T1 Tester

OPERATING AND CALIBRATION MANUAL

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 3126U and/or with firmware revision number 3127. To check the firmware revision number of your instrument, press (AUX) and select OPTIONS.

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HEWLETT PACKARD

HP Part No. 37701-90006
Microfiche Part No. 37701-90031
Printed in U.K. June 1991

WARNING

READ THE FOLLOWING NOTES BEFORE INSTALLING OR SERVICING ANY INSTRUMENT.

1. IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER MAKE SURE THAT THE COMMON TERMINAL OF THE AUTO-TRANSFORMER IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.

2. THE INSTRUMENT MUST ONLY BE USED WITH THE MAINS CABLE PROVIDED. IF THIS IS NOT SUITABLE, CONTACT YOUR NEAREST HP SERVICE OFFICE. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING). * BEFORE SWITCHING ON THIS INSTRUMENT:

   a. Make sure the instrument input voltage selector is set to the voltage of the power source.

   b. Ensure that all devices connected to this instrument are connected to the protective (earth) ground.

   c. Ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient).

   d. Check correct type and rating of the instrument fuse(s).

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility and to the calibration facilities or other International Standards Organization members.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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EMC COMPLIANCE

This product has been tested and complies with FTZ 1046 when used with the following cables:

Cable	HP Part Number
Weco 310	15513A E01
15 pin D	15707A E01
RS-232/V.24	15714A E01

PRINTING HISTORY

The Printing History shown below lists all Editions and Updates of this manual and the printing date(s). The first printing of this 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 1 (37701-90000)	December 1990
Update 1 (37701-90002)	February 1991
Edition 2 (37701-90006)	June 1991

WARNINGS

WARNING: Risk of electric shock

Ensure repeater power is switched off before connecting or disconnecting connectors. Voltages up to ±130 V dc may be present on telephone lines.

AVERTISSEMENT : Risque de choc electrique

Toujours couper l'alimentation du repetiteur avant de brancher ou de debrancher des connecteurs. La tension de la ligne telephonique peut atteindre ± 130 V cc.

WARNING

The instrument must be connected to the protective ground via the power cord or the ground terminal provided at any time that there is a connection to the instrument front panel.

WARRANTY

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environment specifications for the products, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Contents

3. T1 Testing

1

Getting Started

This chapter tells you about the basic features of the instrument and shows you how to use them. The items covered are:

- Switching on
- Setting the T1 Tester to a known state
- Returning to the basic measurement display
- Setting up a measurement
- Making a measurement
- Adding transmit errors
- Observing alarm indications
- Displaying an alarm record
- Displaying basic results and full results
- Adding transmit errors at a fixed rate
- Displaying received signal details
- Displaying a time related alarm record
- Sending line (CSU) loopcodes
- Displaying all error types together

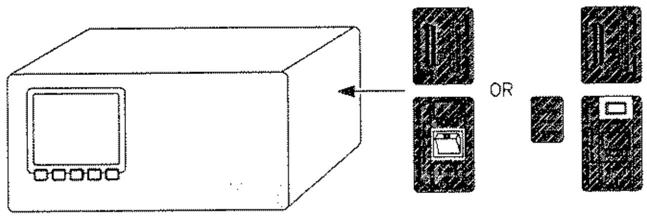
Before Getting Started

Ensure that there are no cables connected to the instrument front panel. Connect the instrument to a power supply of between 85 V ac and 264 V ac. If in doubt see "Installation" in chapter 7.

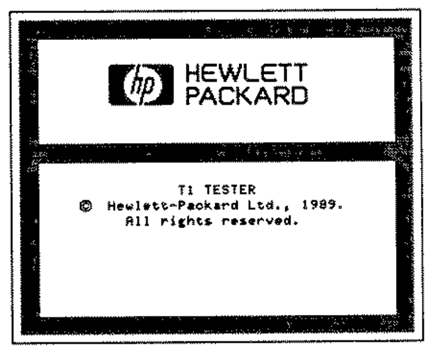
Getting Started

Switch On

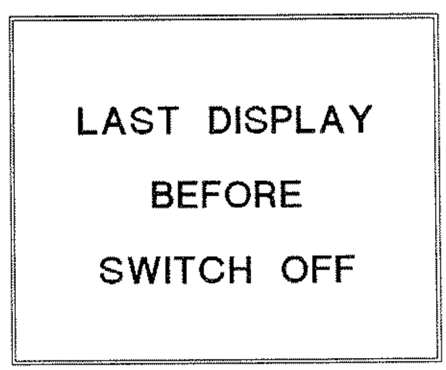
Switch on.



You should see.



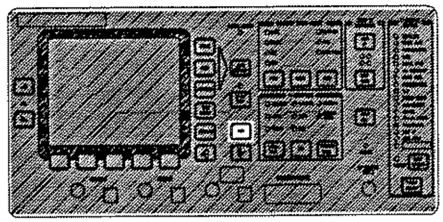
Followed by.



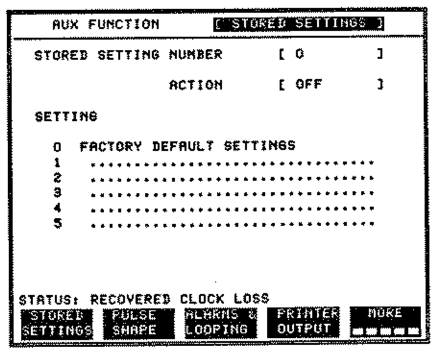
If the T1 Tester is part of a combined T1/Datacom Test Set, set the Datacom module TEST SELECT to T1.

To Set the T1 Tester to a Known State

The T1 Tester can store 1 fixed and 5 user selectable test set-ups.
You are going to recall the fixed set-up.
Press (AUX)

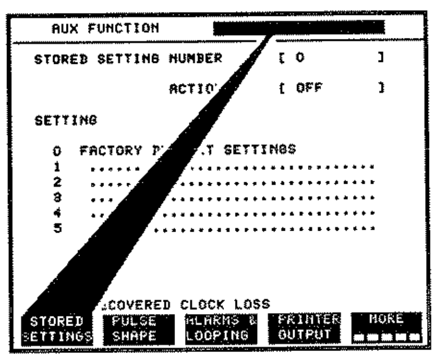


You should see one of the AUX FUNCTION displays with AUX FUNCTION highlighted.

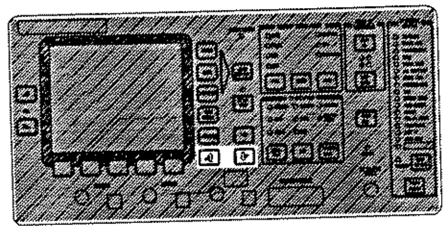


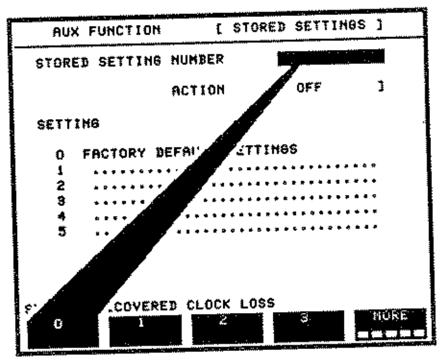
Select STORED SETTINGS

NOTE :
The instrument starts up in the "last used" state. Some of the settings in this procedure may already be selected.



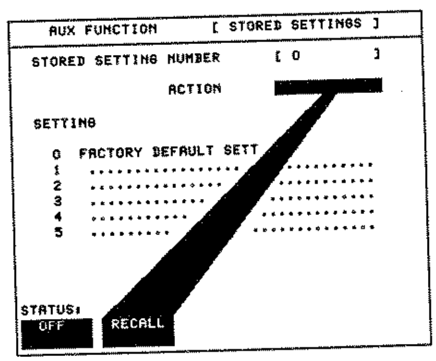
Use ⇩ and ⇧ to highlight STORED SETTING NUMBER [ ]





Select 0.

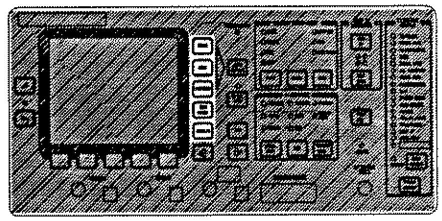
0 is the fixed stored setting.



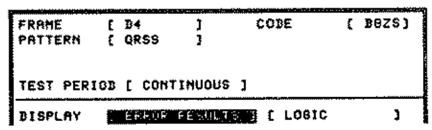
Highlight ACTION [ ].
Select RECALL.

To Return to the Basic Measurement Display

Any measurement set-up key will get you to the basic measurement display. In this case, Press (RESULTS).



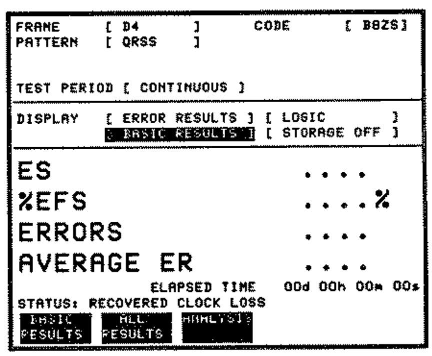
You should see.



To Set Up the Measurement

Set the display to:

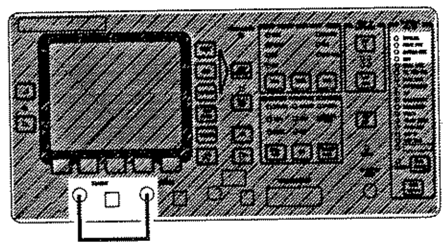
DISPLAY
[ERROR RESULTS] [LOGIC]
[BASIC RESULTS] [STORE OFF].



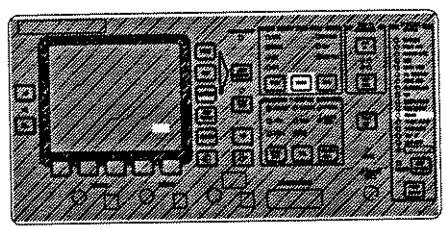
To Loop Transmit/Receive and Make a Measurement

Connect

TRANSMIT to RECEIVE
with a WECO 310 cable. Check that received data is correct (green indicators on).

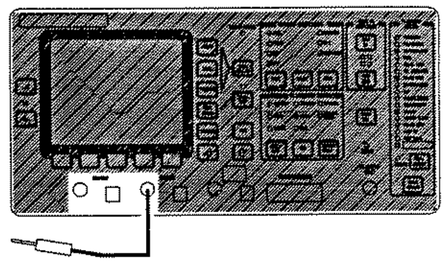


Watch the ERRORS indicator flash and the results display accumulate errors when you press TRANSMIT ERROR INSERT (SINGLE) a few times.

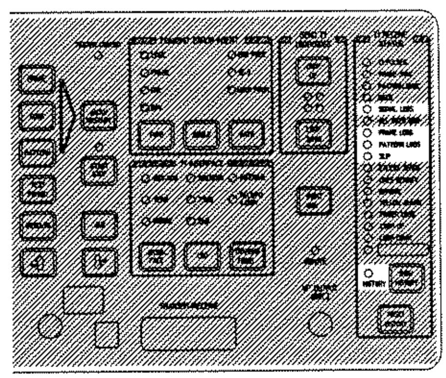


To See Alarm Indicator Operation

Break the signal path.



You should see the alarm indication for the current situation.



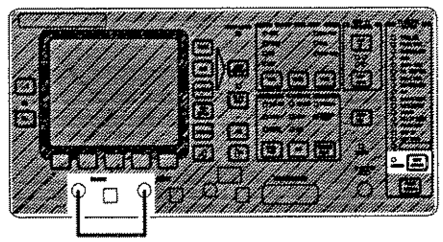
To See an Alarm Record

Reconnect the signal path.

As alarms have occurred in the current test, you should see the HISTORY indicator on.

Press [SHOW HISTORY] to see what they were.

You can use this to check for the occurrence of alarms on unattended tests.

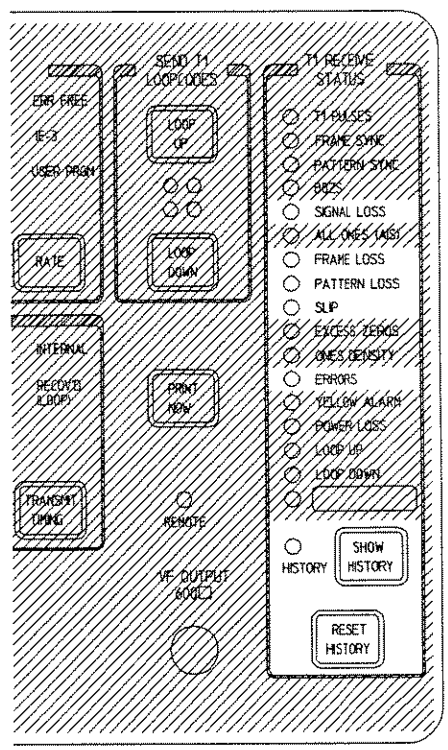


The display is frozen but the test is still running.

Press [SHOW HISTORY] again to unfreeze the display.

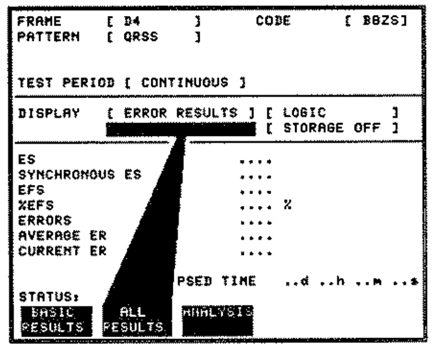
Press [RESET HISTORY].

You should see the HISTORY indicator go off.

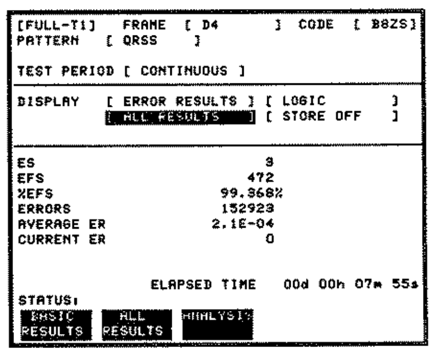


To See More Results

Highlight
[ERROR RESULTS] [LOGIC]
BASIC RESULTS .
Select **ALL RESULTS** .

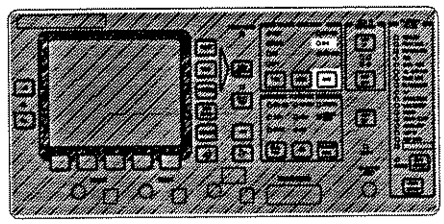


You should see.

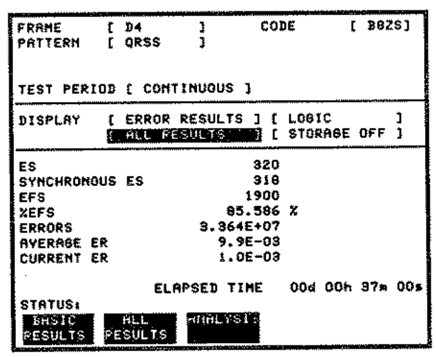


To Add Transmit Errors at a Fixed Rate

Use (RATE) to set TRANSMIT ERROR INSERT to 1E-3.



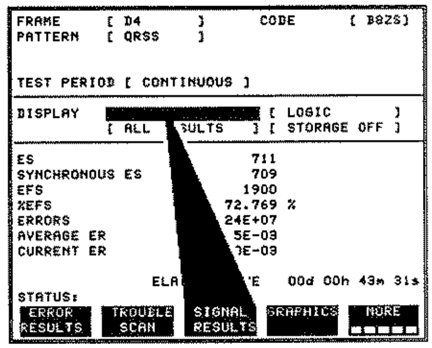
You should see CURRENT ER ... 1.0E - 0.3.



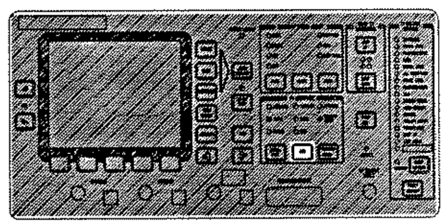
Use (RATE) to set TRANSMIT ERROR INSERT to ERR FREE.

To See Received Signal Details

Press (RESULTS).
Select **SIGNAL RESULTS**.

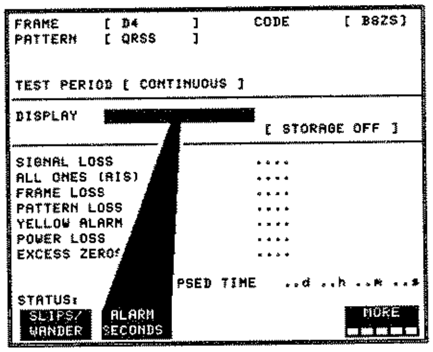


Watch the RECEIVER LEVEL change as you change the transmit level with (LBO) (Line Build Out).

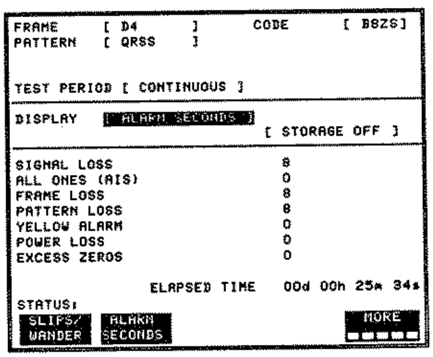


To See a Time Related Alarm Record

Highlight DISPLAY [ ].
Use MORE to change the selections available.
Select ALARM SECONDS.



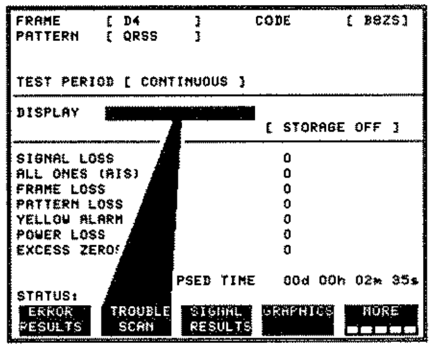
You should see the alarm durations caused by breaking the signal path



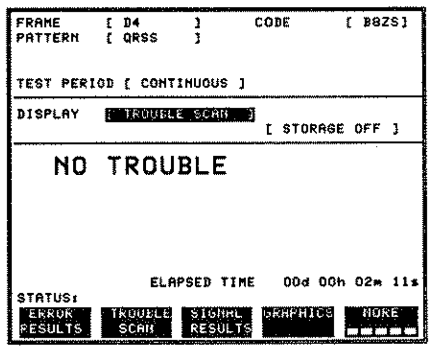
To See All Error Types on One Display

Highlight DISPLAY [ ].
Select TROUBLE SCAN.

Press START/STOP to start a new test.

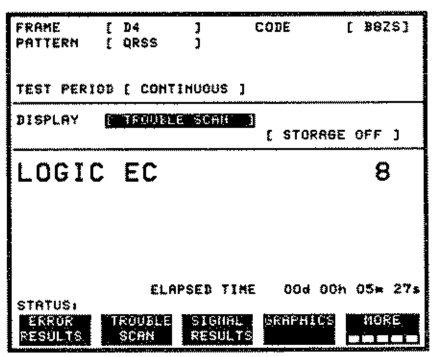


You should see.

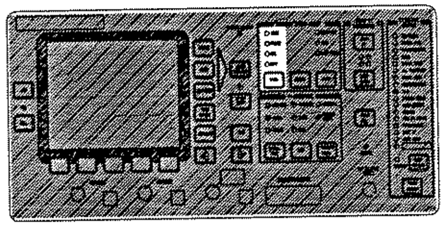


Press TRANSMIT ERROR INSERT (SINGLE) a few times.

You should see.

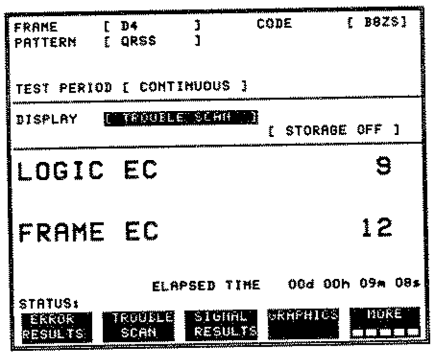


Use TRANSMIT ERROR INSERT (TYPE) To select FRAME.



Press TRANSMIT ERROR INSERT (SINGLE) a few times.

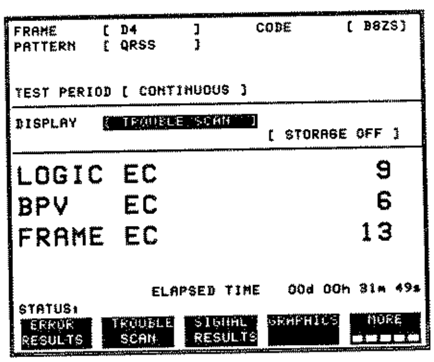
You should see.



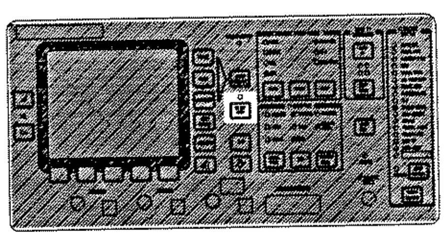
Use TRANSMIT ERROR INSERT (TYPE) To select BPV.

Press TRANSMIT ERROR INSERT (SINGLE) a few times.

You should see.

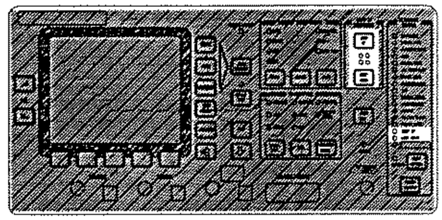


Press (START STOP) to reset the display and start a new test.



To send Line (CSU) Loopcodes

Watch the LOOP UP indicator come on briefly when you press (LOOP UP), then, watch the LOOP DOWN indicator come on for 8 seconds when you press (LOOP DOWN).



After Getting Started

Now that you are familiar with the operation of the instrument and are able to make the basic measurements, it's time to explore.

Press (AUX) and have a look at some of the other things that you can do.

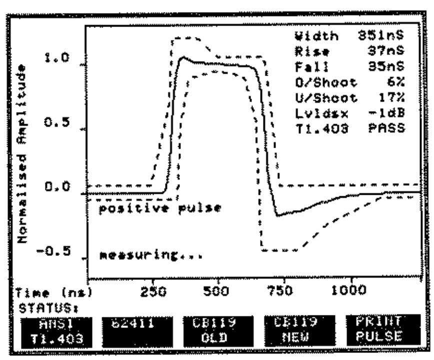
Select the printer/remote control set-up display PRINTER/REM CTL. RS 232 MODE lets you select the function of the RS 232 connector.

Select PRINTER OUTPUT and set up an AUTO TRIGGERED PRINT.

Select VF ACCESS and switch the AUDIO MONITOR ON and OFF.

Select ALARMS & LOOPING. You can change the USER PROGRAM ERROR RATE and set the T1 tester to transmit an alarm here. You can also select LOOPCODES, set the T1 tester to respond to that loopcode, or force the T1 tester to loop up or down.

Select PULSE SHAPE if you have the T1 tester with the pulse shape display option. You will need to press (AUX) again to get back to the other AUXILIARY selections, press a test set-up key to get back to the set-up display or press (RESULTS) to get back to the results display.



2

Getting Ready For T1 Testing

This chapter tells you how to set features which apply to all T1 tests. Check to see if you want to do any of the things in the following list. If not go on to Chapter 3 T1 Testing.

- Selecting T1 on combined T1/Datacom Test Sets.
- Fast Set up.
- Recalling stored set-ups.
- Storing results.
- Setting long user words.
- Setting the date and time.
- Storing test set-ups.

To Select T1 on Combined T1/Datacom Test Sets

If the T1 Tester is part of a combined T1/Datacom Test Set, set the Datacom module TEST SELECT to T1.

Fast Set Up

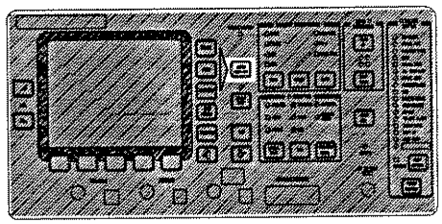
There are five ways to set up the T1 tester :

1. Automatically setting Frame, Code and Pattern to the incoming signal.
2. Recalling stored set-ups.
3. Recalling stored set-ups and modifying them.
4. Manually from the front panel (see Chapter 3 T1 Testing).
5. Over an RS 232 link (see Chapter 10 Remote Control).

To Automatically Set Frame, Code and Pattern To The Incoming Signal

Press (AUTO RESTART)

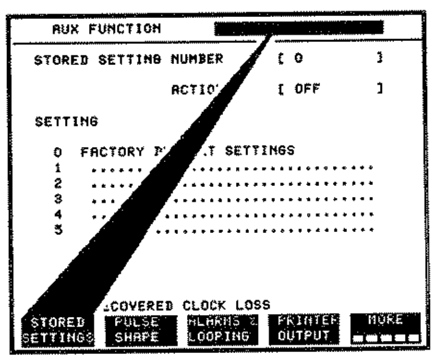
This will also start a new test.



To Recall a Stored Set-Up

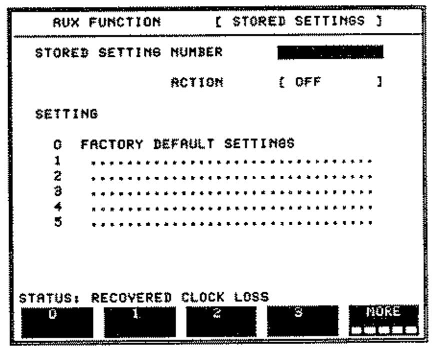
Press (AUX).

Select STORED SETTINGS.



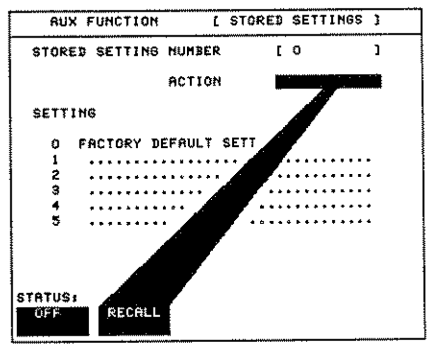
Highlight STORED SETTING NUMBER [ ]

and select the set-up you want.



Highlight ACTION [ ].

Select RECALL.

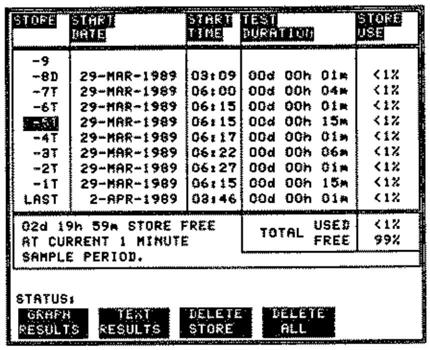


To Set Up For Storage of Results

To see the storage space available before overwriting occurs.

Use (RESULTS), GRAPH RESULTS, TEXT RESULTS STORE STATUS

100% = 32 hours at 1 minute resolution.
20 days at 15 minute resolution.
80 days at 1 hour resolution.

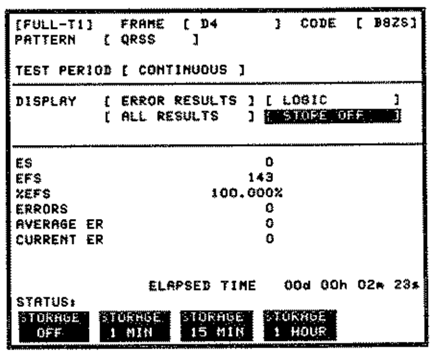


Press (RESULTS).

Set up the test.

Highlight [STORE ......].

Start the test by selecting the storage resolution you want.

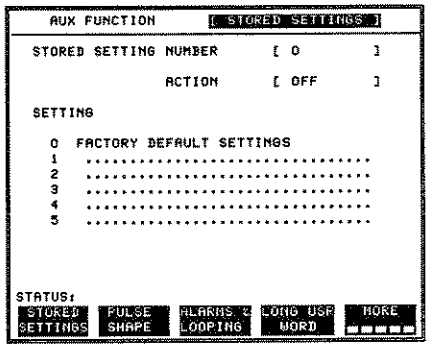


To Set Up Long User Words

You may select and store up to four words of up to 128 bytes. For high error conditions you may select sync on any number of bytes.

Press (AUX).

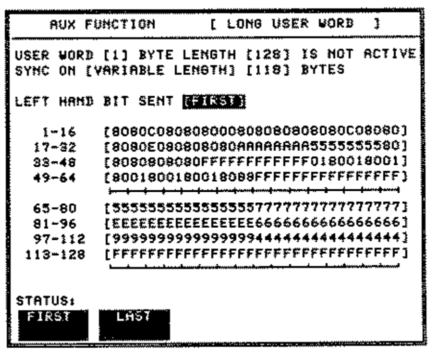
Select LONG USR WORD.



Highlight BYTE LENGTH [ ] and select the number of bytes you want in the pattern.

Highlight SYNC ON [ ] and select the number of error free bytes you want the T1 Tester to sync on.

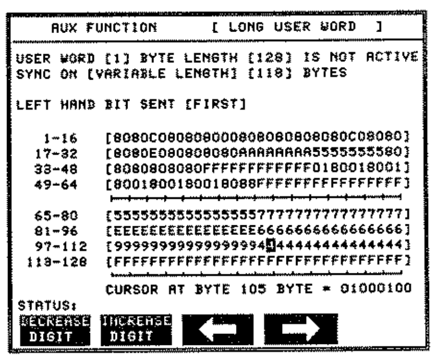
Highlight LEFT HAND BIT SENT [ ] and select FIRST to transmit bits as shown at the bottom of the display, or LAST to transmit bits in the reverse order.



To change a byte

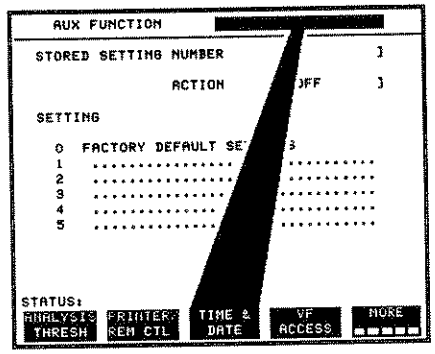
Highlight each of the two hexadecimal characters for that byte and select the byte you want. The binary value is shown at the bottom of the display.

Select SET-UP.

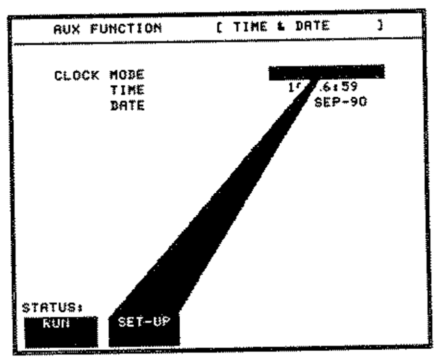


To Set the Date and Time

Press (AUX).



Select TIME & DATE.

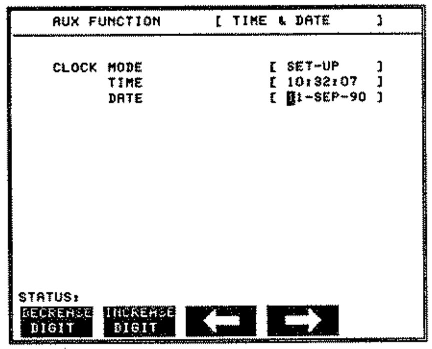


Highlight CLOCK MODE [ ].

Select SET-UP.

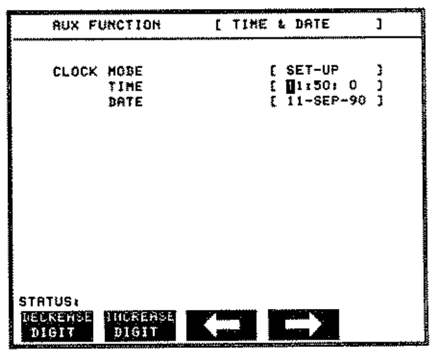
Highlight DATE [ ].

Use ←-- and --▶, INCREASE DIGIT / DECREASE DIGIT and PREVIOUS MONTH / NEXT MONTH to set the date.



Highlight TIME [ ].

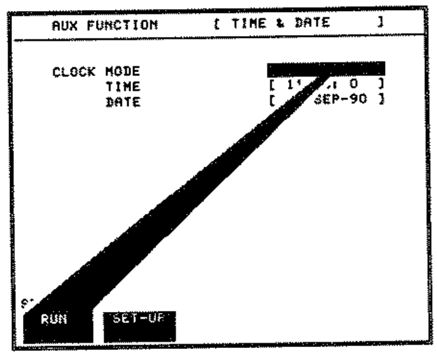
Use ←-- and --▶, and INCREASE DIGIT / DECREASE DIGIT, to set the time.



To Start the Clock at the Selected Time

Highlight CLOCK MODE [ ].

Select RUN.

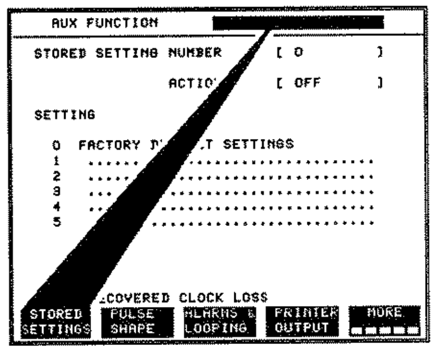


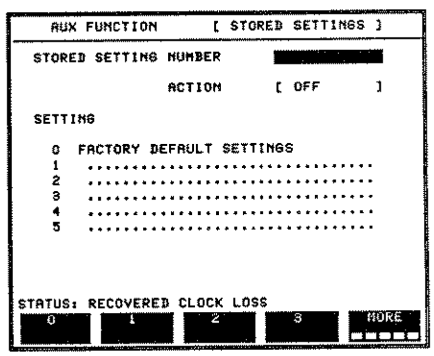
To Store Test Set-Ups

Set up the T1 tester with the settings you want to store.

Press (AUX).

Select STORED SETTINGS.

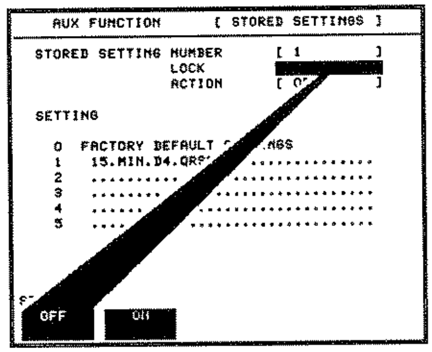




Highlight STORED SETTING NUMBER [ ] and select the number of the store you want to use.

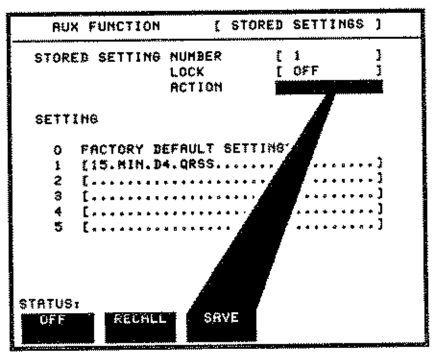
Highlight LOCK [ ].

Select OFF.



Highlight ACTION [ ].

Select SAVE.

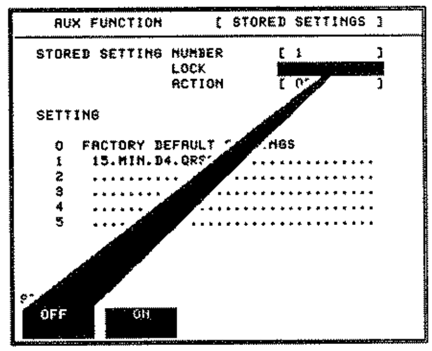


To Indicate Stored Set-Up Content

The display area beside the setting number may be used to give the set-up a title or to leave a message for a future user. The title / message may be set remotely using a terminal connected to the RS 232 connector (see the "Remote Operation" chapter) or manually as follows :

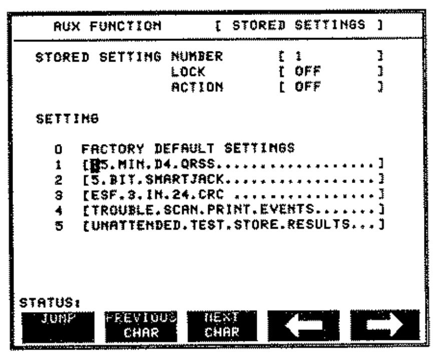
Highlight LOCK [ ].

Select OFF.



Highlight the SETTING description line N [. . . . .].

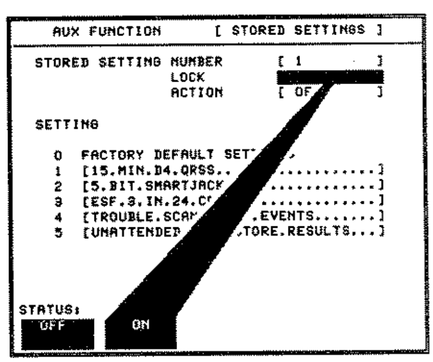
Use JUMP PREVIOUS CHAR NEXT CHAR and ←– and –→ to select characters.



To prevent overwriting without changing LOCK.

Highlight LOCK [ ].

Select ON.

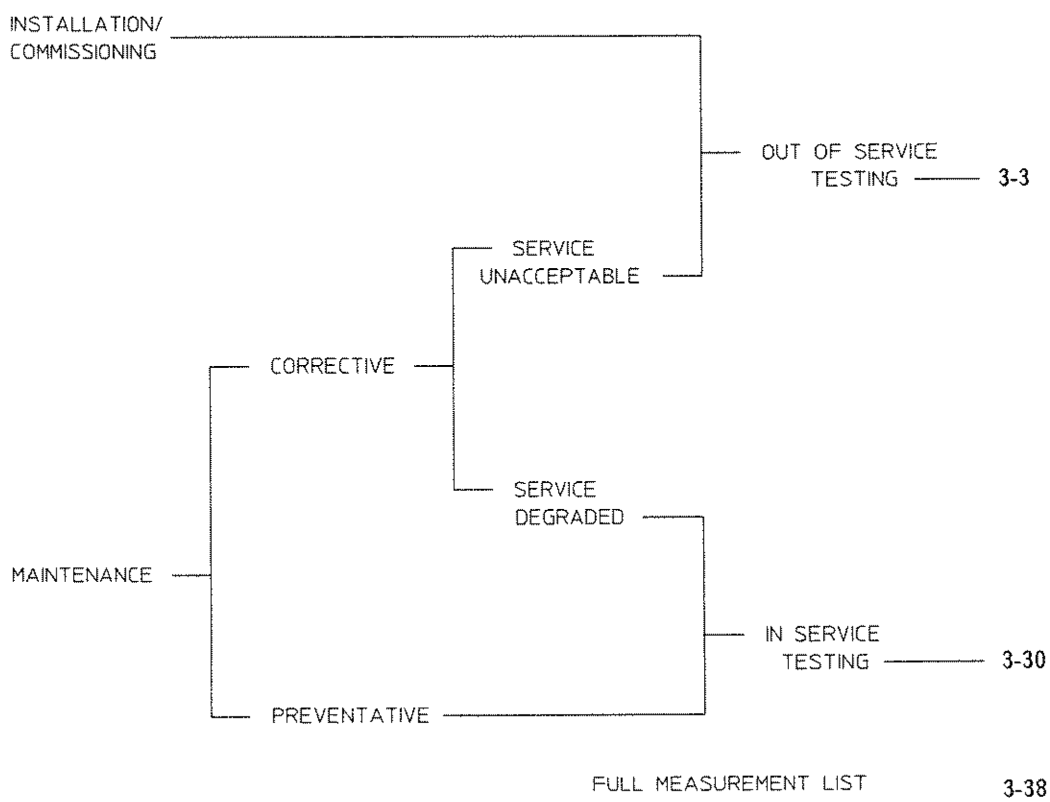


3

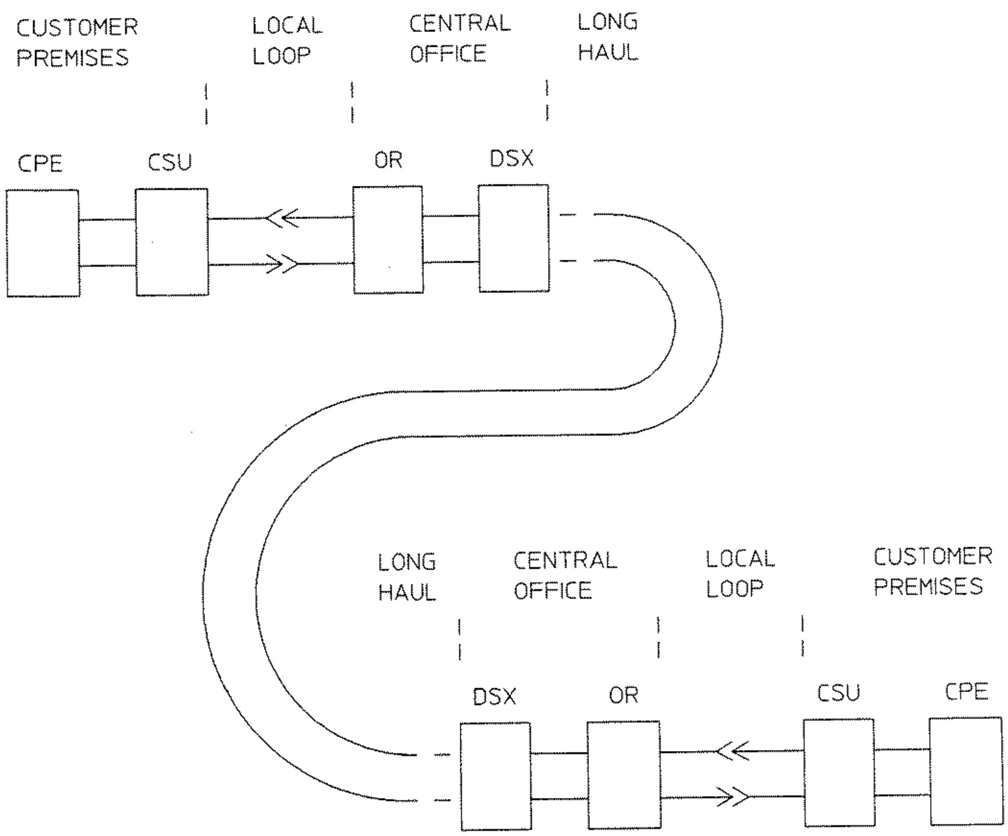
T1 Testing

How to Find Set-Up Examples

The diagram below shows the organization of the information in this chapter. The page numbers lead you to set-up examples.



How a T1 System is Shown in This Manual



Key

CPE = Customer Premises Equipment
CSU = Channel Service Unit
<< = Repeatered, metallic, local loop showing direction of path
OR = Office Repeater
DSX = Cross Connect

Out Of Service Testing

1 Here you can :

Use the instrument as a CSU.

Measure : Frequency

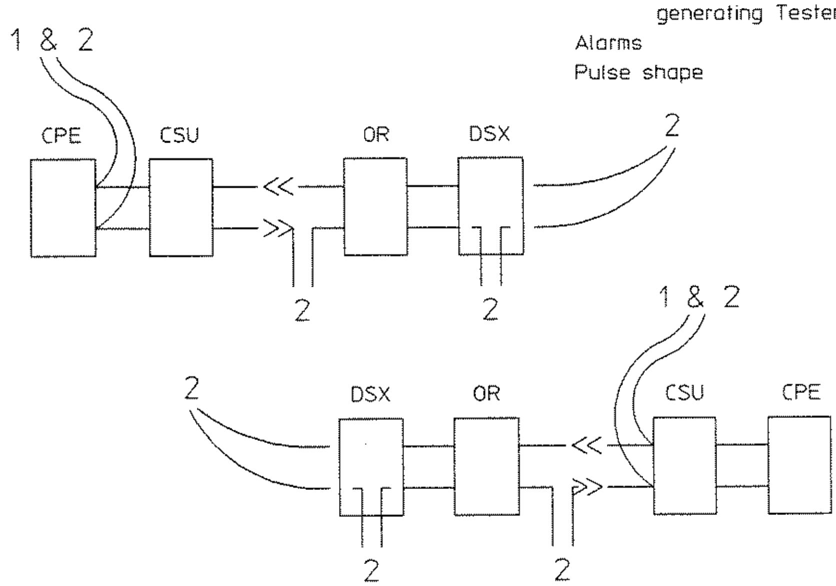
Simplex Current

Level (to set LBO)

Errors (part of loop from generating Tester)

Alarms

Pulse shape



2 Here you can :

Loop up remote CSUs

Generate the test pattern

Measure : Errors (both paths)

Delay (round loop)

Alarms

Pulse shape

Loop down remote CSUs

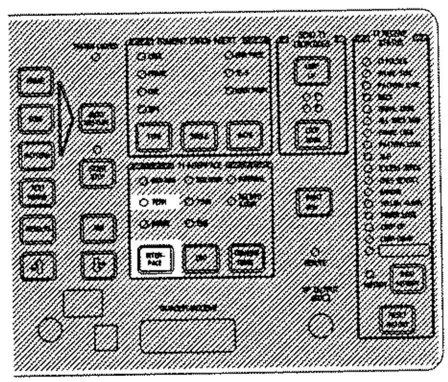
To Set the Terminated (TERM) T1 Line Interface

Out-of-service tests, including use as a portable CSU, usually require the T1 tester to terminate the T1 line. The TERM interface provides a 100Ω termination at the receiver input. The **Loopback** facility may be used to complete the signal path if required.

Warning

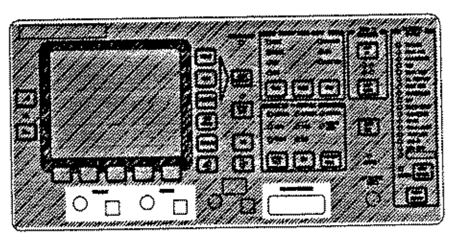
T1 Line voltages are capable of supplying dangerous currents. Power should be removed from the local loop while the T1 tester is being connected or disconnected.

Use [INTERFACE] to set T1 INTERFACE to TERM



To Connect the T1 Tester to the T1 Line

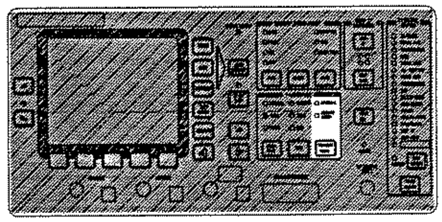
Have the line power disconnected, Connect the T1 tester to the T1 interface and have the power reconnected.



