Agilent 71501D
Jitter Analysis System
User's Guide

Agilent Technologies

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CAUTION

The *caution* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

WARNING

The *warning* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.

The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.

The laser radiation symbol. This warning symbol is marked on products which have a laser output.

The AC symbol is used to indicate the required nature of the line module input power.

| The ON symbols are used to mark the positions of the instrument power line switch.

❍ The OFF symbols are used to mark the positions of the instrument power line switch.

The CE mark is a registered trademark of the European Community.

The CSA mark is a registered trademark of the Canadian Standards Association.

The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

ISM1-A This text denotes the instrument is an Industrial Scientific and Medical Group 1 Class A product.

Typographical Conventions.
The following conventions are used in this book:

Key type for keys or text located on the keyboard or instrument.

Softkey type for key names that are displayed on the instrument's screen.

`Display type` for words or characters displayed on the computer's screen or instrument's display.

User type for words or characters that you type or enter.

Emphasis type for words or characters that emphasize some point or that are used as place holders for text that you type.

General Safety Considerations

The HP 71500A, HP 70820A, and Agilent N1015A products have been designed and tested in accordance with the standards listed on the Manufacturer's Declaration of Conformity, and has been supplied in a safe condition. This documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Install the instrument according to the enclosure protection provided. Instruments do not protect against the ingress of water.
This instrument protects against finger access to hazardous parts within the enclosure.

Install the instrument so that the ON/OFF switch is readily identifiable and is easily reached by the operator. The ON/OFF switch or the detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

The front panel LINE switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.

Position the instruments so it is not difficult to operate the disconnecting device.

WARNING **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only. Altitude up to 2000 Meters, temperature 0 to 40 °C.**

WARNING **No operator serviceable parts inside. Refer servicing to qualified service personnel. To prevent electrical shock do not remove covers.**

WARNING **This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.**

WARNING **To prevent electrical shock, disconnect the instrument from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

WARNING **For continued protection against fire hazard, replace N1015A line fuse only with same type and ratings (1A/250V, part number 2110-1320). The use of other fuses or materials is prohibited.**

CAUTION Connectors are easily damaged when connected to dirty or damaged cables and accessories. When you use improper cleaning and handling techniques, you risk expensive instrument repairs, damaged cables, and compromised measurements. Before you connect any cable to the Agilent 71501D, clean it properly.

CAUTION Total input signal power to the HP 70820A module's front-panel RFINPUT connectors must not exceed +16 dBm. Because there is no RF input attenuator, power in excess of +16 dBm may damage the instrument. The largest measurable power level before signal compression is +4 dBm.

CAUTION To avoid damage, do not exceed +10 dBm input power or ±2 V DC to any N1015A front panel RF inputs. Do not apply DC voltage exceeding ±10V to the N1015A Jitter Modulation Input.

CAUTION The N1015A circuitry can be damaged by electrostatic discharge (ESD). Avoid applying static discharge to the N1015A RF connectors and jitter modulation connectors.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1C and 664 respectively.

CAUTION Always use the three-prong ac power cord supplied with the instruments. Failure to ensure adequate earth grounding by not using this cord may cause instrument damage.

CAUTION The N1015A instrument has autoranging line voltage input. Be sure the supply voltage is within the specified range (110/115/230/240, 50/60 Hz, 110 Watts).

CAUTION Use of controls or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.

1

Introduction

Analysis with the Agilent 71501D

The Agilent 71501D jitter analysis system provides advanced analysis of high-speed digital communication waveforms and the components which generate them. The jitter analyzer configuration performs automatic compliance and network equipment testing, to SONET, SDH, and custom standards. In addition, it can perform diagnostic measurements of the jitter spectrum and waveform.

The Agilent 71501D consists of the following:

- Jitter analyzer personality
- Microwave transition analyzer module (jitter receiver/controller)
- Color display/mainframe
- Jitter modulation source
- Clock source
- Modulation test set
- User's guide

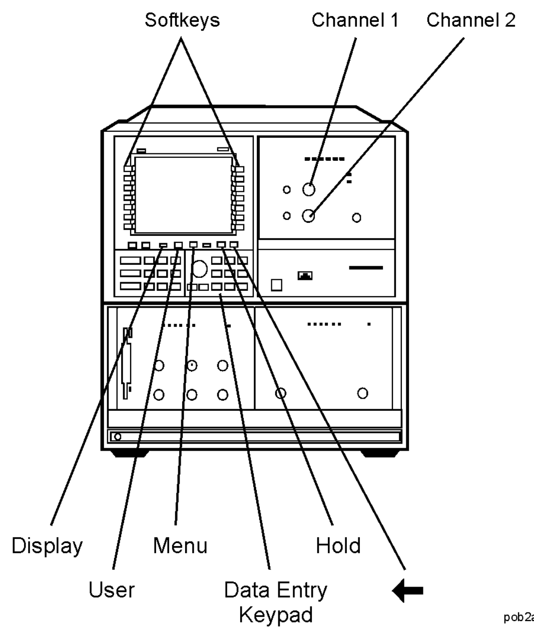
You will also need a pattern generator for all of the jitter applications and an error detector for the jitter tolerance application. The 71501D jitter analysis system can share the 70004A color display with a compatible modular pattern generator and an error detector. The compatible sources have different frequency ranges and FM characteristics. Refer to "Jitter System Configurations" on page 2-3 for a list of possible system equipment. Also refer to Chapter 6, "Specifications and Characteristics" for detailed information.

Shipment Packing List

In your 71501D system shipment there is a document that lists all of the items included in the shipment. The accessory package contains many items that you will need to configure the equipment. Pay particular attention to the 3.5mm (female) to 3.5 mm (female) connectors that you should put on the N1015A modulation test set ports as connector savers.

Menu and Softkey Overview

Most front-panel controls are accessed through softkey menus. Softkeys are the seven buttons located on each side of the 70004A screen. The functions of softkeys change according to the menus displayed on the screen. Use the left-side softkeys to access the major menus.



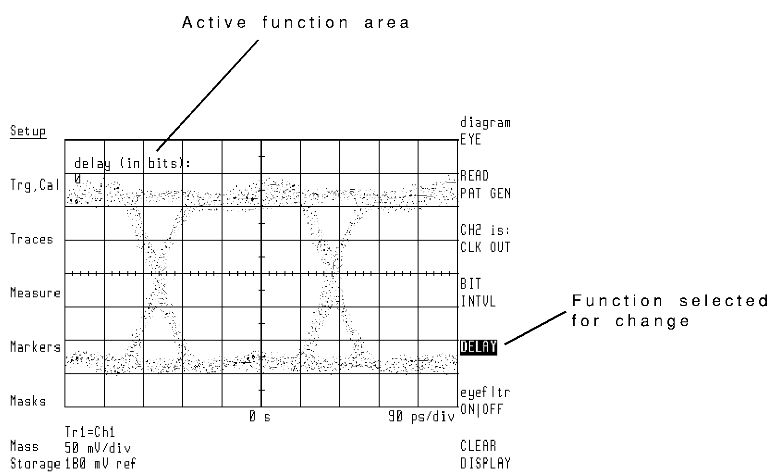
Use the following three front-panel keys on the 70004A display to select the available softkey menus:

USER press to select between the jitter measurement personality and Instrument BASIC menus. (The 71501D jitter analysis personality must first be loaded as described in Chapter 2, “Jitter Analyzer Getting Started”).

MENU press to view menus for the 70820A microwave transition analyzer module. Refer to “Menu Maps” on page 4-3 to learn how to view the pattern generator’s menus.

DISPLAY press to view the menus for the 70004A display.

- A softkey with *ON* and *OFF* in its label can be used to turn the softkey's function on or off. To turn the function on, press the softkey so *ON* is underlined. To turn the function off, press the softkey so *OFF* is underlined. For example, an ON or OFF softkey function for MUX/DMUXwill be indicated in this manual as: *MUX/DMUX ON*.
- A softkey such as *ERRORS BER* offers you a choice of functions. In this case, you could choose to count the number of errors by pressing the softkey until *ERRORS* is underlined, or determine the bit error rate by pressing the softkey until *BER* is underlined. For example, *ERRORS BER <u>BER</u>*.
- When some softkeys, such as *DELAY*, are pressed the first time, only the function will be highlighted, as shown in the graphic below.The display's active function area shows the value of any activated function. To change the value of the function, use the numeric keys, step keys, or knob. When entering a value using the numeric keys, the entry must be terminated by pressing either one of the units keys, such as *MHz*, or if no units are required, the *ENTER* key. When adjusting the value using the step keys or knob, the units are entered automatically by the analyzer. When you are finished entering the value, press the softkey again to highlight the on and off functions. Pressing the **HOLD** key deactivates the active function. Pressing the **HOLD** key a second time blanks the right-side softkeys. Use the ← (backspace) key to backspace over numbers entered using the data-entry keypad.



Analyzer's Setup Menu

Jitter Analysis with the 71501D

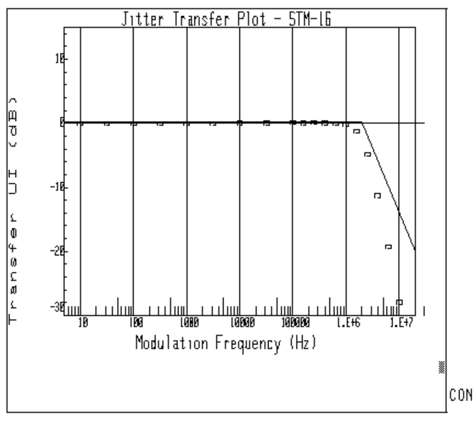
Note

The jitter personality must first be loaded as described in Chapter 2, "Jitter Analyzer Getting Started".

The jitter analyzer can be operated in the following modes:

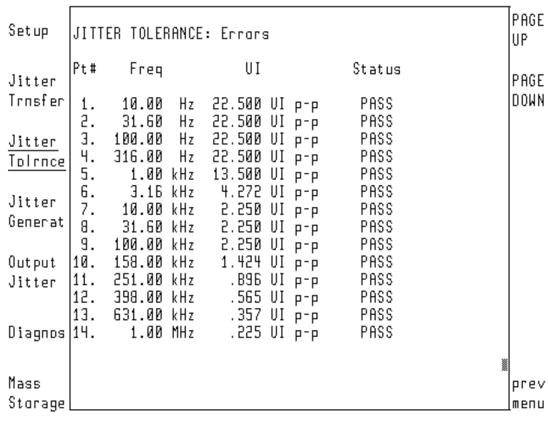
Jitter Transfer Mode

Displays a jitter transfer plot or list of the measured output jitter of the device-under-test divided by the input jitter versus the jitter frequency.



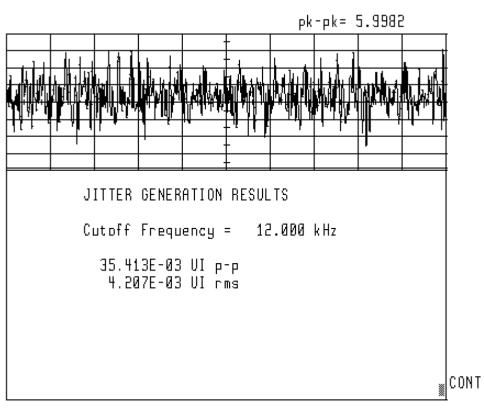
Jitter Tolerance Mode

Displays the error performance in the presence of specified levels of jitter in plot or list form.



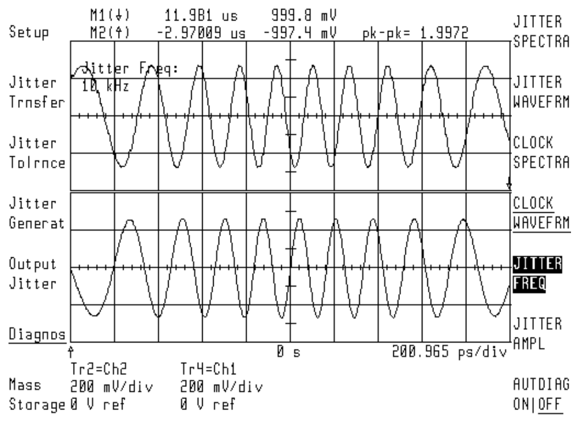
Jitter Output and Generation Mode

Displays results of peak-to-peak and RMS intrinsic jitter measurements.



Diagnostic Measurement Mode

Displays the spectrum and waveform of the clock signal or of the demodulated jitter signal, extracted from the jittered clock signal. Use this mode as an aid to solve jitter-related problems.



Configure for Bench Top or Rack Mount Use

1 Remove the instrument side strips.

2 Attach the hardware:

- If you have the kit for cabinet flanges, attach the flanges to the sides of the front panel. Use the screws that are included in the kit.
- If you have the kit for cabinet flanges and handles, arrange the handles so that they are attached next to the front panel with the flange on the outside of the handle. Use the screws that are included in the kit.

3 Remove the feet and the tilt stands before cabinet mounting the instrument.

CAUTION

Ventilation Requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

Jitter Analyzer Getting Started

Getting Started with the Jitter Analyzer

In this chapter, you will find information on the following topics:

Jitter System Configurations

There must be only *one* of the following instruments:

- modulation source
- microwave transition analyzer
- pattern generator (optionally)
- error detector (optionally)
- N1015A modulation test set (optionally)

There must be *at least one* of the following instruments:

- display/mainframe
- clock source

The 71501D jitter analysis system may consist of the following:

Microwave Transition Analyzer	**Frequency Range**
70820A[a] microwave transition analyzer module: option UF3, expanded memory	DC–40 GHz
Display Mainframe	
70004A[a] color display and mainframe	
Jitter Personality Card[a]	
Jitter Modulation	**Frequency Range**
33250A[a] function/arb waveform generator	80 MHz
3325A/B synthesizer/function generator *(OBSOLETE)*	20 MHz
3324A synthesizer/function generator *(OBSOLETE)*	20 MHz

Modulation Test Set	Frequency Range
N1015A[a] Option 300, 20 MHz modulator Option 310, 80 MHz modulator Option 305, 20 MHz and 80 MHz modulators	 2.4–3.2 GHz 9.8–13 GHz 2.4–3.2 and 9.8–13 GHz
Clock Source	**Frequency Range**
E4422B[b] RF signal generator	250 kHz–4 GHz
83752A[a] synthesized microwave sweeper	10 MHz–20 GHz
83732B synthesized signal generator	10 MHz–20 GHz
70340A modular signal generator	1 GHz–20 GHz
83732A synthesized signal generator *(OBSOLETE)*	10 MHz–20 GHz
70311A Option H08 signal generator with modulation input *(OBSOLETE)*	16 MHz–3.1 GHz

Error Performance Analyzer[c]	Data Rate
86130A BitAlyzer error analyzer	50 Mb/s–3.6 Gb/s
70843C option UHF error performance analyzer (PART OF 71612C pattern generator and error detector)	100 Mb/s–12.5 Gb/s
70843A/B option UHF error performance analyzer *(OBSOLETE)*) (PART OF 71612A/B pattern generator and error detector)	100 Mb/s–12 Gb/s
71603A/B error performance analyzer*(OBSOLETE)* 70841A/B modular pattern generator *(OBSOLETE)* 70842A/B modular error detector *(OBSOLETE)*	100 Mb/s–3 Gb/s

a. Standard instrument for the 71501D jitter analysis system.
b. Recommended clock source for 3 Gb/s applications.
c. Instrument is not bundled with the 70501D jitter analysis system.

Clock Source Considerations

Table 2-1. Compatible Equipment

Clock Source	Compatible Error Performance Instruments
E4422B RF signal generator 83752A microwave signal generator 83732A/B synthesized signal generator	86130A BitAlyzer error performance analyzer 70843A/B/C option UHF error performance analyzer (component of 71612A/B/C) pattern generator error detector 71603B error performance analyzer 70841A/B modular pattern generator 70842A/B modular error detector
70311A Option H08 signal generator	71603B error performance analyzer 70841A/B modular pattern generator 70842A/B modular error detector
70340A modular synthesized signal generator	71603B error performance analyzer 70841A/B modular pattern generator 70842A/B modular error detector 70843A/B/C option UHF error performance analyzer (component of 71612A/B/C) pattern generator error detector
Clock Source	**Compatible Jitter Modulation Instrument**
E4422B RF signal generator	33250A function/arb waveform generator

You can use either a modular or stand-alone clock source and error performance analyzer. Refer to Chapter 3, “Jitter Analyzer Tutorials” for diagrams that show specific application configurations with and without the modulation test set and with modular and stand-alone instruments.

Starting to Make Jitter Measurements

The following sequence of steps shows you how to start making jitter measurements with the 71501D system. This section is intended to familarize you with the measurement process. For more detailed procedures on the specific measurement applications, refer to Chapter 3, “Jitter Analyzer Tutorials”. The steps described in this section are as follows.

1 Set up the equipment.

a Connect the cables to the instruments.

b Set the instrument MSIB and GPIB addresses.

2 Load the analyzer personality.

3 Select the template and measurement conditions.

4 Perform a system calibration.

Step 1. Set Up the Equipment

1 Determine the test equipment configuration.

In this step there are four configuration diagrams to reflect the main differences in the instruments that you may use in your 71501D system. Refer to “Jitter Analyzer Tutorials” on page 3-1 for the following configuration diagrams.

- Modular clock source and error performance analyzer without a modulation test set
- Stand-alone clock source and error performance analyzer without a modulation test set
- Modular clock source and error performance analyzer with a modulation test set
- Stand-alone clock source and error performance analyzer with a modulation test set

2 Connect the front and rear panel cables in the configuration that matches your application and equipment.

The configuration of the jitter analysis system depends on the data rate and jitter modulation capabilities required.

- If the device test-frequency is within the ranges listed below, use the configuration that includes the N1015A modulation test set.

  2.4 to 3.2 GHz with 20 MHz modulation (71501D options 300, 305)

  9.8 to 13 GHz with 80 MHz modulation (71501D options 310, 305)

- If the device test-frequency is outside the ranges listed above, use the configuration that **does not** include the modulation test set.

CAUTION To prevent damage to the 70820A microwave transition analyzer, always have either a bandpass filter or a dc block connected to the analyzer input channels.

3 Connect the GPIB cables in any arrangement as long as all of the instruments are interconnected.

4 Connect the MSIB cables to the instruments in a closed loop fashion. You can install the MMS modules in multiple mainframe configurations.

