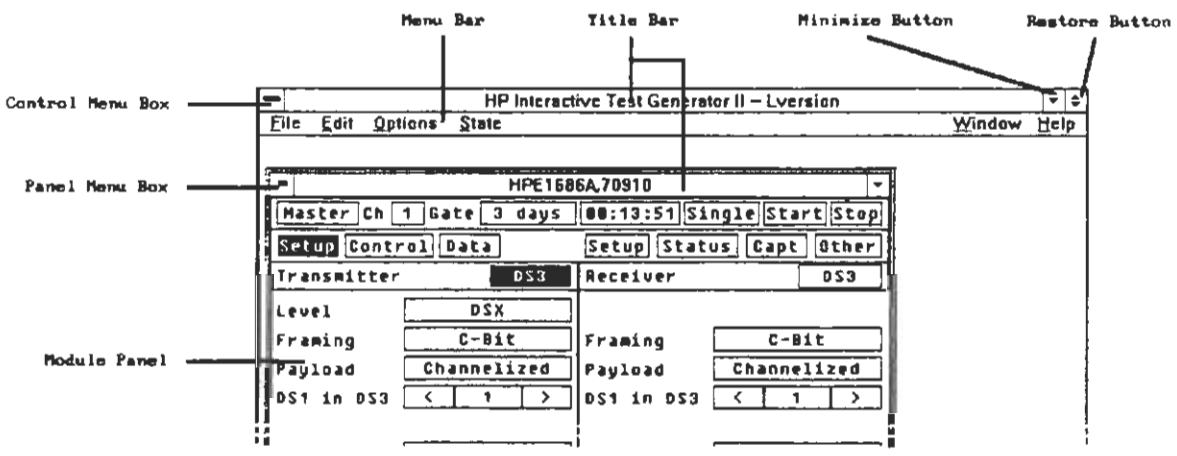
Once loaded into a Windows/HP ITG environment, the module can be controlled through a set of subpanels that appear on the display of your controller.

The HP ITG User Interface

This section assumes that you are familiar with the basic concepts of the user interface and the HP ITG environment. If you are new to Windows and/or HP ITG it is recommended you read the following:

- The *Windows Basics* chapter in the *Microsoft Windows User's Guide* for Windows 3.1.
- The *Instrument Control* chapter in the *HP Interactive Test Generator II User's Manual*.

The main elements of the HP ITG user interface which allow you to interface with the module's soft-panel are shown below, and described in the following table.



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HP ITG User Interface

Element	Description
Control Menu Box	Clicking the mouse on this gives you access to commands which enable you to resize, move, maximize, minimize, close windows, and switch to other tasks. Commands that appear dimmed cannot be selected. Detailed information on the Control Menu box is contained in the *Windows Basics* chapter in the *Microsoft Windows User's Guide*.
Title Bar	Shows the name of the application/module. The HP E1686A title bar also contains the module address (70910). The module panel is active when the bar is highlighted. NOTE: The module address and subaddress on the panel must match your test system's address configuration. To change the panel addresses, click the mouse on **Options** on the main menu bar, then **Configuration** from the list of available modes to display the configuration dialog box. Enter new addresses as required. For further details, refer to the *HP Interactive Test Generator II User's Guide*.
Menu Bar	Clicking the mouse on File, Edit, Options, State, Windows or Help gives you access to a menu. Menu options change depending on what is selected. Detailed information on these menus is contained in *Appendix B* in the *HP Interactive Test Generator II User's Manual*.
Minimize Button (window/panel)	Clicking the mouse on this shrinks the window/panel to an icon (located at the bottom of the display). Detailed information on icons is contained in the *Windows Basics* chapter in the *Microsoft Windows User's Guide*.
Restore Button	If the window is enlarged, clicking the mouse on this restores the window to its previous size.
Panel Menu Box	Clicking the mouse on this gives you access to commands that control module panel operation. Detailed information on controlling a panel is contained in *Instrument Control* in the *HP Interactive Test Generator II User's Manual*.
Mouse Pointer	The pointer (arrow shaped) is used to point to the item you want to select (it moves about the display as you move the mouse). The pointer changes to an hour-glass shape when the controller is busy processing your selection. The mouse pointer can take on other shapes depending on what you are trying to do. More information on the mouse and the mouse pointer is contained in the *Microsoft Windows User's Guide*.

The colors used to distinguish the different displays and buttons on the module soft-panels are as follows:

Display	Color
Display	Harvest Gold
OK Alarm	Forest Green
Failed Alarm	Safety Red

Button	Color
Execute	Magenta
Menu	Evening Blue
Selection	Gray
Reset	Rich Green
Alarm Set	Rich Green
Done	Magenta
Toggle	Turquoise

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Panel Layout

An instrument panel in the HP ITG environment is used to control the module's transmitter and receiver functions. This panel is made up of the following six subpanels:

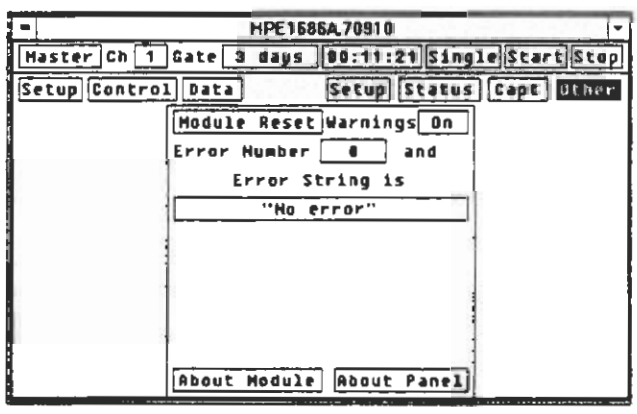
`Setup`	Contains transmit settings that are normally only set up once for a particular measurement.
`Control`	Contains transmit error injection and alarm generation settings that are normally altered during a measurement.
`Data`	Contains transmit DS3 framed settings that are normally altered during a measurement.
`Setup`	Contains receive settings that are normally only set up once for a particular measurement.
`Status`	Contains the alarm and status indicators as well as error measurement results.
`Capt`	Contains X-Bit, FEAC Code, C-Bit (DL) and C-Bit (PMDL) results as well as status information on Special Codes, Inverted DS2 C/Stuff Bits and FEAC Loopback.
`Other`	Contains information relevant to all subpanels, such as module reset and error reporting.

For example, to display the `Other` subpanel:

1. Use the mouse to position the cursor on the `Other` subpanel button located near the top of the display.
2. Click the mouse to display the subpanel.

The "Other" Subpanel

The `Other` subpanel is shown below.



The functions associated with this subpanel are described in the following table.

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Function	Description
Module Reset	This button resets the module to its default condition and returns you to the Tx and Rx **Setup** subpanels.
Warnings	This button disables the Live Mode warning dialog box that appears when changing between subpanels when the module is not in the live mode.
Error Reporting	Select this function to display the error number for any SCPI defined errors that occur while the module is active. The error is read from the system error queue on a first-in-first-out basis with the oldest error being displayed first. Refer to *Appendix B* for more information on error messages.
About Module	Select this function to display the module ID or model number, the serial number and the revision number. The serial and revision numbers are displayed only when the module is in live mode.
About Panel	Select this function to display the revision of the HP ITG panel.

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Programming Using HP ITG

You can create programs to control your module using the HP ITG software product. HP ITG is compatible with Microsoft® Windows™ based user-interface software running on an MS-DOS® based computer.

HP ITG has a logging facility, which when enabled, automatically translates your interactions with the module's HP ITG control-panel into instrument-control code. The code is stored in a file, and consists of calls to instrument "drivers" - files that describe the layout of the module's control-panel, and its HP-IB commands. Each time the configuration of the module's control-panel is altered, the corresponding instrument driver call is logged to the file. You can access this file to edit the code, add comments, include calls to routines featured in other applications, and integrate the code into new or existing programs.

HP ITG can also recognize and translate command structures in various programming languages into instrument-control code. It does this by means of an instrument driver. Supported languages are:

- HP Instrument BASIC for Windows 1.0
- Microsoft C 5.1, 6.0, 6.0ax
- Microsoft C 5.1, 6.0, 6.0ax plus Windows Software Development Kit 3.X (to develop Windows applications)
- Microsoft QuickC® 2.0, 2.5
- Microsoft QuickC for Windows 1.0
- Microsoft QuickBASIC 4.5

For example, the command structures required to select a DS3 PRBS15 pattern in the above languages are shown in the table below.

Prog. Language	Command Structure
HP BASIC	`Hpt_set_str(hpe1686A,"TX_FORMAT","PRBS15")`
C	`hpt_set_str(hpe1686A,"TX_FORMAT","PRBS15")`
QuickBASIC	`hptsetstr(hpe1686A,"TX_FORMAT","PRBS15")`

`hpe1686A` is a variable name that HP ITG generates based on the name assigned to your control-panel when you added the module to the HP ITG soft test system.

`TX_FORMAT` is the component name (in the HP E1686A driver) which is used to select the mode of operation of the module.

`PRBS15` is the value selected from the control-panel.

For further information on generating instrument-control code, refer to the HP ITG User's Handbook.

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Driver Components

The reference table at the end of this chapter lists the HP ITG and HP VEE Driver components. The table includes a brief description of the component, the range of values associated with the component (HP VEE values are shown in brackets), and the component default value.

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Controlling the Module using HP VEE

This section describes how to generate and receive test signals using the HP VEE "state driver panel" facility. HP VEE is compatible with UNIX operating systems, running in a network environment. This allows you to use more than one workstation running the HP E1686A state driver panel at a time, and operate remote systems on the network.

To support operation with HP VEE, the HP E1686A Panel Disk is supplied with the module.

Once loaded onto the UNIX operating system, the module can be controlled, via HP VEE, through a set of subpanels that appear on the display of your controller in exactly the same way as described in the Windows/HP ITG environment.

You can also create programs to control your module using HP VEE component drivers. Refer to the *"Using HP VEE-Engine and HP VEE-Test"* manual and *Appendix A* of this manual for information on programming using this facility.

Driver Components

The following information lists all available buttons on the state dirver and associated values. It also lists the names of the corresponding component drivers and the values that can be assigned to them.

The information is organized to correspond to the following three categories:

- Measurement Control
- DS3 Tx and Rx Operation
- DS1 or E1 Tx and Rx Operation

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Measurement Control

■ State Driver Button

Button	Options
Master/Slave	Slave Master
Channel	1 to 4
Gate	1 sec 10 secs 1 min 5 mins 1 hr 5 hr 24 hr 3 days
Clock (An output displaying elapsed time.)	-
Repeat/Single	Repeat Single
Start	-
Stop	-
Cont	-

■ Component Driver

Component	Input Values	Options
MASTER_SLAVE	0 1	Slave Master
CH_NUMBER	0 to 3	1 to 4
CSYS_INTERGRATION_PERIOD	0 1 2 3 4 5 6 7	1 sec 10 secs 1 min 5 mins 1 hr 5 hr 24 hr 3 days
Clock (An output displaying elapsed time.)	-	-
CSYS_ONCE	0 1	Repeat Single
CSYS_START	1	Start
CSYS_STOP	1	Stop
CSYS_CONT	1	Cont

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DS3 Tx and Rx Operation

The following information is applicable when the module is configured for DS3 operation.

Selecting a DS3 Tx Signal Level (Tx Setup Subpanel)

- State Driver Button

Button	Options
Level	DSX High 900 ft

- Component Driver

Component	Input Values	Options
TX_DS3_LEVEL	0 1 2	DSX High 900 ft

Selecting a DS3 Tx Frame Structure (Tx Setup Subpanel)

- State Driver Button

Button	Options
Framing	C-Bit M23 Unframed

- Component Driver

Component	Input Values	Options
TX_DS3_FRAMING	0 1 2	C-Bit M23 Unframed

If Unframed is selected, see the *Selecting a DS3 Tx Pattern* section.

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Selecting a DS3 Tx Payload (Tx Setup Subpanel)

- State Driver Button

Button	Options
Payload	Channelized Unchannelized

- Component Driver

Component	Input Values	Options
TX_DS3_PAYLOAD	0 1	Channelized Unchannelized

If Unchannelized is selected, see the *Selecting a DS3 Tx Pattern* section.

Selecting a DS2 Group (Tx Setup Subpanel)

- State Driver Button

Button	Options
DS2 in DS3	1 to 7

- Component Driver

Component	Input Values	Options
TX_DS3_DS2_GROUP	0 to 6	1 to 7

This component is valid when an E1 signal is being mapped into the DS3. see the *Selecting an E1 Tributary* section.

Selecting a E1 Tributary (Tx Setup Subpanel)

- State Driver Button

Button	Options
E1 in DS2	1 to 3

- Component Driver

Component	Input Values	Options
TX_DS3_E1_TRIBUTARY	0 to 2	1 to 3

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Selecting a DS1 Channel (Tx Setup Subpanel)

- State Driver Button

Button	Options
DS1 in DS3	1 to 28

- Component Driver

Component	Input Values	Options
TX_DS3_DS1_CHANNEL	0 to 27	1 to 28

This component is valid when a DS1 signal is being mapped into the DS3.

Selecting a DS1/E1 Source (Tx Setup Subpanel)

- State Driver Button

Button	Options
DS1 or E1 Source	Internal External
Other DS1s or E1s	Same All Ones Data AIS

- Component Driver

Component	Input Values	Options
TX_DS3_DSE1_SOURCE	0 1	Internal External
TX_DS3_OTHER_DSE1S	0 1 2	Same All Ones Data AIS

Internal translates into "DS1 TX Module" when DS1s are mappped into the DS3 or "E1 TX Module" when E1s are mappped into the DS3.
"All Ones Data" is not applicable when E1s are mapped into the DS3.

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Selecting a DS3 Tx Pattern (Tx Setup Subpanel)

- State Driver Button

Button	Options
Pattern	PRBS15 PRBS20 PRBS23 User All Ones Idle
Invert (no label)	Normal Invert

- Component Driver

Component	Input Values	Options
TX_DS3_PATTERN	0 1 2 3 4 5	PRBS15 PRBS20 PRBS23 User All Ones Idle
TX_DS3_INVERT_PATTERN	0 1	Normal Invert

Selecting a DS3 Tx Clock Source (Tx Setup Subpanel)

- State Driver Button

Button	Options
Clk Source	Internal External Loop

- Component Driver

Component	Input Values	Options
TX_DS3_CLK_SOURCE	0 1 2	Internal External Loop

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Selecting a Trigger Output (Tx Setup Subpanel)

- State Driver Button

Button	Options
Trig Output	None DS3 Bit Err DS3 BPV Err DS3 EXZ Err DS3 AIS DS3 LOS DS3 F-Bit Err DS3 M-Bit Err DS3 X-Bit Change DS3 Idle DS3 OOF DS3 Frame Clk DS3 FEBE Err DS3 FEAC Change DS3 Bit+Par Err DS3 Bit+CP Err DS3 Bit Err E1 Bit Err E1 BPV Err E1 EXZ Err E1 AIS E1 LOS DS1 Bit Err DS1 BPV Err DS1 EXZ Err DS1 Yellow DS1 AIS DS1 LOS DS1 Frame Clk DS1 Frame Err DS1 OOF DS1 Bit+CRC Err

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■ Component Driver

Component	Input Values	Options
TX_TRIG_OUTPUT	0	None
	1	DS3 Bit Err
	2	DS3 BPV Err
	3	DS3 EXZ Err
	4	DS3 AIS
	5	DS3 LOS
	6	DS3 F-Bit Err
	7	DS3 M-Bit Err
	8	DS3 X-Bit Change
	9	DS3 Idle
	10	DS3 OOF
	11	DS3 Frame Clk
	12	DS3 FEBE Err
	13	DS3 FEAC Change
	14	DS3 Bit+Par Err
	15	DS3 Bit+CP Err
	16	DS3 Bit Err
	17	E1 Bit Err
	18	E1 BPV Err
	19	E1 EXZ Err
	20	E1 AIS
	21	E1 LOS
	22	DS1 Bit Err
	23	DS1 BPV Err
	24	DS1 EXZ Err
	25	DS1 Yellow
	26	DS1 AIS
	27	DS1 LOS
	28	DS1 Frame Clk
	29	DS1 Frame Err
	30	DS1 OOF
	31	DS1 Bit+CRC Err

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Generating DS3 Tx Errors (Tx Control Subpanel)

- State Driver Button

Button	Options
Add Error	Bit Bit+Parity Code (BPV) F-Bit Framing F-Bit N in M M-Bit Framing FEBE Code (EXZ)
Rate	Single Burst 0.9E-9 1.0E-9 1.1E-9 0.9E-8 1.0E-8 1.1E-8 0.9E-7 1.0E-7 1.1E-7 0.9E-6 1.0E-6 1.1E-6 0.9E-5 1.0E-5 1.1E-5 0.9E-4 1.0E-4 1.1E-4 0.9E-3 1.0E-3 1.1E-3 0.9E-2 1.0E-2 1.1E-2
Error[1]	Off On
Off[2]	Off On

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Button	Options
Period[2]	1 µsec 5 µsec 10 µsec 25 µsec 75 µsec 100 µsec 250 µsec 500 µsec 750 µsec 1 msec 2.5 msec 5 msec 7.5 msec 10 msec 25 msec 50 msec 75 msec 100 msec 250 msec 500 msec 750 msec 1 sec
% Duty[2]	10 % 20 % 30 % 40 % 50 % 60 % 70 % 80 % 90 %

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■ Component Driver

Component	Input Values	Options
TX_DS3_ERR_TYPE	0 1 2 3 4 5 6 7	Bit Bit+Parity Code (BPV) F-Bit Framing F-Bit N in M M-Bit Framing FEBE Code (EXZ)
TX_DS3_ERR_RATE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	Single[1] Burst[2] 0.9E-9 1.0E-9 1.1E-9 0.9E-8 1.0E-8 1.1E-8 0.9E-7 1.0E-7 1.1E-7 0.9E-6 1.0E-6 1.1E-6 0.9E-5 1.0E-5 1.1E-5 0.9E-4 1.0E-4 1.1E-4 0.9E-3 1.0E-3 1.1E-3 0.9E-2 1.0E-2 1.1E-2
TX_DS3_ERR_SINGLE[1]	0 1	Off On
TX_DS3_ERR_ON_OFF[2]	0 1	Off On

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Component	Input Values	Options
TX_DS3_ERR_BURST_PERIOD[2]	0	1 μsec
	1	5 μsec
	2	10 μsec
	3	25 μsec
	4	75 μsec
	5	100 μsec
	6	250 μsec
	7	500 μsec
	8	750 μsec
	9	1 msec
	10	2.5 msec
	11	5 msec
	12	7.5 msec
	13	10 msec
	14	25 msec
	15	50 msec
	16	75 msec
	17	100 msec
	18	250 msec
	19	500 msec
	20	750 msec
	21	1 sec
TX_DS3_ERR_BURST_DUTY[2]	0	10 %
	1	20 %
	2	30 %
	3	40 %
	4	50 %
	5	60 %
	6	70 %
	7	80 %
	8	90 %

1. The Error On/Off one shot error inject control is applicable when the single error rate is selected.
2. The Period and % Duty controls are applicable when the Burst error rate is selected.

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Generating DS3 Alarms and Stressing Signals (Tx Control Subpanel)

- State Driver Button

Button	Options	Comments
LOSon/off	On, Off	Same as continuous Stress LOS.
OOFon/off	On, Off	Same as continuous Stress OOF.
AISon/off	On, Off	Same as continuous Stress AIS.
Stress	LOS AIS AIS excl C-Bits Unframed 1010 Frame All Ones Unfrm All Ones X-Bit Toggle OOF	
Duration	Single Continuous	All Stress options except X-Bit Toggle.
Duration	.9 seconds 1 second 1.1 seconds	X-Bit Toggle only.
Pulse On	Off On	All single duration Stress options except X-Bit Toggle and OOF.
XXX Bits	75 Bits 100 Bits 125 Bits 150 Bits 175 Bits 200 Bits 225 Bits 250 bits 275 Bits	
On/Off	Off On	Available with OOF.

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■ Component Driver

Component	Input Values	Options
TX_DS3_STRESS_LOS_BUT	0 1	LOSon LOSoff
TX_DS3_STRESS_OOF_BUT	0 1	OOFon OOFoff
TX_DS3_STRESS_AIS_BUT	0 1	AISon AISoff
TX_DS3_STRESS_TYPE	0 1 2 3 4 5 6 7	LOS AIS AIS excl C-Bits Unframed 1010 Frame All Ones Unfrm All Ones X-Bit Toggle OOF
TX_DS3_STRESS_PERIOD	0 1	Single Continuous
TX_DS3_STRESS-XBIT_PER	0 1 2	.9 seconds 1 second 1.1 seconds
TX_DS3_STRESS_SINGLE	0 1	Off On
TX_DS3_STRESS_LOS_COUNT	0 1 2 3 4 5 6 7 8	75 Bits 100 Bits 125 Bits 150 Bits 175 Bits 200 Bits 225 Bits 250 bits 275 Bits
TX_DS3_STRESS_ON_OFF	0 1	Off On

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Generating DS2 C/Stuffing Bits (Tx Control Subpanel)

- State Driver Button

Button	Options
Inject	DS2 C/Stuff FEAC Code
Invert Bit	C1 C2 C3 Stuff
Off/On	Off On
Pulse Size	4 Bits 5 Bits
	Pulse Invert

- Component Driver

Component	Input Values	Options
TX_DS3_INJ_TYPE	0 1	DS2 C/Stuff FEAC Code
TX_DS3_INJ_CSTUFF_TYPE	0 1 2 3	C1 C2 C3 Stuff
TX_DS3_INJ_CSTUFF_INVERT	0 1	Off On
TX_DS3_INJ_CSTUFF_COUNT	0 1	4 Bits 5 Bits
TX_DS3_INJ_CSTUFF_LABEL	Pulse Invert	0

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Generating FEAC Codes (Tx Control Subpanel)

- State Driver Button

Button	Options
Inject	DS2 C/Stuff FEAC Code
FEAC Code	User DS3 Fail (SA) DS3 LOS/HBER DS3 OOF DS3 AIS Rcvd DS3 Idle Rcvd DS3 Fail (NSA) Common Fail Mul DS1 LOS/HBER DS1 Fail (SA) Sgl DS1 LOS/HBER DS1 Fail (NSA)
FEAC Count	9 Codewords 10 Codewords Constant
Pulse Inject	Off On
FEAC Loopback Inject	Activate Deactivate
FEAC Loopback Message	DS3 Line DS1 Line 1 to DS1 Line 28 DS1 All
FEAC Loopback Count	3 Action, 3 Msg to 15 Action, 15 Msg
Pulse FEAC Loopback Inject	Off On

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■ Component Driver

Component	Input Values	Options
TX_DS3_INJ_TYPE	0 1	DS2 C/Stuff FEAC Code
TX_DS3_INJ_FEAC_CODE	0 1 2 3 4 5 6 7 8 9 10 11	User DS3 Fail (SA) DS3 LOS/HBER DS3 OOF DS3 AIS Rcvd DS3 Idle Rcvd DS3 Fail (NSA) Common Fail Mul DS1 LOS/HBER DS1 Fail (SA) Sgl DS1 LOS/HBER DS1 Fail (NSA)
TX_DS3_INJ_FEAC_COUNT	0 1 2	9 Codewords 10 Codewords Constant
TX_DS3_INJ_FLOOP_SINGLE	0 1	Off On
TX_DS3_INJ_FLOOP_ACTION	0 1	Activate Deactivate
TX_DS3_INJ_FLOOP_MESSAGE	0 1 to 28 29	DS3 Line DS1 Line 1 to DS1 Line 28 DS1 All
TX_DS3_INJ_FLOOP_COUNT	0 to 14	3 Action, 3 Msg to 15 Action, 15 Msg
TX_DS3_INJ_FEAC	0 1	Off On

Generating a DS2 Alarm Bit (Tx Data Subpanel)

■ State Driver Button

Button	Options
DS2 X/A Bit	0 1

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- Component Driver

Component	Input Values	Options
TX_DS3_DS2_XABIT	0 1	0 1

Generating PMDL Bits (Tx Data Subpanel)

- State Driver Button

Button	Options
C-Bit PMDL	All Ones External User

- Component Driver

Component	Input Values	Options
TX_DS3_PMDL	0 1 2	All Ones External User

Generating Data Link (DL) Bits (Tx Data Subpanel)

- State Driver Button

Button	Options
C-Bit DL	All Ones User

- Component Driver

Component	Input Values	Options
TX_DS3_DL	0 1	All Ones User

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Setting FEBE Bits (Tx Data Subpanel)

- State Driver Button

Button	Options
FEBE Bits	000 to 111

- Component Driver

Component	Input Values	Options
TX_DS3_FEBE_UWORD	0 to 15	000 to 111

Selecting a DS3 Rx Frame Structure (Rx Setup Subpanel)

- State Driver Button

Button	Options
Framing	C-Bit M23 Unframed

- Component Driver

Component	Input Values	Options
RX_DS3_FRAMING	0 1 2	C-Bit M23 Unframed

If Unframed is selected, see the *Selecting an Rx Pattern* section.

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Selecting a DS3 Rx Payload (Rx Setup Subpanel)

- State Driver Button

Button	Options
Payload	Channelized Unchannelized

- Component Driver

Component	Input Values	Options
TX_DS3_PAYLOAD	0 1	Channelized Unchannelized

If Unchannelized is selected, see the *Selecting a DS3 Rx Pattern* section.

Selecting a DS3 Rx Pattern (Rx Setup Subpanel)

- State Driver Button

Button	Options
Pattern	PRBS15 PRBS20 PRBS23 User All Ones Idle
Invert (no label)	Normal Invert

- Component Driver

Component	Input Values	Options
RX_DS3_PATTERN	0 1 2 3 4 5	PRBS15 PRBS20 PRBS23 User All Ones Idle
RX_DS3_INVERT_PATTERN	0 1	Normal Invert

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Selecting a DS2 Group (Rx Setup Subpanel)

- State Driver Button

Button	Options
DS2 in DS3	1 to 7

- Component Driver

Component	Input Values	Options
RX_DS3_DS2_GROUP	0 to 6	1 to 7

This component is valid when an E1 signal is being mapped into the DS3, see the *Selecting an E1 Tributary* section.

Selecting an E1 Tributary (Rx Setup Subpanel)

- State Driver Button

Button	Options
E1 in DS2	1 to 3

- Component Driver

Component	Input Values	Options
RX_DS3_E1_TRIBUTARY	0 to 2	1 to 3

Selecting a DS1 Channel (Rx Setup Subpanel)

- State Driver Button

Button	Options
DS1 in DS3	1 to 28

- Component Driver

Component	Input Values	Options
RX_DS3_DS1_CHANNEL	0 to 27	1 to 28

This component is valid when a DS1 signal is being mapped into the DS3.