To Set The Transmit Timing

Use T1 INTERFACE (TRANSMIT TIMING)
To select the transmit timing.

If you have to be the source of timing select INTERNAL, otherwise select RECOV'D (LOOP).



To Use As A Portable CSU / Network Interface

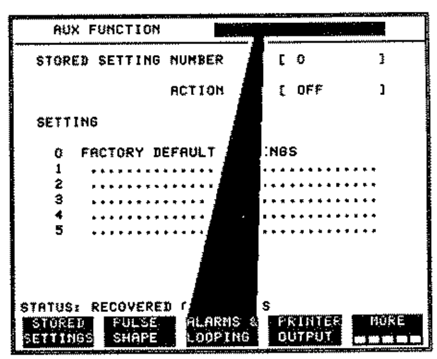
You can make tests on the received data while you are using the T1 tester as a CSU / network interface.

You can loop the T1 tester manually OR set it to loop when it receives a loopcode.

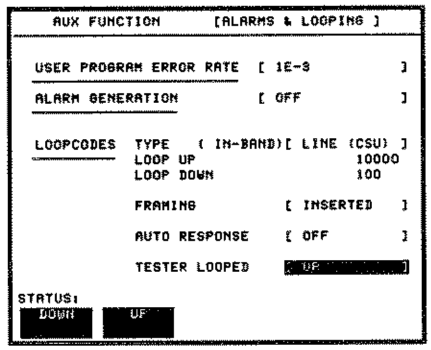
To Loop the T1 Tester Manually

Press (AUX).

Select ALARMS & LOOPING.



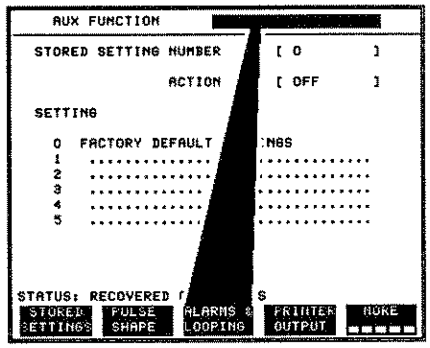
Highlight TESTER LOOPED [ ].
Select UP.



To Set the T1 Tester to Respond to a Loopcode (In-Band)

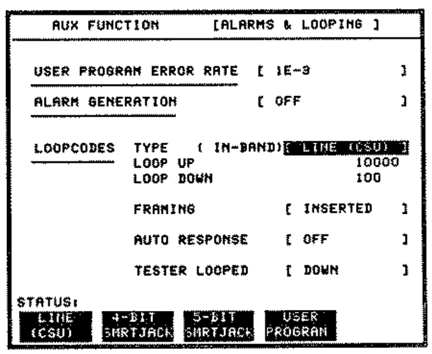
Press (AUX).

Select ALARMS & LOOPING.

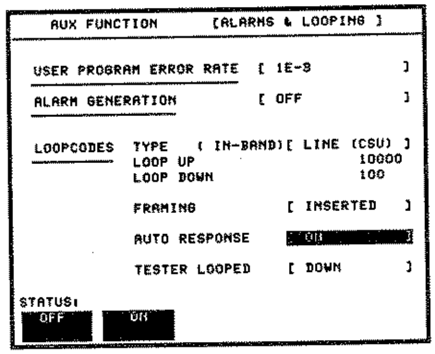


Highlight LOOPCODES TYPE [ ], then select what you want the T1 Tester to respond to.

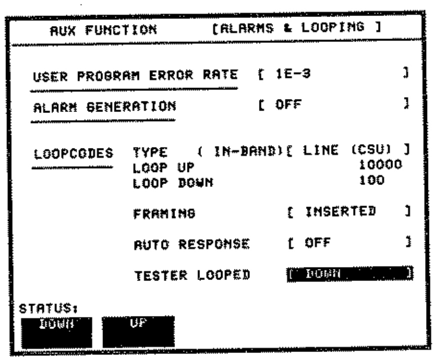
If ESF framing is being used, then ensure [IN-BAND] is selected.



Highlight AUTO RESPONSE [ ].
Select ON.



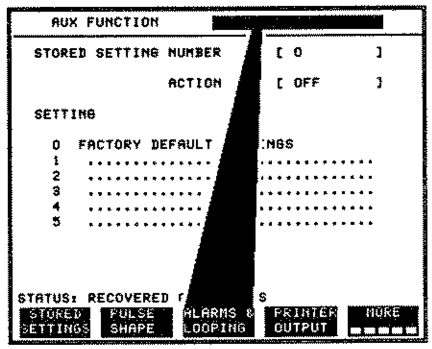
Highlight TESTER LOOPED [ ].
Select DOWN.



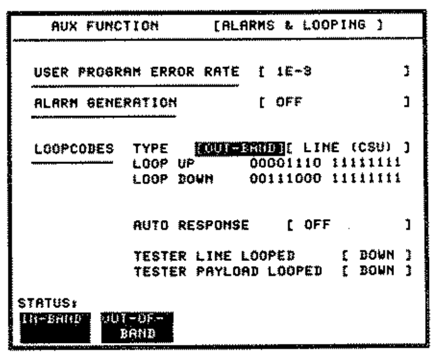
To Set the T1 Tester to Respond to a Loopcode (Out-of-Band)

Out-of-band loopcodes are only available with ESF framing.

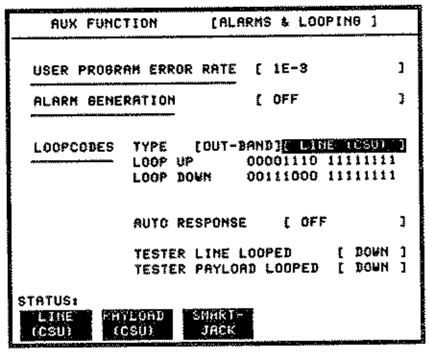
Press (AUX).
Select `ALARMS & LOOPING`.



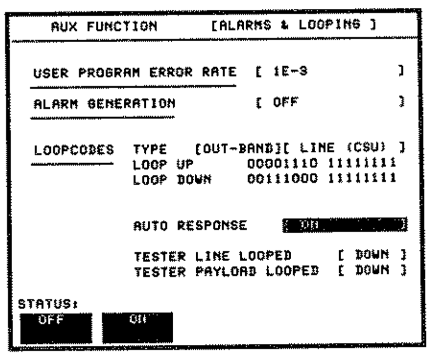
Highlight LOOPCODES TYPE `[ ]`, then select `[OUT-BAND]`.



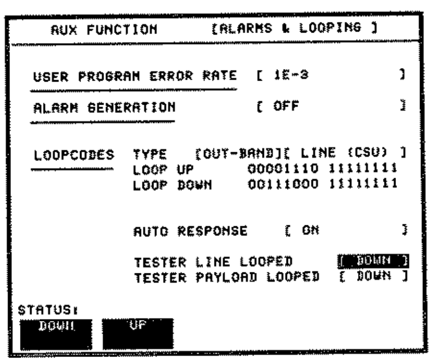
Select the code you want the T1 Tester to respond to: [LINE (CSU)], [PAYLOAD (CSU)] or [SMARTJACK].



Highlight AUTO RESPONSE [ ]. Select ON.



Highlight TESTER LINE LOOPED [ ] and TESTER PAYLOAD LOOPED [ ]. Select DOWN for each.



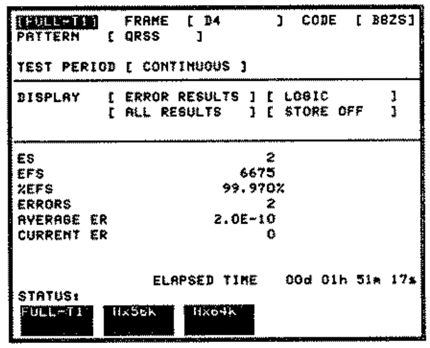
To Make Fractional T1 (n × 56 / n × 64 kBit/s) Tests

A T1 Tester with the optional Fractional T1 capability is required.

Press (RESULTS).

Highlight the fractional or full T1 selection

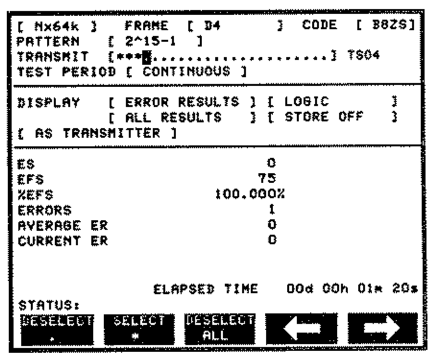
Select **N × 56k** or **N × 64k**.



Select the frame,code and pattern you want.

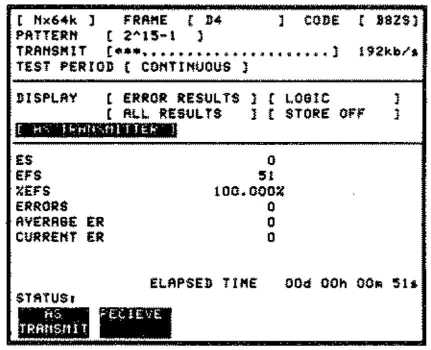
Highlight TRANSMIT [ ], and select the timeslots you want to spread the selected pattern over.

The example shows a 2^15−1 PRBS transmitted in a 192kBit/s Intermediate Bit Rate (IBR) in timeslots 1, 2, and 3.



To set the receive timeslots for 1:1 mapping select **AS TRANSMIT**.

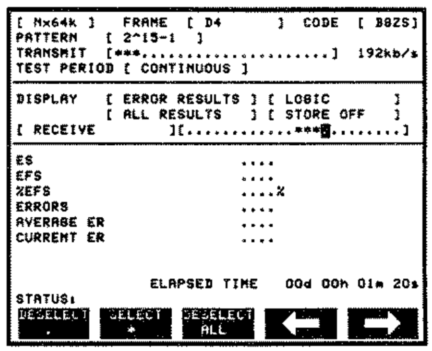
To define your own receive timeslots select **RECEIVE**.



Highlight RECEIVE **[ ]**, and select the timeslots that contain the incoming IBR.

The example shows the selection of timeslots 13, 14, and 15.

If results storage or graphs of results are required, start the test by selecting the storage resolution.



To Transmit Errors and Alarms

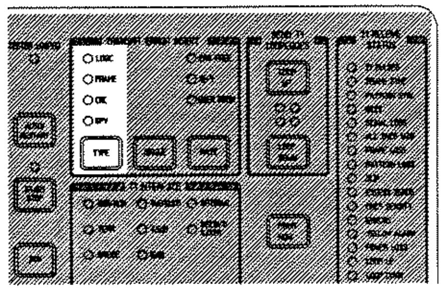
You may insert errors by introducing changes into the transmitted pattern.
You may introduce the yellow alarm into the transmitted pattern.
You may replace the transmitted pattern with unframed all 1's.

To Transmit Errors

You may chose the type of error and the error rate.

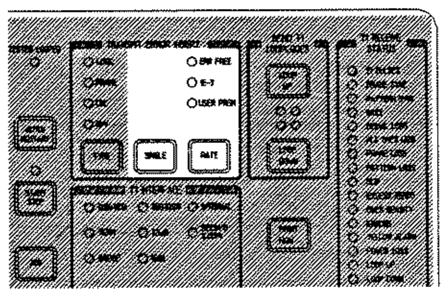
To Choose the Type of Error

Use (TYPE) to set the type of error you want to introduce.



To Choose the Error Rate

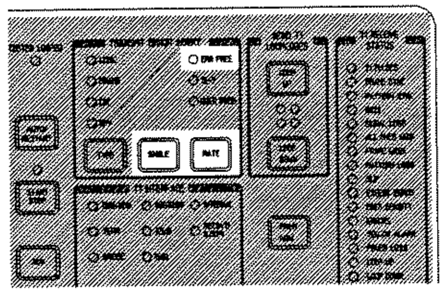
You may choose:
To add errors singly .
To add errors at a fixed rate of 1E − 3.
To select the error rate.



To Add Errors Singly

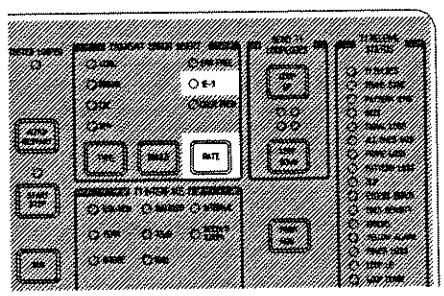
Use (RATE) to select ERR FREE.

Press (SINGLE) to insert an error.



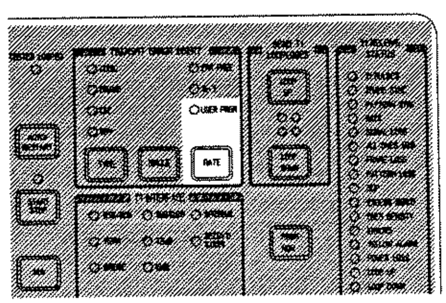
To Add Errors at a Fixed Rate of 1E − 3

Use (RATE) to select 1E − 3.

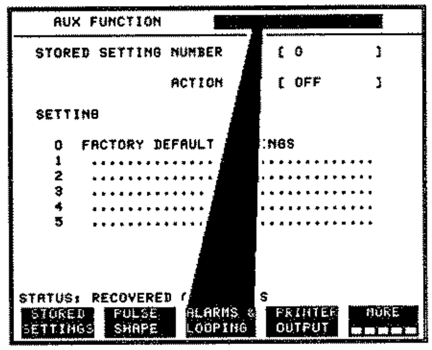


To Select an Error Rate

Use (RATE) to select USER PRGM.

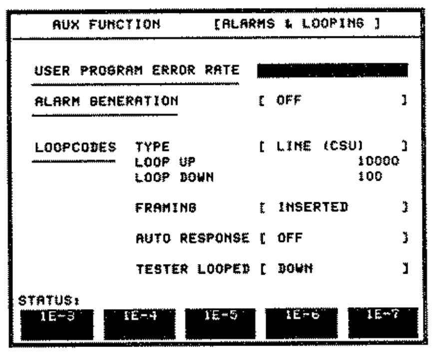


Press (AUX).
Select `ALARMS & LOOPING`.



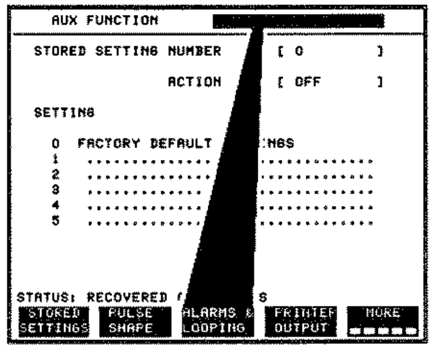
Highlight USER PROGRAM ERROR RATE `[ ]`.

Select the rate `1E – 3`, `1E – 4`, `1E – 5`, `1E – 6` or `1E – 7`.

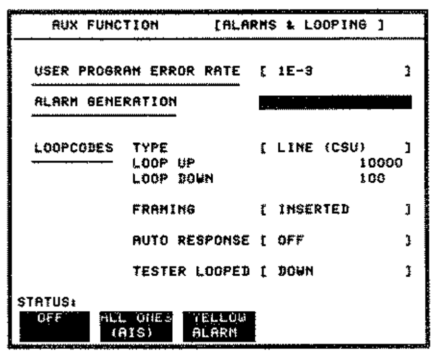


To Transmit Alarms

Press AUX.
Select ALARMS & LOOPING.



Highlight ALARM GENERATION [ ].
Select the type of alarm you want.

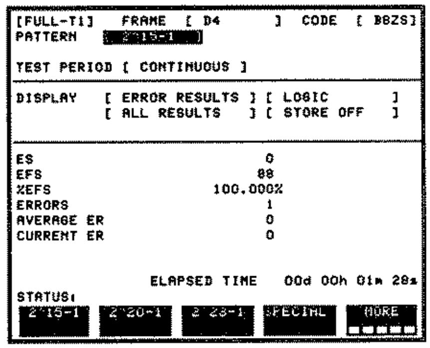


To Transmit and Monitor Signaling Bits

Press (RESULTS).

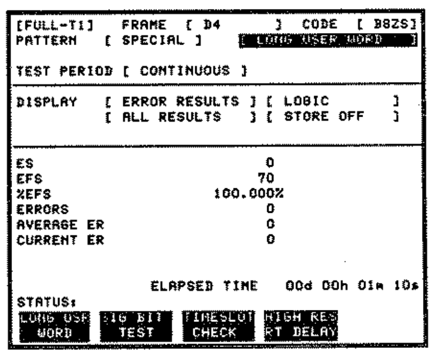
Highlight PATTERN [ ]

Select SPECIAL.



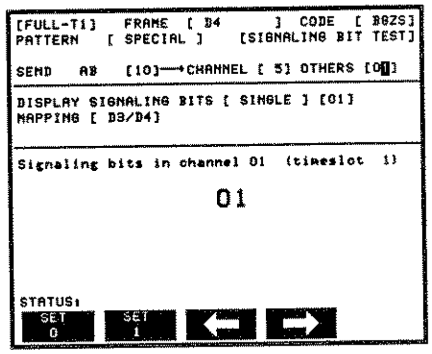
Highlight PATTERN [SPECIAL] [ ]

Select SIG BIT TEST.



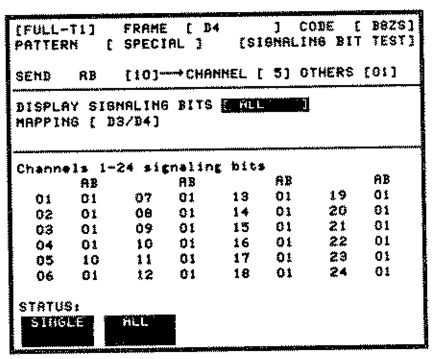
Select the test signaling bits A B (A B C D with ESF),the CHANNEL you want to send them in and the signalling bits to go in the OTHER channels.

This example shows the selection of 1 and 0 as A and B bits in channel 5 with 0 and 1 in the the other channels.



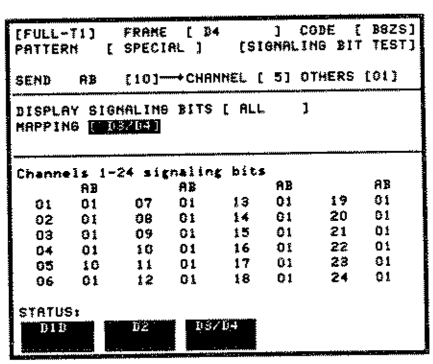
Highlight DISPLAY [SIGNALING BITS] [ ]

To display signaling bits from one channel select SINGLE.
To display signaling bits from all channels select ALL.



Highlight MAPPING [ ]

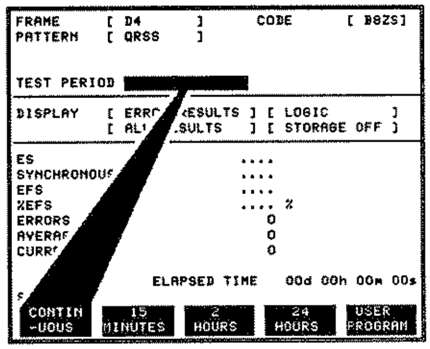
Select the channel / timeslot mapping for the system being tested.



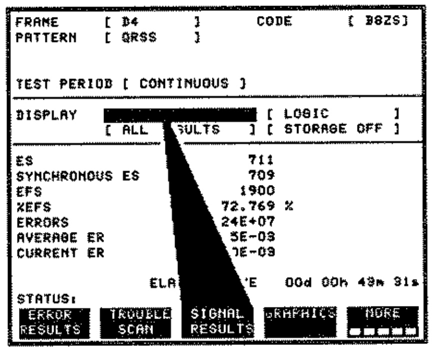
To Make Out-of-Service Tests at the Customer Premises

Level (for LBO setting), Current, Frequency and Pulse Shape

Press (TEST PERIOD) to recall the results display.
Select CONTINUOUS.

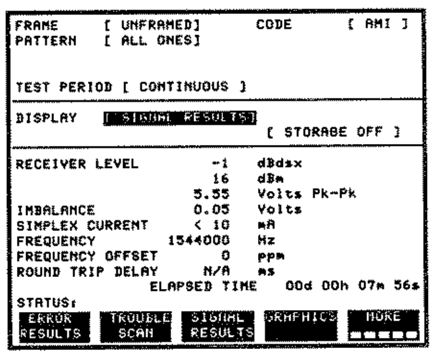


Press (AUTO/RESTART) to set FRAME, CODE and PATTERN to the incoming signal and start an error test.
Highlight DISPLAY [ ].
Select SIGNAL RESULTS.



Use the measured RECEIVER LEVEL to set the T1 Tester transmit LBO.

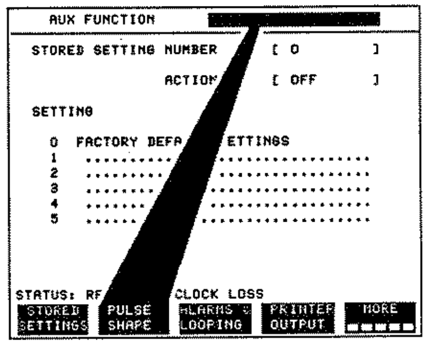
For round trip delay measurement use the QRSS test pattern.



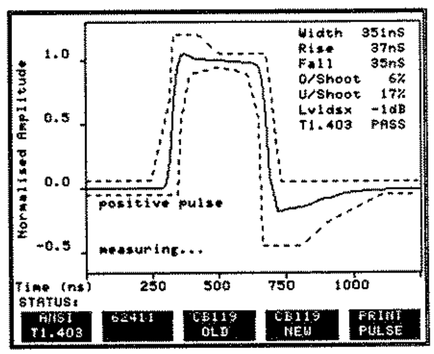
You can now check SIMPLEX CURRENT and FREQUENCY readings. Current is best checked with an all 1's (max current) pattern. Low current might indicate bad PSU's, bad wiring or a bad repeater.
When the CSU or network interface is replaced or installed, its transmit output LBO should be set to the value you set on the T1 Tester to get the correct RECEIVER LEVEL.

If the T1 Tester has the optional Pulse Shape display facility
Press (AUX).

Select PULSE SHAPE.



You can check that the received pulse meets the specified mask.



To Measure Round Trip Delay with Higher Resolution

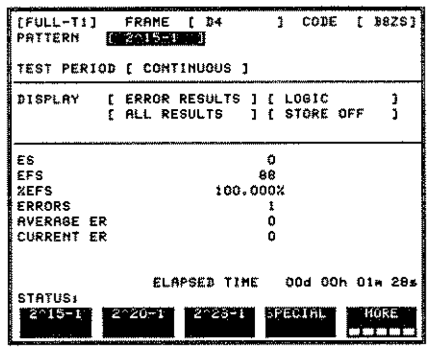
A T1 tester with the fractional T1 capability is required.

Round trip delay is displayed as part of the signal test. A higher resolution display of round trip delay may be obtained as follows:

Press (RESULTS).

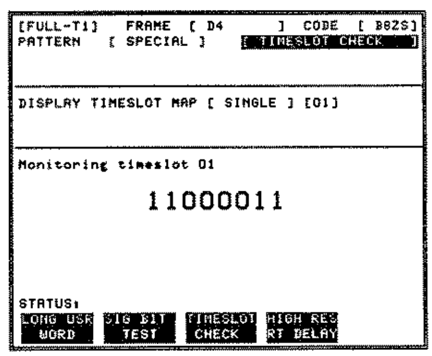
Highlight PATTERN [ ]

Select SPECIAL.

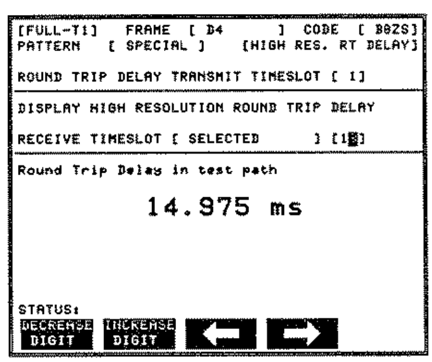


Highlight PATTERN [SPECIAL] [ ]

Select HIGH RES RT DELAY.



Select the transmit and receive timeslots .



To Monitor Errors at the Customer Premises.

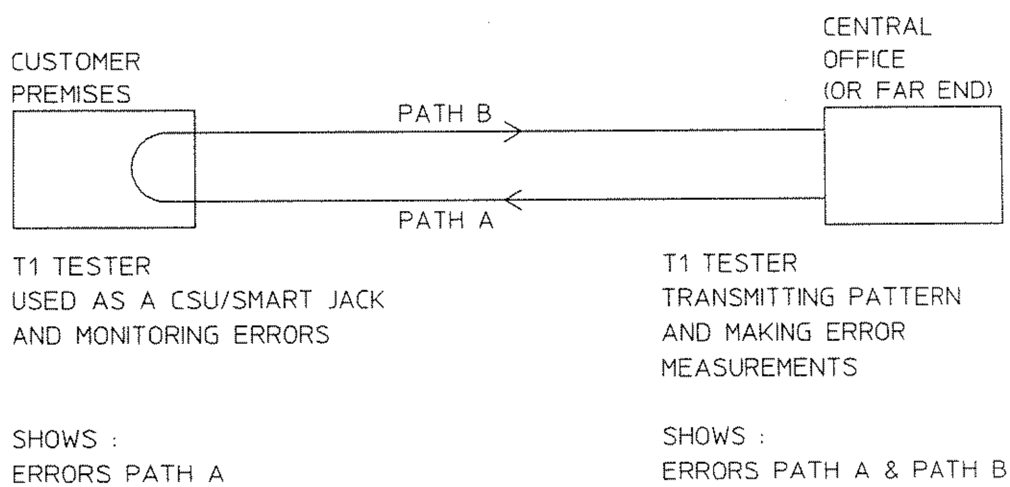
The T1 tester measures and stores all error types simultaneously. The display shows one selected type in "real time". The other types can be displayed at any time, during and after the test, up to the start of the next test. Results may also be stored for later reference.

Single path error tests are most useful as an aid to trouble location when making a looped test from the Central Office or the far end of the circuit with another T1 Tester.

With the T1 Tester at the customer premises looped and set up for the Level,Current and Frequency test (with SIGNAL RESULTS selected) the other results : ERROR RESULTS (ALL RESULTS or BASIC RESULTS), TROUBLE SCAN, ALARM SECONDS and SLIPS AND WANDER, apply to the path being received at the Customer Premises.

Just select a TEST PERIOD, press START STOP and select the error type that you want to DISPLAY in "real time".

Local loop Tests



Out of Service Tests From the Central Office

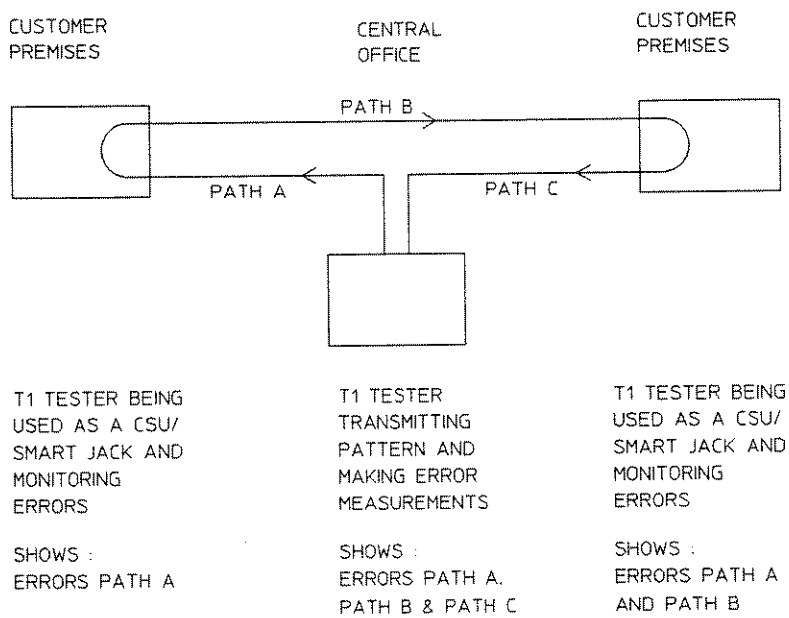
You can make local loop, end to end and round trip loopback tests. Local loop tests are as shown with customer premises tests on page 3-14.

Two kinds of loopback are available when testing devices with ESF framing and out-of-band loopback.

1. LINE (CSU) Loopback - all bits in the T1 signal are retransmitted.
2. PAYLOAD (CSU) Loopback - only the customer data bits are retransmitted, framing and CRC bits are recalculated before being transmitted back to the T1 Tester.

Using both loopbacks help isolate the fault to either the *go* or *return* path of the T1 circuit.

End-to-End and Round Trip Loopback Tests

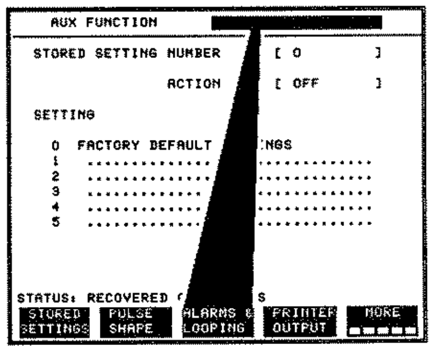


To Loop the CSU, Network Interface, or T1 Tester at the Customer Premises using an In-Band Loopcode

The loop can be set manually at the customer premises. Alternatively, the loopcode can be sent from the T1 tester at the Central Office using the following procedure.

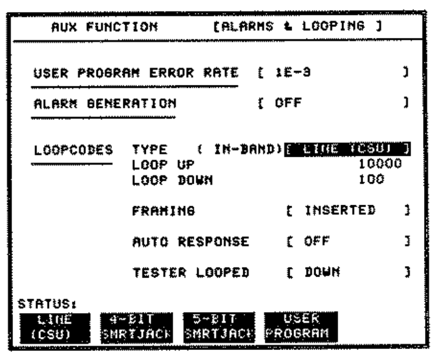
Press (AUX).

Select ALARMS & LOOPING.

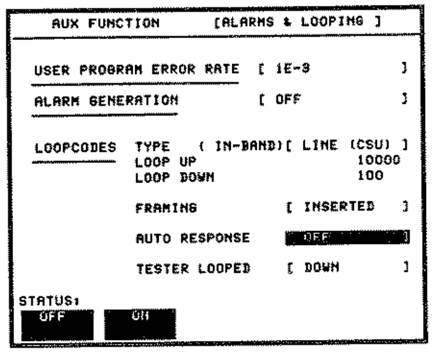


Highlight LOOPCODES TYPE [ ]. Select the loopcode that the far end CSU, Smartjack or T1 tester will respond to.

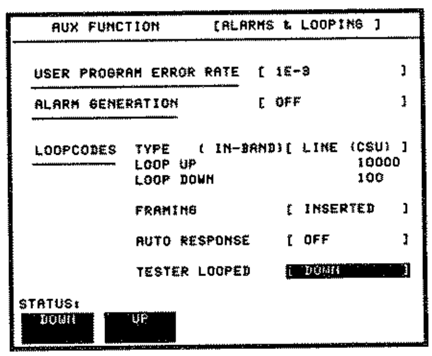
If ESF framing is being used, ensure the LOOPCODE TYPE is set to [IN-BAND].



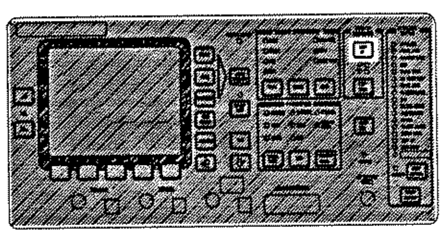
Highlight AUTO RESPONSE [ ].
Select OFF.



Highlight TESTER LOOPED [ ].
Select DOWN.



To send the loop code.
Press (LOOP UP).
For round trip loopback tests you may need to press (LOOP UP) twice.



To Loop the CSU, Network Interface, or T1 Tester at the Customer Premises using an Out-of-Band Loopcode

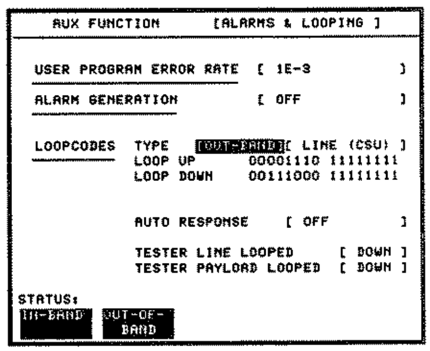
Out-of-band loopcodes are only available with ESF framing.

The loop can be set manually at the customer premises. Alternatively, the loopcode can be sent from the T1 tester at the Central Office using the following procedure.

Press (AUX).

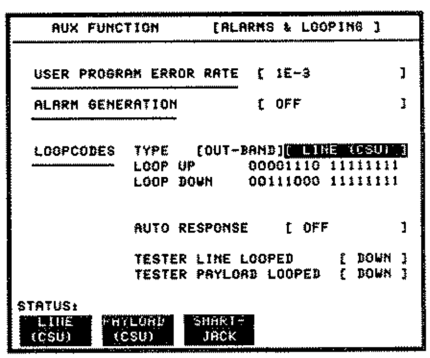
Select ALARMS & LOOPING.

Highlight LOOPCODES TYPE [ ], then select [OUT-BAND].

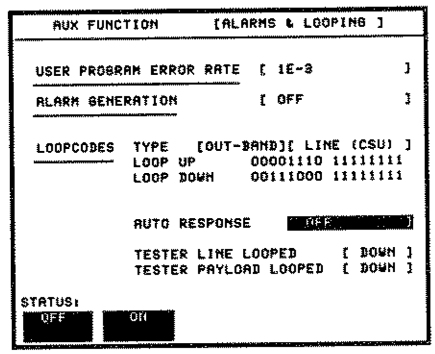


Select which loopback you want: [LINE (CSU)], [PAYLOAD (CSU)] or [SMARTJACK].

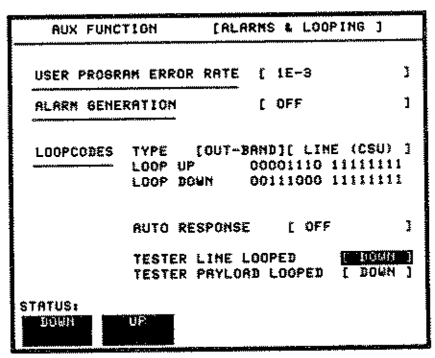
The LOOP UP and LOOP DOWN codes are shown on the display.



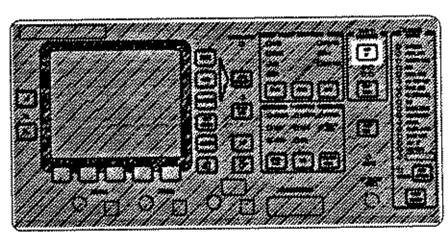
Highlight AUTO RESPONSE [ ].
Select OFF.



Highlight TESTER LINE LOOPED [ ] and TESTER PAYLOAD LOOPED [ ].
Select DOWN for each.



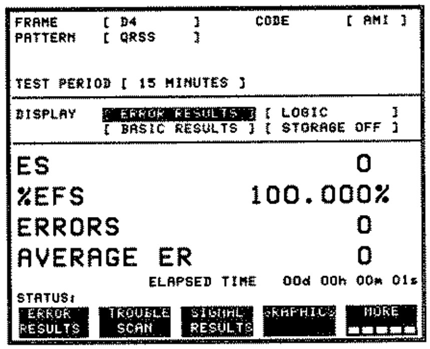
To send the loop code.
Press (LOOP UP).
For round trip loopback tests you may need to press (LOOP UP) twice.



To Set-Up the T1 Tester for a Looped 15 Minute, QRSS, Logic Error Test

Press (FRAME).
Select ESF, D4, SLC96 or UNFRAMED.

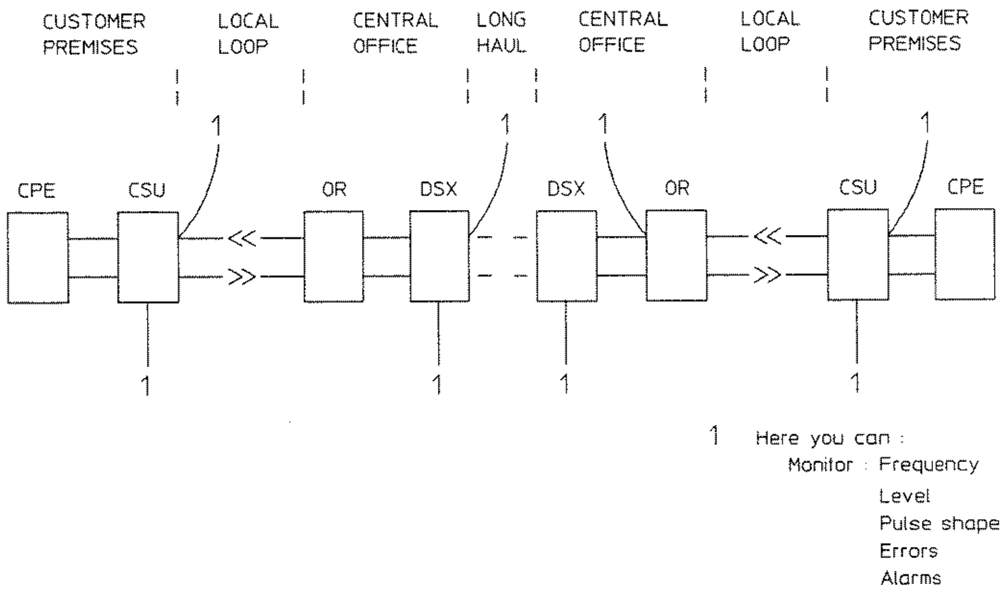
Press (CODE).
Select AMI or B8ZS.
Press (PATTERN).
Select QRSS.
Press (TEST PERIOD).
Select 15 MINUTES.
Press (RESULTS).
Select DISPLAY.
ERROR RESULTS LOGIC
BASIC RESULTS.



To Run the Test

Press (START STOP).
The T1 Tester at the central office will display go and return path errors. If a T1 tester is used as a CSU / network interface at the customer premises, use (START STOP) on that T1 tester to display the single path (central office to customer premises) errors.
You can display the other results either during or after the test. The alternatives are : Frame Errors, BPVs and ESF CRC errors (individually or together in Trouble Scan), All (Error) Results, Signal Results, Alarm Seconds, Slips and Wander or Pulse Shape.

In-Service Testing

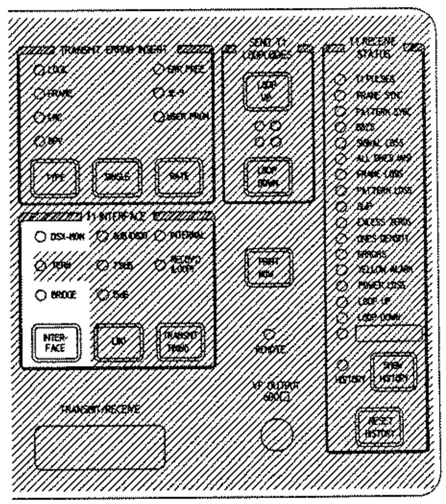


To Set the Monitor Interface

You can set up to monitor at a protected monitor point (DSX-MON) or at an unprotected point (BRIDGE).

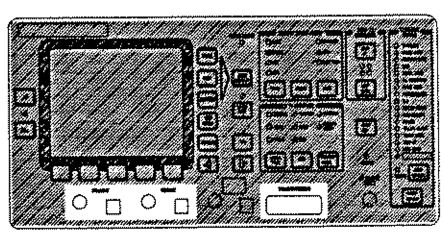
Warning **T1 Line voltages are capable of supplying dangerous currents. Power should be removed from the local loop while the T1 tester is being connected or disconnected. It is recommended that the T1 tester should be connected at a DSX- 1 MON for in-service testing.**

Use (INTERFACE) to set T1 INTERFACE to DSX-MON or BRIDGE.



To Connect the T1 Tester for In-service Testing

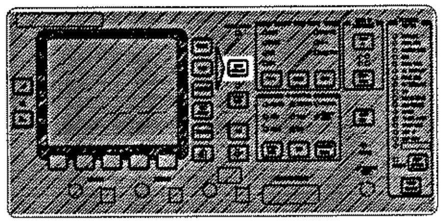
Connect the T1 tester to the monitor point. As the signal is only being received for in-service tests, Transmitter timing selection is not necessary.



To Use the T1 Tester for Line Identification

The least intrusive method of line identification is to look for a known signal in one VF channel.

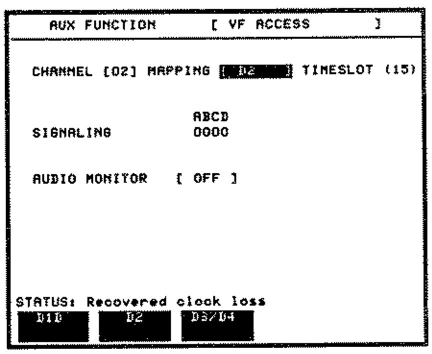
Press (AUTO/RESTART) to set the T1 tester to the incoming Frame, Code and Pattern and start an error test.



Press (AUX) and select VF ACCESS.

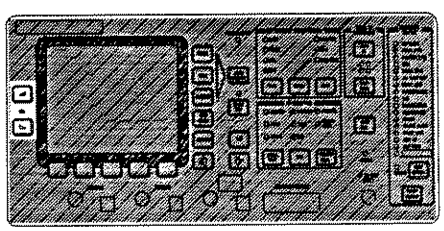
Highlight MAPPING and select [D1D], [D2] or [D3/D4].

Highlight CHANNEL [ ].
Select channels using ◀ ▶ and INCREASE DIGIT or DECREASE DIGIT until the known VF signal is heard.



Mapping is automatic, as the channel setting is changed the timeslot reading on the display is automatically updated - you can see at a glance the channel-to-timeslot relationship.

Highlight AUDIO MONITOR [ ].
Select ON.
Use (◢) and (◣) to adjust the volume.



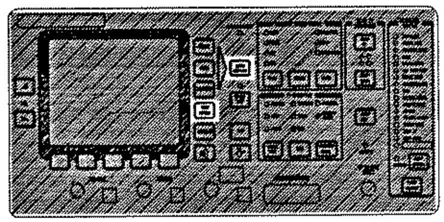
To Make In-Service Tests

To Monitor Circuit Performance

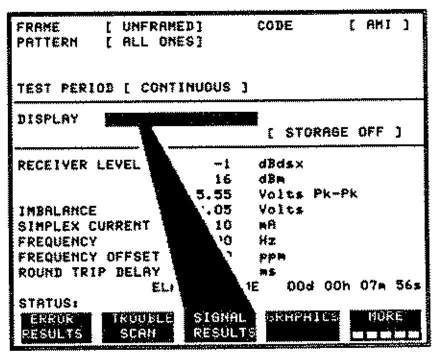
Level, Frequency and Pulse Shape

Press (TEST PERIOD) to recall the results display.
Select CONTINUOUS.

Press (AUTO/RESTART) to set FRAME, CODE and PATTERN to the incoming signal and start an error test.



Highlight DISPLAY [ ].
Select SIGNAL RESULTS.

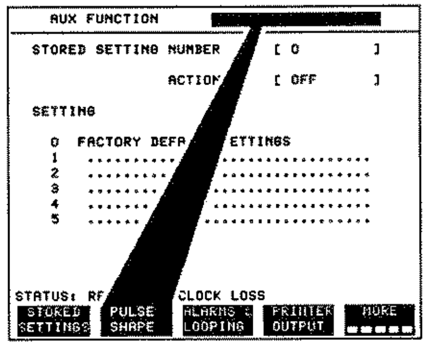


You can now check LEVEL, and FREQUENCY.
Level outside the expected range might indicate a wrongly set LBO, bad wiring, bad splices or a double terminated circuit.
High frequency offset might indicate serious equipment or configuration problems. For example, A faulty clock oscillator, or the terminals at each end of the circuit loop timed from each other.

If the T1 Tester has the optional Pulse Shape display facility

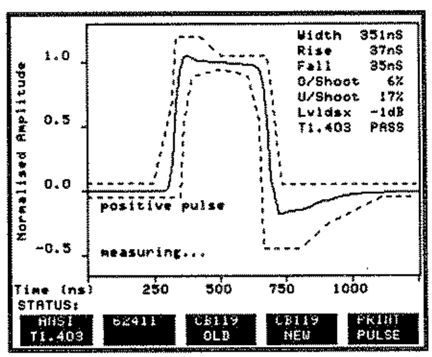
Press (AUX).

Select PULSE SHAPE.



You can now look for gross distortions of the pulse shape.
Remember that the pulse may be slightly distorted by :
The termination of the line.
The monitor point itself.

For testing against a mask, the T1 Tester has to terminate the line directly to avoid these distortions.

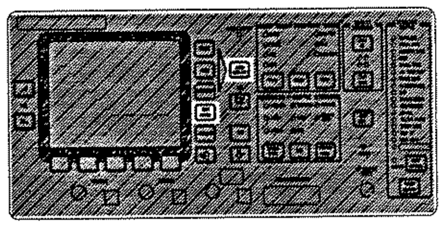


To Set-Up the T1 Tester to Monitor Errors

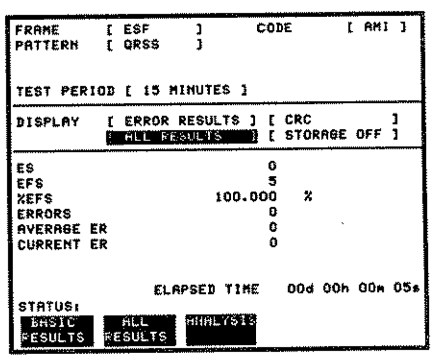
The T1 tester measures and stores all error types simultaneously. The display shows one selected type in "real time". The other types can be displayed at any time, either during or after the test, up to the start of the next test. Results may also be stored for later reference.

Example, to Measure All Errors With Real Time Display of ESF CRC Errors.

Press (TEST PERIOD) to recall the results display.
Select CONTINUOUS.



Press (AUTO/RESTART) to set FRAME, CODE and PATTERN to the incoming signal and start an error test.
Highlight DISPLAY [ ].
Select ERROR RESULTS CRC.
Highlight
[ERROR RESULTS] [CRC].
[ ]
Select ALL RESULTS.



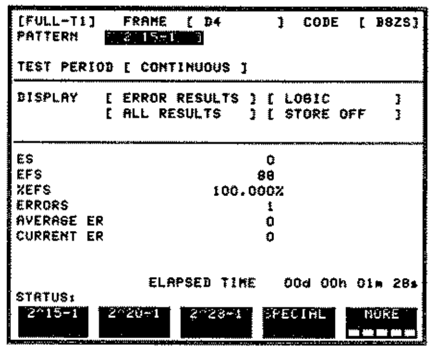
To Monitor Timeslot Map/Content

A T1 Tester with the fractional T1 capability is required.