Cables and Accessories for 71501D System Configurations

Cables:	**Options and Part numbers**
SMA to SMA	8120-4948
BNC cable	8120-2582
Reference BNC to SMB cables	8120-5048
GPIB cables	8120-3445
Miscellaneous:	
3.5 mm (f) to 2.4 mm (f) (2)	1250-2277
6 dB attenuator	8493C
Bandpass Filter 155 Mb/s (2)	71501D Option 400 (0955-0969)
Bandpass Filter 622 Mb/s (2)	71501D Option 410 (0955-0732)
Low Pass Filter 800 MHz (2)	71501D Option 412 (0955-1465)
Low Pass Filter 1.5 GHz (2)	71501D Option 417 (0955-1464)
Bandpass Filter 2488 Mb/s (2)	71501D Option 420 (0955-0731)
Bandpass Filter 2666 Mb/s (2)	71501D Option 430 (0955-1468)
Low Pass Filter 4.0 GHz (2)	71501D Option 435 (0955-1466)
Bandpass Filter 9953 Mb/s (2)	71501D Option 440 (0955-0970)
Bandpass Filter 10.7092 Gb/s (2)	71501D Option 450 (0955-1469)
Bandpass Filter 12.4416 Gb/s (2)	71501D Option 460 (0955-1467)
Low Pass Filter 12.4 GHz (2)	71501D Option 467 (0955-1394)
Bandpass Filter 10.66423 Gb/s (2)	71501D Option 480 (0955-1470)

5 Set the MSIB instrument addresses following the MSIB rules.

Refer to the documentation of the individual MSIB instruments for information on MSIB connection strategy and rules.

- On the rear panel of the 70004A/70820A instrument combination, there are two GPIB connectors. The 70004A GPIB connector is used for remote programming. The 70820A GPIB connector is a private GPIB used for the equipment setup to allow 70820A, jitter personality to control the required instruments. Ensure that the GPIB connections are to the correct connector.
- The standard MSIB address for the 70820A is row 0, column 11. It uses a value one higher than its column address as its address on the private GPIB.
- The jitter system uses one clock source at a time, yet you can connect more than one clock source to the GPIB and MSIB if each clock source has a unique address. You can select a clock source when the jitter personality is first loading, or from the *template/storage VERSION/CONFIG* menu.

6 When the system includes two 70004 display units, dedicate one display to the 70820A and use the other display for other system instruments.

a To assign the display to other instruments, press:

DISPLAY, *Address Map*

b Use the knob to highlight the desired instrument, then press:

Assign Both

c Use the previous two steps to assign the second display to system instruments other than the 71501D, 70820A. Do not press the *NEXT INST* softkey to assign the second display to an instrument. (The second display may take control of the 71501D).

7 Set the GPIB addresses on the individual instruments.

- When using more than one GPIB clock source, you can set the GPIB addresses from 1 through 30, provided that the instruments are at different addresses.
- When you first switch on the power to the 70820A, the instrument polls the connected equipment for GPIB addresses. The 70820A occupies two consecutive GPIB addresses.

To Use Two Displays

When the system includes two 70004 display units, the following procedure is recommended.

1 Dedicate one display to the 70820A and use the second display for other system instruments. To assign the display to other instruments, press:

  DISPLAY, *Address Map*

2 Use the knob to highlight the desired instrument, then press:

  Assign Both

Note

Do not press the *NEXT INST* softkey to assign the second display to an instrument. This is because the second display may take control of the 71501D.

Step 2. Load the Personality

1 Insert the jitter personality card into the front-panel card slot of the 70004A display, facing the metal strip on the card downward and toward the instrument. Make sure the card is fully inserted into the card slot.

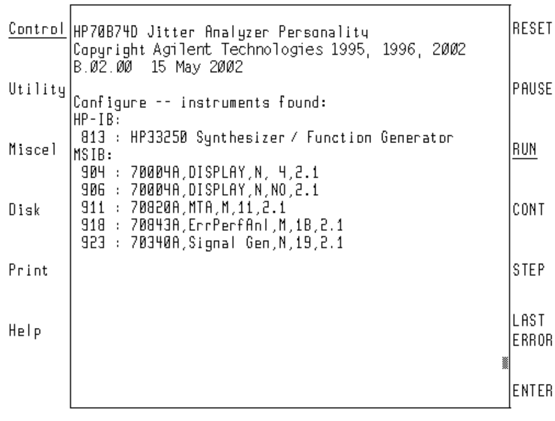
  If the 70004A display was previously assigned to the 70820A module, continue with this procedure. If not, refer to “If the Program Does Not Load” on page 2-12.

2 Switch on the power to all of the instruments, switching on the 70820A last.

3 Wait for the system to complete its start-up routines and load the program.

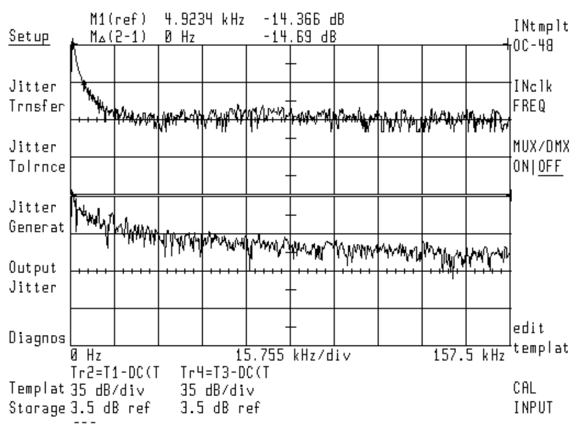
  - After a brief period of time, the display shows the message at the bottom of the screen: `Loading 70874D Please wait.`
  - Wait for the program to finish loading, which takes approximately 6 minutes. A small orange LED next to the card slot will flash on and off while the program is loading. This indicates the program is being read from the card.
  - Do not press any instrument keys until the program is loaded. Pressing keys can cause the automatic program loading to abort.

When you first run the application, it scans both instrument communication busses, MSIB and GPIB, to detect the instruments in the system. This allows the system to adapt to different clock sources, pattern generators and error detectors. After the system has loaded the software, a screen similiar to the following screen is displayed.



Example Screen Displayed after the Software Loads

After the jitter application is loaded, the following screen is displayed.



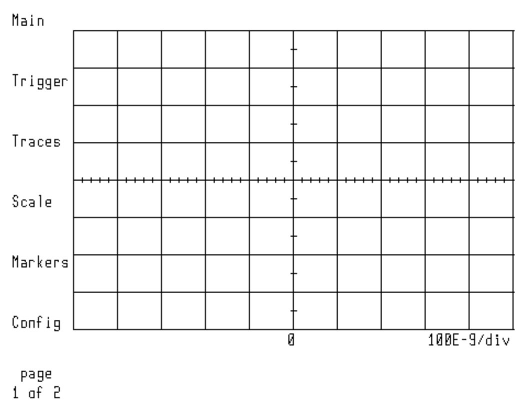
Note

Each time the power is switched on to the 71501D, the analyzer personality must be reloaded into memory. This occurs automatically if the 70874D memory card is inserted in the front-panel card slot before the instrument is switched on.

If the Program Does Not Load

The program has failed to load if one of the following situations occurs:

- The following message is never displayed: `Please wait... Loading Jitter Application` `Loading 70874D from :EXTERNAL, 904. Please wait.`
- The display is assigned to an instrument other than the HP 70820A.
- The display mass storage is assigned to the GPIB device.
- The left-side softkeys match those shown in the following figure.



70820A Module Main Menu

1 To remedy this situation, press:

DISPLAY, *Mass Storage, msi, MEMORY CARD*

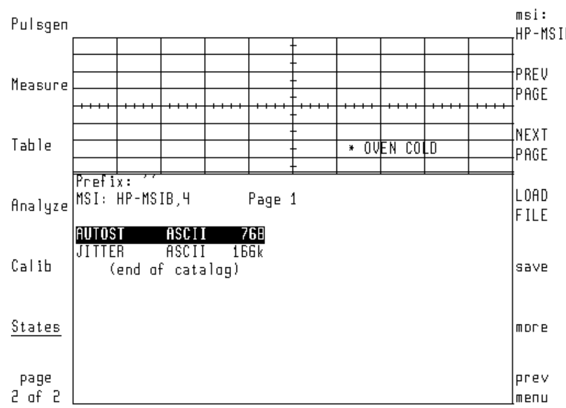
MENU, *page 1 of 2, States, more 1 of 2, mass storage, msi, MSIB CARD*

The active function will show MSIB column 4. The number should match the column number of the 70004A display whose card reader slot contains the jitter analyzer personality card (which is also 4). If the column number is incorrect, key in the correct value and press

ENTER, *prev menu*

2 Turn the front-panel knob to highlight the file "`AUTOST`", and then press *LOAD FILE*.

This process takes approximately 6 minutes.



Screen to Access the AUTOST file

Step 3. Select Template and Measurement Conditions

When the jitter personality begins running, it presets all instruments to their default states. You can select a template that sets the clock frequency and the modulation frequency and amplitude, but leaves error detector and pattern generator settings unchanged. When the main menu is displayed (with `Setup` at the upper left), you may adjust pattern generator or error detector parameters as required by your device or system.

1 Select an existing template by pressing:

Setup, *INtmplt*, *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*

- If you select the *sdh* softkey, the key choices will be standard rates *STM-64, STM-16, STM-4, and STM-1*. The initial selection will be the `SDH` standard at the same clock rate as the previously selected `SONET` standard.
- If you select the *OC-X* or *STM-X* softkey, clock frequency, jitter transfer, and output jitter parameters are set. The jitter magnitude versus jitter frequency template is preset.

To edit a template or create a custom template, refer to “Creating and Editing Templates” on page 4-21.

Note

The clock source and error performance analyzer selected must be capable of operating at the input data rate you specify.

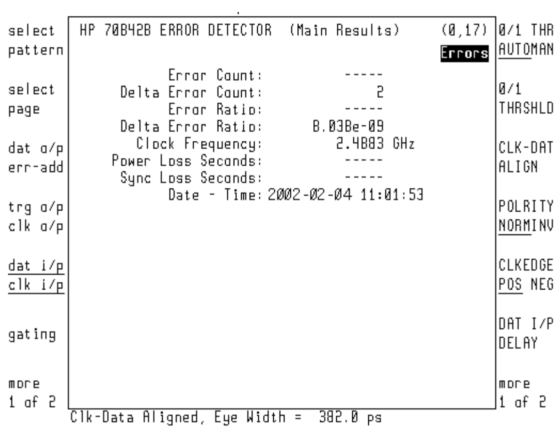
2 Adjust the error performance analyzer to the settings for the specific measurement application.

- If the error detector and pattern generator are part of a stand-alone instrument, adjust the values from the front panel of the error performance analyzer.
- If the error detector and pattern generator are modular instruments, follow the remaining steps in this chapter.

a On the 70004A, press **DISPLAY**, and then the right-side *NEXT INSTR* softkey.

If several instruments are in the system, you may have to press *NEXT INSTR* several times to display the 70842A/B or 70843A/B/C error detector.

b Adjust the error detector settings, through the 70004A softkeys.



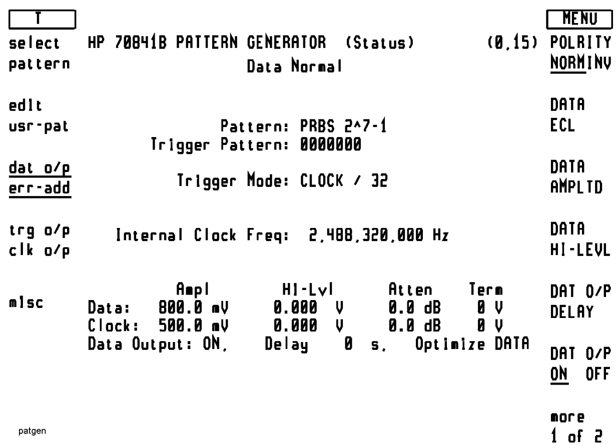
The Main Result Menu of the HP 70842A/B

c To adjust the pattern generator settings, press the left-side *Address Map* softkey. Use the front-panel knob to scroll the box to the column where the 70841A/B or 70843A/B appears.

d Press *ADJUST ROW*, and rotate the knob to move the box to the row where the 70841A/B appears.

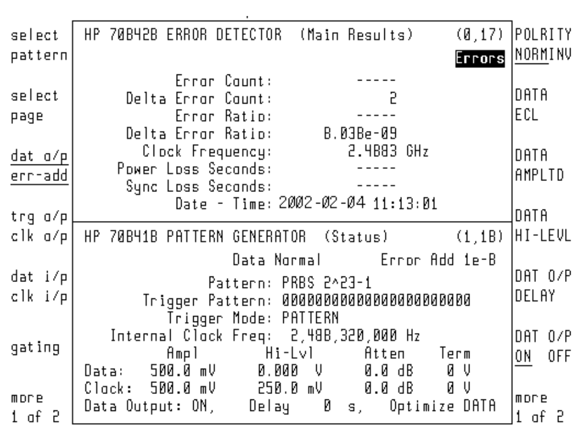
e Press *ASSIGN BOTH.*

f Use the displayed softkey menus, or the MENU key, to set the pattern generator to the desired settings.



Status Screen of the HP 70841A/B

g The error detector and pattern generator displays can be displayed simultaneously by pressing **DISPLAY**, and then the right-side *NEXT INSTR* softkey. Then press **MENU,** *more 1 of 2, Show modules, SHOW PAT GEN.*



h Press **DISPLAY** and then *NEXT INSTR* to return control to the jitter analyzer.

i Press **USER** to return to the jitter analyzer personality menus.

Step 4. Perform a Calibration

CAUTION System calibration should be performed before making jitter transfer and jitter tolerance tests or whenever a new standard or custom template is selected.

The calibration procedure sets the output voltage swing of the synthesized function/sweep generator at given jitter rates to produce the appropriate amount of phase modulation on the clock output of the clock source/signal generator and, therefore, to the input data of the device-under-test.

Messages that may Occur during a Calibration

During calibration, several types of error or warning messages can appear on the display.

- If either of the following two messages appear, the input signal to the indicated channel of the 70820A is too large. To correct the condition, reduce the signal and restart the calibration.

  Error 6211, channel 1 hardware overrange
  Error 6212, channel 2 hardware overrange

- If error messages 480 and 490 appear, this indicates a condition that does *not* need to be corrected. The calibration routine automatically corrects these conditions as they occur.

  Error 480, Vco fll ool transient error.
  Error 490, Nf pll ool transient error.

- If SKIPPED appears in the template editor, a template is loaded containing points at jitter frequencies outside the capability of the clock source, these points will be skipped during calibration. Rather than editing the values on these lines, delete them and add new lines at frequencies within the clock source modulation frequency range. Refer to “Specifications and Characteristics” on page 6-1.

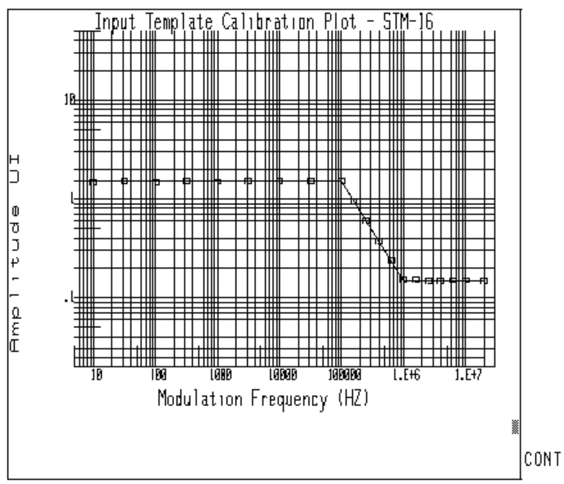
- If UI ADJUST appears in the template editor, the Unit Intervals (UI) were automatically increased to meet the minimum level for a valid measurement.

- If CAL FAILED appears, the calibration routine could not achieve the Unit Intervals (UI) that were specified in the template.

Some modulation frequencies produce spurious sidebands on the output signal from some clock sources. These sidebands may cause measurement or calibration errors.
70311A Modulation frequencies within 40 kHz of an integer multiple of 200 kHz
83752A Modulation frequency near 3.98 MHz

3 Press **USER**, *Setup*, *CAL INPUT*

The calibration can take up to six minutes to execute. When the calibration is finished, the display will be similar to the following graphic.



Note

If you choose a template that exceeds the modulation capabilities of the clock source, the system will adjust the template to modulation levels that are compatible with the source. For example, the minimum modulation rate of the 83752A is about 300 Hz. The templates for 155 Mb/s and 622 Mb/s start below 300 Hz. The 71501D will not attempt to operate the 83752A below 300 Hz. In this case, the starting point of the template will be adjusted to 316 Hz.

Note

If the clock signal is not connected to input 2 of the 70820A, or if the modulation signal is not connected to the clock source, errors will occur when a calibration is attempted.

3

Jitter Analyzer Tutorials

Jitter Analyzer Tutorials

This chapter contains tutorials for the following jitter system applications.

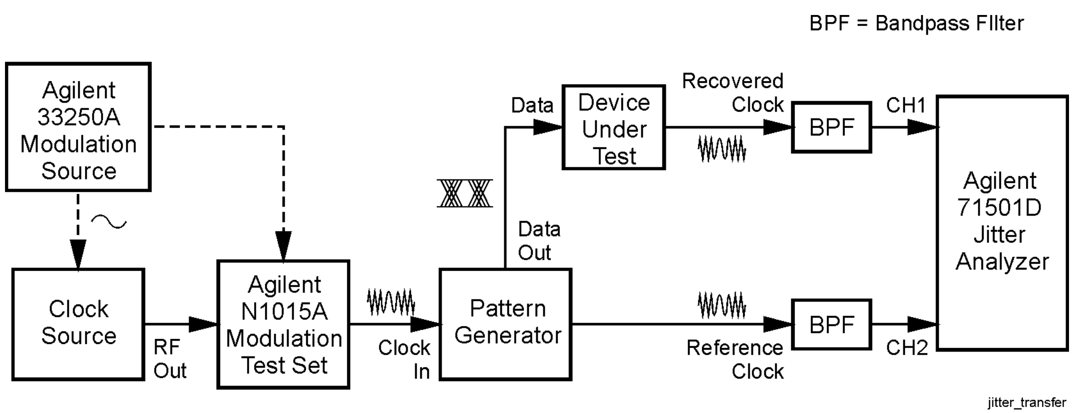
The tutorials are based on the sequential steps shown below.

1. Connect the equipment.
2. Configure measurement conditions.
   a. Select the template.
   b. Make any necessary changes to the template.
   c. Set up the error performance instrument(s).
3. Perform a calibration.
4. Save the template and calibration information.
5. Measure the device response.
6. Change measurement conditions, if necessary.
7. Print the displayed measurement results.