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Selecting an Rx DS3 Clock Source (Rx Setup Subpanel)

- State Driver Button

Button	Options
DS3 Source	External Int. Loopback

- Component Driver

Component	Input Values	Options
RX_DS3_SOURCE	0 1	External Int. Loopback

Selecting a Clock Output (Rx Setup Subpanel)

- State Driver Button

Button	Options
Clk Output	DS3 DS1/E1

- Component Driver

Component	Input Values	Options
RX_DS3_SOURCE	0 1	External Int. Loopback

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Selecting an Rx Trigger Output (Rx Setup Subpanel)

- State Driver Button

Button	Options
Trig Output	None DS3 Bit Err DS3 BPV Err DS3 EXZ Err DS3 AIS DS3 LOS DS3 Parity Err DS3 CP-Bit Err DS3 F-Bit Err DS3 FM-Bit Err DS3 X-Bit Change DS3 Idle DS3 OOF DS3 Frame Clk DS3 FEBE Err DS3 FEAC Change DS3 Sync Loss E1 Bit Err E1 BPV Err E1 EXZ Err E1 AIS E1 LOS E1 Sync Loss DS1 Bit Err DS1 BPV Err DS1 EXZ Err DS1 Yellow DS1 AIS DS1 LOS DS1 Frame Clk DS1 Frame Err DS1 OOF DS1 CRC Err DS1 Sync Loss

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■ Component Driver

Component	Input Values	Options
TX_TRIG_OUTPUT	0	None
	1	DS3 Bit Err
	2	DS3 BPV Err
	3	DS3 EXZ Err
	4	DS3 AIS
	5	DS3 LOS
	6	DS3 Parity Err
	7	DS3 CP-Bit Err
	8	DS3 F-Bit Err
	9	DS3 FM-Bit Err
	10	DS3 X-Bit Change
	11	DS3 Idle
	12	DS3 OOF
	13	DS3 Frame Clk
	14	DS3 FEBE Err
	15	DS3 FEAC Change
	16	DS3 Sync Loss
		E1 Bit Err
	17	E1 BPV Err
	18	E1 EXZ Err
	19	E1 AIS
	20	E1 LOS
	21	E1 Sync Loss
	22	DS1 Bit Err
	23	DS1 BPV Err
	24	DS1 EXZ Err
	25	DS1 Yellow
	26	DS1 AIS
	27	DS1 LOS
	28	DS1 Frame Clk
	29	DS1 Frame Err
	30	DS1 OOF
	31	DS1 CRC Err
	32	DS1 Sync Loss

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Monitoring DS3 Alarms (Rx Status Subpanel)

- State Driver Button

Button	Options
LOS	Off On
OOF	Off On
AIS	Off On
Sync	Off On
X-Bit	Off On
Idle	Off On
M23	Off On
C-BIT	Off On
DS2 X/A Bit	Off On

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■ Component Driver

Component	Output Values	Options
RX_DS3_LOS_IND	0 1	Off On
RX_DS3_OOF_IND	0 1	Off On
RX_DS3_AIS_IND	0 1	Off On
RX_DS3_PSL_IND	0 1	Off On
RX_DS3_XBIT_IND	0 1	Off On
RX_DS3_IDLE_IND	0 1	Off On
RX_DS3_FFM_IND_M23	0 1	Off On
RX_DS3_FFM_IND_CBIT	0 1	Off On
RX_DS2_ALARM_SUMMARY	0 1	Off On

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Monitoring DS2 Alarms (Rx Status - DS2 Results Subpanel)

- State Driver Button

Button	Options
LOS	Off On
OOF	Off On
AIS	Off On
X/A-Bit	Off On

- Component Driver

Component	Output Values	Options
RX_DS2_LOS_IND	0 1	Off On
RX_DS2_OOF_IND	0 1	Off On
RX_DS2_AIS_IND	0 1	Off On
RX_DS2_XBIT_IND	0 1	Off On

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Selecting DS3 Errors (Rx Status Subpanel)

- State Driver Button

Button	Options
Alarm	Sig Loss OOF Sync Loss AIS
Bit	Count Ratio Seconds
P-Bit	Count Ratio Seconds
CP-Bit	Count Ratio Seconds
F-Bit	Count Ratio Seconds
FEBE	Count Ratio Seconds
Frame	Count Ratio Seconds

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■ Component Driver

Component	Input Values	Options
RX_DS3_ALARM_SECONDS	0 1 2	Sig Loss OOF AIS
RX_DS3_BIT_STYLE	0 1 2 3	Count Ratio Seconds
RX_DS3_PBIT_STYLE	0 1 2	Count Ratio Seconds
RX_DS3_CPBIT_STYLE	0 1 2	Count Ratio Seconds
RX_DS3_FBIT_STYLE	0 1 2	Count Ratio Seconds
RX_DS3_FEBE_STYLE	0 1 2	Count Ratio Seconds
RX_DS3_FMBIT_STYLE	0 1 2	Count Ratio Seconds
RX_DS3_BPV_STYLE	0 1 2	Count Ratio Seconds

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Monitoring DS3 Error Results (Rx Status Subpanel)

- State Driver Button

Button	Options
Alarm	Alarm seconds
Bit	Count Ratio Seconds
P-Bit	Count Ratio Seconds
CP-Bit	Count Ratio Seconds
F-Bit	Count Ratio Seconds
FEBE	Count Ratio Seconds
Frame	Count Ratio Seconds

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- Component Driver

Component	Output Values
RX_DS3_ALARM-RESULT	Alarm seconds
RX_DS3_BIT_RESULT	Count Ratio Seconds
RX_DS3_PBIT_RESULT	Count Ratio Seconds
RX_DS3_CPBIT_RESULT	Count Ratio Seconds
RX_DS3_FBIT_RESULT	Count Ratio Seconds
RX_DS3_FEBE_RESULT	Count Ratio Seconds
RX_DS3_FMBIT_RESULT	Count Ratio Seconds
RX_DS3_BPV_RESULT	Count Ratio Seconds

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Measuring DS3 Signal Level (Rx Status Subpanel)

- State Driver Button

Button	Options
Signal	Peak V dBDSX

- Component Driver

Component	Input Values	Output Values	Options
RX_DS3_SIGNAL_STYLE	0 1	-	Peak V dBDSX
RX_DS3_SIGNAL_RESULT	-	Peak V dBDSX	-

Capturing X-Bits, FEAC Codes or C-Bits

- State Driver Button

Button	Options
X-Bit	Text string (2-bits)
FEAC Code	Text string (6-bits)
C-Bit DL	Text string (9-bits)
C-Bit PMDL	Text string (3-bits)

- Component Driver

Component	Output Values
RX_DS3_XBIT_UWORD	Text string (2-bits)
RX_DS3_FEAC_CODE_NAME	Text string (6-bits)
RX_DS3_DL_UWORD	Text string (9-bits)
RX_DS3_PMDL_UWORD	Text string (3-bits)

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Detecting Special Codes (Rx Status - Overhead Display Subpanel)

- State Driver Button

Button	Options
AIS	Off On
AIS xC	Off On
UF1010	Off On
FrA1	Off On
UFrA1	Off On
C1	Off On
C2	Off On
C3	Off On
Stuff	Off On
Activate	Off On
Deactivate	Off On

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■ Component Driver

Component	Input Values	Options
RX_SPECIAL_AIS_IND	0 1	Off
RX_SPECIAL_CAIS_IND	0 1	Off
RX_SPECIAL_UF10_IND	0 1	Off On
RX_SPECIAL_FAO_IND	0 1	Off On
RX_SPECIAL_UFAO_IND	0 1	Off On
RX_CSTUFF_IC1_IND	0 1	Off On
RX_CSTUFF_IC2_IND	0 1	Off On
RX_CSTUFF_IC3_IND	0 1	Off On
RX_CSTUFF_ISTUFF_IND	0 1	Off On
RX_FLOOP_ACT_IND	0 1	Off On
RX_FLOOP_DEACT_IND	0 1	Off On

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DS1 or E1 Tx and Rx Operation

Selecting DS1 or E1 Tx Signal Type (Tx Setup Subpanel)

- State Driver Button

Button	Options
Transmitter	DS3 DS1/E1
Mode	DS1 E1

- Component Driver

Component	Input Values	Options
TX_SELECTION	0 1	DS3 DS1/E1
TX_DSE1_MODE	0 1	DS1 E1

Selecting a DS1 or E1 Tx Line Code (Tx Setup Subpanel)

- State Driver Button

Button	Options
Line Code	AMI B8ZS HDB3

- Component Driver

Component	Input Values	Options
TX_DSE1_LINECODE	0 1 2	AMI B8ZS HDB3

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Selecting a DS1 Tx Frame Structure (Tx Setup Subpanel)

- State Driver Button

Button	Options
Framing	D4 ESF SLC96 Unframed

- Component Driver

Component	Input Values	Options
TX_DSE1_DS1_FRAMING	0 1 2 3	D4 ESF SLC96 Unframed

Selecting a DS1 or E1 Tx Pattern (Tx Setup Subpanel)

- State Driver Button

Button	Options
Pattern	QRSS PRBS15 PRBS20 PRBS23 User 3 in 24 All Ones Loop up Lown Down
Invert (no label)	Off On

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- Component Driver

Component	Input Values	Options
TX_DSE1_PATTERN	0	QRSS
	1	PRBS15
	2	PRBS20
	3	PRBS23
	4	User
	5	3 in 24
	6	All Ones
	7	Loop up
	8	Lown Down
TX_DSE1_INVERT_PATTERN	0	Off
	1	On

Selecting a DS1 or E1 Tx Clock Source (Tx Setup Subpanel)

- State Driver Button

Button	Options
Clk Source	Internal External Loop

- Component Driver

Component	Input Values	Options
TX_DS1_CLK_SOURCE	0	Internal
	1	External
	2	Loop

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Generating DS1 or E1 Errors (Tx Control Subpanel)

- State Driver Button

Button	Options
Add Error	Bit Code (BPV) Code (EXZ)
Rate	Single Burst 0.9E-9 1.0E-9 1.1E-9 0.9E-8 1.0E-8 1.1E-8 0.9E-7 1.0E-7 1.1E-7 0.9E-6 1.0E-6 1.1E-6 0.9E-5 1.0E-5 1.1E-5 0.9E-4 1.0E-4 1.1E-4 0.9E-3 1.0E-3 1.1E-3 0.9E-2 1.0E-2 1.1E-2
Error[1]	Off On
Off[2]	Off On

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Button	Options
Period[2]	1 µsec 5 µsec 10 µsec 25 µsec 75 µsec 100 µsec 250 µsec 500 µsec 750 µsec 1 msec 2.5 msec 5 msec 7.5 msec 10 msec 25 msec 50 msec 75 msec 100 msec 250 msec 500 msec 750 msec 1 sec
% Duty[2]	10 % 20 % 30 % 40 % 50 % 60 % 70 % 80 % 90 %

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■ Component Driver

Component	Input Values	Options
TX_DSE1_ERR_TYPE	0 1 2	Bit+Parity Code (BPV) Code (EXZ)
TX_DSE1_ERR_RATE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	Single[1] Burst[2] 0.9E-9 1.0E-9 1.1E-9 0.9E-8 1.0E-8 1.1E-8 0.9E-7 1.0E-7 1.1E-7 0.9E-6 1.0E-6 1.1E-6 0.9E-5 1.0E-5 1.1E-5 0.9E-4 1.0E-4 1.1E-4 0.9E-3 1.0E-3 1.1E-3 0.9E-2 1.0E-2 1.1E-2
TX_DSE1_ERR_SINGLE[1]	0 1	Off On
TX_DSE1_ERR_ON_OFF[2]	0 1	Off On

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Component	Input Values	Options
TX_DSE1_ERR_BURST_PERIOD[2]	0	1 µsec
	1	5 µsec
	2	10 µsec
	3	25 µsec
	4	75 µsec
	5	100 µsec
	6	250 µsec
	7	500 µsec
	8	750 µsec
	9	1 msec
	10	2.5 msec
	11	5 msec
	12	7.5 msec
	13	10 msec
	14	25 msec
	15	50 msec
	16	75 msec
	17	100 msec
	18	250 msec
	19	500 msec
	20	750 msec
	21	1 sec
TX_DSE1_BURST_DUTY[2]	0	10 %
	1	20 %
	2	30 %
	3	40 %
	4	50 %
	5	60 %
	6	70 %
	7	80 %
	8	90 %

1. The Error On/Off one shot error inject control is applicable when the single error rate is selected.
2. The Period and % Duty controls are applicable when the Burst error rate is selected.

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Generating DS1 or E1 Alarms/Stressing Signals (Rx Control Subpanel)

- State Driver Button

Button	Options	Comments
LOSon/off	On, Off	Same as continuous Stress LOS.
OOFon/off	On, Off	Same as Stress OOF.
AISon/off	On, Off	Same as Stress AIS.
YELon/off		Same as Stress Yellow.
Stress	LOS AIS OOF Yellow	
Duration	Single Continuous	
Pulse On	Off On	
XXX Bits	75 Bits 100 Bits 125 Bits 150 Bits 175 Bits 200 Bits 225 Bits 250 bits 275 Bits	
On/Off	Off On	

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■ Component Driver

Component	Input Values	Options
TX_DSE1_STRESS_LOS_BUT	0 1	LOSon LOSoff
TX_DSE1_STRESS_OOF_BUT	0 1	OOFon OOFoff
TX_DSE1_STRESS_AIS_BUT	0 1	AISon AISoff
TX_DSE1_STRESS_YEL_BUT	0 1	YELon YELoff
TX_DSE1_STRESS_TYPE	0 1 2 3	LOS AIS OOF Yellow
TX_DSE1_STRESS_PERIOD	0 1	Single Continuous
TX_DSE1_STRESS_SINGLE	0 1	Off On
TX_DSE1_STRESS_LOS_COUNT	0 1 2 3 4 5 6 7 8	75 Bits 100 Bits 125 Bits 150 Bits 175 Bits 200 Bits 225 Bits 250 bits 275 Bits
TX_DSE1_STRESS_ON_OFF	0 1	Off On

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Selecting DS1 or E1 Rx Signal Type (Rx Setup Subpanel)

- State Driver Button

Button	Options
Receiver	DS3 DS1/E1
Mode	DS1 E1

- Component Driver

Component	Input Values	Options
RX_SELECTION	0 1	DS3 DS1/E1
RX_DSE1_MODE	0 1	DS1 E1

Selecting a DS1 or E1 Rx Line Code (Rx Setup Subpanel)

- State Driver Button

Button	Options
Line Code	AMI B8ZS HDB3

- Component Driver

Component	Input Values	Options
RX_DSE1_LINECODE	0 1 2	AMI B8ZS HDB3

Selecting a DS1 Rx Frame Structure (Rx Setup Subpanel)

- State Driver Button

Button	Options
Framing	D4 ESF SLC96 Unframe

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- Component Driver

Component	Input Values	Options
RX_DSE1_DS1_FRAMING	0 1 2 3	D4 ESF SLC96 Unframe

Selecting a DS1 or E1 Rx Pattern (Rx Setup Subpanel)

- State Driver Button

Button	Options
Pattern	QRSS PRBS15 PRBS20 PRBS23 User 3 in 24 All Ones Loop Up Loop Down
Invert (No label)	Off On

- Component Driver

Component	Input Values	Options
RX_DSE1_PATTERN	0 1 2 3 4 5 6 7 8	QRSS PRBS15 PRBS20 PRBS23 User 3 in 24 All Ones Loop Up Loop Down
RX_DSE1_INVERT_PATTERN	Off On	

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Selecting a DS1 or E1 Rx Clock Source

- State Driver Button

Button	Options
DS1/E1 Src	DS3 RX Drop External Int. Loopback

- Component Driver

Component	Input Values	Options
RX_DSE1_SOURCE	0 1 2	DS3 RX Drop External Int. Loopback

Monitoring DS1 or E1 Alarms (Rx Status Subpanel)

- State Driver Button

Button	Options
LOS	Off On
AIS	Off On
Yellow	Off On
Sync	Off On
OOF	Off On
COFA	Off On

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■ Component Driver

Component	Output Values	Options
RX_DSE1_LOS_IND	0 1	Off On
RX_DSE1_AIS_IND	0 1	Off On
RX_DSE1_YEL_IND	0 1	Off On
RX_DS3_PSL_IND	0 1	Off On
RX_DSE1_OOF_IND	0 1	Off On
RX_DSE1_COFA_IND	0 1	Off On

Selecting DS1 or E1 Errors (Rx Status Subpanel)

■ State Driver Button

Button	Options
Alarm	Sig Loss OOF Sync Loss AIS Yellow COFA
Bit	Count Ratio Seconds
CRC-6	Count Ratio Seconds
Frame	Count Ratio Seconds

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- Component Driver

Component	Input Values	Options
RX_DSE1_ALARM_SECONDS	0 1 2 3 4 5	Sig Loss OOF Sync Loss AIS Yellow COFA
RX_DSE1_BIT_STYLE	0 1 2	Count Ratio Seconds
RX_DSE1_CRC_STYLE	0 1 2	Count Ratio Seconds
RX_DSE1_FRAME_STYLE	0 1 2	Count Ratio Seconds

Monitoring DS1 or E1 Error Results (Rx Status Subpanel)

- State Driver Button

Button	Options
Alarm	Alarm seconds
Bit	Count Ratio Seconds
CRC-6	Count Ratio Seconds
Frame	Count Ratio Seconds

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- Component Driver

Component	Output Values
RX_DSE1_ALARM-RESULT	Alarm seconds
RX_DSE1_BIT_RESULT	Count Ratio Seconds
RX_DSE1_CRC_RESULT	Count Ratio Seconds
RX_DSE1_FRAME_RESULT	Count Ratio Seconds

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HP ITG and HP VEE Quick Reference (HP VEE values in brackets)

Component	Description	Values	Initial Value
Master_slave		Slave (0),Master (1)	Slave (0)
SS_Mode		System (0), Local (1)	System (0)
SS_Enable		False (0), True (1)	True (1)
SS		START (0),STOP (1) ,CONT.IP_1 (2)	STOP (1)
TRIGGER_LINE			0
INTEGRATION_PERIOD			10
SS_TRIG	Sends system control pulse		0
MEASURING			0
Tx_ds3_level	Select Tx DS3 level	DSX (0), HIGH (1), FT900 (2)	DSX (0)
Tx_ds3_framing	Select Tx DS3 framing	CBIT (0), M23 (1), UNFRAMED (2)	CBIT (0)
Tx_ds3_payload	Select Tx DS3 payload	CHANNELIZED (0),	CHANNEL-
		UNCHANNELIZED (1)	IZED (0)
Tx_ds3_ds1_channel	Select the DS1 channel.	integers 1 (0) to 28 (27), step 1	1 (0)
Tx_ds3_dse1_source	Select DS1 Source	INTERNAL (0), EXTERNAL (1)	INTERNAL (0)
Tx_ds3_other_dse1s	Select Other DS1s source	SAME (0), AONE (1), AIS (2)	SAME (0)
Tx_ds3_ds2_group	Select DS2 group (1 to 7)	1 (0) to 7 (6), step 1	1 (0)
Tx_ds3_e1_tributary	Select E1 tributary	1 (0) to 3 (2), step 1	1 (0)
Tx_ds3_e1_tributary_incr	Increment E1 tributary selection		
Tx_ds3_e1_tributary_decr	Decrement E1 tributary selection		
Tx_ds3_pattern	Select DS3 pattern	PRBS15 (0), PRBS20 (1), PRBS23 (2), UWORD (3), AONE (4), IDLE (5)	PRBS15 (0)
Tx_ds3_pattern_uword	Select DS3 user pattern		10101010
Tx_ds3_invert_pattern	Invert DS3 pattern	OFF (0), ON (1)	OFF (0)
Tx_ds3_clk_source	Select DS3 clock source	INT (0), EXT (1), LOOP (2)	INT (0)
Tx_dse1_mode	Select DS1/E1 mode	DS1 (0), E1 (1)	DS1 (0)
Tx_dse1_linecode	Select DS1/E1 line code	AMI (0), B8ZS (1), HDB3 (2)	AMI (0)
Tx_dse1_ds1_framing	Select DS1/E1 framing	SF (0), ESF (1), SLC96 (2), UNFRAMED (3)	ESF (1)
Tx_dse1_pattern	Select DS1/E1 pattern	QRSS (0), PRBS15 (1), PRBS20 (2), PRBS23 (3), UWORD (4), THREE24 (5), AONE (6), LUWORD (7), LDWORD (8)	QRSS (0)
Tx_dse1_pattern_uword	Select DS1/E1 user pattern		101010101010
			101010101010
Tx_dse1_pattern_luword	Select DS1/E1 loop up pattern		10000
Tx_dse1_pattern_ldword	Select DS1/E1 loop down pattern		100
Tx_dse1_invert_pattern	Invert pattern	OFF (0), ON (1)	OFF (0)
Tx_dse1_clk_source	Select DS1/E1 clock source	INT (0), EXT (1), LOOP (2)	INT (0)
Tx_trig_output	Select TX trigger output	NONE (0), DS3_BIT_ERR (1), DS3_BPV_ERR (2), DS3_EXZ_ERR (3),	NONE (0)
		DS3_AIS (4), DS3_LOS (5), DS3_FBIT_ERR (6), DS3_MBIT_ERR (7), DS3_XBIT_CHNG (8), DS3_IDLE (9), DS3_OOF (10), DS3_FRM_CLK (11), DS3_FEBE_ERR (12), DS3_FEAC_CHNG (13), DS3_DPAR_ERR (14), DS3_DCP_ERR (15), E1_BIT_ERR (16), E1_BPV_ERR (17), E1_EXZ_ERR (18), E1_AIS (19), E1_LOS (20), DS1_BIT_ERR (21), DS1_BPV_ERR (22), DS1_EXZ_ERR (23), DS1_RAI (25), DS1_AIS (26), DS1_LOS (27), DS1_FRM_CLK (28), DS1_FBIT_ERR (29), DS1_OOF (30), DS1_DCRC_ERR (31)	

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HP ITG and HP VEE Quick Reference (HP VEE values in brackets) (continued)

Component	Description	Values	Initial Value
Tx-ds3_stress_type	Select DS3 stress	LOS (0), AIS (1), CAIS (2), UF10 (3), FAONE (4), UFAONE (5), XBIT (6), OOF (7)	LOS (0)
Tx_ds3_err_on_off	Enable DS3 burst error add	OFF (0), ON (1)	OFF (0)
Tx_ds3_err_type	DS3 error add selections	DATA (0), DPARITY (1), BPV (2), FBIT (3), FBIT_GRP (4), MBIT (5), FEBE (6), EXZ (7)	BPV (2)
Tx_ds3_err_rate	DS3 error add rate	SINGLE (0), BURST (1), LO_EXPN9 (2), MID_EXPN9 (3), HI_EXPN9 (4), LO_EXPN8 (5), MID_EXPN8 (6), HI_EXPN8 (7), LO_EXPN7 (8), MID_EXPN7 (9), HI_EXPN7 (10), LO_EXPN6 (11), MID_EXPN6 (12), HI_EXPN6 (13), LO_EXPN5 (14), MID_EXPN5 (15), HI_EXPN5 (16), LO_EXPN4 (17), MID_EXPN4 (18), HI_EXPN4 (19), LO_EXPN3 (20), MID_EXPN3 (21), HI_EXPN3 (22), LO_EXPN2 (23), MID_EXPN2 (24), HI_EXPN2 (25)	SINGLE (0)
Tx_ds3_err_single	Single error add		
Tx_ds3_err_burst_period	Select DS3 Error Add Burst Period	USEC1 (0), USEC5 (1), USEC10 (2), USEC25 (3), USEC50 (4), USEC75 (5), USEC100 (6), USEC250 (7), USEC500 (8), USEC750 (9), MSEC1 (10), MSEC2P5 (11), MSEC5 (12), MSEC7P5 (13), MSEC10 (14), MSEC25 (15), MSEC50 (16), MSEC75 (17), MSEC100 (18), MSEC250 (19), MSEC500 (20), MSEC750 (21), SEC1 (22)	USEC1 (0)
Tx_ds3_err_burst_duty	Select DS3 error burst % duty	PERCENT10 (0), PERCENT30 (1), PERCENT30 (2), PERCENT40 (3), PERCENT50 (4), PERCENT60 (5), PERCENT70 (6), PERCENT80 (7), PERCENT90 (8)	PERCENT 10 (9)
Tx_ds3_err_fbit_n	Select error add F-Bit N	1 (0) to 9 (8), step 1	1 (0)
Tx_ds3_err_fbit_m	Select error add F-Bit M	10 (0) to 32 (31)	10 (0)
Tx_ds3_err_mbit_count	Select DS3 error add M-Bit framing duration	COUNT1 (0), COUNT2 (1), COUNT3 (2), COUNT4 (3), COUNT5 (4)	COUNT1 (0)
Tx_ds3_err_exz_count	Select DS3 error add code (EXZ) duration	COUNT3 (0), COUNT4 (1), COUNT5 (2), COUNT6 (3)	COUNT3 (0)
Tx_ds3_stress_period	Select DS3 stress period	ONCE (0), CONSTANT (1)	ONCE (0)
Tx_ds3_stress_single	DS3 stress single inject		
Tx_ds3_stress_on_off	Enable/disable constant DS3 stress	OFF (0), ON (1)	OFF (0)
Tx_ds3_stress_los_count	Select number of bits in single duration	COUNT75 (0), COUNT100 (1), COUNT125 (2), COUNT150 (3), COUNT175 (4), COUNT200 (5), COUNT225 (6), COUNT250 (7), COUNT275 (8)	COUNT100 (1)
Tx_ds3_stress_xbit_per	Select DS3 stress X-Bit duration	SECONDLO (0), SECOND (1), SECONDHI (2)	SECOND (1)
Tx_ds3_inj_type	Select DS3 inject type	CSTUFF (0), FEAC_CODE (1)	CSTUFF (0)
Tx_ds3_inj_feac_on_off	Enable/disable constant FEAC code injection	OFF (0), ON (1)	OFF (0)
Tx_ds3_inj_single	Single FEAC code injection		
Tx_ds3_inj_feac	Single FEAC loopback injection		
Tx_ds3_inj_cstuff_count	Select burst of 4 or 5 frames	BURST4 (0), BURST5 (1)	BURST4 (0)
Tx_ds3_inj_cstuff_invert	Switch C-Stuff invert bit off/on	OFF (0), ON (1)	OFF (0)
Tx_ds3_inj_cstuff_type	Select DS3 injection invert bit type	INVERTC1 (0), INVERTC2 (1), INVERTC3 (2), INVERTSTUFF (3)	INVERTC1 (0)
Tx_ds3_inj_floop_count	Select FEAC loopback inject count	THREE (0), FOUR (1), FIVE (2), SIX (3), SEVEN (4), EIGHT (5), NINE (6), TEN (7), ELEVEN (8), TWELVE (9), THIRTEEN (10), FOURTEEN (11), FIFTEEN (12)	TEN (7)
Tx_ds3_inj_floop_action	Select FEAC loopback inject action	ACTIVATE (0), DEACTIVATE (1)	ACTIVATE (0)

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HP ITG and HP VEE Quick Reference (HP VEE values in brackets) (continued)

Component	Description	Values	Initial Value
Tx_ds3_inj_floop_message	Select FEAC loopback inject message	DS3LINE (0), DS1LINE1 (1), DS1LINE2 (2), DS1LINE3 (3), DS1LINE4 (4), DS1LINE5 (5), DS1LINE6 (6), DS1LINE7 (7), DS1LINE8 (8), DS1LINE9 (9), DS1LINE10 (10), DS1LINE11 (11), DS1LINE12 (12), DS1LINE13 (13), DS1LINE14 (14), DS1LINE15 (15), DS1LINE16 (16), DS1LINE17 (17), DS1LINE18 (18), DS1LINE19 (19), DS1LINE20 (20), DS1LINE21 (21), DS1LINE22 (22), DS1LINE23 (23), DS1LINE24 (24), DS1LINE25 (25), DS1LINE26 (26), DS1LINE27 (27), DS1LINE28 (28), DS1ALL (29)	DS3LINE (0)
Tx_ds3_inj_feac_count	Select an FEAC codeword inject period	NINE (0), TEN (1), CONSTANT (2)	NINE (0)
Tx_ds3_inj_feac_code	Select an FEAC Code	UWORD (0), DS3_SA (1), DS3_LOS (2), DS3_OOF (3), DS3_AIS (4), DS3_IDLE (5), DS3_NSA (6), DS3_CEF (7), DS1_MLOS (8), DS1_SA (9), DS1_LOS (10), DS1_NSA (11)	DS3_SA (1)
Tx_ds3_inj_feac_uword	Select a DS3 injection FEAC user code	000000	
Tx_ds3_stress_ais_but	Toggle AIS		
Tx_ds3_stress_los_but	Toggle LOS		
Tx_ds3_stress_oof_but	Toggle OOF		
Tx_dse1_stress_type	Select DS1/E1 stress type	LOS (0), AIS (1), OOF (2), YELLA (3)	LOS (0)
Tx_dse1_err_type	Select DS1/E1 error add type	DATA (0), DCRC (1), BPV (2), FRAME (3), EXZ (4)	DATA (0)
Tx_dse1_err_rate	Select DS1/E1 Error Rate	SINGLE (0), BURST (1), LO_EXPN9 (2), MID_EXPN9 (3), HI_EXPN9 (4), LO_EXPN8 (5), MID_EXPN8 (6), HI_EXPN8 (7), LO_EXPN7 (8), MID_EXPN7 (9), HI_EXPN7 (10), LO_EXPN6 (11), MID_EXPN6 (12), HI_EXPN6 (12), LO_EXPN5 (13), MID_EXPN5 (14), HI_EXPN5 (15), LO_EXPN4 (16), MID_EXPN4 (17), HI_EXPN4 (18), LO_EXPN3 (19), MID_EXPN3 (20), HI_EXPN3 (21), LO_EXPN2 (22), MID_EXPN2 (23), HI_EXPN2 (24)	SINGLE (0)
Tx_dse1_err_on_off	Enable/disable DS1/E1 error burst add	OFF (0), ON (1)	OFF (0)
Tx_dse1_err_single	DS1/E1 error add single		
Tx_dse1_err_burst_period	Select DS1/E1 Burst Error Add period	USEC1 (0), USEC5 (1), USEC10 (2), USEC25 (3), USEC50 (4), USEC75 (5), USEC100 (6), USEC250 (7), USEC500 (8), USEC750 (9), MSEC1 (10), MSEC2P5 (11), MSEC5 (12), MSEC7P5 (13), MSEC10 (14), MSEC25 (15), MSEC50 (16), MSEC75 (17), MSEC100 (18), MSEC250 (19), MSEC500 (20), MSEC750 (21), SEC1 (22)	USEC1 (0)
Tx_dse1_err_burst_duty	Select DS1/E1 burst error add duty	PERCENT10 (0), PERCENT20 (1), PERCENT30 (2), PERCENT40 (3), PERCENT50 (4), PERCENT60 (5), PERCENT70 (6), PERCENT80 (7), PERCENT90 (8)	PERCENT10 (0)
Tx_dse1_err_exz_count	Select DS1/E1 error add duration	COUNT3 (0), COUNT4 (1), COUNT5 (2), COUNT6 (3), COUNT7 (4), COUNT8 (5), COUNT9 (6), COUNT10 (7), COUNT11 (8), COUNT12 (9), COUNT13 (10), COUNT14 (11), COUNT15 (12), COUNT16 (13)	COUNT3 (0)
Tx_dse1_stress_period	Select DS1/E1 stress duration	ONCE (0), CONSTANT (1)	ONCE (0)
Tx_dse1_stress_single	DS1/E1 stress single		
Tx_dse1_stress_on_off	Enable/disable constant DS1/E1 stress	OFF (0), ON (1)	OFF (0)
Tx_dse1_stress_los_count	Select DS1/E1 stress bit count	COUNT75 (0), COUNT100 (1), COUNT125 (2), COUNT150 (3), COUNT175 (4), COUNT200 (5), COUNT225 (6), COUNT250 (7), COUNT275 (8)	COUNT100 (1)
Tx_dse1_stress_ais_but	Toggle DS1/E1 AIS		

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HP ITG and HP VEE Quick Reference (HP VEE values in brackets) (continued)