Press (RESULTS).

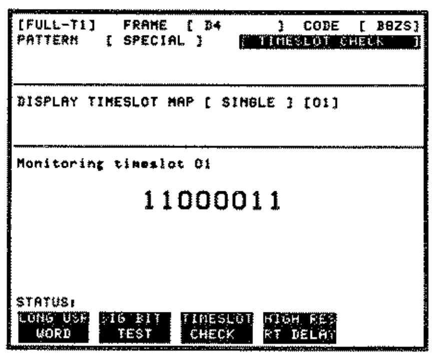
Highlight PATTERN [ ]

Select SPECIAL.



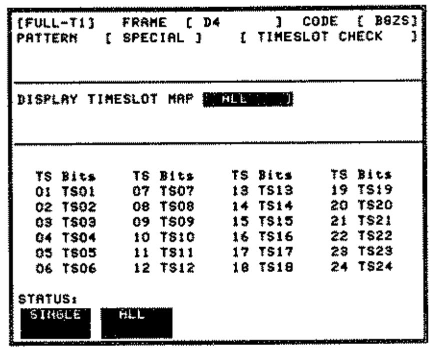
Highlight PATTERN [SPECIAL] [ ]

Select TIMESLOT CHECK.

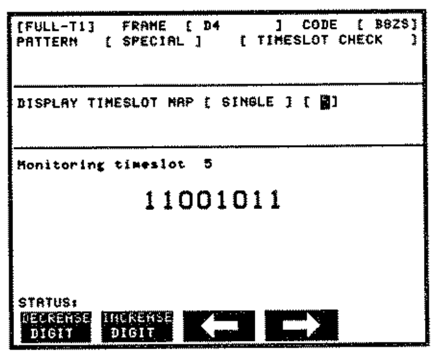


Highlight TIMESLOT MAP [ ]

For a timeslot map select ALL.



To monitor the content of a single timeslot select SINGLE
highlight TIMESLOT MAP [SINGLE] [ ]
and select the timeslot number.



Full Measurement List.

Error Measurements	Type Of Error			
	Logic	BPV	Frame	CRC (ESF)
Error count	*	*	*	*
Error ratio, average	*	*	*	*
Error ratio, current	*	*		*
Error seconds	*	*	*	*
Error free seconds	*	*		*
% error free seconds	*	*		*
Out of frame events			*	
Change of frame alignment events			*	
Frame loss seconds			*	
Loss of frame events			*	
Severely errored framing events			*	

Error Measurements	Type Of Error			
	Logic	BPV	Frame	CRC (ESF)
Unavailable seconds	*		*	*
% availability (unavailability)	*		*	*
Error seconds	*			*
Severely errored seconds	*		*	*
Degraded minutes	*			*
Consecutive severely errored seconds	*		*	*

Alarm Seconds

Power loss
Alarm indication seconds (<3 zeros in two consecutive frames)
Frame loss
Signal loss (175 consecutive zeros)
Yellow Alarm
(D4 / SLC-96, zero in bit 2 of every timeslot)
(ESF, data link contains repeated 1111111100000000)
Pattern loss
Ones density / Excess zeros (>15 zeros)

Signal Results

Frequency, absolute and offset from 1544000Hz
Received level, dBm or dBdsx
Simplex current, mA
Balance
Round trip delay

Slips and Wander

Out of service slips (pattern slips)
Clock slips (optional)

Pulse Shape (optional) access via AUX

Test Patterns

2^15−1 PRBS, 2^20−1 PRBS, 2^23−1 PRBS, QRSS, 3 in 24, ALL ONES, 1 in 8, 1 in 2, 55 octet, userword, live, special (see below).

SPECIAL PATTERNS : Long user word, Signaling bit test, Timeslot check, High resolution round trip delay, 404Hz tone*, 1004Hz tone*, 2804Hz tone*.

* available only with N × 64kBit/s.

Auxiliary Functions

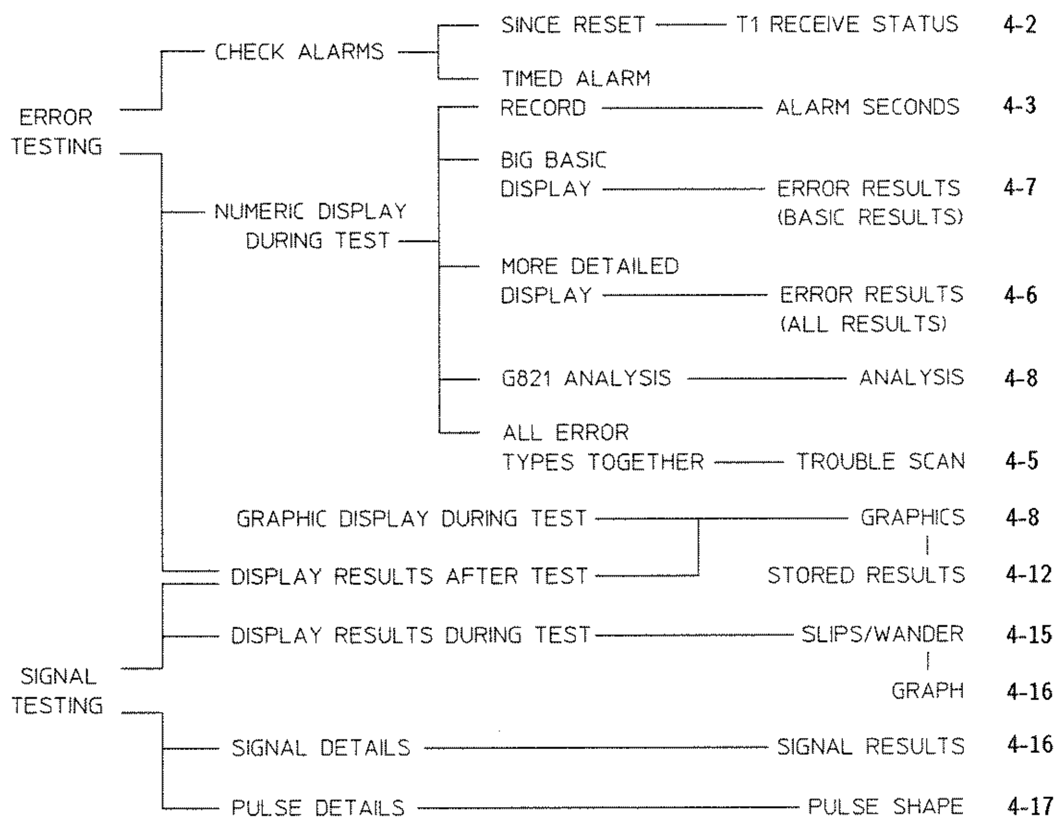
Function	Selections
Pulse shape (optional)	T1.403, 62411, CB119 old, T1.102 / 119 new
Transmit functions	
Error insertion rate	10E-3, 10E-4, 10E-5, 10E-6, 10E-7
Alarm generation type	Off, Yellow, All ones (AIS)
Loopcode	
Mode	In band
Types	Line , 4-bit network interface 5-bit network interface User programmable (3 to 8 bits selectable) Loop up Loop down
Framing	Inserted, overwritten
Printer output	
Squelch	On, off
Print on demand	Current settings, results snapshot
Auto triggered print	Off, event results, every 15 minutes, every 2 hours, end of test, messages only
Stored settings	
Setting number	User selectable 1 to 5
Fixed setting	0
Title/message	User selectable

Function	Selections
Remote control	
RS-232 mode	Computer control, Terminal control, Hewlett Packard printer, Alternative printer (80 col or Condensed)
ENQ ACK	On, off
X on / X off	Off, Rx only, Tx only, Rx and Tx
Speed	300, 600, 1200, 1800, 2400. 4800, 9600 baud
7 bit data parity	0's, 1's, even, odd
Stop bits	1, 2
Time / date	
Real time clock	Run, set-up
Set-up	23 hours 59 minutes 59 seconds
Date	Day month year
VF access	
Channel	01 to 24
Signalling	A B C D
Audio monitor	On, off
Pulse shape result	
	Rise time, fall time, width, overshoot, undershoot, pass/fail Instantaneous wander, positive wander, negative wander, pk-pk wander

4

Displaying Test Results

The result display choices available are shown on the diagram below. The page numbers lead you to set-up examples.



To Display Alarms

The current alarm conditions are always displayed when the T1 tester is connected to the T1 line.

One or more occurrences of an alarm during a test, since the last history reset, may be displayed at any time until the start of the next test.

A record of total alarm durations may be displayed during or after a test at any time until the start of the next test.

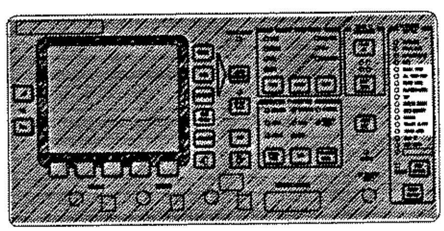
A graphic representation of alarms may be displayed by T1 testers with the graphics facility (see To Display Alarm And Error Graphs).

All alarm displays for previously stored results may be recalled on T1 testers with the storage facility (see To Display Stored Results).

A timed record of alarms may be obtained by triggering a printer output (see PRINTING).

To See the Current Alarm Conditions.

The current alarm conditions are always displayed on the T1 RECEIVE STATUS INDICATORS.

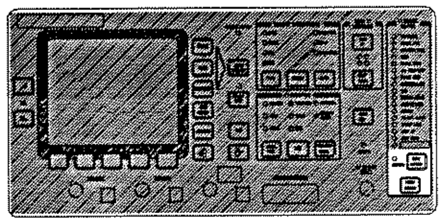


To See the Alarm History

You can run an unattended test and use alarm history to see if any alarms occurred while you were away.

The occurrence of alarms since the start of a test with (START STOP) / (AUTO/RESTART) or since a history reset during a test, is shown while (SHOW HISTORY) is held down.

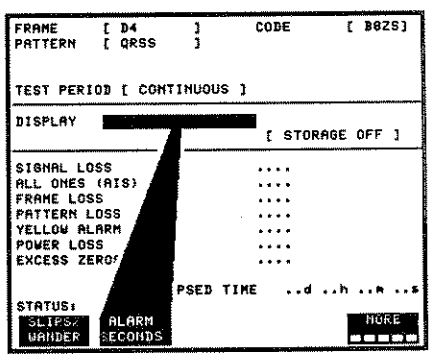
To clear this record press (HISTORY RESET).



To See the Record of Total Alarm Durations.

This record is the total of each type of alarm since the start of the test. The record is reset at the start of each test. The results of ten tests are stored by T1 testers with the storage / graphics facility (see To Display Alarm and Error, Graphs) and (To Display Stored Results).

Press (RESULTS).
Select **ALARM SECONDS**.



To Display Errors

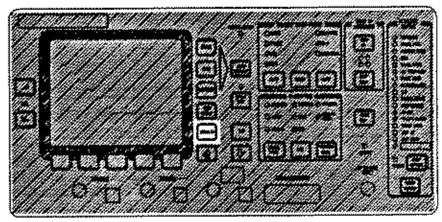
When you run a test, all errors are measured and recorded. You chose how you want to display them. The display can be changed, at any time, during and after the test. The record is reset at the start of each test.
The results of ten tests are stored by T1 testers with the storage / graphics facility.
A timed record of result displays may be obtained by triggering a printer output (see PRINTING).

The choice of display at any one time is :

1. A display of the error count of each error type `TROUBLE SCAN`:
   a. Logic Error Count.
   b. BPV Count.
   c. Frame Error Count.
   d. CRC Error Count.
2. A display of the basic results of one error type in large characters (Logic, Frame, BPV or CRC) `BASIC RESULTS`
   a. Error Seconds.
   b. %Error Free Seconds.
   c. Error Count.
   d. Average Error Rate.
3. A more detailed display of the results of one error type (Logic, Frame, BPV or CRC) `ALL RESULTS` **This shows the basic results plus :**
   a. Synchronous Error Seconds.
   b. Error Free Seconds.
   c. Current Error Rate.
4. The G821 analysis of one error type (Logic, Frame or CRC) `ANALYSIS`.
5. Bar charts of error count updated at selected intervals during the test `GRAPH RESULTS` (see To Display Alarm and Error, Graphs).
6. A complete set of results for the previous ten tests in graphic and numeric form including G821 analysis (see To Display Stored Results).

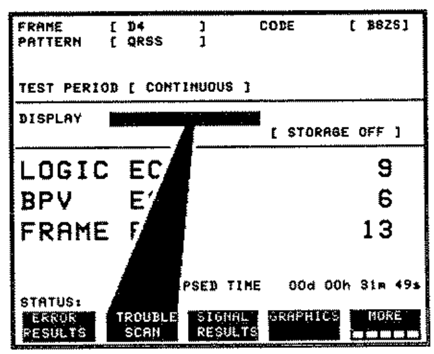
To Select One of the Error Displays

Press (RESULTS).



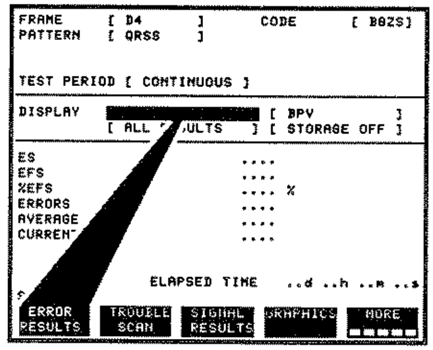
To Display the Error Count of Each Error Type

Select TROUBLE SCAN .

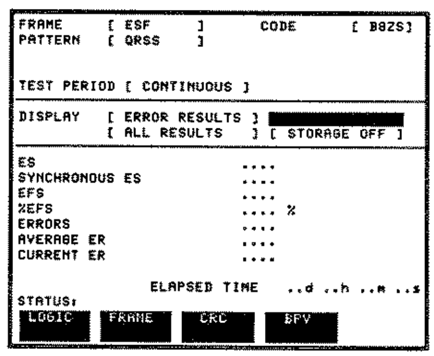


To Display Details of One Error Type

Select ERROR RESULTS.



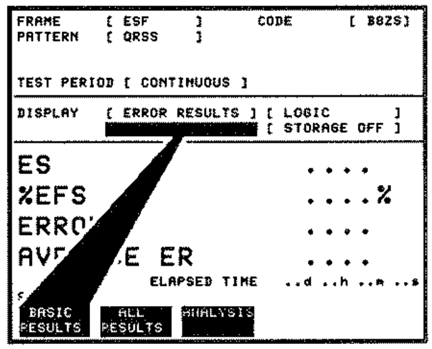
Highlight the Error Type and select the type of error you want to display.



For a Display of Basic Errors in Large Characters

Highlight
DISPLAY [ERROR RESULTS] [ ]
[ ].

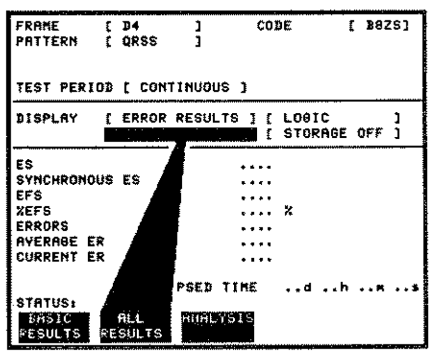
Select BASIC RESULTS.



For a More Detailed Display of One Type Of Error

Highlight
DISPLAY [ERROR RESULTS] [ ]
[ ].

Select ALL RESULTS.

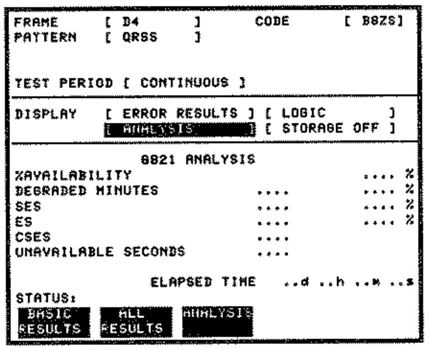


For a G821 Analysis Display of One Type Of Error

The T1 Tester with the optional G821 Analysis facility is required.

Highlight
DISPLAY
[ERROR RESULTS] [ ]
[ ].

Select ANALYSIS.



To Display Alarm and Error Graphs

The T1 tester with the optional graphics facility is required.

During and after a test you can display :

A graphic representation of all alarms (in two sections) simultaneously, with a timescale.
A graphic representation of all types of error count, any two simultaneously, with a timescale.
Any combination of the above : one section of the alarm display with the count of one error type simultaneously.

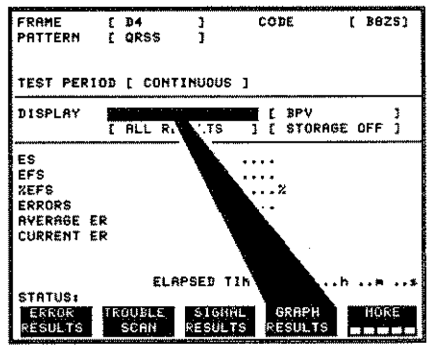
The graphs make it easy to see how errors and alarms relate to each other and to time of day. Knowing the time pattern of errors often helps point to their cause.

The graphs are constructed from results stored at intervals selected before the test (1, 15 or 60 minutes). The displayed resolution is limited to the storage resolution.

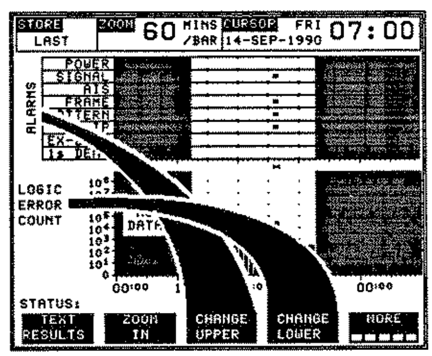
To Select One of the Graphic Displays

To display results as graphs, the test must be started by selecting a storage resolution.

Press (RESULTS).
Select GRAPH RESULTS.

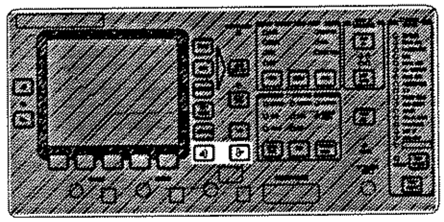


Select each of the two simultaneous displays with CHANGE UPPER and CHANGE LOWER.

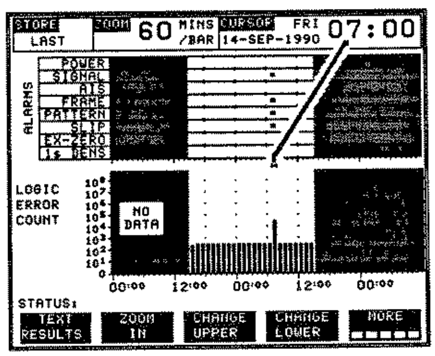


To Select the Time “Window” and Resolution of the Graphic Display

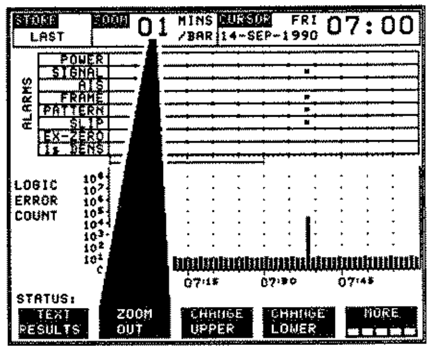
Select the time “window” with and



The start time of the cursor is shown in the CURSOR box.



Select the resolution with ZOOM IN ZOOM OUT.



To Return to the Normal Measurement Display

Press (RESULTS).

To Display Stored Results

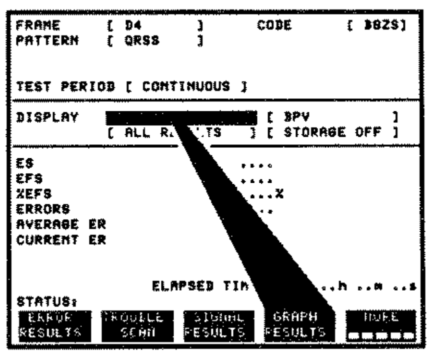
The T1 tester with the optional Storage facility is required.
To display stored results, the test must must have been started by selecting a storage resolution.
You can display the following details of previously stored tests :

The settings used.
The alarms.
The errors and G821 analysis.
The slips and wander.
The alarms and error counts in graphical form.
The test date and time.

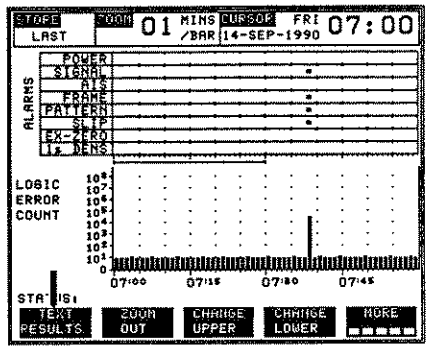
You do not need to carry a printer a printer around. You can store the results and process them later.

To Display One of the Stored Results.

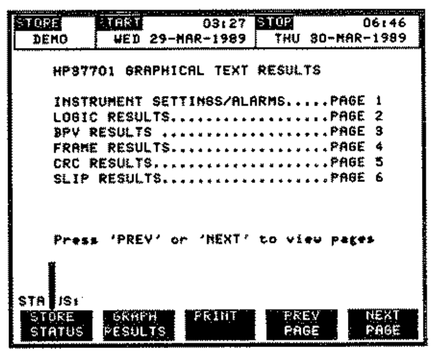
Press (RESULTS).
Select GRAPH RESULTS.



Select TEXT RESULTS.

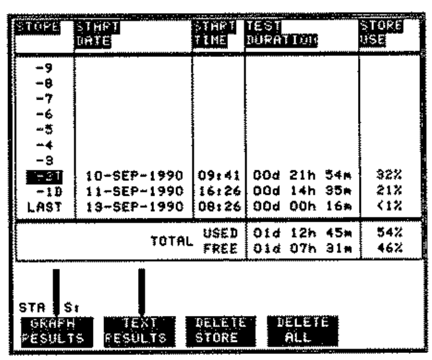


Select STORE STATUS.



Use ⇧ and ⇩ to highlight the test result you want to display.

Select GRAPH RESULT or TEXT RESULT.

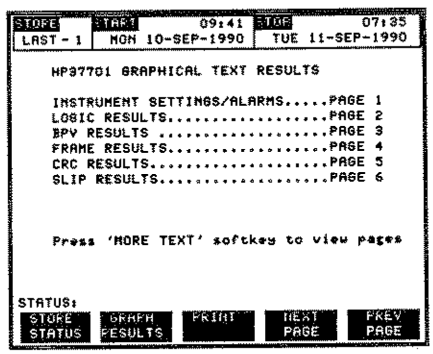


Graphic Display - to Select Error Type or Alarms

see Page 4-9

Numeric Display - to Select Error Type, Alarms or Slips/Wander

Use PREV PAGE / NEXT PAGE to scroll through the displays.



To Return to the Normal Measurement Display

Press (RESULTS).

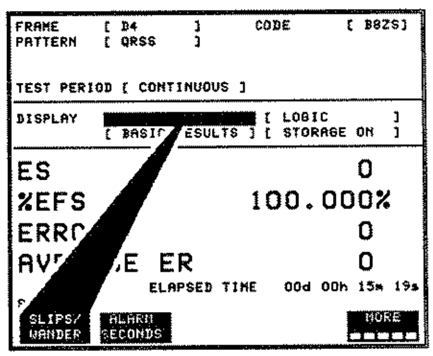
To Display Pattern Slips, Clock Slips and Wander

The T1 tester with the optional clock slips/wander facility is required for display of clock slips and wander.
The T1 tester needs a reference at the front panel TIMING REF DS1 INPUT for any clock slips/wander test.

You can display CLOCK SLIPS in graphical form at any time when the T1 tester is connected to the T1 line and has a timing reference.
PATTERN SLIPS and CLOCK SLIPS counts may be displayed, during or after a test at any time until the start of the next test.
WANDER analysis may be displayed, during or after a test at any time until the start of the next test.
The recorded total PATTERN SLIPS counts, CLOCK SLIPS counts and WANDER analysis, for each of the previous ten stored test results, may be displayed if a T1 tester with the optional clock slips/wander facility and the optional storage facility is used (see To Display Stored Results Page xx).

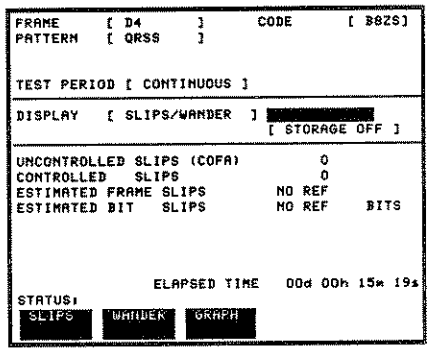
To Select One of the Slips/wander Displays

Press (RESULTS).
Select SLIPS or Slips/wander depending on facilities available.



For T1 Testers with the Clock Slips/Wander Facility.

Highlight
[SLIPS /WANDER] [ ].
Select SLIPS WANDER or GRAPH.

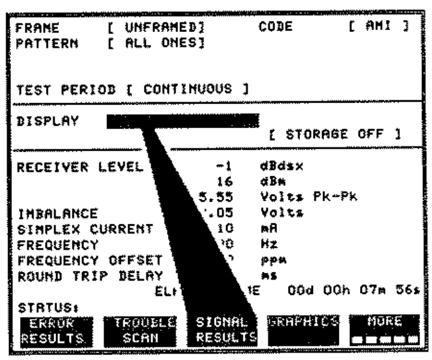


You can quickly see timing differences between two T1 signals with the high resolution of the slips graph feature.

To Display Signal Results

Signal results may be displayed at any time when the T1 tester is connected to a T1 line. Round trip delay is displayed when the QRSS pattern is selected. For high resolution round trip delay see chapter 3.

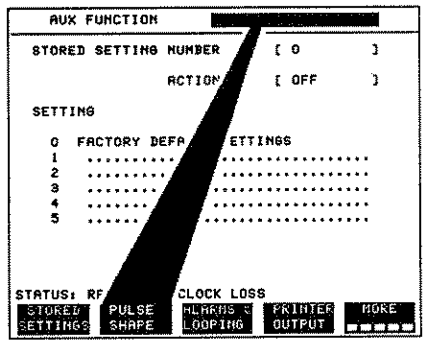
Press (RESULTS).
Select SIGNAL RESULTS.



To Display Pulse Shape

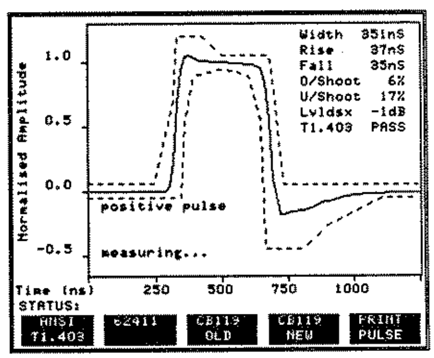
The T1 tester with the optional pulse shape facility is required.
Pulse Shape may be displayed at any time when the T1 tester is connected to a T1 line.

Press (AUX).
Select `PULSE SHAPE`.



To Change the Pulse Mask

Select `T1.403`, `62411`, `CB119 OLD` or `T1.102/119 NEW`.



To Return to the Normal Measurement Display

Press (RESULTS).

5

Preparing To Print Results.

Printing is enabled by selecting the one of the printing functions of the RS232 connector.
The T1 tester can be set to provide an RS232 output to any one of three types of printer:

1. Any Hewlett - Packard 80 column printer (recommended type HP2225D).
2. An alternative type which may be:
   a. Any other 80 column printer.
   b. A 40 column printer which is capable of handling 80 column condensed format.

Cabling information is given in the Installation chapter of this manual.

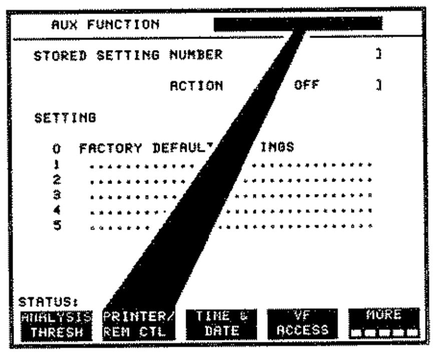
To Select a Printer Output.

An output suitable for the printer being used, must be selected before any print operation can be performed.

To Select an Output Suitable for a Hewlett - Packard 80 Column Printer.

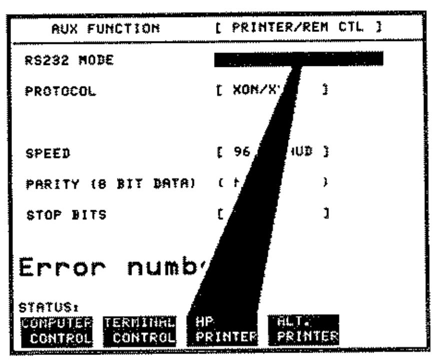
Press (AUX).

Select `PRINTER REM CTL`.



Highlight RS232 MODE `[ ]`.

Select `HP PRINTER`.

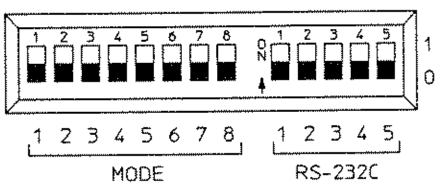


Example Set-Up Using a Hewlett-Packard Thinkjet Printer, Model 2225D.

To make the printer and T1 tester compatible, the switches on the rear panel of the printer, MODE and RS-232C, and the settings on the T1 tester AUX, PRINTER / REMOTE CONTROL display must be compatible.
The following example gives one set of compatible settings and the information necessary to select alternatives.

Printer

Printer MODE and RS-232C Settings

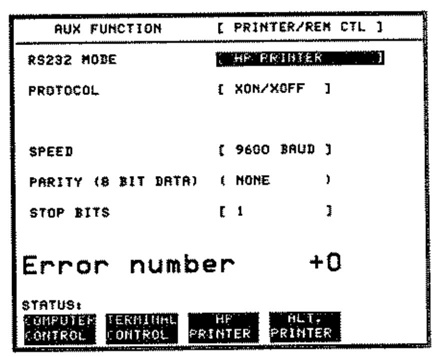


The MODE switches :
1,2 and 5 = 0 : for all interfaces.
3 = 0 : no perforation skip.
4 = 0 : 11 inch paper length.
4 = 1 for 12 inch.
6, 7 and 8 = 0 : ROMAN characters.

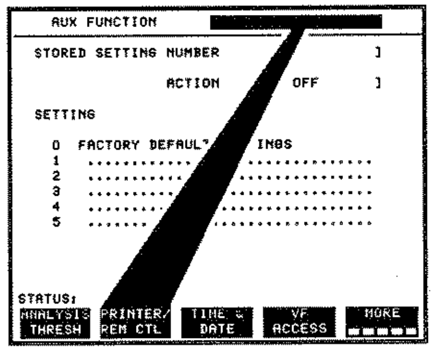
The RS 232C switches :
1 = 0 : XON/XOFF.
1 = 1 for DTR set.
2,3 = 0 : parity none / 8 bit data .
2,3 = 0,1 odd / 7 bit data,
2,3 = 1,0 even / 7 bit data,
2,3 = 1,1 one / 7 bit data.
4,5 = 0 : 9600 baud.
4,5 = 0,1 19200 baud,
4,5 = 1,0 2400 baud,
4,5 = 1,1 1200 baud.

T1 Tester

Compatible T1 Tester AUX PRINTER / REM CTL display.

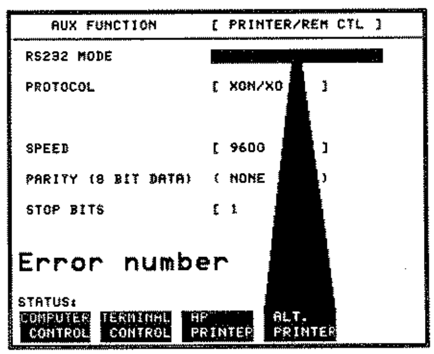


To Select an Output Suitable for an Alternative Printer.



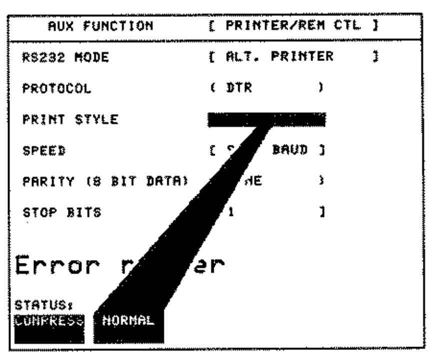
Press (AUX).

Select PRINTER REM CTL.



Highlight RS232 MODE [ ].

Select ALT. PRINTER.



Highlight PRINT STYLE [ ].

For an 80 column printer select NORMAL.

For a 40 column Printer select COMPRESS.

Set the PROTOCOL, SPEED, PARITY and STOP BITS to be compatible with the printer being used.

6

Printing Results

Before printing results, an RS232 output, suitable for the printer being used, must be selected (AUX - PRINTER REM CTL). Selection details are given in Chapter 5, Preparing to Print Results.

The following printer outputs are available:

Print	Availability
Major alarms only.	Automatically triggered
Alarms and Error count.	Automatically triggered. For previous tests as graphs *.
Signal details.	The existing signal details at any time.
Full results.	Automatically triggered. At any time up to the start of the next test. For previous tests in tabular form *.
Pulse shape.	The existing pulse shape at any time *.
Full T1 tester settings.	The existing settings at any time.

* Availability depends on T1 tester option.
Selections may be changed during a test.
Print on demand is available while auto triggered print is in use.

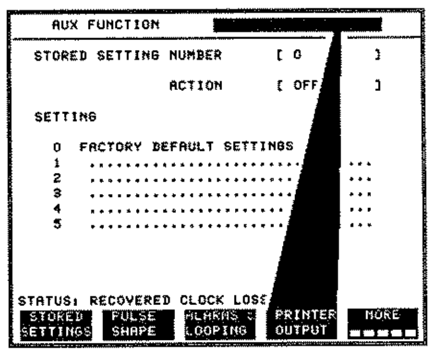
To Print Only the Occurrence of Major Alarms.

The date, time and state of the following alarms are printed when any of them occur or clear:

- Power loss
- Signal loss
- All ones
- Frame loss
- Pattern loss

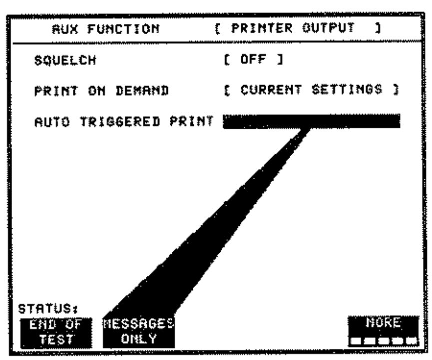
Press (AUX).

Select PRINTER OUTPUT.



Highlight AUTO TRIGGERED PRINT [ ].

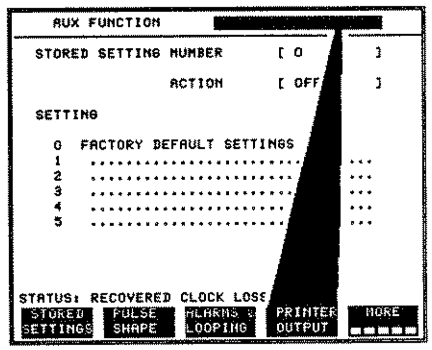
Select MESSAGES ONLY.



To Suppress Printing After 10 Consecutive Seconds with Major Alarms.

Press (AUX).

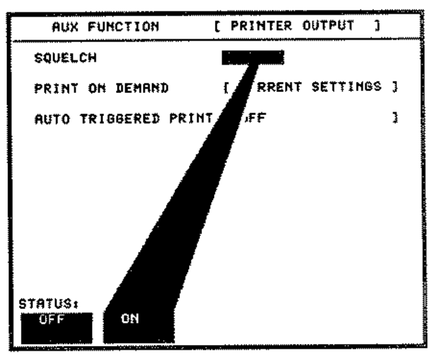
Select PRINTER OUTPUT.



Highlight SQUELCH [ ].

Select ON.

Printing is restored after 2 error free seconds.



To Print Only Alarms and Error Count

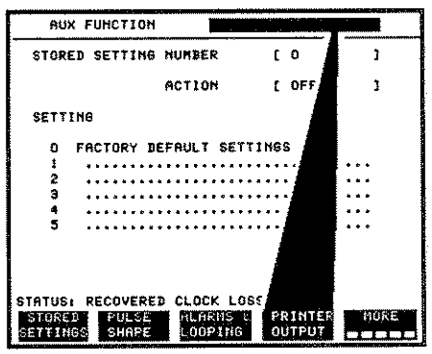
The following choices are available:

1. An automatically triggered print of the test being run.
2. A print in graphical form of a stored result if the T1 tester has the optional storage facility.
   a. Between the end of a test and the start of the next test.
   b. For any of the previously stored test results.

To Automatically Trigger a Print of Alarms and Error Count.

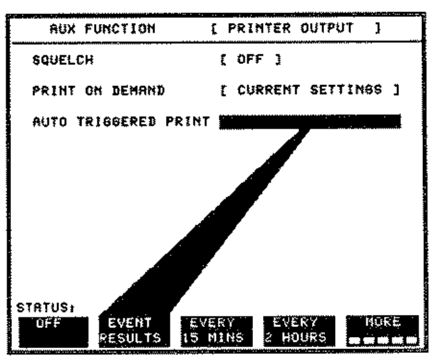
Press (AUX).

Select PRINTER OUTPUT.



Highlight
AUTO TRIGGERED PRINT [ ].

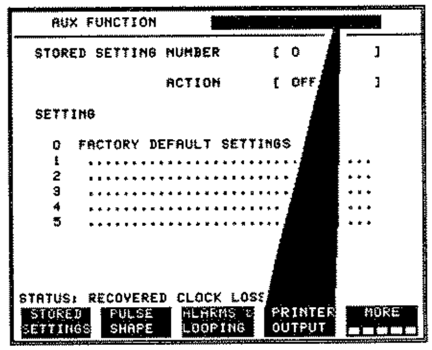
Select EVENT RESULTS.



To Suppress Printing After 10 Consecutive Seconds with EVENT Results

Press (AUX).

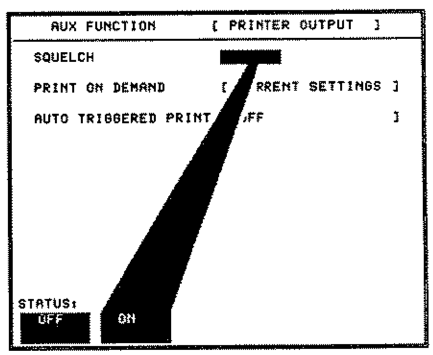
Select PRINTER OUTPUT.



Highlight SQUELCH [ ].

Select ON.

Printing is restored after 2 error free seconds.



To Print Graphs of Alarms and Error Count.

The T1 tester with the optional graphics facility is required.

What you get is what you see plus alarms.

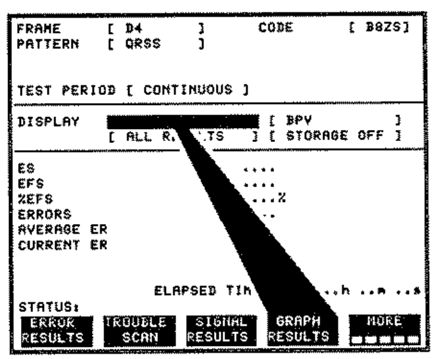
The general procedure is:
Get the result of the test as a graphic display.
Select the pair of error result graphs to be printed.
Select the time period and resolution.
Press PRINT.

Three graphs are printed. The two selected plus a graph of ten alarms (all except Loop up / loop down).
If alarms are displayed an additional graph will be printed.
Results of live traffic, frame off, tests produce only the two valid graphs, BPV errors and alarms.

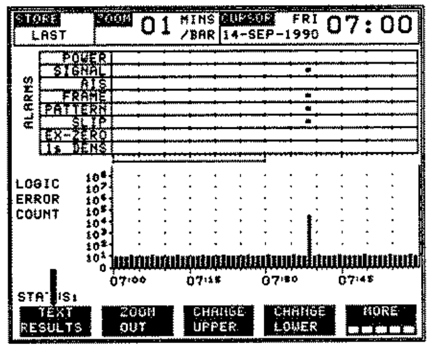
NOTE : The test must have been started by selecting a storage resolution.

Press (RESULTS).

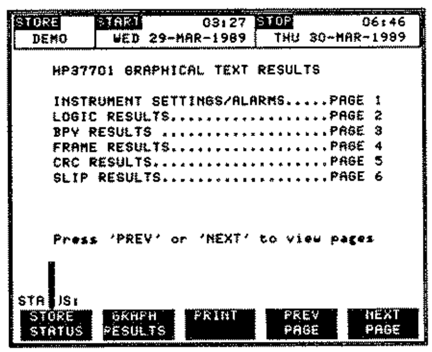
Select GRAPH RESULTS.



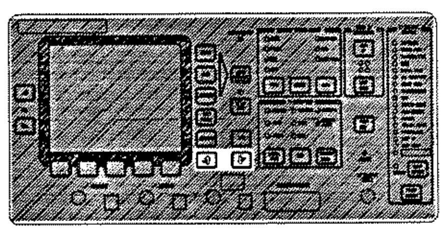
Select TEXT RESULTS.



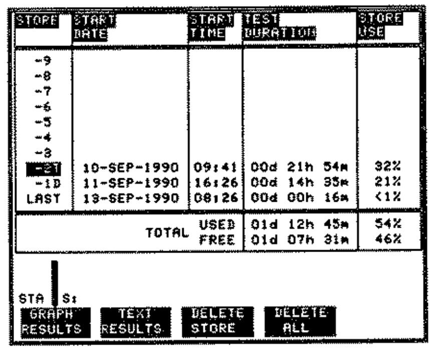
Select STORE STATUS.



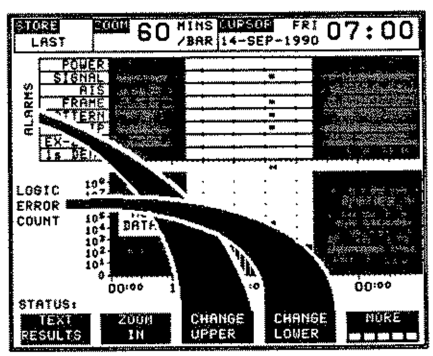
Use ⇧ and ⇩ to highlight the test result to be printed.



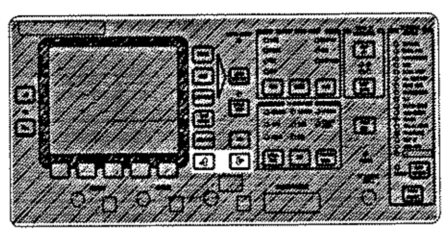
Select GRAPH RESULTS.



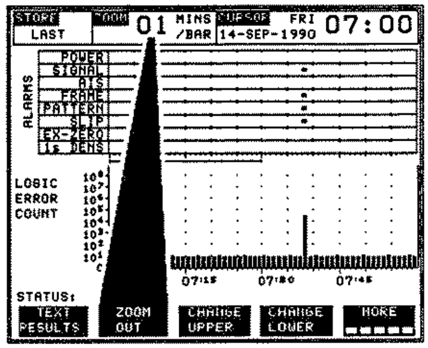
Display the graphs to be printed by selecting CHANGE UPPER and CHANGE LOWER.



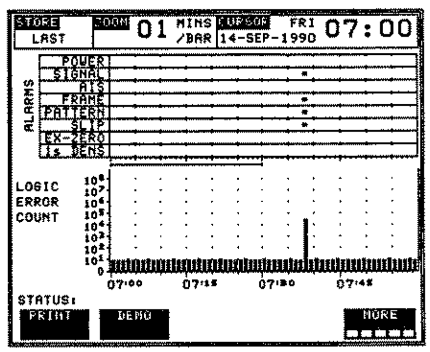
Select the time "window" with and .



Select the resolution with ZOOM IN ZOOM OUT.



Select PRINT.



To Print Signal Details

Signal details may be printed on demand during a test.

The signal details are printed as part of a full results print, see the following information on "To Print Full Results".

To Print Full Results

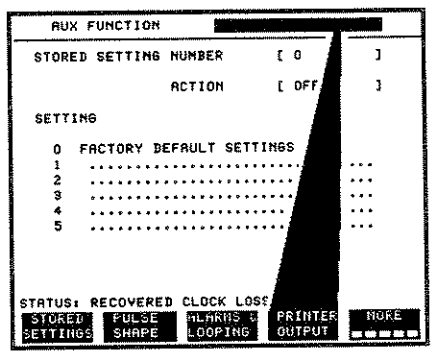
The following choices are available:

1. An automatically triggered print at time intervals or at the end of the test.
2. A print on demand during or after a test, up to the start of the next test.
3. A print in tabular form of a stored result.

To Automatically Trigger a Print of Full Results.

Press (AUX).

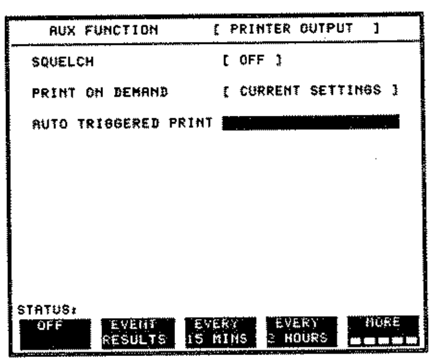
Select PRINTER OUTPUT .



Highlight
AUTO TRIGGERED PRINT [ ] .

Select how often you want to print.
The following choices are available:

- Every 15 minutes EVERY 15 MIN .
- Every 2 hours EVERY 2 HOURS .
- At the end of the test END OF TEST .

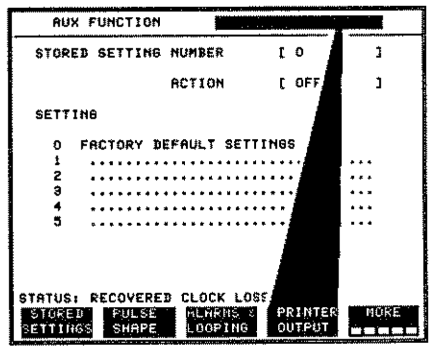


To Print Full Results On Demand

The present state of the test may be printed during a test. In this case the analysis, although printed, may not be meaningful.
The full results may be printed at any time after a test up to the start of the next test.