Note There are two menus connected to the USER key. When you press the key multiple times, the displayed menu toggles between the jitter analyzer and the Instrument BASIC menu.

Tutorial 1: Jitter Transfer Measurements

Jitter transfer is typically used to describe how a clock recovery module or repeater locks and tracks data as the data has jitter placed upon it. The measurement is the ratio of the jitter on the output of the device or system compared to the jitter on the data going into the device. The following diagram shows signal flow for the test process.



What you will learn in this tutorial:

- Configure the equipment and set up a measurement.
- Perform a calibration.
- Perform a jitter transfer measurement.
- Combine measurement traces through averaging.
- Change the corner frequency of the test specification.
- Change the gain amplitude of the test specification.
- Plot the measurement results.
- Measure jitter transfer on regenerators that do not have clock signal outputs.

Step 1. Configure the Equipment

Note

The equipment connections are the same for jitter transfer and jitter generation measurements.

1. Connect the front and rear panel cables in the configuration that matches the device test-frequency and your system equipment. Refer to "Jitter System Configurations" on page 2-3 for a list of 71501D system equipment.
2. Determine if the device test-frequency is within the following ranges:
   - 2.4 to 3.2 GHz with 20 MHz modulation (71501D options 300, 305)
   - 9.8 to 13 GHz with 80 MHz modulation (71501D options 310, 305)

- If the device test-frequency is within the ranges listed above, use a configuration that includes the N1015A modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-5 on page 3-12.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-7 on page 3-16.
- If the device test-frequency is outside the ranges listed above, use a configuration that **does not** include the modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-1 on page 3-6.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-3 on page 3-10.

For each type of configuration (with and without the test set) there is a connection diagram for stand-alone clock source and error performance analyzer (70843A/B/C, 86130A), and a connection diagram for modular clock source and error performance analyzer (70841A/B, 70842A/B).

Also, refer to the list of connections that corresponds to the type of configuration (with or without the test set). See Table 3-1 on page 3-8 and Table 3-2 on page 3-14.

Note If you reconfigure the equipment after the jitter personality has been loaded, refer to "Rescan the Equipment after Reconfiguring" on page 4-19.

CAUTION To prevent damage to the 70820A microwave transition analyzer, always have either a bandpass filter or a dc block connected to the analyzer input channels. Make sure that the bandpass filter matches the frequency range that you will be measuring.

3 Connect filters to the 70820A inputs.

- If you are performing SONET/SDH testing with the 86130A or 71612/70843 combination of instruments use these filters:

  2.488 Gb/s bandpass (Opt. 420) plus 4 GHz low pass (Opt. 435)
  2.66 Gb/s bandpass (Opt. 430) plus 4 GHz low pass (Opt. 435)
  622 Mb/s bandpass (Opt. 410) plus 800 MHz low pass (Opt. 412)

Note In the testing conditions mentioned, the lowpass filter is required to prevent the higher clock harmonics emanating from the pattern generator clock output.

- If you are performing SONET/SDH testing with the 71603/71841/70842 combination of instruments, only a band pass filter is required.
- If you are performing 10 Gb/s testing using the 71612/70843 combination of instruments, the band pass filter guard band is adequate.

Note When using clock frequencies where bandpass filters are not available, a low pass filter plus a DC block (11742A) can be substituted for the bandpass filter. The DC block protects the 70820 sampling input from the DC level of the pattern generator clock output.

- For 622 Mb/s testing, use an 800 MHz low pass filter (Opt. 412).
- For 1 to 1.25 Gb/s testing, use a 1.5 GHz low pass filter (Opt. 417).
- For 2.4 to 3.3 Gb/s testing, use a 4.0 GHz low pass filter (Opt. 435).
- For 9 to 11.5 Gb/s testing, use a 12.4 GHz low pass filter (Opt. 467).

4 Set the GPIB and MSIB addresses for the system instruments.

5 Refer to "To Use Two Displays" on page 2-10 if you have more than one 70004A display in your equipment configuration.

Connections Without the Modulation Test Set

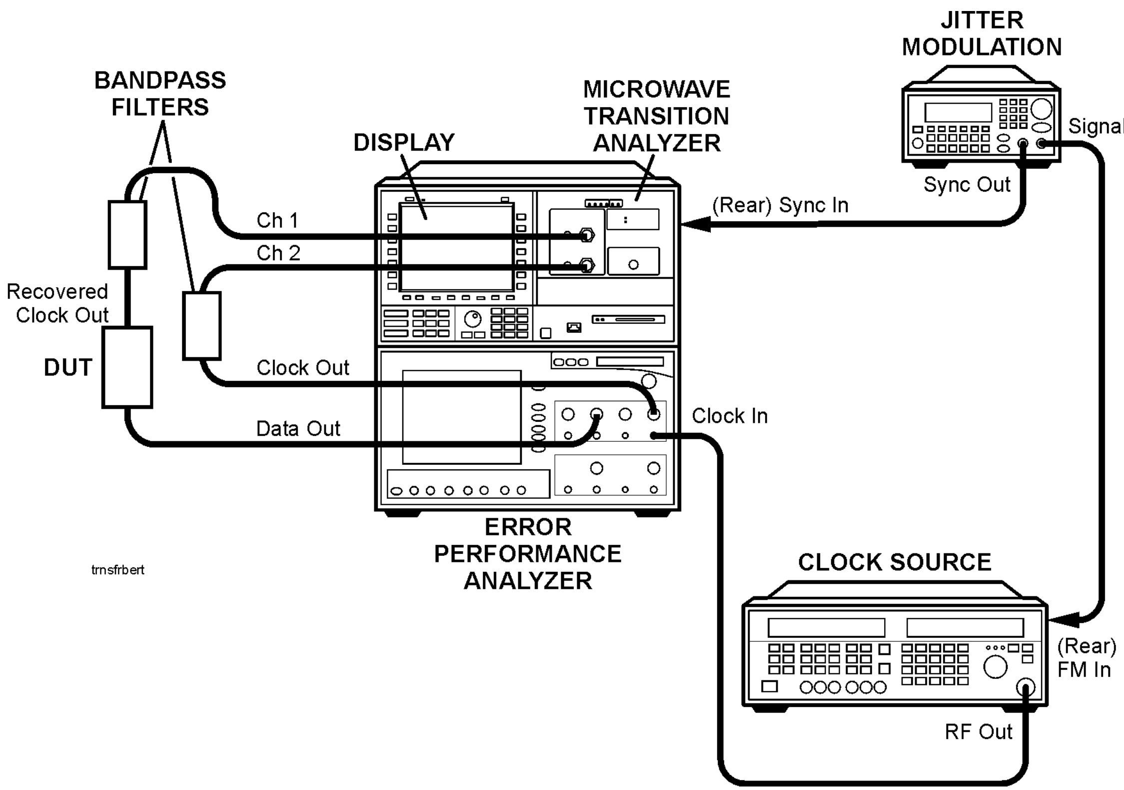


Figure 3-1. Jitter Transfer and Generation Connections with Stand-Alone[1] Error Performance Analyzer and Stand-Alone[2] Clock Source

1. The 70843A/B/C and 86130A stand-alone error performance analyzers are compatible with the 71501D.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources that are compatible with the 71501D.

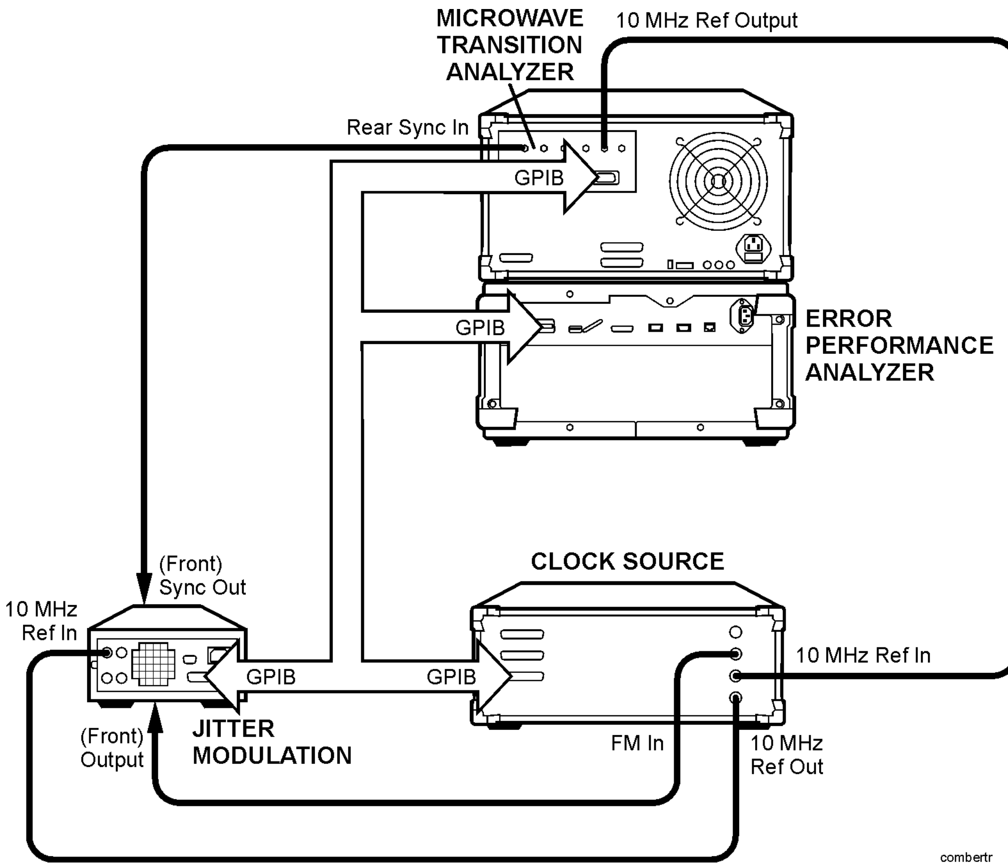


Figure 3-2. Rear Panel[1] Connections for Stand-Alone Error Performance Analyzer and Stand-Alone Clock Source

1. If you are using an 83752 clock source, connect a BNC tee and a 50 ohm termination to the rear panel FM IN.

Table 3-1. Jitter Transfer and Generation Measurements with no Test Set

Make This Instrument Connection	TO	This Instrument
Jitter Modulation SYNC OUT	TO	Microwave Transition Analyzer SYNC IN (rear panel)
Jitter Modulation SIGNAL/OUTPUT	TO	Clock Source FM IN EXT 1 INPUT (front panel for E4422B)
Jitter Modulation GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Clock Source (Stand-Alone) RF OUTPUT Clock Source (Modular) CLOCK OUT	TO	Pattern Generator CLOCK IN
Clock Source 10 MHz REF OUT (rear panel)	TO	Jitter Modulation 10 MHz REF IN (rear panel)
Clock Source (Stand-Alone) GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Microwave Transition Analyzer 10 MHz RF OUT (rear panel)	TO	Clock Source 10 MHz REF IN (rear panel)
Microwave Transition Analyzer GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Pattern Generator CLOCK OUT (through BP filter)	TO	Microwave Transition Analyzer CH 2
Pattern Generator DATA OUT	TO	DUT Data In
DUT Clock Out	TO	Microwave Transition Analyzer CH 1 (through filter)
Pattern Generator (Stand-Alone) GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Configuration with 2 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG & ED/Mainframe MSIB IN (rear panel)
PG & ED/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)
Configuration with 3 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG/Mainframe MSIB IN (rear panel)
PG/Mainframe MSIB OUT (rear panel)	TO	ED or Clk Source/Mainframe MSIB IN (rear panel)
ED or Clk Source/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)

a. The GPIB connections can be made in any order. The only requirement is that all GPIB instruments are interconnected.

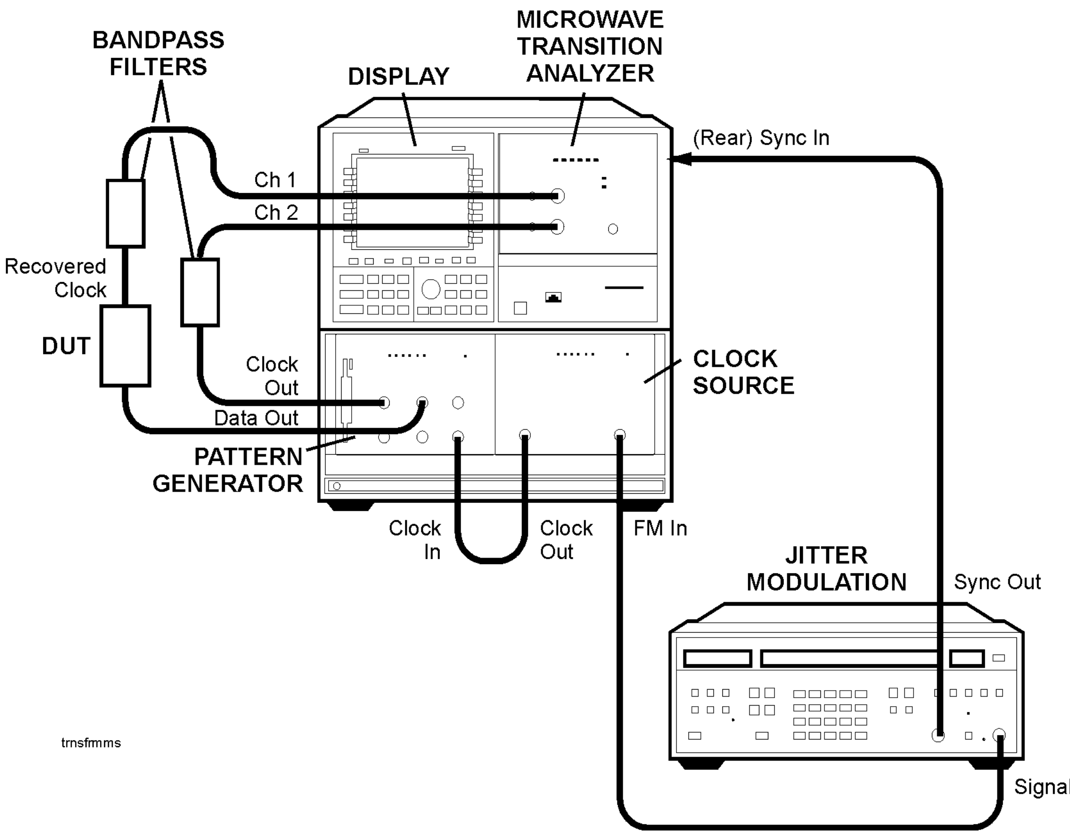


Figure 3-3. Jitter Transfer and Generation Connections with Modular[1] Error Performance Analyzer and Modular[2] Clock Source

1. The 70841A/B and 70842A/B are the modular error performance analyzers compatible with the 71501D.
2. See "Jitter System Configurations" on page 2-3 for a list of clock sources that are compatible with the 71501D.

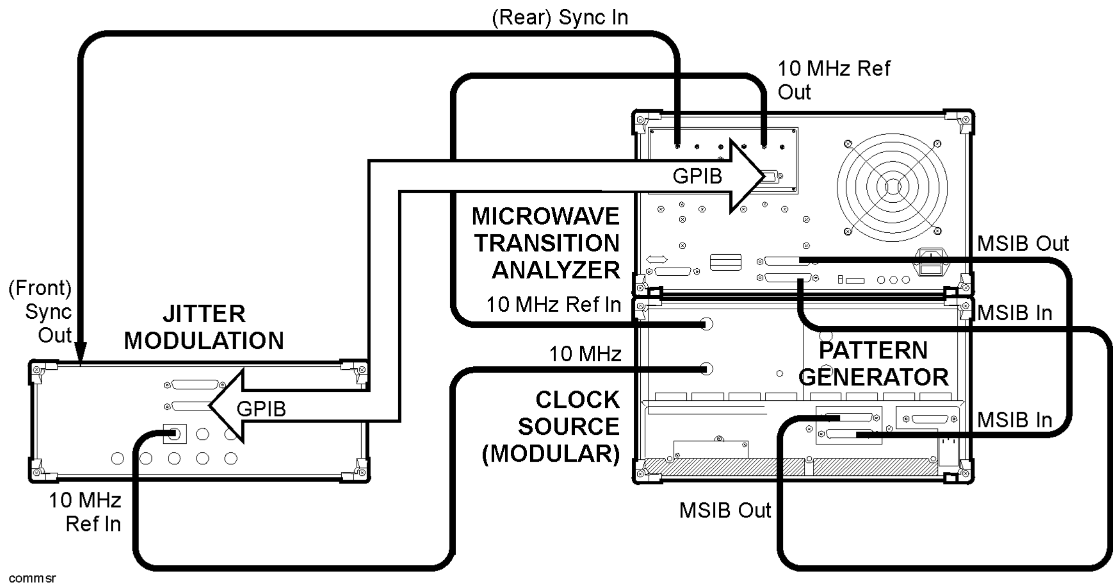


Figure 3-4. Rear Panel Connections for Modular Error Performance Analyzer and Modular Clock Source

Connections With the Modulation Test Set

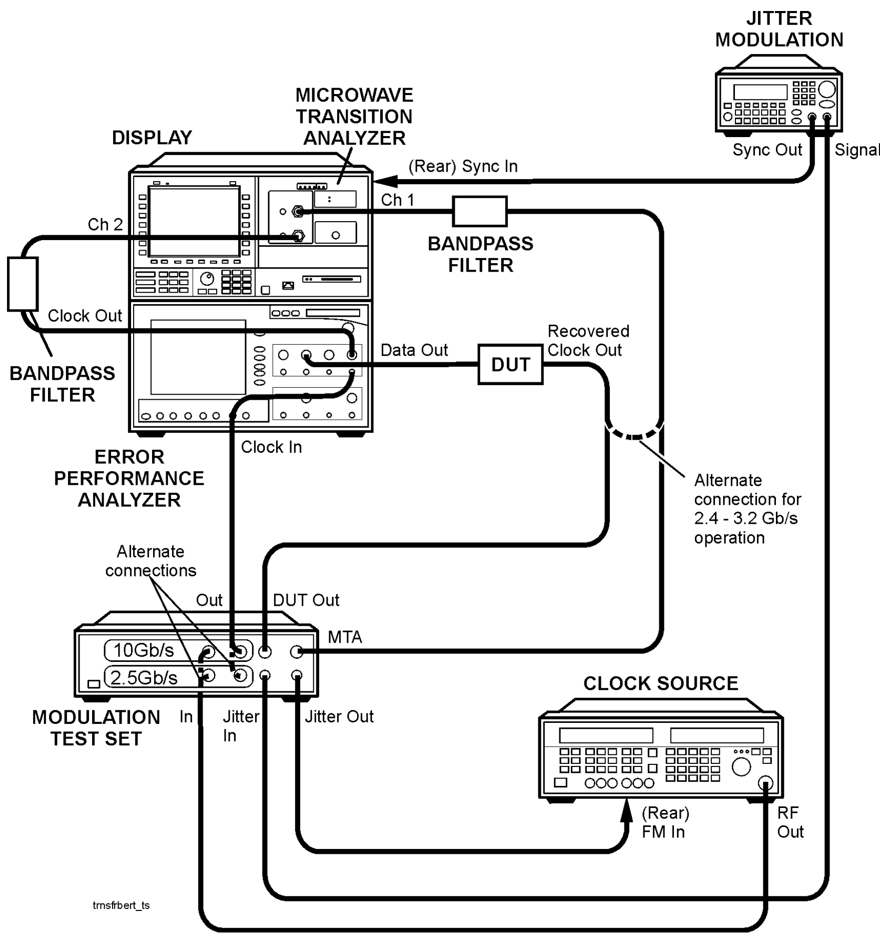


Figure 3-5. Jitter Transfer and Generation Connections with Modulation Test Set and Stand-Alone[1] Error Performance Analyzer and Stand-Alone[2] Clock Source