Component	Description	Values	Initial Value
Tx_dse1_stress_los_but	Toggle DS1/E1 LOS		
Tx_dse1_stress_oof_but	Toggle DS1/E1 OOF		
Tx_dse1_stress_yel_but	Toggle DS1/E YEL constant stress		
Tx_ds3_xbits	Select Tx DS3 X-Bits	XBIT00 (0), XBIT11 (1)	XBIT11 (1)
Tx_ds3_ds2_stuff	Select DS3 - DS2 Stuff type	ZERO (0), ONE (1), PREVIOUS (2)	PREVIOUS (2)
Tx_ds3_ds2_xabit	Select Tx DS3 - DS2 X/A Bit	ZERO (0), ONE (1)	ZERO (0)
Tx_ds3_dl	Select Tx DS3 C-Bit DL (data link)	AONES (0), UWORD (1)	AONES (0)
Tx_ds3_dl_uword	Select Tx DS3 C-Bit DL user word		111111111
Tx_ds3_pmdl	Select Tx DS3 C-Bit PMDL	AONES (0), EXTERNAL (1), UWORD (2)	AONES (0)
Tx_ds3_pmdl_uword	Select Tx DS3 C-Bit PMDL user word		111
Rx_ds3_framing	Select Rx DS3 framing	CBIT (0), M23 (1), UNFRAMED (2)	CBIT (0)
Rx_ds3_payload	Select Rx DS3 payload	CHANNELIZED (0),	CHANNEL-
		UNCHANNELIZED (1)	IZED (0)
Rx_ds3_ds1_channel	Select DS1 in DS3 channel	integers 1 (0) to 28 (27)	1 (0)
Rx_ds3_ds2_group	Select Rx DS2 in DS3 group	1 (0) to 7 (6), step 1	1 (0)
Rx_ds3_e1_tributary	Select Rx DS2 in DS3 tributary	1 (0) to 3 (2)	1 (0)
Rx_ds3_drop_linecode	Select Rx DS3 Drop port line code	AMI (0), B8ZS (1), HDB3 (2)	AMI (0)
Rx_ds3_pattern	Select Rx DS3 pattern	PRBS15 (0), PRBS20 (1), PRBS23 (2), UWORD (3), AONE (4), IDLE (5)	PRBS15 (0)
Rx_ds3_pattern_uword	Select Rx DS3 user pattern		10101010
Rx_ds3_invert_pattern	Invert pattern	OFF (0), ON (1)	OFF (0)
Rx_ds3_source	Select Rx DS3 source	EXT (0), LOOP (1)	EXT (0)
Rx_dse1_mode	Select Rx DS1/E1 mode	DS1 (0), E1 (1)	DS1 (0)
Rx_dse1_linecode	Select Rx DS1/E1 line code	AMI (0), B8ZS (1), HDB3 (2)	AMI (0)
Rx_dse1_source	Select Rx DS1/E1 source	INT (0), EXT (1), LOOP (2)	INT (0)
Rx_dse1_ds1_framing	Select Rx DS1 framing	SF (0), ESF (1), SLC96 (2), UNFRAMED (3)	ESF (1)
Rx_dse1_pattern	Select Rx DS1/E1 Pattern	QRSS (0), PRBS15 (1), PRBS20 (2), PRBS23 (3), UWORD (4), THREE24 (5), AONE (6), LUWORD (7), LDWORD (8)	QRSS (0)
Rx_dse1_pattern_uword	Select Rx DS1/E1 user pattern		101010101010
	Word		101010101010
Rx_dse1_pattern_luword	Select Rx Ds1/E1 loop up pattern		10000
Rx_dse1_pattern_ldword	Select Rx Ds1/E1 loop down pattern		100
Rx_dse1_invert_pattern	Invert pattern	OFF (0), ON (1)	OFF (0)
Rx_trig_output	Select Rx DS1/E1 trigger output	NONE (0), DS3_BIT_ERR (1), DS3_BPV_ERR (2), DS3_EXZ_ERR (3)	NONE (0)
Rx_clock_output	Select Rx DS1/E1 clock output	DS3 (0), DSE1 (1)	DS3 (0)
Rx_ds3_idle_ind	Report Rx DS3 Idle status indicator	ON (0), OFF (1)	OFF (1)
Rx_ds3_xbit_ind	Report Rx DS3 X-Bit status indicator	ON (0), OFF (1)	OFF (1)
Rx_ds3_los_ind	Report Rx DS3 LOS status indicator	ON (0), OFF (1)	OFF (1)
Rx_ds3_psl_ind	Report Rx DS3 Sync status indicator	ON (0), OFF (1)	OFF (1)
Rx_ds3_oof_ind	Report Rx DS3 OOF status indicator	ON (0), OFF (1)	OFF (1)
Rx_ds3_ais_ind	Report Rx DS3 AIS status indicator	ON (0), OFF (1)	OFF (1)

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HP ITG and HP VEE Quick Reference (HP VEE values in brackets) (continued)

Component	Description	Values	Initial Value
Rx_ds3_ffm_ind_cbit		ON (0), OFF (1)	OFF (1)
Rx_ds3_ffm_ind_m23		ON (0), OFF (1)	OFF (1)
Rx_ds3_alarm_seconds	Select DS3 alarm seconds type	LOS (0), OOF (1), PSL (2), AIS (3)	LOS (0)
Rx_ds3_alarm_result	Rx DS3 alarm seconds result		INVALID
Rx_ds3_bit_style	Select Rx DS3 bit style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_ds3_bit_result	Rx DS3 bit result		INVALID
Rx_ds3_pbit_style	Select Rx DS3 P-bit style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_ds3_pbit_result	Rx DS3 P-Bit result		INVALID
Rx_ds3_cpbit_style	Select Rx DS3 CP-Bit style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_ds3_cpbit_result			INVALID
Rx_ds3_fbit_style	Select Rx DS3 F-Bit style	COUNT (0), RATE (1), ESECS (1)	COUNT (0)
Rx_ds3_fbit_result	Rx DS3 F-Bit result		INVALID
Rx_ds3_fmbit_style	Select Rx DS3 FEBE style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_ds3_fmbit_result	Rx DS3 FM-Bit result		INVALID
Rx_ds3_bpv_style	Rx DS3 code style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_ds3_bpv_result	Rx DS3 BPV result		INVALID
Rx_ds3_signal_style	Select DS3 signal level style	PVOLTS (0), DBDSX (1)	PVOLTS (0)
Rx_ds3_signal_result	Rx DS3 signal level result		INVALID
Rx_ds2_los_ind	Rx DS2 LOS indicator	ON (0), OFF (1)	OFF (1)
Rx_ds2_oof_ind	Rx DS2 OOF indicator	ON (0), OFF (1)	OFF (1)
Rx_ds2_ais_ind	Rx DS2 AIS indicator	ON (0), OFF (1)	OFF (1)
Rx_ds2_xbit_ind	Rx DS2 X/ABit indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_b8zs_ind	Rx DS1/E1 B8ZS indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_hdb3_ind	Rx DS1/E1 HDB3 indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_los_ind	Rx DS1/E1 LOS indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_psl_ind	Rx DS1/E1 Sync indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_oof_ind	Rx DS1/E1 OOF indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_yel_ind	Rx DS1/E1 Yellow indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_ais_ind	Rx DS1/E1 AIS indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_cofa_ind	Rx DS1/E1 COFA indicator	ON (0), OFF (1)	OFF (1)
Rx_dse1_alarm_seconds	Select Rx DS1/E1 alarm seconds type	LOS (0), OOF (1), PSL (2), AIS (3), RAI (4), COFA (5)	LOS (0)
Rx_dse1_alarm_result	Rx DS1/E1 alarm seconds result		INVALID
Rx_dse1_bit_style	Select Rx DS1/E1 bit style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_dse1_bit_result	Rx DS1/E1 bit result		INVALID
Rx_dse1_crc_style	Select DS1/E1 CRC style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_dse1_crc_result	Rx DS1/E1 CRC result		INVALID
Rx_dse1_frame_style	Select Rx DS1/E1 frame style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_dse1_frame_result	Rx DS1/E1 frame result		INVALID
Rx_dse1_bpv_style	Select Rx DS3 code style	COUNT (0), RATE (1), ESECS (2)	COUNT (0)
Rx_dse1_bpv_result	Rx DS1/E1 code result		INVALID
Rx_dse1_signal_style	Select RX DS3 signal style	PVOLTS (0), DBDSX (1)	PVOLTS (0)
Rx_dse1_signal_result	Rx DS1/E1 signal result		INVALID
Rx_ds3_capture	Rx DS3 capture		
Rx_special_ais_ind	Rx DS3 AIS indicator	ON (0), OFF (1)	OFF (1)
Rx_special_cais_ind	Rx DS3 CAIS indicator	ON (0), OFF (1)	OFF (1)
Rx_special_uf10_ind	Rx DS3 UF1010 indicator	ON (0), OFF (1)	OFF (1)
Rx_special_fao_ind	Rx DS3 UF1010 indicator	ON (0), OFF (1)	OFF (1)

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HP ITG and HP VEE Quick Reference (HP VEE values in brackets) (continued)

Component	Description	Values	Initial Value
Rx_special_ufao_ind	Rx DS3 UFrA1 indicator	ON (0), OFF (1)	OFF (1)
Rx_stuff_invert_ind	Rx DS3 stuff invert indicator	ON (0), OFF (1)	OFF (1)
Rx_floop_act_ind	Rx DS3 FEAC Loopback Activate indicator	ON (0), OFF (1)	OFF (1)
Rx_floop_deact_ind	Rx DS3 FEAC Loopback Deactivate indicator	ON (0), OFF (1)	OFF (1)
Rx_floop_act_mess	Rx DS3 FEAC loopback activate message	NONE (0), DS3LINE (1), DS1LINE1 (2), DS1LINE2 (3), DS1LINE3 (4), DS1LINE4 (5), DS1LINE5 (6), DS1LINE6 (7), DS1LINE7 (8), DS1LINE8 (9), DS1LINE9 (10), DS1LINE10 (11), DS1LINE11 (12), DS1LINE12 (13), DS1LINE13 (14), DS1LINE14 (151), DS1LINE15 (16), DS1LINE16 (17), DS1LINE17 (18), DS1LINE18 (19), DS1LINE19 (20), DS1LINE20 (21), DS1LINE21 (22), DS1LINE22 (23), DS1LINE23 (24), DS1LINE24 (25), DS1LINE25 (26), DS1LINE26 (27), DS1LINE27 (28), DS1LINE28 (29), DS1ALL (30), UNKNOWN (31)	NONE (0)
Rx_floop_deact_mess	Rx DS3 FAC loopback deactivate message	NONE (0), DS3LINE (1), DS1LINE1 (2), DS1LINE2 (3), DS1LINE3 (4), DS1LINE4 (5), DS1LINE5 (6), DS1LINE6 (7), DS1LINE7 (8), DS1LINE8 (9), DS1LINE9 (10), DS1LINE10 (11), DS1LINE11 (12), DS1LINE12 (13), DS1LINE13 (14), DS1LINE14 (151), DS1LINE15 (16), DS1LINE16 (17), DS1LINE17 (18), DS1LINE18 (19), DS1LINE19 (20), DS1LINE20 (21), DS1LINE21 (22), DS1LINE22 (23), DS1LINE23 (24), DS1LINE24 (25), DS1LINE25 (26), DS1LINE26 (27), DS1LINE27 (28), DS1LINE28 (29), DS1ALL (30), UNKNOWN (31)	NONE (0)
Rx_ds3_xbit_uword	Rx DS3 overhead display X-Bits user word		INVALID
Rx_ds3_feac_code_name	Rx DS3 FEAC code		INVALID
Rx_ds3_dl_uword	Rx DS3 C-Bit DL user word		INVALID
Rx_ds3_pmdl_uword	Rx DS3 C-Bit PMDL user word		INVALID
Reset	Reset component		0
RM_RESET	Rack manager rest		0
VOID_STRING	Temporary string		""
Error			0
Error_code	Other panel error number		INVALID
Error_string	Error Sstring on Other panel		INVALID
Abt_module	Gives module description		0
Module_id	Module product number		HPE1686A
Module_ser	Module serial number		NOT LIVE
Module_fw	Module firmware revision		MODE

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5

Command Reference

This chapter contains detailed information on the SCPI (Standard Commands for Programming Instruments) and IEEE 488.2 common commands you will use when writing programs to control your module. The chapter contains the following sections:

- **SCPI Overview**
  Gives a brief overview of the SCPI Standard.
- **SCPI Command Format**
  Describes the SCPI command format and conventions.
- **Module Functions**
  Lists the module functions and associated SCPI command subsystems.
- **Status Register Hierarchy**
  Provides a diagram illustrating the module status reporting hierarchy.
- **HP 1686A SCPI Command Reference**
  Provides detailed information on the commands in each subsystem.

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SCPI Overview

Standard Commands for Programmable Instruments (SCPI) is a standard of the SCPI Consortium that provides guidelines for remote programming commands for instruments. The goal of SCPI is to reduce Automatic Test Equipment (ATE) program development time. It accomplishes this by providing a consistent programming environment for instrument control and data usage. This programming environment uses defined programming messages, instrument responses, and data formats across all SCPI instruments, regardless of manufacturer.

SCPI is based on two IEEE standards:

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*
- ANSI/IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, Protocols, and Common Commands. For use with ANSI/IEEE Standard 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation*

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SCPI Command Format

Module functions such as making measurements, retrieving data, and querying instrument's status, are performed by stringing together SCPI "nodes" into commands. The SCPI commands are based on a hierarchical structure called a "subsystem" which comprises a top level "root" node and one or more lower-level nodes and their parameters.

Command Syntax

In this manual commands are shown as a mix of upper- and lowercase characters.

Commands can be abbreviated for shorter program line lengths. The uppercase characters define the abbreviated form of the command.

Command are formed by linking the root node with lower-level nodes. A leading colon (:) is optional. A colon (:) is used to link nodes. If the command requires a parameter, a space must separate the lowest level node and the parameter. If there is more than one parameter, a comma (,) is used to separate the parameters. If you have a choice of parameter or node, a vertical line (|) is used to separate the options available.

An example of a typical command and its abbreviated form are shown below:

```
[:]OUTPut[1]:TELecom:DS3:LEVel <level>
 OUTP[1]:TEL:DS3:LEV <level> (abbreviated)
```

Query Commands

Commands become query commands when a question mark (?) is added to the lowest level node in the command. A typical example of a query command and its abbreviated form are shown below:

```
[:]FETCh[:SCALar][:DATA]:TELecom:DS3:POVerhead:XBIT?
FETC[:SCAL][:DATA]:TEL:DS3:POV:XBIT? (abbreviated)
```

If the query command requires a parameter, a space must separate the lowest level node and the parameter.

Optional Nodes

In this manual, nodes which are enclosed within square brackets [ ] are "optional". The brackets only highlight the optional node, they are not part of the command. An optional node may be omitted from a command, and the command will still remain valid. For example, the command

```
FETC[:SCAL][:DATA]:TEL:DS3:POV:FEAC?  becomes:
FETC:TEL:DS3:POV:FEAC?
```


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Parameters

In this manual parameters are shown in angled brackets <>. There are six parameter types used in commands. These are listed in the following table.

Parameter Types	Description
Numeric	All commonly used decimal numbers including optional signs, decimal points, and scientific notation. Examples are `123`, `123E2`, `-123`, `-1.23E2`, `.123`, `.123E2` and `1.2300E-01`. Special cases include `MINimum` and `MAXimum`. A numeric parameter can also be specified in hex, octal, and/or binary. Examples are `#H7B`, `#Q173` and `#B11110111`.
Boolean	A single binary condition that is either true or false. Examples are `ON`, `OFF`, `1` and `0`.
Discrete	Values that are represented by a string of alpha characters. Examples are `INTernal` and `EXTernal`.
String	Any set of ASCII characters enclosed within single quotes or double quotes. Examples are '10101010' or "10101010".

Optional Parameters

In this manual parameters enclosed in square brackets [ ] are optional. The brackets only highlight the optional parameters; they are not part of the command.

If you do not specify a value for an optional parameter a default value is automatically selected.

Linking Command Statements

Command statements can be linked using a semicolon (;) and a colon (:). For example.

```
SOUR[1]:DATA:TEL:DS3:ALAR;:STAT:QUES:INST:PRIM:COND?
```


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Module Functions

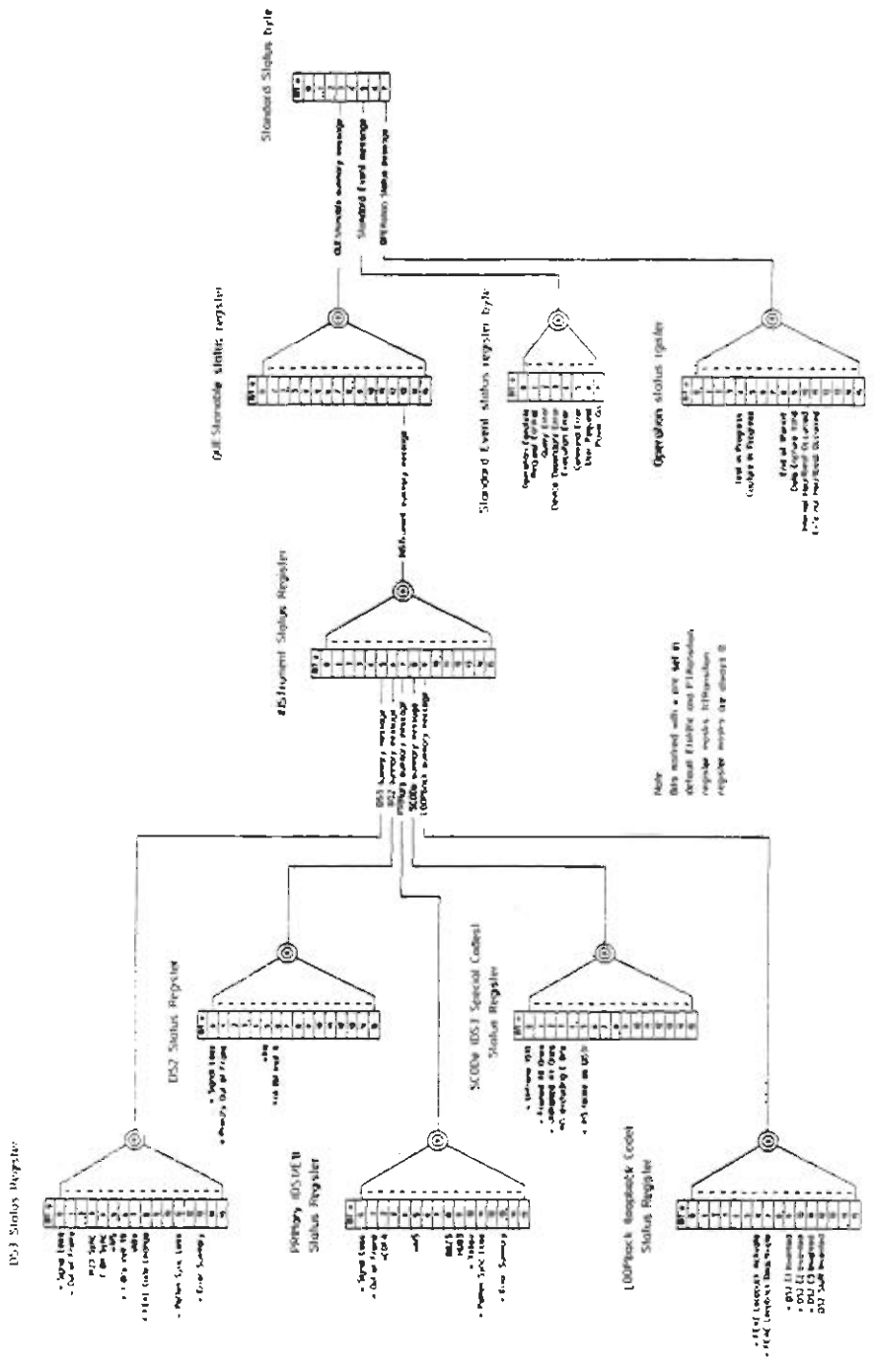
Module functions are controlled by commands contained in SCPI subsystems. To help you identify which subsystem you require use the following table:

Module Functions	Subsystem
DS3 Transmitter	
To set the DS3 transmitter output level.	OUTPut[1]
To control device-specific settings which are used to configure the modules DS3 transmitter	SOURce[1]
DS3 Receiver	
To control the line code of the receiver-side DS1/E1 DROP output port	OUTPut[1]
To control device-specific settings which are used to configure the modules DS3 receiver. For example setting the DS3 Source, Framing, Payload, Pattern and DS1, DS2 and E1 channels.	SENSe
Part of the DS3 receiver overhead capture comands. Used to return the following HP 1686A results: XBIT?, FEAC?, DLINK?, PMDL? and MESS?.	FETCh
DS1/E1 Transmitter	
To control the line code on the DS1/E1 TX out port.	OUTPut[1]
To control device-specific settings which are used to configure the modules DS1/E1 transmitter. For example setting Signal, Framing, Pattern and Clock .	SOURce[1]
DS1/E1 Receiver	
To control the line code on the DS1/E1 RX output port.	INPut
To control device-specific settings which are used to configure the modules DS1/E1 receiver. For example, setting Source, Signal, Framing and Pattern selections.	SENSe[1]
General Setup Commands	
To select the Transmit trigger output source	SOURce2
To select the receiver trigger output source and the destination of the receiver Clock In port.	SOURce3
(Administrative)	
To control status reporting; returns status and alarm values and special code and loopback code detection values.	STATus
Used to return the following HP 1686A results: XBIT?, FEAC?, DLINK?, PMDL? and MESS?.	FETCh

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Status Register Hierarchy

The module status reporting hierarchy is shown in the following diagram. Also shown is the bit-labelling for each status register structure.



Module Staus Reporting Hierarchy

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HP E1686A SCPI Command Reference

This section provides detailed information on all commands in each subsystem. The commands are listed in alphabetical order.

Valid commands

"Valid" may generally be read as "relevant", indicating that although they will be accepted and processed, they will not affect the current operations. SCPI errors might not be issued by the module for commands sent during invalid circumstances.

Issuing commands

Commands should be issued only in valid circumstances; that is, when changing the configuration, the sequencing of commands is significant. More general configuration changes should be made first. for example selecting DS1 or E1 mode before specifying the lower signal characteristics, such as DS1 framing.

Query commands

Unless noted, every configuration command has a corresponding query command, not shown here. Query responses always take the short command form when possible. Numeric values may vary in format between commands, particularly with respect to a leading "+" character.

When operating this module from an automated program capable of rapidly controlling the module, the user must be alert to normal time limitations in test set operation that are not obvious from manual, ITG-based operation. Sufficient time must be allowed for the receivers to achieve frame and pattern synchronization, particularly with stressful signals. This a random delay, but can be a second or two in worst case situations. Before detecting or injecting unusual events, the receiver or transmitter should be allowed to stabilize after changing the signal configuration.

Incorrect Results

Note that invalid or out of range results return a value of +9.91E+37

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DS3 Transmit Setup Commands

OUTP[1]:TEL:DS3:LEV <level>

Description [:]OUTPut[1]:TELecom:DS3:LEVel <level> sets the transmitter output level.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
level	discrete	DSX | HIGH | F900	None

Comments None.

SOUR[1]:DATA:TEL:DS3:CLOC <source>

Description [:]SOURce[1]:DATA:TELecom:DS3:CLOCk <source> sets the DS3 clock source. Results are undefined if EXT is selected without a clock source present, or LOOP is selected without a received signal.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	INTernal| EXTernal | LOOPback	None

Comments None.

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SOUR[1]:DATA:TEL:DS3:FRAM <frame>

Description [:]SOURce[1]:DATA:TELecom:DS3:FRAMing <frame> sets the type of DS3 framing.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
frame	discrete	UNFRamed | M23 | CBIT	none

Comments None.

SOUR[1]:DATA:TEL:DS3:PAYL <chan>

Description [:]SOURce[1]:DATA:TELecom:DS3:PAYLoad <chan> This command is valid only if DS3 TX framing is set to M23 or CBIT framing. The DS3 TX drop signal is undefined if this is set to UNCHannel.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
channel	discrete	UNCHannel | CHANnelized	none

Comments None.

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SOUR[1]:DATA:TEL:DS3:PAYL:PATT <pattern>

Description [:]SOURce[1]:DATA:TELecom:DS3:PAYLoad:PATTern <pattern> sets the payload pattern. This command is valid only if DS3 Tx framing is set to UNFRamed or the payload is set to UNCHannel.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
pattern	discrete	PRBS15|PRBS20|PRBS23|AONE|IDLE |VALue	none

Comments SOUR:DATA:TEL:DS3:PAYL:PATT:VAL and SOUR:DATA:TEL:DS3:PAYL:PATT:VLEN should be refreshed when VAL, AONE or IDLE are selected, because these patterns can change the current internal pattern value or length.

The patterns available for selection are:

PRBS - 2^{15-1}, 2^{20-1}, 2^{23-1}
AONE - All Ones
IDLE
VALue - user programmable word

SOUR[1]:DATA:TEL:DS3:PAYL:PATT:VAL <value>

Description [:]SOURce[1]:DATA:TELecom:DS3:PAYLoad:PATTern:VALue <value>
Sets the user-programmable DS3 payload pattern data of 2 to 8 bits. with value 0 to 255 right-justified in an 8-bit unsigned word.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 255	none

Comments This command should be used only with SOUR:DATA:TEL:DS3:PAYL:PATT VAL.

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SOUR[1]:DATA:TEL:DS3:PAYL:PATT:VLEN <length>

Description

[:]SOURce[1]:DATA:TELecom:DS3:PAYLoad:PATTern:VLENgth <length>
Sets the user-programmable DS3 payload pattern bit length, using the <length> rightmost bits of the user-programmable pattern.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 8 (bits)	None

Comments

This command should be used only with SOUR:DATA:TEL:DS3:PAYL:PATT VAL.

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SOUR[1]:DATA:TEL:DS3:PAYL:PATT:INV <boolean>

Description

[:]SOURce[1]:DATA:TELecom:DS3:PAYLoad:PATTern:INVert <boolean>
This command inverts the data bits of any PRBS DS3 Tx pattern.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
boolean	boolean	OFF or 0 | ON or 1	none

Comments

OFF or 0 - Pattern not inverted
ON or 1 - Pattern inverted

This command is valid only with PRBS15, PRBS20 and PRBS23 patterns.

SOUR[1]:DATA:TEL:DS3:CHAN <numeric>

Description

[:]SOUR[1]:DATA:TELecom:DS3:CHANnel <numeric> defines the selected DS1 channel in DS3. This command is only valid if the Tx DS1/E1 module mode is DS1 and DS3 Tx CHANnelized payload is valid.
The primary mode should be set to DS1 before sending this command.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 28	none

Comments

None.

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SOUR[1]:DATA:TEL:DS3:PRIM:SOUR <source>

Description [:]SOURce[1]:DATA:TELecom:DS3:PRIMary:SOURce <source> sets the primary source to internal or external. This command is only valid for DS3 Tx CHANnelized payload.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	INTernal | EXTernal	none

Comments
INTernal - internal DS1/E1 module
EXTernal - front panel DS1/E1 input

SOUR[1]:DATA:TEL:DS3:PRIM:BACK <other>

Description [:]SOURce[1]:DATA:TELecom:DS3:PRIMary:BACKground <other> This command is only valid if DS3 Tx CHANnelized payload. AONE is valid only for DS1 Primary mode.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
other	discrete	SAME | AONE |AIS	none

Comments
SAME - same as foreground channel.
AONE - all ones (data)
AIS

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SOUR[1]:DATA:TEL:DS3:GRO <numeric>

Description [:]SOURce[1]:DATA:TELecom:DS3:GROup <numeric> selects a DS2 group from 1 to 7.
This command is only valid if the Tx DS1/E1 module mode is E1 and DS3 Tx CHANnelized payload is valid.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 7	none

Comments The primary mode should be set to E1 before sending this command.

SOUR[1]:DATA:TEL:DS3:TRIB <numeric>

Description [:]SOURce[1]:DATA:TELecom:DS3:TRIButary <numeric> selects an E1 tributary from 1 to 3.
This command is only valid if the Tx DS1/E1 module mode is E1 and DS3 Tx CHANnelized payload is valid. The primary mode should be set to E1 before sending this command.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 3	none

Comments Tributaries are from 1 to 3 E1 in DS2 channel number.

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DS3 Transmit Control Commands

Introduction This section contains commands for injecting errors and special signals.

Note 

For their duration, these settings displace the ongoing Setup and Data settings.

SOUR[1]:DATA:TEL:DS3:ERR:<type><mode>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:<type><mode > turns DS3 error injection off, or injects a single <type> error before turning error/signal injection off, or turns on a continuous <type> error rate or burst mode. Relevant RATE or BURST parameters should be set before this command.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
type	discrete	PATTern |PPARity | BPV | FBIT	none
mode	discrete	NONE | ONCE | RATE | BURSt	none

Comments Type selections are:

PATTern - unchannelized or unframed
PPARity - framed only
BPV
FBIT - framed only

Mode selections are:

NONE - All DS3 error injection off
ONCE - Single error, then all DS3 error injection off.
RATE - Turn on constant rate
BURSt - Turn on continuous burst

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SOUR[1]:DATA:TEL:DS3:ERR:<type><mode>

Description

[:]SOURce[1]:DATA:TELecom:DS3:ERRor:<type> <mode> turns DS3 error/signal injection off, or injects a single error group before turning error injection off, or starts a constant error rate.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
type	discrete	FEBE | FBNM	none
mode	discrete	NONE | ONCE | RATE	none

Comments

Type selections are:

FEBE - C-Bit only
FBNM - F-Bit n in m, framed only

Mode selections are:

NONE - All DS3 error injection off
ONCE - Single, then all DS3 error injection off
RATE - Turn on constant rate

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SOUR[1]:DATA:TEL:DS3:ERR:<type><mode>

Description

[:]SOURce[1]:DATA:TELecom:DS3:ERRor:<type><mode> turns DS3 error/signal injection off, or injects a single EXZ or MBIT error group before turning error/signal injection off.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
type	discrete	EXZ | MBIT	none
mode	discrete	NONE | ONCE	none

Comments

This command is transient, and has no query.

Type selections are:

EXZ
MBIT - framed only

Mode selection are:

NONE - All DS3 error injection off
ONCE - Single group, then all DS3 error injection off

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SOUR[1]:DATA:TEL:DS3:ERR:RATE <rate>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:RATE <rate> sets the continuous error injection rate, and should be set before errors are injected in continuous rate mode. This command does not turn error injection on.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
rate	numeric	m = 0.9, 1.0, 1.1; n = 2 to 9	none

Comments Only the following rates are legal values for continuous FEBE errors: 1.0E-4, 1.0E-5, 1.0E-6, 1.0E-7, 1.0E-8.
This data is overwritten by the BURSt mode, and must be refreshed after switching from BURSt to RATE.