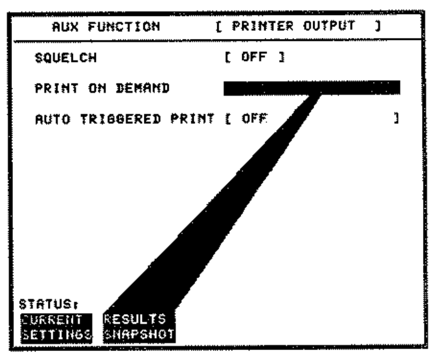
Press (AUX).

Select PRINTER OUTPUT.

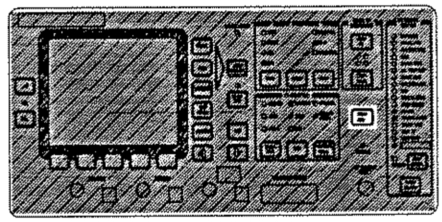


Highlight
PRINT ON DEMAND [ ].

Select RESULTS SNAPSHOT.



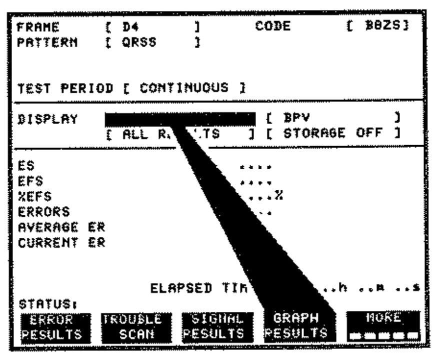
Press (PRINT NOW).



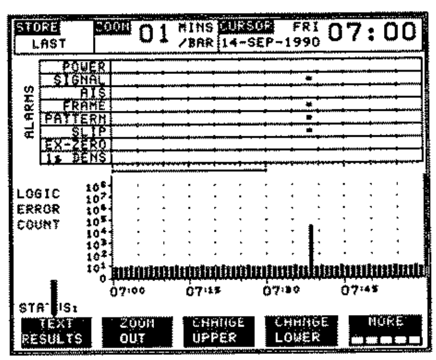
To Print the Stored Results of a Previous Test

The T1 tester with the optional results storage facility is required.

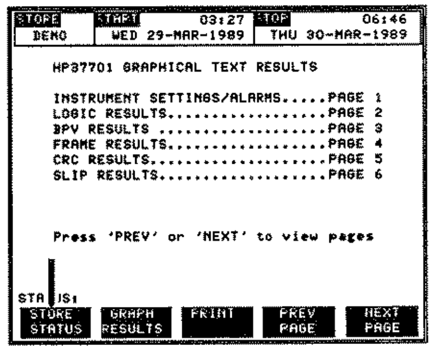
Press (RESULTS).
Select GRAPH RESULTS.



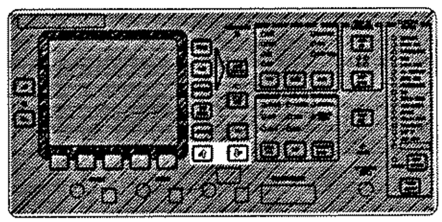
Select TEXT RESULTS.



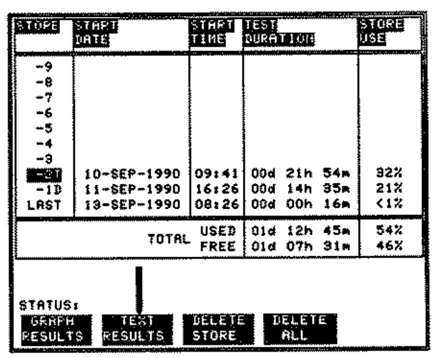
Select STORE STATUS.



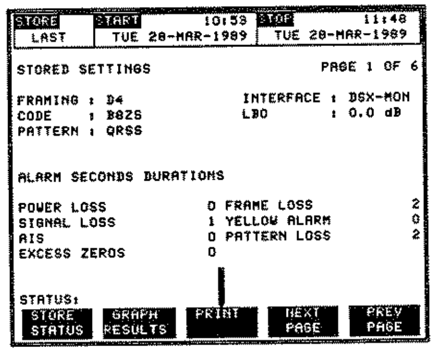
Use ⇧ and ⇩ to highlight the test result to be printed.



Select TEXT RESULT.



Select PRINT.

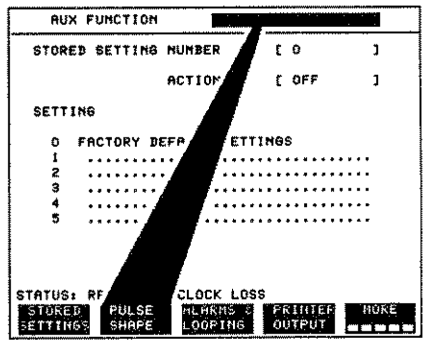


To Print the Pulse Shape

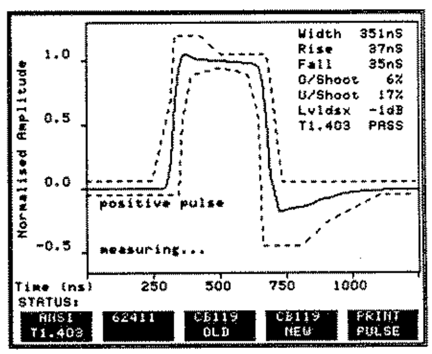
The pulse shape may be printed at any time during a test.

Press (AUX).

Select PULSE SHAPE.



Select PRINT PULSE.

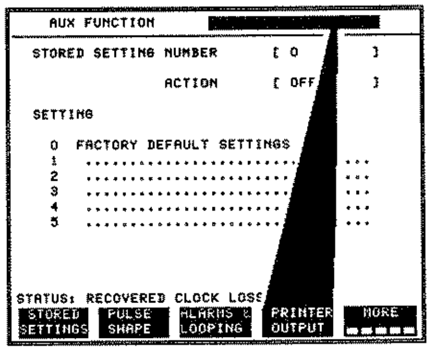


To Print the Full T1 Tester Settings.

The full T1 tester settings may be printed at any time.

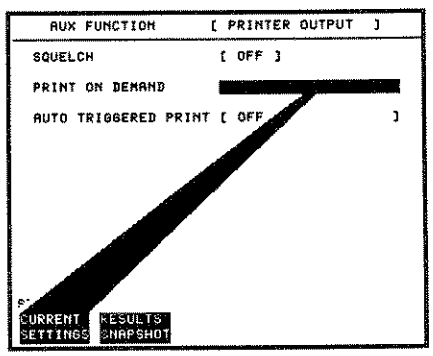
Press (AUX).

Select PRINTER OUTPUT.

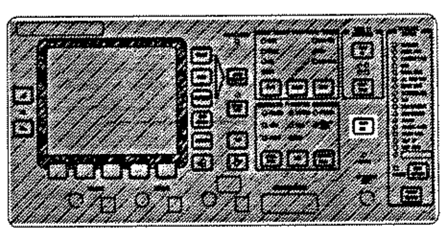


Highlight
PRINT ON DEMAND [ ].

Select CURRENT SETTINGS.



Press (PRINT NOW).



7

General Information

Introduction

This manual contains information which allows the user to operate and calibrate the Hewlett-Packard Model 37701A T1 Tester. The T1 tester may be part of An HP 37711A T1/Datacom Test Set.

On the title page of this manual is a Microfiche Part Number. This number can be used to order 4 X 6 inch microfilm transparencies of the manual.

Each microfiche contains up to 96 photo duplicates of the manual pages.

Specification

Instrument specifications are listed on Page 7-4. These specifications are the performance standards or limits against which the instrument is tested.

Safety Considerations

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The instrument and manual should be reviewed for safety markings and instructions before operation. Also read the Warning page at the front of this manual.

Options Available

The following options are available and may have been ordered with the T1 Tester:

Option 001	Pulse Shape, Clock Slips and Wander Measurement Facility.
Option 002	Alternative Power Source, Internal Battery.
Option 003	Results Storage and Graphic Presentation Facilities.
Option 004	Fractional T1, Timeslot check and Timeslot high resolution round trip delay.
Option 910	Provides an additional copy of the Operating and Calibration Manual.
Option 915	Used for ordering a copy of the Service Manual to enable a service trained person to troubleshoot and repair the instrument.
Option W30	3-year Extended Support. W30 is an extended hardware support agreement. It provides 2-year extended hardware support beyond the standard 1-year return to bench warranty.

To See a Display of Options Fitted to your T1 Tester.

Press (AUX) and select OPTIONS

Accessories Supplied

The accessories supplied with the T1 Tester are:

Accessories Supplied	*Part Number*
Power Cord	See Installation
Operating and Calibration Manual	HP 37701-90006
Protective Front Cover	HP 37701-00002

Accessories Available

The following accessories are available and may have been ordered with the T1 Tester:

HP 15901A	Datacom Module.
HP 15513A	Test Cord, WECO 310 - WECO 310, length 1m (3 feet).
HP 15513A H02	Test Cord, WECO 310 - WECO 310, length 3m (10 feet).
HP 18182A	Test Cord, WECO 310 - Alligator clips.
HP 15670A	Test Cord, Bantam - Bantam, length 3m (10 feet).
HP 15707A	Test Cord, DB15 male - modular RJ48, length 3m (10 feet).
HP 92219H	Cable, RS-232-C, T1 Tester (DTE) - Terminal / Computer (DTE), Gnd,Tx,Rx only.
HP 5060-4461	Cable, RS-232-C, T1 Tester (DTE) - Modem (DCE), Gnd,Tx,Rx only.
HP 15711A	19-inch rack mount kit.
HP 15710A	Carrying Case.
HP 2225D	Printer, ThinkJet RS-232-C.
HP 15714A	Cable, T1 Tester - HP 2225D Printer.
HP 5060-4462	RS 232 Test plug.

Specification

Except where otherwise stated the following parameters are warranted performance specifications. Parameters described as "typical" or "nominal" are supplemental characteristics which provide a useful indication of the typical, but non-warranted, performance characteristics.

Specifications

Framing: D4, ESF, SLC-96 (Ft only), Unframed
Line Code: AMI, B8ZS

Test Patterns

QRSS:	2^20-1 PRBS, D20+D17+1=0 with 14 zero limit
2^15-1 PRBS:	D15+D14+1=0
2^20-1 PRBS:	D20+D17+1=0
2^23-1 PRBS:	D23+D18+1=0
All ones	
1:1	(101010 ...)
1:7	(01000000 ...)
3 in 24	(01000100 00000000 00000100 ...)

55 OCTET, (Network Equipment Technologies)
User programmable word, length 3 to 24 bits
4 user programmable patterns, length 8 to 1024 bits in 8 bit intervals. Pattern programmed in hexadecimal from the front panel or over remote control. The order of bit transmission is selectable.
Live (for use when monitoring live traffic)

Notes: Framing bits are inserted into these patterns in D4, SLC96, and ESF modes. For any user pattern with a pattern length which is a sub-multiple of the frame length (192 bits), the pattern is synchronized to the frame such that the F-bit always occurs at the start of the pattern. This helps to prevent excess zeros caused by framing.

All Signaling Bits Display
Used to display the signaling bits for all receive channels. The transmit signaling bits can be set in all signaling channels.

Auto/Restart
Framing, line code and pattern are automatically determined. The previous measurement results are zeroed and the instrument restarts measuring.

Monitor Mode
Monitor mode is for use on live traffic where no known test pattern exists. No

pattern synchronization is attempted and pattern error results and pattern slips are not presented. Monitor Mode can be selected by setting the test pattern to "Live". It is automatically set on pressing Auto/Restart if no recognizable pattern is found.

TRANSMITTER

Transmitter timing

The transmitter can be timed from the clock recovered at the receiver (loop timed) or from the internal clock

Internal Tx Clock

Frequency:	1.544 MHz
Stability:	±5 ppm 0 to 40°C (nominal).
	±10 ppm 0 to 50°C
Ageing:	±2 ppm per year typical

Tx Error Add

Types:	Logic, BPV, Frame or CRC (ESF only)
Rates:	Selectable 10^-3, 10^-4, 10^-5, 10^-6 or 10^-7, or SINGLE

Notes: Logic errors are inserted only in test patterns, not in framing bits. They include both 0 to 1 and 1 to 0 conversions without violating the 15-zero constraint in the case of QRSS. With ESF they are inserted before CRC calculation and so do not result in CRC errors. Pattern error insertion never causes bipolar violations, CRC or frame errors. Bipolar violations are inserted across both data bits and F-bits. They include both + to - and - to + conversions with equal probability. Other conversions are excluded since they would result also in logic errors. BPV insertion does not cause logic, CRC or frame errors nor affects B8ZS coding. Frame errors are only added to those F-bits which are used for framing. A CRC error is added by inverting one of the 6 CRC bits in a CRC block (an ESF multiframe). An error injection rate of 10^-n corresponds to one errored CRC block in 10^n CRC BLOCKS.

Specifications

Tx Alarms

AIS: Unframed All Ones.

Yellow Alarm: bit 2 of each timeslot = 0 (D4 and SLC-96) 8 ones/8 zeros pattern in facility data link (ESF)

Validity: Alarms can be generated with any test pattern. They are disabled when loop codes are being generated. Yellow alarm is not available in unframed mode.

Tx loopback codes (in-band)

Loopback	Loop-up code	Loop-down code
Line loopback	10000	100
4-bit "smrtjack" (NI)	1100	1110
5-bit "smrtjack" (NI)	11000	11100
User	xxxxxxxx	xxxxxxxx

The loopback codes may be sent with or without framing. With framing, the default state is that the framing bits temporarily overwrite the loopcode. The user can select framing to be inserted in loopcodes. The loop-up code is sent for 8 seconds, or will stop after loop-up is detected at the receiver. If loop-up is detected within the first second, a "Pre- exist loop" will be flagged. The loop-down code will be sent for 8 seconds, or will stop when the loop-down code ceases to be received. If no loop-down code is detected at the receiver within the first second, then the instrument cannot determine whether the far end has unlooped and the transmission of loop-down will continue for the full 8 seconds. Accuracy of loopcode intervals: ± 1 Second.

Tx loopback codes (out-of band)

Out-of-band loopback is only available with ESF framing. Loopcodes (16-bit message) are sent in the ESF 4 kbit/s data link in the format:

Loopback	Loop-up code	Loop-down code
Line loopback	00001110 11111111	00111000 11111111
Payload loopback	00010100 11111111	00110010 11111111
Smartjack loopback	00010010 11111111	00100100 11111111

Out–of–band loopcode repetition: 15

Idle code. When not transmitting loopcodes, the tx sends idle code (repeated 01111110) in the data link.

Output

Impedance:	100 ohm balanced (nominal)
Pulse Shape:	meets ANSI Standard T1.102-1987
Pulse Height:	$\pm$3V $\pm$600mv (at the center)
Pulse Imbalance:	Ratio of voltage in +ve and -ve pulses; 0 $\pm$ 100 mV
Pulse Width:	324 $\pm$30 nsecs (measured at half amplitude)
Rise & Decay Time:	75 ns maximum. (10% to 90%)
LBO:	7.5dB and 15dB nominal

RECEIVER

DSX-MON

For connection to protected monitor points. Automatic gain control (AGC) between 0 and +36dB compensates for the flat loss at these points, no specific frequency dependent gain is provided except $\pm$6db DSX is allowed for cross connect cabling.

Rate:	1.544 Mb/s $\pm$ 130 ppm
Pulse shape:	DSX-1 compatible per ANSI Std T1.102-1987
Input Impedance:	100 ohms nominal
Dynamic Range:	+6 to -30dB relative to DSX-1 level

TERMINATED

For terminating unprotected DSX-1 points or line terminations up to -36db caused by lines of approx 6000 feet of cable. Frequency dependent gain is provided.

Specifications

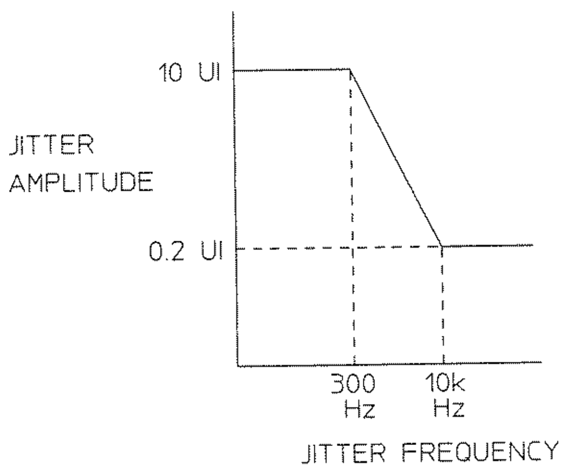
Input Impedance: 100 ohms nominal
Dynamic Range: 6V pk-pk to 95mV pk-pk or 0 to +36db equalization @ 772kHz

BRIDGE

For use where the circuit is already terminated. Specification as TERMINATED, except input impedance is 1kohm (nominal).

Jitter Tolerance

The receiver will operate without error in the presence of a signal with jitter within the nominal mask shown below. These specifications apply for data with maximum zero runs of 14.



Alarm LEDs (red)

The indication remains for 100 ms beyond the duration of the alarm condition. The history function shows any alarm which occurred during the last measurement period.

Signal Loss: triggered by 175 or more consecutive zeros at the receiver (TR-TSY-000475)
All ones (AIS): triggered when any two consecutive frames contain less than 3 zeroes

Frame Loss:	see Frame Loss Criteria
Pattern Loss:	triggered by loss of synchronization to the selected test pattern
Slip:	triggered by controlled or uncontrolled slips (out-of-service testing only)
Excess Zeros:	triggered by >15 consecutive zeros
Ones Density:	triggered by a received ones density <12.5% over a 100mS period
Errors:	triggered by an error from any of the available sources in any 1 Second period
Yellow Alarm:	triggered by bit 2 of every timeslot set to zero (D4 and SLC-96) or facility data link contains repeated 1111111100000000 (ESF)
Power loss:	triggered when power is removed from the instrument during a measurement period
Loop up:	triggered when the instrument detects a loop up code (as defined on the AUX TX/RX page) for at least 100mS
Loop Down:	triggered when the instrument detects a loop down code (as defined on the AUX TX/RX page) for at least 100mS

Excess Wander (Optional):	triggered when greater than 5 UI of wander is exceeded in any 15 minute period or 28 UI in any 24 hour period
Status LEDs (green):	T1 pulses, Frame Sync, Pattern Sync, B8ZS

Signal Indication

The presence of T1 pulses is indicated when 1) A 1544 kHz clock ± 500ppm (nominal) is recovered, and 2) Peak levels (nominal) are between +6 and -30 dBdsx (DSX-MON) or 0 and -36db at 772 kHz (TERM or BRIDGE).

Frame Sync Criteria

D4:	24 consecutive error-free Ft and Fs bits (nominal)
ESF:	24 consecutive error-free Fe bits and then 3 CRC error-free multiframes (nominal)
SLC-96:	24 consecutive error-free Ft bits (nominal)

Specifications

Frame Loss Criteria

D4:	2 in 4 Ft bits in error
ESF:	2 in 4 Fe bits in error
SLC-96:	2 in 4 Ft bits in error

Pattern sync

Sync Loss:	Sync loss is deemed to have occurred if the error ratio exceeds 4% as measured over a decisecond
Sync Gain:	Sync is regained after 32 error-free clock periods

Test Period

Range:	1 minute to 100 days or continuous.
Resolution:	1 minute/1 hour/1 day
Fixed intervals:	5 min,15 min,2 hour
Indicator:	Green LED above START/STOP key is illuminated while measurement is in progress

CSU EMULATION

Status Messages

Loop codes are as set for the transmitter. If a set loop code is detected the presence of LOOP UP or LOOP DOWN will be indicated on the Receive Status LED's (latched by the "history" function).

Autoresponse Mode

In-Band	If Autoresponse is ON, the instrument performs a line loopback if the LOOP UP code is present > 5 seconds. If the LOOP DOWN code is detected and Autoresponse is ON, the instrument removes the line loopback if the LOOP DOWN code is present for more than 5 seconds (nominal). The line loopback can be set ON/OFF manually. Tx error injection and alarm generation are disabled in Line loopback mode.

Out-of-Band When autoresponse is enabled the instrument responds to any out–of–band loopcode. There are two types of loopback available *LINE* and *PAYLOAD*. The loopcodes are as follows:

Received Code	Tester Response
Line loop-up	Enable line loopback
Line loop-down	Disable line loopback
Payload loop-up	Enable payload loopback
Payload loop-down	Disable payload loopback
Smartjack loop-up	Enable line loopback
Smartjack loop-down	Disable line loopback

The instrument is capable of having both loopbacks (line and payload) enabled simultaneously. When this occurs, the net effect is line loopback.

The current status of the two loopbacks is indicated on the LOOPCODES display, these can be manually overridden at any time by the user. The instrument TESTER LOOPED LED lights when either loopback is enabled.

Loopcode Detection

Out-of-Band The receiver constantly monitors for a valid 16-bit message on the ESF data link. Valid messages will remain for at least 10 repetitions and each takes 4 ms. The instrument samples the messages every 5 ms, and a valid loopcode will be flagged whenever 6 out of the last 5 ms samples have contained the same valid loopcode.
Loopcodes are not detected if PATTERN is set to SPECIAL.

Loopback	Loop-up code	Loop-down code
Line loopback	00001110 11111111	00111000 11111111
Payload loopback	00010100 11111111	00110010 11111111
Smartjack loopback	00010010 11111111	00100100 11111111

Line Loopback

When line loopback is selected or set by the LOOP UP code, loop timing is forced and the instrument retransmits the recovered receive data. BPVs, frame errors, CRC errors and logic errors are all preserved.

MEASUREMENTS

Error sources:	Logic errors, BPVs, Frame errors (Ft & Fs bits for D4 mode, Fe bits for ESF mode, Ft bits for SLC-96 mode), CRC errors (ESF only)
	For B8ZS the zero replacement code will not be reported as a BPV error (0V10V1).

Recovered Clock Frequency Measurement

Resolution:	1 Hz
Accuracy:	± 5ppm 0 to 40°C (nominal) ± 10ppm 0 to 50°C
Ageing:	±2ppm per year,typical
Result Presentation:	Absolute frequency (Hz) and frequency offset in ppm from 1544000Hz.

Pattern Slip Measurements

Valid for all PRBS patterns. If framing is present, then CONTROLLED and UNCONTROLLED slips can be distinguished. For unframed modes it is meaningless to use these terms, and a single measurement of SLIPS is made.

Slip Criteria:	Once the error detector has gained sync, a pattern slip is counted if the received pattern is the same as the test pattern over 32 consecutive bits and Sync Loss is simultaneously true.
Uncontrolled Slip:	If a pattern slip is accompanied by a COFA (change of frame alignment) then it is an uncontrolled slip.
Controlled Slip:	If a pattern slip is not accompanied by a COFA then it is a controlled slip (or frame slip).

Simplex Current Measurement

Volt Drop:	Nominal 8 Volts drop @ 60mA
Range:	from ± 10 to ± 200 mA (Unsigned)
Accuracy:	5% ± 1mA
Resolution:	1 mA

Specifications

Simplex current measurements are possible on all front panel Tx/Rx connectors.

Caution

Span Power Measurements
Extreme care should be taken when operating with hazardous voltages. Span power can generate voltages of up to ± 130V dc.

A dc connection is provided between the receiver and the transmitter paths for operation on wet lines. Ensure span power is removed before connecting or disconnecting the test set.

Signal Level Measurement

Presentation:	Volts, dBdsx and dBm (the dBm result is the dBdsx result plus 17dB, correct for an all-ones signal)
Range:	+6dbdsx to -36 dBdsx (12 Volts to 100mV peak to peak)
Voltage Accuracy:	± 10% (2V to 12V), ± 30% (100mV to 2V)
Voltage Resolution:	50mV (2V to 12V), 10mV (60mV to 2V)
Level Accuracy:	± 1dB (-9dBdsx to +6dBdsx) ± 2dB (-19dBdsx to -10dBdsx) ± 3dB (-36dBdsx to -20dBdsx)
Level Resolution:	1dB

Round Trip Delay Measurement

Only valid for QRSS

Range:	1mS to 670mS
Resolution:	1mS
Accuracy:	3% (nominal)

CHANNEL ACCESS

The user can select a single channel (1..24) to be demultiplexed from the incoming T1 stream and u-law decoded D1D, D2 or D3/D4 channel assignment mapping can be selected. The VF signal can be monitored on a loudspeaker mounted behind the instrument front panel or can be fed to an external instrument. The signaling bits associated with the selected channel or all channels simultaneously may be displayed. Voice frequency access, and signaling bit access are available for D4, ESF and SLC−96 modes.

VF Output

Output Impedance: 600 ohm balanced (nominal)
Reference Level: 0dB TLP (nominal)
Dynamic Range: +3dBm to -50 dBm relative
Frequency Response: Within ± 0.25 dB from 300Hz to 3KHz (nominal)
Ref 1010 Hz at -10 dBm: Within +0.25dB,-0.9dB (nominal)

Signal-to-Quantisation Noise Ratio

1010 Hz Level	Quantisation Noise
0 dBm to -30 dBm	-35 dB minimum (nominal)
-30 dBm to -40 dBm	-29 dB minimum (nominal)
-40 dbm to -45 dBm	-24 dB minimum (nominal)

Gain Tracking Error

1010 Hz Level	-10 dBm error
+3 dBm to -40 dBm	± 0.3 dB maximum (nominal)
-40 dBm to -50 dBm	± 0.6dB maximum (nominal)

Intrinsic Noise: <15 dBrnco (nominal).

RESULTS

Error Results

Error Count. Errors are counted for all sources over total elapsed time. Counting is not inhibited during alarm conditions, except during pattern sync loss for 300ms (nominal) following instrument power restoration and during signal loss. The counting of errors during pattern loss is user selectable over remote control.

Elapsed time starts after a signal has been detected at the input. BPV results are available at this time. Frame and CRC results are available only after frame sync has been achieved during a measurement. Pattern (logic) results are available after pattern sync has been achieved.

Error Seconds. Asynchronous error seconds are counted for all error sources

Error Count and Error Second. 6-digit display for < 1,000,000 errors, X.XXX Exponent YY display for >= 1,000,000 errors. For CRC error counts, an incorrect CRC checksum is counted as one error.

Ave. Error Ratio. Average error ratio over total elapsed time

Cur. Error Ratio. Current error ratio, measured over the last second

Error Ratio Format. X.X Exponent YY display

Error Free Seconds. The number of error free seconds expressed as a count

% Error-free Secs. The number of error free seconds expressed as a percentage of the number of seconds in the measurement period

Percentage format. XX.XX% or 100.00%

SEF Count. Count of Severely Errored Framing events (SEFs) within the measurement period. An SEF event occurs if 2 or more errors are detected in the framing pattern within a 3 ms period. Consecutive 3 ms periods are examined. Valid in ESF mode only.

OOF Count. Count of Out Of Frame events (OOFs) within the measurement period. An OOF event occurs if 2 or more errors are detected in any 4 consecutive frame bits. Valid in all framed modes.

LOF Count. A count of the number of times a frame loss occurs for >3 seconds

Frame Loss Seconds. Count of the number of Frame Loss Seconds.

Alarm Seconds

Display Format:	9-Digit display for < 1,000,000,000 seconds
Alarms presented:	Yellow Alarm, Pattern Loss, Frame Loss, Signal Loss, AIS, Excess Zeros, Power Loss

Trouble Scan

Displays any non-zero error count (in "large" characters) for the four error types LOGIC, FRAME, BPV and CRC. If the results are all zero then "No Trouble Found" is displayed.

Pattern slips

Uncontrolled (COFAs) and controlled (no COFA). Count of both types with no direction indication.

Time-of-day Clock

Stability: ± 0.01 % (nominal)

DATA LOGGING

Logging to external printer

External printer data logging provides output of results and instrument control settings via the RS-232 serial port. The recommended printer is an HP Thinkjet. A selectable graphics mode supports other common printers e.g. Epson and Seiko.

Printout types. settings, events (printout of current results triggered by errored seconds or alarms), timed (printout of current results every xx minutes), manual (printout of current results on demand). All printouts include time, date and instrument serial number.

PRINTER and REMOTE CONTROL PORT

This dual purpose port is a full duplex RS-232-C serial interface configured as a DCE. Direct connection may be made to DTEs, such as printers and terminals. An adaptor (crossover) cable is required for connection to modems, or other DCEs. The port can be assigned either to printing or remote control, but not both together.

Printer output

Baud rate:	300, 600, 1200, 1800, 2400, 4800, 9600
Data bits:	8
Parity:	None
Stop bits:	1 or 2
Transmit pacing:	ENQ/ACK, Xon/Xoff or DTR

Remote control

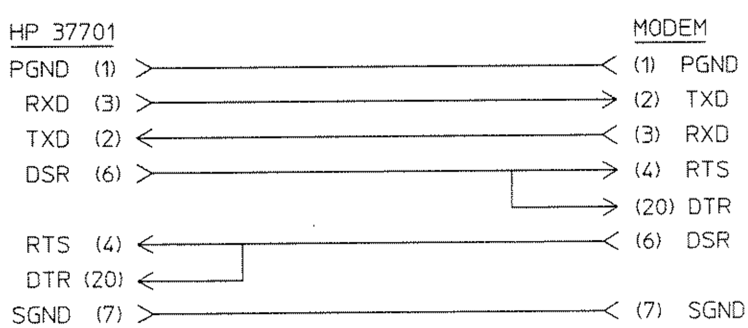
Baud rate:	300, 600, 1200, 1800, 2400, 4800, 9600
Data bits:	7
Parity:	ODD, EVEN, ZEROS, ONES
Stop bits:	1 or 2
Pacing:	ENQ/ACK, Xon/Xoff (Rx only, Tx only or Rx & Tx) or DTR (Txonly)

In addition to Xon/Xoff and ENQ/ACK character handshake flow control, the 37701A provides an optional COMMAND PROMPT to facilitate remote control via a "dumb" terminal. When this feature is in use, the remote control device waits after sending a command until a user-selectable prompt character is returned by the 37701A to signify that it is ready to accept a new command.

RS-232-C connector configuration

Pin	Mnemonic	Description
1	PGND	Connected to chassis ground
2	TXD	37701A data input
3	RXD	37701A data output
4	RTS	Internally connected to CTS in 37701A
5	CTS	Internally connected to RTS in 37701A
6	DSR	Set "ON" by 37701A when powered
7	SGND	Signal ground
8	DCD	Set "ON" by 37701A when powered
20	DTR	When DTR transmit pacing is selected, data output from the 37701A is inhibited if DTR is held "OFF" by receiving device.

Modem operation. Remote control via a modem link requires a pair of full duplex modems. Connection between the 37701A and the modem should be by means of a cable configured as shown below:



General

Size: 340mm (13.4") wide, 190mm (7.5") high, 208mm (8.2") deep (including front panel cover). Battery power (option 002) adds 64mm (2.5") to depth.

Weight: 4.5kg (10lbs). Battery power (option 002) adds 2.6kg (5.6lbs).

Operating temperature:	0 to +50C
Storage temperature:	-40 to +70C

AC Supply: 85-265V 47-66Hz, continuous input voltage selection.

Power consumption:	30VA
LpA < 70 dB	LpA < 70 dB
operator position	am Arbeitsplatz
normal operation	Normaler Betrieb
per ISO 7779	nach DIN 45635 T. 19

Instrument settings storage

All settings and results are saved in protected memory when the instrument is switched off. In addition, the user can store up to five complete setups, with names, and recall them.

Connectors

Tx/Rx - bantam jacks, 310 jacks and DB15 connector, all in parallel
Slip reference - bantam jack and 310 jack in parallel
VF output - 310 jack
RS-232 printer output/remote control - DB25 connector

OPTIONS

Pulse shape and clock slips measurements (option 001)

Pulse Shape

Measurements. Pulse Width, Rise Time, Fall Time, Overshoot, Undershoot, Level(dBdsx), Mask pass/fail, pulse shape display

Range: +6 to -26dBdsx (nominal)
Measurement time: 11 seconds (nominal)

The following four items are specified for DSX-1 pulses within ± 3dB of 0dBdsx, specifications are nominal for other signals.

Pulse width range: 200-500ns, accuracy:± 20ns (nominal)
Rise time resolution: 1nS (nominal)
Fall time resolution: 1nS (nominal)

Overshoot/undershoot resolution: 1% (nominal)

Pulse Masks: Pub 62411, ANSI T1.403, CB 119 (Old equipment), ANSI T1.102/CB 119 (New equipment)

The measured pulse is automatically fitted to the selected mask. For signal levels within ± 3dBdsx (nominal), pass/fail is indicated. Positive and negative pulses are displayed alternately. On a random data signal, pulses which are preceded and followed by at least 3 zeros are used to compute measurements. If this criterion cannot be met, pulses which are preceded and followed by at least 1 zero will be used. If neither of these criteria can be met, any pulse will be used and a message "insufficient zeros, pulse truncated" will be displayed to the user. Under these conditions, the pulse trace is reduced to 600nS.

Clock slips measurement

Measurements. Estimated Clock Slips, Estimated Frame Slips, Positive Peak Wander, Negative Peak Wander, Peak to Peak Wander,

Time Interval Error, 15 Minute Wander, 24 Hour Wander

Specifications

Timing Reference DSX Input.

Rate:	1.544 Mb/s ± 130 ppm
Pulse Shape:	DSX-1 compatible as per ANSI Std T1.102-1987 There is an indication if no reference signal is present.
Input Impedance:	100 ohms (nominal)
Dynamic Range:	+6dB to -30dB relative to DSX-1 level (nominal)

Wander Measurement.

Bandwidth:	Low pass response -3dB at 10Hz (nominal)
Resolution:	0.125 UI
Accuracy:	± 0.125 UI ± 0.5% of reading, for wander frequency up to 1Hz
Range:	± 99999 UI

Battery power (option 002)

Battery type:	sealed lead-acid
Operating time:	1.5 hours (typical, display on continuously) 3 hours (typical, display timed off)

Built-in recharger, battery charges while instrument is connected to AC, whether operating or not

Recharge time: 9 hours (typical)

Instrument automatically switches off when battery is low, before performance is impaired. Once instrument has switched off, a flashing LED indicates a low battery. A low battery message is displayed 15 minutes (nominal) before the instrument switches off. To maximize operating time, display switches off 5 minutes after user stops pressing keys. Measurements continue and status LEDs remain on. Pressing any key brings the display back on.

Result storage and graphic presentation (option 003)

Internal electronic result storage. Automatic storage for up to 10 periods with a maximum of 99 days total capacity. Once all the store capacity has been used, the oldest test data will be discarded. Storage can be switched on or off. Data is retained when the instrument is switched off.

Stored End-of-Period Results. Errored seconds, error Count, synchronous errored seconds, average

error ratio, error free seconds, %error free seconds

Stored End-of-period G.821 analysis. %availability, degraded minutes, %degraded minutes, severely errored seconds, %severely errored seconds, errored seconds, %errored seconds, consecutive severely errored seconds, unavailable seconds.

Stored End-of-Period Alarm Seconds. Power Loss, AIS, signal loss, frame loss, pattern Loss, excess zeros

Graphic result presentation. Histogram display or printout versus time-of-day of two error sources, based on current or stored measurement period.

Error Sources. Logic, BPV, Frame, CRC, Alarms

Display Format.

Width:	60 bars
Bar resolution:	1 minute, 15 minutes, 60 minutes
Error count scale:	Pseudo-logarithmic range of more than 8 decades, each decade represented linearly.

G.821 error results during measurement. Performed on logic and CRC errors, limited analysis on F-bit errors.
%availability, degraded minutes, %degraded minutes, severely errored seconds, %severely errored seconds, errored seconds, %errored seconds, consecutive severely errored seconds, unavailable seconds.

n × 56/n × 64 kBit/s measurements (option 004)

Fractional T1 modes:	n × 56 kBit/s, n × 64 kBit/s contiguous or non–contiguous. Background timeslots filled with idle code 01111111.
Test patterns:	QRSS, 8 bit user defined word (64 kbit/s), 7 bit user defined word (56 kbit/s), 4 user defined patterns (8 to 1024 bits), 2^15–1 PRBS, 2^20–1 PRBS, 2^23–1 PRBS.
Test tones (for single 64 kBit/s timeslot only):	404 Hz, 1004 Hz, 2804 Hz.

Timeslot check:	Shows digital content of one or all timeslots. Transmitter sends varying identification in all timeslots simultaneously. The origin timeslot number is displayed for any received timeslot containing an identification code.
Timeslot delay measurement:	High resolution round trip delay measurement in any timeslot. Range 10 μs to 0.6 s, resolution 10 μs.

8

Installation

Introduction

This section provides installation instructions for the Hewlett-Packard Model 37701A T1 Tester and its accessories. This section also includes information about initial inspection, preparation for use, packaging, storage and shipment.

Initial Inspection

Warning **To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, meters and so on).**

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 instrument has been checked mechanically and electrically. Procedures for checking electrical performance are given in Chapter 5 of this manual. If the contents are incomplete, if there is mechanical damage or defect or if the T1 Tester does not pass the Performance Tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement at HP option without waiting for claim settlement.

Preparation for Use

Warning

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on.

A. Note that the protection provided by grounding the instrument cabinet may be lost if any power cable other than the three-pronged type supplied is used to couple the ac line voltage to the instrument.

B. If this instrument is to be energized via an auto-transformer to reduce or increase the line voltage, make sure that the common terminal is connected to the neutral pole of the power source.

C. The power cable plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor (grounding).

Power Requirements

The instrument requires a power source of (95 to 240 V ac) ±10%, 47 to 66 Hz single phase. The power consumption is less than 30 VA for any instrument including those with the alternative battery power option (Option 002).

Line Fuses

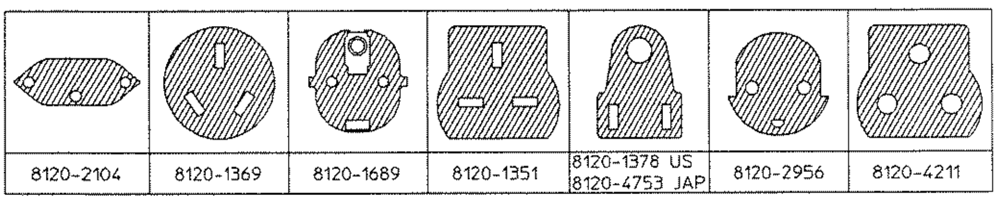
The line fuses are located in a compartment on the side panel above the line power input connector and line switch. The correct rating is 250V, 1 A Timed (HP 2110 - 0674).

Caution

Before connecting the instrument to a power outlet ensure that a fuse of the correct rating is fitted.

Power Cable

This instrument is equipped with a three-wire power cable. When connected to a properly grounded power outlet, this cable grounds the instrument case. The type of power cable supplied with each instrument depends on the country of destination. Refer to the following figure for the part numbers of the power cables and plug configurations available. The number shown below each plug is the Hewlett-Packard part number of a power cable equipped with that plug. If the appropriate power cable is not included with the instrument, notify the nearest Hewlett-Packard Sales and Service Office and a replacement will be provided.



The color code used in each power cable is given below:

Line	Brown
Neutral	Blue
Ground	Green/yellow

Battery (Option 002)

Warning **For operator protection during battery operation, connect the chassis terminal on the rear panel to earth ground.**

Two 6 V 3 Ah lead acid batteries (HP 1420-0123) are located inside the battery compartment at the rear of the instrument.

The instrument will run with fully charged batteries (at an ambient temperature of 25 degrees centigrade) for nominally 1.5 hours with settings and results displayed or 2.5 hours with the display blanked.

Power consumption is optimized by automatically blanking the display if there is greater than 2 minutes between key presses. Pressing any key re-displays settings.

When the instrument detects that the battery voltage is low, it displays a `Battery low !!!!` status message. This message remains displayed until the battery voltage drops below the minimum level that guarantes valid results. When this condition is reached, there is an automatic instrument power down and the red *LOW BATTERY* indicator on the side panel then flashes to show the batteries require re-charging.

It is recommended that the batteries be re-charged as soon as possible to optimize battery life.

To Charge the Batteries (Option 002)

Caution To avoid over charging, do not use an external charger. The instrument has its own charging circuit.

Connect the ac power cord, the green *CHARGING* indicator lights - full charge is obtained after 9 hours at 25 degrees centigrade. The battery charges with the power switch in the *ON* or *STANDBY* position.

To Change the Batteries

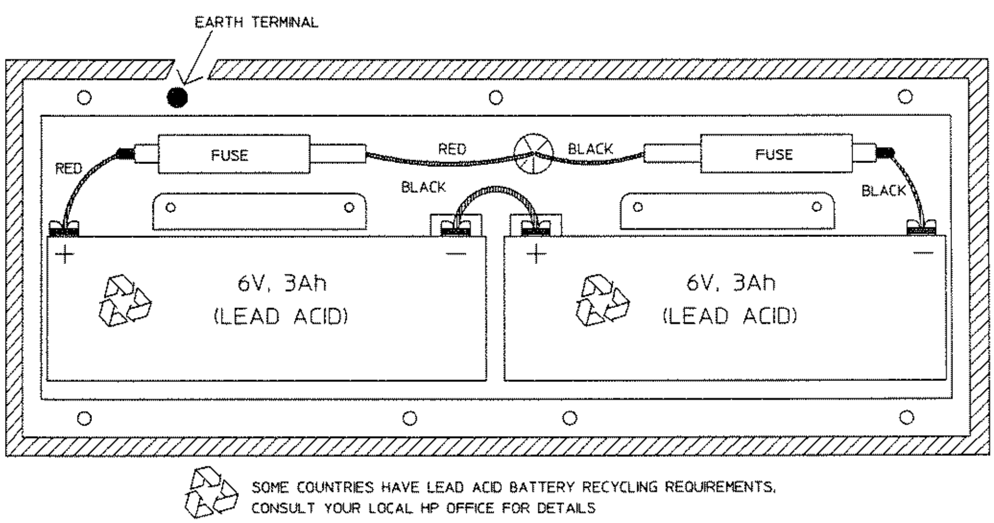
Warning

The battery should only be changed by someone who is aware of the hazards involved.

Do not short circuit the battery terminals, it may cause serious personal injury.

Do not incinerate or otherwise mutilate the battery. It might burst or release toxic materials causing personal injury.

1. Ensure that the instrument power switch is set to *STANDBY* and disconnect the ac power cord (if one is connected).
2. Remove the eleven securing screws on the rear panel then remove the back-plate.



3. Disconnect the batteries.
4. Replace the batteries.
5. Re-connect the new batteries.

Battery Fuses

Two 5 A fast blow fuses (HP 2110-0010) are located inside the battery compartment at the rear of the instrument.

To Change a Blown Fuse

1. Ensure that the instrument power switch is set to *STANDBY* and disconnect the ac power cord (if one is connected).
2. Remove the eleven securing screws on the rear panel then remove the back-plate.
3. Disconnect the batteries.
4. Replace blown fuse.
5. Re-connect the batteries.

Mating Connectors (Front Panel)

Connectors which mate with the T1 Tester connectors are listed in the following table.

T1 tester Port	Connector type	Mating Connector Part Number
TRANSMIT	WECO 310	HP 1251-0695
TRANSMIT	BANTAM	HP 1251-3060
RECEIVE	WECO 310	HP 1251-0695
RECEIVE	BANTAM	HP 1251-3060
TIMING REF DS1 INPUT	WECO 310	HP 1251-0695
TIMING REF DS1 INPUT	BANTAM	HP 1251-3060
TRANSMIT/RECEIVE	15 WAY D	HP 1251-5503
VF OUTPUT	WECO 310	HP 1251-0695
RS 232 C	25 W D SUBMIN	HP 1251-0063 (plug) HP 1251-1438 (hood)

T1 Tester Selection When Using a T1/DATACOM TEST SET

The T1 Tester may form part of a T1/Datacom Test Set. To select T1 operation, set the DATACOM MODULE, TEST SELECT to T1.

ACCESSORY Port - for Datacom Module Connection

Caution The Datacom-lid cable must only be connected or disconnected with the instrument powered down.

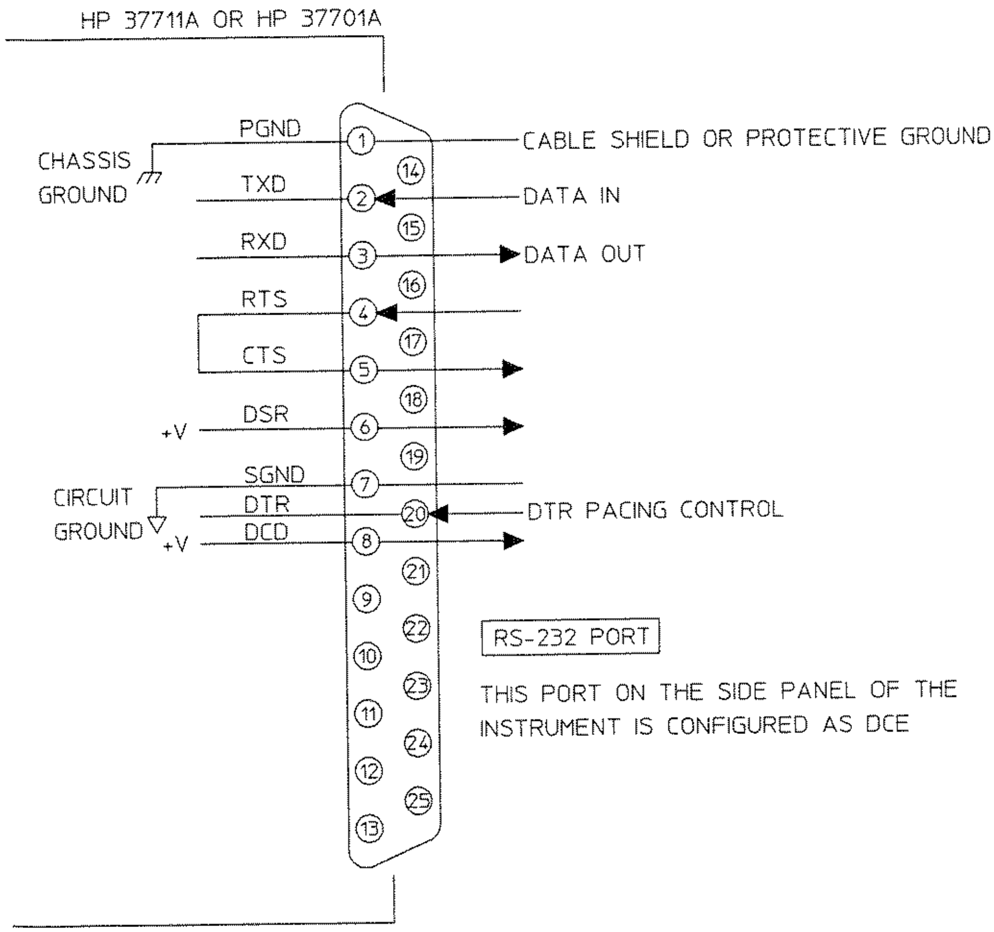
RS-232 Port - for Printer or Remote Control Connection

Caution This port is located on the side panel of the HP 37711A or HP 37701A and is NOT to be confused with the RS-232/V.24 port on the Datacom Module.