1. The 70843A/B/C or 86130A error performance analyzer.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources.

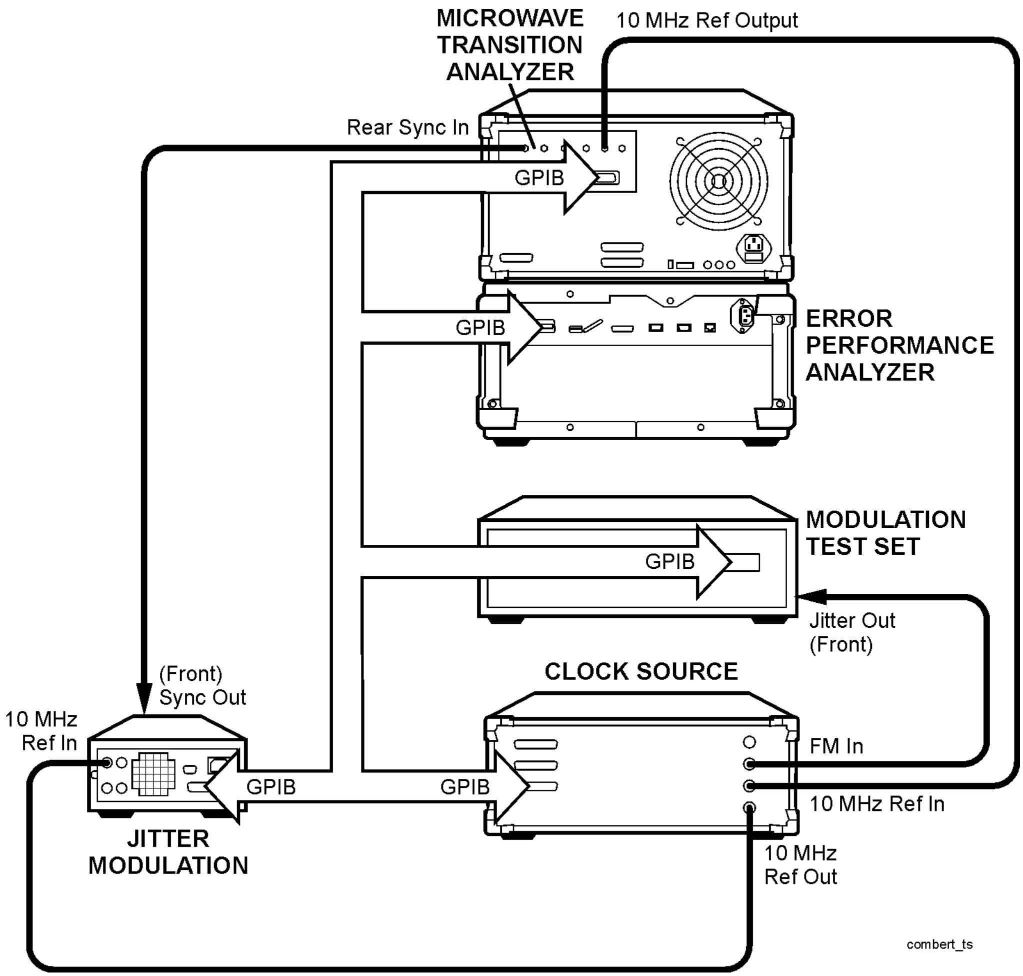


Figure 3-6. Rear Panel[1] Connections with Modulation Test Set and Stand-Alone Error Performance Analyzer and Stand-Alone Clock Source

1. If you are using an 83752 clock source, connect a BNC tee and a 50 ohm termination to the rear panel FM IN.

Table 3-2. Jitter Transfer and Generation with the Modulation Test Set

Make This Instrument Connection	TO	This Instrument
Jitter Modulation SYNC OUT	TO	Microwave Transition Analyzer SYNC IN (rear panel)
Jitter Modulation SIGNAL	TO	Test Set JITTER MODULATION IN
Jitter Modulation GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Clock Source RF OUTPUT (stand-alone) Clock Source CLOCK OUT (modular)	TO	Test Set IN (2.5 Gb/s or 10 Gb/s)
Clock Source 10 MHz REF OUT (rear panel)	TO	Jitter Modulation 10 MHz REF IN (rear panel)
Clock Source GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Microwave Transition Analyzer 10 MHz RF OUT (rear panel)	TO	Clock Source 10 MHz REF IN (rear panel)
Microwave Transition Analyzer GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Pattern Generator CLOCK OUT (through BP filter)	TO	Microwave Transition Analyzer CH 2
Pattern Generator DATA OUT	TO	DUT Data In
DUT Clock Out	TO	Test Set DUT OUT
Pattern Generator (Stand-Alone) GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Test Set JITTER MODULATION OUT	TO	Clock Source FM IN (rear panel for stand-alone) EXT 1 INPUT (front panel for E4422B)
Test Set CH1 MTA[b] (through filter)	TO	Microwave Transition Analyzer CH 1 (9.8–13 Gb/s operation)
Test Set OUT (2.5 Gb/s or 10 Gb/s)	TO	Patter Generator CLOCK IN
Test Set GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Configuration with 2 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG & ED/Mainframe MSIB IN (rear panel)
PG & ED/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)
Configuration with 3 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG/Mainframe MSIB IN (rear panel)
PG/Mainframe MSIB OUT (rear panel)	TO	ED or Clk Source/Mainframe MSIB IN (rear panel)
ED or Clk Source/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)

a. The GPIB connections can be made in any order. The only requirement is that all GPIB instruments are interconnected.

b. The test set DUT Out and CH1 MTA port connections are for 9.8-13 Gb/s operation and act only as a thru for 2.4-3.2 Gb/s operation. If the test set does not have these ports, connect the device under test recovered clock out directly to the channel 1 bandpass filter.

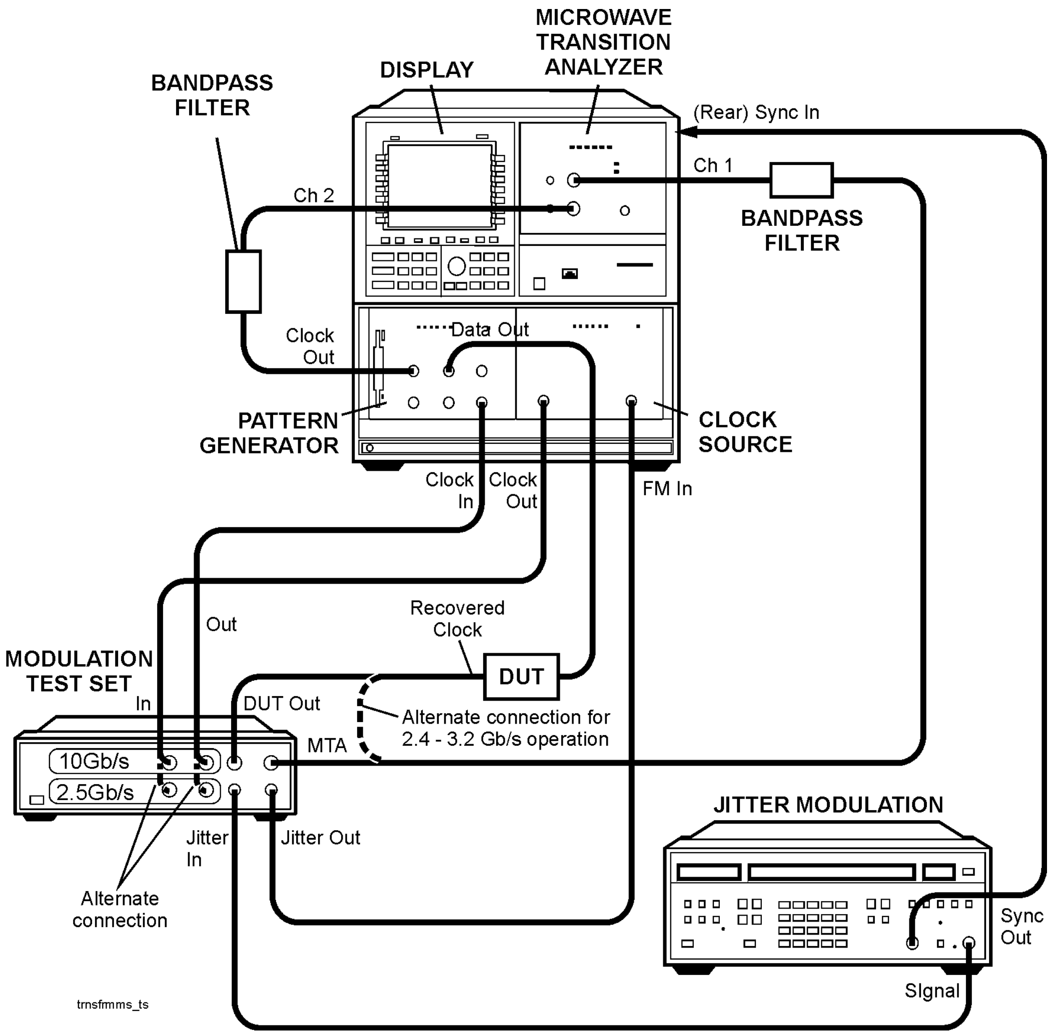


Figure 3-7. Jitter Transfer and Generation Connections with Modulation Test Set and Modular[1] Error Performance Analyzer and Modular[2] Clock Source

1. The 70841A/B and 70842A/B are the modular error performance analyzers compatible with the 71501D.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources that are compatible with the 71501D.

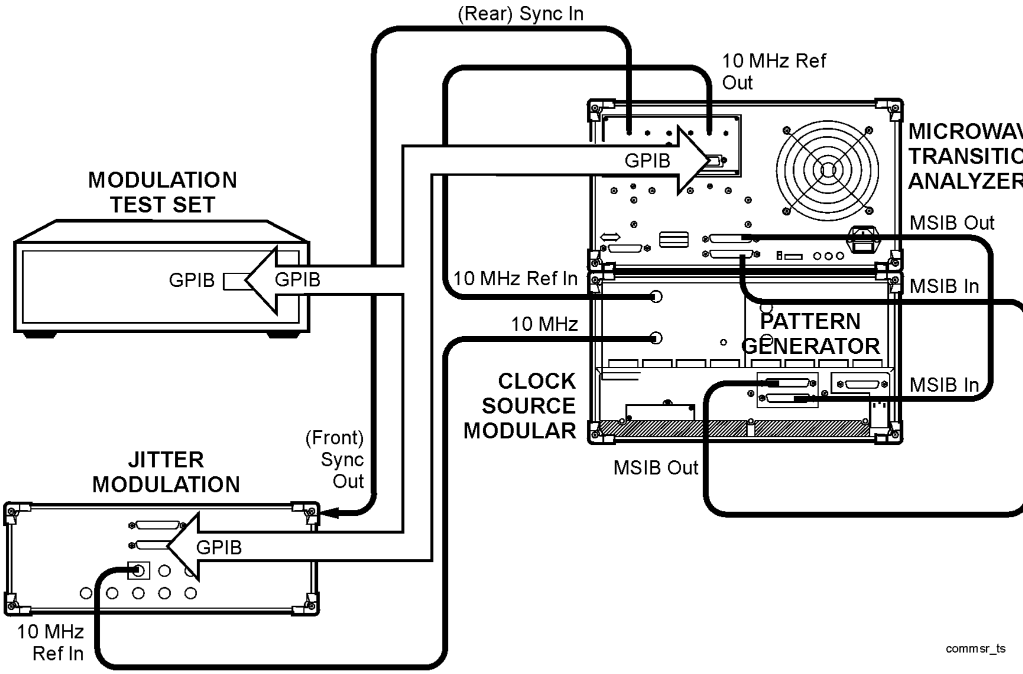


Figure 3-8. Rear Panel Connections with Modulation Test Set and Modular Error Performance Analyzer and Modular Clock Source

CAUTION All GPIB and MSIB connections must be made *prior* to turning on the system.

Step 2. Set Up the Measurement Conditions

1 Insert the jitter personality card into the front-panel card slot of the 70004A, facing the metal strip on the card downward and toward the instrument.

2 Switch on the power to all of the equipment. Switch on the power to the 70820A last. The start up process takes about 6 minutes.

Note If you reconfigure the equipment after the jitter personality has been loaded, refer to “Rescan the Equipment after Reconfiguring” on page 4-19.

3 Select a template by pressing *Setup*, *INtmplt*, then select one of the templates: *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*.

- If you want to review the test point frequencies and levels for a template that you selected, press *Setup*, *Edit Template*. To adjust the measurement conditions specified in the available templates, refer to “Creating and Editing Templates” on page 4-21.
- If the data is at an FEC rate or is at a rate other than 155 Mb/s, 622 Mb/s, 2488 Mb/s, 9953 Mb/s, select the desired input data rate by pressing *INclock FREQ*, and entering the data rate (for OC48FEC enter 2.66606 Gb/s, for OC192FEC enter 10.7092 Gb/s).
- If the device under test has different data rates between the input and output, the 71501D must be in the MUX/DEMUX mode. Refer to “To Use Different Input/Output Data Rates” on page 4-24.

Note The clock source and error performance analyzer selected must be capable of operating at the input data rate you specify. The signal level from the pattern generator clock out to channel 2 of the 70820A must be 0.5 to 1.0 V peak-to-peak. The signal level from the device under test output, to either the N1015A or channel 1 of the 70820A, must be -2 to +4 dBm (0.5 to 1V peak-to-peak). If signals exceed this level, use the 6 dB attenuator to reduce voltage levels.

4 Set up the error performance instruments.

- If the jitter system has a modular error detector or pattern generator, refer to page 2-14 for a detailed procedure on how to set up the modular instruments.
- If the equipment setup has two displays, or one display that you must switch between the 70820A and the error performance analyzer instruments, refer to “To Use Two Displays” on page 2-10.

Step 3. Perform a Calibration

Note

If the template you are using was previously saved with calibration data, the calibration data is automatically loaded with the template and no calibration is required.

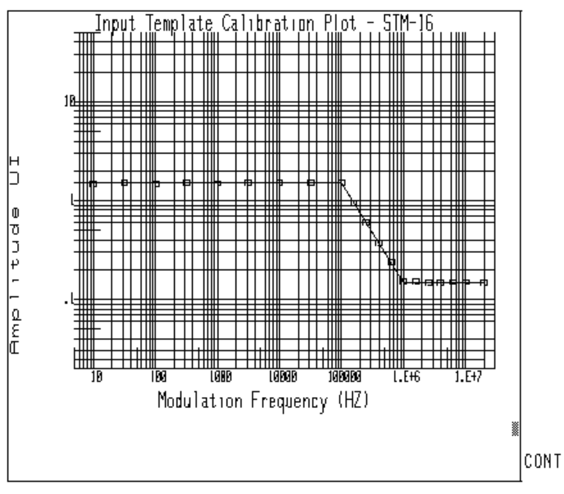
CAUTION

System calibration should be performed before making jitter transfer and jitter tolerance tests or whenever a new standard or custom template is selected.

1 Press USER until the *Setup* key appears on the left menu. Press *Setup*, *CAL INPUT.*

2 The calibration can take up to six minutes to execute. When the calibration is finished, the display will be similar to the following graphic.

3 To return to the Main menu, press *CONT*.



Step 4. Perform the JitterTransfer Measurement

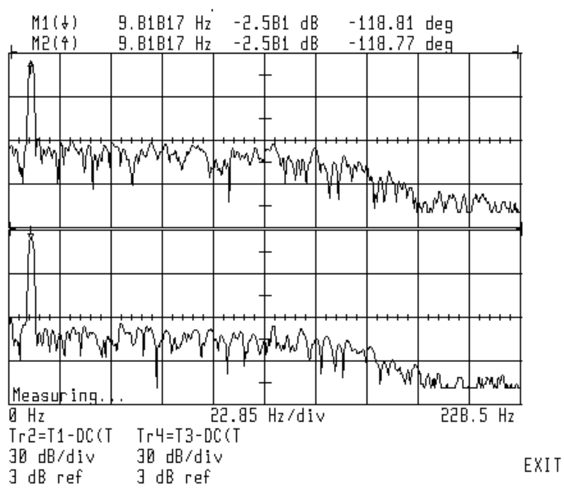
1 To perform a jitter transfer measurement, press:

Jitter Trnsfer, MEASURE TRNSFER

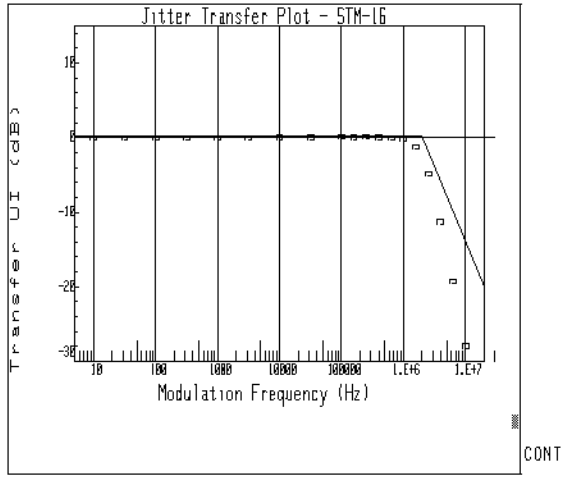
Note

You could press *PAUSE ON* before you press *MEASURE TRNSFER* so the 70820A pauses between setting the jitter frequency and taking the measurement data. This pause allows you to change conditions on the test device before each measurement. For example, you may need to ensure that the device stays phase-locked. Pressing *PAUSE OFF* returns the 70820A to automatically setting the jitter frequency and immediately taking measurement data.