SOUR[1]:DATA:TEL:DS3:ERR:BURS:PER <period>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:BURSt:PERiod <period> sets the burst error injection period, and should be set before errors are injected in burst mode.
This data is overwritten by the RATE mode, and must be refreshed after switching from RATE to BURSt.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
period	numeric	1 to n (see Comments below)	µs

Comments The burst error injection period is as follows:

period 1, 5, 10, 25, 50, 75,
100, 250, 500, 750,
1000, 2500, 5000, 7500
10000, 25000, 50000, 75000,
100000, 250000, 500000, 750000, 1000000

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SOUR[1]:DATA:TEL:DS3:ERR:BURS:DUTY <duty>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:BURSt:DUTY <duty> sets the burst error injection duty cycle, and should be set before errors are injected in burst mode.
This data is overwritten by the RATE mode, and must be refreshed after switching from RATE to BURSt.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
duty	numeric	10 to 90 by 10% duty cycle	None

Comments The duty cycle is the ratio of operating time to total elapsed time as a percentage.

SOUR[1]:DATA:TEL:DS3:ERR:FBNM:N:COUN <n>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:FBNM:N:COUNt <n> sets the "F-Bit N in M" error mode N parameter.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
N parameter	numeric	1 to 9	None

Comments None.

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SOUR[1]:DATA:TEL:DS3:ERR:FBNM:M:COUN <m>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:FBNM:M:COUNt <m> sets the "F-Bit N in M" error mode M parameter.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
M parameter	numeric	10 to 32	None

Comments M= 10 to 32 in steps of 1

SOURce[1]:DATA:TEL:DS3:ERR:MBIT:COUN <numeric>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:MBIT:COUNt <numeric> This command determines the number of M-Bit errors in a single M-Bit error injection group.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 5	None

Comments n = 1 to 5 number of bits in error.

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SOUR[1]:DATA:TEL:DS3:ERR:EXZ:COUN <count>

Description [:]SOURce[1]:DATA:TELecom:DS3:ERRor:EXZ:COUNt <count> determines the number of EXZ bits in a single EXZ error group. This value is overwritten by the LOS count, and should be refreshed before injecting an EXZ burst.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	3 to 6	None

Comments Selects number of bits in error from 3 to 6 in single bits.

SOUR[1]:DATA:TEL:DS3:ALAR <alarm>

Description [:]SOURce[1]:DATA:TELecom:DS3:ALARm <alarm>This command determines the type of continuous alarm injected. All selections except NONE will initiate the indicated alarm injection.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
alarm	discrete	NONE|AIS|CAIS|UF10 |FAO |UFAO | OOF |LOS	None

Comments The following list explains the alarm abbreviations:

NONE - All DS3 alarms off
AIS - AIS
CAIS - AIS excl C-Bits
UF10 - Unframed 1010
FAO - Framed All Ones
UFAO - Unframed All Ones
OOF - Out of Frame
LOS - Loss of Signal

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SOUR[1]:DATA:TEL:DS3:ALAR:<alarm><mode>

Description [:]SOURce[1]:DATA:TELecom:DS3:ALARm:<alarm><mode> injects the indicated type of single alarm event. All ongoing alarms are turned off before the single alarm event is initiated.
This command is transient, and has no query.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
alarm	discrete	AIS|CAIS|UF10 |FAO |UFAO | XBIT |LOS	None
mode	discrete	NONE | ONCE	None

Comments **Type** selections are:

AIS - AIS (110 msec)
CAIS - AIS excl C-Bits (110 msec)
UF10 - Unframed 1010 (110 msec)
FAO - Framed All Ones (110 ms)
UFAO - Unframed All Ones(110 ms)
XBIT - X-Bit Toggle (variable)
LOS - Loss of Signal (variable)

Mode selections are:

NONE - Turns all DS3 alarms off.
ONCE - Single alarm burst, then all DS3 alarms off.

SOUR[1]:DATA:TEL:DS3:ALAR:XBIT:PER <period>

Description [:]SOURce[1]:DATA:TELecom:DS3:ALARm:XBIT:PERiod <period>
This command determines the duration of a single X-Bit toggle event.
This command is transient, and has no query.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
period	numeric	0.9 | 1.0 | 1.1	Seconds

Comments None.

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SOUR[1]:DATA:TEL:DS3:ALAR:LOS:COUN <count>

Description

[:]SOURce[1]:DATA:TELecom:DS3:ALARm:LOS:COUNt <count>
This command determines the number of LOS alarm bits in a single LOS alarm injection group.
This value is overwritten by the EXZ count, and should be refreshed before injecting an LOS burst.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	75 to 275 in steps of 25	bits

Comments

The values given in the table above are groups of bits.

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SOUR[1]:DATA:TEL:DS2:POV:CST:INV <state>

Description [:]SOURce[1]:DATA:TELecom:DS2:POVerhead:CSTuff:INVert <state> inverts the selected DS2 C/Stuff bit.
It is valid only if DS3 Channelized C-Bit or M23 framing, and DS1/E1 is set to DS1 mode.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
state	boolean	0 | 1	None

Comments state 0= normal
state 1= Invert from normal

SOUR[1]:DATA:TEL:DS2:POV:CST:BIT <bit>

Description [:]SOURce[1]:DATA:TELecom:DS2:POVerhead:CSTuff:BIT <bit> selects the DS2 C or Stuff bit to be inverted.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
bit	discrete	C1 | C2 |C3 | STUFf	None

Comments None

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SOUR[1]:DATA:TEL:DS2:POV:CST ONCE

Description [:]SOURce[1]:DATA:TELecom:DS2:POVerhead:CSTuff ONCE
This command initiates a short inversion from the current C/Stuff bit state. For example, if the current invert state is ON, this will pulse a non-inverted state.
It is valid only if DS3 Channelized C-Bit or M23 framing, and DS1/E1 is set to DS1 mode.

This command is transient, and has no query.

SOUR[1]:DATA:TEL:DS2:POV:CST:COUN <count>

Description [:]SOURce[1]:DATA:TELecom:DS2:POVerhead:CSTuff:COUNt <count> sets the length of a single DS2 C/Stuff inversion.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	5 (Burst) | 4 (Burst)	None

Comments None

SOUR[1]:DATA:TEL:DS3:POV:LOOP ONCE

Description [:]SOURce[1]:DATA:TELecom:DS3:POVerhead:LOOPback ONCE
This command injects a single DS3 FEAC loopback signal group. The FEAC loopback signal is injected over any normal FEAC signal.

It is valid only during C-Bit framing.

This command is transient, and has no query.

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SOUR[1]:DATA:TEL:DS3:POV:LOOP:ACT <action>

Description [:]SOURce[1]:DATA:TELecom:DS3:POVerhead:LOOPback:ACTion <action> This command determines the action codeword in a DS3 FEAC loopback signal group. It corresponds to ANSI T1.107a Figure 19B.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
action	discrete	ACTivate| DEACtivate	None

Comments None

SOUR[1]:DATA:TEL:DS3:POV:LOOP:MESS <value>

Description [:]SOURce[1]:DATA:TELecom:DS3:POVerhead:LOOPback:MESSage <value>This command determines the message codeword in a DS3 FEAC loopback signal group. It corresponds to the 6-bit codeword described in ANSI T1.107a Figure 19B.
Any 6-bit value is allowed; the user is responsible for adhering to values defined in T1.107a.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 63	None

Comments None

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SOUR[1]:DATA:TEL:DS3:POV:LOOP:COUN <count>

Description [:]SOURce[1]:DATA:TELecom:DS3:POVerhead:LOOPback:COUNt <count> This command determines the number of command repetitions in each DS3 FEAC loopback signal group.
Each group consists of <count> repetitions of the action codeword followed by <count> repetitions of the message codeword.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	3 to 15	None

Comments None.

SOUR:DATA:TEL:DS3:POV:FEAC <mode>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:FEAC <mode> controls the FEAC codeword. ON turns a constant DS3 FEAC signal injection on.
ONCE injects a single DS3 FEAC codeword group before turning FEAC codeword injection off.
The NONE state transmits an all-ones idle signal.
It is valid only if DS3 framing is CBIT.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
mode	discrete	NONE| ON| ONCE	None

Comments
NONE - Off
ON - Continuous
ONCE - Single group

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SOUR:DATA:TEL:DS3:POV:FEAC:CODE <value>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:FEAC:CODE <value>
This command determines the message codeword in a DS3 FEAC signal group. It is a 6-bit value, corresponding to the six codeword bits described in ANSI T1.107a Figure 19A.
Any 6-bit value is allowed; the user is responsible for adhering to legal T1.107a values.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 63	None

Comments None.

SOUR:DATA:TEL:DS3:POV:FEAC:COUN <count>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:FEAC:COUNt <count>
This command determines the number of codeword repetitions in each DS3 FEAC signal group. Each group consists of <count> repetitions.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	9|10 (repetitions)	None

Comments None.

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DS3 Transmit Overhead Data Commands

SOUR:DATA:TEL:DS3:POV:XBIT <value>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:XBIT <value>This command sets the steady-state values for the DS3 Tx X-Bits. This command is only valid if DS3 Tx framing is M23 or CBIT.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 3 (2-bit X-bit value)	None

Comments None.

SOUR:DATA:TEL:DS3:POV:DLIN <value>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:DLINk <value> This command sets the steady-state values for the DS3 Tx C-Bit data link bits. It is valid only if DS3 Tx framing is CBIT.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 511	None

Comments None.

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SOUR:DATA:TEL:DS3:POV:FEBE <value>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:FEBE <value> This command sets the steady-state values for the 3 DS3 FEBE bits.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 7	None

Comments None.

SOUR:DATA:TEL:DS3:POV:PMDL <source>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:PMDLink <source> This command sets the steady-state values for the DS3 C-Bit path maintenance bits.
VALue is valid only when a user-programmable pattern has been defined.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	EXTernal | VALue	None

Comments Source= EXTernal (front panel) or VALue (Internal User Programmable Word)

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SOUR:DATA:TEL:DS3:POV:PMDL:VAL <value>

Description [:]SOURce:DATA:TELecom:DS3:POVerhead:PMDLink:VALue <value> This command sets the user-programmable data link overhead code, and is only valid when SOURce is INT.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 7	None

Comments None.

SOUR:DATA:TEL:DS2:POV:XAB <value>

Description [:]SOURce:DATA:TELecom:DS2:POVerhead:XABit <value> sets the DS2 X/A-Bit. It is valid only for framed, channelized DS3.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 |1	None

Comments None.

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SOUR:DATA:TEL:DS2:POV:CST:STUF <value>

Description [:]SOURce:DATA:TELecom:DS2:POVerhead:CSTuff:STUFf <value> sets the value of the DS2 stuff bit.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	discrete	ZERO |ONE |PREVious	None

Comments NOTE: This command also sets the expected Rx value of the bit, used by the LOOPback status register to determine DS2 Stuff inversion.

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DS3 Receiver Setup Commands

OUTP[1]:TEL:DROP:CODE: <code>

Description [:]OUTPut[1]:TELecom:DROP:CODE: <code> This command sets the line code of the receiver-side DS1/E1 drop output connector.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
code	discrete	AMI |B8ZS |HDB3	None

Comments B8ZS with DS1 framing only
HDB3 with E1 framing only

SENS:DATA:TEL:DS3:SOUR <source>

Description [:]SENSe:DATA:TELecom:DS3:SOURce <source> selects the DS3 source.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	EXTernal | LOOPback	None

Comments None.

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SENS:DATA:TEL:DS3:FRAM <framing>

Description [:]SENSe:DATA:TELecom:DS3:FRAMing <framing>

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
framing	discrete	UNFRamed | M23 | CBIT	None

Comments None.

SENS:DATA:TEL:DS3:PAYL <chan>

Description [:]SENSe:DATA:TELecom:DS3:PAYLoad <chan>This command is valid only if DS3 Rx framing is not UNFRamed.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
chan	discrete	UNCHannel | CHANnelized	None

Comments None.

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SENS:DATA:TEL:DS3:PAYL:PATT <pattern>

Description [:]SENSe:DATA:TELecom:DS3:PAYLoad:PATTern <pattern> This command is valid only if DS3 Rx framing is set to UNFRamed or the DS3 Rx payload is set to UNCHannel.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
pattern	discrete	PRBS15 | PRBS20 |PRBS23 | AONE | IDLE | VALue	None

Comments SENS:DATA:TEL:DS3:PAYL:PATT:VAL and SENS:DATA:TEL:DS3:PAYL:PATT:VLEN should be refreshed when VAL, AONE or IDLE are selected, as these patterns can change the current internal pattern value or length.

The available patterns are:

PRBS - 2^{15-1}, 2^{20-1} , 2^{23-1}
AONE - all ones
IDLE
VALue - user programmable word

SENS:DATA:TEL:DS3:PAYL:PATT:VAL <value>

Description [:]SENSe:DATA:TELecom:DS3:PAYLoad:PATTern:VALue <value> sets the DS3 Rx payload pattern data in the range 0 to 255. This command is valid only if a VALue pattern is valid.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 255	None

Comments None.

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SENSe:DATA:TELecom:DS3:PAYLoad:PATTern:VLENth <length>

Description [:]SENSe:DATA:TELecom:DS3:PAYLoad:PATTern:VLENth <length> sets the number of bits to be used in the corresponding VALue.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 8	Bits

Comments This command should be used only with SENS:DATA:TEL:DS3:PAYL:PATT VAL.

SENS:DATA:TEL:DS3:PAYL:PATT:INV <boolean>

Description [:]SENSe:DATA:TELecom:DS3:PAYLoad:PATTern:INVert <boolean> This command inverts the PRBS DS3 Rx pattern data bits.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
boolean	numeric	0 or OFF |1 or ON	None

Comments

0= Pattern not inverted
1= Pattern inverted

This command should be used only with PRBS15, PRBS20, PRBS23 patterns.

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SENS:DATA:TEL:DS3:CHAN <numeric>

Description [:]SENSe:DATA:TELecom:DS3:CHANnel <numeric> Defines selected DS1 channel in DS3.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 28 (DS1 channel in DS3)	None

Comments This command is only valid if the Rx DS1/E1 module is set to DS1 and CHANnelized payload is valid.

The primary mode should be set to DS1 before sending this command.

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SENS:DATA:TEL:DS3:GRO <numeric>

Description [:]SENSe:DATA:TELecom:DS3:GROup <numeric> selects DS2 channel number in DS3.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 7 (DS2 channel number)	None

Comments This command is only valid if the Rx DS1/E1 module is set to E1 and DS3 Rx CHANnelized payload is valid.
The primary mode should be set to E1 before sending this command.

SENS:DATA:TEL:DS3:TRIB <numeric>

Description [:]SENSe:DATA:TELecom:DS3:TRIButary <numeric> selects the E1 in DS2 channel number.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
numeric	numeric	1 to 3	None

Comments This command is only valid if the Rx DS1/E1 module is set to E1 and DS3 Rx CHANnelized payload is valid.
The primary mode should be set to E1 before sending this command.

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DS3 Receiver Status Commands

SENS:DATA? <data_handle><period>

Description [:]SENSe:DATA? <data_handle><period> This command returns test measurements.
<data_handle> is selected from the following list:

"ASEConds:DS3:LOS" - DS3 LOS alarm seconds
"ASEConds:DS3:OOF" - DS3 OOF alarm seconds
"ASEConds:DS3:PSL" - DS3 PSL alarm seconds
"ASEConds:DS3:AIS" - DS3 AIS alarm seconds

" ECOunt:DS3:PATTern" - DS3 bit error count
" ERATio:DS3:PATTern " - DS3 bit error ratio
" ESEConds:DS3:PATTern" - DS3 bit error seconds

"ECOunt:DS3:PBIT" - DS3 P-Bit error count
"ERATio:DS3:PBIT" - DS3 P-Bit error ratio
"ESEConds:DS3:PBIT" - DS3 P-Bit error seconds

"ECOunt:DS3:CBIT" - DS3 C-Bit error count
"ERATio:DS3:CBIT" - DS3 C-Bit error ratio
"ESEConds:DS3:CBIT" - DS3 C-Bit error seconds

"ECOunt:DS3:FBIT" - DS3 F-Bit error count
"ERATio:DS3:FBIT" - DS3 F-Bit error ratio
"ESEConds:DS3:FBIT" - DS3 F-Bit error seconds

"ECOunt:DS3:FEBE" - DS3 FEBE error count
"RATio:DS3:FEBE" - DS3 FEBE error ratio
"ESEConds:DS3:FEBE" - DS3 FEBE error seconds

"ECOunt:DS3:FRAMe" - DS3 Frame error count
"ERATio:DS3:FRAMe" - DS3 Frame error ratio
"ESEConds:DS3:FRAMe" - DS3 Frame error seconds

"ECOunt:DS3:CODE" - DS3 Code error count
"ERATio:DS3:CODE" - DS3 Code error ratio
"ESEConds:DS3:CODE" - DS3 Code error seconds

"PVOLts:DS3:SIGNal" - DS3 signal strength in peak volts
"DBDSx:DS3:SIGNal" - DS3 signal strength in dbDSX

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Comments

period is [CUMulative] for current values, or **IPERiod** for the last finished repeat test results. **SIGNal** measurements are not gated, and thus have no **IPERiod** measurements.
Measurements not meaningful in the current context or out of range return the invalid value of +9.91E+37.

STAT:QUES:INST:<register>:COND

Description

[:]STATus:QUEStionable:INSTrument:<register>:CONDition? selects DS2 or DS3 register.
This command returns status and alarm values. See diagram of status registers for contents. Status registers are IEEE 488.2 and SCPI compliant, and all standard SCPI register commands may be used. The full set is not shown here.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
register	discrete	DS3 |DS2	None

Comments

None.

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STAT:QUES:INST:<register>:EVENt?

Description

[:]STATus:QUEStionable:INSTrument:<register>:EVENt? This command returns special code and loopback code detection values. See diagram of status registers for contents. Status registers are IEEE 488.2 and SCPI compliant, and all standard SCPI register commands may be used.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
register	discrete	SCODe |LOOPback	None

Comments

<register> selections are:

SCODe - Special Code register
LOOPback - Loopback Codes (FEAC and DS2 C-Bit/Stuff invert)

Note

The expected value of the DS2 Stuff bit is determined by the [:]SOURce:DATA:TELecom:DS2:POVerhead:CSTuff:STUFf command

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DS3 Receiver Overhead Capture Commands

FETC[:SCAL][:DATA]:TEL:DS3:POV:XBIT?

Description [:]FETCh[:SCALar][:DATA]:TELecom:DS3:POVerhead:XBIT? returns the value of the XBIT.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 3	None

Comments None.

FETC[:SCAL][:DATA]:TEL:DS3:POV:FEAC?

Description [:]FETCh[:SCALar][:DATA]:TELecom:DS3:POVerhead:FEAC? Returns 0:63 if a valid FEAC signal code was detected. Returns 64 if an all-ones idle signal is detected, and 66 if no valid codeword framing is detected.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 63 | 64 | 66	None

Comments Note: Detection of a codeword is per ANSI T1.107a-1990. No processing of the codeword values is performed by the VXI module. The ITG performs comparisons values specified in ANSI T1.107a-1990 Figure 19A.

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FETC[:SCAL][:DATA]:TEL:DS3:POV:DLINk?

Description [:]FETCh[:SCALar][:DATA]:TELecom:DS3:POVerhead:DLINk? returns a value from 0 to 511.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 511	None

Comments None.

FETC[:SCAL][:DATA]:TEL:DS3:POV:PMDL?

Description [:]FETCh[:SCALar][:DATA]:TELecom:DS3:POVerhead:PMDLink? returns a value from 0 to 7.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 7	None

Comments None.

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FETC[:SCAL][:DATA]:TEL:DS3:POV:LOOP:MESS?

Description

[:]FETCh[:SCALar][:DATA]:TELecom:DS3:POVerhead:LOOPback:MESSage? returns the last codeword received during a declared FEAC Loopback event.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 63	None

Comments

Returns: 0 to 63 FEAC loopback codeword
Note that the loopback activate/deactivate status bits are only loosely coupled with this message. If both activate and deactivate bits are set, it is not possible to determine which event the message is associated with.

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DS1/E1 Transmit Setup Commands

OUTP[1]:TEL:PRIM:CODE <code>

Description [:]OUTPut[1]:TELecom:PRIMary:CODE <code> This command sets the line code on the DS1/E1 Tx module output connector.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
code	discrete	AMI | B8ZS | HDB3	None

Comments B8ZS is valid only when the DS1/E1 Tx mode is set to DS1, and HDB3 is valid only when the DS1/E1 Tx mode is set to E1.

SOUR[1]:DATA:TEL:PRIM:SIGN <mode>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:SIGNal <mode> This command sets the DS1/E1 Tx module mode to DS1 or E1 operation. It determines the drop/insert format available to the DS3 module, and should be set before DS3 commands relating to drop and insert channel parameters.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
mode	discrete	DS1 | E1	None

Comments None.

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SOUR[1]:DATA:TEL:PRIM:FRAM <framing>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:FRAMing <framing> This command sets the DS1/E1 Tx module DS1 framing. It is not valid if the DS1/E1 Tx mode is set to E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
framing	discrete	D4|ESF|SLC96|UNFRamed	None

Comments None.

SOUR[1]:DATA:TEL:PRIM:PATT <pattern>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern <pattern> sets the DS1/E1 Tx module pattern generator.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
pattern	discrete	QRSS|PRBS15|PRBS20| PRBS23|VALue|TITF|AONE|LUP| LDOWn	None

Comments The patterns available are:

QRSS
PRBS - $2^{15} - 1$, $2^{20} - 1$ or $2^{23} - 1$
VALue - user programmable word
TITF - 3 in 24
AONE - all ones
LUP - user programmable Loop Up
LDOWn - user program. Loop Down

Note that SOUR:DATA:TEL:PRIM:PATT:VAL and SOUR:DATA:TEL:PRIM:PATT:VLEN should be refreshed when VAL, TITF, AONE, LUP or LDOW are selected, as these patterns can change the current internal pattern value or length. LUP and LDOWn are not valid in E1 mode.

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SOUR[1]:DATA:TEL:PRIM:PATT:VAL <value>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:VALue <value> Sets the user-programmable DS1/E1 payload pattern data in the range 0 to 16777215.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 1.6777215E+7	None

Comments This command sets the DS1/E1 Tx module user-programmable bit pattern. It applies to the currently selected DS1/E1 Tx mode, DS1 or E1.
This command should be used only with SOUR:DATA:TEL:PRIM:PATT VAL.

SOUR[1]:DATA:TEL:PRIM:PATT:VLEN <length>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:VLENgth <length> Sets the length of the user-programmable DS1/E1 payload pattern data in the range 2 to 24 bits.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 24	Bits

Comments This command sets the DS1/E1 Tx module user-programmable bit pattern. It applies to the currently selected DS1/E1 Tx mode, DS1 or E1.
This command should be used only with SOUR:DATA:TEL:PRIM:PATT VAL.

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SOUR[1]:DATA:TEL:PRIM:PATT:LUP:VAL <value>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:LUP:VALue <value> Sets the user-programmable DS1/E1 loopup pattern data in the range 0 to 16777215.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 1.6777215E+7	None

Comments Sets the user-programmable DS1/E1 loopup pattern data in the range 0 to 16777215.

This command should be used only with SOUR:DATA:TEL:PRIM:PATT LUP.

SOUR[1]:DATA:TEL:PRIM:PATT:LUP:VLEN <length>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:LUP:VLENgth <length> Sets the user-programmable DS1/E1 loopup pattern data in the range 2 to 24 bits.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 24	None

Comments

Note 

The pattern selection must be set to LUP before sending this command.

This command should be used only with SOUR:DATA:TEL:PRIM:PATT LUP.

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SOUR[1]:DATA:TEL:PRIM:PATT:LDOW:VAL <value>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:LDOWn:VALue <value> Sets the user-programmable DS1/E1 loopup pattern data in the range 0 to 16777215.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 1.6777215E+7	None

Comments This command should be used only with SOUR:DATA:TEL:PRIM:PATT LDOW.

SOUR[1]:DATA:TEL:PRIM:PATT:LDOW:VLEN <length>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:LDOWn:VLENgth <length> Sets the user-programmable DS1/E1 loopup pattern data in the range 2 to 24 bits.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 24	None

Comments This command should be used only with SOUR:DATA:TEL:PRIM:PATT LDOW.

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SOUR[1]:DATA:TEL:PRIM:PATT:INV <boolean>

Description

[:]SOURce[1]:DATA:TELecom:PRIMary:PATTern:INVert <boolean>
This command inverts the data bits of any QRSS or PRBS DS1/E1 Tx pattern.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
state	boolean	1 or ON |0 or OFF	None

Comments

boolean 1 = invert pattern
boolean 0 = do not invert pattern

This command is valid only with patterns QRSS, PRBS15, PRBS20. and PRBS23.

SOUR[1]:DATA:TEL:PRIM:CLOC <source>

Description

[:]SOURce[1]:DATA:TELecom:PRIMary:CLOCk <source> determines the source of the DS1/E1 Tx module clock source. If EXT is selected and there is no clock present at the selected source, or if LOOP is selected and the DS1/E1 Rx module is set to a different mode or no rx signal is present, results are undefined.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	INTernal| EXTernal | LOOPback	None

Comments

Clock Source selections are:

INTernal - internal clock
EXTernal - external clock
LOOPback - clock from DS1/E1 Rx port

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DS1/E1 Transmit Control Commands

SOUR[1]:DATA:TEL:PRIM:ERR:<type> <mode>

Description [:]SOUR[1]:DATA:TELecom:PRIMary:ERRor:<type> <mode> This command turns DS1 error/signal injection off, or injects a single data error before turning error/signal injection off, or turns on a continuous data error rate or burst mode.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
type	discrete	PATTern| PCRC |BPV | FRAMe	None
mode	discrete	NONE | ONCE | RATE | BURSt	None

Comments
NONE - All DS1/E1 error injection off.
ONCE - Single error, then all DS1/E1 error injection off.
RATE - turn constant rate on.
BURSt - turn continuous bursts on.

SOUR[1]:DATA:TEL:PRIM:ERR:EXZ <mode>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ERRor:EXZ <mode> This command turns DS3 EXZ injection off, or injects a single EXZ error group (length 3 to 16) before turning error/signal injection off.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
mode	discrete	NONE | ONCE	None

Comments
NONE - All DS1/E1 error injection off.
ONCE - Single error, then all DS1/E1 error injection off.
This command is transient, and has no query.

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SOUR[1]:DATA:TEL:PRIM:ERR:RATE <rate>

Description [:]SOUR[1]:DATA:TELecom:PRIMary:ERRor:RATE <rate> selects the error rate from the range of values given below.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
rate	numeric	m = 0.9, 1.0, 1.1; n = 2 to 9	None

Comments None.

SOUR[1]:DATA:TEL:PRIM:ERR:BURS:PER <burst>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ERRor:BURSt:PERiod <burst>

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
burst	numeric	1| 5| 10| 25| 50| 75	µs
burst	numeric	100| 250| 500| 750	µs
burst	numeric	1000| 2500| 5000| 7500	µs
burst	numeric	10000| 25000| 50000| 75000	µs
burst	numeric	100000| 250000| 750000| 1000000	µs

Comments None.

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SOUR[1]:DATA:TEL:PRIM:ERR:BURS:DUTY <duty>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ERRor:BURSt:DUTY <duty>

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
duty	numeric	10 to 90 percent of period (in steps of 10)	percent

The duty cycle is the ratio of operating time to total elapsed time as a percentage.

Comments None.

SOUR[1]:DATA:TEL:PRIM:ERR:EXZ:COUN <count>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ERRor:EXZ:COUNt <count> determines the number of EXZ bits in a single EXZ error group.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	3 to 16	None

Comments None.

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SOUR[1]:DATA:TEL:PRIM:ALAR <alarm>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ALARm <alarm> This command determines the type of continuous alarm injected.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
alarm	discrete	NONE | AIS | OOF | LOS| YELLow	None

Comments

NONE - All DS1/E1 alarms off
AIS - AIS
OOF - Out of Frame
LOS - Loss of Signal
YELLow

SOUR[1]:DATA:TEL:PRIM:ALAR:LOS <mode>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ALARm:LOS <mode> This command initiates a single LOS group. All ongoing alarms are turned off before the single alarm event is initiated.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
mode	discrete	NONE | ONCE	None

Comments This command changes the alarm type to LOS.

NONE - All DS1/E1 alarms off.
ONCE - Single LOS group, then all DS1/E1 alarms off.

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SOUR[1]:DATA:TEL:PRIM:ALAR:LOS:COUN <count>

Description [:]SOURce[1]:DATA:TELecom:PRIMary:ALARm:LOS:COUNt <count> determines the number of LOS alarm bits in a single LOS alarm injection group.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
count	numeric	75 to 275 in 25 bit steps	None

Comments None.

DS1/E1 Transmit Overhead Data Commands

Comments None.

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DS1/E1 Receive Setup Commands

INP:TEL:PRIM:CODE <code>

Description [:]INPut:TELecom:PRIMary:CODE <code> sets the line code on the DS1/E1 Rx module output.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
code	discrete	AMI | B8ZS | HDB3	None

Comments B8ZS is valid only when the DS1/E1 Rx mode is set to DS1, and HDB3 is valid only when the DS1/E1 Rx mode is set to E1.

SENS[1]:DATA:TEL:PRIM:SOUR <source>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:SOURce <source>

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	INTernal | EXTernal | LOOPback	None

Comments The source selections are:

INTernal - DS3 drop
EXTernal - front panel connector
LOOPback - DS1/E1 Tx loopback

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SENS[1]:DATA:TEL:PRIM:SIGN <mode>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:SIGNal <mode> This command sets the DS1/E1 Rx module mode to DS1 or E1 operation. It determines the drop/insert format available to the DS3 module, and should be set before DS3 commands relating to drop and insert channel parameters.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
mode	discrete	DS1 | E1	None

Comments None.

SENS[1]:DATA:TEL:PRIM:FRAM <framing>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:FRAMing <framing> This command sets the DS1/E1 Rx module DS1 framing. It is not valid if the Rx mode is set to E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
framing	discrete	D4 | ESF | SLC96 | UNFRamed	None

Comments None.