This port is a full duplex RS-232C serial interface configured as Data Communications Equipment (DCE). This port can be connected directly to printers, dumb terminals and controllers which are configured as Data Terminal Equipment (DTE).

Using an adaptor cable (see page xx), this port can also be connected to modems and other devices which are configured as DCE.

The *RS-232* connector pinout configuration and signal flow are shown in the following diagram:



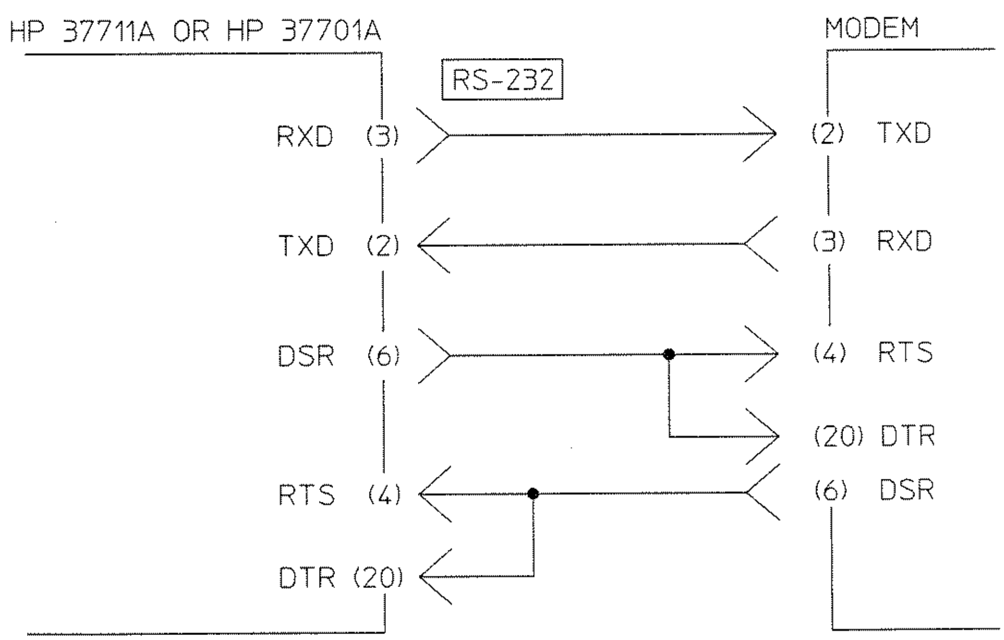
The *RS-232* port can only transmit or recieve asynchronous data, any device connected to it must be set for asynchronous operation. The character formats for Printer and Remote Control are as follows:

	Printer Operation	Remote Control
Baud Rate	300, 600, 1200, 1800, 2400, 4800 or 9600	
Data Bits	8	7
Parity	None	Odd, Even, Zeros, Ones
Stop Bits	1 or 2	
Pacing	ENQ/ACK, Xon/Xoff or DTR	

For more details on Printer operation and Remote Control, see chapters 5 Prepraring to print, chapter 6 Printing Results and chapter 10 Remote Control.

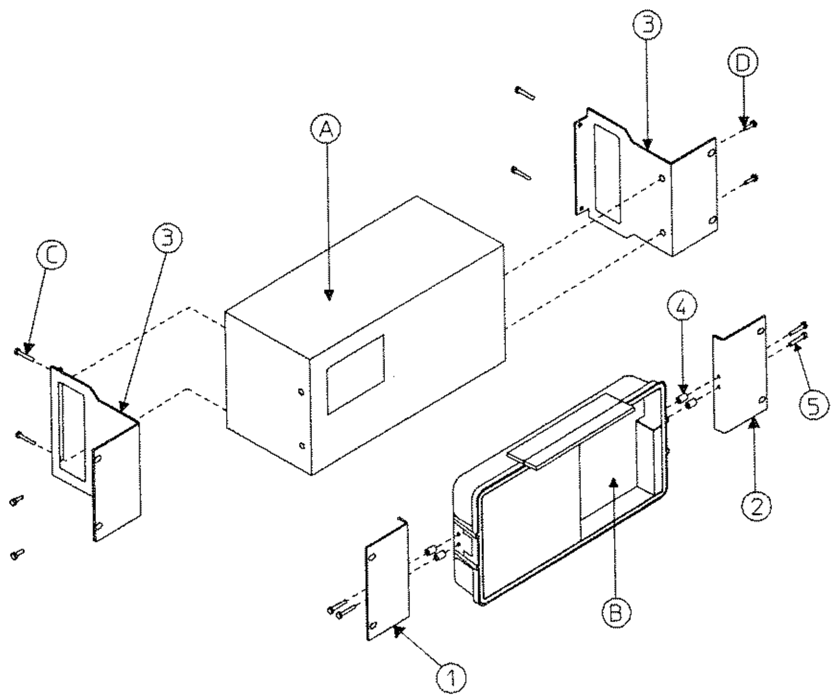
Modem Connection

Only a full duplex modem may be used. The cable connecting the *RS-232* port to the modem should be configured as follows:



DCE TO DCE

Rack Mounting



PROCEDURE FOR MOUNTING BRACKETS TO (A)

1. REMOVE 4 SCREWS (C) HOLDING REAR FEET
2. REMOVE 12 SCREWS (D) HOLDING FRONT FEET
3. PLACE BRACKETS ITEM 3 (2 OFF) IN POSITION AND FIX USING EXISTING SCR (4 OFF "C") FROM THE REAR FEET AND (4 OFF "D") FROM THE FRONT FEET

PROCEDURE FOR MOUNTING BRACKETS TO (B)

1. REMOVE 4 SCREWS BENEATH LATCH CATCH AND REMOVE DATACOM ASSY FROM THE PLASTIC COVER
2. REMOVE THE LATCH CATCHES BY REMOVING THE NUTS AND WASHERS ON THE INSIDE OF THE PLASTIC COVER
3. REFIT DATACOMS ASSY INSIDE PLASTIC COVER
4. PLACE BRACKETS ITEMS 1 & 2 IN POSITION AND FIX USING SCREWS ITEM 5 (4 OFF) AND SPACERS ITEM 4 (4 OFF)

RACK MOUNT KITS

ITEM	QTY	KIT No. / DESCRIPTION	HP 37711A		HP 37701A		HP 15901A
			HP 15713A	HP 15716A	HP 15711A	HP 15715A	HP 15712A
1	1	BRACKET	37701-00031	37701-00031			37701-00031
2	1	BRACKET	37701-00032	37701-00032			37701-00032
3	2	BRACKET	37701-00029	37701-00039	37701-00029	37701-00039	

Operating Environment

Temperature	The instrument may be operated in temperatures from 0 degrees centigrade to +50 degrees centigrade. The temperature for battery operation is 0 degrees centigrade to +40 degrees centigrade.
Humidity	The instrument may be operated in environments with humidity up to 95% at 40 degrees centigrade. However, the instrument should also be protected from temperature extremes which may cause condensation within the instrument.
Altitude	The instrument may be operated at altitudes up to 4,600m (15,000 ft).
Air Flow	To provide adequate cooling, an air gap of approximately 3-inches should be maintained around the instrument.

Storage and Shipment

Environment

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

Temperature	−40 degrees centigrade to +75 degrees centigrade without a battery and −20 degrees centigrade to +55 degrees centigrade with a battery.
Humidity	90%
Altitude	15,300m (50,000 ft)

The instrument should also be protected from temperature extremes which may cause condensation within the instrument.

Packaging

Tagging for Service

If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the front of the service manual (if you have one) or give details on a label then attach the tag or label to the instrument.

Original Packaging

Containers and material identical to those used in the factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number and full serial number. Also mark the container "FRAGILE" to ensure careful handling.

Other Packaging

The following general instructions should be used for re-packing with commercially available materials:

a. Wrap instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service center, attach a tag indicating type of service required, return address, model number and full serial number.)

b. Use strong shipping container. A double-walled carton of 35-pound test material is adequate.

c. Use a layer of shock absorbing material 70 to 100 mm (3 to 4 inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the control panel with the front cover provided or with cardboard.

d. Seal shipping container securely.

e. Mark the shipping container clearly.

f. In any correspondence, refer to instrument by model number and full serial number.

9

T1 Tester Performance Tests

Introduction

This chapter contains procedures which test the HP 37701A electrical performance to the specifications in Chapter 7.

There are two levels of performance testing contained in this chapter:

Operational Verification	Provides >90% confidence that the instrument is operating to its full warranted specification.
Full Performance Test	Ensures that the instrument is operating to its full warranted specification.

Results of the Performance Test may be recorded on the Test Record at the end of this chapter, or on the Abbreviated Test Record at the end of the Operational Verification procedures.

Calibration Cycle

Results recorded on the Test Record at incoming inspection can be used for comparison in yearly maintenance and calibration or after repairs or adjustments.

Recommended Test Equipment

The test equipment required is listed in the following table. Equipment which meets or exceeds the critical specifications may be substituted for the recommended model.

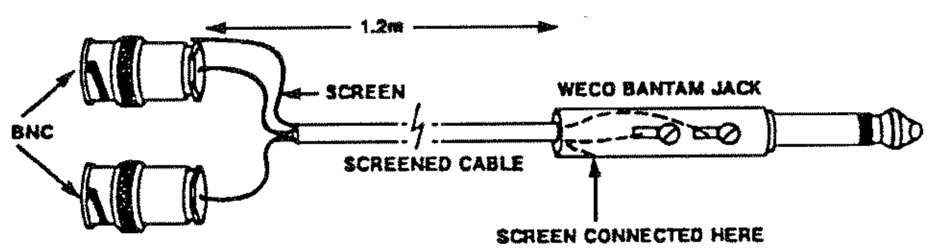
Recommended Test Equipment

Instrument	Critical Specification	Recommended Model
Signature Multimeter	Unique	HP 5005B
Frequency Counter	0.00015% accuracy up to 1.544 MHz; Trigger Level O/P available	HP 5316B OPT 001
DC Voltmeter	1% accuracy	HP 3456A
AC Voltmeter	2% accuracy at 772 kHz	HP 3458A
Printer	80 column HP-IB printer	HP 2225A Thinkjet
Synthesizer / Function Generator (2 off)	50 Ω unbalanced output. Sinewave frequency range 772 kHz ± 110Hz; Level range 23dBm to −20dBm	HP 3325B
Oscilloscope	100 MHz bandwidth; Dual I/P 50 Ω and 1 MΩ	HP 54201A/D
DC Power Supply	Variable DC supply voltage up to 20 V	HP 6205B
Impedance Converter	110 Ωbalanced (nominal) to 75 Ω unbalanced (nominal)	HP 15508B
WECO 310 to WECO 310 cable	Unique	HP 15513A
Bantam to bantam cable	Unique	HP 15670A
WECO 310 to BNC adapter (3 off)	Unique	HP 1251-3757
75 Ω Termination	75 Ω ±1%	HP 15522-80010

Recommended Test Equipment (continued)

Instrument	Critical Specification	Recommended Model
15 way connector	15 way D-shell connector male	HP 1251-5503
RS-232 Loopback connector	Unique	HP 5060-4462
Accessory cable	Unique	HP 15901-60002
Dual BNC to WECO 310 cable	see figure below	
Resistor	100 Ω ± 1%	HP 0757-0178
Resistor	33 Ω ± 1%; 5W	HP 0811-0563

Dual BNC to Weco Bantam Cable



Description	QTY	HP Part Number
BNC Connector (male)	2	1250-1448
Weco Bantam Jack	1	1251-3060
1.2 m Length of Screened Cable	-	8120-2272

Operational Verification

The Operational Verification tests quickly establish with >90% confidence that the HP 37701A meets the specifications listed in Chapter 7. If any test fails to meet specification, refer to the Adjustments in the Service Manual. If after adjustment the specification still cannot be met, refer to the troubleshooting in the Service Manual.

Default Settings

Description

The instrument default settings are factory preset and will be called to reconfigure the instrument when the following procedure is performed. The table below lists the default settings.

Procedure

1. Press AUX.
2. Press the STORED SETTINGS softkey.
3. Select STORED SETTING NUMBER and press 0 0, is the default. Use ⇧ and ⇩ to highlight this field.
4. Select ACTION (again using the ⇧ and ⇩ keys) and press RECALL.
5. Now press FRAME to show the results page.

Default Settings

FRAME	D4
CODE	B8ZS
PATTERN	QRSS
TRANSMIT ERROR INSERT:	
TYPE	LOGIC
RATE	ERR FREE
T1 INTERFACE:	
INTERFACE	DSX-MON
LBO	0dB(DSX)
TRANSMIT TIMING	INTERNAL
TEST TIME	CONTINUOUS

T1 Tester Self Test

Description

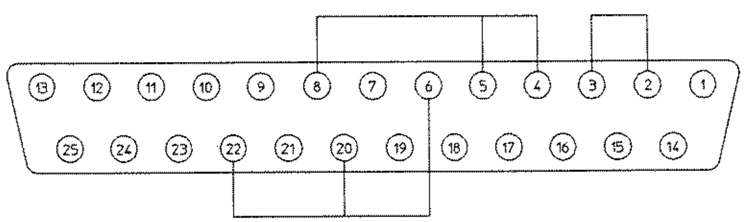
These tests give a high degree of confidence that the HP 37701A is operating to it's warranted specification. A description of each test is given on page 9-8.

Equipment

RS-232 Loopback Connector : HP 5060-4462
15 Way Connector : HP 1251-5503

Procedure

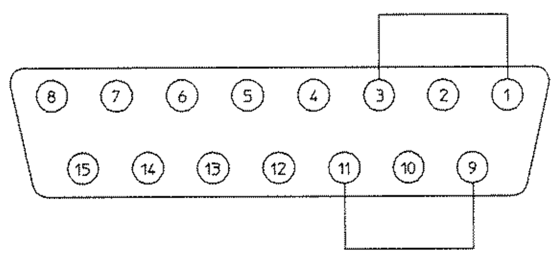
1. Connect the HP 37701A TRANSMIT Weco 310 output to the RECEIVE Weco 310 input (front panel).
2. Connect the RS-232 loopback connector to the RS-232 port (side of the instrument). Alternatively use wire links to either modify an RS-232 connector or connect across the RS-232 port as shown below.



RS-232 Connections

3. Press HP 37701A (AUX), select SELF TEST (use MORE to bring up the SELF TEST field) and set the TEST TYPE for ALL TESTS.
4. Press HP 37701A (START/STOP) and verify that "TEST STATUS PASSED" is displayed at the end of ALL TESTS, approximately 7 minutes (Opt 004 approx 15 minutes).

5. Disconnect the HP37701A TRANSMIT Weco 310 output from the RECEIVE Weco 310 input.
6. Connect the TRANSMIT Bantam output to the RECEIVE Bantam input (front panel).
7. Set the TEST TYPE for PATTERN TEST (use the ⇧ and ⇩ keys to bring up the PATTERN TEST field).
8. Press HP37701A START/STOP and verify that "TEST STATUS PASSED" is displayed at the end of the PATTERN test.
9. Disconnect the HP37701A TRANSMIT Bantam output from the RECEIVE Bantam input.
10. Take the 15 way Connector and use wire links to connect pins 1 to 3 and pins 9 to 11 (see figure below). Connect the modified 15 way connector to the TRANSMIT/RECEIVE D- Shell connector (front panel) this gives the required loopback.



15 way connections on the pin out side of HP 1251-5503.

11. Press START/STOP and verify that "TEST STATUS PASSED" is displayed at the end of the PATTERN test.

Note

If a self test fails, each test can be run individually to discover the extent of the instrument malfunction. Refer to the service manual Troubleshooting to find out how to correct this failure.

T1 Self Tests, Order and Fail Codes

When ALL TESTS is selected the individual tests (1 to 15)are performed in the order shown in the following table. Test 1 is a general test of the Control Processor Unit (CPU). Tests 2 to 15 use a comparison of measured results and expected results. The measurements are made on signals which are externally looped back from transmitter to receiver. If a test failure occurs, the failure code displayed indicates the part of the individual test which has failed. The test which failed is indicated by the group of failure codes shown in the following table. A more detailed list of fail codes is given with the remote control information in chapter 10.

Fail Code Group	Test	Test Number
1 to 99	CPU	1
100 to 299	Pattern	2
300 to 399	Frame	3
400 to 499	Line Code	4
500 to 599	Error Type	5
600 to 699	Error Ratio	6
700 to 799	Alarms	7
800 to 899	Line Interface	8
900 to 999	Level Measurement	9
1000 to 1099	Clock Recovery	10
1100 to 1199	Pulse Shape	11
1200 to 1299	Round Trip Delay	12
1300 to 1399	Slips	13
1400 to 1499	OOF and SEF	14
1500 to 1599	Signalling Bit	15

Auto Configure

Specifications

Framing, line code and pattern are automatically determined.

Description

The HP 37701A's ability to generate an Unframed, All Ones alarm is used to verify that the receiver will auto configure onto the incoming data.

Equipment

None

Procedure

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP 37701A TRANSMIT output to the RECEIVE input.
3. Press HP 37701A (AUX), select ALARMS & LOOPING and set the ALARM GENERATION for ALL ONES.
4. Press HP 37701A (FRAME). Note that the display shows the FRAME set for D4, the CODE set for B8ZS and the PATTERN set for QRSS. Also, the T1 RECEIVE STATUS leds should show T1 PULSES, ALL ONES, FRAME LOSS, PATTERN LOSS and ERRORS all ON (the HISTORY led may also be on due to previous signal conditions).
5. Press AUTO/RESTART and verify that the display now shows the FRAME set for UNFRAMED, the CODE set for AMI and the PATTERN set for ALL ONES.

   The T1 RECEIVE STATUS leds should now show T1 PULSES, PATTERN SYNC and ALL ONES all ON (History may also be on).

Pulse Mask (Option 001)

Specifications

Pulse Masks ANSI T1.403. The measured pulse is automatically fitted to the selected mask. For signal levels within ± 3dBdsx (nominal), pass/fail is indicated. Positive and negative pulses are displayed alternately.

Description

This test verifies the Pulse Mask measurement by connecting the HP 37701A TRANSMIT to RECEIVE and verifying that an isolated pulse from the received data meets the mask called up.

Equipment

None

Procedure

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP 37701A TRANSMIT output to the RECEIVE input.
3. Press HP 37701A (FRAME) and select UNFRAMED.
4. Press HP 37701A (PATTERN) and select 1 IN 8.
5. Wait 15 seconds. Press HP 37701A (AUX) and select PULSE SHAPE.
6. Ensure that both the positive and negative pulses displayed are within the mask shown and that T1.403 PASS is displayed adjacent to the mask (note: the display will alternate between positive and negative pulses continually).

Voice Frequency Output

Specifications

VF Output

Output Impedance:	600 ohm balanced (nominal)
Reference Level:	0dB TLP (nominal)
Dynamic Range:	+3dBm to -50 dBm relative
Frequency Response:	Within ± 0.25 dB from 300Hz to 3KHz (nominal)

Description

This test verifies the HP 37701A ability to demultiplex a single timeslot from an incoming T1 stream and decode it into a voice frequency signal. The volume control range is also exercised during this test.

Equipment

Oscilloscope	:HP 54201A/D (a 1700 series scope can be used)
Weco 310 to BNC Adapter	:HP 1251-3757

Procedure

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP 37701A TRANSMIT output to the RECEIVE input. Connect the VF OUTPUT to the Oscilloscope 1Mohm input using the Weco 310 to BNC adapter.
3. Press HP 37701A (AUX) and select SELF TEST (use the MORE key to bring up the SELF TEST field). Set the TEST TYPE for SIG BITS (use the (⇧), (⇩) and MORE keys to bring up the SIG BITS field).
4. Press HP 37701A (START/STOP) and verify that a 2 volts peak to peak (typically) sinewave with a period of 1.0ms is displayed. Slight stepping may be present on the waveform, but there should be no obvious breaks or other

visible distortion. (note: If the SELF TEST ends before this procedure has been completed, simply press the START/STOP key to resume the test).

5. Press HP 37701A VOL to verify that the 1 Khz tone is audible from the Loudspeaker. Vary volume level using the VOL control keys to ensure that the tone can be increased and reduced to a point where no tone is audible from the loudspeaker.

Recovered Loop Timing

Specifications

Transmitter timing: The transmitter can be timed from the clock recovered at the receiver (loop timed)

Description

This test verifies that the transmitter output data rate can be timed by the received data rate.

Equipment

Synthesizer	: HP 3325B
Frequency Counter	: HP 5316B Option 001
Weco 310 to BNC Adapter	: HP 1251-3757
Balanced to Unbalanced Converter	: HP 15508B
75 Ohm Termination	: HP 15522-80010
T Connector	

Procedure

1. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the Synthesizer SIGNAL output to the HP37701A RECEIVE input using the Weco 310 to BNC Adapter. Connect the HP37701A TRANSMIT output to the Frequency Counter via the Balanced to Unbalanced Converter terminated in the 75 Ohm Termination (T Connector required).
3. Press HP37701A (FRAME) and select UNFRAMED.
4. Press HP37701A (CODE) and select AMI.
5. Press HP37701A (PATTERN) and select ALL ONES.
6. Set the HP37701A *T1 INTERFACE* (TRANSMIT TIMING) to RECOVD (LOOP).

Recovered Loop Timing

7. Set the Synthesizer to generate a 772.110 KHz sinewave, 500mV pk-pk, a.c. coupled signal.
8. Verify that the Frequency Counter tracks the received Synthesizer frequency - 772.11 KHz (Set the Frequency Counter to trigger on positive transitions and adjust the trigger level for a reading. If the Frequency Counter reads incorrectly, adjust the Frequency Counter trigger level for a reading of 1.1 volts at the trigger level output - use a DC Voltmter to measure this).
9. Adjust the Synthesizer to generate a 771.890 KHz signal and verify that the Frequency Counter tracks the received Synthesizer frequency - 771.89 KHz.

Internal Transmitter Clock

Specifications

Internal Tx Clock

Frequency:	1.544 MHz
Stability:	±5 ppm 0 to 40°C (nominal)
	±10 ppm 0 to 50°C
Ageing:	±2 ppm per year typical

Description

This test verifies that the Internal Transmitter Clock frequency is within 12PPM with the provision that the instrument has been through it's yearly calibration cycle.

Equipment

Frequency Counter	: HP 5316B Option 001
Balanced to Unbalanced Converter	: HP 15508B
75 Ohm Termination	: HP 15522-80010
T Connector	

Procedure

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP 37701A TRANSMIT port to the Frequency Counter via the Balanced to Unbalanced Converter. Terminate the Frequency Counter input in 75 Ohms (use the T Connector).
3. Press HP 37701A [FRAME] and select UNFRAMED.
4. Press HP 37701A [PATTERN] and select ALL ONES.
5. Ensure that the Frequency Counter reads between 772,009.3Hz and 771,990.7Hz.

Alarm Leds (red)

This is a functional test of the Alarm leds

Equipment

None

Procedure

1. Connect the HP37701A TRANSMIT output to the RECEIVE input.
2. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
3. If either the POWER LOSS led or the HISTORY led in the T1 RECEIVE STATUS area of the front panel is on, then press (RESET HISTORY).
4. The following *T1 RECEIVE STATUS* leds should be on: T1 PULSES, FRAME SYNC, PATTERN SYNC and B8ZS.
5. Disconnect the Transmit port from the Receive port and ensure that the green leds are off and that the SIGNAL LOSS, FRAME LOSS, PATTERN LOSS, SLIP and HISTORY leds are on. The SLIP led depends on the timing of the signal path break and may not always come on.
6. Reconnect the Transmit port to the Receive port.
7. Press HP 37701A (AUX), select `ALARMS AND LOOPING` and set the ALARM GENERATION for All ONES.
8. Ensure that the ALL ONES, FRAME LOSS, PATTERN LOSS, ERRORS and HISTORY leds are on. T1 PULSES should be the only green led on.
9. Set the ALARM GENERATION to OFF.
10. Press HP 37701A (FRAME) and select `UNFRAMED`.
11. Press HP 37701A (CODE) and select `AMI`.
12. Press HP 37701A (PATTERN) and select `USER WORD`. Set the USER WORD for a 17 bit length (10000000000000000) and ensure that the EXCESS ZEROS and ONES DENSITY leds are on. T1 PULSES and PATTERN SYNC are the only green leds on.

13. Decrease the USER WORD length to 16 bits and ensure that the EXCESS ZEROS led goes off while the ONES DENSITY led remains on. T1 PULSES and PATTERN SYNC are the only green leds on.
14. Decrease the USER WORD length to 9 bits, ensure that the ONES DENSITY led is on, then decrease the USER WORD length to 8 bits and ensure that the ONES DENSITY led goes off. T1 PULSES and Pattern SYNC are the only green leds on.
15. Press HP 37701A (LOOP UP) and ensure that the LOOP UP led comes on momentarily (ignore other leds which momentarily flash on). T1 PULSES and PATTERN SYNC are the only green leds on.
16. Press HP 37701A (LOOP DOWN) and ensure that the LOOP DOWN led comes on for approximately 8 seconds (ignore other leds which momentarily flash on). T1 PULSES and PATTERN SYNC are the only leds on.
17. Switch the instrument power off then on and ensure that the POWER LOSS led and the HISTORY leds are on. T1 PULSES and PATTERN SYNC are the only green leds on.
18. Press HP 37701A (START/STOP) to clear the POWER LOSS led and the HISTORY led.
19. Disconnect the Transmit port from the Receive port then reconnect again. Ensure that the HISTORY led is on. Press (SHOW HISTORY) to view the results of disconnection (HISTORY LED flashes once key is pressed).
20. Press HP 37701A (RESET HISTORY). Ensure that the HISTORY led goes off and that when (SHOW HISTORY) is pressed, the only Red Led to come on is a flashing HISTORY led.
21. Press (RESET HISTORY) to disable the flashing HISTORY led.

(see page 9-6)

T1 Tester Self Test

Description

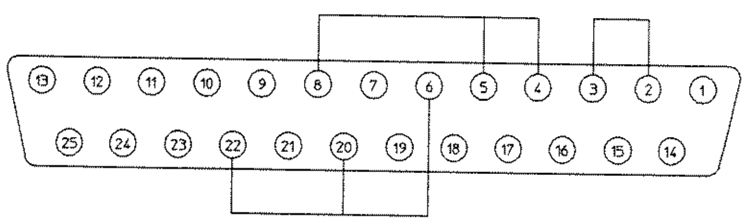
These tests give a high degree of confidence that the HP 37701A is operating to it's warranted specification. A description of each test is given on page 9-8.

Equipment

RS-232 Loopback Connector	: HP 5060-4462
15 Way Connector	: HP 1251-5503

Procedure

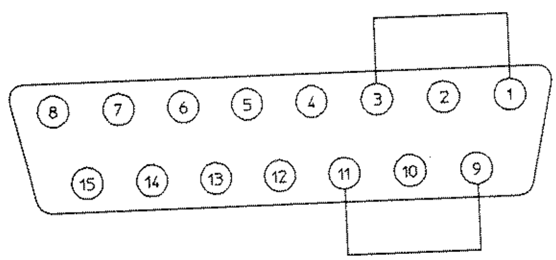
1. Connect the HP 37701A TRANSMIT Weco 310 output to the RECEIVE Weco 310 input (front panel).
2. Connect the RS-232 loopback connector to the RS-232 port (side of the instrument). Alternatively use wire links to either modify an RS-232 connector or connect across the RS-232 port as shown below.



RS-232 Connections

3. Press HP 37701A (AUX), select `SELF TEST` (use `MORE` to bring up the SELF TEST field) and set the TEST TYPE for ALL TESTS.
4. Press HP 37701A (START/STOP) and verify that "TEST STATUS PASSED" is displayed at the end of ALL TESTS, approximately 7 minutes (Opt 004 approx 15 minutes).

5. Disconnect the HP37701A TRANSMIT Weco 310 output from the RECEIVE Weco 310 input.
6. Connect the TRANSMIT Bantam output to the RECEIVE Bantam input (front panel).
7. Set the TEST TYPE for PATTERN TEST (use the ⇧ and ⇩ keys to bring up the PATTERN TEST field).
8. Press HP37701A (START/STOP) and verify that "TEST STATUS PASSED" is displayed at the end of the PATTERN test.
9. Disconnect the HP37701A TRANSMIT Bantam output from the RECEIVE Bantam input.
10. Take the 15 way Connector and use wire links to connect pins 1 to 3 and pins 9 to 11 (see figure below). Connect the modified 15 way connector to the TRANSMIT/RECEIVE D- Shell connector (front panel) this gives the required loopback.



15 way connections on the pin out side of HP 1251-5503.

11. Press (START/STOP) and verify that "TEST STATUS PASSED" is displayed at the end of the PATTERN test.

Note

If a self test fails, each test can be run individually to discover the extent of the instrument malfunction. Refer to the service manual Troubleshooting to find out how to correct this failure.

T1 Self Tests, Order and Fail Codes

When ALL TESTS is selected the individual tests (1 to 15)are performed in the order shown in the following table. Test 1 is a general test of the Control Processor Unit (CPU). Tests 2 to 15 use a comparison of measured results and expected results. The measurements are made on signals which are externally looped back from transmitter to receiver. If a test failure occurs, the failure code displayed indicates the part of the individual test which has failed. The test which failed is indicated by the group of failure codes shown in the following table. A more detailed list of fail codes is given with the remote control information in chapter 10.

Fail Code Group	Test	Test Number
1 to 99	CPU	1
100 to 299	Pattern	2
300 to 399	Frame	3
400 to 499	Line Code	4
500 to 599	Error Type	5
600 to 699	Error Ratio	6
700 to 799	Alarms	7
800 to 899	Line Interface	8
900 to 999	Level Measurement	9
1000 to 1099	Clock Recovery	10
1100 to 1199	Pulse Shape	11
1200 to 1299	Round Trip Delay	12
1300 to 1399	Slips	13
1400 to 1499	OOF and SEF	14
1500 to 1599	Signalling Bit	15

Same as 9-15

Internal Transmitter Clock

Specifications

Internal Tx Clock

Frequency:	1.544 MHz
Stability:	±5 ppm 0 to 40°C (nominal)
	±10 ppm 0 to 50°C
Ageing:	±2 ppm per year typical

Description

This test verifies that the Internal Transmitter Clock frequency is within 7PPM with the provision that the instrument has been through it's yearly calibration cycle.

Equipment

Frequency Counter	: HP 5316B Option 001
Balanced to Unbalanced Converter	: HP 15508B
75 Ohm Termination	: HP 15522-80010
T Connector	

Procedure

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP 37701A TRANSMIT port to the Frequency Counter via the Balanced to Unbalanced Converter. Terminate the Frequency Counter input in 75 Ohms (use the T Connector).
3. Press HP 37701A (FRAME) and select UNFRAMED.
4. Press HP 37701A (PATTERN) and select ALL ONES.
5. Ensure that the Frequency Counter reads between 772,009.3Hz and 771,990.7Hz.

Transmitter Pattern Generation

Specifications

QRSS:	2^20-1 PRBS, D20+D17+1=0 with 14 zero limit
2^15-1 PRBS:	D15+D14+1=0
2^20-1 PRBS:	D20+D17+1=0
2^23-1 PRBS:	D23+D18+1=0
All ones	
1:1	(101010 ...)
1:7	(01000000 ...)
3 in 24	(01000100 00000000 00000100 ...)

55 OCTET (Network Equipment Technologies)
User programmable word, length 3 to 24 bits

Description

A Signature Multimeter is used to verify that the HP37701A transmitter produces the above specified and user defined patterns. Since the output is set to give a repeating pattern the Signature Multimeter produces a unique signature for each pattern.

Equipment

Signature Multimeter : HP 5005B
Accessory Cable : HP 15901-60002

Procedure

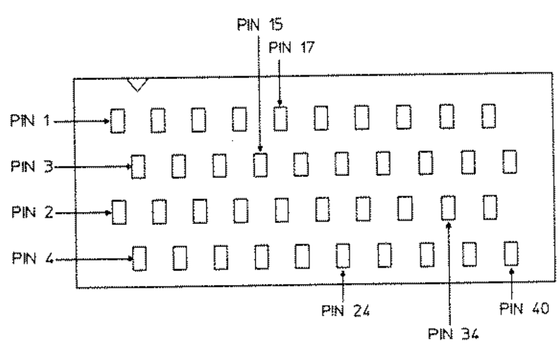
1. Set the HP37701A Power switch to OFF.
2. Connect the Accessory Cable to the ACCESSORY port at the side of the instrument.
3. Set the Signature Multimeter as follows:

Transmitter Pattern Generation

FUNCTION	: NORM
THRESHOLD DATA (TTL)	: High=2.00V, Low= 0.80V
CLOCK (TTL)	: 1.40V
ST-SP (TTL)	: 1.40V
POLARITY CLOCK	: Positive Edge
START	: Positive Edge
STOP	: Positive Edge

4. Connect the Signature Multimeter probes as follows (note: It will be necessary to attach a wire to pin 15 to allow two probes to be connected):

Probe	Accessory Cable Connection
Start (green)	15
Stop (red)	15
Clock (yellow)	34
Gnd (black)	24



Accessory Cable Pinout

5. Set the HP37701A Power switch to ON.
6. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
7. Set the HP37701A to (FRAME) and select UNFRAMED.

8. Press HP37701A (PATTERN), select for the patterns shown in the table below and verify the unique signature on the Signature Multimeter using the probe connected to Accessory Cable pin 40:

Pattern	Signature
QRSS	PPA5
3 IN 24	AC1P
ALL ONES	7339
1 IN 8	0P5C
1 IN 2	H117
55 OCTET	FC67
USER WORD	8C6F
2^15-1	5A8H
2^20-1	F149 - allow for settling time
2^23-1	A38U - allow for settling time

A/O 3/24/94 H.P. says this does NOT WORK. J.S.

Transmitter Line Coding

Specifications

Line Code: AMI, B8ZS

Description

A Signature Multimeter is used to verify that the HP37701A transmitter produces the above specified line coding. Since the output is set to give a repeating pattern the Signature Multimeter produces a unique signature for each pattern.

Equipment

Signature Multimeter	: HP 5005B
Accessory Cable	: HP 15901-60002

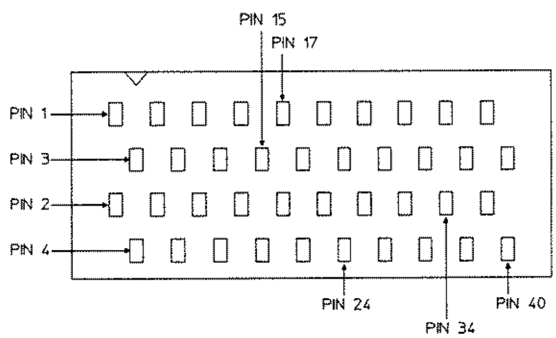
Procedure

1. Set the HP37701A Power switch to OFF.
2. Connect the Accessory Cable to the ACCESSORY port.
3. Set the Signature Multimeter as follows:

FUNCTION	: NORM
THRESHOLD DATA (TTL)	: High=2.00V, Low= 0.80V
CLOCK (TTL)	: 1.40V
ST-SP (TTL)	: 1.40V
POLARITY CLOCK	: Positive Edge
START	: Positive Edge
STOP	: Positive Edge

4. Connect the Signature Multimeter probes as follows (note: It will be necessary to attach a wire to pin 15 to allow two probes to be connected):

Probe	Accessory Cable Connection
Start (green)	15
Stop (red)	15
Clock (yellow)	34
Gnd (black)	24



Accessory Cable Pinout

5. Set the HP37701A Power switch to ON.
6. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
7. Press HP37701A (FRAME) and select UNFRAMED.
8. Press HP37701A (CODE) and select AMI.
9. Press HP37701A (PATTERN) and select USER WORD. Set the USER word to 12 bit length (100000000000).
10. Press HP37701A (CODE), select as shown in the table below and verify the unique signature on the Signature Multimeter using the probe connected to Accessory Cable pin 40:

(CODE)	Signature
AMI	0814
B8ZS	08FH

Transmitter Frame Pattern

Specifications

Framing: D4, ESF, SLC-96 (Ft only)

Description

A Signature Multimeter is used to verify that the HP37701A transmitter continually produces the above specified framing patterns. Since the output is set to give a repeating pattern the Signature Multimeter produces a unique signature for each pattern.

Equipment

Signature Multimeter	: HP 5005B
Accessory Cable	: HP 15901-60002

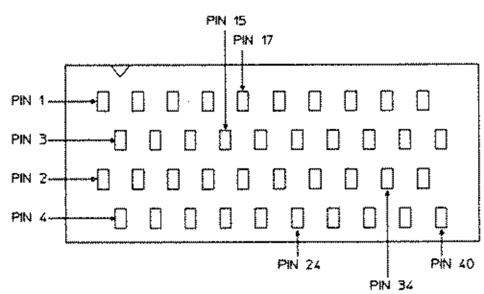
Procedure

1. Set the Power switch to OFF.
2. Connect the Accessory Cable to the ACCESSORY port (at the side of the instrument).
3. Set the Signature Multimeter as follows:

FUNCTION	: NORM
THRESHOLD DATA (TTL)	: High=2.00V, Low= 0.80V
CLOCK (TTL)	: 1.40V
ST-SP (TTL)	: 1.40V
POLARITY CLOCK	: Positive Edge
START	: Positive Edge
STOP	: Positive Edge

4. Connect the Signature Multimeter probes as follows (note: It will be necessary to attach a wire to pin 17, to allow two probes to be connected):

Probe	Accessory Cable Connection
Start (green)	17
Stop (red)	17
Clock (yellow)	34
Gnd (black)	24



Accessory Cable Pinout

5. Set the HP37701A Power Switch to ON.
6. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
7. Press HP37701A (FRAME) and select ESF.
8. Press HP37701A (PATTERN) and select 1 IN 2
9. Press HP37701A (FRAME), to select as per the table below. Use the Signature Multimeter to verify the signatures at pin 40. Note, any of the ESF signatures list below are valid.

Transmitter Frame Pattern

FRAME	Signature
ESF	U5U7, 44FU, U98A, 3224, F54P, 2U66, 64P9 or U457
D4	333C
SLC96	U880

Transmitter Error Add

Specifications

Tx Error Add

Types: Logic
Rates: Selectable 10^-3, 10^-4, 10^-5, 10^-6 or 10^-7, or SINGLE

Description

The ability of the HP37701A transmitter to generate various error rates is verified by inserting errors into a repeating AMI (0000) pattern and using a Frequency Counter to count the error rate. When errors are inserted, zeros become ones at a rate dependant on the error ratio. For example, if a 1544kb/s rate has errors inserted at 1E-3, then the positive and negative ones appear at a 1544 Hz (1544kb/s x 1E-3) rate.

Note

In the following procedure the Frequency Counter triggers on the positive pulses therefore the reading on the counter will be at half the error rate (for the example above, 772Hz)

Equipment

Frequency Counter	: HP 5316B Option 001
Balanced to Unbalanced Converter	: HP 15508B
75 Ohm Termination	: HP 15522-80010
T Connector	

Procedure

1. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP37701A TRANSMIT output to the Frequency Counter input via the Balanced to Unbalanced Converter. Terminate the Frequency Counter in 75 Ohms (use the T Connector).
3. Press HP37701A [FRAME] and select UNFRAMED.

4. Press HP37701A (CODE) and select AMI.

5. Press HP37701A (PATTERN) and select USER WORD then set the USER WORD LENGTH to 4 (0000).

6. Set the HP37701A *TRANSMIT ERROR INSERT* (RATE) to 1E-3.

7. Verify that the Frequency Counter reads 772 Hz +/- 0.0093 Hz (Set the Frequency Counter to trigger on positive transitions, and adjust for a reading. If the Frequency Counter reads incorrectly, adjust the Frequency Counter trigger level for a reading of 1.1 Volt at the trigger level output - use a DC Voltmeter to measure this).

8. Press HP37701A (AUX) and select ALARMS & LOOPING. Set the *TRANSMIT ERROR INSERT* (RATE) to USER PRGM. Use the (⇧) and (⇩) keys to select USER PROGRAM ERROR RATE.

   Select the rate using the softkeys and check the Frequency Counter reading is as shown in the table below (set the Frequency Counter attenuation to × 20). Note: Frequency Counter period mode could be used in this test.

Error Add Rate	Frequency Counter Reading
1E-3	772 Hz +/- 0.0093 Hz
1E-4	77.2 Hz +/- 0.00093 Hz
1E-5	7.72 Hz +/- 0.000093 Hz
1E-6	772 x 10^3 Hz +/- 0.0000093 Hz
1E-7	77.2 x 10^3 Hz +/- 0.00000093 Hz

Error Add - Single

9. Set the HP37701A *TRANSMIT ERROR INSERT* (RATE) to ERR FREE.

10. Set the Frequency Counter to TOT START (measures absolute count).

11. Press HP37701A (SNGLE) 6 times to insert 6 errors.

12. Verify that the reading on the Frequency Counter is 3 counts (note: Single errors inserted are of opposite polarity therefore the Frequency Counter, being triggered on the positive pulses, reads only half the errors inserted).

Transmitter Output

Specifications

Output

Impedance:	100 ohm balanced (nominal)
Pulse Shape:	meets ANSI Standard T1.102-1987
Pulse Height:	±3V ±600mv (at the center)
Pulse Width:	324 ±30 nsecs (measured at half amplitude)
Rise & Decay Time:	75 ns maximum. (10% to 90%)

Description

This test verifies the transmitter output level and pulse shape.

Equipment

Oscilloscope	: HP 54201A/D
Dual BNC to Weco 310 Cable	: see page 9-3
Thinkjet Printer	: HP 2225A

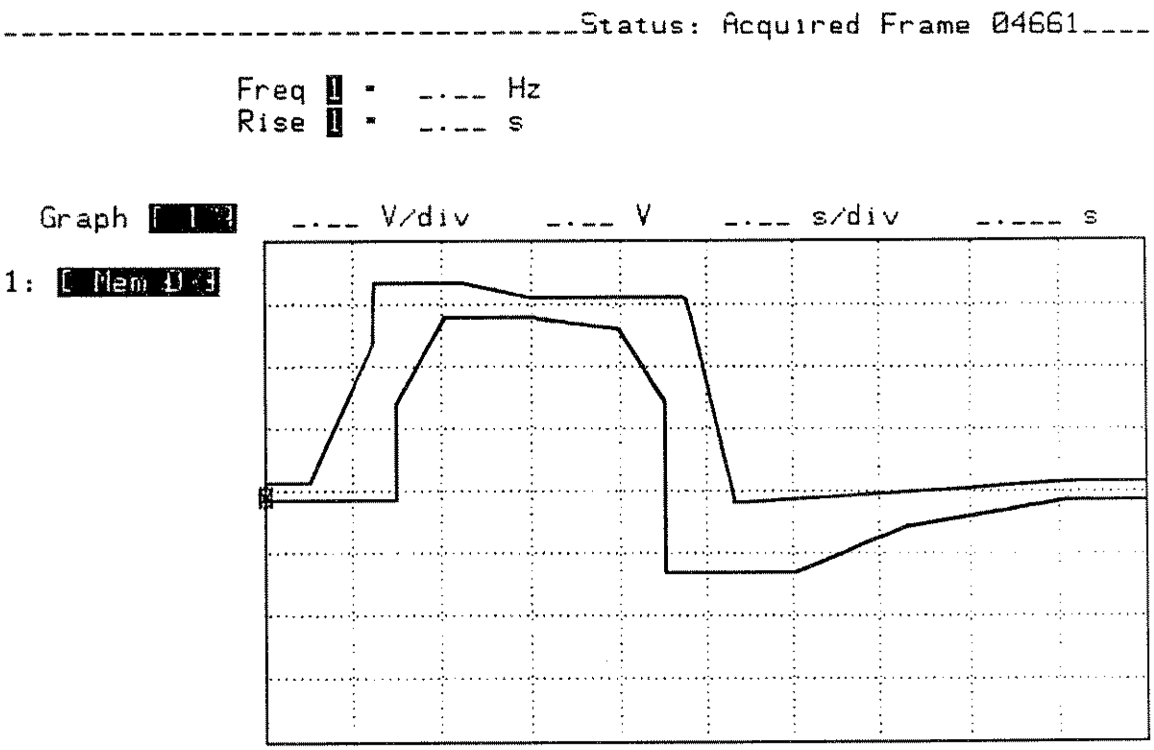
Procedure

1. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the TRANSMIT output to the Oscilloscope channels 1 and 2 via the Dual BNC to Weco 310 Cable.
3. Connect the Thinkjet printer, set to LISTEN ALWAYS, to the Oscilloscope via HP-IB.
4. Press HP37701A (FRAME) and select UNFRAMED.
5. Press HP37701A (CODE) and select AMI.
6. Press HP37701A (PATTERN) and select 1 IN 8.
7. Configure the Oscilloscope as follows, then display Channel 1-2

```
Status [Configuration] _________Status: Acquired Frame 00059____
                                Setup Label

Channel [ 1-2 ]                              Timebase
              Inputs          Input 1-2       Sampling @  200 MHz
  Range       4.0 V           8.0 V           Mode        [ Trig'd   ]
  Offset      0.000 V         0.000 V         Range       1.00 µs
  Probe       [  1:1   ]      [  1:1    ]     Acquire     [Real Time ]
  Coupling    [dc ] [50 Ω]    [dc ] [50 Ω]    Delay       -190.000 ns
  Store Mode  [Ave] [256 ]    [Ave] [256 ]    Reference   [   Left   ]
  Auto Scale  [ Disabled ]    [ Disabled ]    Auto Scale  [ Disabled ]
  Label

Trigger
                                   * Refer to State Trigger Menus
  Mode [    Analog Only    ]         for Assignment and Sequence

  Analog Source [ Chan 1 ] [+ Slope ]    Auto Scale [ Disabled ]
         Level  [ Adjust ] 1.000 V       On Event   0000
         Probe  [  1:1   ]               Coupling   [dc ] [50 Ω]
```

8. Adjust the Oscilloscope Delay to position the positive peak pulse amplitude at mid-pulse-width point on the third division in from the left screen edge.
9. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.4V and 3.6V.
10. Measure the pulse width at half the pulse amplitude and verify that this is between 294ns and 354ns.
11. Measure the rise and decay time (10% to 90%) of the pulse and verify that this is no more than 73ns.
12. Adjust the Oscilloscope Range (gain) to set the peak pulse amplitude at the mid-pulse-width point one division down from the top of the screen (3V).