While the measurement is being performed, the display will look similar to the following graphic.



When the measurement is complete, the display will look similar to the following graphic.



Colored boxes are displayed on the measured data points:

- Green box, data passed (within transfer specification template)
- Red x, data failed (exceeds transfer specification)

2 Press *Cont* to return to the trace display.

Change the Number of Sweeps

3 To change the number of measurements made at each frequency, press:

AVERAGE SWEEPS, then enter the number of sweeps, and press *ENTER*

The number of sweeps to be averaged can be entered using the knob, step keys, or numeric keypad. A larger value increases measurement repeatability and reduces measurement uncertainty, but increases the data acquisition time.

Note For measurements at jitter frequencies above 1 MHz, an averaging factor of 10 is automatically implemented.

4 To activate the Average function so the displayed data is the average of data measured during a number of sweeps, press:

average ON

Change the Corner Frequency

The jitter transfer acceptance specification, or output template, may be adjusted by changing the corner frequency and the gain amplitude.

The corner frequency is the point at which the transfer specification 20 dB/ decade rolloff begins. Standard input templates select the corner frequency specified in the standard. The minimum and maximum values for transfer corner frequency are limited by the clock source selected.

5 Set the corner frequency to 1.3 MHz by pressing:

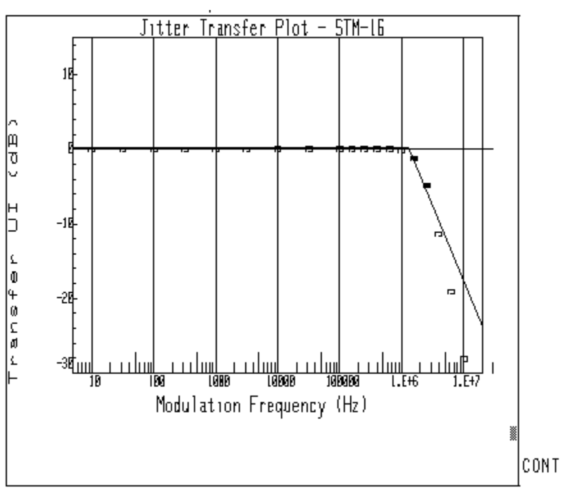
CORNER FREQ > 1.3 *MHz*

The value can be entered using the knob, step keys, or numeric keypad. It is not necessary to remeasure jitter transfer when the corner frequency or gain amplitude is changed.

6 To re-plot or list the same data with the new acceptance specification, press:

trnsfer results > *PLOT TRNSFER* or *PLOT DELTA* or *LIST TRNSFER*

Notice that changing the corner frequency has changed the point at which the output specification rolls off, as shown in the example below.



Display Showing New Corner Frequency

7 Return to the trace display by pressing:

Cont

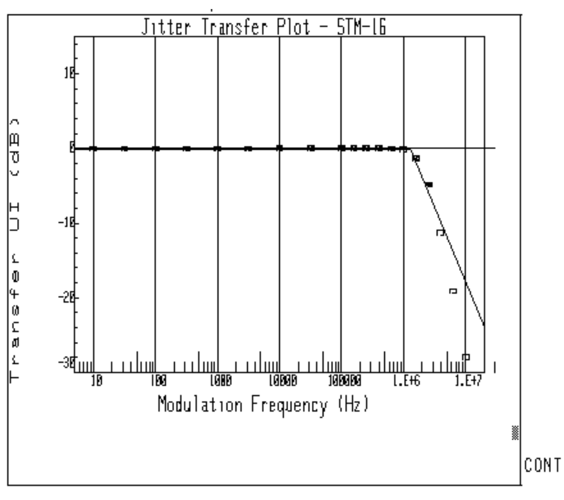
Change the Gain Amplitude

Gain amplitude is the maximum allowable value of the jitter transfer function. The default is 0.1 dB.

8 Set the gain amplitude to 0 dB by pressing:

GAIN AMPLTD > 0 dB

The value can be entered using the knob, step keys, or numeric keypad. Notice that changing the gain amplitude changed the specification against which the transfer function is plotted, as shown in the example below. (This may be difficult to see in the jitter transfer plot, but will be more apparent in the following data analysis.)



Example of a Display Showing a New Gain Amplitude

9 Return to the trace display by pressing,

Cont

View the Results of Jitter Transfer

10 Display the results of the last transfer measurement and the results menu by pressing:

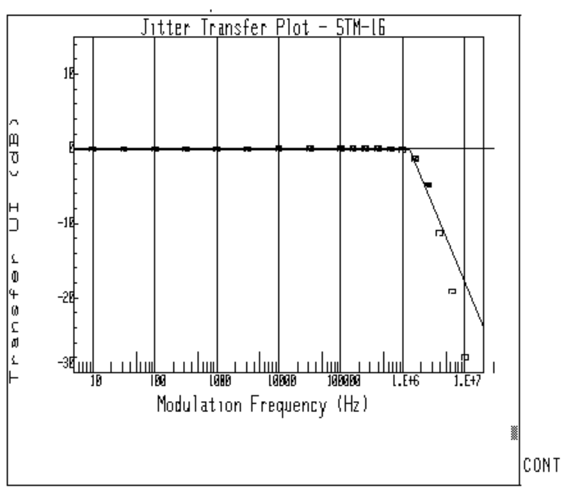
trnsfer results

The data can be viewed three ways:

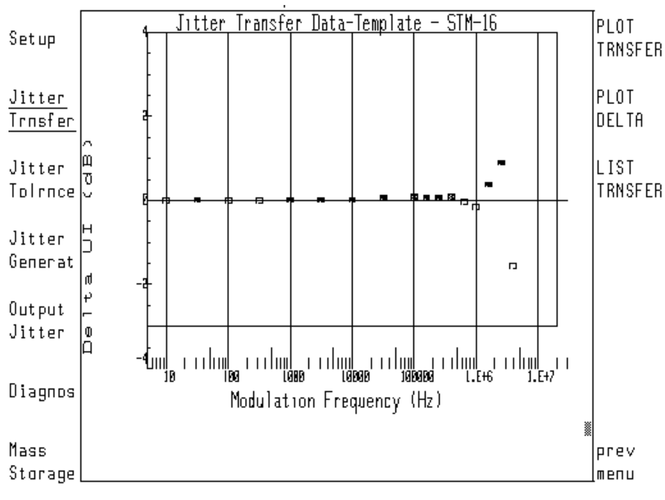
`PLOT TRNSFER` displays the measured jitter transfer function and the selected transfer specification template in a graphical mode. The plot created using the Plot Transfer function is the same as the plot created using the Measure Transfer function.

`PLOT DELTA` plots the deviation between the jitter transfer function and the current output template (specification).

`LIST TRNSFER` displays a numeric list of the jitter transfer function values measured during the jitter transfer measurement, including: transfer function test limit values, the margin between the transfer data and the transfer specification limit, and the pass/fail status.

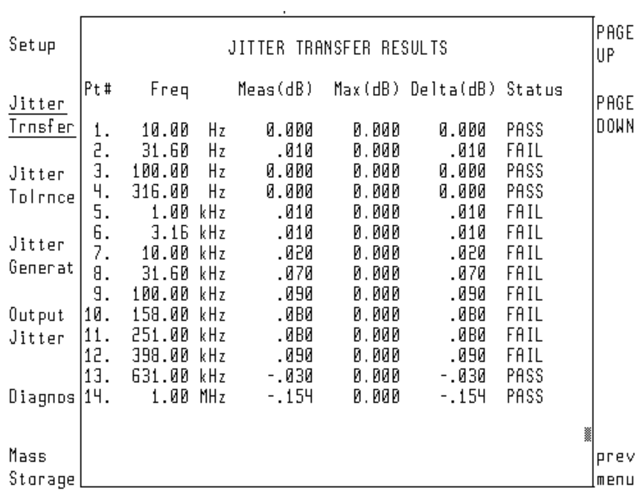


Example of a PLOT TRNSFER Function



Example of a PLOT DELTA Function

Several points exceed the transfer specification. This is due to the change in both the allowable gain amplitude and the corner frequency.



JITTER TRANSFER RESULTS

Pt#	Freq	Meas(dB)	Max(dB)	Delta(dB)	Status
1.	10.00 Hz	0.000	0.000	0.000	PASS
2.	31.60 Hz	.010	0.000	.010	FAIL
3.	100.00 Hz	0.000	0.000	0.000	PASS
4.	316.00 Hz	0.000	0.000	0.000	PASS
5.	1.00 kHz	.010	0.000	.010	FAIL
6.	3.16 kHz	.010	0.000	.010	FAIL
7.	10.00 kHz	.020	0.000	.020	FAIL
8.	31.60 kHz	.070	0.000	.070	FAIL
9.	100.00 kHz	.090	0.000	.090	FAIL
10.	158.00 kHz	.080	0.000	.080	FAIL
11.	251.00 kHz	.080	0.000	.080	FAIL
12.	398.00 kHz	.090	0.000	.090	FAIL
13.	631.00 kHz	-.030	0.000	-.030	PASS
14.	1.00 MHz	-.154	0.000	-.154	PASS

Example of a LIST TRNSFER Function

Saving the Data

You can save the calibration data, the input template, and modifications to the default test parameters so you can reuse them later. (This calibration data is only valid for the specific signal generator and synthesizer/function generator on which the calibration was performed.)

11 To save the template and its associated calibration information, insert a formatted RAM card into the card slot of the 70820A and press:

Templat Storage

If you need to format a RAM card, refer to "To Initialize (format) a Memory Card" on page 4-42.

12 After the catalog of files is displayed, press:

typing aids

13 Use the alphanumeric typing aids, knob and Select Char function or an external HP-IL keyboard to enter a filename (eight characters maximum), and then press:

ENTER LINE > SAVE TEMPLAT

For a list of the parameters that are saved as part of the template, refer to "SAVE_TEMPLATE" on page 5-27.

Measure Jitter Transfer on Regenerators that Do Not Have Clock Signal Outputs

The process of data regeneration typically requires clock recovery and a subsequent concern with jitter transfer. Some regenerators have clock recovery but do not have external access to the recovered clock signal. Jitter transfer measurements with the 71501D system are made only on clock signals. In this scenario, the data signal must simulate a clock signal to allow a jitter transfer measurement. For example, a 10101010 type data signal can simulate a clock signal.

The jitter transfer measurement results may not be the same as what would occur with a true data pattern. This would be true for a device where clock recovery performance is pattern dependent.

A square wave clock signal goes through one complete cycle over a data bit period. Hence a 10101010 data signal replicates a clock signal at a frequency equivalent to one-half the data rate. This procedure requires the 71501D to be in the DMUX or demultiplex mode. The procedure is as follows:

1 Create a custom or user pattern in the pattern generator:

- If you are using a stand-alone error performance analyzer (86130A), enter a pattern (1,0,1,0,1,0,1,0) from the analyzer front panel.
- If you are using a 71603B, press the following on the 70004A:

  Menu, *more, 1/2, edit usr-pat, internal pattern 1, more 1/3, set pat length* to 8

  Enter 1,0,1,0,1,0,1,0, *more 2/3, more 3/3, save pattern, internal pattern 1*

- If you are using a 71612A/70843A, press the following on the 70004A:

  Pattern, *Edit ram usr, internal pattern 1, set pat length* to 8

  Enter 1,0,1,0,1,0,1,0, *Save pattern, Internal pattern 1*

2 To return to the Jitter menu on the 70820, press:

Display, *next instr*

Continue pressing *next instr* until the 70820 appears at the bottom of the display.

3 To display the Jitter Analysis menu, press:

User

Continue pressing the *User* key until the Jitter Analysis menu appears.

4 To select the Demultiplex mode, press:

Setup, *MUX/DEMUX ON*

Set the output rate to one-half the actual data rate. For example, if the DUT operates at 2488.32 Mb/s, set the output rate to 1244.16 Mb/s. *Do not round off significant digits.*

OUTclk freq,1244.16 Mb/s

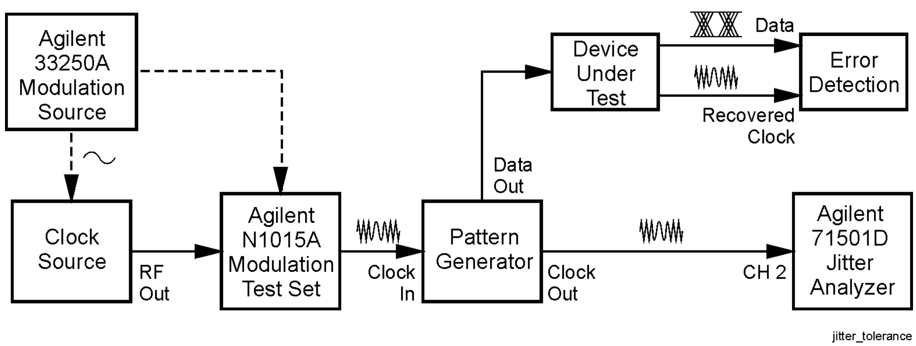
The jitter transfer measurement can now be performed using the procedures described earlier.

Tutorial 2: Jitter Tolerance Measurements

A jitter tolerance measurement is used to describe the ability of a device or system to maintain communication quality in the presence of jitter. The test can be viewed in two ways:

- A standards-based compliance test that requires the equipment to maintain a specific bit-error-ratio (BER) level at pre-defined jitter levels and jitter frequencies.
- A test that determines the actual jitter levels where the device under test can no longer maintain a desired BER.

The following diagram shows the signal flow in the jitter tolerance test process.



What you will learn in this tutorial:

- Configure the equipment and set up the measurement.
- Perform a calibration.
- Perform a jitter tolerance measurement.
- Select the bit-error-rate threshold.
- Select the gating time.
- Perform a margin test.
- Perform manual jitter tolerance measurements.
- Plot the measurement results.

Step 1. Connect the Equipment

1. Connect the front and rear panel cables in the configuration that matches the device test-frequency and your system equipment. Refer to “Jitter System Configurations” on page 2-3 for a list of 71501D system equipment.
2. Determine if the device test-frequency is within the following ranges:
   - 2.4 to 3.2 GHz with 20 MHz modulation (71501D options 300, 305)
   - 9.8 to 13 GHz with 80 MHz modulation (71501D options 310, 305)

- If the device test-frequency is within the ranges listed above, use a configuration that includes the N1015A modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-13 on page 3-38.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-15 on page 3-42.
- If the device test-frequency is outside the ranges listed above, use a configuration that **does not** include the modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-9 on page 3-32.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-11 on page 3-36.

For each type of configuration (with and without the test set) there is a connection diagram for stand-alone clock source and error performance analyzer (70843A/B/C, 86130A), and a connection diagram for modular clock source and error performance analyzer (70841A/B, 70842A/B).

Also, refer to the list of connections that corresponds to the type of configuration (with or without the test set). See Table 3-3 on page 3-34 and Table 3-4 on page 3-40.

Note If you reconfigure the equipment after the jitter personality has been loaded, refer to “Rescan the Equipment after Reconfiguring” on page 4-19.

CAUTION To prevent damage to the 70820A microwave transition analyzer, always have either a bandpass filter or a dc block connected to the analyzer input channels. Make sure that the bandpass filter matches the frequency range that you will be measuring.

3. Connect filters to the 70820A inputs.

   - If you are performing SONET/SDH testing with the 86130A or 71612/70843 combination of instruments use these filters:

     2.488 Gb/s bandpass (Opt. 420) plus 4 GHz low pass (Opt. 435)
     2.66 Gb/s bandpass (Opt. 430) plus 4 GHz low pass (Opt. 435)
     622 Mb/s bandpass (Opt. 410) plus 800 MHz low pass (Opt. 412)

Note In the testing conditions mentioned, the lowpass filter is required to prevent the higher clock harmonics emanating from the pattern generator clock output.

   - If you are performing SONET/SDH testing with the 71603/71841/70842 combination of instruments, only a band pass filter is required.

   - If you are performing 10 Gb/s testing using the 71612/70843 combination of instruments, the band pass filter guard band is adequate.

Note When using clock frequencies where bandpass filters are not available, a low pass filter plus a DC block (11742A) can be substituted for the bandpass filter. The DC block protects the 70820 sampling input from the DC level of the pattern generator clock output.

   - For 622 Mb/s testing, use an 800 MHz low pass filter (Opt. 412).
   - For 1 to 1.25 Gb/s testing, use a 1.5 GHz low pass filter (Opt. 417).
   - For 2.4 to 3.3 Gb/s testing, use a 4.0 GHz low pass filter (Opt. 435).
   - For 9 to 11.5 Gb/s testing, use a 12.4 GHz low pass filter (Opt. 467).

4. Set the GPIB and MSIB addresses for the system instruments.

5. Refer to “To Use Two Displays” on page 2-10 if you have more than one 70004A display in your equipment configuration.

Connections without the Modulation Test Set

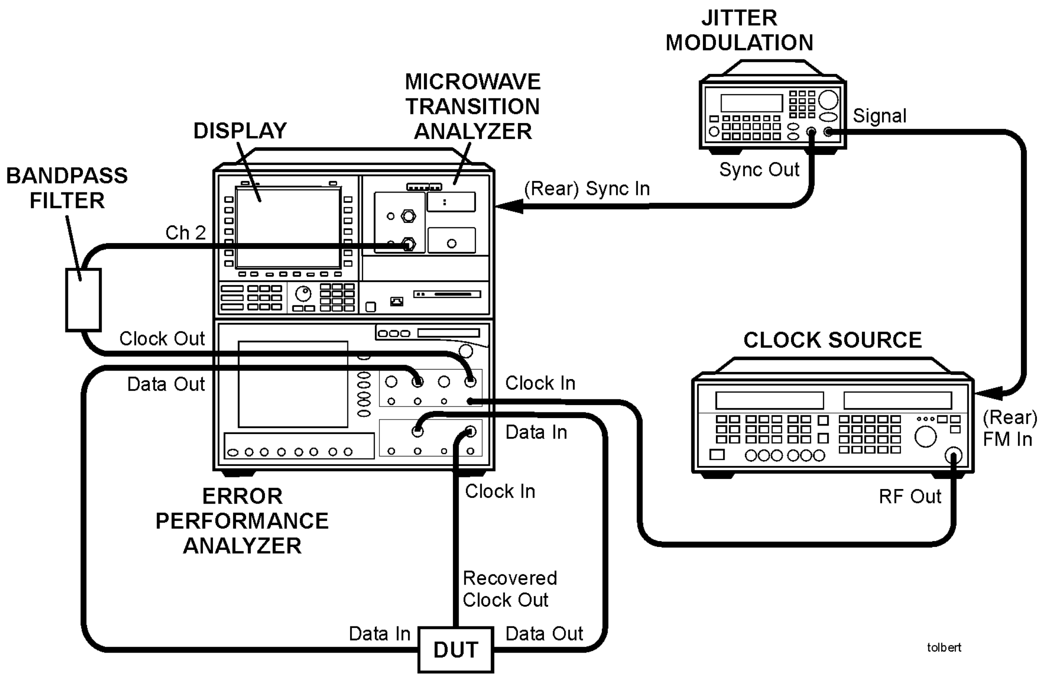


Figure 3-9. Jitter Tolerance Connections wth Stand-Alone[1] Error Performance Analyzer and Stand-Alone[2] Clock Source

1. The 70843A/B/C and 86130A stand-alone error performance analyzers are compatible with the 71501D.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources that are compatible with the 71501D.