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SENS[1]:DATA:TEL:PRIM:PATT <pattern>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern <pattern> This command sets the DS1/E1 Rx module pattern generator.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
pattern	discrete	QRSS| PRBS15| PRBS20|PRBS23|VALue|TITW |AONE|LUP|LDOWn	None

Comments The patterns available are:

QRSS
PRBS - $2^{15} - 1$, $2^{20} - 1$ or $2^{23} - 1$
VALue - user programmable word
TITW - 3 in 24

AONE - all ones
LUP - user-program. Loop Up
LDOWn - user-program. Loop Down

Note that SENS:DATA:TEL:PRIM:PATT:VAL and SENS:DATA:TEL:PRIM:PATT:VLEN should be refreshed when VAL, TITF, AONE, LUP or LDOW are selected, as these patterns can change the current internal pattern value or length.
LUP and LDOWn are not valid in E1 mode.

SENS[1]:DATA:TEL:PRIM:PATT:VAL <value>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:VALue <value> sets the DS1/E1 Rx module user-programmable bit pattern. It applies to the currently selected Rx mode, DS1 or E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 1.6777215E+7	None

Comments This command is used with SENS:DATA:TEL:PRIM:PATT VAL.

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SENS[1]:DATA:TEL:PRIM:PATT:VLEN <length>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:VLENgth <length> This command sets the DS1/E1 Rx module user-programmable bit pattern. It applies to the currently selected Rx mode, DS1 or E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 24	None

Comments This command is used with SENS:DATA:TEL:PRIM:PATT VAL.

SENS[1]:DATA:TEL:PRIM:PATT:LUP:VAL <value>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:LUP:VALue <value> sets the DS1/E1 Rx module user-programmable loopup pattern. It applies to the currently selected Rx mode, DS1 or E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
value	numeric	0 to 1.6777215E+7	None

Comments This command is used with SENS:DATA:TEL:PRIM:PATT LUP. This command is not valid in E1 mode.

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SENS[1]:DATA:TEL:PRIM:PATT:LUP:VLEN <length>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:LUP:VLENgth <length> sets the DS1/E1 Rx module user-programmable loopup pattern. It applies to the currently selected Rx mode, DS1 or E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 24	None

Comments This command is used with SENS:DATA:TEL:PRIM:PATT LUP.

SENS[1]:DATA:TEL:PRIM:PATT:LDOW:VAL <value>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:LDOWn:VALue <value> This command sets the DS1/E1 Rx module user-programmable loopdown pattern. It applies to the currently selected Rx mode, DS1 or E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	0 to 1.6777215E+7	None

Comments This command is used with SENS:DATA:TEL:PRIM:PATT LDOW. This command is not valid in E1 mode.

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SENS[1]:DATA:TEL:PRIM:PATT:LDOW:VLEN <length>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:LDOWn:VLENgth <length> This command sets the DS1/E1 Rx module user-programmable loopdown pattern size (in bits). It applies to the currently selected Rx mode, DS1 or E1.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
length	numeric	2 to 24	None

Comments This command is used with SENS:DATA:TEL:PRIM:PATT LDOW.

SENS[1]:DATA:TEL:PRIM:PATT:INV <boolean>

Description [:]SENSe[1]:DATA:TELecom:PRIMary:PATTern:INVert <boolean> This command inverts the data bits of any QRSS or PRBS DS1/E1 Rx pattern.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
state	boolean	1 or ON| 0 or OFF	None

Comments

1 or ON = invert pattern
0 or OFF = do not invert pattern

This command is valid only with primary patterns QRSS, PRBS15, PRBS20, and PRBS23.

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DS1/E1 Receive Status Commands

SENS:DATA? <data_handle><period>

Description [:]SENSe:DATA? <data_handle><period> returns test measurements.

<data_handle> is selected from the following list:

"ASEConds:PRIMary:LOS"	DS1/E1 LOS alarm seconds.
"ASEConds:PRIMary:OOF"	DS1/E1 OOF alarm seconds.
"ASEConds:PRIMary:PSL"	DS1/E1 PSL alarm seconds.
"ASEConds:PRIMary:AIS"	DS1/E1 AIS alarm seconds.
"ASEConds:PRIMary:YELLow"	DS1/E1 YELLow alarm seconds. (RAI)
"ASEConds:PRIMary:COFA"	DS1/E1 COFA alarm seconds.
"ECOunt:PRIMary:PATTern"	DS1/E1 bit error count.
"ERATio:PRIMary:PATTern"	DS1/E1 bit error ratio.
"ESEConds:PRIMary:PATTern"	DS1/E1 bit error seconds.
"ECOunt:PRIMary:CRC"	DS1/E1 Data & CRC error count.
"ERATio:PRIMary:CRC"	DS1/E1 Data & CRC error ratio.
"ESEConds:PRIMary:CRC"	DS1/E1 Data & CRC error seconds.
"ECOunt:PRIMary:FRAMe"	DS1/E1 Data & Frame error count.
"ERATio:PRIMary:FRAMe"	DS1/E1 Data & CRC error ratio.
"ESEConds:PRIMary:FRAMe"	DS1/E1 Data & CRC error seconds.
"ECOunt:PRIMary:CODE"	DS1/E1 Data & Code error count.
"ERATio:PRIMary:CODE"	DS1/E1 Data & Code error ratio.
"ESEConds:PRIMary:CODE"	DS1/E1 Data & Code error seconds.
"PVOLts:PRIMary:SIGNal"	DS1/E1 signal strength in peak volts.
"DBDSx:PRIMary:SIGNal"	DS1/E1 signal strength in dbDSX.

<period> is [CUMulative] for current values, or IPERiod for the last finished repeat test results. SIGNal measurements are not gated, and thus have no IPERiod measurements.

Measurements not meaningful in the current context or out of range return the "invalid" value of +9.91E+37.

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STAT:QUES:INST:PRIM:COND?

Description

[:]STATus:QUEStionable:INSTrument:PRIMary:CONDition?
This command returns status and alarm values. See diagram of status registers for contents. Status registers are IEEE 488.2 and SCPI compliant, and all standard SCPI register commands may be used.

If [:]SENSe[1]:DATA:TELecom:PRIMary:SOURce = INTernal, B8ZS and HDB3 indicators are always 0, and the LOS indicator is equal to the DS3 LOS indicator state.

DS1/E1 Receive Capture Commands

None.

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General Setup Commands

SOUR2:TRIG <source>

Description [:]SOURce2:TRIGger <source> Transmit trigger output source. Selections are valid only when appropriate. Source selections are:

NONE	None
D3PAT	DS-3 Pattern (Bit) Error
D3PPAT	DS-3 Patt. & Parity Error
D3CPAT	DS-3 Patt. & CP-Bit Error
D3FBIT	DS-3 F-Bit Error
D3MBIT	DS-3 M-Bit Error
D3FEBE	DS-3 FEBE Error
D3BPV	DS-3 BPV Error
D3EXZ	DS-3 EXZ Error
D3XBIT	DS-3 X-Bit Change
D3IDLE	DS-3 Idle
D3AIS	DS-3 AIS
D3FEAC	DS-3 FEAC Change
D3LOS	DS-3 Loss of Signal
D3OOF	DS-3 Loss of Frame

PPAT	Prim. Pattern (Bit) Error
PPCRC	Prim. Pat & CRC Err (DS1 only)
PFRAM	Primary F-Bit Error (DS1 only)
PBPV	Primary BPV Error
PEXZ	Primary EXZ Error
PYEL	DS1 Yellow (RAI) (DS1 only)
PFCL	DS1 Frame Clock (DS1 only)
PAIS	Primary AIS
PLOS	Primary Loss of Signal
POOF	DS1 Out of Frame (DS1 only)

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SOUR3:TRIG

Description

[:]SOURce3:TRIGger
Receive trigger output source. Selections are valid only when appropriate. Source selections are:

NONE	None
D3PAT	DS-3 Pattern (Bit) Error
D3PAR	DS-3 Parity Error
D3CPB	DS-3 CP-Bit Error
D3FBIT	DS-3 F-Bit Error
D3FRAM	DS-3 F & M Bit Error
D3FEBE	DS-3 FEBE Error
D3BPV	DS-3 BPV Error
D3EXZ	DS-3 EXZ Error
D3XBIT	DS-3 X-Bit Change
D3IDLE	DS-3 Idle
D3AIS	DS-3 AIS
D3FEAC	DS-3 FEAC Change
D3LOS	DS-3 Loss of Signal
D3OOF	DS-3 Loss of Frame
D3PSL	DS-3 Pattern Sync Loss
D3FCL	DS-3 Frame Clock
PPAT	Prim. Pattern (Bit) Error
PPCRC	DS1 ESF CRC Error
PFRAM	DS1 F-Bit Error
PBPV	Primary BPV Error
PEXZ	Primary EXZ Error
PYEL	DS1 Yellow (RAI)
PFCL	DS1 Frame Clock
PAIS	Primary AIS
PLOS	Primary Loss of Signal
POOF	DS1 Out of Frame
PPSL	Primary Pattern Sync Loss
D2LOS	DS-2 Loss of Signal
D2OOF	DS-2 Out of Frame
D2AIS	DS-2 AIS
D2XBIT	DS-2 X-Bit Change

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SOUR3:CLOC:SOUR

Description [:]SOURce3:CLOCk:SOURce This command selects the destination of the front panel RX external clock input.

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	DS3|PRIMary	None

Comments
DS3
PRIMary - DS1/E1 module

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Alarm Hierarchies

Measurement Inhibition

The following table describes the conditions under which results are inhibited.

Measurement Inhibition

DS3 Measurements Inhibited		Not Affected
LOS	Bit, P-Bit, CP-Bit, F-Bit, FEBE, Frame, Code, all overhead fields, OOF AS, AIS AS, PSL AS	LOS AS, Signal
OOF	Bit, P-Bit, CP-Bit, F-Bit, FEBE, Frame, all overhead fields, AIS AS, PSL AS	OOF AS, LOS AS, Code, Signal,
PSL	Bit	P-Bit, CP-Bit, F-Bit, FEBE, Frame, Code, Signal, all overhead fields, AIS AS, OOF AS, PSL AS, LOS AS.

Primary Measurements

Measurement Inhibition

Primary Measurements		Not Affected
LOS	Bit, CRC, Frame, Code, OOF AS, PSL AS, AIS AS, Yellow AS, COFA AS	LOS AS, Signal
AIS	Bit, CRC, Frame, OOF AS, PSL AS, Yellow AS, COFA AS	AIS AS, LOS AS, Code, Signal
OOF	Bit, CRC, Frame, PSL AS, Yellow AS	Code, OOF AS, AIS AS, LOS AS, COFA AS, Signal
PSL	Bit	CRC, Frame, LOS AS, OOF AS, PSL AS, AIS AS, Yellow AS, COFA AS, Signal

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Alarm/Status Inhibition

Active alarms suppress conditions indented below them.

Alarm/Status Inhibition

DS3 Alarm/Status				Reason
LOS				
PSL (unframed)				needs signal
OOF				needs signal
	AIS			needs framing
		M23 Sync		needs normal C-Bits
		C-Bit Sync		needs normal C-Bits
	Idle			needs framing
	PSL (frm & unch)			needs framing
	DS2 LOS (chan)			needs framing
	DS2 AIS			needs DS2 signal
		DS2 OOF		needs DS2 signal
			DS2 X/A Bit	needs DS2 framing

Primary

Alarm/Status Inhibition

Primary			Reason
LOS			
AIS			needs signal, no frm & pat
	OOF (DS1 FRM)		needs signal
		PSL (DS1 FRM)	needs framing
		Yellow	needs framing
	PSL (not DS1 FRM)		needs signal
	COFA (DS1 FRM)		needs framing
B8ZS			needs signal
HDB3			needs signal

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TRIGger2 Subsystem - Controlling Timing Signals

This subsystem selects and controls the "timing signal" (or heartbeat) used by the module. The timing signal may be supplied from any suitable Transport Overhead (TOH) receiver module, for example the HP E1672A, or a command module such as the HP E1405A may be used. If this method is used to supply the timing signal, then several mainframes may be synchronized. The timing signal occurs at a 100 ms rate, and is used to update the following:

- Status information related to the received signal.
- Measurement results.
- Measurement gating.

If the timing signal is not present then the module generates its own timing signal until an external signal is provided.

This section contains the following:

- A SCPI Command Quick Reference for the subsystem.
- Detailed information on the command in the subsystem.

SCPI Command Quick Reference

The tasks and commands (abbreviated form) associated with the timing signal are listed in the following table. More detailed information on commands follows on after the table.

TRIGger2 Quick Reference

Task	Command
To configure the subsystem to the "idle" state .	`ABOR2`
To continuously initiate the TRIGger2 subsystem.	`INIT2:CONT <boolean>`
To determine which "VXI backplane trigger line" is being used as the command synchronization trigger.	`TRIG2:SOUR?`

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[:]ABORt2

Description Puts the TRIGger2 subsystem into its idle state

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[:]INITiate2:CONTinuous <boolean>

Description

Enables the TRIGger2 subsystem to be continuously initiated.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
boolean	boolean	0|OFF|ON|1	none

Comments

- When ON|1 is selected, continuous triggering (by the selected trigger source) enables measurement results to be repeatedly updated.
- When OFF|0 is selected and the TRIGger2 subsystem is in the idle state, it remains in this state until ON|1 is selected.
- When OFF|0 is selected and the TRIGger2 subsystem is not in the idle state, it completes the current measurement update before adopting the idle state.

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[:]TRIGger2:SOURce <source>

Description Selects the VXI backplane "trigger line" as the module timing trigger.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
source	discrete	TTLTrigger0| TTLTrigger2| TTLTrigger4| TTLTrigger6	none

Query Command Returns the current trigger source.

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TRIGger3 Subsystem - Command Synchronization

This subsystem operates in conjunction with the TRIGger2 subsystem to control the measurement integration (gating) period. The timing is provided using the `TRIGger3[:IMMediate]` command or by using the synchronization trigger inputs from the VXI backplane.

This section contains the following:

- A SCPI Command Quick Reference for the subsystem.
- Detailed information on the command in the subsystem.

SCPI Command Quick Reference

The tasks and commands (abbreviated form) associated with the command synchronization trigger signal are listed in the following table. More detailed information on commands follows on after the table.

TRIGger3 Quick Reference

Task	Command
To configure the subsystem to the "idle" state .	`ABOR3`
To continuously initiate the TRIGger3 subsystem.	`INIT3:CONT <boolean>`
To immediately initiate a command synchronization trigger.	`TRIG3[:IMM]`
To select which synchronous command will be executed (when a suitable trigger is receive) following a TRIGger3 subsystem initialization.	`TRIG3:COMM <comd>`
To determine which "VXI backplane trigger line" is being used as the command synchronization trigger.	`TRIG3:SOUR?`

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[:]ABORt3

Description Puts the TRIGger3 subsystem into its idle state.

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[:]INITiate3:CONTinuous <boolean>

Description Enables the TRIGger3 subsystem to be continuously initiated.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
boolean	boolean	0|OFF|ON|1	none

Comments

- When ON|1 is selected, continuous triggering (by the selected trigger source) enables the TRIG3:COMM command to be repeatedly executed.
- When OFF|0 is selected and the TRIGger3 subsystem is in the idle state, it remains in this state until ON|1 is selected.

  A trigger cannot be monitored in the idle state, therefore the TRIG3:COMM command cannot be actioned.
- When OFF|0 is selected and the TRIGger3 subsystem is not in the idle, one of two possibilities occurs:
  - If the TRIGger3 subsystem is in the "wait for trigger" state it will not respond to command synchronization pulses. However it will still respond to the TRIG3:IMM command.
  - If the TRIGger3 system is not in the "wait for trigger" state, it will proceed until it returns to the idle state.

Query Command Returns the current trigger state.

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[:]TRIGger3[:IMMediate]

Description Initiates an immediate command synchronization trigger.

Comments

- If the TRIGger3 subsystem is initialized into the "wait for trigger" state then the TRIG3:COMM command will be executed.

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[:]TRIGger3:COMMand <cmd>

Description

Selects the synchronous function to be executed when the appropriate trigger occurs and the TRIGger3 subsystem is in its initialized state.

Parameters

Parameter Name	Parameter Type	Range of Values	Default Units
cmd	discrete	STARt|STOP|CONTinue|ONCE	none

Comments

- When STARt is selected, the current measurement results are cleared and a new measurement period begins. STARt and STOP define the measurement period.
- When STOP is selected, the current measurement results are stored.
- When CONTinue is selected, the measurement period is restarted without clearing the results.
- When ONCE is selected, the measurement is over a single gating period. The gating period is the frequency with which the measurement results are updated and is defined by the TRIGger2 subsystem.
- When STARt or ONCE is selected, allowances must be made for the settling time of the module's circuits before a measurement begins. This can be done by introducing a delay of several seconds after any configuration change, or by monitoring the status registers for a suitable stable state.

Query Command

Returns the current selected command.

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[:]TRIGger3:SOURce?

Description Returns the selected VXI backplane "trigger line" used by the module as the command synchronization trigger.

Response

Response Name	Response Type	Range of Values	Default Units
char_data	discrete	TTLT1|TTLT3|TTLT5|TTLT7	none

Comments

- The trigger selection is always the line adjacent to the timing trigger line and numerically greater.

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IEEE 488.2 Common Command Format

Common commands (as defined by the IEEE 488.2 Standard) perform functions such as reset, self-test, status byte query and so on. The command format comprises an asterisk (*) and a command keyword. The command may also include parameters which must be separated from the keyword by a space character. Some examples of common commands are:

```
*RST
*STB?
```

IEEE 488.2 Common Command Reference

The IEEE 488.2 common commands which are used to control the module are listed in the following table.

Task	Command
To clear the event registers, all queues (except the Output queue) and the "operation complete" flag.	*CLS
To set the content of the standard event status enable register.	*ESE <numeric>
To query the standard event status enable register.	*ESE?
To set the content of the standard event status register.	*ESR <numeric>
To check the content of the standard event status register.	*ESR?
To check the module's identity.	*IDN?
To generate an operation complete message when all pending operations are finished. This command sets the OPC bit in the status event register.	*OPC
To reset the module to its default values.	*RST
To set the contents of the service request enable register.	*SRE <numeric>
To check the contents of the service request enable register.	*SRE?
To check the content of the status byte register.	*STB?
To synchronize the operation of the module to other modules in the system. The "wait-to-continue" command stops all executing and query commands until the operation complete message is true.	*WAI

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Linking IEEE 488.2 and SCPI Commands

The IEEE 488.2 common commands and SCPI commands can be linked using a semicolon (;) and a colon (:). Examples of linking commands are:

```
OUTP[1]:TEL:DS3:LEV;: SOUR[1]:DATA:TEL:DS3:CLOC<source>
```

Default Settings

Note 

The module can be configured to its default settings by using the *RST IEEE 488.2 common command.

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6

Performance Tests

About this Chapter

This chapter contains information to enable you to test the HP E1686A to the warranted specification given in Appendix A, and comprises the following sections:

- **Recommended Test Equipment**
  Lists the equipment required for testing the module.
- **Calibration Cycle**
  Recommends the time period between verification of performance.
- **Operational Verification Tests**
  Provides tests which quickly establish with >90% confidence the module is performing properly, without testing the full warranted specification.
- **Performance Tests**
  Contains the performance test procedures. Each test is self-contained, and the tests can be performed individually or in any order. The tests, and the order in which they appear, are listed below:

  Test 1: DS3 Clock Operation

  Test 2: DS1 Clock Operation

  Test 3: E1 Clock Operation

  Test 4: DS3 Pulse Shape

  Test 5: DS1 Pulse Shape

  Test 6: DS3 Back-to-Back Operation

  Test 7: FEAC Codes and DS2 C-Bit Stuffing

  Test 8: DS1 Back-to-Back Operation

  Test 9: E1 Back-to-Back Operation

- **Test Records**
  Contains an Operational Verification Test Record and a Performance Test Record for recording the results of each test.

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Recommended Test Equipment

Test equipment which meets or exceeds the critical specifications may be substituted for the recommended model.

Instrument	Critical Specification	Recommended Model	Use
VXI Mainframe	C-size.	HP E1400A/B	All tests
Slot 0 Command Module	VXIbus translator for register-based modules.	HP E1405B or HP E1406A	All tests
Controller	Runs DOS 5.0, Windows 3.1, and HP ITG II with the HP E1686A driver software product. HP-IB compatible.	HP Vectra	All tests
Signal Generator	Frequency range: 1 MHz to 50 MHz	HP 8656B	1-3
Frequency Counter	Frequency range: 1 Hz to 50 MHz	HP 5335A Opt.030.010	1-3
Digital Oscilloscope	input impedance dc 1 MΩ. Telecom mask option	HP 54502A	4-6
75 Ω Terminator	75 Ω ± 0.2%	HP 11094B	4-6
75 Ω BNC-BNC Cable	Qty 1.	HP 15525A	1,4
50 Ω BNC-BNC Cable	Qty 2.	HP 8120-1839	1-3
75 Ω Unbal/110 Ω Bal Converter	Qty 1.	HP 15508B	5,6
Weco 310-Bantam cable	Qty 1.		5,6
50 Ω N type/BNC cable	Qty 1.		1-3
100 ΩBantam cable	Qty 1.		1-3

Calibration Cycle

The module requires periodic verification of its performance. Depending on the use and environmental conditions, the module should be checked using the performance tests at least every 24 months. Results recorded on the Performance Test Record can be used for comparison in calibration.

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Operational Verification

Perform Performance Tests 7, 9 and 10 to quickly establish with >90% confidence that the module meets the warranted specifications listed in Appendix A.

Performance Tests

Caution



The VXI Mainframe and module-under test must be powered-up for a minimum of 30 minutes before carrying out tests.

Note



If any of the performance tests fail, refer to *Returning the Module for Service in Chapter 1* for information on obtaining a replacement module.

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Test 1: DS3 Clock Operation

Description

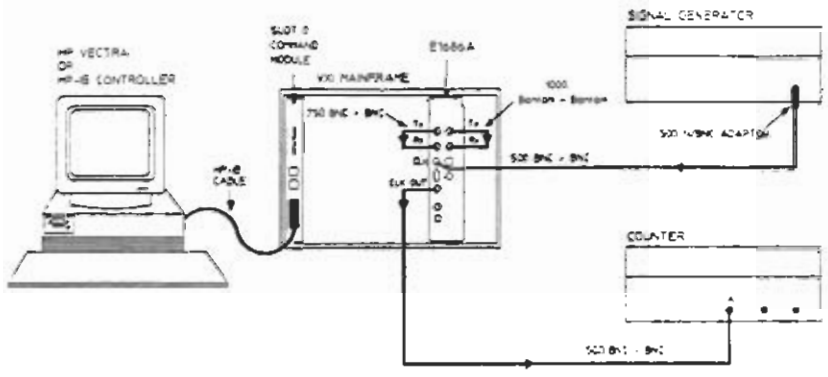
This test checks four areas of operation, these are:

- Internal Clock accuracy
- External Clock range
- Receiver frequency offset tolerance
- Receiver Clock output frequency

In all cases the transmitter clock frequency is measured by the counter at the receiver **Clock Out** port, with the transmitter connected directly to the receiver.

Procedure

1. Connect the equipment as shown in the following figure:



2. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.
   If the soft-panel is already loaded and configured click on (Other), (Module Reset) to reset the HP E1686A module to a known condition.

3. Cycle the power on the counter and preset the signal generator. Then set them as follows:

   Counter:- Freq. A; Input A; Z= 50Ω

   Signal Generator:- Carrier Frequency - 44.736 MHz; Carrier Amplitude:- 1 volt

4. Set the HP E1686A module as follows:

   Transmitter, DS3, Clk source (External).

   Click on (SLAVE) to set module to (MASTER).
   Click on (Repeat) to set gating to (Single).

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5. Adjust the counter *Input A level* control until the yellow indicator flashes continuously. Now set the GATE ADJ control for approximately 0.5 second gating.
6. Check that the counter frequency display is approximately 44.7360 MHz.
7. Select the (DS1|E1) Receiver on the E1686A and go to the (STATUS) subpanel. Click on (START) to commence gating.
8. Check that all alarms are OFF (coloured green) and that all errors are zero.
9. Set the signal generator to -100ppm offset as follows:
   CARRIER (FREQ) 44.73 (MHz)

   Check that the counter tracks this change in frequency.
10. Check that all alarms are OFF and that the HP E1686A error count is zero.
11. Set the signal generator to +100 ppm offset as follows:

    CARRIER (FREQ) 44.74 (MHz)

    Check that the counter tracks this change in frequency.
12. Check that all alarms are OFF and that the HP E1686A error count is zero.
13. Remove the connection to the DS3 **Clock Input** port and check that the DS3 signal LED extinguishes.
14. Set the E1686A DS3 transmitter clock to internal by clicking on Clk source (External). Check that the DS3 signal LED is illuminated.
15. Read the frequency displayed on the counter, and check it is 44.736 MHz ±20 ppm, that is between 44,735,106 Hz to 44,736,894 Hz.

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Test 2: DS1 Clock Operation

Description

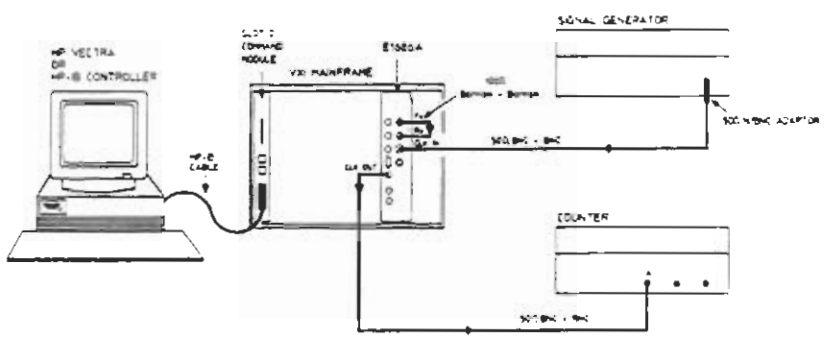
This test checks four areas of operation, these are:

- Internal clock accuracy
- External clock range
- Receiver frequency offset tolerance
- Receiver clock output frequency

In all cases the DS1 transmitter clock frequency is measured by the counter at the receiver **Clock Out** port with the transmitter connected directly to the receiver.

Procedure

1. Connect the equipment as shown in the following figure:



2. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.
   If the soft-panel is already loaded and configured click on (Other), (Module Reset) to reset the HP E1686A module to a known condition.
3. Cycle the power on the counter, and preset the signal generator. Then set the counter and signal generator as follows:

   Counter:- Freq. A: Input A; Z= 50Ω

   Signal Generator:- Carrier Frequency 1.544 MHz; Amplitude 1 Volt
4. Set the HP E1686A module as follows:

   Receiver Clock Output (DS1), DS1/E1 Source (External).

   Transmitter, DS1, Clk Source (External)

   Click on (SLAVE) to set module to (MASTER).

   Click on (Repeat) to set gating to (Single).

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5. Adjust the counter *Input A level* control until the yellow indicator flashes continuously. Now set the GATE ADJ control for approximately 0.5 second gating.
6. Check that the counter frequency display is approximately 1.5440 MHz.
7. Select the [DS1|E1] Receiver on the HP E1686A and go to the [STATUS] subpanel. Click on [START] to commence gating.
8. Check that all alarms are OFF (coloured green) and that all errors are zero.
9. Set the signal generator to -100ppm offset as follows:

   CARRIER [FREQ] 1.5438 [MHz]

   Check that the counter tracks this change in frequency.
10. Check that all alarms are OFF and that the HP E1686A error count is zero.
11. Set the signal generator to +100ppm offset as follows:

    CARRIER [FREQ] 1.5442 [MHz]

    Check that the counter tracks this change in frequency.
12. Check that all alarms are OFF and that the HP E1686A error count is zero.
13. Remove the connection to the DS1 **Clock In** port and check that the DS1 signal LED extinguishes.
14. Set the E1686A DS1 transmitter clock to Internal by clicking on Clk source [External].
    Check that the DS1 signal LED is illuminated.
15. Read the frequency displayed on the counter, and check it is 1.544 MHz ±20ppm (that is within 1.543970 MHz to 1.544030 MHz).

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Test 3: E1 Clock Operation

Description

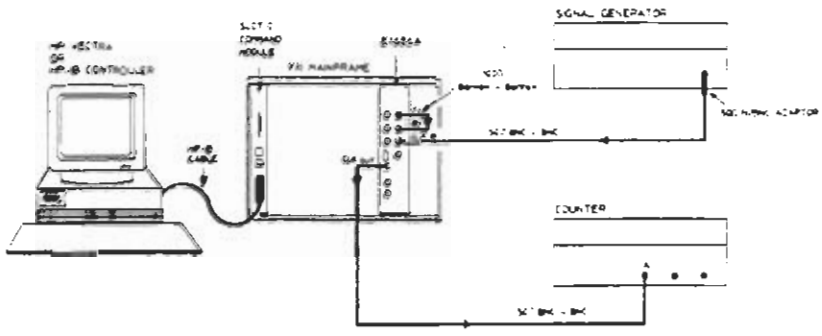
This test checks four areas of operation as follows:

- Internal clock accuracy.
- External clock range.
- Receiver frequency offset tolerance
- Receiver clock output frequency

In all cases the E1 transmitter clock frequency is measured by the counter at the receiver **Clock Out** port, with the transmitter connected directly to the receiver.

Procedure

1. Connect the equipment as shown in the following figure:



2. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar. and ensure Automatic Update is asserted.
   If the soft-panel is already loaded and configured click on (Other), (Module Reset) to reset the HP E1686A module to a known condition.
3. Cycle the power on the counter, and preset the signal generator. Set the counter and signal generator as follows:

   Counter:- Freq. A; Input A; Z= 50Ω

   Signal Generator:- Carrier Frequency 2.048 MHz; Amplitude 1 Volt

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4. Set the HP E1686A module as follows:

   Receiver E1. Receiver Clock Output [E1], DS1/E1 Source [External].