13. Set the Oscilloscope SYSTEM to Peripherals and set for TALK ONLY and PRINTER.
14. Use the Oscilloscope HARDCOPY function to obtain a printout of the displayed pulse.
15. Place the mask, shown in the following figure, over the pulse and ensure that the pulse falls within the mask (a transparent copy of the following figure should be used).



16. Adjust the Oscilloscope Delay to position the negative pulse at mid-pulse-width point on the third division in from the left screen edge then reset the Range (gain) to 1.00 V/div.
17. Repeat steps 9 to 15 for the negative pulse (note: step 12 will be one division UP from the bottom of the screen (-3V).

Recovered Clock Frequency Measurement

Specifications

Recovered Clock Frequency Measurement

Resolution:	1 Hz
Accuracy:	± 5ppm 0 to 40°C (nominal)
	± 10ppm 0 to 50°C
Ageing:	± 2ppm per year,typical

Description

This test verifies that the recovered clock frequency measurement capability is within 12 ppm with the provision that the instrument has been through its yearly calibration cycle.

Note A Synthesizer is used to generate a signal at 772 Khz (half the data rate) which corresponds to a ternary all ones signal at the receiver input.

Equipment

Synthesizer	: HP 3325B
Frequency Counter	: HP 5316B Option 001
Weco 310 to BNC Adapter	: HP 1251-3757
T Connector	

Procedure

1. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
2. Equipment set-up: Place the T Connector on the Synthesizer SIGNAL output. Connect the Synthesizer to the HP37701A RECEIVE input using the Weco 310 to BNC Adapter. Also, connect the Synthesizer to the Frequency Counter.
3. Press HP37701A (FRAME) and select UNFRAMED.

4. Press HP37701A (PATTERN) and select ALL ONES.
5. Press HP37701A (CODE) and select AMI.
6. Set the Synthesizer to generate a 772 KHz sinewave, 500mV pk-pk, a.c. coupled.
7. Adjust the Synthesizer frequency to set it for 772000 Hz +/- 0.75 Hz as read on the Frequency Counter.
8. Press HP37701A (RESULTS) and select SIGNAL RESULTS.
9. Verify that the HP37701A FREQUENCY displayed is between 1544019 MHz and 1543981 MHz.

Receiver Equalization, Gain and Level Measurement

Specifications

DSX-MON For connection to protected monitor points. Automatic gain control (AGC) between 0 and +36dB compensates for the flat loss at these points

Rate:	1.544 Mb/s ± 130 ppm
Input Impedance:	100 ohms nominal
Dynamic Range:	+6 to -30dB relative to DSX-1 level

BRIDGE For use where the circuit is already terminated. Specification as TERMINATED, except input impedance is 1kohm (nominal).

TERMINATED For terminating unprotected DSX-1 points or line terminations up to -36db. Frequency dependent gain is provided.

Input Impedance:	100 ohms nominal
Dynamic Range:	6V pk-pk to 95mV pk-pk or 0 to +36db equalization @ 772kHz

Description

This test verifies the receiver operation over the specified input level range and that the level measurement accuracy is met. A synthesizer is used to generate a signal at half the data rate which corresponds to a ternary all ones signal. Setting the level from 6.5dBdsx (23dBm) to -36.5dBdsx (-20dBm) relative to the nominal signal level allows us to verify Equalization in the receive TERM and BRIDGE mode and Automatic Gain in the receive DSX-MON mode. Level measurement accuracy is verified in the receive TERM mode. A mismatch between the synthesizer and HP37701A impedance, allows us to generate the required levels into the HP37701A.

Equipment

Synthesizer	: HP 3325B
AC Voltmeter	: HP 3458A
Resistor, 100 Ohms	: HP 0757-0178
Weco 310 to BNC Adapter	: HP 1251-3757
T Connector	

Procedure

1. Recall the HP37701A DEFAULT SETTINGS as shown on page 9-5.
2. Equipment set up: Place the T connector on the Synthesizer SIGNAL output. Connect the Synthesizer to the HP 37701A RECEIVE input using the WECO to BNC adapter. Also, connect the Synthesizer to the AC Voltmeter.
3. Press HP37701A (FRAME) and select UNFRAMED
4. Press HP37701A (CODE) and select AMI
5. Press HP37701A (PATTERN) and select ALL ONES.
6. Press HP37701A (RESULTS) and select ERROR RESULTS.
7. Set the Synthesizer as follows:

Frequency	: 772 KHz
Function	: Sinewave

DSX-MON (Automatic Gain)

8. Set the Synthesizer to 9.7Vp-p and fine tune it until the AC Voltmeter reads 4.484Vrms (6.5dBdsx). note: set for AC Voltmeter readings shown and disregard the additional digits throughout these tests.
9. Press HP37701A (START/STOP) and verify that there are no errors displayed.
10. Set the Synthesizer to 139mVp-p and fine tune it until the AC Voltmeter reads 63.3mVrms (-30.5dBdsx) then repeat step 9.

TERM (Equalization)

11. Press HP37701A *T1 INTERFACE* (INTERFACE) to select TERM.
12. Set the Synthesizer to 4.9Vp-p and fine tune it until the AC Voltmeter reads 2.247Vrms (0.5dBdsx).
13. Press HP37701A (START/STOP) and verify that there are no errors displayed.
14. Set the Synthesizer to 70.4mVp-p and fine tune it until the AC Voltmeter reads 31.7Vrms (-36.5dBdsx), then repeat step 13.

BRIDGE (Equalization)

15. Press the HP37701A *T1 INTERFACE* (INTERFACE) to select BRIDGE.
16. Connect the 100 Ohm resistor across the AC Voltmeter terminals and repeat steps 12 to 14.
17. Remove the 100 Ohm resistor.

TERM (Level Measurement)

18. Press HP37701A *T1 INTERFACE* (INTERFACE) to select TERM.
19. Press HP37701A (RESULTS) and select `SIGNAL RESULTS`.
20. Set the Synthesizer to the synth v p-p level shown in the table below and fine tune it until the AC Voltmeter reads as shown in the Amplitude *AC Vrms* column then verify that the RECEIVER LEVEL limits for *dBdsx* and *Volts Pk-Pk* given are met.

Amplitude		RECEIVER LEVEL	
Synth Vp-p	*AC Vrms*	*dBdsx*	*Volts Pk-Pk*
9.23	4.233	+5 to +7	10.75 to 13.15
4.66	2.12	-1 to +1	5.4 to 6.6
1.45	0.67	-8 to -12	1.7 to 2.1
0.467	0.212	-17 to -23	0.42 to 0.78
0.075	0.0336	-33 to -39	0.07 to 0.12

Wander/Slips Measurement (Option 001)

Specifications

Measurements Estimated Clock Slips, Estimated Frame Slips, Positive Peak Wander, Negative Peak Wander, Peak to Peak Wander, Time Interval Error

Timing Reference DSX Input

Rate: 1.544 Mb/s ± 130 ppm. There is an indication if no reference signal is present.

Wander Measurement

Bandwidth:	Low pass response -3dB at 10Hz (nominal)
Resolution:	0.125 UI
Accuracy:	± 0.125 UI ± 0.5% of reading, for wander frequency up to 1Hz

Description

The Wander measurement is verified in two steps - First, the Receiver and Timing Reference inputs have the HP 37701A Transmitter coupled simultaneously to both. This exercises the wander measurement circuitry by using a division of the Reference input to latch the wander counters and so enable a count of the Receiver input bits. With both inputs being the same,the Wander measurement should be zero based on the expected count being correct. Secondly, two sources are used, one to provide an input to the Receiver port and the other as an input to the Timing Reference port. The sources frequencies are locked together but with one source offset by a known frequency. This allows us to measure for an expected number of bit Slips.

Equipment

Synthesizer/Function Generator (2 off)	: HP 3325B*
Weco 310 to BNC Adapters (3 off)	: HP 1251-3757
T Connector	

*A HP 3335 may be substituted for one of the HP 3325B's.

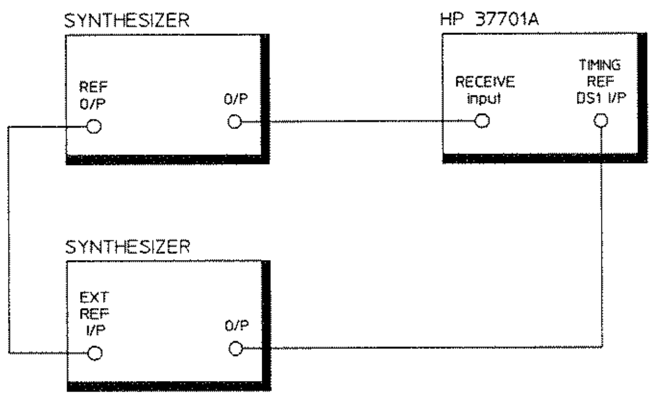
Procedure

Wander

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the HP 37701A TRANSMIT output to the RECEIVE input and the TIMING REF DS1 INPUT simultaneously using the WECO 310 to BNC Adapters (T Connector required).
3. Press HP 37701A (RESULTS), select SLIPS/WANDER and set the DISPLAY for WANDER (note: the WANDER, SLIPS or GRAPH soft keys are revealed by moving the (⇧) and (⇩) keys to the WANDER, SLIP or GRAPH field).
4. Press (START/STOP) and verify that the display shows POSITIVE PEAK WANDER and NEGATIVE PEAK WANDER readings of 0.000 ± 0.125 BITS.
5. Remove the input from the TIMING REF DS1 INPUT and ensure that the display shows NO REF for POSITIVE PEAK WANDER, NEGATIVE PEAK WANDER, PEAK TO PEAK WANDER & TIME INTERVAL ERRORS.

Slips and Wander

6. Connect the equipment as shown below:



7. Press HP 37701A (TEST PERIOD), select USER PROGRAM and set the TEST PERIOD for 1 MINUTE.
8. Press HP 37701A (RESULTS) and set the DISPLAY for SLIPS
9. Press HP 37701A (FRAME) and select UNFRAMED.
10. Press HP 37701A (CODE) and select AMI.
11. Press HP 37701A (PATTERN) and select ALL ONES.
12. Set both Synthesizers amplitudes to 500mV pk to pk, ac coupled.
13. Set the Synthesizer connected to the RECEIVE input to generate a sinewave at 772092.36Hz and the Synthesizer connected to the TIMING REF DS1 INPUT to generate a sinewave at 772100.36Hz.
14. Press HP 37701A (START/STOP) and verify that the display shows the following at the end of the test period:

UNCONTROLLED SLIPS	: N/A
CONTROLLED SLIPS	: N/A
ESTIMATED FRAME SLIPS	: -4 to -5
ESTIMATED BIT SLIPS	: -959 to -961 BITS

15. Press HP 37701A (RESULTS), set the DISPLAY for WANDER and verify that the display shows the following:

POSITIVE PEAK WANDER	: 0.000 BITS
NEGATIVE PEAK WANDER	: 955.125 to 964.875 BITS
PEAK TO PEAK WANDER	: 955.125 to 964.875 BITS
TIME INTERVAL ERROR	: -955.125 to -964.875 BITS
PEAK TO PEAK 15 MINUTES	:.... BITS
PEAK TO PEAK 2 HOURS	:.... BITS

16. Set the DISPLAY for SLIPS.
17. Set The Synthesizer connected to the RECEIVE input to generate 771891.64Hz and the Synthesizer connected to the TIMING REF DS1 INPUT to generate 771899.64 Hz and repeat steps 14 to 16.
18. Swop over the HP 37701A RECEIVE input with the TIMING REF DS1 INPUT, press HP 37701A (START/STOP) and verify that the display shows the following at the end of the test period:

UNCONTROLLED SLIPS	: N/A
CONTROLLED SLIPS	: N/A
ESTIMATED FRAME SLIPS	: 4 to 5
ESTIMATED BIT SLIPS	: 959 to 961

19. Set the DISPLAY for WANDER and verify that the display shows the following:

POSITIVE PEAK WANDER	: 955.125 to 964.875 BITS
NEGATIVE PEAK WANDER	: 0.000 BITS
PEAK TO PEAK WANDER	: 955.125 to 964.875 BITS
TIME INTERVAL ERROR	: 955.125 to 964.875 BITS
PEAK TO PEAK 15 MINUTE	:.... BITS
PEAK TO PEAK 2 HOURS	:.... BITS

Simplex Current Measurement

Specifications

Range:	from $\pm$ 10 to $\pm$ 200 mA (Unsigned)
Accuracy:	5% $\pm$ 1mA
Resolution:	1 mA

Description

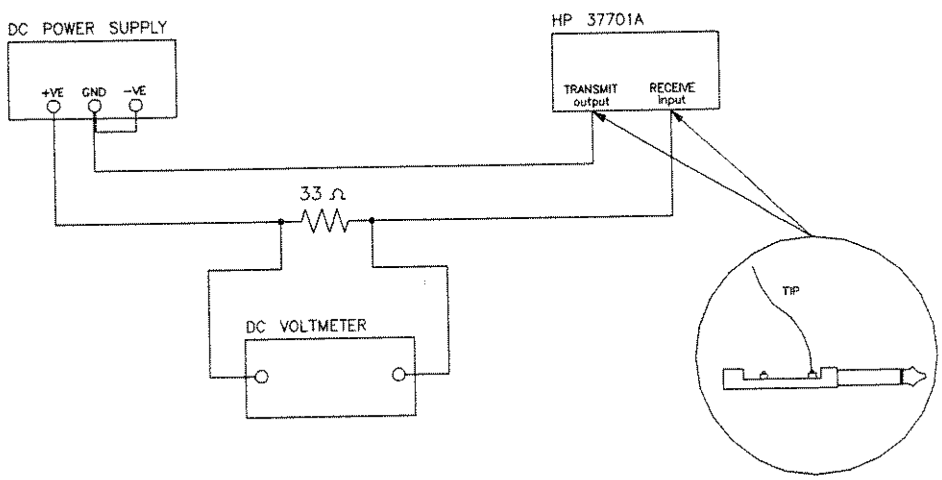
This test verifies that the HP 37701A will complete the current path and make a measure of Simplex Current.

Equipment

DC Power Supply	: HP 6205B
DC Voltmeter	: HP 3456A
33 Ohm, 1%, 5W Resistor	: 0811-0563

Procedure

1. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
2. Connect the equipment as shown below:



Note: Weco 310 to BNC Adapters can be used in the HP 37701A TRANSMIT and RECEIVE ports to allow connections to be made.

3. Press HP 37701A (RESULTS) and select SIGNAL RESULTS.
4. Adjust the DC Power Supply until the DC Voltmeter reads as shown in the table below and verify that the HP 37701A displayed SIMPLEX CURRENT measurement meets the limits given in the table.

DC Voltmeter Reading	SIMPLEX CURRENT
6.60V	200 +/-11 mA
1.98V	60 +/-4 mA
0.33V	10 +/-1.5 mA

 All 9-16 (same)

Alarm Leds (red)

This is a functional test of the Alarm leds

Equipment

None

Procedure

1. Connect the HP37701A TRANSMIT output to the RECEIVE input.
2. Recall the HP 37701A DEFAULT SETTINGS as shown on page 9-5.
3. If either the POWER LOSS led or the HISTORY led in the T1 RECEIVE STATUS area of the front panel is on, then press (RESET HISTORY).
4. The following *T1 RECEIVE STATUS* leds should be on: T1 PULSES, FRAME SYNC, PATTERN SYNC and B8ZS.
5. Disconnect the Transmit port from the Receive port and ensure that the green leds are off and that the SIGNAL LOSS, FRAME LOSS, PATTERN LOSS, SLIP and HISTORY leds are on. The SLIP led depends on the timing of the signal path break and may not always come on.
6. Reconnect the Transmit port to the Receive port.
7. Press HP 37701A (AUX), select `ALARMS AND LOOPING` and set the ALARM GENERATION for All ONES.
8. Ensure that the ALL ONES, FRAME LOSS, PATTERN LOSS, ERRORS and HISTORY leds are on. T1 PULSES should be the only green led on.
9. Set the ALARM GENERATION to OFF.
10. Press HP 37701A (FRAME) and select `UNFRAMED`.
11. Press HP 37701A (CODE) and select `AMI`.
12. Press HP 37701A (PATTERN) and select `USER WORD`. Set the USER WORD for a 17 bit length (10000000000000000) and ensure that the EXCESS ZEROS and ONES DENSITY leds are on. T1 PULSES and PATTERN SYNC are the only green leds on.

13. Decrease the USER WORD length to 16 bits and ensure that the EXCESS ZEROS led goes off while the ONES DENSITY led remains on. T1 PULSES and PATTERN SYNC are the only green leds on.
14. Decrease the USER WORD length to 9 bits, ensure that the ONES DENSITY led is on, then decrease the USER WORD length to 8 bits and ensure that the ONES DENSITY led goes off. T1 PULSES and Pattern SYNC are the only green leds on.
15. Press HP 37701A (LOOP UP) and ensure that the LOOP UP led comes on momentarily (ignore other leds which momentarily flash on). T1 PULSES and PATTERN SYNC are the only green leds on.
16. Press HP 37701A (LOOP DOWN) and ensure that the LOOP DOWN led comes on for approximately 8 seconds (ignore other leds which momentarily flash on). T1 PULSES and PATTERN SYNC are the only leds on.
17. Switch the instrument power off then on and ensure that the POWER LOSS led and the HISTORY leds are on. T1 PULSES and PATTERN SYNC are the only green leds on.
18. Press HP 37701A (START/STOP) to clear the POWER LOSS led and the HISTORY led.
19. Disconnect the Transmit port from the Receive port then reconnect again. Ensure that the HISTORY led is on. Press (SHOW HISTORY) to view the results of disconnection (HISTORY LED flashes once key is pressed).
20. Press HP 37701A (RESET HISTORY). Ensure that the HISTORY led goes off and that when (SHOW HISTORY) is pressed, the only Red Led to come on is a flashing HISTORY led.
21. Press (RESET HISTORY) to disable the flashing HISTORY led.

Operation Verification Test Record

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
	T1 Tester Self Test			
9-6	Step 4: "TEST STATUS PASSED" displayed.			
9-7	Step 8: "TEST STATUS PASSED" displayed.			
	Step 11: "TEST STATUS PASSED" displayed.			
	Auto Configure			
9-9	Step 5: FRAME set for UNFRAMED CODE set for AMI PATTERN set for ALL ONES			
	Pulse Mask (Option 001)			
9-10	Step 6: positive pulses within the mask. negative pulses within the mask. T1.403 PASS displayed.			
	Voice Frequency Output			
9-11	Step 4: 2 volts pk-pk (typically) sinewave with a period of 1.0ms displayed.			
9-12	Step 5: 1 kHz tone is audible. Tone can be increased and reduced.			

Operation Verification Test Record (continued)

Page No.	Test Description	Result Min	Result Actual	Result Max
	Recovered Loop Timing			
9-14	Step 8: received Synthesizer frequency -772.11 kHz.			
	Step 9: received Synthesizer frequency -771.89 kHz.			
	Internal Transmitter Clock			
9-15	Step 5: Frequency Counter reading.	771.991Hz		772.009Hz
	Alarm Leds (red)			
9-16	Step 4: T1 PULSES, FRAME SYNC, PATTERN SYNC and B8ZS leds on.			
9-16	Step 5: green leds off. SIGNAL LOSS, FRAME LOSS, PATTERN LOSS and SLIP * leds on.			
9-16	Step 8: ALL ONES, FRAME LOSS, PATTERN LOSS and ERRORS leds on.			
9-16	Step 12: EXCESS ZEROS and ONES DENSITY leds on.			

* Occurrence of SLIP depends on signal path break time.

Operation Verification Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
9-17	Step 13: EXCESS ZEROS led off and ONES DENSITY led on.			
9-17	Step 14: USER WORD length 9 bits, ONES DENSITY led on. USER WORD length 8 bits, ONES DENSITY led off.			
9-17	Step 15: LOOP UP led comes on momentarily.			
9-17	Step 16: LOOP DOWN led comes on approx. 8 seconds.			
9-17	Step 17: POWER LOSS and HISTORY leds on.			
9-17	Step 19: HISTORY led on.			
9-17	Step 20: HISTORY led goes off. No Red Leds come on.			

Performance Test Record

Page No.	Test Description		Result		
			Min	*Actual*	*Max*
	T1 Tester Self Test				
9-19	Step 4: "TEST STATUS PASSED" displayed.				
9-20	Step 8: "TEST STATUS PASSED" displayed.				
	Step 11: "TEST STATUS PASSED" displayed.				
	Internal Transmitter Clock				
9-22	Step 5: Frequency Counter reading.		771,990.7Hz		772,009.3Hz
	Transmitter Pattern Generation				
9-25	Step 8: QRSS	PPA5			
	3 IN 24	AC1P			
	ALL ONES	7339			
	1 IN 8	0P5C			
	1 IN 2	H117			
	55 OCTET	FC67			
	USER WORD	8C6F			
	2^15-1	5A8H			
	2^20-1	F149			
	2^23-1	A38U			
	Transmitter Line Coding				
9-27	Step 10: AMI	0814			
	B8ZS	08FH			

Performance Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
	Transmitter Frame Pattern			
9-30	Step 9: ESF FH4C D4 333C SLC96 U880			
	Transmitter Error Add			
9-33	Step 7: Frequency Counter reading	771.9907Hz		772.0093Hz
9-33	Step 8: Frequency Counter readings			
	1E-3	771.9907Hz		772.0093Hz
	1E-4	77.19907Hz		77.20093Hz
	1E-5	7.719907Hz		7.720093Hz
	1E-6	.7719907Hz		.7720093Hz
	1E-7	.07719907Hz		.07720093Hz
	Step 12: Frequency Counter reading 3 counts.			
	Transmitter Output			
9-35	Step 9: peak pulse amplitude.	2.4V		3.6V
	Step 10: pulse width at half pulse amplitude.	294ns		354ns
	Step 11: rise and decay time <73ns.			

Performance Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
9-36	Step 15: pulse falls within the mask.			
	Step 17: Repeat of Steps (9) to (15).			
	(9) peak pulse amplitude	2.4V		3.6V
	(10) pulse width at half pulse amplitude.	294ns		354ns
	(11) rise and decay time <73ns.			
	(15) pulse falls within the mask.			
	Recovered Clock Frequency Measurement			
9-38	Step 9: FREQUENCY displayed.	1543981MHz		1544019MHz
	Receiver Equalization, Gain and Level Measurement			
	DSX-MON (Automatic Gain)			
9-40	Step 9: no errors displayed.			
	Step 10: no errors displayed.			
	TERM (Equalization)			
9-41	Step 13: no errors displayed.			
	Step 14: no errors displayed.			
	BRIDGE (Equalization)			
	Step 16: 2.247V rms - no errors displayed. 31.7V rms - no errors displayed.			

Performance Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
	TERM (Level Measurement)			
9-41	Step 20: *Synth Vp-p* *AC Vrms*			
	9.23 4.233	+5dBdsx 10.75Vpk-pk		+7dBdsx 13.15Vpk-pk
	4.66 2.12	-1dBdsx 5.4Vpk-pk		+1dBdsx 6.6Vpk-pk
	1.45 0.67	-8dBdsx 1.7Vpk-pk		-12dBdsx 2.1Vpk-pk
	0.467 0.212	-17dBdsx 0.42Vpk-pk		-23dBdsx 0.78Vpk-pk
	0.075 0.0336	-33dBdsx 0.07Vpk-pk		-39dBdsx 0.12Vpk-pk
	Wander/Slips Measurement (Option 001)			
9-44	Step 4: POSITIVE PEAK WANDER NEGATIVE PEAK WANDER	-0.125 -0.125		+0.125 +0.125
	Step 5: POSITIVE PEAK WANDER, NEGATIVE PEAK WANDER, PEAK TO PEAK WANDER & TIME INTERVAL ERRORS all show NO REF.			
9-45	Step 14: UNCONTROLLED SLIPS - N/A CONTROLLED SLIPS - N/A ESTIMATED FRAME SLIPS ESTIMATED BIT SLIPS	 -5 -961		 -4 -959
	Step 15: POSITIVE PEAK WANDER : NEGATIVE PEAK WANDER : PEAK TO PEAK WANDER : TIME INTERVAL ERRORS : PEAK TO PEAK 15 MINS..... .....BITS PEAK TO PEAK 2 HOURS..... .... BITS	0.000 BITS 955.125 BITS 955.125 BITS -955.125 BITS		0.000 BITS 964.875 BITS 964.875 BITS -964.875 BITS

Performance Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
9-46	Step 17 Repeat of Steps (14) to (16).			
	(14) UNCONTROLLED SLIPS - N/A			
	CONTROLLED SLIPS - N/A			
	ESTIMATED FRAME SLIPS	-5		-4
	ESTIMATED BIT SLIPS	-961		-959
	(15) POSITIVE PEAK WANDER :	0.000 BITS		0.000 BITS
	NEGATIVE PEAK WANDER :	955.125 BITS		964.875 BITS
	PEAK TO PEAK WANDER :	955.125 BITS		964.875 BITS
	TIME INTERVAL ERRORS :	-955.125 BITS		-964.875 BITS
	PEAK TO PEAK 15 MINS..... .....BITS			
	PEAK TO PEAK 2 HOURS..... .... BITS			
	Step 18: UNCONTROLLED SLIPS - N/A			
	CONTROLLED SLIPS - N/A			
	ESTIMATED FRAME SLIPS	4		5
	ESTIMATED BIT SLIPS	959		961
	Step 19: POSITIVE PEAK WANDER :	955.125 BITS		964.875 BITS
	NEGATIVE PEAK WANDER :	0.000 BITS		0.000 BITS
	PEAK TO PEAK WANDER :	955.125 BITS		964.875 BITS
	TIME INTERVAL ERRORS :	955.125 BITS		964.875 BITS
	PEAK TO PEAK 15 MINS..... .....BITS			
	PEAK TO PEAK 2 HOURS..... .... BITS			
	Simplex Current Measurement			
9-49	Step 4: SIMPLEX CURRENT			
	DC Voltmeter Reading			
	6.60V	189ma		211ma
	1.98V	56ma		64ma
	0.33V	8.5ma		11.5ma

Performance Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
	Alarm Leds (red)			
9-50	Step 4: T1 PULSES, FRAME SYNC, PATTERN SYNC and B8ZS leds on.			
9-50	Step 5: green leds off. SIGNAL LOSS, FRAME LOSS, PATTERN LOSS and SLIP * leds on.			
9-50	Step 8: ALL ONES, FRAME LOSS, PATTERN LOSS and ERRORS leds on.			
9-50	Step 12: EXCESS ZEROS and ONES DENSITY leds on.			

* Occurrence of SLIP depends on signal path break time.

Performance Test Record (continued)

Page No.	Test Description	Result		
		Min	*Actual*	*Max*
9-51	Step 13: EXCESS ZEROS led off and ONES DENSITY led on.			
9-51	Step 14: USER WORD length 9 bits, ONES DENSITY led on. USER WORD length 8 bits, ONES DENSITY led off.			
9-51	Step 15: LOOP UP led comes on momentarily.			
9-51	Step 16: LOOP DOWN led comes on approx. 8 seconds.			
9-51	Step 17: POWER LOSS and HISTORY leds on.			
9-51	Step 19: HISTORY led on.			
9-51	Step 20: HISTORY led goes off. No Red Leds come on.			

10

Remote Control

Tests may be set up and run, results may be stored and retrieved, using the remote control facility. The operation of the Tester is the same as in manual operation from the front panel.

Additional facilities are available when using remote control:

Complete test configurations may be down loaded to the Tester either for immediate use or to be stored in the tester memory for future use.

Results may be returned to the controller for display, printing or further analysis.

Command History

The commands contained in this chapter apply directly to instruments with serial prefix(es) and/or firmware revision numbers given on the *Title Page* of this manual. In the command descriptions which follow you may be directed to the *Command History* table at the end of this chapter. This table contains a description of command changes for each firmware revision.

Preparation for Remote Control

The Tester may be controlled directly from a controller at the same location as the Tester, or over a telephone link via modems.

Where control is over a telephone link, the link may be a leased line or a dial-up line.

The controller may be a "dumb" terminal or a computer.

The Tester must be correctly connected and correctly set up for successful remote control.

The RS232C port may be configured for either printer or remote control operation. When printer operation is selected, 8 bit data is transmitted and Xon/Xoff selection may be "ON" or "OFF" only. When remote control operation is selected, 7 bit data is assumed and Xon/Xoff selections are :

OFF, Rx ONLY, Tx ONLY or Rx AND Tx.

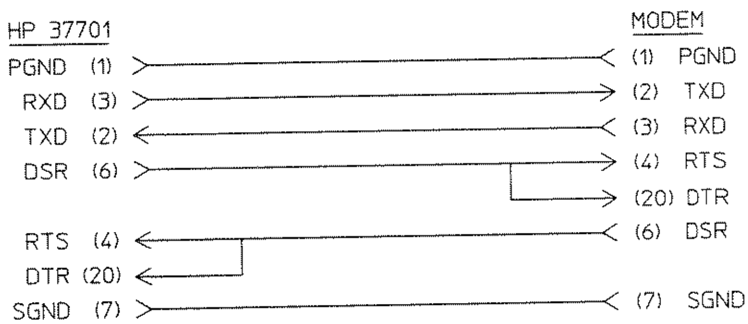
The tester receive buffer has a capacity of 128 bytes.

Remote Control / Printer Pin Assignments

Pin	Mnemonic	Description
1	PGND	Connected to chassis ground
2	TXD	37701A data input
3	RXD	37701A data output
4	RTS	Looped to pin 5
5	CTS	Looped to pin 4
7	SGND	Signal ground
20	DTR	Inhibits data output from the 37701A when held "OFF" by the receiving device.

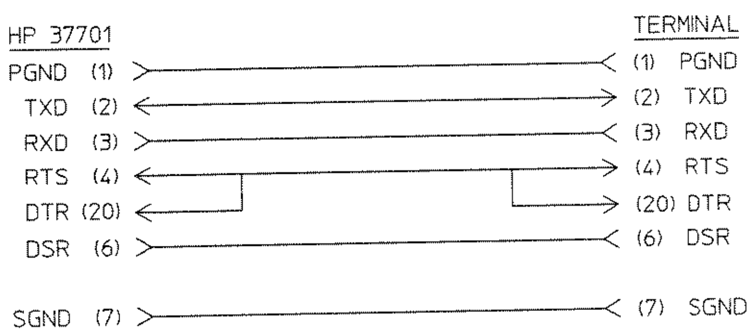
To Connect to Telephone Lines via Modems

The connections of a cable suitable for Tester / modem connection are shown in the following figure.



To Connect for Direct Operation

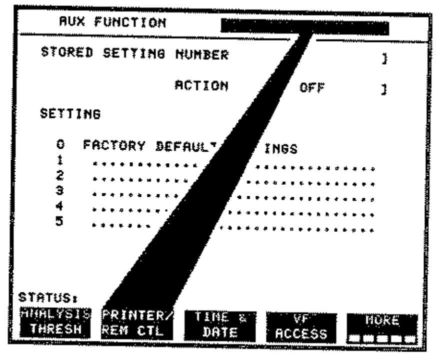
The connections of a cable suitable for direct connection to a controller are shown in the following figure.



To Set the Tester for Operation from a Terminal

Press (AUX)

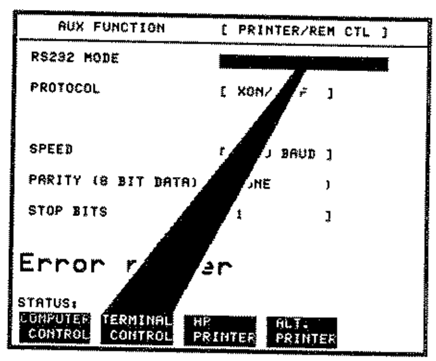
Select PRINTER REM CTL



Highlight

RS232 MODE [ ]

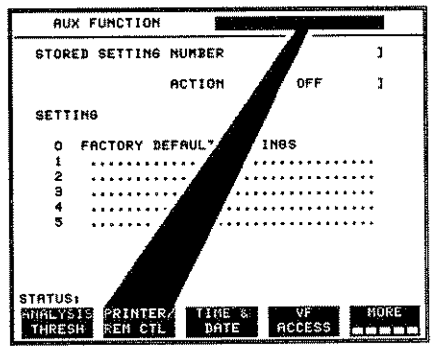
Select TERMINAL CONTROL



To Set the Tester for Operation from a Computer

Press (AUX)

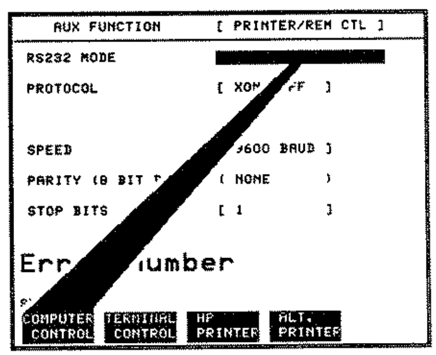
Select `PRINTER REM CTL`



Highlight

RS232 MODE [ ]

Select `COMPUTER CONTROL`



Remote Operation

The following information assumes the user is familiar with the local operation of the tester.

Remote operation is performed by a computer or "dumb" terminal connected to the RS 232 C port on the side of the tester. This port is also used as the printer output port. The printing of results may be performed by returning the results to the computer or printing terminal, or alternatively by storing them in the tester for printing at a later time.

The tester is operated by commands which are listed later in this chapter. Commands are shown in the actual form required and are presented in "computer type" for example the command for starting a test is shown as `STR`.

Many commands must be qualified with a variable for example the command `COD` which selects the line code as has a qualifier <n> which specifies the type of line code AMI or B8ZS.

The qualifier <n> is presented in italic type.

The preferred form of the complete command has a space between the mnemonic and the variable. For example `COD 1` is preferred to `COD1`.

The possible alternative values for <n> are presented as a list. There is usually a choice in the form of the variable, a digit or an alpha-numeric code.

The command information for setting the line code to AMI or B8ZS is presented in the following form:

`COD` *n*	*n* =	`1` or `AMI`	AMI coding
		`2` or `B8ZS`	B8ZS coding

To set the code to AMI send: `COD 1` or `COD AMI`
To set the code to B8ZS send: `COD 2` or `COD B8ZS`
A space between the mnemonic part of the command (`COD`) and the variable (*n*) is desirable.

In local operation, all of the front panel controls are responsive and control the tester. In remote operation the controls which change parameters are inoperative, the tester being controlled by the remote controller. The front panel display reflects the remote programming commands received.

At power on the tester assumes the local state. To gain control of the tester the controller must put the tester into the remote state. This is accomplished by sending the "remote control enable" command (`RMT`). The tester can be returned to local control by sending the "return to local" command (`LCL`).

Commands are normally separated by "newlines" which can be either a single carriage return character or a carriage return-line feed pair.

Terminal Control

In general this chapter describes how to control the tester under computer control. The differences when using a terminal are given here.

The operational differences with terminal use are :

- Characters typed are echoed to the terminal.
- The tester provides a prompt at the beginning of the command line.
- Rudimentary input editing (backspace, erase line) is provided.
- An asynchronous interrupt (quit) is provided.
- Errors are reported as text messages.
- A command history is provided.
- Status bit queries indicate active bits in mnemonic form.
- Selectable variable queries can return mnemonic values.

Note that line feeds are always ignored in input. (It is possible to put multiple commands on one line by separating them with semicolons.) Output lines are always separated by carriage return-line feed pairs, regardless of which separator was used on input. This is different to "computer mode", where the separator used for output is always the same as was used for input.

The length of an input line is limited to 280 characters. If the user tries to type more than 278 characters (the last two are used to store the `CR LF`), the terminal bell rings and the extra characters are discarded.

Prompting and Input Editing

The Prompt

With terminal operation, the tester provides a prompt which is displayed on the terminal screen. This prompt may be customized by the user. The preset prompt is :

```
HP37701A>
```

Input Editing

There are three special function characters used for input editing :

BACKSPACE This character (DELETE) causes the last character typed to be erased (the tester outputs BACKSPACE-SPACE-BACKSPACE). If the user attempts to backspace over the prompt, the terminal bell rings.

KILL This character (control-U) causes all of the line from the prompt to the end to be erased.

INTERRUPT This character (control-C) interrupts the execution of the current command and the tester outputs a newline followed by a prompt. Pressing (BREAK) has the same effect.

Error Reporting

When using "computer" mode, errors in parsing or execution cause the processing of the current command to cease, and an error code describing the nature of the problem is placed in the error register, which the user can examine by issuing the ERR? command. In "dumb terminal" mode, the tester reports errors when they occur, without the user performing any special action. When an error occurs, the tester will echo the faulty command with a text message explaining what the problem was.

Examples :

Example 1 : `IDX?` sent instead of `ID?`.

```
HP37701A> idx?
idx? : Command header error
```

Example 2 : A command sent when the tester was not under remote control.

```
HP37701A> rst
rst : Command not executable in local mode
```

Example 3 : A mixture of valid and invalid commands sent.

```
HP37701A> id? ; idx?
HP37701A
idx? : Command header error
HP37701A>
```

In the third example above, a line contains one legal command (id?), and one illegal command (idx?). The legal command is executed, and the response written to the terminal, followed by an error message for the illegal command.

Note that in "dumb terminal" mode, the tester error register is NOT updated. This is because the tester effectively follows each error with an internal ERR? command, which has the effect of clearing the error register.

Mnemonic Responses

When in "computer mode", commands which query tester status registers (e.g. STA?,RQS? etc.) simply return integers. Where these registers are really collections of bits, each indicating a separate condition, "dumb terminal" mode will output a mnemonic string indicating which bits are active, in addition to the integer value of the register.

Example

```
HP37701A> sta?
28 <RDY LCL FPS>
```

In addition to mnemonic responses for status register queries, "dumb terminal" mode has the facility to return mnemonic responses to selectable variable queries.

Example

```
HP37701A> pat?
QRSS
```

"dumb terminal" mode also provides a command history feature. The tester maintains a buffer of up to 20 commands (or 200 characters, whichever runs out first) of commands entered. Commands are entered into the history buffer whether legal or not, and a command is only not put into the history if it is exactly the same as the last command sent. If there is no space in the history store when a new command is received, commands are deleted from the store, oldest first, until there is enough space.

Commands are provided to list the contents of the store, re-execute the last command sent and to re-execute a particular command, specified by its number. These commands are not themselves placed into the history store.

`!l` : Lists the contents of the history store (if any).

NOTE : Character `l` in this command must be the lower case of character `L`.

Example : Response to a request to list the contents of the history store `!l`

```
HP37701A> !!
1 : sta?
2 : rst
3: id?
4: str
5: STA?
HP37701A>
```

`!!` : Echoes and re-executes the last command in the history store.

Example : To re-execute the last command.

The last command in the previous example was `STA?`.
Typing `!!` after the prompt will cause the STA? command to be returned to the terminal and re-executed.

```
HP37701> !!
STA? 20 <RDY FPS>
```

`! n` : Echoes and re-executes command number n in the history store.

The command number is either the number given by the "!l" command, or a negative number indicating the "second from last (-2)" etc. If the selected command is not in the store the command is echoed and an error message is written to the terminal.

The following errors can occur when using history commands :

`bad history command -- unrecognized history command.`

`no such history command -- the specified command is not in the store.`

Programming Tips

The programming information given here covers the following :

The maximum rate of reading status registers.
How to determine the start/running/stop status of a test.
Delay in execution of some commands.

Reading of Status Registers

All status registers are updated on a 100ms basis, with the exception of the err register, which will be updated when a remote control error occurs. There is therefore no point in reading the registers at a faster rate than this, and the status register reads actually enforce a 100ms delay before the next read can be attempted. To minimize command queuing therefore, do not send status register query commands at a greater rate than every 100ms.

Determining Start and Stop

There are various bits associated with starting and stopping. These are as follows:

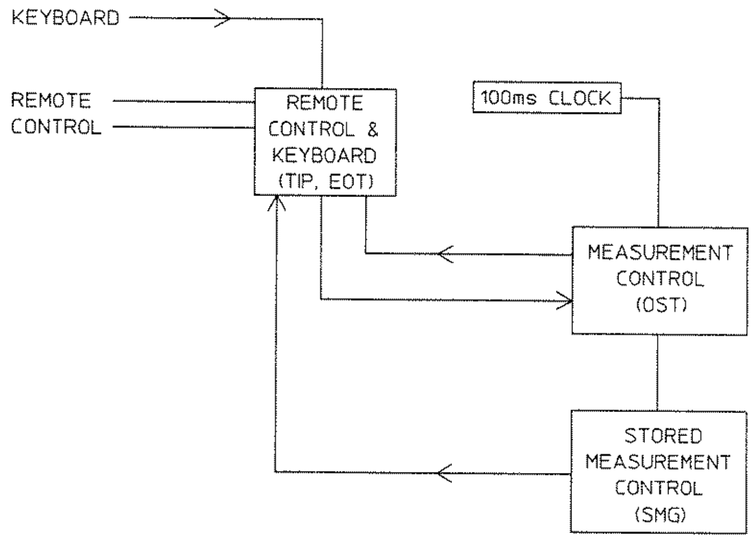
STA:
- EOT - Set at end of testing period
- TIP - Set whilst the tester is testing
- SMG - Set when Stored Measurement and Graphics (SMG) operations are in progress

STB:
- EOT - Set at end of testing period (same as STA)

RDY:
- OST - Set when the tester actually starts testing.

The significance of these bits is as follows: When the OST bit is set, any errors generated at the input to the tester will be counted; and when the SMG bit is set data may not be read from the results store.

The relationships between these bits is shown in the following diagram.



Start/Stop operation timing

Restarting with the STR command or with START/STOP

Under these circumstances, the TIP bit will go TRUE and the EOT bit will go FALSE very soon after the command is received. As soon as a valid measurement can be carried out (i.e. a signal is presented) the OST bit will go TRUE. When testing has started this information is passed to the stored measurement graphics process, which will set the SMG bit some time later. The time it takes to set the bit depends on whatever other loading the tester is getting at the time, but typically may be up to 2 seconds.

Stopping with the STP command, with START/STOP or after a timed measurement

Under these circumstances, the TIP bit will go FALSE, the OST bit will go FALSE and the EOT bit will go TRUE very soon after the command is received. Sometime later the SMG bit will be cleared. All the bits will have settled to their new values by typically 2 seconds after the command is received.

The Delay in the Execution of Some Commands

If the tester is controlled from a computer which sets a timeout for remote control read and write operations then it is important to realize what factors can contribute to delays.

The execution of commands can take a long time, for example `RST` will typically take 2 seconds for complete execution. The tester has an input buffer in excess of 100 characters, and can buffer up several commands before executing them. This is deliberate and desirable. It can lead to some long response times for example if the command `RST;RST;RST;ID?` is sent it will be more than 6 seconds before a response to the `ID?` command is received. The programmer should bear these considerations in mind when programming any timeouts.

THE COMMANDS

COMMON CAPABILITY MESSAGES

Reset

The reset action message presets the instrument to its default state. A full listing of this default state is given in this chapter. The predefined default state is as follows:-

- Configuration defined by preset panel 0
- Starts testing
- All buffers flushed
- Stop asserting SRQ (not relevant in this instrument)
- Service request mask set to ERR (not relevant in this instrument)
- Clear all errors
- Clear alarm change and key registers
- Clear status registers except for DAT bit
- Ready register bits LQE, STC, ASC set. RAC set in computer mode,clear in dumb terminal mode.

The remote control parser and executor are also reset by this command. The command is as follows:-

```
RST
```

Remote

This command causes the instrument to go remote with local lockout. The command is as follows:-

```
RMT
```

Local

This command causes the instrument to disable local lockout and return to local. The command is as follows:-

LCL

Clear

This command clears all instrument errors and flushes all buffers without affecting the programmed state of the instrument. The following things are performed by executing this command:-

- All buffers flushed
- Clear all errors
- Clear alarm change and key registers
- Clear all bits in status registers, except for DAT and TIP which retain their original values
- Ready register RAC bit set in computer mode, clear in dumb terminal mode

The command is as follows:-

CLR

Device Clear

This is implemented on the 37701A by sending a [BREAK]. These will return the instrument to the initialized condition regardless of the current state. A delay of at least 200ms should be allowed after sending this command. Its effect is identical to sending CLR.

Key Query

This command returns the value of the last key pressed on the front panel. The value is returned as an integer whose meaning is given below. If no key was pressed since the last time the command was used, 0 is returned. Note that this command does not wait until a key is pressed. The command is as follows:-

KEY? returns	1 = Up Arrow
	2 = Down Arrow
	3 = Softkey 1
	4 = Softkey 2
	5 = Softkey 3
	6 = Softkey 4
	7 = Softkey 5
	8 = Aux
	9 = Interface Select
	10 = Line Build Out
	11 = Transmitter Timing
	12 = Transmit Error Type
	13 = Transmit Error Rate
	14 = Frame
	15 = Code
	16 = Pattern
	17 = Period
	18 = Results
	19 = Auto Run
	20 = Show History Depressed
	22 = Loopup
	23 = Loopdown
	24 = Decrease Volume
	25 = Increase Volume
	26 = Start/Stop
	27 = Print Now
	28 = Reset History
	29 = Single Error
	31 = Show History Released

Request Service Mask

This command is used to enable or disable the reasons for setting the RQS bit in status register A and B. Associated with status register A is a mask which enables or disables the various sources (ie only the positive edge of a bit in status register A with it's corresponding mask bit enabled will cause the RQS bit to be set.)

RQS *n*	*n* =	0 to 30719	Status reg A mask range

The mask has a bit map identical to that of status register A,and can be set in three different ways.

1) The parameter can be a single 16 bit integer, corresponding to the addition of binary weighted bits wishing to be enabled. Eg. if we wished to enable STR and ERR then the command would be:-

`RQS 288`

2) The parameter can be a list of the binary weighted integers corresponding to all those sources wishing to be enabled separated by commas. Eg. if we wished to enable STR, ERR and FPS then the command would be:-

`RQS 256,4,32`

3) The parameter can be a list of three letter mnemonics defined in Status Registers, separated by commas. Eg. if we wished to enable ERR, RDY and LCL then the command would be:-

`RQS ERR,RDY,LCL`

As well as the three methods of passing the parameter outlined above, any combination may be used,remembering that the result is always evaluated to a 16 bit integer. Care should be taken to ensure the resultant integer is in range and the desired sources are enabled (Although range checking is done, no checking of constituent parameters is performed to ensure that they are binary values). There are two other special parameters to this command. They are `RQS ON` and `RQS OFF`. `RQS OFF` is not equivalent to `RQS 0` because it disables all reasons for SRQ but remembers the stored mask. Upon receipt of the `RQS ON` command service requests should be enabled again with the same mask as before (NOTE any positive edges of sources with their mask set should be caught, so that they will set the RQS bit when the `RQS ON` command is sent). If the `RQS ON` command is sent without a corresponding `RQS OFF` command sent before it, the instrument shall assume the 'RQS ERR' state as a default.