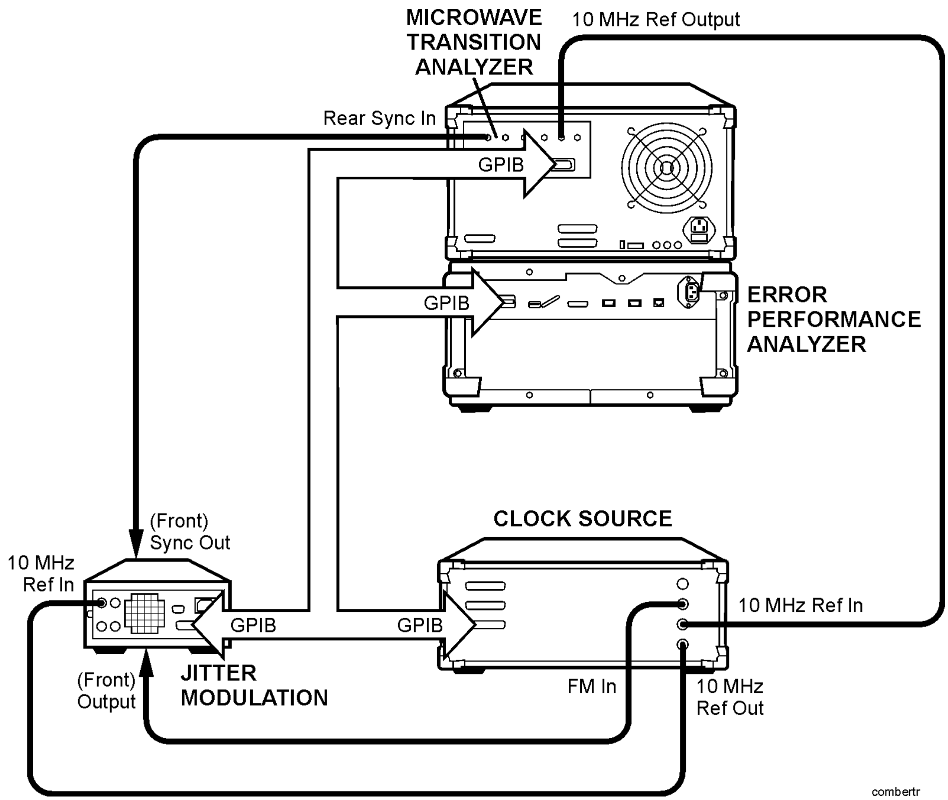


Figure 3-10. Rear Panel[1] Connections with Stand-Alone Error Performance Analyzer and Stand-Alone Clock Source

1. If you are using an 83752 clock source, connect a BNC tee and a 50 ohm termination to the rear panel FM IN.

Table 3-3. Connections for Jitter Tolerance with No Modulation Test Set

Make This Instrument Connection	TO	This Instrument
Jitter Modulation SYNC OUT	TO	Microwave Transition Analyzer SYNC IN (rear panel)
Jitter Modulation SIGNAL	TO	Clock Source FM IN EXT 1 INPUT (front panel for E4422B)
Jitter Modulation GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Clock Source (Stand-Alone) RF OUTPUT Clock Source (Modular) CLOCK OUT	TO	Pattern Generator CLOCK IN
Clock Source 10 MHz REF OUT (rear panel)	TO	Jitter Modulation 10 MHz REF IN (rear panel)
Clock Source (Stand-Alone) GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Microwave Transition Analyzer 10 MHz RF OUT (rear panel)	TO	Clock Source 10 MHz REF IN (rear panel)
Microwave Transition Analyzer GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Pattern Generator DATA OUT	TO	DUT DATA IN
Pattern Generator CLOCK OUT (through BP filter)	TO	Microwave Transition Analyzer CH 2
Pattern Generator (Stand-Alone) GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
DUT DATA OUT	TO	Error Detector DATA IN
DUT CLOCK OUT	TO	Error Detector CLOCK IN
Configuration with 2 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG & ED/Mainframe MSIB IN (rear panel)
PG & ED/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)
Configuration with 3 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG/Mainframe MSIB IN (rear panel)
PG/Mainframe MSIB OUT (rear panel)	TO	ED or Clk Source/Mainframe MSIB IN (rear panel)
ED or Clk Source/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)

a. The GPIB connections can be made in any order. The only requirement is that all GPIB instruments are interconnected.

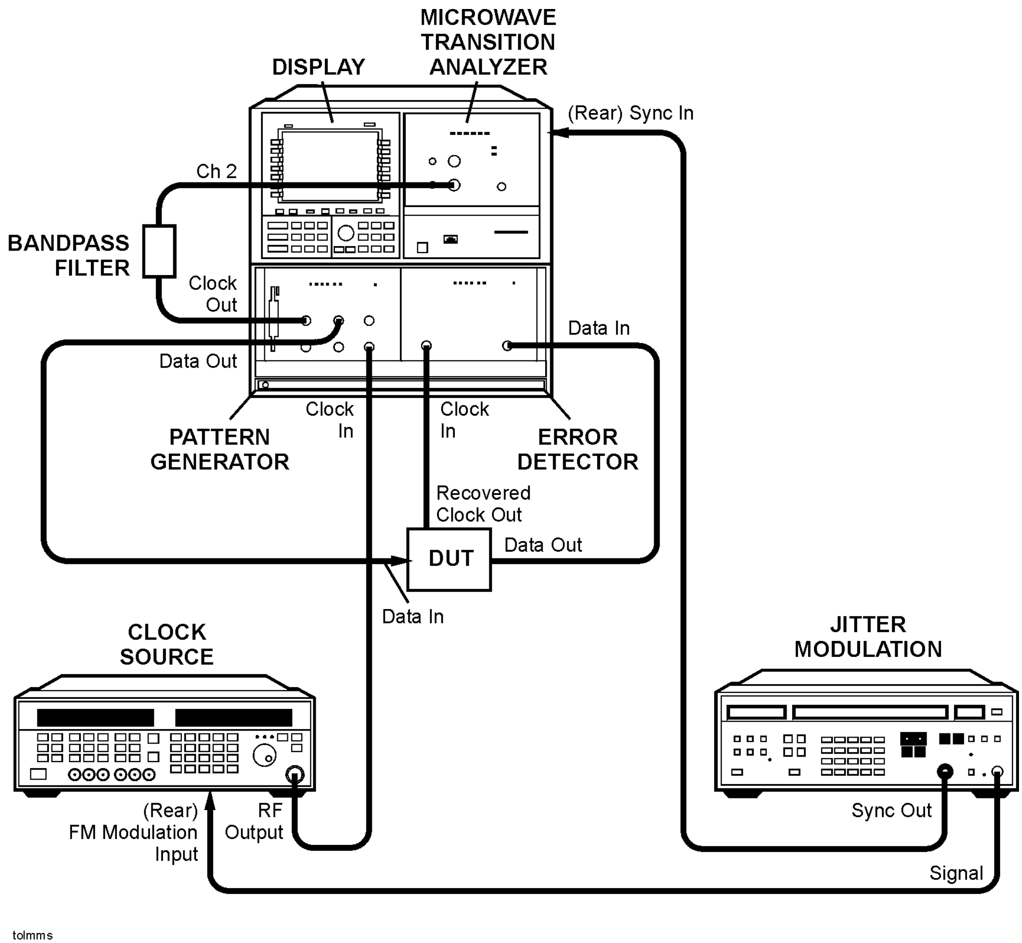


Figure 3-11. Jitter Tolerance Connections with Modular[1] Error Performance Analyzer and Modular[2] Clock Source

1. The 70841A/B and 70842A/B are the modular error performance analyzers compatible with the 71501D.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources that are compatible with the 71501D.

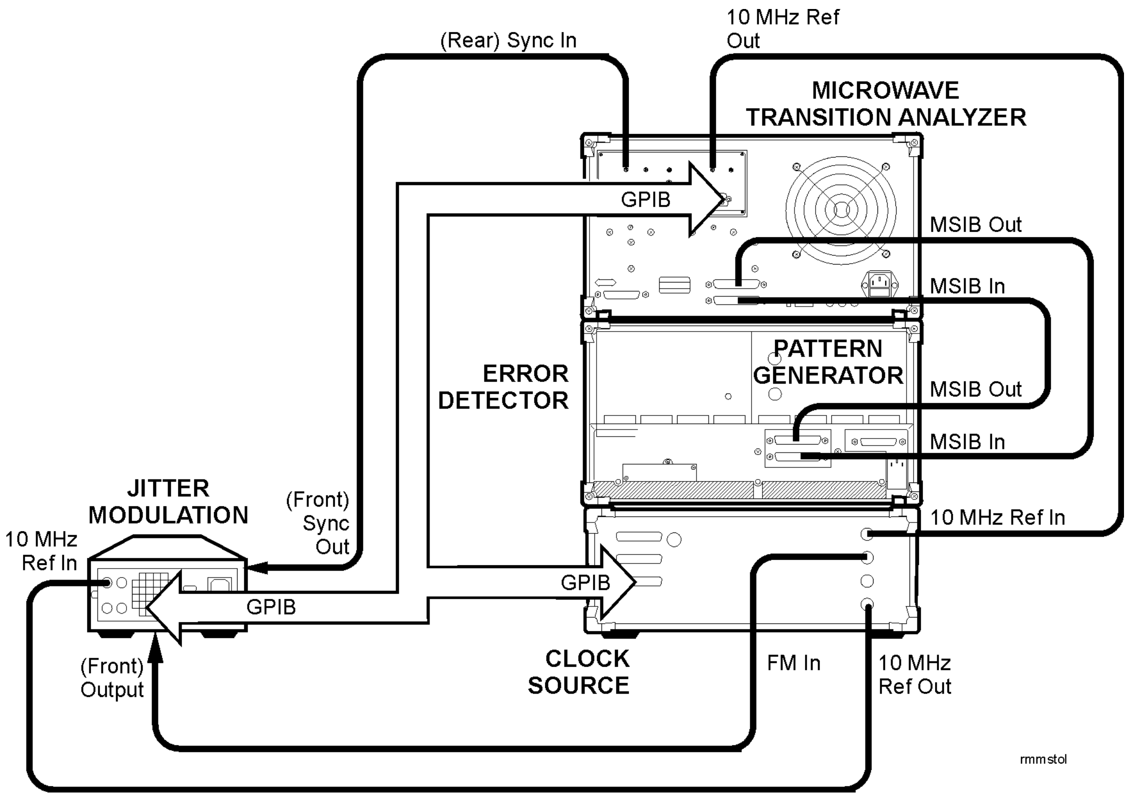


Figure 3-12. Rear Panel Connections with Modular Error Performance Analyzer and Modular Clock Source

Connections with the Modulation Test Set

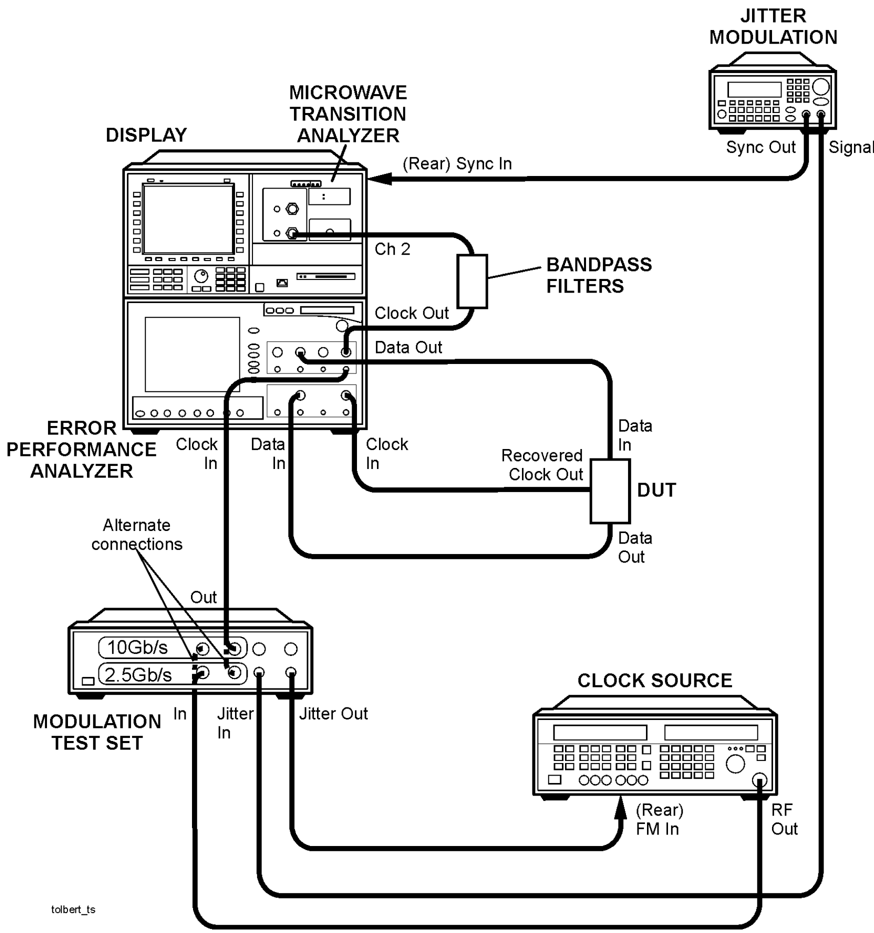


Figure 3-13. Jitter Tolerance Connections with Test Set and Stand-Alone[1] Error Performance Analyzer and Stand-Alone[2] Clock Source

1. The 70843A/B/C or 86130A error performance analyzer.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources.

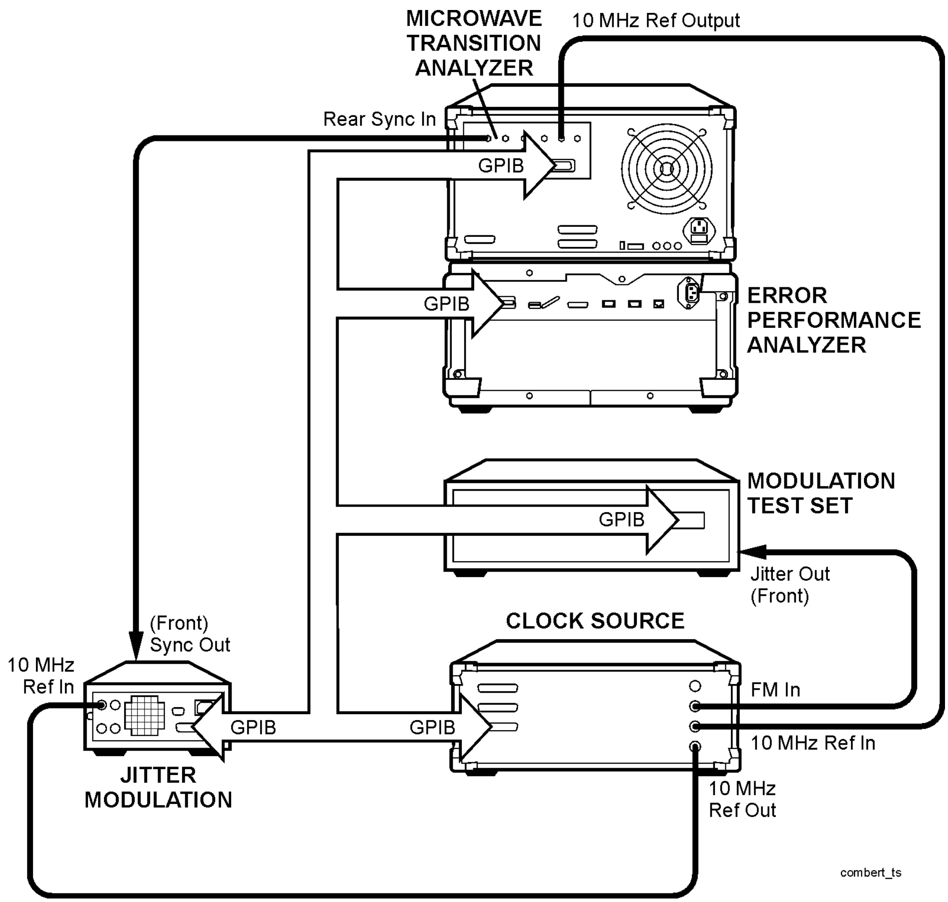


Figure 3-14. Rear Panel[1] Connections with Stand-Alone Error Performance Analyzer and Stand-Alone Clock Source

1. If you are using an 83752 clock source, connect a BNC tee and a 50 ohm termination to the rear panel FM IN.

Table 3-4. Connections for Jitter Tolerance with a Modulation Test Set

Make This Instrument Connection	TO	This Instrument
Jitter Modulation SYNC OUT	TO	Microwave Transition Analyzer SYNC IN (rear panel)
Jitter Modulation SIGNAL	TO	Test Set JITTER MODULATION IN
Jitter Modulation GPIB (rear panel)	TO	GPIB INTERCONNECT (rear panel)[a]
Clock Source (Stand-Alone) RF OUTPUT Clock Source (Modular) CLOCK OUT	TO	Test Set IN (2.5 Gb/s or 10 Gb/s)
Clock Source 10 MHz REF OUT (rear panel)	TO	Jitter Modulation 10 MHz REF IN (rear panel)
Clock Source (Stand-Alone) GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Microwave Transition Analyzer 10 MHz RF OUT (rear panel)	TO	Clock Source 10 MHz REF IN (rear panel)
Microwave Transition Analyzer GPIB (rear panel)	TO	GPIB INTERCONNECT[a] (rear panel)
Pattern Generator CLOCK OUT (through filter)	TO	Microwave Transition Analyzer CH2
Pattern Generator DATA OUT	TO	DUT DATA IN
Test Set OUT (2.5 Gb/s or 10 Gb/s)	TO	Pattern Generator CLOCK IN
Test Set JITTER MODULATION OUT	TO	Clock Source FM IN (rear panel) EXT 1 INPUT (front panel for E4422B)
DUT RECOVERED CLOCK OUT (through splitter)	TO	Error Detector CLOCK IN
DUT DATA OUT	TO	Error Detector DATA IN
Configuration with 2 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG & ED/Mainframe MSIB IN (rear panel)
PG & ED/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)
Configuration with 3 MMS Mainframes		
MTA/Mainframe MSIB OUT (rear panel)	TO	PG/Mainframe MSIB IN (rear panel)
PG/Mainframe MSIB OUT (rear panel)	TO	ED or Clk Source/Mainframe MSIB IN (rear panel)
ED or Clk Source/Mainframe MSIB OUT (rear panel)	TO	MTA/Mainframe MSIB IN (rear panel)

a. The GPIB connections can be made in any order. The only requirement is that all GPIB instruments are interconnected.