   Transmitter, E1, Clk Source [External]

   Click on [SLAVE] to set module to [MASTER].
   Click on [Repeat] to set gating to [Single].

5. Adjust the counter *Input A level* control until the yellow indicator flashes continuously. Now set the GATE ADJ control for approximately 0.5 second gating.

6. Check that the counter frequency display is approximately 2.0480 MHz.

7. Select the [DS1|E1] Receiver on the HP E1686A and go to the [STATUS] subpanel. Click on [START] to commence gating.

8. Check that all alarms are OFF (coloured green) and that all errors are zero.

9. Set the signal generator to -100 ppm offset as follows:

   CARRIER [FREQ] 2.04779 [MHz]

   Check that the counter tracks this change in frequency.

10. Check that all alarms are OFF and that the HP E1686A error count is zero.

11. Set the signal generator to +100 ppm offset as follows:

    CARRIER [FREQ] 2.04821 [MHz]

    Check that the counter tracks this change in frequency.

12. Check that all alarms are OFF and that the HP E1686A error count is zero.

13. Remove the connection to E1 **Clock In** port and check that the E1 signal LED extinguishes.

14. Set the E1686A E1 transmitter clock to Internal by clicking on Clk source [External].
    Check that the E1 signal LED is illuminated.

15. Read the frequency displayed on the counter, and check it is 2.048 MHz ±20 ppm (that is within 2.047959 MHz to 2.048041 MHz).

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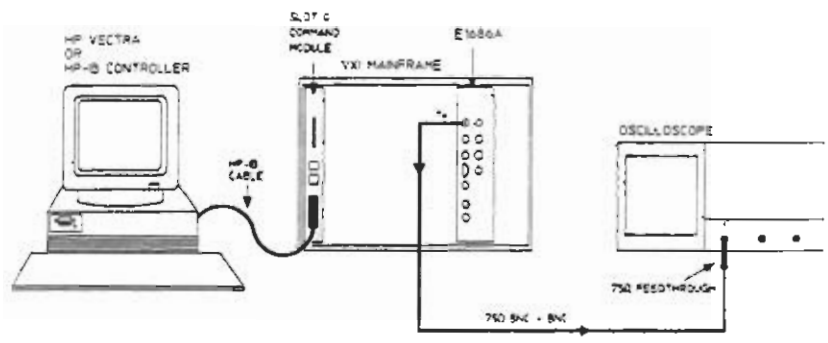
Test 4: DS3 Pulse Shape

Description

This test checks the pulse shape of the DSX-3, DS-Hi and DS3-900 signals at the DS3 TX port. The DSX-3 signal is checked against the specified mask, the other signals are checked visually.

Procedure

1. Connect the equipment as shown in the following Figure:



2. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.

   If the soft-panel is already loaded and configured click on (OTHER), (Module Reset) to reset the HP E1686A to a known condition.

3. To test the positive pulse shape press the following keys on the oscilloscope:

   (RECALL), (CLEAR) (resets the oscilloscope)

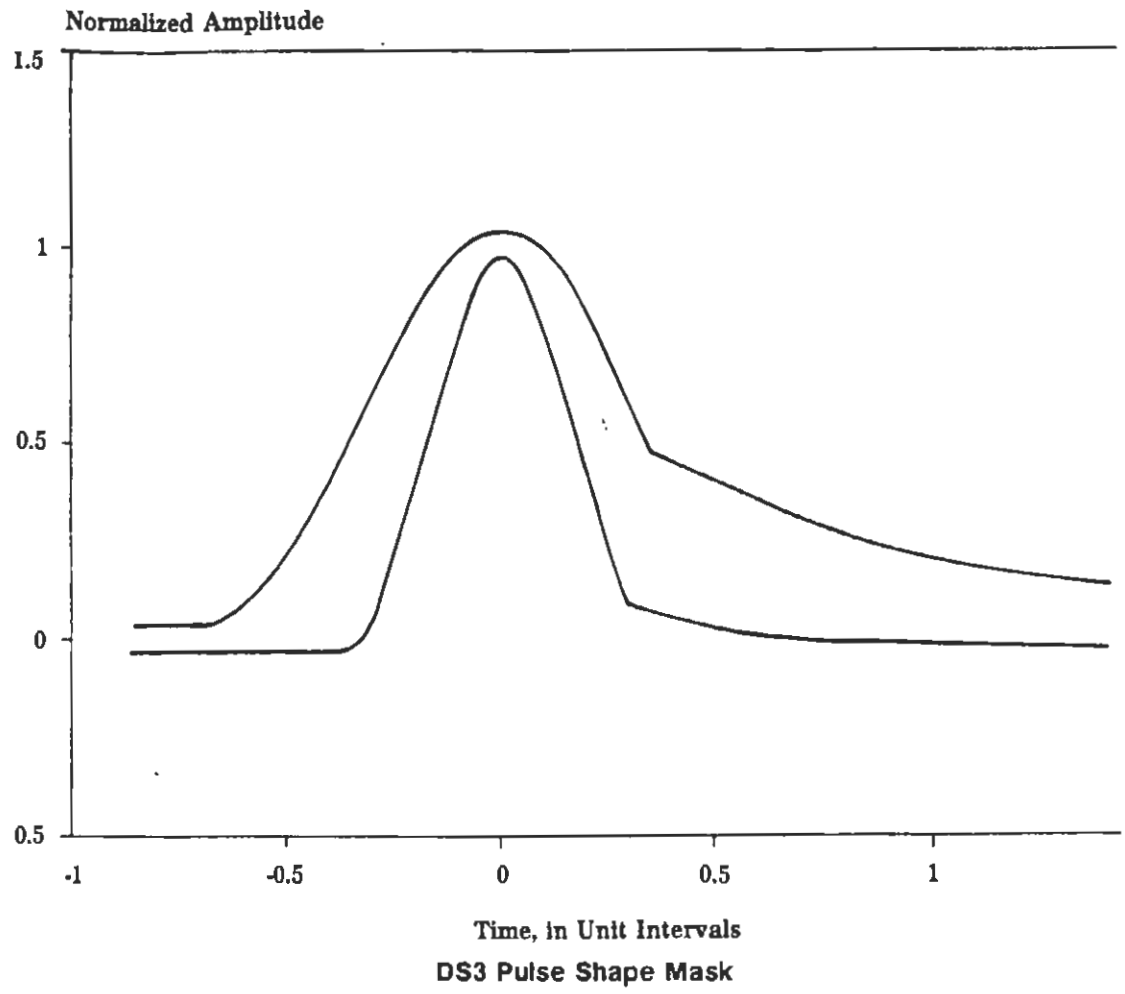
   (WFORM SAVE), select MASK, DS3 ANSI T1.102 STORE

   Press the (SHIFT) key and (AUTO-SCALE) (to start Auto-mask)

   (DEFINE MEAS), select COMPARE, TEST ON, Allowance 0.2 div.

4. Check that the indicator in the top left hand corner of the screen indicates that the pulse shape meets the mask. The Allowance factor of 0.2 div allows for differences between the current T1.102 mask specification and the specification implemented in the HP 54502A Oscilloscope, it may therefore appear that the pulse is outside the mask. Note if your Oscilloscope does not have a mask feature obtain a printout of the displayed pulse. Place the mask shown in the following figure, over the printout and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

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DS3 Pulse Shape Mask

Equations for DSX-3 Eye Diagram Mask

Upper Curve	
Time Axis Range unit intervals	Normalized Amplitude Equation
$-0.85 \leq T \leq -0.68$	0.03
$-0.68 \leq T \leq 0.36$	$0.5\{1 + sin\left[(\frac{\pi}{2})(1 + \frac{T}{0.34})\right]\} + 0.03$
$0.36 \leq T \leq 1.4$	$0.08 + 0.407e^{-1.84(T-0.36)}$

Lower Curve	
$-0.85 \leq T \leq -0.36$	-0.03
$-0.36 \leq T \leq 0.28$	$0.5\{1 + sin\left[(\frac{\pi}{2})(1 + \frac{T}{0.18})\right]\} + 0.03$
$0.28 \leq T \leq 1.4$	$0.11e^{-3.42(T-0.3)} - 0.03$

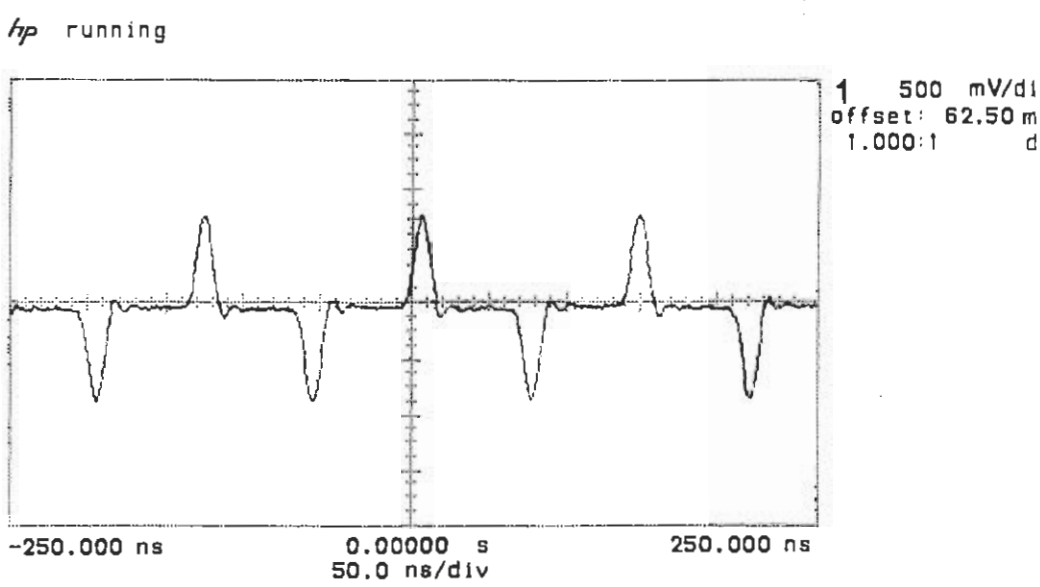
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5. To test the negative pulse shape set the HP E1686A DS3 transmitter to (Unframed), (User) pattern (100100).
6. Press (AUTO-SCALE) on the oscilloscope. Now adjust the oscilloscope EDGE TRIGGER for negative slope and mid-level of the negative pulse. There should be a steady display on the oscilloscope. Press (TIME BASE) and set the oscilloscope to repetitive mode.
7. Display the mask by pressing (WFORM SAVE), STORE INVERSE.
8. Fit the signal inside the mask using the following controls: Timebase, Delay, Channel Sensitivity/Offset.
   Use the controls on FINE MODE to make small adjustments once the signal is close to the mask shape. Adjust until the indicator in the top left corner of the screen indicates that the pulse shape meets the mask. Note that it may appear that the pulse is outside the mask. This difference is accounted for through the use of the allowance factor.

   Note if your Oscilloscope does not have a mask feature obtain a printout of the displayed pulse. Place the mask shown in figure 6-1 over the printout and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

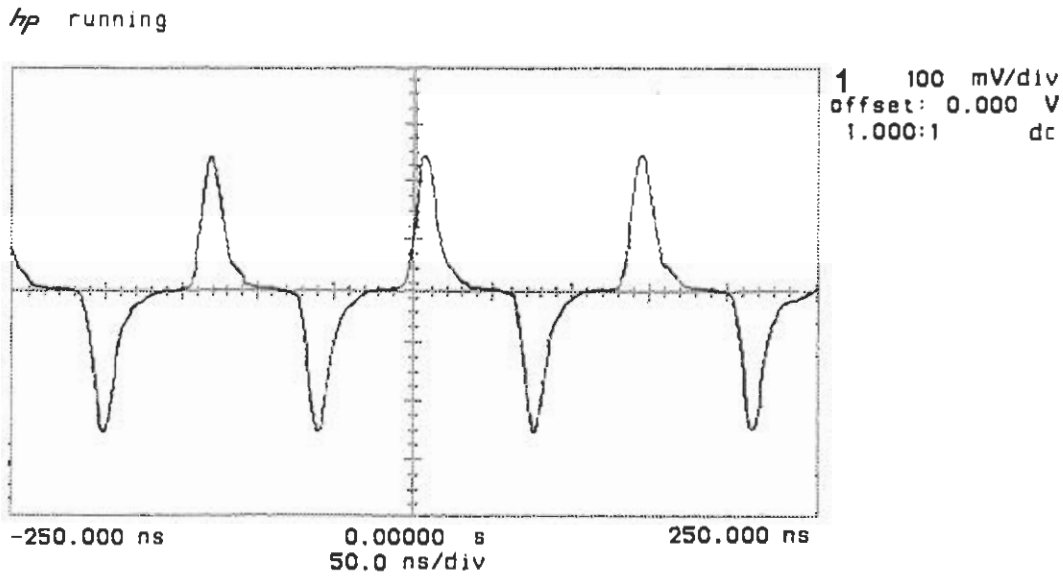
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9. Set the HP E1686A DS3 transmitter level to (High) and press (AUTO SCALE) on the oscilloscope. Check the shape and level of the displayed signal are similar to that shown in the following figure:



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10. Set the HP E1686A DS3 transmitter level to (900 ft) and press (AUTO SCALE) on the oscilloscope. Check the shape and level of the displayed signal are similar to that shown in the following figure:



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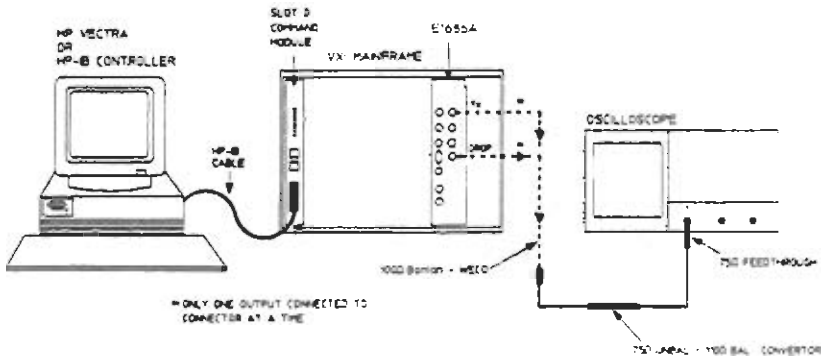
Test 5: DS1 Pulse Shape

Description

This test checks the pulse shape of the DS1 signals output at the Transmit and DROP ports.

Procedure

1. Connect the equipment as shown in the following figure:



2. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.

   If the soft-panel is already loaded and configured click on (OTHER), (Module Reset) to reset the HP E1686A to a known condition.

3. Set the HP E1686A DS1 Transmit Line Code to (B8ZS).

4. To test the positive pulse shape press the following keys on the oscilloscope:

   (RECALL), (CLEAR) (resets the oscilloscope)

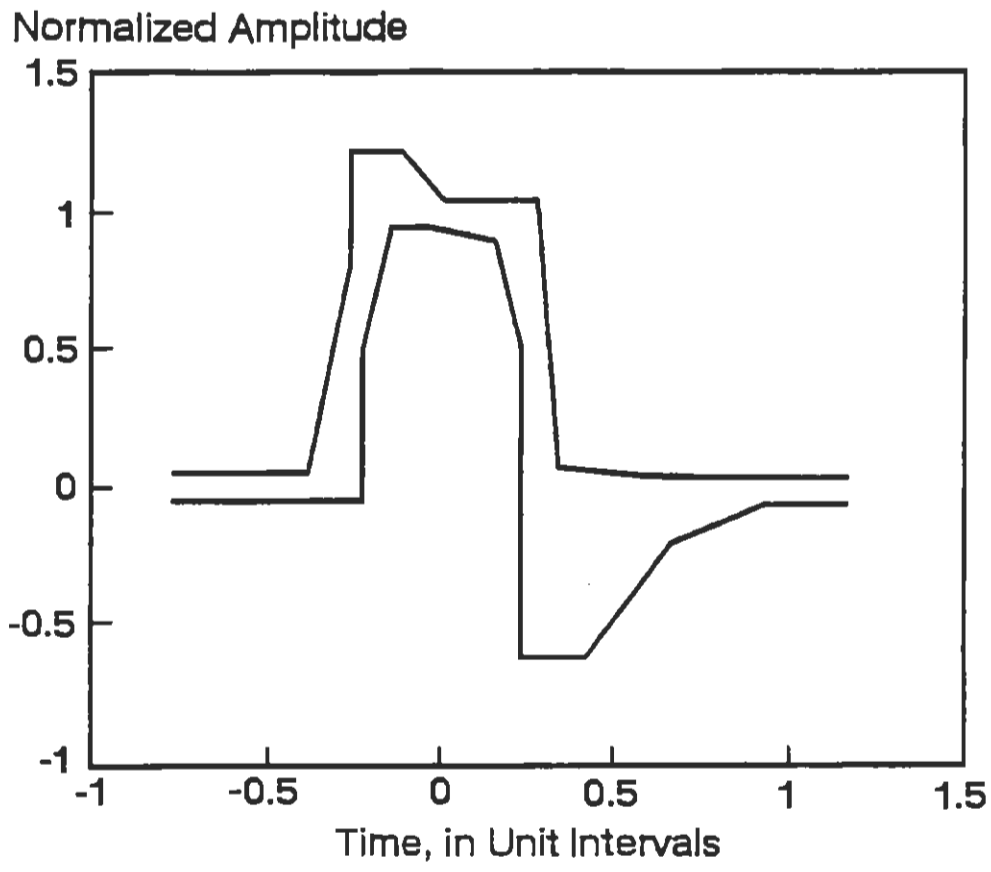
   (WFORM SAVE), select MASK, DSIold ANSI T1.102 STORE

   Press the (SHIFT) key and (AUTO-SCALE) (to start Auto-mask)

5. Check that the indicator in the top left hand corner of the screen indicates that the pulse shape meets the mask. The Allowance factor of 0.2 div allows for differences between the current T1.102 mask specification and the specification implemented in the HP 54502A Oscilloscope, it may therefore appear that the pulse is outside the mask.

   Note if your Oscilloscope does not have a mask feature obtain a printout of the displayed pulse. Place the mask shown in the following figure, over the printout and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

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DS1 Pulse Shape Mask

Values for DS1 Eye Diagram Mask

Minimum Curve		Maximum Curve	
Time in unit intervals	Normalized Amplitude	Time in unit intervals	Normalized Amplitude
-0.77	-0.05	-0.77	0.05
-0.23	-0.05	-0.39	0.05
-0.23	0.5	-0.27	0.8
0.15	0.95	-0.27	1.22
-0.04	0.95	-0.12	1.22
-0.15	0.9	0.0	1.05
0.23	0.5	0.27	1.05
0.23	-0.62	0.34	0.08
0.42	-0.62	0.58	0.05
0.66	-0.2	1.16	0.05
0.93	-0.05		
1.16	-0.05		

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6. To test the negative pulse shape set the HP E1686A DS1 Transmitter to [Unframed], [User] pattern [1000 0000].
7. Press [AUTO-SCALE] on the oscilloscope. Now adjust the oscilloscope EDGE TRIGGER for negative slope and mid-level of the negative pulse. There should be a steady display on the oscilloscope. Press [TIME BASE] and set the oscilloscope to repetitive mode.
8. Display the mask by pressing [WFORM SAVE], STORE INVERSE.
9. Fit the signal inside the mask using the following controls: Timebase, Delay, Channel Sensitivity/Offset.
   Use the controls on FINE MODE to make small adjustments once the signal is close to the mask shape. Note if your Oscilloscope does not have a mask feature obtain a printout of the displayed pulse. Place the mask shown in figure 6-4 over the printout and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).
10. Change the connection from the DS1 TX Output to the DROP Output port.
11. To test the positive pulse shape, set the HP E1686A as follows:

    [OTHER], [Module Reset]

    Receiver: DS3 Source [Int. Loopback], DROP port [B8ZS]

    Transmitter: DS1 Line Code [B8ZS]
12. Check the positive pulse shape as in steps 4 and 5 of this procedure.
13. To test the negative pulse shape set the HP E1686A as follows:

    [OTHER], [Module Reset]

    Receiver: DS3 Source [Int. Loopback], DROP port [B8ZS]

    Transmitter: DS1 Line Code [B8ZS], Framing [Unframed], pattern [User], [1000 0000]
14. Check the negative pulse shape by repeating steps 7 through 9.

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Test 6: DS3 Back-to-Back Operation

Description

This test checks the operation of the DS3 transmitter and receiver. Error free operation is checked then errors/alarms are injected in the transmitted signal and the receiver is used to measure/detect the errors/alarms.

Procedure

Note:- No connections are necessary for this test.

1. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.

   If the soft-panel is already loaded and configured click on (OTHER), (Module Reset) to reset the HP E1686A to a known condition.

2. Set the HP E1686A module as follows:

   Receiver DS3 Source (Int. Loopback).

   Click on (SAVE) to set the module to (MASTER).

   Click on (REPEAT) to set gating to (Single).

3. Go to the receiver (Status) subpanel. Start gating on the HP E1686A.
   Check that all DS3 receiver alarms are OFF (green) and that all error counts are zero.

Note 

There are two pages of error count results - use (NEXT) to access the second page.

4. Repeat step 3 with the DS3 transmitter and receiver (Setup) subpanels set to the following framing types:

   a. M23

   b. Unframed

5. Set the DS3 transmitter and receiver to C-bit framing. Go to the transmitter (Control 1) subpanel and the receiver (Status) subpanel. Re-start gating.

6. Select Error Add (Bit + Parity). Add single errors by clicking on (Error). check that for each error added the P-Bit and CP-Bit error counters are incremented by one count.

7. Set the HP E1686A as follows:

   Error Rate (Burst), (On)

   Period (1 sec)

   % Duty (50%)

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Check that the DS2 [OOF] alarm flashes steadily OFF and ON (that is, red then green) and that the P-Bit and CP-Bit errors increment.

8. Set the HP E1686A as follows:

   Rate [1.0E-4], P-Bit [Ratio], CP-Bit [Ratio]

9. Re-start gating and check that the P-Bit and CP-Bit Error Ratio's are approximately 1E-04.

10. Repeat step 6 for all error types as listed in the following table. Re-start gating for each error type.

Error Type	Error Add	Expected Result
Code (BPV)	Single	Code count increments by one
F-Bit Framing	Single	Frame/F-Bit counts increment by one
M-Bit Framing	One group	Frame count increments by one
FEBE	Single	FEBE count increments by one
CODE (EXZ)	4 bits	Code count increments by at least one

11. Set HP E1686A as follows:

    Click on DS3 [Stressing], then set:

    Stress [LOS]

    Duration [Continuous]

    [ON]

12. Check that the DS3 and DS1 signal LED's on the module front panel are OFF. Check that the DS3 receiver [Status] subpanel shows [LOS] in red, and that the Alarm [Sig Loss] increments once every second.

13. Repeat step 11 for all stress types as shown in the following table: Check DS3 receiver alarms match the table.

Stress Type	Front Panel Alarms ON	Rx Status Alarms ON
AIS	DS3 Errors, DS2 OOF, DS1 OOF	AIS, DS2 OOF
AIS excl. C-bits	DS2 OOF, DS1 OOF	DS2 OOF
OOF	DS2 OOF, DS1 OOF	DS3 OOF

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14. On the HP E1686A select DS3 Receiver (Capt) page. Select (Events Display) then click on (clear) after setting each stress type in the table below. Check that the HP E1686A Alarms match the table below.

Stress Type	**Front Panel Alarms ON**	**Rx Special Codes Alarms ON**
Unframed 1010	DS2 OOF, DS1 OOF	UF1010
Framed all ones	DS1 AIS	Fr A1
Unframed all ones	DS2 OOF, DS1 AIS	UFrA1

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Test 7: FEAC Codes and DS2 C-bit Stuffing

Description

This test checks that the DS3 transmitter and receiver have the ability to generate and detect FEAC codes and C-bit stuff inversion.

Procedure

Note:- No connections are necessary for this test.

1. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.

   If the soft-panel is already loaded and configured click on (OTHER). (Module Reset) to reset the HP E1686A to a known condition.

2. Set the HP E1686A module as follows:

   Transmitter (Control)

   Click on (Injecting)

   Inject (FEAC Code)

   Code (DS3 Fail (SA))

   (Constant), (on)

   Receiver DS3 source (Int. Loopback)

   Receiver (Capt.)

3. Click on (Capture) and check the received FEAC Code is (DS3 Fail (SA)).

4. Repeat step 3 for each FEAC code as given in the following table. Check that the received code matches the transmitted code.

Inject FEAC Code
DS3 LOS/HBER
DS3 OOF
DS3 AIS Rcvd
DS3 Idle Rcvd
DS3 Fail (NSA)
Common Fail
Mul DS1 LOS/HBER
DS1 Fail (SA)
Sgl DS1 LOS/HBER
DS1 Fail (NSA)

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5. Change the HP E1686A settings as follows:

   Inject (DS2 C/Stuff)

   Invert bit (C1)

   (OFF)

   Pulse size (5 bits)

   Change the DS3 Receiver to the (Events Display) page.

6. Click on (Clear), then (Pulse Invert) and check that the C1 Alarm on the Capture page is ON (red).

7. Repeat step 6 for C2, C3 and Stuff. Check that the detected alarm matches the transmitted alarm.

8. Repeat steps 6 and 7 for pulse size (4 bits). Check that alarms stay OFF.

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Test 8: DS1 Back-to-Back Operation

Description

This test checks the operation of the DS1 transmitter and receiver. Error free operation is verified, then Errors/Alarms are injected into the transmitted signal and the receiver used to measure/detect the Errors/Alarms.

Procedure

Note: no connections are required for this test.

1. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar, and ensure Automatic Update is asserted.

   If the soft-panel is already loaded and configured click on (OTHER), (Module Reset) to reset the HP E1686A to a known condition.

2. Set the HP E1686A module as follows:

   Receiver (DS1/E1), Line Code (B8ZS)

   DS1/E1 Source (Int. Loopback)

   Transmitter (DS1/E1), Line Code (B8ZS)

   Click on (SLAVE) to set the module to (MASTER).
   Click on (REPEAT) to set gating to (Single).

3. Go to the receiver (Status) subpanel. Start gating on the HP E1686A. Check that all DS1 alarms are OFF (green) and that all error counts are zero.

4. Repeat step 3 with the DS1 transmitter and receiver (Setup) subpanel set to the following framing types:

   a. D4
   b. SLC96
   c. Unframed

5. Set the DS1 transmitter and receiver to ESF framing.

6. Repeat step 3 with the DS1 transmitter and receiver (Setup) subpanels set to the following patterns:

   a. PRBS15
   b. PRBS20
   c. PRBS23
   d. User
   e. 3 in 24
   f. All Ones
   g. Loop Up
   h. Loop Down

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7. Set the DS1 transmitter and receiver patterns to QRSS. Go to the transmitter (Control) subpanel and the receiver (Status) subpanel. Re-start gating.
8. Add bit errors to the transmitted DS1 signal by clicking on (Error). Check that for each error added the receiver bit error counter increments by one.
9. Select Error Add (Bit + CRC), and re-start gating. Add single errors by clicking on (Error). Check that for each error added the receiver Bit and CRC-6 error counters are incremented by one.
10. Repeat step 8 for all error types as given in the following table. Re-start gating for each error type.

Error Type	Error Add	Expected Result
Code (BPV)	Single	Code count increments by one.
F-bit	Single	Frame count increments by one.
Code (EXZ)	8 bits	Code count increments by at least one

11. Set HP E1686A module as follows:

    Click on DS1 (Stressing), then set:

    Stress (LOS)

    Duration (Continuous)

    (On)

12. Check that the DS1 signal LED on the module front panel is OFF. Check that the DS1 receiver (Status) subpanel shows (LOS) in red, and that the alarm (Sig Los) increments once every second.
13. Repeat step 11 for all stress types listed in the following table. Check DS1 receiver alarms match the table.

Stress Type	Front Panel Alarms ON	Rx Status Alarms ON
AIS	AIS	AIS
OOF	OOF	OOF
yellow	none	yellow

14. Go to the transmitter (Setup) page and set the DS1 transmitter pattern to PRBS15. Check that the DS1 receiver (Status) subpanel shows (SYNC) in red. Check that the "Sync Loss " LED on the module front panel is ON.

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Test 9: E1 Back-to-Back Operation

Description

This test checks the operation of the E1 transmitter and receiver. Error free operation is verified, then Errors/Alarms are injected into the transmitted signal, and the receiver used to measure/detect the Errors/Alarms.

Procedure

Note: no connections are necessary for this test.

1. Load and configure the HP E1686A soft-panel with address 70910. Click the mouse on Options on the HP ITG menu bar. and ensure Automatic Update is asserted.

   If the soft-panel is already loaded and configured click on (OTHER), (Module Reset) to reset the HP E1686A to a known condition.

2. Set the HP E1686A module as follows:

   Transmitter (DS1/E1), Mode (E1), Line Code (HDB3)

   Receiver (DS1/E1), Mode (E1), Line Code (HDB3)

   DS1/E1 Source (Int. Loopback)

   Click on (SLAVE) to set the module to (MASTER).
   Click on (REPEAT) to set gating to (Single).

3. Go to the receiver (Status) subpanel. Start gating on the HP E1686A.

   Check that all E1 alarms are OFF and that all error counts are zero.

4. Repeat step 3 with the E1 transmitter and receiver (Setup) subpanels set to the following patterns:

   a. PRBS15
   b. PRBS20
   c. PRBS23
   d. User
   e. 3 in 24

5. Set E1 transmitter and receiver patterns to QRSS. Go to the transmitter (Control) subpanel and the receiver (Status) subpanel. Re-start gating.

6. Add bit errors to the transmitted E1 signal by clicking on (Error). Check that for each error added, the receiver bit error count increments by one.

7. Repeat step 6 for each of the error types listed in the following table. Re-start gating for each error type.

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Error Type	Error Add	Expected Result
Code (BPV)	Single	Code count increments by one
Code (EXZ)	4 bits	Code count increments by at least one

8. Set the HP E1686A module as follows:

   Click on Stressing [None], then set:

   Stress [LOS]

   Duration [Continuous]

   [On]

9. Check that the E1 signal LED on the module front panel is OFF, and the E1 receiver status shows [LOS] (red). Check also that the Alarm [Sig Loss] increments once every second.