The complement of this command is used to inspect the Service Request mask. The command responds with a 16 bit integer equivalent to the binary weighted values of those sources which are enabled (outlined in Status Registers).

`RQS?` returns `0` to `30719`

Instrument Identification

This command sets the response to an instrument identification query, HP 37701A or HP 37711A. The data is stored in an EEROM which may be programmed only a finite number of times. The command should therefore be used sparingly.

`ID` *n*	*n* =	1 or `HP 37701A`
		2 or `HP 37711A`

Instrument Identification Query

This command is a request for identification from the instrument. This is included to be compatible with "common capabilities" and as a standard[1] response. The command is as follows:-

`ID?` returns `HP37701A`

Revision Date Query

This command is a request for the instruments firmware revision information. The instrument returns two four digit date codes separated by a comma, these date codes are in standard HP serial number format (a four digit code, where the first two digits indicate the year (from 1960),and the next two indicate the week (01 to 52)). The firmware revision date comes first, followed by the Codes and Formats date. The command is as follows:-

`REV?` returns *dddd,ffff*	*dddd* =	Firmware date code
	ffff =	Codes and Formats date

Serial Number Query

This command is a request for the instrument to return it's individually assigned serial number. The command is as follows:-

`SER?` returns "*dddddUnnnnn*"

A command in the same form, `SER` "*dddddUnnnnn*" may be used to set a new serial number.

1. Users should be aware that if the tester has an accessory fitted, the id returned will be different, to reflect this.

Error Code Query

This command is a request to read the instrument's error register. The error register contains an integer in the range -32768 to 32767. The error codes have various meanings, some defined by "common capabilities" and some instrument dependent (see Error Codes for a full listing). If no error exists at the time of enquiry, then 0 is returned. The error register is cleared on reading the register or by sending the CLR command.

The error register will also contain the result of a remotely initiated selftest command. This is cleared as above. The command is as follows:-

ERR? returns -32768 to 32767

Ready Code Query

This command is a request to read the instrument's ready register. The result is a binary weighted decimal integer. The meanings of the bits is given in "Status Registers". The command is as follows:-

RDY? returns 0 to 127

Status/Events Query

This command is a request for the instrument to return the contents of status register A. It responds with an integer which represents the 16 bit binary weighted contents of the status register bits. A detailed description of status register A is given in "Status Registers". The command is as follows:-

STA? returns 0 to 32767

Status Query

This command is a request for the instrument to return the contents of status register B. It responds with an integer which represents the 8 bit binary weighted contents of the status register bits. The act of executing this command also clears the RQS bit in status registers A and B (similar to the serial poll). A detailed description of status register B is given in "Status Registers". The command is as follows:-

STB? returns 0 to 255

Options Query

This command is a request for the instrument to return its option number. The command is as follows:-

`OPT?` returns *nnn* or *0*	*0* =	HP37701A (standard instrument)
	nn1 =	Pulse Mask and Wander added
	n1n =	G821 Analysis and SMG added
	1nn =	Fractional T1 added

Where n could be zero or a blank in the case of leading zeros.

CONFIGURATION COMMANDS

Instrument Configuration

This command takes as its parameter a block of data which specifies the instrument's internal setup state. The block is a IEEE Std 728 '#H' format. This is intended only for restoring an instrument state saved using the CON? query and hence its internal format is not elaborated.

NOTE: This command does not record the settings of remote control sources, or current states of remote control registers. It is equivalent in scope to store/recall preset panels. One block should not be compared with another in a comparison attempt as redundant but variable information is also included in the block.

The command is as follows:- `CON #H`

The complement of this command is used to enquire about the configuration of the instrument; it returns the configuration of the instrument in exactly the same form, namely the IEEE Std 728 #H data block. The command is as follows:-

`CON?` returns `#H`*data block*

Framing Type

Selects the framing configuration.

`FRM` *n*	*n* =	1 or `ESF`
		2 or `D4`
		3 or `SLC96`
		4 or `UNFRAMED`

The corresponding query returns the framing configuration, in integer form as described above:-

`FRM?` returns *frame type* = 1 to 4

Pulse Mask Polarity Query

Provides the polarity of the pulse mask displayed.

`PPO?` returns *pulse polarity*	*pulse polarity* = 0	No pulse has yet been sampled
	1	Positive pulse on display
	2	Negative pulse on display

Pulse Truncated Query

Provides truncation information about the currently displayed pulse.

`PTC?` returns *pulse truncated info*	*pulse truncated info* = 0	No pulse has yet been sampled
	1	Pulse on display is not truncated
	2	Pulse on display is truncated

Pulse Mask Selection

Selects the type of pulse mask the pulse will be measured against.

`PMS` *n*	*n* =	1 or `ANSIT1403`
		2 or `P62411`
		3 or `OCB119`
		4 or `NCB119` or `ANSIT1102`

The corresponding query returns the current mask selection, in integer form as described above.

`PMS?` returns *pulse mask type* = 1 to 4

Application Type

Selects the major application of the instrument.

`APP` *n*	*n* =	1 or `FULLT1`	Full T1 measurements are enabled
		2 or `N56K`	N × 56k timeslot measurements are enabled
		3 or `N64K`	N × 64k timeslot measurements are enabled

The corresponding query returns the currently selected coding, in integer form as described above:-

APP? returns *application type* = 1 to 3

Receiver Timeslot Selection

Selects whether the timeslots should map the transmitter timeslots or should be selectable.

RXT *n*	*n* =	1 or ASTX	Receiver timeslots are same as transmitter
		2 or RECEIVE	Receiver timeslots are selectable

The corresponding query returns the currently selected coding, in integer form as described above:-

RXT? returns *timeslot selection* = 1 to 2

Transmitter Multiple Timeslot Selection

Selects the transmit timeslots for fractional T1 measurements. It also selects the receiver timeslots when that selection is as RX. The information is passed as a binary representation of the timeslot selection field. Timeslot n is selected (deselected) depending on the corresponding mask element being 0 or 1.

TTM "*timeslots*"	*timeslots* =	24 characters, 0 or 1

The corresponding query returns the currently selected coding, in integer form as described above:-

TTM? returns "*timeslots*" = 24 characters, 0 or 1

Receiver Multiple Timeslot Selection

Selects the receiver timeslots for fractional T1 measurements. The information is passed as a binary representation of the timeslot selection field. Timeslot n is selected (deselected) depending on the corresponding mask element being 0 or 1.

RTM "*timeslots*"	*timeslots* =	24 characters, 0 or 1

The corresponding query returns the currently selected coding, in integer form as described above:-

RTM? returns "*timeslots*" = 24 characters, 0 or 1

Pattern Type

Selects the pattern to be transmitted and configures the receiver accordingly.

PAT *n*	*n* =	1 or QRSS	2^20-1 PRBS, D20+D17+1=0 (14 zero limit)
		2 or THREEIN24	
		3 or ALLONES	
		4 or ONEIN8	
		5 or ONEIN2	101010 ...
		6 or OCTET55	55 octet
		7 or USER	User programmable 3 to 24 bit word
		8 or LIVE	Invokes Monitor Mode
		9 or PRBS15	2^15-1 PRBS, D15+D14+1=0 (inverted)
		10 or PRBS20	2^20-1 PRBS, D20+D17+1=0
		11 or PRBS23	2^23-1 PRBS, D23+D18+1=0 (inverted)
		12 or SPECIAL	Special pattern, use of alternative, SPT recommended

The corresponding query returns the currently selected pattern, in integer form as described above:-

PAT? returns *pattern type* = 1 to 12

If 12 is returned, SPT?is required to define which special pattern is selected.

Special Pattern / Test Type

Selects which of several special patterns or tests should be used.

SPT *n*	*n* =	1 or LONGWRD	8 to 1024 bit long user word
		2 or SIGBIT	Signaling bit test
		3 or TSCHECK	Timeslot check test
		4 or HIRESRTD	High resolution round trip delay
		5 or TONE1	Tone 1 (404Hz)
		6 or TONE2	Tone 2 (1004Hz)
		7 or TONE3	Tone 3 (2804Hz)

The corresponding query returns the currently selected pattern, in integer form as described above:-

SPT? returns *pattern type* = 0 to 7

Where 0 corresponds to: no special pattern selected.

Long User Word

Specifies the identification number and pattern for one of the long user words. The word length is determined automatically by the length of pattern selected.

LUW *n*,*#H data*	*n* = 1 to 4	User word number
	#H data = #Haabbcc ...	Long user word data (1 to 128 bytes)

The corresponding query returns the long user word pattern in #H block form:-

LUW?*n* returns *#H data*

Where *data* is 1 to 128 bytes, each byte comprising 2 hex characters.

Long User Word Length

Specifies the pattern length for one of the long user words.

This command may be used to restrict the pattern length of an existing long user word. It may also be used to restore the length to its original value after remotely changing the first n bytes.

LUL *n*,*length*	*n* = 1 to 4	User word number
	length = 1 to 128	Long user word length in bytes

The corresponding query returns the long user word pattern length:-

LUL?*n* returns *length*

Long User Word Select

Specifies which of 4 long user words to use.

LUS *n*	*n* = 1 to 4	Long user word number

The corresponding query returns the currently selected long user word, in integer form as described above:-

LUS? returns *long user word* = 1 to 4

Long User Word Sync Mode

Specifies whether the sync should be based on the length of the whole word or on a specified number of bytes.

LUY *n,sync mode*	*n* =	1 to 4	User word number
	sync mode =	1or FULL	Full word length used
		2or VARIABLE	Number of bytes can be controlled

The corresponding query returns the currently selected sync mode:-

LUY?*n* returns *sync mode* 1or 2

Long User Word Sync Length

Specifies the long user word sync length which will be used when variable sync length is selected.

LSL *n,length*	*n* =	1 to 4	Long user word number
	length =	1 to 128	Number of bytes for sync

The corresponding query returns the currently selected sync length, in integer form as described above:-

LSL?*n* returns *sync length* = 1 to 128

Long User Word Left Hand Bit

Specifies whether the left hand bit of the user word bytes should be sent first or last. This command will set the bit transmission order for all 4 of the long user words.

LHB *direction*	*direction* =	1 or FIRST	Left hand bit sent first
		2 or LAST	Left hand bit sent last

The corresponding query returns the selected direction, in integer form as described above:-

LHB? returns *direction* = 1 or 2

Coding Type

Selects the coding type to be transmitted and configures the receiver accordingly.

COD *n*	*n* =	1 or AMI	AMI coding
		2 or B8ZS	B8ZS coding

The corresponding query returns the currently selected coding, in integer form as described above:-

COD? returns *coding type* = 1 to 2

User Defined Pattern

Sets the user defined pattern.

PAU *length*,"*patt*"	*length* =	3 to 24
	"*patt*" =	*length* characters 0 or 1

The corresponding query command returns the pattern length and content:-

PAU? returns *length*,"*patt*"

User Defined Pattern (Fractional T1)

Sets the user defined pattern.

PAF *mode*,"*pattern*"

mode =	1 or FULLT1	Full T1 user word *length* 3 to 24 bits
	2 or N56K	N×56Kbit/s user word *length* 7 bits
	3 or N64K	N×64Kbit/s user word *length* 8 bits
"*pattern*" =	*length* characters	0 or 1

The corresponding query command returns the fractional T1 pattern:-

PAF? *mode* returns "*user pattern*"

Send Signaling Bits

Selects the "foreground" signaling bit sequence for use in the signaling bit test. The user is able to separately select the AB bits for use in D4 etc. and the ABCD bits for use in ESF.

SSB *sig bit type*, "*sig bits*"

sig bit type =	1 or AB	D4 type
	2 or ABCD	ESF type
"*sig bits*" =	binary00 to 11	D4 type signaling bits
	binary0000 to 1111	ESF type signaling bits

The corresponding query command returns the selected signaling bits in integer form as described above:-

SSB? *sig bits type* returns "*sig bits*"

Send Background Signaling Bits

Selects the "background" signaling bit sequence for use in the signaling bit test. The signaling bits in all channels except the one selected for the "foreground" will have their signaling bits set to this value.

SSO *sig bit type*,"*sig bits*"

sig bit type =	1 or AB	D4 type
	2 or ABCD	ESF type
"*sig bits*" =	binary00 to 11	D4 type signaling bits
	binary0000 to 1111	ESF type signaling bits

The corresponding query command returns the selected signaling bits in integer form as described above:-

SSO? *sig bits type* returns "*sig bits*"

Send Signaling Bits in Channel

Selects the channel that the foreground signaling bits should be inserted into.

SSI *sig bit channel*	*channel* = 1 to 24	Foreground channel.

The corresponding query returns the selected channel, in integer form as described above:-

SSI? returns *channel* = 1 to 24

High Resolution Round Trip Delay Transmit Timeslot Selection

Selects the timeslot that the high resolution round trip delay should be transmitted on.

RTT *rtd timeslot*	*timeslot* = 1 to 24	rtd timeslot.

The corresponding query returns the selected channel, in integer form as described above:-

RTT? returns *timeslot* = 1 to 24

High Res Round Trip Delay Rx Timeslot Select

Selects the timeslot that the high resolution round trip delay measurement should be received from if the rx timeslot is not "AS TRANSMITTER".

RTR *rtd timeslot*	*timeslot* = 1 to 24	rtd timeslot.

The corresponding query returns the selected rtd rx timeslot in integer form as described above:-

RTR? returns *rtd rx timeslot* = 1 to 24

High Res Round Trip Delay Rx From Select

Selects whether the high resolution round trip delay rx timeslot should be the same as the transmitter timeslot or should be selectable.

RTF *n*	*n* =	1 or ASTX	Receiver timeslot is the same as transmitter
		2 or SELECT	Receiver timeslot is selectable

The corresponding query returns the currently selected timeslot mode in integer form as described above:-

RTF returns *timeslot from mode* = 1 or 2

VF Channel Select

This command selects the VF channel.

VFC *n*	*n* =	1 to 24	Channel No.

The corresponding query returns the selected channel, in integer form as described above:-

VFC? returns *channel number* = 1 to 24

Send Tone in Channel

Selects the channel number that any tones should be transmitted in.

STO *channel no*	*channel no* =	1 to 24	Channel to send tone in.

The corresponding query returns the selected channel, in integer form as described above:-

STO? returns *channel number* = 1 to 24

VF Channel Audio Select

This command selects VF access audio on or off.

VFA *n*	*n* =	0 or OFF	Disable audio
		1 or ON	Enable audio

The corresponding query returns the audio selection, in integer form as described above:-

VFA? returns *audio selection* = 0 or 1

VF Channel Mapping

This command selects the type of channel mapping to be used.

`CHM` *n*	*n* =	`1` or `D1D`	D1D mapping
		`2` or `D2`	D2 mapping
		`3` or `D3/D4`	D3/D4 mapping

The corresponding query returns the channel mapping selection, in integer form as described above:-

`CHM?` returns *mapping selection* = `1`, `2` or `3`

VF Timeslot Query

This command returns the current timeslot, in integer form:-

`VFT?` returns *vf timeslot* = `1` to `24`

Test Period

This command selects the mode of test duration control.

`TPD` *n*	*n* =	`1` or `CON`	Continuous (Controlled by START/STOP)
		`2` or `T15M`	15 minute timed test
		`3` or `T2H`	2 hour timed test
		`4` or `T24M`	24 hour timed test
		`5` or `USER`	User defined test duration (see TDU)

The corresponding query returns the test time mode, in integer form as described above:-

`TPD?` returns *test time type* = `1` to `5`

Test Duration

Selects the user-defined test duration, applicable when the "USER" test time mode is in force.

`TDU` *duration*,*units*	*duration* =	`1` to `100`	Duration of test
	units =	`0` or `SECONDS`	Test duration is seconds
		`1` or `MINUTES`	Test duration is minutes
		`2` or `HOURS`	Test duration is hours
		`3` or `DAYS`	Test duration is days

The corresponding query returns the user-defined test duration, in integer form as described above:-

TDU? returns *duration,units*

CSU Auto Mode

The following commands enable the instrument to automatically respond to in-band and out-of-band loop-up or down codes.

Use the following command if the instrument is to respond to in-band codes.

CSA *n*	*n* =	0 or OFF	CSU auto is disabled
		1 or ON	CSU auto is enabled

The corresponding query returns the currently selected CSU loop up state, in integer form as described above.

CSA? returns *csu in-band auto type* = 0 or 1

Use the following command the instrument is to respond to out-of-band codes.

COA *n*	*n* =	0 or OFF	CSU auto is disabled
		1 or ON	CSU auto is enabled

The corresponding query returns the currently selected CSU loop up state, in integer form as described above.

COA? returns *csu out-of-band auto type* = 0 or 1

Loopback Band

This command configures the instrument for in-band or out-of-band loopback operation. An error is generated if out-of-band is selected and framing is not ESF.

LPB *n*	*n* =	1 or INBAND	Set to respond to in-band loopcodes
		2 or OUTBAND	Set to respond to out-of-band loopcodes

The corresponding query returns the current type of loopbacks, in integer form as described above.

LPB? returns *csu loopback type* = 1 or 2

CSU Manual Mode

Three commands can cause the instrument to loop up or down. The instrument can be set for in-band LINE loop-up, or for out-of-band PAYLOAD or LINE loop-up.

Use the following command to achieve an in-band loop-up.

CSM *n*	*n* =	0 or DOWN	The instrument is not looped up
		1 or UP	The instrument is looped up

The corresponding query returns the currently selected CSU loop up state, in integer form as described above. Notice that this will also be set to up when the instrument has auto response on and an in-band loop-up code has been received.

CSM? returns *in-band loop up state* = 0 or 1

Use the following command to achieve an out-of-band LINE loop-up.

COL *n*	*n* =	0 or DOWN	The instrument is not looped up
		1 or UP	The instrument is looped up

The corresponding query returns the currently selected CSU loop up state, in integer form as described above. Notice that this will also be set to up when the instrument has auto response on and an out-of-band LINE loop up code has been received.

COL? returns *out-of-band line loop up state* = 0 or 1

Use the following command to achieve an out-of-band PAYLOAD loop-up.

COP *n*	*n* =	0 or DOWN	The instrument is not looped up
		1 or UP	The instrument is looped up

The corresponding query returns the currently selected CSU loop up state, in integer form as described above. Notice that this will also be set to up when t the instrument has auto response on and an out-of-band PAYLOAD loop up code has been received.

`COP?` returns *out-of-band payload loop up state* = 0 or 1

Alarm Generation Type

Selects the type of alarms to be generated. Alarms can be generated with any pattern. They are disabled when loopcodes are being generated. Yellow alarm is not valid in unframed mode. If in unframed mode an error will be generated.

NOTE : This value is always set to off after the instrument is power cycled.

`ALG` *n*	*n* =	1 or `OFF`	Alarm generation disabled
		2 or `AIS`	Unframed all ones
		3 or `YELLOW`	Yellow alarm

The corresponding query returns the type of alarm generation in integer form as described above:-

`ALG?` returns *alarm type* = 1 to 3

Loopback Type

Two commands enable the instrument to respond to, or transmit in-band or out-of-band loopcodes.

Use the following command for in-band loopcodes.

`LPC` *n*	*n* =	1 or `LINE`	Line loopback (CSU)
		2 or `FAC4B`	4-bit facility loopback
		3 or `FAC5B`	5-bit facility loopback
		4 or `USER`	User defined (see LPU & LPD commands)

The corresponding query returns the loopback type, in integer form as described above:-

`LPC?` returns *in-band loopback type* = 1 to 4

Use the following command for out-of-band loopcodes.

LOC *n*	*n* =	1 or LINE	Line loopback (CSU)
		2 or PAYLOAD	Payload loopback
		3 or SMARTJACK	Smartjack loopback

The corresponding query returns the loopback type, in integer form as described above:-

LOC? returns *out-of-band loopback type* = 1 to 3

User Defined Loopdown

Sets the user defined in-band loopdown code.

LPD *length,"code"*	*length* =	3 to 8	Number of loopcode bits
	"code" =	00000000 to 11111111	*length* characters

The corresponding query command returns the in-band loopdown length and code:-

LPD? returns *length,"code"*

User Defined Loopup Code

Sets the user defined in-band loopup code.

LPU *length,"code"*	*length* =	3 to 8	Number of loopcode bits
	"code" =	00000000 to 11111111	*length* characters

The corresponding query command returns the in-band loop up length and code:-

LPU? returns *length,"code"*

Loopup

This command causes the instrument to perform a loopup. It is equivalent to pressing the loopup key on the front panel. If this is attempted during testing, autosetup or selftest an error is generated.

LUA

Loopdown

This command causes the instrument to perform a loopdown. It is equivalent to pressing the loopdown key on the front panel. If this is attempted during testing, autosetup or selftest an error is generated.

LDA

Loopup (In-Band) status Query Command

This query command returns the outcome of the last in-band loopup/down command.

LST? returns *flag*	*response* =	0	No attempt to loopup has yet been made
		1	The last loopup was successful
		2	The last loopup failed
		3	A pre-existing loopup was detected

Loopback Code Framing

Selects insertion or overwriting of in-band loopcode framing.

LPF *n*	*n* =	1 or INSERT	insertion of framing
		2 or OVERWRITE	overwriting of framing

The corresponding query returns the loopcode framing type, in integer form as described above:-

LPF? returns *in-band loopcode frm type* = 1 or 2

Printer Squelch

PRS *n*	*n* =	1 or OFF	Squelch disabled
		2 or ON	Squelch enabled

The corresponding query returns the loopback type, in integer form as described above:-

PRS? returns *squelch type* = 1 or 2

Printer Demand

Selects the mode of log on demand triggering of printer output.

Note that in practise this command cannot be acted upon immediately. The instrument will only allow logging to occur when the remote control is deselected. This is not a facility available on remote control.

`PRD` *n*	*n* =	1 or `SETTINGS`	Instrument settings output
		2 or `RESULTS`	Results snapshot output

`PRD?` returns *print on demand type* = 1 or 2

Printer Auto Trigger

Selects the mode of auto triggering of printer output.

Note that in practise this command cannot be acted upon immediately. The instrument will only allow logging to occur when the remote control is 126 deselected. This is not a facility available on remote control.

`PRA` *n*	*n* =	1 or `OFF`	No auto triggered output
		2 or `EVENT`	Event log summaries
		3 or `FIFTEENMIN`	Results at 15 minute intervals
		4 or `TWOHOUR`	Results at 2 hour intervals
		5 or `ENDOFTEST`	End of test results
		6 or `MESSAGEONLY`	Only major messages

`PRA?` returns *auto trigger type* = 1 to 6

Interface Type

Selects T1 interface type.

`IFC` *n*	*n* =	1 or `DSX`	DSX monitor interface
		2 or `TERM`	100 ohm terminated interface
		3 or `BRIDGE`	> 1kohm bridged interface

The corresponding query returns the interface type, in integer form as described above:-

IFC? returns *interface type* = 1 to 3

Line Build Out

Selects T1 line build out.

LBO *n*	*n* =	1 or ZERO	0dB
		2 or SEVENPOINTFIVE	7.5dB
		3 or FIFTEEN	15dB

The corresponding query returns the line build out value, in integer form as described above:-

LBO returns *line build out type* = 1 to 3

Transmit Timing

Selects transmit timing source.

TRT *n*	*n* =	1 or INTERNAL
		2 or RECOVERED

The corresponding query returns the transmit timing source, in integer form as described above:-

TRT? returns *timing source type* = 1 or 2

Signaling Bit Display Type Select

This command allows either single or all signaling bits to be displayed. This is necessary because certain results may only be read when this is correctly configured. (Cf. SIG?, SCG?)

SBD *n*	*n* =	1 or SINGLE	A single t/s sig. bit is displayed
		2 or ALL	All t/s sig. bits are displayed

SBD? returns *displayed sig bit type* = 1 or 2

Signaling Bit Display Channel Select

Selects the channel number that should be displayed when the single channel monitor test is selected.

SBS *channel no*	*channel* = 1 to 24	Channel to display.

The corresponding query returns the selected channel in integer form as described above:-

SBS? returns *channel no* = 1 or 24

Timeslot Map Display Type Select

This command allows either single or all timeslots to be displayed in the timeslot check measurement. This is necessary because certain results may only be read when this is correctly configured. (Cf. TSS?, BIT?)

TMD *n*	*n* = 1 or SINGLE	A single t/s sig. bit is displayed
	2 or ALL	All t/s sig. bits are displayed

TMD? returns *displayed t/s check type* = 1 or 2

Timeslot Map Display Timeslot Select Command

Selects the timeslot number that should be displayed when a single timeslot is selected in the timeslot map test.

TMS *timeslot no*	*timeslot* = 1 to 24	Timeslot to display.

The corresponding query returns the selected timeslot in integer form as described above:-

TMS? returns *timeslot no* = 1 or 24

MISCELLANEOUS COMMANDS

Autoconfigure

This command causes the autotrigger to be initiated. It is equivalent to pressing the "auto" key. The progress of the autoconfigure can then be determined by the bit in the RDY register. If autoconfigure or self test is in progress an error is generated. The instrument will start testing when autoconfigure has been completed.

AUT

Stored Panel Lock

This command allows the stored panels to be store locked. That is to say, if the stored panel lock is set then the save operation is prohibited. After any save or recall operation this field is always set back to ON.

SLK *n*	*n* =	0 or OFF	Stored panel lock disabled
		1 or ON	Stored panel lock enabled

SLK? returns *store lock status* = 0 or 1

Beep Command

This command causes an audio "beep" to be made by the instrument. It has no local equivalent operation and is as follows:-

BEEP

Volume Command

This command sets the volume. It is equivalent to pressing either the increase or decrease volume keys on the front panel.

VOL *parameter*	*parameter* =	OFF or 0	Switches sound to its quietest level
		ON or 1	Switches sound to its loudest level
		DECREASE or 2	Decreases the level
		INCREASE or 3	Increases the level
		MIDRANGE or 4	Sets the level to a midrange value

Save Panel Command

This command instructs the instrument to save[2] it's current configuration in one of the non-volatile memory locations. They are numbered 1 thru 5.

`SAV` n,*"panel_descriptor"*	n =	Panel selector (1 to 5)
	"panel_descriptor" =	Text string (0 to 32 characters)

2. See also the SLK command.

Panel Descriptor Query

This command returns the text string descriptor associated with the designated panel.

`NAM?` n

The response is a text string of 0 .. 32 characters.

Recall Panel Command

This command instructs the instrument to configure itself as defined in one of the non-volatile memory locations, dependent upon the associated parameter. Recalling panel 0 will reset the instrument to its default settings (similar to RST command).

`RCL` n

Start Measurement

This command causes the instrument to start or restart testing, the period being defined by the 'TPD' command. This command is always valid, except when a special test such as signaling bits, timeslot check or high resolution round trip delay has been selected, and clears all error counters before commencing. This command is equivalent to pressing the Start/Stop button on the front panel, and is as follows:-

`STR`

- There will be a delay of up to 500mS between the execution of this command and the actual start of testing. This is because the start of testing must be synchronized to the instruments internal 100mS clock, see Programming Tips for more details.

Stop Measurement

This command causes the instrument to stop testing, irrespective of the type of test period it is performing. The results are now left unchanged and can be inspected at leisure.

STP

- There will be a delay of up to 500mS between the execution of this command and the actual end of testing. This is because the end of testing must be synchronized to the instruments internal 100mS clock, see Programming Tips for more details.
- If this command is sent while the instrument has stopped, an error is generated.

T1/Datacom Mode

Selects the mode of the instrument to be either telecom or datacom.

Note: This command causes the instrument to be completely reconfigured. During this reconfiguration any remote control commands sent to the instrument will be ignored, and afterwards the instrument will be LOCAL.

MODE *n*   *n* = 1 or DATACOM
                      2 or TELECOM

An error is generated if this command is sent to an HP 37701A, i.e. the accessory must be fitted for correct operation of this command.

The corresponding query command returns the currently selected mode in integer format as described below:-

MODE? returns 1 or 2

RS232C Printer Interface

This command configures the printer serial interface configuration. Notice that it sets up parameters for both HP and ALT type printers.

PTR *baud_rate,stop_bits,protocol,style*	*baud_rate* =	1 or 300
		2 or 600
		3 or 1200
		4 or 1800
		5 or 2400
		6 or 4800
		7 or 9600
	stop_bits =	1 or ONE
		2 or TWO
	protocol =	0 or OFF
		1 or ENQUACK
		2 or XONXOFF
		3 or DTR
	style =	1 or COMPRESSED
		2 or NORMAL

Notice that the data width is always set to 8 bits wide. This is equivalent to 7 bit wide data with zeroes parity. Notice that this command does not set the RS 232 port up to be a printer interface, it only sets up the parameters.

PTR? returns *baud_rate,stop_bits,protocol,style*	*baud_rate* =	1 to 7
	stop_bits =	1 or 2
	protocol =	0 to 3
	style =	1 or 2

Date Set-Up

This command sets the date in the instrument, in terms of the year, month, and day. If a non-existent date is passed (31st November), then an error is generated. This command is equivalent to selecting "TIME AND DATE SETUP" mode on the front panel, updating the setup date, then selecting "TIME AND DATE RUN" mode.

`DAT` *years,months,days*	*years* =	1980 to 2050	
	months =	1	JAN
		2	FEB
		3	MAR
		4	APR
		5	MAY
		6	JUN
		7	JLY
		8	AUG
		9	SEP
		10	OCT
		11	NOV
		12	DEC
	days =	1 to 31	

The complementary command returns current the real time clock date in string form as shown above.

`DAT?` returns *years,months,days*

Time Set-Up

This command sets the time in the instrument in terms of hours, minutes, and seconds. This command is equivalent to selecting "TIME AND DATE SETUP" mode on the front panel, updating the setup time, then selecting "TIME AND DATE RUN" mode.

`TIM` *hours,mins,secs*	*hours* =	0 to 23
	mins =	0 to 59
	secs =	0 to 59

The complementary command returns the time in string form as shown above.

`TIM?` returns *hours,mins,secs*

Display

Switches the Instrument electroluminescent display ON or OFF. Notice that for instruments without battery power, this will not have any effect (ie. the display will remain on, even if off is sent). The command is still valid however, as is the corresponding query command.

DIS *n*	$n =$	0 or OFF	Display disabled
		1 or ON	Display enabled

The complementary command returns the current threshold in integer form as described above:-

DIS? returns *display status* = 0 or 1

ALM Query

This command is a request for the instantaneous status of the alarms in the instrument. They are returned as an integer representing the binary weighted alarm bits of the Alarm Register.

When executed, the "ALM" command clears the ALC bit in both status register A and B. A change in state of any of these alarms causes the ALC bit to be set in status registers A and B only if their corresponding mask is enabled in the alarm mask register.

The "ALM" command has no local equivalent, and is as follows:-

ALM?

The complementary command returns the current threshold in integer form as described above:-

ALM? returns n = 0 to 16383

Alarm change Query

This command is a request to determine which alarms have changed their state. The bits which have changed are returned as an integer representing the binary weighted alarm bits of the Alarm Register.

When executed, the "ALC?" command clears all alarm change bits.

The "ALC?" command has no local equivalent, and is as follows:-

ALC? returns n = 0 to 16383

Where the bits have the same significance as the alarm register.

Alarm Mask

Sets up Alarm Mask Register (AMR). This register is used to determine under what conditions the Alarm Change (ALC) bit in Status Register A should be set. If a bit in the Alarm Status register changes (either from 1 to 0 or vice-versa), and the corresponding bit in the Alarm Mask Register is set, the ALC bit in Status Registers A and B are set. The ALC bit is cleared by the ALM?, RST, CLR commands.

The argument to AMR can be specified in a number of ways:-

- As a binary-weighted integer
- As a list of integer values (which are OR'ed)
- As a list of alarm mnemonics

AMR n $n = 0$ to 30719

To disable all alarms, specify AMR 0 or AMR NONE.

The corresponding query returns the current value of Alarm Mask Register in integer form as described above.

AMR? returns $n = 0$ to 30719

History Query

This command is a request to determine which alarms have been set during the last testing period or during the current testing period if testing is in progress. The history alarms are all reset at the start of a testing period. In addition they may be reset by the "HSR" command. The bits which have been set are returned as an integer representing the binary weighted alarm bits of the Alarm Register.

The "HIS?" command is equivalent to pressing the history key on the front panel, and is as follows:-

HIS? returns $n = 0$ to 16383

Where the bits have the same significance as the alarm register.

History Reset

This command resets the history leds and the bits in the history register. It is equivalent to pressing the history reset key on the front panel and is as follows:-

HSR

TSS? *n*

Returns:-

flag,*oor*,*n*	*flag* =	0 or 1	Validity Flag
	oor =	0	The monitor result is timeslot data
	oor =	1	The monitor result is a mapped timeslot
	n =	0 to 255	Monitor result (timeslot data)
	n =	1 to 24	Monitor result (mapped timeslot)

ERROR INSERT COMMANDS

Error Insert Rate

Selects the rate of error addition into the transmitter data stream.

`EIR` *n*	*n* =	`1` or `ERRFREE`	Error insert disabled
		`2` or `ONEINMIN3`	Insert errors at 10^-3 ratio
		`3` or `USER`	Insert errors at user defined rate

The corresponding query returns the error insert mode, in integer form as described above:-

`EIR?` returns *error insert mode* = `1` to `3`

Error Insert Type

Selects the type of errors to be inserted. Error insert rate must be set to other than "ERRFREE".

`EIT` *n*	*n* =	`1` or `LOGIC`	Insert logic errors
		`2` or `FRAME`	Insert frame errors
		`3` or `CRC`	Insert CRC errors
		`4` or `BPV`	Insert BPV errors

The corresponding query returns the error insert type, in integer form as described above:-

`EIT?` returns *error insert type* = `1` to `4`

User Defined Error Insert Ratio

Selects user defined error insert ratio.

`EIU` *n*	*n* =	`1` or `EMIN3`	1 in 10^-3
		`2` or `EMIN4`	1 in 10^-4
		`3` or `EMIN5`	1 in 10^-5
		`4` or `EMIN6`	1 in 10^-6
		`5` or `EMIN7`	1 in 10^-7

`EIU?` returns *error rate* = `1` to `5`

Single Error Insert

This command injects a single error into the generator output stream provided that the generator is in error free mode. If not, an error is produced. This command is equivalent to pressing the front panel single error button.

```
SEI
```

RESULT QUERY COMMANDS

This section contains all measurement result query commands. If these commands are executed outside testing, the last testing period results are returned; during testing the results returned are dependent on the type of measurement period.
If the instrument is in CONTINUOUS, TIMED or USER modes, the results returned are the "current" results.

Some results are not always available, therefore they return not only the result but a validity flag. In addition a second flag indicates whether the result is inrange, under or overrange. For most results this will always be inrange, but it is used in the case of simplex current and wander results. It is included in all results however, to maintain a consistent format.

Wander Lock Query

This query command returns the instantaneous lock status of the wander measurement.

`WLK?` returns *flag* =	0	No reference present
	1	Reference is present

Logic Error Result Query

This command requests one of the logic error results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

`RLE?` *n*	*n* =	1 or ES	Asynchronous error seconds count
		3 or EFS	Error free seconds
		4 or PCEFS	% error free seconds
		5 or EC	Error count
		6 or ER	Average error ratio
		7 or CUER	Current error ratio

See also the *Command History* table at the end of this chapter.

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Count, Seconds Result if <1000000000
	n =	XX.XXE+X	Count, Seconds Result if ≥1000000000
	n =	0.0 to 1.0E-XX	Ratio Result
	n =	XX.XXX or 100.000	Percentage Result

These results will be invalid if the pattern is LIVE.

Logic Analysis Result Query

This command requests one of the logic analysis results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

RLA? *n*	*n* =	1 or PCAVAIL	% availability
		2 or DM	Degraded minutes count
		3 or PCDM	% degraded minutes
		4 or SES	G821 severely errored seconds count
		5 or PCSES	% G821 severely errored seconds
		6 or ES	G821 error seconds count
		7 or PCES	% G821 error seconds
		8 or CSES	Consecutive severely errored seconds
		9 or UAS	Unavailable seconds count

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Count, Seconds Result if <1000000000
	n =	XX.XXE+X	Count, Seconds Result if ≥1000000000
	n =	XX.XXX or 100.000	Percentage Result

These results will be invalid if the pattern is LIVE.

BPV Error Result Query

This command requests one of the BPV error results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

RBP? *n*	*n* =	1 or ES	Asynchronous error seconds count
		2 or EFS	Error free seconds
		3 or PCEFS	% error free seconds
		4 or EC	Error count
		5 or ER	Average error ratio
		6 or CUER	Current error ratio

Returns:-

flag,*oor*,*n*	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Count, Seconds Result if $<$1000000000
	n =	XX.XXE+X	Count, Seconds Result if $\geq$1000000000
	n =	0.0 to 1.0E-XX	Ratio Result
	n =	XX.XXX or 100.000	Percentage Result

Frame Error Result Query

This command requests one of the frame error results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

RFE? *n*	*n* =	1 or ES	Asynchronous error seconds count
		2 or EC	Error count
		3 or OOFC	Out of frame events count
		4 or COFA	COFA events count
		5 or LOSS	Frame loss seconds count
		6 or LOFC	Loss of frame events count
		7 or SEFC	Severely errored framing events count
		8 or ER	Average error ratio

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = 0.0 to 1.0E-XX	Ratio Result

These results will be invalid if the framing type is UNFRAMED.

Frame Analysis Result Query

This command requests one of the frame analysis results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

RFA? *n*	*n* = 1 or PCAVAIL	% availability
	2 or UAS	Degraded minutes count
	3 or SES	Unavailable seconds count
	4 or CSES	G821 severely errored seconds count
		Consecutive severely errored seconds

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = XX.XXX or 100.000	Percentage Result

These results will be invalid if the framing type is UNFRAMED.

CRC Error Result Query

This command requests one of the CRC error results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

RCR? *n*	*n* =	1 or ES	Asynchronous error seconds count
		2 or EFS	Error free seconds
		3 or PCEFS	% error free seconds
		4 or EC	Error count
		5 or ER	Average error ratio
		6 or CUER	Current error ratio

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Count, Seconds Result if <1000000000
	n =	XX.XXE+X	Count, Seconds Result if ≥ 1000000000
	n =	0.0 to 1.0E-XX	Ratio Result
	n =	XX.XXX or 100.000	Percentage Result

These results will only be valid if the framing type is ESF.

CRC Analysis Result Query

This command requests one of the CRC analysis results. The format of the result returned will depend upon the selected result. This will reset the EOT bits in STA and STB.

RCA? *n*	*n* =	1 or PCAVAIL	% availability
		2 or DM	Degraded minutes count
		3 or PCDM	% degraded minutes
		4 or SES	G821 severely errored seconds count
		5 or PCSES	% G821 severely errored seconds
		6 or ES	G821 error seconds count
		7 or PCES	% G821 error seconds
		8 or CSES	Consecutive severely errored seconds
		9 or UAS	Unavailable seconds count

Returns:-

flag,*oor*,*n*	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = XX.XXX or 100.000	Percentage Result

These results will only be valid if the framing type is ESF.

Receiver Level Result Query

This command requests the receiver level result. This will reset the EOT bits in STA and STB.

RRL? *n*	*n* = 1 or LEVDSX	Signal level in dBx
	2 or LEVDBM	Signal level in dBm
	3 or LEVVOLTS	Signal level in volts
	4 or LEVBAL	Imbalance in volts

Returns:-

flag,*oor*,*n*	*flag* = 0 or 1	Validity Flag
	oor = 0 or 1	Underrange or inrange
	n = -40 to +6	dBx
	n = -23 to +23	dBm
	n = 0 to X.XX	Volts

The measurement will be underrange if no signal is present.

Wander Results Query

This command requests the wander results. Opt.001 is required to perform this measurement and an error number will be generated if it is not fitted. This will reset the EOT bits in STA and STB.

`RWN?` *n*	*n* =	1 or `WANINST`	instantaneous wander
		2 or `WANPOS`	positive pk wander
		3 or `WANNEG`	negative peak wander
		4 or `WANPKPK`	pk-pk wander
		5 or `WAN15MIN`	15 min wander
		6 or `WAN24HR`	24 hour wander

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	0 or 1	underrange
	n =	0 to XXX.XXX	Wander

The result will be underrange if the wander reference circuit has lost lock.

The result will be invalid in no wander measurement hardware is present.

Signaling Bits Result Query

This command requests the signaling bits result as displayed on the VF access page. This will reset the EOT bits in STA and STB.

`RSG?` returns *flag,oor,n,"sigbits"*

flag =	0 or 1	Validity Flag
oor =	1	Out of range (always inrange)
n =	0,2,4	length
"sigbits" =	0000 to 1111	signaling bits

The result will be invalid if the framing is SLC96 or UNFRAMED, or the SIGNALING BIT, TIMESLOT CHECK or HI RTD special tests have been selected.

Channel Monitor All Signalling Bits Query Command

This command requests the bit result for the currently selected signalling bit display. The returned result will be a binary number string. Results will be invalid if the pattern is anything other than SPECIAL - SIG BIT TEST with the displayed result type field set to ALL.

The timeslot that the channel corresponds to will depend on the mapping selected (Cf. CHM command).

This will reset the EOT bits in STA and STB.

`SIG?` when n is a channel number

Returns:-

flag,*oor*,"n"	*flag* =	0 or 1	Validity Flag
	oor =	1	Inrange
	"n" =	"00" to "11"	Signaling bits for non ESF framing in channel n
		"0000" to "1111"	Signaling bits for ESF framing in channel n

Channel Monitor single signaling bits Query Command

This command requests the signaling bit result from the currently selected channel. The result will only be valid if the special signaling bit test has been selected, and the display type is set to single. The returned result will be a binary number string.

The timeslot that the channel corresponds to will depend on the mapping selected (Cf. CHM command).

This will reset the EOT bits in STA and STB.

`SCG?`

Returns:-

flag,*oor*,"n"	*flag* =	0 or 1	Validity Flag
	oor =	1	Inrange
	"n" =	"00" to "11"	Signaling bits for non ESF framing
		"0000" to "1111"	Signaling bits for ESF framing

Simplex Current Result Query

This command requests the simplex current result. This will reset the EOT bits in STA and STB.

`RSI?` returns	*flag*,*oor*,n	*flag* =	0 or 1	Validity Flag
		oor =	0 or 1	underrange
		n =	0 to XXX	milliamps

The result will be underrange if the current drops below 10mA.

Signal Frequency Result Query

This command requests the signal frequency result. This will reset the EOT bits in STA and STB.

`RSF?` returns *flag,oor,n*	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = XXXXXXX	Hz

Notice that this result remains valid even if no signal is present. Under these circumstances the count will be zero.

Signal Frequency Offset Result Query

This command requests the signal frequency offset result. This will reset the EOT bits in STA and STB.

`RFO?` returns *flag,oor,n*	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to XXX	parts per million

Notice that this result remains valid even if no signal is present. Under these circumstances the count will be zero.

Signal Round Trip Delay Query

This command requests the signal round trip delay. This will reset the EOT bits in STA and STB.

`RRT?` returns *flag,oor,n*	*flag* = 0 or 1	Validity Flag
	oor = 0 or1	underrange
	n = 1 to 500	milliseconds

The result will go underrange if no signal is present.

Power Fail Alarm Seconds Result Query

This command requests the power fail alarm seconds result. This will reset the EOT bits in STA and STB.

RPF? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always inrange)
		n = 0 to 999999999	Seconds

Yellow Alarm Seconds Result Query

This command requests the yellow alarm seconds result. This will reset the EOT bits in STA and STB.

RYA? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always inrange)
		n = 0 to 999999999	Seconds

This result will be invalid if the framing selection is OFF.

Excess Zeros Alarm Seconds Result Query

This command requests the excess zeros alarm seconds result. This will reset the EOT bits in STA and STB.

RXZ? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always inrange)
		n = 0 to 999999999	Seconds

Pattern Loss Seconds Result Query

This command requests the pattern loss alarm seconds result. This will reset the EOT bits in STA and STB.

RPL? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always invalid)
		n = 0 to 999999999	Seconds

This result will be invalid if the pattern is set to LIVE.

Frame Loss Alarm Seconds Result Query

This command requests the frame loss alarm seconds result. This will reset the EOT bits in STA and STB.

RFL? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always inrange)
		n = 0 to 999999999	Seconds

This command will be invalid if the framing is set to OFF.

Signal Loss Alarm Seconds Result Query

This command requests the signal loss alarm seconds result. This will reset the EOT bits in STA and STB.

RSL? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always invalid)
		n = 0 to 999999999	Seconds

All Ones AIS Alarm Seconds Result Query

This command requests the all ones (AIS) alarm seconds result.

RAO? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always invalid)
		n = 0 to 999999999	Seconds

Uncontrolled Slips Result Query

This command requests the uncontrolled slips result. This will reset the EOT bits in STA and STB.

RUS? returns	*flag,oor,n*	*flag* = 0 or 1	Validity Flag
		oor = 1	Out of range (always invalid)
		n = 0 to 999999999	Slip count

This result will be valid if we have a PRBS or QRSS pattern or we have any framing other than unframed.

Controlled Slips Result Query

This command requests the controlled slips result. This will reset the EOT bits in STA and STB.

`RCS?` returns	*flag*,*oor*,*n*	*flag* = `0` or `1`	Validity Flag
		oor = `1`	Out of range (always inrange)
		n = `0` to `999999999`	Slip count

This result is only valid if the pattern is a PRBS or QRSS and the framing is anything other than unframed.

Bit Slips Result Query

This command requests the bit slips result. This will reset the EOT bits in STA and STB.

`RBS?` returns	*flag*,*oor*,*n*	*flag* = `0` or `1`	Validity Flag
		oor = `1`	Out of range (always inrange)
		n = `0` to `999999999`	Slip count

This result will only be valid if the option is fitted.

Estimated Frame Slips Result Query

This command requests the estimated frame slips result. This will reset the EOT bits in STA and STB.

`RFS?` returns	*flag*,*oor*,*n*	*flag* = `0` or `1`	Validity Flag
		oor = `1`	Out of range (always inrange)
		n = `0` to `999999999`	Slip count

This result will only be valid if the option is fitted.

Pulse Mask Result Query

This command requests the pulse mask result.

Only valid when pulse mask option fitted. This will reset the EOT bits in STA and STB.