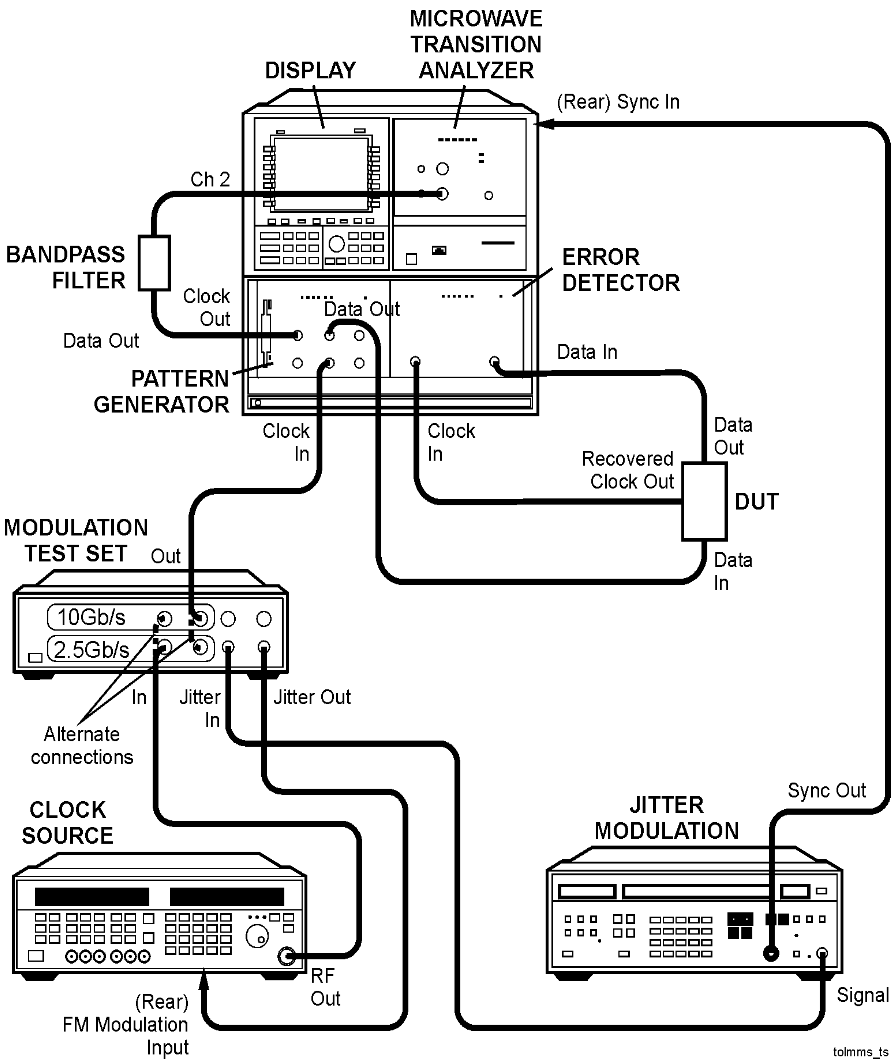


Figure 3-15. Jitter Tolerance Connections with Test Set and Modular[1] Error Performance Analyzer and Modular[2] Clock Source

1. The 70841A/B and 70842A/B are the modular error performance analyzers compatible with the 71501D.
2. See “Jitter System Configurations” on page 2-3 for a list of clock sources that are compatible with the 71501D.

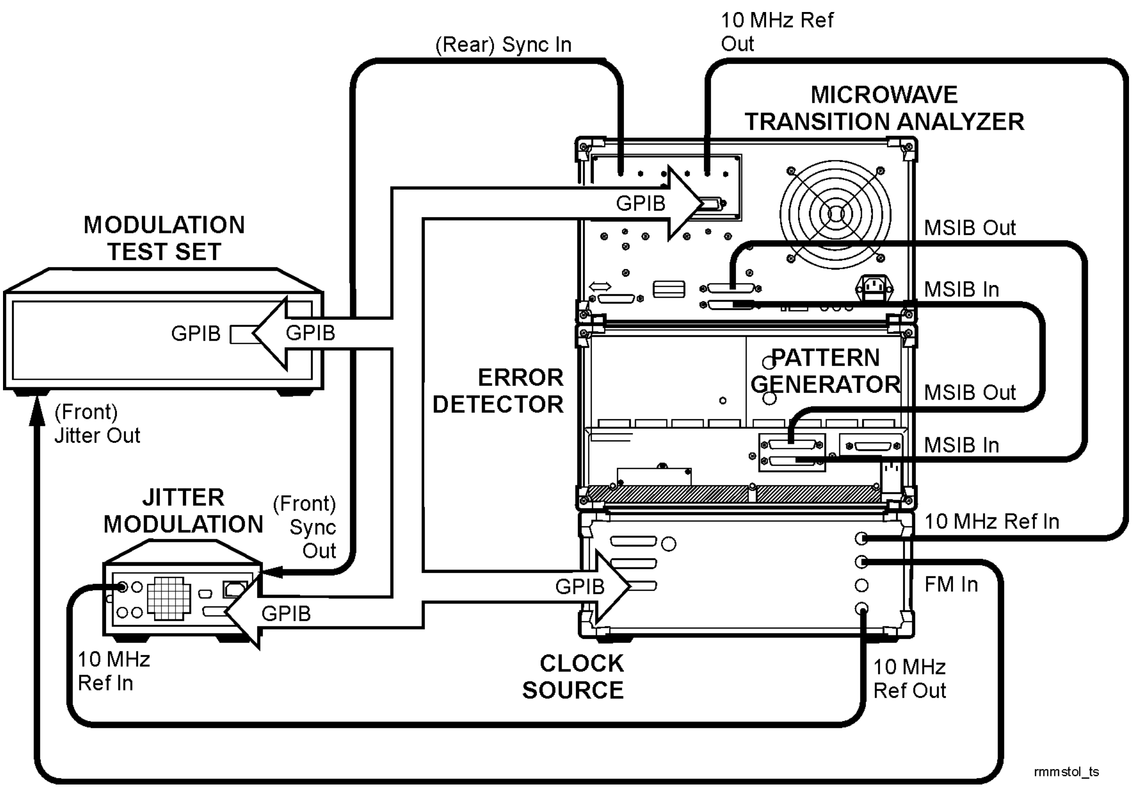


Figure 3-16. Rear Panel Connections with Modulation Test Set and Modular Error Performance Analyzer and Modular Clock Source

Note

If the device-under-test has no recovered clock signal, refer to "Jitter Tolerance for Devices without a Recovered Clock Output" on page 3-55.

CAUTION

All GPIB and MSIB connections must be made *prior* to turning on the system.

Step 2. Set Up the Measurement Conditions

1 Insert the jitter personality card into the front-panel card slot of the microwave transition analyzer, facing the metal strip on the card downward and toward the instrument. Make sure the card is fully inserted into the card slot.

2 Switch on the power to all of the equipment. Switch on the power to the 70820A last. The start up process takes about 6 minutes.

Note If you have reconfigured the equipment after the jitter personality has been loaded, refer to “Rescan the Equipment after Reconfiguring” on page 4-19.

3 Select a template by pressing *Setup*, *INtmplt*, then select one of the templates: *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*.

- If you want to review the test point frequencies and levels for a template that you selected, press *Setup*, *Edit Template*. To adjust the measurement conditions specified in the available templates, refer to “Creating and Editing Templates” on page 4-21.
- If the data is at an FEC rate or is at a rate other than 155 Mb/s, 622 Mb/s, 2488 Mb/s, 9953 Mb/s, select the desired input data rate by pressing *INclock FREQ*, and entering the data rate (for OC48FEC enter 2.66606 Gb/s, for OC192FEC enter 10.7092 Gb/s).
- If the device under test has different data rates between the input and output, the 71501D must be in the MUX/DEMUX mode. Refer to “To Use Different Input/Output Data Rates” on page 4-24.

Note The clock source and error performance analyzer selected must be capable of operating at the input data rate you specify. The signal level from the pattern generator clock out to channel 2 of the 70820A must be 0.5 to 1.0 V peak-to-peak. The signal level from the device under test output, to either the N1015A or channel 1 of the 70820A, must be -2 to +4 dBm (0.5 to 1V peak-to-peak). If signals exceed this level, use the 6 dB attenuator to reduce voltage levels.

Step 3. Perform a Calibration

Note

Calibration should be performed before making jitter transfer and jitter tolerance tests.

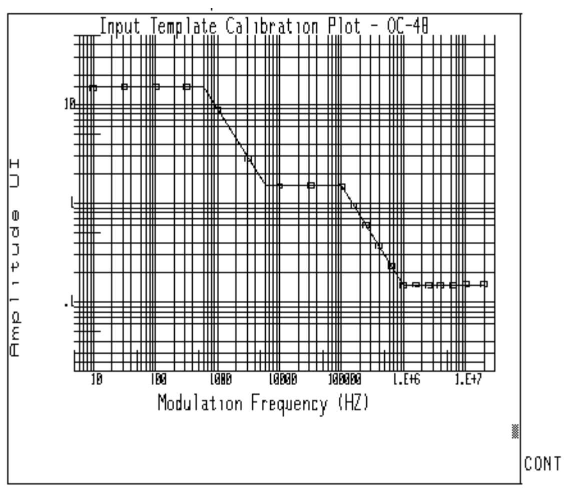
Note

If the template you are using was previously saved with calibration data, the calibration data is automatically loaded with the template and no calibration is required.

1 Press **USER**, *Setup, CAL INPUT.*

2 The calibration can take up to six minutes to execute. When the calibration is finished, the display will be similar to the following graphic.

3 To return to the Main menu, press *CONT*.



Example Jitter Tolerance Calibration Plot

Step 4. Perform the Jitter Tolerance Measurement

1 To set the error criteria for a jitter tolerance measurement:

a Check for the existence of any errored bits by pressing:

Jitter Tolerance, Errors BER Errors (this is the default setting)

b Measure the bit error rate by pressing:

Errors BER BER

c Select the BER threshold by pressing:

BER THRESHLD

Use the knob, step keys or keypad to adjust the threshold. The default is 1×10^{-7}. For example to enter a BER threshold of 1×10^{-10}, press:

BER THRESHLD, 1 E – 10 ENTER

The error rate can be entered using the knob, step keys or numeric keypad. If the error rate is lower than the specified BER threshold during the gating time, the test will pass at each frequency in the template. The BER test is repeated at each frequency test point.

2 Set the error detector to the desired data pattern.

Stand-Alone Error Performance Analyzer

- If you are using a stand-alone error performance analyzer (70843A/B/C with 70004A display or 86130A), press the following keys on the error performance analyzer to set the data pattern.

  On the 70843A/B/C and 70004A, press **Lcl**, **Pattern** and choose a pattern.

  On the 86130A, press **Local**. In the **Pattern** menu, click **Pattern Select** and choose a pattern.

Modular Error Detector

- If you are using a modular error detector (70842A/B), press the following keys from the 70004A:

  DISPLAY, *NEXT INSTR*
  Continue pressing until "70842" is displayed.

  USER, *pattern*, and then select the desired data pattern

  DISPLAY, *NEXT INSTR*
  Continue pressing until "70820" is displayed. Then press **USER, USER**.

Note If the device-under-test is a multiplexer, a pattern must be set up for either the pattern generator or the error detector, so that all bits received by the error detector are specified by its pattern.

Optional Step

Set a Reference Line

3 Select a test reference line by pressing:

tolrnce options, OC-48

The displayed reference line does not affect the pass/fail status of the test. The actual jitter test levels are determined by the input template.

Perform a Tolerance Measurement

4 Perform a jitter tolerance measurement by pressing:

MEASURE TOLRNCE

Note You could press *PAUSE ON* before you press *MEASURE TOLRNCE* so the 70820A pauses between setting the jitter frequency and taking the measurement data. This pause allows you to change conditions on the test device before each measurement. For example, you may need to ensure that the device stays phase-locked. Pressing *PAUSE OFF* returns the 70820A to automatically setting the jitter frequency and immediately taking measurement data.

Perform Clock and Data Alignment and Set the Gating Time

The analyzer prompts you to perform a clock and data alignment and to set the gating time.

5 Perform a clock and data alignment and set the gating time to measure at least 100 errored bits. For example, with the data rate at 2488 Mb/s and the BER threshold at 1×10^{-9}, set the gating time to 41 seconds. Refer to “Gating Time for Jitter Tolerance Measurements” on page 4-13 for information on calculating the gating time for other conditions.

Stand-Alone Error Performance Analyzer

- If you are using a stand-alone error performance analyzer (70843A/B/C with 70004A display or 86130A), press the following keys on the error performance analyzer to align the data and set the gating time.

  On the 70843A/B/C and 70004A, press **LCL**, **USER**, *input & eye*, *CLK-DAT ALIGN*. Then press **gating**, *GATE BY TIME*, *GATING PERIOD*, **41**, *SECONDS*.

  On the 86130A, press **Local.** In the *ED Setup* menu, click *Clock/Data Center*. Then in the *ED Setup* menu, click *Accumulation Setup*, *Activation Mode Single*. In the **Period**, select **Time** and enter **41** seconds.

Modular Error Detector

- If you are using a modular error detector (70842A/B) follow these steps.

a Press **DISPLAY,** *NEXT INSTR* .

Continue pressing *NEXT INSTR* until "`70842`" is displayed at the bottom of the screen.

b Press **MENU,** *dat i/p clk i/p*, *0/1 THR AUTO MAN <u>AUTO</u>*, *CLK-DAT ALIGN*

The error detector performs a clock and data alignment for the BER test. The data polarity and clock edge slope may need to be changed in order to synchronize the clock and data.

Wait for the alignment procedure to finish before proceeding to the next step.

c Press *gating*, *GATING PERIOD* **41** *SEC.*

d To return to the jitter menu, press **DISPLAY,** *NEXT INSTR* .

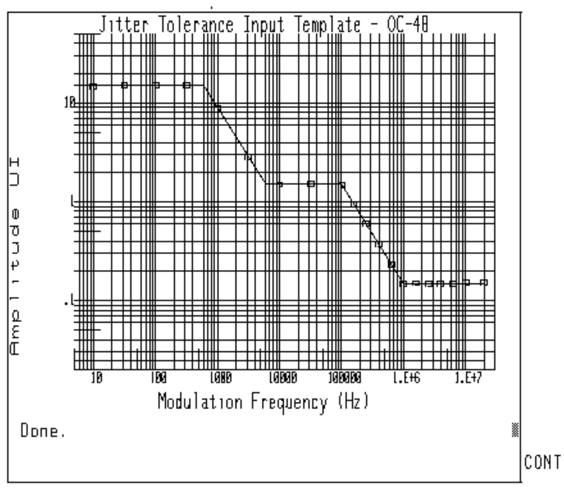
e Press *NEXT INSTR* until "`70820`" is displayed at the bottom of the screen.

f Press *USER, USER, CONT.*

After you have performed a clock and data alignment and set the gating time, the display should be similar to the following figure as the measurements are performed.

Note

Ensure that the error detector has synchronized and is measuring a bit error ratio (BER) of 0 before proceeding. Otherwise, the jitter test results will be incorrect.



Display of a Jitter Tolerance Measurement using BER Detection.

Colored boxes are displayed on the measured data points:

- Green box indicates data passed (bit error rate conditions were met)
- Red x indicates data failed (bit error rate conditions were not met)

Use the ERROR Function

6 To determine if any errors occur at any of the jitter test frequencies, press:

ERRORS BER <u>*ERRORS*</u> *CONT*

7 Perform a jitter tolerance measurement by pressing:

*MEASURE TOLRNC*E *CONT*

Although the testing criteria changed, the display is the same as shown previously when using the *ERRORS BER* <u>*BER*</u> function.

Measure to a Margin

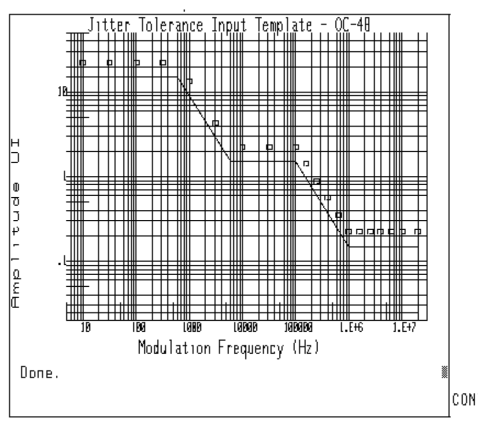
The two techniques for performing a jitter tolerance margin test are:

- Increasing (or decreasing) the level of the standard tolerance template by a fixed percentage.
- Using the jitter tolerance search routine.

8 Increase the jitter level of a jitter tolerance template by 50% by pressing:

Jitter Tolrnce, Margin, 50, ENTER

The jitter level of each test point is increased by 50%. For example, a jitter level of 15 UI would increase to 22.5 UI. Jitter margin levels can be increased by 100%, or decreased to 1% (enter –99%) of the current template levels. Depending on the data rate, clock frequency, and level of jitter defined by the template, jitter margin levels of 100% may not be possible due to system hardware limitations. In this case, the system automatically defaults to the highest attainable jitter level.



Example of the Template and Margin Test

The tolerance search feature may be used to automatically modify the jitter level at each frequency in a template.