10. Set Stress [AIS], [On]. Check the E1 AIS LED on the module front panel is ON, and the E1 receiver [Status] subpanel shows [AIS] in red.

11. Set Stress [AIS], [OFF]. Go to the transmitter [Setup] subpanel and set Pattern to PRBS15. Check that the E1 receiver [Status] subpanel shows [Sync] in red.
    Check that the "Sync Loss" LED on the module front panel is ON.

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Test Record - Operation Verification

Hewlett-Packard Model E1686A Module

Serial No.:

Tested by:

Date:

Operation Verification Test Record

Test No.	Test Description	Result
Test 8	**DS1 Back-to-Back Operation**	
Step 3	DS1 Alarms OFF (green)	PASS/FAIL
	DS1 Error count zero	PASS/FAIL
Step 4	D4 Alarms OFF	PASS/FAIL
	D4 Error count zero	PASS/FAIL
	SLL96 Alarms OFF	PASS/FAIL
	SLL96 Error count zero	PASS/FAIL
	Unframed Alarms OFF	PASS/FAIL
	Unframed Error count zero	PASS/FAIL
Step 6	Alarms OFF and Error Count zero for following patterns:	
	PRBS15; PRBS20; PRBS23; User; 3 in 24; all ones; Loop Up; Loop Down	PASS/FAIL
Step 8	Error count increments by one	PASS/FAIL
Step 9	Bit and CRC-6 Error count increments by one	PASS/FAIL
Step 10	Code error count increments by one	PASS/FAIL
	F-Bit - frame count increments by one	PASS/FAIL
	Code (EXZ) count increments by at least one	PASS/FAIL
Step 12	DS1 signal LED OFF	PASS/FAIL
	DS1 Receive status (LOS) in red	PASS/FAIL
	(Sig Loss) increments once every second	PASS/FAIL
Step 13	Stress Types: AIS, OOF, yellow	
	Front panel alarms	PASS/FAIL
	Rx status alarms	PASS/FAIL
Step 14	DS1 status: (SYNC) (in red)	PASS/FAIL
	Sync Loss LED ON	PASS/FAIL

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Operation Verification Test Record (continued)

Test No.	Test Description	Result
Test 9	**E1 Back-to-Back Operation**	
Step 3	E1 Alarms OFF	PASS/FAIL
	Error count zero	PASS/FAIL
Step 4	PRBS15: Alarms OFF; Error count zero	PASS/FAIL
	PRBS20: Alarms OFF; Error count zero	PASS/FAIL
	PRBS23: Alarms OFF; Error count zero	PASS/FAIL
	User: Alarms OFF; Error count zero	PASS/FAIL
	3 in 24: Alarms OFF; Error count zero	PASS/FAIL
Step 6	Rx error count increments by one	PASS/FAIL
Step 7	Code (BPV): single error - count increments by one	PASS/FAIL
	Code (EXZ) 4 bits - count increments by at lest one	PASS/FAIL
Step 9	E1 signal LED OFF	PASS/FAIL
	E1 Rx status (LOS) (red)	PASS/FAIL
	(Sig Los) increments once every second	PASS/FAIL
Step 10	E1 AIS LED ON	PASS/FAIL
	E1 Receiver (Status) shows (AIS) in red	PASS/FAIL
	Sync Loss LED is ON	PASS/FAIL

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Test Record - Performance Tests

Hewlett-Packard Model E1686A Module
Serial No.:
Tested by:
Date:

Performance Test Record

Test No.	Test Description	Result
Test 1	**DS3 Clock Operation**	
Step 6	Counter frequency	PASS/FAIL
Step 8	Alarms OFF; Errors zero	PASS/FAIL
	-100 ppm Offset	
Step 9	Counter Frequency 44.73 MHz	PASS/FAIL
Step 10	Alarms OFF; Errors zero	PASS/FAIL
	+100 ppm Offset	
Step 11	Counter Frequency 44.74 MHz	PASS/FAIL
Step 12	Alarms OFF; Errors zero	PASS/FAIL
Step 13	DS3 SIGNAL LED OFF	PASS/FAIL
Step 14	DS3 SIGNAL LED ON	PASS/FAIL
Step 15	Frequency Accuracy	44,735,106 - 44,736,894 Hz
Test 2	**DS1 Clock Operation**	
Step 6	Counter Frequency	PASS/FAI
Step 8	Alarms OFF	PASS/FAIL
	Errors zero	PASS/FAIL
	-100 ppm Offset	
Step 9	Frequency 1.5438 MHz	PASS/FAIL
Step 10	Alarms OFF	PASS/FAIL
	Errors zero	PASS/FAIL
	+100 ppm Offset	PASS/FAIL
Step 11	Counter Frequency 1.5442 MHz	PASS/FAIL
Step 12	Alarms OFF	PASS/FAIL
	Errors zero	PASS/FAIL
Step 13	DS1 signal LED OFF	PASS/FAIL
Step 14	DS1 signal LED ON	PASS/FAIL
Step 15	Frequency	1.543970 to 1.544030 MHz

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Performance Test Record (continued)

Test No.	Test Description	Result
Test 3	**E1 Clock Operation**	
Step 6	Counter Frequency	PASS/FAIL
Step 8	Alarms OFF; Errors zero	PASS/FAIL
Step 9	Frequency 2.04779 MHz	PASS/FAIL
Step 10	Alarms OFF; Errors zero	PASS/FAIL
Step 11	Frequency 2.04821 MHz	PASS/FAIL
Step 12	Alarms OFF; Errors zero	PASS/FAIL
Step 13	E1 signal LED OFF	PASS/FAIL
Step 14	E1 signal LED ON	PASS/FAIL
step 15	Counter Frequency Accuracy	2.047959 - 2.048041 MHz
Test 4	**DS3 Pulse Shape**	
Step 4	Positive pulse within mask	PASS/FAIL
Step 8	Negative pulse within mask	PASS/FAIL
Step 9	Pulse shape/level correct (High)	PASS/FAIL
Step 10	Pulse shape/level correct (900 ft)	PASS/FAIL
Test 5	**DS1 Pulse Shape**	
Step 5	Tx output: Positive pulse within mask	PASS/FAIL
Step 9	Tx output:Negative pulse within mask	PASS/FAIL
Step 12	Drop port output:Positive pulse within mask	PASS/FAIL
Step 14	Drop port output:Negative pulse within mask	PASS/FAIL
Test 6	**DS3 Back-to-Back Operation**	
Step 3	DS3 receiver alarms OFF; Errors zero	PASS/FAIL
Step 6	Counters increment by one	PASS/FAIL
Step 7	OOF alarm flashes	PASS/FAIL
	P-bit/CP-bit error count increments	PASS/FAIL
Step 9	P-bit/CP-bit error ratio 1E-04	PASS/FAIL
Step 10	Counters increment by one	PASS/FAIL
Step 12	DS3/DS1 signal LED's OFF	
	DS3 Status (LOS)	PASS/FAIL
	Alarm (Sig Loss) increments once/sec	PASS/FAIL

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Performance Test Record (continued)

Test No.	Test Description	Result
Step 13	**Front Panel Alarms ON**	
	AIS: DS3 Errors ON	PASS/FAIL
	AIS: DS2 OOF ON	PASS/FAIL
	AIS: DS1 OOF ON	PASS/FAIL
	AIS excl. C-bits: DS2 OOF ON	PASS/FAIL
	AIS excl. C-bits: DS1 OOF ON	PASS/FAIL
	OOF: DS2 OOF ON	PASS/FAIL
	OOF: DS1 OOF ON	PASS/FAIL
Step 13	**Rx Status Alarms ON**	
	AIS: AIS ON	PASS/FAIL
	AIS: DS2 OOF ON	PASS/FAIL
	AIS excl. C-bits: DS2 OOF ON	PASS/FAIL
	OOF: DS3 OOF ON	PASS/FAIL
Step 14	**Front Panel Alarms ON**	
	Unframed 1010: DS2 OOF ON	PASS/FAIL
	Unframed 1010: DS1 OOF ON	PASS/FAIL
	Framed all ones: DS1 AIS ON	PASS/FAIL
	Unframed all ones: DS2 OOF ON	PASS/FAIL
	Unframed all ones: DS1 AIS ON	PASS/FAIL
	Rx Special Codes Alarms ON	PASS/FAIL
	Unframed 1010: UF1010 ON	PASS/FAIL
	Framed all ones: Fr A1 ON	PASS/FAIL
	Unframed all ones: UFrA1 ON	PASS/FAIL
Test 7	**FEAC Codes**	
Step 3	Received code (DS3 Fail (SA))	PASS/FAIL
Step4	Received code DS3 LOS/HBER	PASS/FAIL
	Received code DS3 OOF	PASS/FAIL
	Received code DS3 AIS Recvd	PASS/FAIL
	Received code DS3 Idle Recvd	PASS/FAIL
	Received code DS3 Fail (NSA)	PASS/FAIL
	Received code common fail	PASS/FAIL
	Received code Mul DS1 LOS/HBER	PASS/FAIL
	Received code DS1 Fail (SA)	PASS/FAIL
	Received code Sgl DS1 LOS/HBER	PASS/FAIL
Step 6	C1 Alarm ON (red)	PASS/FAIL
Step 7	C2 ON, C3 ON, Stuff ON	PASS/FAIL
	C3 ON	PASS/FAIL
	Stuff ON	PASS/FAIL
Step 8	C2 ON	PASS/FAIL
Step 8	C3 ON	PASS/FAIL
Step 8	Stuff OFF	PASS/FAIL

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Performance Test Record (continued)

Test No.	Test Description	Result
Test 8	**DS1 Back-to-Back Operation**	
Step 3	DS1 Alarms OFF (green)	PASS/FAIL
	DS1 Error count zero	PASS/FAIL
Step 4	D4 Alarms OFF	PASS/FAIL
	D4 Error count zero	PASS/FAIL
	SLC96 Alarms OFF	PASS/FAIL
	SLC96 Error count zero	PASS/FAIL
	Unframed Alarms OFF	PASS/FAIL
	Unframed Error count zero	PASS/FAIL
Step 6	Alarms OFF and Error Count zero for following patterns:	
	PRBS15;	PASS/FAIL
	PRBS20;	PASS/FAIL
	PRBS23;	PASS/FAIL
	User:	PASS/FAIL
	3 in 24;	PASS/FAIL
	all ones;	PASS/FAIL
	Loop Up:	PASS/FAIL
	Loop Down	PASS/FAIL
Step 8	Error count increments by one	PASS/FAIL
Step 9	Bit and CRC-6 Error Counters increments by one	PASS/FAIL
Step 10	Code error count increments by one	PASS/FAIL
	F-Bit - frame count increments by one	PASS/FAIL
	Code (EXZ) count increments by at least one	PASS/FAIL
Step 12	DS1 signal LED OFF	PASS/FAIL
	DS1 Receive status (LOS) in red	PASS/FAIL
	(Sig Loss) increments once every second	PASS/FAIL
Step 13	Stress Types: AIS, OOF, yellow	
	Front panel alarms	PASS/FAIL
	Rx status alarms	PASS/FAIL
Step 14	DS1 status: (SYNC) (in red)	PASS/FAIL
	Sync Loss LED ON	PASS/FAIL

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Performance Test Record (continued)

Test No.	Test Description	Result
Test 9	**E1 Back-to-Back Operation**	
Step 3	E1 Alarms OFF; Error count zero	PASS/FAIL
Step 4	PRBS15: Alarms OFF; Error count zero	PASS/FAIL
	PRBS20: Alarms OFF; Error count zero	PASS/FAIL
	PRBS23: Alarms OFF; Error count zero	PASS/FAIL
	User: Alarms OFF; Error count zero	PASS/FAIL
	3 in 24: Alarms OFF; Error count zero	PASS/FAIL
Step 6	Rx Bit error count increments by one	PASS/FAIL
Step 7	Code (BPV): single error - Code count increments by one	PASS/FAIL
	Code (EXZ) 4 bits - Code count increments by at least one	PASS/FAIL
Step 9	E1 signal LED OFF	PASS/FAIL
	E1 Rx status (LOS) (red)	PASS/FAIL
	(Sig Los) increments once every second	PASS/FAIL
Step 10	E1 AIS LED ON	PASS/FAIL
	E1 Receiver (Status) shows (AIS) in red	PASS/FAIL
Step 11	E1 Rx Status (Sync) (red)	PASS/FAIL
	Sync Loss LED is ON	PASS/FAIL

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7

Adjustments

About this Chapter

This chapter contains information to enable you to return the HP E1686A to peak operating capabilities, and comprises the following sections:

- **Safety Considerations**
  Provides information about warnings and cautions that must be followed for your protection, and to avoid damage to the module.
- **Equipment Required**
  Lists the equipment required to adjust the variable components.
- **Adjustable Component Location**
  Identifies the location of the adjustable components on the module.
- **Adjustment Procedure**
  Provides a step-by-step procedure to adjust each channels' electrical output signal to within the specified limits.

Safety Considerations

This chapter contains warnings and cautions that must be followed for your protection and to avoid damage to the equipment.

In the interests of safety, consult the WARNING page at the front of this manual, and familiarize yourself with the safety labels on the Mainframe and clamshell enclosure of the module.

Warning



Any interruption of the protective (Grounding) Conductor inside or outside the Mainframe, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Any intentional interruption is prohibited.

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Equipment Required

A complete list of equipment required to perform the adjustment procedure is given in the table below. Any equipment which satisfies the critical specifications may be substituted for the recommended model.

Instrument	Critical Specification	Recommended Model
Controller*	Runs DOS 5.0, Windows 3.1, and HP ITG II/HP VEE. HP-IB compatible.	HP Vectra
VXI Mainframe	C-size.	HP 1400A/B
VXI Slot 0 Module	VXIbus translator for register-based modules.	HP E1405B or HP E1406A
HP-IB Cable	Unique.	HP 10833B
Digital Oscilloscope	input impedance dc 1 MΩ. Telecom mask option	HP 54502A
75 Ω Terminator	75 Ω ± 0.2%	HP 11094B
VXI Bus Extender Card	Unique.	TEK 73A-850
Adjustment Tool	Non-conductive.	HP 8710-1355
75 Ω BNC-BNC Cable	Qty 1.	HP 15525A

* Loaded with HP E1686A D-SCPI device driver. Refer to Chapter 2 for details.

Adjustable Component Location

Inspect the front rightside of the HP E1686A and locate the three potentiometers near the back of the module (see diagram below).

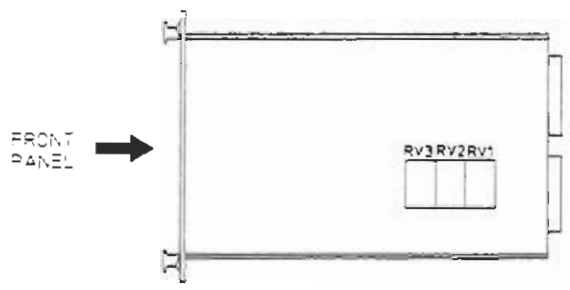


Figure 7-1. Adjustment location

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Adjustment Procedure

Description The DSX3 levels of DSX, 900 ft and High are checked and adjusted for the correct amplitude.

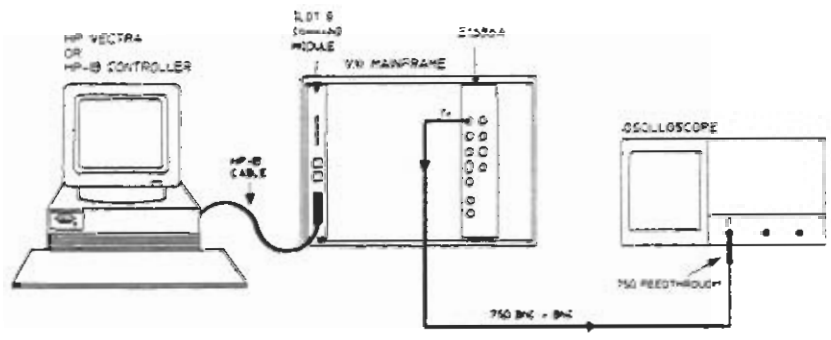
Warning

Maintenance described herein is performed with power supplied to the module, and the module installed via a VXIbus Extender Card. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

Caution

- The VXIbus Mainframe, Slot 0 Command Module, and module must be powered-up for a minimum of 30 minutes before any adjustments are performed.

1. Remove the outer case of the HP E1686A (nine screws).
2. Inspect the HP E1686A and locate the position of the three potentiometers, see figure 7-1.
3. Insert the VXI Extender Card into the VXI Mainframe and attach the HP E1686A. Connect the equipment as shown below.



4. Load and configure the HP E1668A HP ITG/HP VEE soft-panel with address 70910. Click the mouse on `Options` on the menu bar at the top of the screen, and ensure `Automatic Update` is asserted.
5. Click the mouse on the `Other` subpanel of the HP E1686A. Click on the `Reset` button to reset the module to its default values.

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6. Using the voltage measuring facilities on the oscilloscope adjust RV2 for a level as close to 0.48 volts as possible. This adjusts the DSX DS3 level.
7. Using the HP ITG soft panel select DS3 level 900 ft.
8. Using the voltage measuring facilities on the oscilloscope adjust RV1 for a level as close to 0.28 volts as possible.
9. Using the HP ITG soft panel select DS3 level High.
10. Using the voltage measuring facilities on the oscilloscope adjust RV3 for a level as close to 0.91 volts as possible.
11. Disconnect all equipment and replace the HP E1686A outer cover.

7-4 Adjustments

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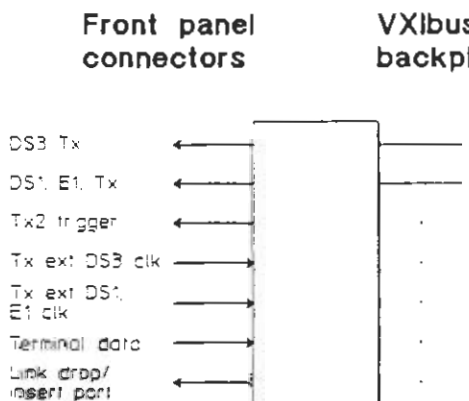
Specifications

HP E1686A DS1/DS3 transceiver

Specifications

The HP E1686A module generates and analyzes signals at DS3, DS1 and E1 rates. It tests at the line rate and on any selected sub-channel within the line signal. The receiver is fully independent of the transmitter. The DS3 and DS1/E1 generators and receivers are also fully independent. The transceiver supports five modes of operation.

- DS3 transmitter and receiver.
- DS1 transmitter and receiver (simultaneous to DS3 if required).
- E1 transmitter and receiver (simultaneous to DS3 if required).
- Channelized or structured DS3 transceiver.
- Hybrid structured DS3 transceiver.



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Transmitter

Line rates: 1.544, 2.048, 44.736 Mb/s.

Frame formats
DS3: M23, C-Bit, unframed.
DS1: SF, ESF, SLC-96 (TR8), unframed.
E1: Unframed.

Sub-channel structuring

Line rate	DS3	DS1	E1
DS3	x 1	x 28	x 21
DS1		x 1	
E1			x 1

Sub-channel loading:

A test pattern is loaded in the sub-channel selected for test.

Data Pattern	DS3	DS1	E1
QRSS		•	•
PRBS 15	•	•	•
PRBS 20	•	•	•
PRBS 23	•	•	•
User-defined 2 -8 bit	•		
User-defined 2-24 bit		•	•
3 in 24		•	•
External DS1, E1	•		
Loop up/down (user-defined)		•	
AIS	•	•	•
All ones	•	•	•
Idle	•		

Note: The PRBS patterns can be true or inverted polarity.

The remaining sub-channels are loaded with a selectable background pattern (framed all ones or AIS) or the same as the selected channel.

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Error add: Errors can be applied to the line signal or a selected sub-channel as follows:

Error type	DS3	DS1	E1
Data bit	•	•	•
CRC and data		•	
Parity and data	•		
BPV	•	•	•
Frame	•	•	
FEBE	•		
EXZ	•	•	•

Error ratios:

Off, single, m x 10^{-n} (m = 0.9, 1.0, 1.1; n = 2 to 9), burst (For all error types. FEBE and EXZ | single only).

Alarm generation *Unless otherwise indicated, the following alarms can be generated at all rates.*

LOS: Burst, on, off.

AIS: Burst (DS3 only), on, off.

LOF: DS3, DS1 only.

X-bit/yellow alarm

FEAC control: DS3 only.

DS3 terminal data link access:

The terminal-to-terminal path maintenance data link can be set to all ones or drop/insert from front panel port.

Clock **Clock modes:** Internal (± 20 ppm at all rates), external, looped.

External transmit clock input
Transparent to frequency and jitter components on the applied inputs.
Frequency: Interface rate ± 100 ppm.
Level: 1.0 to 5.0 V p-p ac coupled.
Connectors (for both inputs): BNC 50 ohm.

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Data

DS3 transmit signal output
Rate: 44.736 Mb/s.
Line code: B3ZS bipolar.
Levels: DSX3, high, 900 feet.
Connector: BNC 75 ohm to ground.

DS1, E1 transmit signal output
DS1: 1.544 MHz.
E1: 2.048 MHz
Level: Typical 3.0 V peak ± 1 dB.
Line codes: AMI, B8ZS (DS1); AMI, HDB3 (E1).
Connector: Bantam, 100 ohm balanced.

DS3 terminal data link drop/insert port
Interface: RS-232-C (synchronous DCE).
Connector: DB-9.
Connections: Ground, transmit data in, transmit clock out, receive data out, receive clock out.

Trigger output
Level: TTL compatible.
Impedance: 50 ohm to ground.
Connector: BNC.

Error injection and alarm/status trigger sources:

Trigger source	DS3	DS1	E1
Data bit	•	•	•
CRC + data		•	
Parity data	•		
BPV	•	•	•
Frame	•	•	
F and M bit	•		
FEBE	•		
EXZ	•	•	•
RAI (yellow)		•	
Frame clock	•	•	
X-bit state change	•		
Idle	•		
AIS	•	•	•
FEAC code change	•		
LOS	•	•	•
LOF	•	•	

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Receiver

Line rates: As for transmitter.
Frame format: As for transmitter.
Sub-channel structures: As for transmitter.
Data patterns: As for transmitter.

Receiver clock: Recovered from the incoming line-coded signal.
Rates: 44.736, 2.048, 1.544 Mb/s (±100ppm).

Clock outputs: Two clock inputs are provided: DS3 and DS1/E1 rates.
Connectors: BNC, 50 ohm.

DS3 receive input
Level: DSX3.
Line code: B3ZS.
Connector: BNC 75 ohm.

DS1, E1 receive input
The DS1, E1 receive input also serves as the input for an externally supplied signal to be inserted into the structured DS3 signal.
Level: DSX1.
Line codes: AMI, B8ZS (DS1); AMI, HDB3 (E1).
Connector: Bantam 100 ohm balanced.

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Trigger output

Error trigger source (selectable)	DS3	DS2	DS1	E1
Bit	•		•	•
CRC			•	
Parity	•			
CP	•			
BPV	•		•	•
F	•		•	
M	•			
F and M	•			
FEBE	•			
RAI (yellow)			•	
Frame clock	•		•	
X-bit state change	•	•		
Idle	•			
AIS	•	•	•	•
FEAC code change	•			
LOS	•	•	•	•
OOF	•	•	•	
Pattern sync loss	•		•	•

Levels: TTL compatible.
Connector: BNC 50 ohm (nominal).

Results

Error Analysis:

Measurements are performed at line rate or on a selected sub-channel. All sources of results are monitored and results accumulated simultaneously. Two results - cumulative and period are available for each of:

- Error count
- Error ratio
- Error seconds.

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All three error results are available simultaneously for:

Result sources	DS3	DS1	E1
Bit	•	•	•
Parity	•		
CP	•		
F	•		
BPV	•	•	•
F and M	•		
FEBE	•		
CRC		•	
Frame		•	

Bit errors are not accumulated during the period that any alarm is present.

Alarm and status seconds:

Alarm and status	DS3	DS2	DS1	E1
LOS	•	•	•	•
FFM	•			
OOF	•	•	•	
Pattern sync	•		•	•
AIS	•		•	•
Yellow	•	•	•	
COFA			•	
EXZ	•		•	•
Signal present	•		•	•
M23 frame	•			
C-bit frame	•			
X-bit	•	•		
Idle	•			
SF sync			•	
ESF sync			•	
B8ZS valid			•	
HDB3 valid				•

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Bit errors are not accumulated during the period that any alarm is present.

Alarm and status seconds

Alarm and status seconds	DS3	DS1	E1
LOS sec	•	•	•
AIS sec	•	•	•
Idle sec	•		
OOF sec	•	•	
PSL sec	•	•	•
Yellow sec		•	
COFA sec		•	

Signal measurements

On both the DS3 and DS1 inputs.
Received signal level, peak voltage (± 5%); received signal level referenced to DSXn level (± 1 dB).

Status indicators

Generic indicators: Failed, VXI control bus error, VXI bus access, and gating.

Signal indicators
DS3: Signal, OOF, pattern sync loss, errors.
DS2: OOF.
DS1/E1: Signal, OOF (DS1 only), AIS, pattern sync loss, errors.

VXIbus characteristics:

Device type: Message based.
VXIbus backplane connectors: P1 and P2 (as defined in VXIbus Specification Rev 1.3)
Local bus connection: None.
Module keying: None.

Physical

Size: 2 slot, C-size.
Weight: 2.04 kg (nominal).

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Power Requirements

Maximum current drawn from VXIbus dc voltage rails:

Volts dc	Current dc	Dynamic current	Fuse Rating
+5 V	3.3 A	300 mA	5 A
+12 V	2.5 mA	25 mA	16 A
-12 V	10 μA	1 μA	16 A
-5.2V	300 mA	30 mA	5 A
-2 V	20 mA	2 mA	16 A

The power rails are fused with non-operator replaceable Axial Leaded, Fast Blow fuses as above with a 125 V rating.

Power dissipation: 41 W (nominal).

Cooling Requirements

For 10°C rise 4.5 liters/second 0.2 mm H_20

Environmental

Operating temperature: 0 to 55 °C.
Storage Temperature: -40 to +70 °C.
Humidity: 95% RH to 40 °C.
EMC: Meets CISPR11 Level A and EN55011.

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B

Error Messages

This appendix lists module specific and SCPI error messages. The error messages are listed in numerical order.

Error Reporting

When an error occurs, the module's error indicator lights and an error message is stored in the module's internal error queue. To access the message depends on how the module is controlled:

- If you are using SCPI commands, the message can be read using the `SYSTem:ERRor?` command.
- If you are using the Windows/HP ITG panels, the message can be viewed by clicking the mouse on the `Error Number` button on the `Other` subpanel.

It is recommended that error messages are read from this queue as they occur, since the error condition may affect the integrity of a measurement.

Up to 30 error messages can be held in the queue. Messages are read on a first-in first-out basis; when a message is read it is removed from the queue. If the error queue becomes full and another error condition is detected, the last entry in the queue is replaced with error message −350, "Queue overflow". No more errors are recorded while this condition exists.

If no error messages reside in the error queue, the message +0, "No error" is returned to an error queue inquiry.

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Error Numbers

Error messages are grouped into several classes, where each class is allocated a range of error numbers as shown in the table below. These numbers can be positive (+) or negative (−). Positive numbers represent module specific errors; negative numbers represent general Standard Commands for Programming Instruments (SCPI) errors.

Error Type	Error No. Range	Error Class
Module Errors	1 to 32767	Indicates that an error has been detected in the module.
Command Errors	−100 to −199	Indicates that an IEEE 488.2 syntax error has been detected by the module's parser.
Execute Errors	−200 to −299	Indicates that an error has been detected in the module's execution control block.
Device Specific Errors	−300 to −399	Indicates that the module has detected an error which is not a command error, execute error, or query error.
Query Errors	−400 to −499	Indicates that the output queue control of the module has detected a problem with the message exchange protocol.

+VE Numbered Errors

There are no positive numbered errors specified for the HP E1686A.

-VE Numbered Errors

These are listed on the following pages.

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Negative Numbered Errors

Error N°.	Error Message	Error Description
0	"No error"	No error/event in error/event queue.
−100	"Command error"	This is the generic syntax error for devices that cannot detect more specific errors.
−101	"Invalid character"	A syntactic element contains a character which is invalid for that type.
−102	"Syntax error"	An unrecognized command or data type was encountered.
−103	"Invalid separator"	The parser was expecting a separator and encountered an illegal character.
−104	"Data type error"	The parser recognized a data element different than that allowed.
−105	"GET not allowed"	A group execute trigger (GET) was received within a program message.
−108	"Parameter not allowed"	More parameters were received than expected for the header.
−109	"Missing parameter"	Fewer parameters were received than required for the header.
−110	"Command header error"	An error was detected in the header.
−111	"Header separator error"	A character which is not a legal header separator was encountered while parsing the header.
−112	"Program mnemonic too long"	The header contains more than 12 characters.
−113	"Undefined header"	The command is syntactically correct, but it is undefined for this specific device.
−114	"Header suffix out of range"	The value of a numeric suffix attached to a program mnemonic makes the header invalid.
−120	"Numeric data error"	An error was detected when parsing a data element which appears to be numeric, including the nondecimal numeric types.
−121	"Invalid character in number"	An invalid character for the data type being parsed was encountered.
−123	"Exponent too large"	The magnitude of the exponent was larger than 32000.
−124	"Too many digits"	The mantissa of a decimal numeric data element contained more than 255 digits, excluding leading zeros.
−128	"Numeric data not allowed"	A legal numeric data element was received, but the device does not accept one in this position for the header.
−130	"Suffix error"	An error was detected when parsing a suffix.
−131	"Invalid suffix"	The suffix does not follow the syntax, or the suffix is inappropriate for this device.
−134	"Suffix too long"	The suffix contained more than 12 characters.