`RPM?` *n*	$n =$	1 or `RTIME`	pulse rise time (nS)
		2 or `FTIME`	pulse fall time (nS)
		3 or `WIDTH`	pulse width (nS)
		4 or `OVERSHOOT`	pulse overshoot (nS)
		5 or `UNDERSHOOT`	pulse undershoot (nS)
		6 or `OVERALL`	pass/fail

Returns:-

flag,*oor*,*n*	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	$n =$	0 to 999	Pulse mask result
	$n =$	0 or 1	Overall result; 1 = pass, 0 = fail

Pulse Mask Plot Query

This command requests the pulse plot information.

Only valid when pulse mask option fitted.

`RPP?` returns *n*,*cr*,*lf*,[*validity*,*lwr_msk_pnt*, *pulse_pnt*,*upp_msk_pnt*,*cr*,*lf*]*n

validity indicates that the pulse points are valid. Some will not be valid if the pulse has been truncated . A value of 0 for n means that the result is not yet available.

The points themselves are in terms of the pixel coordinates as would be sent to a printer.

Elapsed Time Result Query

This command requests the elapsed time since the start of the current test. This will reset the EOT bits in STA and STB.

`ELP?` returns *flag,dd,hh,mm,ss*	*flag* =	0 to 1	Validity Flag
	dd =	0 to 99	Days
	hh =	0 to 23	hours
	mm =	0 to 59	Minutes
	ss =	0 to 59	Seconds

Timeslot Monitor Query Command

This command requests the bit result from the currently selected timeslot. The returned result will be a binary number string. This will reset the EOT bits in STA and STB. The result will be invalid if the test has not been selected.

`BIT?`

Returns:-

flag,oor,"n"	*flag* =	0 or 1	Validity Flag
	oor =	1	Inrange
	"*n*" =	"00000000" to "11111111"	Monitor result

TX Timeslot bandwidth query

This command requests the TX fractional T1 bandwidth in kHz. It corresponds to the tx bandwidth field displayed beside the tx timeslot selection field.

`TBW?` returns *n*	*n* =	0 to 1544	Bandwidth (in kHz)

Timeslot Swap Result Query Command

This result gives details about any swapped timeslots. Querying a particular timeslot will return information specifying that either a valid timeslot data stream has been detected or that no valid signature has been detected. In the case of the latter the current timeslot data is returned instead.

This will reset the EOT bits in STA and STB.

Round Trip Delay in Timeslot Query Command

This result gives details of round trip delay in a timeslot. The result will be underrange if no signal is present and invalid if the test has not been selected.

This will reset the EOT bits in STA and STB.

`RDT?`

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	0 to 11	Underrange or Inrange
	n =	0 to 999.999	Round trip delay in timeslot (ms)

STORED RESULTS COMMANDS

In general the commands do not work during testing since the stored measurement graphics (SMG) store would be subject to manipulations that corrupt the access made by the remote control.

All query commands which request G.821 analysis data from the store will generate an error if the G.821 option is not fitted. All the remainder of the commands will generate an error if the stored measurement graphics option is not fitted.

Get store size and usage

`SMS?` returns *storesize*,*storeuse*

storesize	=	SMG store size in samples
storeuse	=	How many store entries are in use

Note that automatic compaction will take place when the store is full.

Get store use information

`SMC?` returns *storenum*,*demobit*,*year*,*month*,*day*,*hour*,*min*, *length*,*res*

storenum	=	store number (-9 to 0) where 0 is the most recent
demobit	=	1 for DEMO measurements, else 0
year	=	year test was started
month	=	month test was started
day	=	day test was started
hour	=	hour test was started
min	=	minute test was started
length	=	the number of samples in the test
res	=	the resolution of the samples in minutes

followed by one line: `EOI`

Entries will only be printed for store entries that are in use. For example:

```
 0, 0, 1990,  1, 24, 10, 14,   2345, 1
-1, 0, 1990,  1, 10, 23, 54,  12980, 1
-2, 1, 1989, 12, 24,  7, 45,    458, 15
-3, 0, 1989, 12,  5,  7, 23,    561, 15
-4, 0, 1989, 11,  7,  8, 12,   2197, 60
EOI
```

Get store data

`SMD?` *n* returns store sample data as a series of records, one for each sample, for store *n*. The number of records depends on how many values are sampled in each period. The store number *n* should be in the range 0 to −9. The form is:

logic-data,*bpv-data*,*frame-data*,*crc-data*,"*alarms1*", "*alarms2*"

followed by one line: `EOI`

Graph data is returned as exponential numbers for example 3E+6. The alarms are organized as follows:

"*alarms1*" =	d0	Ones density alarm
	d1	Excess zeros alarm
	d2	Slip alarm
	d3	Pattern loss alarm
	d4	Frame loss alarm
	d5	AIS alarm
	d6	Signal loss alarm
	d7	Power loss alarm
"*alarms2*" =	d0	reserved for future use (may be 0 or 1)
	d1	reserved for future use (may be 0 or 1)
	d2	reserved for future use (may be 0 or 1)
	d3	reserved for future use (may be 0 or 1)
	d4	Loopdown detected alarm
	d5	Loopup detected alarm
	d6	Excess wander alarm
	d7	Yellow alarm

Note the precision is limited to one decimal digit of mantissa and one decimal digit of exponent. Alarms are returned as strings of 1's and 0's, for example "10011000".

An example of the response to `SMD?` *n* is:

```
0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"

1E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"

4E+1, 5E+2, 1E+1, 0E+0, "00010000", "10000000"
0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
8E+8, 5E+5, 2E+2, 1E+0, "00000110", "00110000"
0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
EOI
```

Get store data in compressed form

The command `SMZ?` *n* returns store sample data for store *n* in a more compressed form than that of the `SMD?` command. Each output line is prepended by a integer repeat count. Since for live data a lot of the samples will be zero, the data size will be very much compressed, this is useful when operating over modems where transmission is slow. It is up to the controller to interpret the data back to its uncompressed form. Example output:

```
2, 0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
1, 4E+1, 5E+2, 1E+1, 0E+0, "00010000", "10000000"
2, 0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
1, 8E+8, 5E+5, 2E+2, 1E+0, "00000110", "00110000"
2, 0E+0, 0E+0, 0E+0, 0E+0, "00000000", "00000000"
EOI
```

Storage Lock

This command enables/disables the storing of results to the store. An error will be generated if the instrument is not fitted with stored measurement graphics.

SRG *n*	*n* =	0 or OFF	data will not be stored
		1 ON or MIN1	data will be stored at 1 minute resolution
		2 or MIN15	data will be stored at 15 minute resolution
		3 or HR1	data will be stored at 1 hour resolution

The corresponding query returns the current storage status,in integer form as described above:-

SRG? returns *storage selection* = 0 to 3

NOTE: The string of results is always disabled after the instrument has stopped or is restarted. Notice that this command causes the instrument to restart, and no "STR" command is required. If an "STR" command is sent then the instrument will restart and disable the storage.

Stored Logic Error Result Query

This command requests a logic error result from a specified store. The format of the result returned will depend upon the selected result.

SRLE? *store,result*	*store* =	-9 to 0	Store number
	result =	1 or ES	Asynchronous error seconds count
		3 or EFS	Error free seconds
		4 or PCEFS	% error free seconds
		5 or EC	Error count
		6 or ER	Average error ratio

See also the *Command History* table at the end of this chapter.

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = 0.0 to 1.0E-XX	Ratio Result
	n = XX.XXX or 100.000	Percentage Result

These results will be invalid if the stored pattern was LIVE.

Stored Logic Analysis Result Query

This command requests a stored logic analysis result from a specified store. The format of the result returned will depend upon the selected result.

SRLA? *store,result*	*store* =	-9 to 0	Store number
	result =	1 or PCAVAIL	% availability
		2 or DM	Degraded minute count
		3 or PCDM	% degraded minutes
		4 or SES	G821 severely errored seconds count
		5 or PCSES	% G821 severely errored seconds
		6 or ES	G821 error seconds count
		7 or PCES	% G821 error seconds
		8 or CSES	Consecutive severely errored seconds
		9 or UAS	Unavailable seconds count

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = XX.XXX or 100.000	Percentage Result

These results will be invalid if the stored pattern was LIVE.

Stored BPV Error Result Query

This command requests a stored BPV error result from a specified store. The format of the result returned will depend upon the selected result.

SRBP? *store,result*	*store* =	-9 to 0	Store number
	result =	1 or ES	Asynchronous error seconds count
		2 or EFS	Error free seconds count
		3 or PCEFS	% error free seconds
		4 or EC	Error count
		5 or ER	Average error ratio

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Count, Seconds Result if <1000000000
	n =	XX.XXE+X	Count, Seconds Result if ≥1000000000
	n =	0.0 to 1.0E-XX	Ratio Result
	n =	XX.XXX or 100.000	Percentage Result

Stored Frame Error Result Query

This command requests a stored frame error result from a specified store. The format of the result returned will depend upon the selected result.

SRFE? *store,result*	*store* =	-9 to 0	Store number
	result =	1 or ES	Asynchronous error seconds count
		2 or EC	Error count
		3 or OOFC	Out of frame events count
		4 or COFA	COFA events count
		5 or LOSS	Frame loss seconds count
		6 or LOFC	Loss of frame events count
		7 or SEFC	Severely errored framing events count
		8 or ER	Average error ratio

Returns:-

flag,oor,n	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Count, Seconds Result if <1000000000
	n =	XX.XXE+X	Count, Seconds Result if ≥1000000000
	n =	0.0 to 1.0E-XX	Ratio Result

These results will be invalid if the stored framing type was UNFRAMED.

Stored Frame Analysis Result Query

This command requests a stored frame analysis result from a specified store. The format of the result returned will depend upon the selected result.

`SRFA?` *store,result*	*store* =	`-9` to `0`	Store number
	result =	`1` or `PCAVAIL`	% availability
		`2` or `UAS`	Unavailable seconds count
		`3` or `SES`	G821 severely errored seconds count
		`4` or `CSES`	Consecutive severely errored seconds

Returns:-

flag,oor,n	*flag* =	`0` or `1`	Validity Flag
	oor =	`1`	Out of range (always inrange)
	n =	`0` to `999999999`	Count, Seconds Result if <1000000000
	n =	`XX.XXE+X`	Count, Seconds Result if ≥1000000000
	n =	`XX.XXX` or `100.000`	Percentage Result

These results will be invalid if the stored framing type was UNFRAMED.

Stored CRC Error Result Query

This command requests a stored CRC error result from a specified store. The format of the result returned will depend upon the selected result.

`SRCR?` *store,result*	*store* =	`-9` to `0`	Store number
	result =	`1` or `ES`	Asynchronous error seconds count
		`2` or `EFS`	Error free seconds count
		`3` or `PCEFS`	% error free seconds
		`4` or `EC`	Error count
		`5` or `ER`	Average error ratio

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = 0.0 to 1.0E-XX	Ratio Result
	n = XX.XXX or 100.000	Percentage Result

These results will only be valid if the stored framing type was ESF.

Stored CRC Analysis Result Query

This command requests a stored CRC analysis result from a specified store. The format of the result returned will depend upon the selected result.

SRCA? *store,result*	*store* = -9 to 0	Store number
	result = 1 or PCAVAIL	% availability
	2 or DM	Degraded minute count
	3 or PCDM	% degraded minutes
	4 or SES	G821 severely errored seconds count
	5 or PCSES	% G821 severely errored seconds
	6 or ES	G821 error seconds count
	7 or PCES	% G821 error seconds
	8 or CSES	Consecutive severely errored seconds
	9 or UAS	Unavailable seconds count

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Count, Seconds Result if <1000000000
	n = XX.XXE+X	Count, Seconds Result if ≥1000000000
	n = XX.XXX or 100.000	Percentage Result

These results will only be valid if the stored framing type was ESF.

Stored Wander Results Query

This command requests a stored wander result from a specified store. Opt.001 is required to perform this measurement and an error number will be generated if it is not fitted.

SRWN? *store*,*result*	*store* =	-9 to 0	Store number
	result =	1 or WANINST	instantaneous wander
		2 or WANPOS	positive pk wander
		3 or WANNEG	negative peak wander
		4 or WANPKPK	pk-pk wander
		5 or WAN15MIN	15 min wander
		6 or WAN24HR	24 hour wander

Returns:-

flag,*oor*,*n*	*flag* =	0 or 1	Validity Flag
	oor =	0 or 1	underrange
	n =	0 to XXX.XXX	Wander

The result will be underrange if the wander reference circuit had lost lock when the result was being stored.

Stored Power Fail Alarm Seconds Result Query

This command requests the stored power fail alarm seconds result from a specified store.

SRPF? *store* = -9 to 0 Store number

Returns:-

flag,*oor*,*n*	*flag* =	0 or 1	Validity Flag
	oor =	1	Out of range (always inrange)
	n =	0 to 999999999	Seconds

Stored Yellow Alarm Seconds Result Query

This command requests the stored yellow alarm seconds result from a specified store.

SRYA? *store* = -9 to 0 Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Seconds

This result will be invalid if the stored framing selection was OFF.

Stored Excess Zeros Alarm Seconds Result Query

This command requests the stored excess zeros alarm seconds result from a specified store.

SRXZ? *store* =	-9 to 0	Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Seconds

Stored Pattern Loss Seconds Result Query

This command requests the stored pattern loss alarm seconds result from a specified store.

SRPL? *store* =	-9 to 0	Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always invalid)
	n = 0 to 999999999	Seconds

This result will be invalid if the stored pattern was set to LIVE.

Stored Frame Loss Alarm Seconds Result Query

This command requests the stored frame loss alarm seconds result from a specified store.

SRFL? *store*	= −9 to 0	Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Seconds

This result will be invalid if the stored framing was set to OFF.

Stored Signal Loss Alarm Seconds Result Query

This command requests the stored signal loss alarm seconds result from a specified store.

SRSL? *store*	= −9 to 0	Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Seconds

Stored All Ones AIS Alarm Seconds Result Query

This command requests the stored all ones (AIS) alarm seconds result from a specified store.

SRAO? *store*	= −9 to 0	Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Seconds

Stored Uncontrolled Slips Result Query

This command requests the stored uncontrolled slips result from a specified store.

SRUS? *store* = -9 to 0 Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Slip count

This result will be valid if the stored pattern was a PRBS or QRSS pattern and the stored framing was anything other than unframed.

Stored Controlled Slips Result Query

This command requests the stored controlled slips result from a specified store.

SRCS? *store* = -9 to 0 Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Slip count

This result will be valid if the stored pattern was a PRBS or QRSS pattern and the stored framing was anything other than unframed.

Stored Bit Slips Result Query

This command requests the bit slips result. Opt.001 is required to perform this measurement and an error number will be generated if it is not fitted.

SRBS? *store* = -9 to 0 Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Slip count

Stored Estimated Frame Slips Result Query

This command requests the stored estimated frame slips result from a specified store. Opt.001 is required to perform this measurement and an error number will be generated if it is not fitted.

`SRFS?` *store* = -9 to 0   Store number

Returns:-

flag,oor,n	*flag* = 0 or 1	Validity Flag
	oor = 1	Out of range (always inrange)
	n = 0 to 999999999	Slip count

Stored Framing Type Query

This command requests the stored framing type for a specified store.

`SFRM?` *store* = -9 to 0   Store number

Returns *frame type* = 1 to 4

Refer to the FRM? command for a detailed breakdown of the reply.

Stored Coding Type Query

This command requests the stored coding type for a specified store.

`SCOD?` *store* = -9 to 0   Store number

Returns *code type* = 1 to 2

Refer to the COD? command for a detailed breakdown of the reply.

Stored Pattern Type Query

This command requests the stored pattern type for a specified store.

SPAT? *store* = -9 to 0   Store number

Returns *pattern type* = 1 to 12

Refer to the PAT? command for a detailed breakdown of the reply.

Stored Interface Type Query

This command requests the stored interface type for a specified store.

SIFC? *store* = -9 to 0   Store number

Returns *interface type* = 1 to 3

Refer to the IFC? command for a detailed breakdown of the reply.

Stored Test Time Query

This command requests the stored test time for a specified store.

STPD? *store* = -9 to 0   Store number

Returns *test time type* = 1 to 5

Refer to the TPD? command for a detailed breakdown of the reply.

Stored Elapsed Time Result Query

This command requests the elapsed time since the start of the current test from a specific store.

SELP? *store* = -9 to 0   Store number

Returns *flag*,*dd*,*hh*,*mm*,*ss*

flag =	0 or 1	Validity
dd =	0 to 99	Flag Days
hh =	0 to 23	Hours
mm =	0 to 59	Minutes
ss =	0 to 59	Seconds

Stored Test Duration (user defined) Query

This command requests the stored user defined test duration from a specific store.

STDU? *store* = −9 to 0 Store number

Returns *duration,units*

Refer to the TDU? command for details of this reply.

Stored User Defined Pattern Query

This command requests the user defined pattern from a specified store.

SPAU? *store* = −9 to 0 Store number

Returns *length,"patt"*

Refer to the PAU? command for details of this reply.

Stored Application Query

This command requests the stored major application of the instrument.

SAPP? *store* = −9 to 0 Store number

Returns *application type* 1 to 3

Refer to the APP? command for details of this reply.

Stored Receiver Timeslot Selection Query

This command requests the stored timeslot mapping.

SRXT? *store* = -9 to 0 Store number

Returns *timeslot mode* 1 to 2

Refer to the RTX? command for details of this reply.

Stored Long User Word Selection Query

This command requests the stored long user word number.

SLUS? *store* = -9 to 0 Store number

Returns *long user word number* 1 to 4

Refer to the LUS? command for details of this reply.

Stored Special Pattern/Test Query

This command requests the special pattern/test from a specified store.

SSPT? *store* = -9 to 0 Store number

Returns *special pattern/test* 0 to 7

Refer to the SPT? command for details of this reply.

Stored Transmitter Multiple Timeslot Query

This command requests the stored transmit timeslots for fractional T1 measurements.

STTM? *store* = -9 to 0 Store number

Returns "*timeslots*" 24 characters,0 or 1

Refer to the TTM? command for details of this reply.

Stored Receiver Multiple Timeslot Query

This command requests the stored transmit timeslots for fractional T1 measurements.

`SRTM?` *store* = -9 to 0 Store number

Returns "*timeslots*" 24 characters,0 or 1

Refer to the RTM? command for details of this reply.

Stored User Defined Pattern (Fractional T1) Query

This command requests the stored user pattern.

`SPAF?` *store* = -9 to 0 Store number

Returns "*user pattern*"

Refer to the PAF? command for details of this reply.

Pulse Mask and Data Plot Query

This command requests the pulse plot information along with the various measurements which are carried out on the pulse. This command is used in conjunction with the PST/PST? and PSR commands.

Only valid when pulse mask option fitted.

`RPD?` Returns

0, cr, lf

or

n, cr, lf

trigger date, cr, lf

trigger time, cr, lf

mask, pol, rise, fall, width, osh, ush, lvl, pass/fail, cr, lf

Followed by
validity, lwr msk pnt, pulse pnt, upp msk pnt, cr, lf
for each point. (There will be n-3 of these lines).

where

trigger date	= yyyy,mm,dd
trigger time	= hh,mm,ss
mask	= 1 to 4
pol	= 0 or 1
rise	= 0 to 999 ns
fall	= 0 to 999 ns
width	= 0 to 999 ns
osh	= 0 to 100%
ush	= 0 to 100%
lvl	= −40 to +10 dBdsx
pass/fail	= 0 or 1

Validity indicates that the pulse points are valid. Some will not be valid if the pulse has been truncated . A value of 0 for <n> means that the trigger condition has not yet been satisfied.

The points themselves are in terms of the pixel coordinates as would be sent to a printer.

Pulse Sample Trigger Mask

This command is used to enable or disable the conditions for storing data and point information about a pulse shape and mask measurement.

PST *n*	*n* = 0 to 63	Pulse sample trigger mask range

The mask can be set in three different ways.

1. The parameter can be a single 16 bit integer , corresponding to the addition of binary weighted bits wishing to be enabled. Eg. if we wished to trigger

on truncated pulses which failed to fit the mask, then the command would be:-

PST 20

2. The parameter can be a list of the binary weighted integers corresponding to all those trigger events to be enabled, separated by commas. For example if we wished to enable POS, FIT and NTR then the command would be:-

   PST 1,8,32

3. The parameter can be a list of three letter mnemonics, defined in the status register section of this chapter, separated by commas. For example if we wished to enable POS, NFT and TRU then the command would be:-

   PST POS,NFT,TRU

   As well as the three methods of passing the parameter outlined above, any combination may be used,remembering that the result is always evaluated to a 16 bit integer. Care should be taken to ensure the resultant integer is in range and the desired sources are enabled (Although range checking is done, no checking of constituent parameters is performed to ensure that they are binary values). A special form of the command is PST ANY or PST 0 which has the effect of accepting any pulse as suitable.

   The complement of this command is used to inspect the pulse sample trigger mask. The command responds with a 16 bit integer equivalent to the binary weighted values of those sources which are enabled (detailed under status registers).

The corresponding query returns the trigger mask, in integer form as described above:-

PST? returns *range* = 0 to 63

Pulse Sample Trigger Reset

This command is used to reset (or rearm) the pulse mask trigger. After this command has been sent, the first pulse to meet the trigger conditions specified by the pulse sample trigger register will have its points and data stored for subsequent reading by the RPD? command.

PSR

Pattern Loss Count Criterion

This command is used to specify whether errors should be counted or suppressed during periods of pattern loss. This information is stored in EEROM and will be retained under all circumstances. It is supplied so that you can customize the instrument to your own requirements.

As an EEROM can only be programmed a finite number of times, the use of this command should be limited.

PTLC *n*	*n* =	0 or NOCOUNT	Errors will not be counted during pattern loss
		1 or COUNT	Errors will be counted during pattern loss

The corresponding query returns the currently selected count criterion, in integer form as described above:-

PTLC? returns *count criterion* = 0 or 1

SELF TEST COMMANDS

Number Of Tests

This command yields the total number of self tests implemented in this instrument as used by the 'TST' command. ie If the reply is '3' then the commands 'TST 0 ... TST 3' are legal.

`NTST?` returns n $n = 15$ for this instrument

Number of Sub-tests in a Test

This command yields the total number of selftest subtests within a test, i.e. 'TST 3' is a selftest. Within this test are a number of hidden subtests which can be accessed by the command:

`NSUB?` t returns	$n =$	Total number of tests within subtest t
	$m =$	Number of runnable tests in current option structure

Self-test

The self test command performs a selected self-test on the instrument. A subsequent response of "0" to the "ERR?" query command indicates that the test has passed, any other number indicates a failure (error codes are listed at the end of this chapter).

TST *n*	*n* =	0 or ALL	Do all the tests
		1 or TEST1	Test CPU ROM/RAM etc
		2 or TEST2	Test all words and prbs's
		3 or TEST3	Test the different types of framing
		4 or TEST4	Test AMI and B8ZS coding
		5 or TEST5	Test the different error types
		6 or TEST6	Test the different error ratios
		7 or TEST7	Test AIS and yellow alarm
		8 or TEST8	Test the interfaces
		9 or TEST9	Tests different input levels
		10 or TEST10	Tests recovered clock with 2-23 sequence
		11 or TEST11	Checks pulse mask spec
		12 or TEST12	Tests round trip delay
		13 or TEST13	Tests COFAs and uncontrolled slips
		14 or TEST14	Tests OOF and SEF counts
		15 or TEST15	Tests signaling bits

Default Conditions

The following settings are used for the instrument following loss of non-volatile memory (NVM). The "RST" command and "RCL 0" command reset the instrument (except for remote control settings) to these conditions.

System: (Unaffected by "RCL 0")	SRQ mask register	ERR
	Status register A (STA)	LCL*, RDY
	Ready register	LQE, STC, ASC, DRO
	Error register	0
	Alarm mask register	32767
	Key register	0
Transceiver Settings:		
	Application	FULL T1
	Frame	D4
	Code	B8ZS
	Pattern	QRSS
	Interface	DSX-MON
	Clk Source	INT
Transmitter Settings:		
	Error Type	LOGIC
	Error Rate	ERR FREE
	Transmit Timeslots	TIMESLOT 1 ONLY
	Prog. Error Rate	10E-3**
	Alarm Generation	OFF
Receiver Settings:		
	Receiver Timeslot Mode	AS TRANSMITTER
	Receiver Timeslots	TIMESLOT 1 ONLY
Results Control:		
	Test Period Type	CONTINUOUS
	Test Duration (User)	10 MINUTES
Printer:		
	Squelch	OFF
	Print On Demand	CURRENT SETTINGS
	Auto Triggered Print	OFF

Loopcodes in-band (DEFAULT):	Type	LINE (CSU)
	Framing	INSERTED
	User Prog. Loopup Length	8
	User Prog. Loopup Pattern	10101010
	User Prog. Loopdown Length	8
	User Prog. Loopdown Pattern	10101010
	Auto Response	OFF
	Tester Looped	DOWN
Loopcodes out-of-band:		
	Code	LINE
	Auto response	OFF
	Line looped	DOWN
	Payload looped	DOWN
VF access:		
	Channel	1
	Audio Monitor	OFF
	Channel mapping	D3/D4
Signaling bit test:		
Foreground:	Channel	01
	Signaling bits (non-ESF)	01
	Signaling bits (ESF)	0101
Background:		
	Signaling bits (non-ESF)	01
	Signaling bits (ESF)	0101
Tones pattern:		
	Send tone in	01
Timeslot map test:		
	Mode	SINGLE
	Timeslot	01
High resolution round trip delay:	Tx Timeslot	01
	Rx Timeslot	01
	Rx mode	AS TRANSMITTER

Other Functions:

Pulse Mask Type	ANSI T1.403
Stored Setting Number	0
Stored Panel Lock	ON
Real Time clock mode	RUN
Selftest Function	ALL
Storage	OFF

* This default only after power on

** Only available when Error Rate selection set to USER PRGM.

Status Registers

STATUS REGISTER A

This register is accessed by the "STA?" command and contains a 16 bit word describing the instrument's status. Each bit is a latched record of an event (not an instantaneous reading). The cause of setting and method of clearing are described below:-

DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
MSG	RQS	ERR	RDY	LCL	FPS	PWR	RQC

DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8
0	SMG	DAT	TIP	-	SCA	ALC	EOT

Bits marked (-) may be either 0 or 1.

Bit 0 RQC : For compatibility with "common capabilities". Not used in this instrument.

Bit 1 PWR : For compatibility with "common capabilities". The instrument is about to power down or the battery is in a low state of charge.

Bit 2 FPS : Front panel service request. A front panel switch has been pressed. Cleared by "KEY?" , "RST" or "CLR".

Bit 3 LCL : Local operation. This is set when the power has just been cycled. Cleared by "STA?", "STB?", "CLR" or "RST".

Bit 4 RDY : This bit is a direct reflection of the DRO bit (bit 3) of the ready register. It is set when a command causes the instrument to output data, cleared when the instrument has finished outputting the data.

Bit 5 ERR : Error. An error of some description has occurred (see "ERR?" command and Error Codes for further information). Cleared by "ERR?","CLR" or "RST".

Bit 6 RQS :	Service requested. This is required for common capability reasons. It has no function in this instrument.
Bit 7 MSG :	For compatibility with "common capabilities". There is an ASCII string in the display area or the instrument has something to say. Not used in this instrument.
Bit 8 *EOT :	This bit is set when the instrument reaches the end of its testing period. It is set as the results become valid at EOT. Cleared by "STR", "RST" or "CLR", or by reading any result.
Bit 9 *ALC :	Alarm change. This is set when any of the alarms in the alarm status register change and their corresponding mask in the alarm mask register is enabled. Cleared by "ALM?", "RST" or "CLR".
Bit 10 *SCA :	Scan Trouble detected. Set when the scan has found an error in one of its tests. Cleared by "STR", "RST" or "CLR".
Bit 12 *TIP :	This bit is set during any testing period and cleared when the instrument is not testing. It is set at the start of any period by "STR" and cleared by "RST" or "CLR".
Bit 13 *DAT :	When set the instrument is in datacom mode, else it is in telecom mode.
Bit 14 *SMG :	When set the instrument is logging data to an smg store. Stored results or setting information can only be read when this is cleared.
Bit 15 0 :	Zero. This is included to be compatible with "common capabilities" and is used to ensure a positive number for "STA?" response in 16 bit computers.

* = Status bit not HP standard.

STATUS REGISTER B

This register is accessed by the "STB?" command and contains an 8 bit word describing the important instrument status information. Each bit is a latched record of an event (not an instantaneous reading). The causes of setting and method of clearing are described below:-

DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
DAT	RQS	ERR	RDY	LCL	FPS	ALC	EOT

Bit 0 *EOT : This bit is set when the instrument reaches the end of its testing period. It is set as the results become valid at EOT. Cleared by "STR", "RST" or "CLR", or by reading any result.

Bit 1 ALC : Alarm change. This is set when any of the alarms in the alarm status register change and their corresponding mask in the alarm mask register is enabled. Cleared by "ALM?", "RST" or "CLR".

Bit 2 FPS : Front panel service request. A front panel switch has been pressed. Cleared by "KEY?", "RST" or "CLR".

Bit 3 LCL : Local operation. This is set when the power has just been cycled. Cleared by "STA?", "STB?" or "CLR".

Bit 4 RDY : Ready. A direct reflection of the DRO bit (bit 3) of the ready register. It is set when a command causes the instrument to output data, cleared when the instrument has finished outputting the data. NOTE: There is a (small but) finite time between reading the last byte of a message and the RDY bit going low.

Bit 5 ERR : Error. An error of some description has occurred (see "ERR?" command for further information). Cleared by "ERR?", "CLR" or "RST".

Bit 6 RQS : Service requested. This bit is set if an SRQ is generated for any reason.

Cleared by "STB?", "RST" or "CLR".

Bit 7 *DAT : Set when the instrument is in datacom mode, else it is in telecom mode.

READY REGISTER

This register is accessed using the RDY? command. The ready register is a byte with binary weighted bits assigned as follows:-

DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	LQE	STC	ASC	DRO	AOC	OST	RAC

Bit 0 RAC : Ready to accept new command. This bit is included for "common capabilities" and is not used in this instrument. This bit will always appear set except in dumb terminal mode where it will always appear clear.

Bit 1 OST : Operation started, this bit is set when the instrument starts testing and reset when it has stopped. This is used to show when the testing has actually started. (cf. STR in Stat reg A).

Bit 2 AOC : All operations complete. This bit is included for "common capabilities" and is not used in this instrument. This bit will always appear clear.

Bit 3 DRO : Data ready for output. This bit is set while a command is outputting data on reply to a query command and is included for common capabilities but has no real use in this instrument. However, the RDY bit in status registers A and B directly follow this bit and a positive transition of the former will generate an SRQ if its mask is enabled. On reads of these registers this bit will always appear set.

Bit 4 ASC : Auto-setup complete. This bit is cleared following a request for auto-setup, and set on completion of that setup.

Bit 5 STC : Self-Test complete. This bit is cleared following a request for self test, and set on test complete.

Bit 6 LQE : Logging queue empty. This bit indicates that the logging queue is empty. Included for common capabilities, but will always be set on this instrument.

ALARM REGISTER

This register is accessed by the ALM? command. A "1" in a bit position indicates that the specified condition is prevailing. If a given alarm condition changes and the corresponding bit in the Alarm Mask Register (see AMR/AMR?) is a "1", then the Alarm Change (ALC) bit will be set in Status Registers A & B.

DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
ERR	OSD	EX0	SLP	PTL	FML	AIS	SGL

DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8
0	-	UAV	EXW	LPD	LPU	PWL	YEL

Bits marked (-) may be either 0 or 1.

Bit 0 SGL : Signal loss. Set when no signal is present.

Bit 1 AIS : All 1s signal. Set when an all ones data pattern is received.

Bit 2 FML : Frame loss. Set when frame sync is lost.

Bit 3 PTL : Pattern loss. Set when pattern sync is lost.

Bit 4 SLP : Slip detected. Set if a slip has occurred in the last 100mS.

Bit 5 EX0 : Excess Zeros. Set if excess zeros have occurred in the last 100mS.

Bit 6 OSD : Ones Density. Set if density $<$ 12.5 % in the last 100mS.

Bit 7 ERR : Errors. Set if an error has occurred in the last 100mS.

Bit 8 YEL : Yellow Alarm. Set if a yellow alarm has occurred in the last 100mS.

Bit 9 PWL : Power Loss. Set if a power loss has occurred during the last run period, or the currently running period.

Bit 10 LPU : Loopup detected. Set if a loopup pattern is being detected.

Bit 11 LPD : Loopdown detected. Set if a loopdown pattern is being detected.

Bit 12 EXW : Excess Wander. Set if excess wander has occurred.

Bit 13 UAV : Unavailability. This flag is set when the system under test appears to be unavailable during a testing period (Notice that this will be set if any of the three types of error (ie. logic, frame or crc) go unavailable. If option 003 is not fitted, then this bit will always be false.

PULSE SAMPLE MASK REGISTER

This register is accessed by the PST/PST? commands. Reading or writing a "1" in a bit position indicates that the specified condition is prevailing.

DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
-	-	NTR	TRU	FIT	NFT	NEG	POS

DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8
0	-	-	-	-	-	-	-

Bits marked (-) may be either 0 or 1.

Bit 0 POS : Positive Pulse: Pulse must be positive polarity to satisfy the trigger condition.

Bit 1 NEG : Negative Pulse: Pulse must be negative polarity to satisfy the trigger condition.

Bit 2 NFT : No Fit. The pulse must be outwith the mask to satisfy the trigger condition.

Bit 3 FIT : Fit. The pulse must be fit within the mask to satisfy the trigger condition.

Bit 4 TRU : Truncated. The pulse must be truncated to satisfy the trigger condition.

Bit 5 NTR : Not Truncated. The pulse must be non truncated to satisfy the trigger condition.

Error Codes

The following tables list the error codes which are returned following an ERR? command.

Parse Time Errors (Error codes -100 to -200)

The errors listed here occur during the parsing of HPIB commands.

-100	Command error (Unknown command)
-101	Invalid character received
-110	
-111	Command header error
-120	Header delimiter error
-121	Numeric argument error
-122	Wrong data type (Numeric expected)
-123	Precision error; rounding occurred
-129	Numeric overflow
-130	Missing numeric argument
-131	Non numeric argument error
-132	Wrong data type (char expected)
-133	Wrong data type (string expected)
-134	Wrong data type (block type #A required)
-135	Data overflow : string or block too long
-139	Error in #H block
-141	Missing non numeric argument
-142	Command buffer overflow
-143	Comma is not a legal command separator
-144	Argument delimiter error
-150*	Comma is not a legal command separator
-151*	Invalid message unit delimiter
-160	CR found without following LF
-161	RS232 Parity Error
-162	RS232 Framing Error
-163	RS232 UART Overrun Error
	RS232 Internal Input Buffer Overrun Error

* = Instrument dependent error code.

Execution Time Errors (Error codes -200 to -349)

These errors are caused at execution time of remote control commands.

-200	No can do (generic execute error)
-201	Not executable in local mode
-202	Settings lost due to RTL or PON
-203	Trigger ignored
-211	Legal command, but settings conflict
-212	Argument out of range
-221	Busy doing something else
-222	Insufficient capability or configuration
-231	Input buffer full or overflow
-232	Output buffer full or overflow
-240*	Reserved
-241*	Command not implemented
-250*	Command illegal during testing
-251*	Command illegal when not testing
-252*	Cannot start with testing period of zero
-300*	Only permitted when the selection is error free
-301*	Recall settings only allowed
-302*	Only allowed in telecom mode
-303*	Only allowed in datacom mode
-304*	Not allowed when tx is generating an alarm
-305*	Not allowed when an HP37701A
-306*	The cct is already sweeping
-307*	The cct is not sweeping
-308*	Not allowed when sweep running
-309*	Not allowed because accy faulty
-310*	Only allowed when store is telecom
-311*	Only allowed when store is datacom
-312*	Cannot start when generating FOX pattern
-313*	Not allowed when async data rate is 19.2kb/s
-314*	Only allowed when out-of-band loopcode selected
-315*	Only allowed when in-band loopcode selected
-316*	Only allowed when ESF framing selected
-317*	Not allowed when tester looped
-318*	Only allowed when application in Nx64
-319*	Not allowed when special test selected

* = Instrument dependent error code.

Option or Capability Errors (Error codes -350 to -370)

The error codes in this section are issued if a legal command is received, but it cannot be executed due to insufficient capability or unsuitable option configuration. They are all diagnosed by the remote control parser or executor.

-350	Instrument has no pulse mask measurement capability
-351	Instrument has no wander measurement capability
-352	Instrument has no G821 analysis capability
-353	Instrument has no Fractional T1 capability

Error Codes for Stored Measurement Results and Graphics

-410	Not allowed while SMG running
-411	Requested SMG store out of range
-412	Requested SMG store unused - no data
-413	Requested SMG text result out of range
-414	SMG option not fitted

Self-Test Errors (Error codes 1 to 1599)

Self-test halts when a self-test error occurs. The error codes are listed below.

1 to 99 CPU Self-Test Errors

10	ROM ID's different
11	ROM 1 Number Incorrect
12	ROM 2 Number Incorrect
13	ROM max number values do not agree
14	ROM dates do not agree
15	ROM 1 CRC test fails
16	ROM 2 CRC test fails
20	RAM test fails
51	Printer RS232 loopback test fails
60	RTC set incorrectly
61	RTC not ticking correctly
81	Keybd processor internal RAM fails
82	Keybd processor external RAM fails
83	Keybd processor ROM fails
90	Video RAM fails

100 to 299 Pattern Test Errors

211	DSX i/f; PRBS 15 failed to sync
213	DSX i/f; PRBS 15 had errors
214	odd t/s;QRSS failed to sync
216	odd t/s;QRSS had errors
217	odd t/s;QRSS failed to sync
219	odd t/s;QRSS had errors
221	DSX i/f; PRBS 20 failed to sync
223	DSX i/f; PRBS 20 had errors
224	even t/s;QRSS failed to sync
226	even t/s;QRSS had errors
227	odd t/s;PRBS 15 failed to sync
229	odd t/s;PRBS 15 had errors
231	DSX i/f; QRSS failed to sync
233	DSX i/f; QRSS had errors
234	all t/s;QRSS failed to sync
236	all t/s;QRSS had errors
237	odd t/s;PRBS 20 failed to sync
241	DSX i/f; PRBS 23 failed to sync
243	DSX i/f; PRBS 23 had errors
244	mixed t/s;QRSS failed to sync
246	mixed t/s;QRSS had errors
247	odd t/s;PRBS 23 failed to sync
249	odd t/s;PRBS 23 had errors

	251	DSX i/f; 1 in 2 failed to sync
	253	DSX i/f; 1 in 2 had errors
	261	DSX i/f; 1 in 8 failed to sync
	263	DSX i/f; 1 in 8 had errors
	271	DSX i/f; 3 in 24 failed to sync
	273	DSX i/f; 3 in 24 had errors
	281	DSX i/f; 55 OCTET failed to sync
	283	DSX i/f; 55 OCTET had errors
	291	DSX i/f; All Ones failed to sync
	293	DSX i/f; All Ones had errors
300 to 399	Framing Test Errors	
	311	D4 Framing failed to sync
	313	D4 Framing had errors
	321	ESF Framing failed to sync
	323	ESF Framing had errors
	331	SLC96 Framing failed to sync
	333	SLC96 Framing had errors
400 to 499	Coding Test Errors	
	411	AMI coding failed to sync
	413	AMI coding had errors
	421	B8ZS coding failed to sync
	423	B8ZS coding had errors
500 to 599	Error Type Test Errors	
	511	Logic error subtest failed to gain sync
	512	Logic error result too low
	513	Logic error result too high
	521	BPV error subtest failed to gain sync
	522	BPV error result too low
	523	BPV error result too high
	531	Frame error subtest failed to gain sync
	532	Frame error result too low
	533	Frame error result too high
	541	CRC error subtest failed to gain sync
	542	CRC error result too low
	543	CRC error result too high

600 to 699 Error Ratio Test Errors

611	1E-3 error subtest failed to gain sync
612	1E-3 error result too low
613	1E-3 error result too high
621	1E-4 error subtest failed to gain sync
622	1E-4 error result too low
623	1E-4 error result too high
631	1E-5 error subtest failed to gain sync
632	1E-5 error result too low
633	1E-5 error result too high
641	1E-6 error subtest failed to gain sync
642	1E-6 error result too low
643	1E-6 error result too high
651	1E-7 error subtest failed to gain sync
652	1E-7 error result too low
653	1E-7 error result too high
661	Single error subtest failed to gain sync
662	Single error result too low
663	Single error result too high

700 to 799 Alarm Test Errors

710	Framing off; no alarm generated; but alarm being detected
720	Framing off; could not detect AIS
730	Framing off; could not deselect AIS
740	Framing D4; could not detect Yellow Alarm
750	Framing D4; could not deselect Yellow Alarm
760	Framing ESF; could not detect Yellow Alarm
770	Framing ESF; could not deselect Yellow Alarm

800 to 899 Interface Test Errors

811	TERM i/f; PRBS 15 failed to sync
813	TERM i/f; PRBS 15 had errors
821	TERM i/f; PRBS 20 failed to sync
823	TERM i/f; PRBS 20 had errors
831	TERM i/f; QRSS failed to sync
833	TERM i/f; QRSS had errors
841	TERM i/f; PRBS 23 failed to sync
843	TERM i/f; PRBS 23 had errors
851	TERM i/f; 1 in 2 failed to sync
853	TERM i/f; 1 in 2 had errors
861	TERM i/f; 1 in 8 failed to sync
863	TERM i/f; 1 in 8 had errors
871	TERM i/f; 3 in 24 failed to sync
873	TERM i/f; 3 in 24 had errors
881	TERM i/f; 55 OCTET failed to sync
883	TERM i/f; 55 OCTET had errors
891	TERM i/f; All Ones failed to sync
893	TERM i/f; All Ones had errors

900 to 999	Level Test Errors	
	911	DSX i/f subtest failed to gain sync
	912	DSX i/f result too low
	913	DSX i/f result too high
	921	0dB TERM i/f subtest failed to gain sync
	922	0dB TERM i/f result too low
	923	0dB TERM i/f result too high
	931	7.5dB TERM i/f subtest failed to gain sync
	932	7.5dB TERM i/f result too low
	933	7.5dB TERM i/f result too high
	941	15dB TERM i/f subtest failed to gain sync
	942	15dB TERM i/f result too low
	943	15dB TERM i/f result too high
1000 to 1099	Clock Test Errors	
	1011	Clock recovery test failed to sync
	1012	Clock recovery count too low
	1013	Clock recovery count too high
1100 to 1199	Pulse Mask Test Errors	
	1111	Pulse mask failed
1200 to 1299	Round Trip Delay Test Errors	
	1211	Could not gain sync
	1212	Result not valid
	1213	Result not correct
	1221	Could not gain sync
	1222	Result not valid
	1223	Result not correct
1300 to 1399	Slip Test Errors	
	1311	Could not gain sync
	1312	Could not gain sync
	1313	Incorrect counts
	1314	Results not valid
	1321	Could not gain sync
	1322	Could not gain sync
	1323	Incorrect counts

1400 to 1499	OOF & SEF Test Errors	
	BASE COUNTS 1410,1416,1422,1428,1434 1440,1446,1452,1458,1464 1470,1476	
	BASE COUNT + 1	Could not gain sync
	BASE COUNT + 2	Incorrect OOF count
	BASE COUNT + 3	Incorrect SEF count
	BASE COUNT + 4	Incorrect frame error count
	BASE COUNT + 5	Incorrect validity bits
1500 to 1599	Signaling Bit Test Errors	
	BASE COUNTS 1510,1515,1520,1525,1530 1535,1540,1545,1550,1555 1560,1565,1570	
	BASE COUNT + 2	Incorrect decoded signaling bits
	BASE COUNT + 3	Incorrect decoded signaling bits
	BASE COUNT + 4	Incorrect validity bits

Restart Causing Commands

The following commands cause the instrument to discard current results and start a new test.

Mnemonic	Notes
FRM	
COD	
PAT	
PAU	If application is full T1 or Opt 004 not fitted
TDU	
PAF	If word modified is relevant to current application
TPD	
SAV	
RCL	
TIM	
DAT	
IFC	
LUW	If longer user word is active
LUL	If longer user word is active
LUS	If longer user word is active
LUY	If longer user word is active
LSL	If longer user word is active
LHB	If longer user word is active
SPT	
STO	If tones are selected
TTM	If the application is n x 56 or n x 64
RTM	If the application is n x 56 or n x 64
STR	
SRG	
RST	

Command History

Command	Page No.	Change Description	Firmware
RLE?	10-41	Add 2 or SYES (synchronous error seconds count) to *result* parameter	3049 and below
SRLE?	10-57	Add 2 or SYES (synchronous error seconds count) to *result* parameter	3049 and below
APP	10-22	Delete	3113 and below
BIT?	10-63	Delete	3113 and below
LHB	10-26	Delete	3113 and below
LSL	10-26	Delete	3113 and below
LUL	10-25	Delete	3113 and below
LUS	10-25	Delete	3113 and below
LUW	10-25	Delete	3113 and below
LUY	10-26	Delete	3113 and below
OPT?	10-20	Delete 3 (fractional T1)	3113 and below
PAF	10-27	Delete	3113 and below
PAT	10-24	Delete 12 or SPECIAL	3113 and below
PTLC	10-84	Delete	3113 and below
RPD?	10-81	Delete	3113 and below
PST	10-82	Delete	3113 and below
RDT?	10-64	Delete	3113 and below
RTF	10-29	Delete	3113 and below
RTM	10-23	Delete	3113 and below
RTR	10-29	Delete	3113 and below
RTT	10-29	Delete	3113 and below
RXT	10-23	Delete	3113 and below
SAPP?	10-79	Delete	3113 and below
SBD?	10-38	Delete	3113 and below
SBS?	10-39	Delete	3113 and below
SCG?	10-57	Delete	3113 and below
SIG?	10-56	Delete	3113 and below
SPAF?	10-81	Delete	3113 and below
SLUS?	10-80	Delete	3113 and below
SRG	10-68	Delete	3113 and below
SRTM?	10-81	Delete	3113 and below
SRXT?	10-80	Delete	3113 and below

Command History (continued)

Command	Page No.	Change Description	Firmware
SPT	10-24	Delete	3113 and below
SSB	10-28	Delete	3113 and below
SSI	10-28	Delete	3113 and below
SSO	10-28	Delete	3113 and below
SSPT?	10-80	Delete	3113 and below
STO	10-38	Delete	3113 and below
SSTM?	10-80	Delete	3113 and below
TBW?	10-63	Delete	3113 and below
TDU	10-31	Delete	3113 and below
TMD	10-39	Delete	3113 and below
TMS	10-39	Delete	3113 and below
TSS?	10-63	Delete	3113 and below
TTM	10-23	Delete	3113 and below