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Negative Numbered Errors (continued)

Error No°.	Error Message	Error Description
−138	"Suffix not allowed"	A suffix was encountered after a numeric parameter which does not allow suffixes.
−140	"Character data error"	An error was detected when parsing a character data element.
−141	"Invalid character data"	Either the character data element contains an invalid character, or the particular element received is not valid for the header.
−144	"Character data too long"	The character data element contained more than 12 characters.
−148	"Character data not allowed"	A legal character data element was encountered where prohibited by the device.
−150	"String data error"	An error was encountered when parsing a string data element.
−151	"Invalid string data"	A string data element was expected, but was invalid for some reason.
−158	"String data not allowed"	A string data element was encountered but was not allowed by the device at this point in parsing.
−160	"Block data error"	An error was encountered when parsing a block data element.
−161	"Invalid block data"	A block data element was expected, but was invalid for some reason.
−168	"Block data not allowed"	A legal block data element was encountered but was not allowed by the device at this point in parsing.
−170	"Expression error"	An error was encountered when parsing an expression data element.
−171	"Invalid expression"	The expression data element was invalid.
−178	"Expression data not allowed"	A legal expression data was encountered but was not allowed by the device at this point in parsing.
−180	"Macro error"	An error was encountered when defining a macro or executing a macro.
−181	"Invalid outside macro definition"	A macro parameter placeholder ($<number>) was encountered outside a macro definition.
−183	"Invalid inside macro definition"	The program message unit sequence, sent with a `*DDT` or `*DMC` command, was syntactically invalid.
−184	"Macro parameter error"	Indicates that a command inside the macro definition had the wrong number or type of parameters.
−200	"Execution error"	This is the generic syntax error for devices that cannot detect more specific errors.
−211	"Trigger ignored"	A group execute trigger (GET), `*TRG`, or triggering signal was received and recognized by the device but was ignored because of device timing considerations.
−212	"Arm ignored"	An arming signal was received and recognized by the device but was ignored.

B-4 Error Messages

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Negative Numbered Errors (continued)

Error N°.	Error Message	Error Description
−213	"Init ignored"	A request for a measurement initiation was ignored as another measurement was already in progress.
−214	"Trigger deadlock"	The trigger source for the initiation of a measurement is set to group execute trigger (GET) and subsequent measurement query is received.
−215	"Arm deadlock"	The arm source for the initiation of a measurement is set to group execute trigger (GET) and subsequent measurement query is received.
−220	"Parameter error"	A program data element related error occurred.
−221	"Settings conflict"	A legal program data element was parsed but could not be executed due to the current device state.
−222	"Data out of range"	A legal program data element was parsed but could not be executed because the interpreted value was outside the legal range.
−223	"Too much data"	A legal program data element of block, expression, or string type was received that contained more data than the device could handle due to memory or related device-specific requirements.
−224	"Illegal parameter value"	The numeric value specified is not allowed.
−230	"Data corrupt or stale"	Possibly invalid data; new reading started but not completed since last access.
−231	"Data questionable"	Measurement accuracy is suspect.
−240	"Hardware error"	A legal program command or query could not be executed because of a hardware problem in the device.
−241	"Hardware missing"	A legal program command or query could not be executed because of missing device hardware.
−250	"Mass storage error"	A mass storage error occurred.
−251	"Missing mass storage"	A legal program command or query could not be executed because of missing mass storage.
−252	"Missing media"	A legal program command or query could not be executed because of missing media.
−253	"Corrupt media"	A legal program command or query could not be executed because of corrupt media.
−254	"Media full"	A legal program command or query could not be executed because the media was full.
−255	"Directory full"	A legal program command or query could not be executed because the media directory was full.
−256	"File name not found"	A legal program command or query could not be executed because the file name on the device media was not found.
−257	"File name error"	A legal program command or query could not be executed because the file name on the device media was in error.

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Negative Numbered Errors (continued)

Error N°.	Error Message	Error Description
−258	"Media protected"	A legal program command or query could not be executed because the media was protected.
−260	"Expression error"	An expression program data element related error occurred.
−261	"Math error in expression"	A syntactically legal expression program data element could not be executed due to a math error.
−270	"Macro error"	A macro-related execution error occurred.
−271	"Macro syntax error"	A syntactically legal macro program data sequence could not be executed due to a syntax error within the macro definition.
−272	"Macro execution error"	A syntactically legal macro program data sequence could not be executed due to some error in the macro definition.
−273	"Illegal macro label"	The macro label defined in the `*DMC` command could not be accepted by the device.
−274	"Macro parameter error"	The macro definition improperly used a macro parameter placeholder.
−275	"Macro definition too long"	A syntactically legal macro program data sequence could not be executed because the string or block contents were too long for the device to handle.
−276	"Macro recursion error"	A syntactically legal macro program data sequence could not be executed because the device found it to be recursive.
−277	"Macro redefinition not allowed"	A syntactically legal macro label in the `*DMC` command could not be executed because the macro label was already defined.
−278	"Macro header not found"	A syntactically legal macro label in the `*GMC?` query command could not be executed because the header was not previously defined.
−280	"Program error"	A downloaded program-related execution error occurred.
−281	"Cannot create program"	An attempt to create a program was unsuccessful.
−282	"Illegal program name"	The name used to reference a program was invalid.
−283	"Illegal variable name"	An attempt was made to reference a non-existent variable in a program.
−284	"Program currently running"	Certain operations dealing with programs may be illegal while the program is running.
−285	"Program syntax error"	A syntax error appears in a downloaded program.
−286	"Program runtime error"	A program runtime error has occurred.
−300	"Device-specific error"	This is the generic device-dependent error for devices that cannot detect more specific errors.
−310	"System error"	An error, termed "system error" by the device, has occurred.

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Negative Numbered Errors (continued)

Error N°.	Error Message	Error Description
−311	"Memory error"	An error was detected in the device's memory.
−312	"PUD memory lost"	The protected user data (PUD) saved by the `*PUD` command has been lost.
−313	"Calibration memory lost"	The non-volatile calibration data used by the `*CAL?` query command has been lost.
−314	"Save/recall memory lost"	The non-volatile data saved by the `*SAV?` query command has been lost.
−315	"Configuration memory lost"	The non-volatile configuration data saved by the device has been lost.
−330	"Self-test failed"	The self-test has failed.
−350	"Queue overflow"	The error queue is full as more than 30 errors have occurred.
−400	"Query error"	This is the generic query error for devices that cannot detect more specific errors.
−410	"Query INTERRUPTED"	Data was not read from the output buffer before another command was executed.
−420	"Query UNTERMINATED"	A command that generates data was not able to finish executing due to a configuration error.
−430	"Query DEADLOCKED"	Command execution cannot continue because the mainframe's command input and data output buffers are full. Clearing the instrument restores control.
−440	"Query UNTERMINATED after indefinite response"	A query was received in the same program message after a query requesting an indefinite response was executed.

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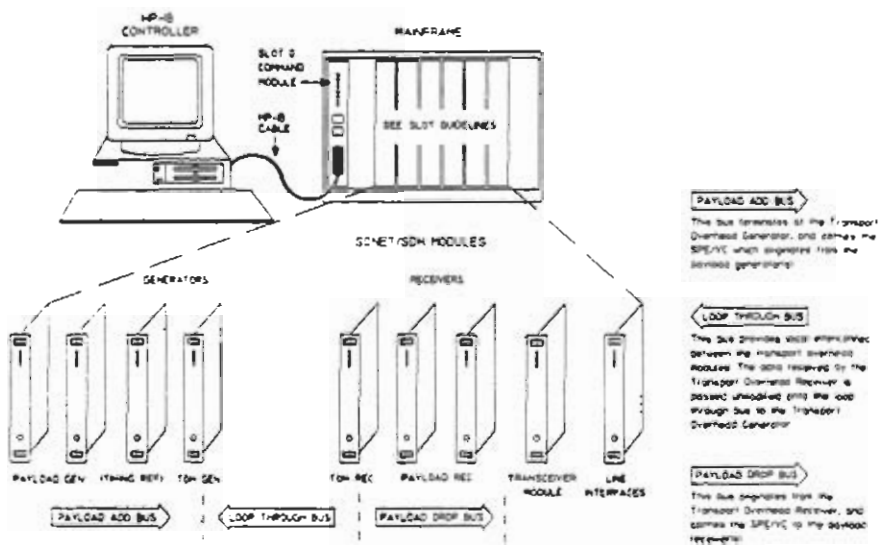
Using the HP E1686A in the HP 75000 Series 90 System

Overview

The HP E1686A DS1/DS3 transceiver can be used in the HP 75000 Series 90 System - a VXI C-size modular system. The elements that make up the system are listed below:

- HP-IB Controller
- Mainframe
- Slot 0 Command Module
- SONET/SDH Modules
- Three Intermodule Buses

The following diagram shows the relationship between the above elements:



Slot Guidelines

The relative positioning of the modules within the Mainframe is shown above. The slot guidelines which must be observed are as follows:

- The Transport Overhead Generator module must be to the left of the Transport Overhead Receiver with no vacant slots between them.
- All generators must be to the left of the Transport Overhead Generator with no vacant slots between them.
- If a Timing Reference is part of the system, it must be positioned between the Transport Overhead Generator and right-most payload generator.
- All receivers must be to the right of the Transport Overhead Receiver with no vacant slots between them.
- If a transceiver module is part of the system, it must be to the right of any receiver module.
- By convention, Line Interfaces are positioned to the right of all other modules.
- Other VXIbus modules must not be located immediately next to any Series 90 generator or receiver.

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Controller/Module Communication

To enable the HP-IB Controller to communicate with modules in the Mainframe, commands are first applied to an HP-IB/VXIbus Interface contained on the Slot 0 Command Module. The commands are then passed along the Mainframe's VXIbus backplane, and routed to specific modules using commander/servant module addressing; for more information on *Addressing* see below.

Commanders and Servants

A "commander" is a message-based module which can control up to 7 "servant" modules. Servant modules are normally register-based.

Addressing

The addressing used in the Series 90 System is outlined in the following table:

Element	Comments
Controller	Assigned an HP-IB interface select code - normally 7.
Slot 0 Command Module	a. Assigned an HP-IB primary address - normally 9. b. Assigned a VXIbus logical address - normally 0.
Commander	a. Assigned a VXIbus logical address - its value must be a multiple of 8, and is set using switches located on the module. The commander's HP-IB secondary address is derived from the logical address by dividing the logical address value by 8. b. Assigned a VXIbus servant area - its value is set by a second series of switches located on the module, and defines the number of servants that the commander can control. Normally, the servant area value is set to 7.
Servant	Assigned a VXIbus logical address - its value must fall within the following two boundaries: the first boundary is defined by adding 1 to its commander's logical address, the second boundary is defined by adding together the commander's servant area value and logical address value. *For example, if a commander has a logical address of 24, and a servant area of 7, the servant area address range is 25 through 31.* Note that the servant area address range must not include commander modules.

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Programming Using HP VEE

HP VEE allows you to quickly develop simple application programs which involve interaction with the HP 1686A and other modules. Larger, more complex applications can also be developed provided the techniques recommended in this appendix are applied.

HP VEE also provides various ways to programme your application depending on the size of your system, and the type of tests you are running.

Before programming, it is recommended that you review Section 5 of the *"Using HP VEE-Engine and HP VEE-Test"* Manual. This section provides general guidelines on the use of HP VEE with instrumentation which also applies to this module.

Controlling Modules

HP VEE interacts with each module via two instrument drivers:

- **State Drivers**

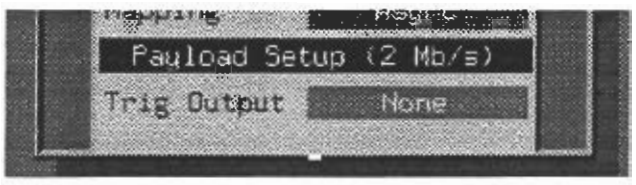
  State drivers correspond very closely to the HP ITG component drivers described in Chapters 3 and 4 of this manual. When active, the state driver controls all module settings. Using state drivers allows easy access to all functions in the module (with the exception of system control components), but makes the model very large if used for all interactions with the hardware throughout the test. When initially developing the test, state drivers can be useful for investigating the best way to perform a particular test or function since they provide full control and status reporting for the module-under-test.



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■ **Component Drivers**

Component drivers provide access to single components in a module. Once a test application has been developed, it is recommended that any state drivers are replaced with component drivers. The design of the control structure may contribute a larger overhead to the development of the application as all components must be controlled individually. This, however, is compensated for by the reduction in time to load libraries and the re-use of common control code.



Using State Drivers

Selecting a State Driver Object

Select **Instrument** from the **I/O** menu. A menu of available instruments is displayed. Select the instrument you want and click on the **State Driver** button. The state driver is displayed with the default subpanel (usually Setup) and default values of all components.

Adding Components to State Drivers

A state driver actively controls the module provided:
(a) a module state driver panel is displayed in an HP VEE window
(b) there is an HP-IB connection to the system
(c) the modules are powered up

All functions of a module are provided by components. The state of the function depends on the current value of the component. Clicking on a button in a state driver causes a component (or several components) to be activated, and allows the value of the visible component to change. If a component is added to a driver (either state driver or component driver), it has the same action as when activated by clicking on the equivalent button. The value of the component is sent as an input to the component, that is, a data object of the appropriate type is connected to the component input terminal.

Added components are only activated when the driver object is activated. Once activated, they overwrite the current component value with the value input to the added component. Any status component will also be updated on the displayed panel when the state driver object is activated. Components can be added to state drivers in three ways:

■ **Using the Object Menu and Button**

Click on the left hand button while pointing at the driver object to display the object menu. Select **Add Terminals/Select Input Component** or select **Add Terminals/Select Output Component.** You are prompted to select the component field for the terminal. Click on the field or button you want to add the component for. The appropriate component is added.

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- **Using the Object Menu**

  Click on the left hand button while pointing at the driver object to display the object menu. Select **Terminals/Add Data Input** to display the list of available input components, or **Terminals/Add Data Output** to display the list of available output components. Select the component you want to add from the list and click on OK.

- **Using the Object Open View**

  Open the driver object and place the mouse cursor over the left hand border (for input) or the right hand border (for output) and press Ctrl-A. The list of available components is displayed. Select the component you want to add from the list and click on OK.

Deleting Components from State Drivers

Open the driver object and place the mouse cursor over the component you want to delete (left hand border for input, or right hand border for output) and press Ctrl-D. The component is removed.

Using Component Drivers

Selecting a Component Driver Object

Select **Instrument** from the **I/O** menu to display the menu of available instruments. Select the appropriate instrument, then click on the **CompDriver** button. The component driver is displayed with the module number shown. To activate a component driver, either an input or an output component terminal must be added to the component driver object.

Adding an Input or Output Terminal

There are two ways of adding terminals to a component driver:

- **Using the Object Menu**

  Click on the component driver object with the right hand mouse button to reveal the menu. Select **Terminals/Add data input** or **Terminals/Add data output**. A menu of available components is displayed in either case for adding to the component driver.

- **Using the Open View**

  Double click on the component driver object to open it. To add an input component, point to the left hand terminal area and type CTRL-A. A menu of available input components is displayed for adding. To add an output component, point to the right hand terminal area and type CTRL-A. A menu of available output components is displayed for adding.

Adding Extra Components

It is possible to add several components, both input and output, to the same driver. The procedure for adding more components is the same as for adding the first. HP VEE executes the components in the order in which they are added. If any of the component actions is time critical or must be executed in a particular order they must be added in the correct order.

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Building Tests

It is assumed that you have access to the HP VEE programming manuals listed below and are familiar with the terminology used in HP VEE.

- Using HP VEE-Engine and HP VEE-Test
- HP VEE-Engine and HP VEE-Test Reference

You should also be familiar with the module's use and functions.

Test Structure

To create a test function, first determine the sequence of events you want to take place in the tests. For example, you might want to:

1. Set up signal structure and channel if appropriate.
2. Establish a known good signal and check that no errors or alarms are present.
3. Apply an error, alarm or other stimulus to the signal.
4. Check that an appropriate response is present in the signal.

This cycle can be repeated in a test with several stages with different stimuli being applied.

Setting Measurement Parameters

An appropriate signal type must be set up before a test is run. Although the modules will operate with default values of all parameters, consider:

- Which mode of operation is to be used?
- Which network element configurations will the test be applied to?
- What line rates are to be used?
- Which channel?
- What stimulus is to be applied?
- What response do you expect under normal error free operation?
- What response is to be tested for?

Many parameter options are dependant on other parameter settings, therefore, some care is needed to ensure that the signal parameters are set up correctly. In the final model, any parameter which does not take its default value must be set by applying the correct input values to the component driver. While developing the test, it is useful exploring the mode of operation of the system using a state driver to control signal parameters until the correct component driver states have been identified. This allows the effect of parameter settings (and the effect of the test) to be observed to ensure correct operation.

For the next stage, components can be added one at a time and their operation observed. However, when you add a component using the method described above, it will not be activated until the model is started (for example, using a start object). Values displayed on the panel are updated when the model is being run.

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Creating Test Prototypes

Using State Drivers for Prototyping Tests

1. Select **Instrument** from the **I/O** menu and select the instrument from the displayed list then click on **state driver.**
2. Repeat until all modules in the system have state drivers displayed. (This may be a group or a single module)
3. Set up the required signal and check that the modules interact as expected. (Detailed descriptions of the various functions and options are given in Chapter 3.)
4. Identify the ITG component associated with the field you want to set in the state driver as follows:
   (a) Click on the state driver object with the right mouse button to bring up the object menu
   (b) Select **Add Terminals/Select Input Component**
   (c) Click on the state driver field and an input component will be added to the state driver. An output component may be added in the same way using **Add Terminals/Select Output Component**

The same component added to a component driver has the same effect as activating the field (button) on the state driver.

Running Prototype Tests with State Drivers

Your initial prototype HP VEE model can contain only state driver objects. These can be replaced partly or wholly by component drivers. State drivers communicate with the instrumentation any time a button is clicked; the settings shown on the panels indicate how the instrument is configured. All modules involved in the test should be set up, via the panels, with the parameter values to be used in your test. The effect of the test can be observed to ensure correct operation.

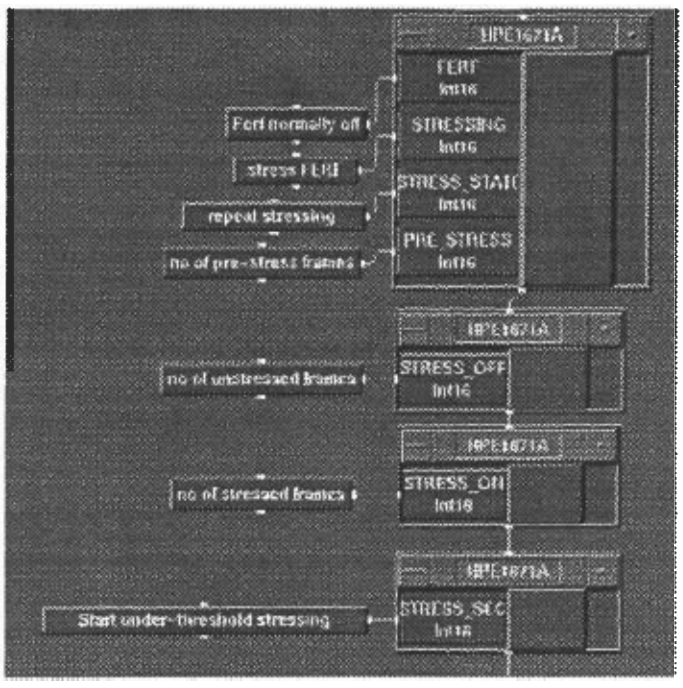
For the next stage, components can be added one at a time and their operation observed. However, when you add a component using the method described above, it will not be activated until the model is started (for example, using a start object). Values displayed on the panel are updated when the model is dynamic.

Constraints in Sequencing and Timing

Many actions which a module performs involve activating several components. For example, component A may need to be set to a particular value before component B will function correctly. If both components are added to the same driver object, the component which is added first is executed first (this is displayed at the top of the terminal area). Hence, any components added later automatically go to the end of the queue and are executed last. To ensure correct sequencing, components may need to be added to separate driver objects and the objects sequenced. Alternatively, existing components must be deleted and all components added in the correct order of execution. The use of multiple state driver objects in a model can make the model very large and should be avoided if possible.

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As with all real time applications, a particular command or measurement may take a significant time to execute. A useful technique in this case is to use separate driver objects for each component (or set of components) which slows execution or allows delay objects to be introduced between component drivers. Again, the large model size will restrict the use of this technique with state drivers.



Creating the Test Function using Component Drivers

Prototype tests using state drivers allow you to investigate the action of functions provided by the modules, and to identify the components which access the required functions. The test can be constructed by selecting component driver objects for the required modules, and adding the relevant components. The objects are then built in to the complete test model. It is more efficient to add as many components as possible to one driver as there is relatively insignificant overhead in calling extra driver objects. This allows for greater flexibility and control of sequencing and timing.

Building the HP VEE model around the instrumentation control follows the same guidelines as creating any other HP VEE model. The main priorities are to keep the model to a manageable size and to allow easy maintenance, testing and development. There are a number of techniques that can be used to reduce the size of the model without reducing its functionality, thereby helping you develop and maintain the model. These are described in the following section "Programming Guidelines".

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Programming Guidelines

Keeping Your Model View to a Manageable Size

The arrangement of objects on the screen does not affect how the model is executed. This is controlled by the connections between data and sequence terminals. If a model is awkwardly displayed, it may be difficult to follow how the model has been built, making maintenance and further development prone to error. Ideally, it should be possible to view the whole of your model on one screen to allow the logic of the model to be seen clearly. In addition:

- **Close all objects down to icons**

  Reduces size of the object on the screen and allows interconnection to be viewed more clearly. To do this:

  1. Click on the button on the top right hand corner of the object using the left mouse button. For a user object, two buttons are displayed. The minimize button is the left of the pair.
  2. Move the object to a suitable position.

- **Minimize icon size (while still allowing any title to be seen clearly)**

  All objects can be sized. Make groups of similar objects the same size if, for example, they follow in a sequence. Titles of objects should be visible, but icon size should be minimized within these constraints. To do this:

  1. Close the object down (see above) and position the object so that the top left hand corner is correctly placed.
  2. Click on the object using the rigbt mouse button to bring up the object menu and select `Size`.
  3. Position the displayed corner symbol where the bottom left hand corner of the object is to be and click on the left mouse button.

- **Remove any unnecessary bitmaps**

  Some objects have bitmaps associated with them (formula boxes are a good example) which are visible when objects are closed. Unless the bitmap is directly relevant to the purpose of the object, bitmaps can be removed to reduce the size of the closed view, and clarify the model interconnections. To do this:

  1. Click on the closed object using the right mouse button to bring up the object menu
  2. Select `Layout/Delete BitMap`.

- **Avoid placing objects so that connecting threads follow a complex route**

  If connected objects are not adjacent to each other, connecting lines generally follow a complex route. This may be impossible to avoid, but try arranging the objects in your model view so that most connected objects are adjacent.

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Using Formula Objects

Formula objects can be used in place of other types of object. In particular, function calls may be made from within a formula. There are several advantages to this technique:

- The model view becomes less cluttered
- The number of objects required is reduced
- The amount of memory required is significantly reduced
- The model will execute quicker

Calling a Function from a Formula Object

■ **Opening a Formula Object**

1. From the Math menu, select Formula to retrieve a formula object.
2. Type the name of the function into the formula object.

   Enclose any input parameters in brackets. Parameters must be listed in the order they have been placed in the function definition, from top to bottom. If there are no input parameters, empty brackets must be typed after the function name.
3. Add input terminals to the formula object for all input parameters.

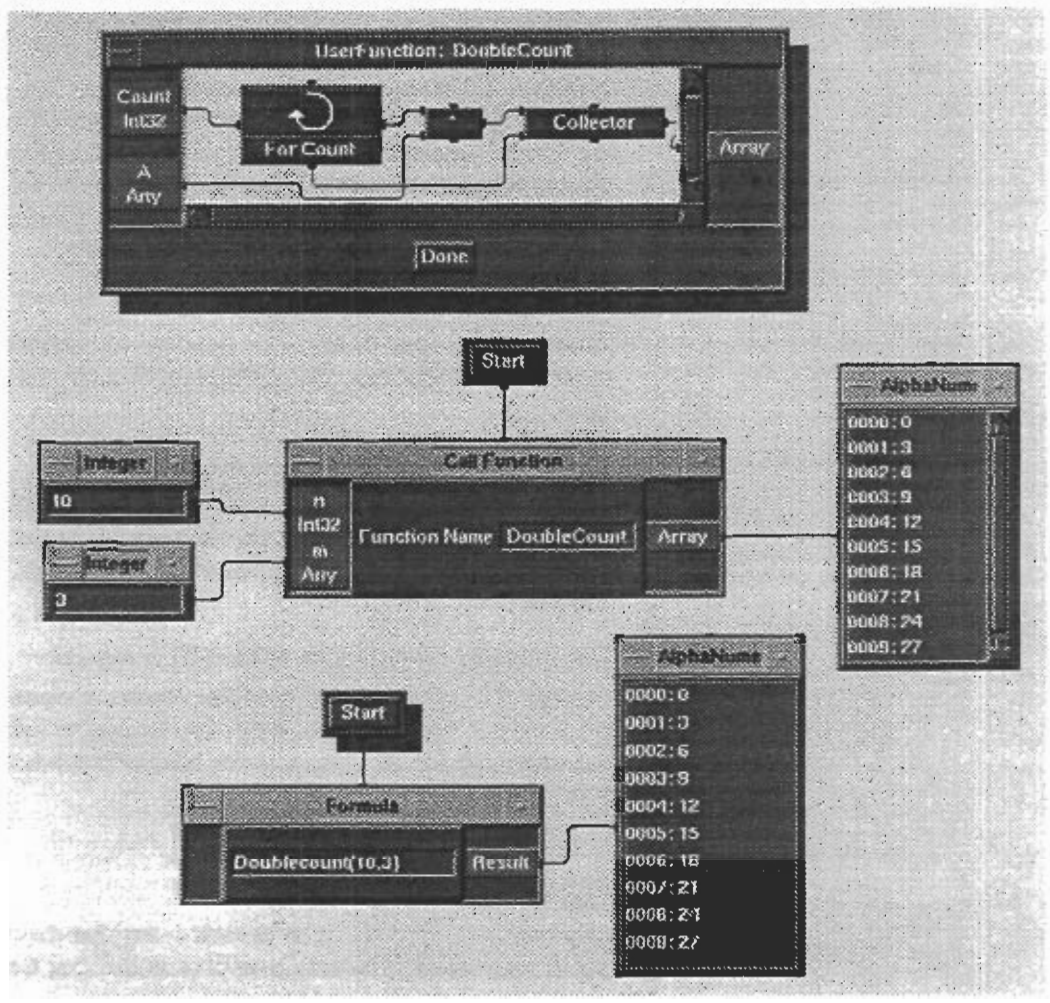
   If there are no input parameters, any existing input terminals must be removed. Unconnected inputs are not allowed.

Any result of executing the function is sent to the Result output of the formula object. Note that only functions with a single output result can be used in this way as there is no way to differentiate between more than one result.

Most functions require inputs which in a normal function call are represented as terminal pins. For example, a function which outputs all numbers between 0 and `n`, and multiplied by `m`, needs two inputs `n` and `m`. Having created a suitable function DoubleCount, you could call it using a call function object.

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Alternatively, you can call the same function from within a formula object. In this case, there is no need for input terminals and data objects to provide the input values. These are supplied as parameters of the function.



■ **Complex Expressions within a Formula Object**

Any combination of legal mathematical expressions, operators and functions can be used within a formula object. For example,

(Function1(A,B)+Function2(C,D)) or Function(A,B)? 1: 0

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Optimizing on Execution Time

- **Process data as an array**
  HP VEE can process data in any data shape, allowing complete arrays to be input to other objects. Also, it is not necessary to iterate through each element of the array since the array is processed as a whole. Where possible, this property should be used and array data should be processed in parallel (that is, if you want to perform an operation on every element of the array, operate on the array as a whole). When large sets of data or ranges of values have to be processed in the same way, data should first be stored in an array and processed in parallel. Processing as an array is much faster than processing each element individually.

- **Use icons instead of open views**
  Closing down open views where possible will avoid having to update any displays and significant time saving can be achieved while running a model.

- **Reduce the number of objects to a minimum**
  The fewer objects contained in the model the faster the model will run. Perform as many functions as possible in each object, maximizing on the use of formula objects (see above). In particular, nest functions in formula objects.

- **Use multiple conditions in If/Then/Else objects**
  Instead of using several If/Then/Else objects, use one object with multiple conditions. Conditional boxes can also be used to call functions. Alternatively, formula boxes can be used with triadic operators to perform conditional tests.

Using Libraries

Where possible, write functions in such a way that they can be used many times in your model. Similarly, user objects and user functions can be used many times if they are stored in suitable libraries.

Minimizing Memory Usage

The larger the size of a model, the longer it takes to load and run. As your application develops with more libraries being added to the system, significant delays will occur in loading and reloading software in the event of repeating tests.

To minimize memory usage:

- **Minimize the number of layers in a function**
  Avoid creating user objects which contain only a few objects.

- **Minimize the number of objects**
  If possible, replace several objects with a single formula object, especially when making function calls. See "Using Formula Objects" above.

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■ **Use global variables efficiently**

Keep the number of global variable names to a minimum in an application by re-using them within and between libraries. Where possible, store several variables in a record structure. Allocation of memory for storage of global variables causes fragmentation of the usable memory and slows retrieval.

Other Guidelines

- Observe order of execution. Unconnected objects are fired immediately after starting the model and may not have been initialized correctly.
- Null containers are produced by, for example, collectors, or when the Xq terminal is fired. This can cause a thread to be activated when no data has been sent.
- Use generic functions where possible.
- Use meaningful titles for every object to improve the readability of any model you create. Keep titles as short as possible to allow the model to be viewed on the screen, but ensure they contain enough information to describe its purpose. Because of its graphical nature, it is not possible to comment code in HP VEE as in other languages.

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