Determine Specific Jitter Levels at Which BER is Degraded

- tolerance search
- single-point (manual) tolerance testing

9 To enable searching, press:

Jitter Tolerance, tolrnce options, SEARCH ON OFF <u>ON</u>

- If the search is on, the tolerance result plot and list will show the highest jitter level at which the DUT error criterion is met at each jitter frequency in the template.
- If the search is off, the plot and list show performance at the template level (modified by Margin).

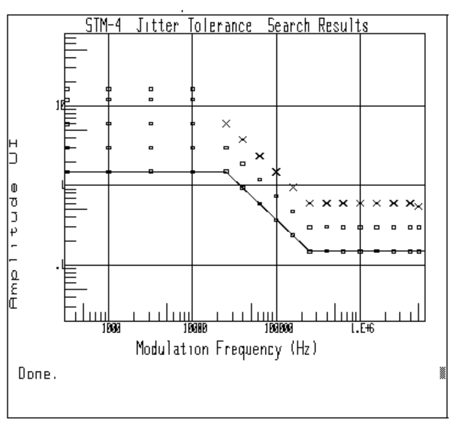
10 Set the search factor, for example to 1.5, by pressing: *SEARCH Factor* 1.5 ENTER

Note If you use the knob to set the search factor, the value is automatically entered as you set it.

11 Press *prev menu*, *MEASURE TOLRNCE*.

The tolerance measurement is made repeatedly. In the first measurement, the jitter amplitude specified in the template, modified by *Margin*, and brought into the system's jitter amplitude range is used. The subsequent measurements are repeated at the same jitter frequency after the jitter amplitude is multiplied by the search factor (default value is 1.2).

- If the search factor is >1, the test is repeated at increasing jitter amplitudes until the DUT fails.
- If the search factor is between 0 and 1, the test is repeated with decreasing jitter amplitudes until the DUT passes.



Example of the Search Factor Feature

Perform a Single Point Jitter Tolerance Test

12 To perform a jitter tolerance test at 158 kHz, with a jitter amplitude of 0.3 UI, a bit error rate of 1 x $10^{-8,}$ and a gating time of 10 seconds press:

Jitter Tolrnce, *Errors BER* BER, *BER THRESHLD* 1 E – 8 ENTER, *Manual Tolrnce*

Wait for the initial calibration to be completed.

13 Set the gating time to 10 seconds on the error detector.

Stand-Alone Error Performance Analyzer

- If you are using a stand-alone error performance analyzer (70843A/B/C with 70004A or 86130A), press the following keys on the error performance analyzer to set the gating time.

  On the 70843 and 70004A, press **LCL**, **gating**, *GATE BY TIME*, *GATING PERIOD*, **10**, *SECONDS*.

  On the 86130A, press **Local.** Then in the *ED Setup* menu, click *Accumulation Setup*. In the **Period**, select **Time** and enter **10** seconds.

Modular Error Detector

- If you are using a modular error detector (70842A/B) follow these steps.

a Press **DISPLAY,** *NEXT INSTR* . Continue pressing *NEXT INSTR* until "`70842`" is displayed at the bottom of the screen.

b Press **DISPLAY,** *NEXT INSTR*
Continue pressing *NEXT INSTR* until "70842" is displayed.

c Press *MENU, dat i/p clk i/p, gating, GATING PERIOD* 10 SEC

d To return to the jitter menu, press:

DISPLAY, *NEXT INSTR* and continue pressing *NEXT INSTR* until "70820" is displayed.

14 Press the following keys on the 70820A to set the jitter frequency to 158 kHz:

USER, **USER**, *Diagnos*, *JITTER FREQ*, 158 kHz

As the test frequency is changed, a one-point calibration is performed.

15 Set the jitter amplitude to 0.3, by pressing *JITTER AMPL,* 0.3 ENTER

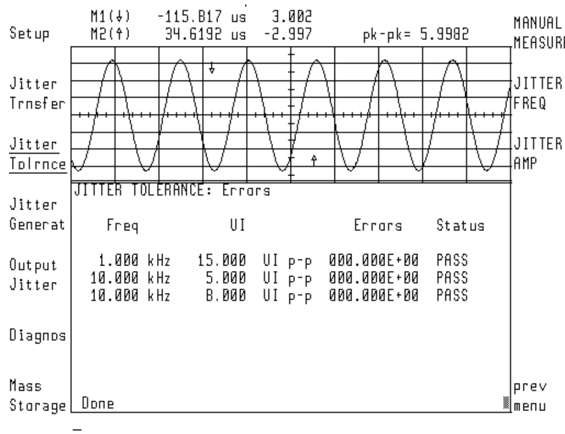
16 Perform the test by pressing:

USER, *manual tolrnce*, *MANUAL MEASURE*

The BER test is made using the set conditions. When the BER test is completed the test results are displayed.

The magnitude of the jitter amplitude may be limited due to system limitations. If the level you entered exceeds the system capability, the analyzer automatically sets it to the highest attainable level.

The jitter analyzer displays the results of the manual tolerance measurements at a given jitter frequency in a table. A new table is created when the jitter frequency is changed.



Example Results of the Manual Tolerance Test

Display the Last Measurement

17 To display the measurement results in either a graphical or list form, press:

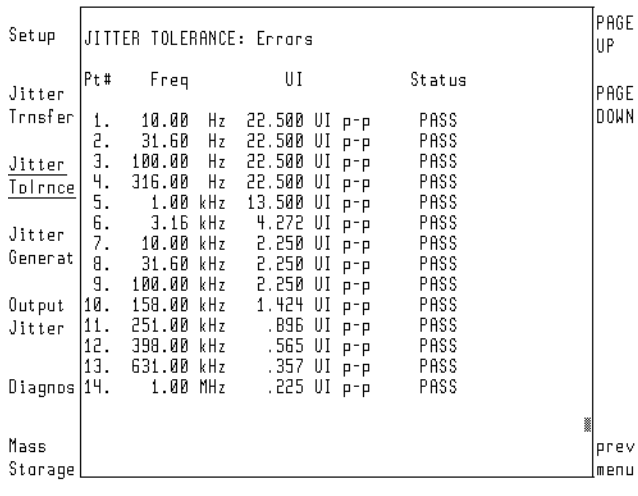
tolrnce results

The data collected during the last measurement is displayed.

Note If tolerance search is activated, the data plotted or listed is the last success. That is, the highest jitter level at which the test criterion (ERRORS or BER) was met. If tolerance search is off, the data plotted or listed is at the template level, modified by margin.

18 To display the results in list form, press:

LIST TOLRNCE



Pt#	Freq	UI	Status
1.	10.00 Hz	22.500 UI p-p	PASS
2.	31.60 Hz	22.500 UI p-p	PASS
3.	100.00 Hz	22.500 UI p-p	PASS
4.	316.00 Hz	22.500 UI p-p	PASS
5.	1.00 kHz	13.500 UI p-p	PASS
6.	3.16 kHz	4.272 UI p-p	PASS
7.	10.00 kHz	2.250 UI p-p	PASS
8.	31.60 kHz	2.250 UI p-p	PASS
9.	100.00 kHz	2.250 UI p-p	PASS
10.	158.00 kHz	1.424 UI p-p	PASS
11.	251.00 kHz	.896 UI p-p	PASS
12.	398.00 kHz	.565 UI p-p	PASS
13.	631.00 kHz	.357 UI p-p	PASS
14.	1.00 MHz	.225 UI p-p	PASS

Example of Tabular Results of the Tolerance Test

19 To return to the main tolerance menu, press:

prev menu, prev menu

Saving the Data

20 To save the calibration data, the input template, and modifications to the default test parameters so you can use them later, insert a formatted RAM card into the card slot of the 70820A and save the data and press:

Templat Storage

If you need to format a card, refer to "To Initialize (format) a Memory Card" on page 4-42.

21 After the catalog of files is displayed, press:

typing aids

22 Use the alphanumeric typing aids, knob and the Select Char function or an external HP-IL keyboard to enter a filename (eight characters maximum), and then press:

ENTER LINE, SAVE TEMPLAT

Note

Gating time changes to the error detector are not saved. (The calibration data is only valid for the specific signal generator and synthesizer/function generator used in the measurement.)

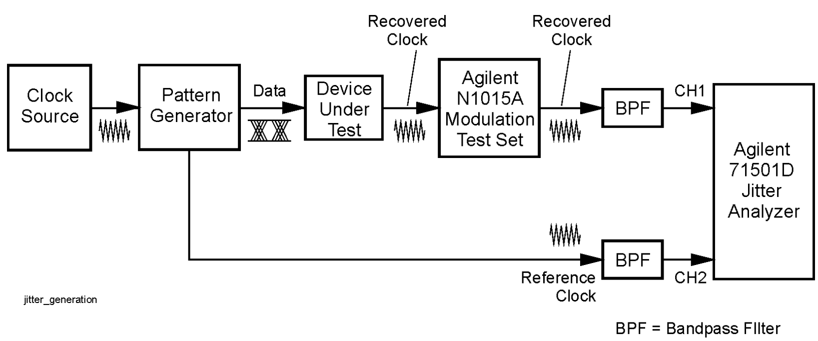
For a list of the parameters that are saved as part of the template, refer to "SAVE_TEMPLATE" on page 5-27.

Jitter Tolerance for Devices without a Recovered Clock Output

If the device being tested has no clock output, perform the jitter tolerance measurement by connecting the device-under-test as if a bit error rate test were being performed, independent of jitter. For example, bit error rate tests are often performed on devices with only a data output. In these cases, the clock signal from the pattern generator can be connected directly to the clock input of the error detector.

Tutorial 3: Jitter Generation and Output

Jitter generation and output jitter are measurements which determine the amount of jitter a component or system adds to an input data signal. In this measurement the jitter source is disabled so no jitter modulation is applied to the data. The jitter-free data from the error performance anlayzer is routed to the device under test (DUT), and the DUT output clock signal is received and measured by the 71501D. The following diagram shows the signal flow for the measurement process.



The jitter generation and output jitter measurements are performed using the same procedure. The only difference is the output jitter measurements are performed at two different low frequency rejection bands. The bandwidth(s) for the measurements are set with a user-definable software filter for low frequency rejection and a hardware bandpass filter for high frequency rejection.

What you will learn in this tutorial:

- Set the measurement frequency range.
- Select the number of noise traces to be averaged.
- Perform a jitter generation measurement.

Step 1. Connect the Equipment

Note

The equipment connections are the same for the jitter generation and jitter transfer measurements.

1. Connect the front and rear panel cables in the configuration that matches the device test-frequency and your system equipment.
2. Determine if the device test-frequency is within the following ranges:
   - 2.4 to 3.2 GHz with 20 MHz modulation (71501D options 300, 305)
   - 9.8 to 13 GHz with 80 MHz modulation (71501D options 310, 305)

- If the device test-frequency is within the ranges listed above, use a configuration that includes the N1015A modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-5 on page 3-12.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-7 on page 3-16.
- If the device test-frequency is outside the ranges listed above, use a configuration that **does not** include the modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-1 on page 3-6.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-3 on page 3-10.

For each type of configuration (with and without the test set) there is a connection diagram for stand-alone clock source and error performance analyzer (70843A/B/C, 86130A), and a connection diagram for modular clock source and error performance analyzer (70841A/B, 70842A/B).

Also, refer to the list of connections that corresponds to the type of configuration (with or without the test set). See Table 3-1 on page 3-8 and Table 3-2 on page 3-14.

Note If you reconfigure the equipment after the jitter personality has been loaded, refer to “Rescan the Equipment after Reconfiguring” on page 4-19. All GPIB connections must be made prior to turning on the system.

CAUTION To prevent damage to the 70820A microwave transition analyzer, always have either a bandpass filter or a dc block connected to the analyzer input channels. Make sure that the bandpass filter matches the frequency range that you will be measuring.

3 Connect filters to the 70820A inputs.

- If you are performing SONET/SDH testing with the 86130A or 71612/70843 combination of instruments use these filters:

  2.488 Gb/s bandpass (Opt. 420) plus 4 GHz low pass (Opt. 435)
  2.66 Gb/s bandpass (Opt. 430) plus 4 GHz low pass (Opt. 435)
  622 Mb/s bandpass (Opt. 410) plus 800 MHz low pass (Opt. 412)

Note In the testing conditions mentioned, the lowpass filter is required to prevent the higher clock harmonics emanating from the pattern generator clock output.

- If you are performing SONET/SDH testing with the 71603/71841/70842 combination of instruments, only a band pass filter is required.
- If you are performing 10 Gb/s testing using the 71612/70843 combination of instruments, the band pass filter guard band is adequate.

Note When using clock frequencies where bandpass filters are not available, a low pass filter plus a DC block (11742A) can be substituted for the bandpass filter. The DC block protects the 70820 sampling input from the DC level of the pattern generator clock output.

- For 622 Mb/s testing, use an 800 MHz low pass filter (Opt. 412).
- For 1 to 1.25 Gb/s testing, use a 1.5 GHz low pass filter (Opt. 417).
- For 2.4 to 3.3 Gb/s testing, use a 4.0 GHz low pass filter (Opt. 435).
- For 9 to 11.5 Gb/s testing, use a 12.4 GHz low pass filter (Opt. 467).

4 Set the GPIB and MSIB addresses for the system instruments.

5 Refer to “To Use Two Displays” on page 2-10 if you have more than one 70004A display in your equipment configuration.

Step 2. Set Up the Measurement Conditions

1 Insert the jitter personality card into the front-panel card slot of the microwave transition analyzer, facing the metal strip on the card downward and toward the instrument. Make sure the card is fully inserted into the card slot.

2 Switch on the power to all of the equipment. Switch on the power to the 70820A last. The start up process takes about 6 minutes.

Note If you have reconfigured the equipment after the jitter personality has been loaded, refer to "Rescan the Equipment after Reconfiguring" on page 4-19.

3 Select a template by pressing *Setup*, *INtmplt*, then select one of the templates: *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*.

- If you want to review the test point frequencies and levels for a template that you selected, press *Setup*, *Edit Template*. To adjust the measurement conditions specified in the available templates, refer to "Creating and Editing Templates" on page 4-21.
- If the data is at an FEC rate or is at a rate other than 155 Mb/s, 622 Mb/s, 2488 Mb/s, 9953 Mb/s, select the desired input data rate by pressing *INclock FREQ*, and entering the data rate (for OC48FEC enter 2.66606 Gb/s, for OC192FEC enter 10.7092 Gb/s).
- If the device under test has different data rates between the input and output, the 71501D must be in the MUX/DEMUX mode. Refer to "To Use Different Input/Output Data Rates" on page 4-24.

Note The clock source and error performance analyzer selected must be capable of operating at the input data rate you specify. The signal level from the pattern generator clock out to channel 2 of the 70820A must be 0.5 to 1.0 V peak-to-peak. The signal level from the device under test output, to either the N1015A or channel 1 of the 70820A, must be -2 to +4 dBm (0.5 to 1V peak-to-peak). If signals exceed this level, use the 6 dB attenuator to reduce voltage levels.

Optional Step

4 Set the low frequency rejection (corner frequency):

- If you are making a jitter generation measurement, press:

  Jitter Generat, LOWFREQ CORNER, enter a value other than the default value, then press *ENTER*:

  50 kHz for OC192
  12 kHz for OC48, OC12, and OC3

Acceptable values are 10 Hz–1 MHz.

- If you are making a jitter output measurement, press:

  Output Jitter LOWFREQ CORNER1, enter a value other than the default value, then press *ENTER*

  LOWFREQ CORNER2, enter a value other than the default value, then press *ENTER*

The output jitter measurement is measured in two bands, with different high-pass filter corner frequencies. For example, the default frequencies are:

- 500 Hz and 65 kHz for 155 Mbits/s
- 1 kHz and 250 kHz for 622 Mbits/s
- 20 kHz and 1 MHz for 995 Mbits/s
- 5 kHz and 1 MHz for 2488 Mbits/s

Note Limit the low frequency filter setting to 1 MHz. Otherwise, the jitter sensitivity will change when measuring higher frequencies.

High frequency rejection is provided by a hardware filter, producing:

- 1.25 MHz noise high frequency corner at 155 Mb/s (part number 0955-0969)
- 5 MHz noise high frequency corner at 622 Mb/s (part number 0955-0732)
- 20 MHz noise high frequency corner at 2488 Mb/s (part number 0955-0731)
- 80 MHz noise high frequency corner at 9923 Mb/s (part number 0955-0970)

5 Set the measurement sensitivity to high or normal.

- If your 71501D system meets the following conditions, the high-sensitivity mode is automatically selected:

❐ N1015A test set with a 10 GHz modulator is in the equipment configuration
❐ Clock source frequency is set in the range of 9.8 to 13 GHz
❐ Input and output clock rates are the same
❐ MUX/DEMUX is set to OFF

- If your 71501D system does not meet all of the conditions listed above, you will not be able to select the high-sensitivity mode. The normal-sensitivity mode will be automatically selected.

Note You can select and de-select the sensitivity mode manually by pressing *Jitter Generat*, *HISENS ON|OFF* for jitter generation, or pressing *Output Jitter*, *HISENS ON|OFF* for output jitter.

The high-sensitivity mode allows measurements with a lower noise floor. See the following examples of typical performance:

High-sensitivity mode at 10 Gb/s has 0.02 UI peak-to-peak noise floor.

Normal-sensitivity mode at 10 Gb/s has 0.06 UI peak-to-peak noise floor.

Step 3. Perform Jitter Generation or Output Jitter Measurement

1 Perform the jitter measurement.

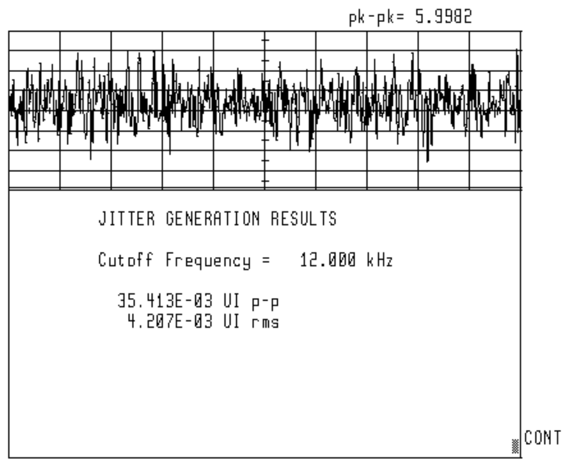
- If you are making a jitter generation measurement, press:

  MEASURE GENERAT

- If you are making an output jitter measurement, press:

  MEASURE OUT JIT

The measured result is the integrated phase noise in the band between the software high-pass filter corner frequency and the hardware filter bandwidth.



Example Tabular Results of the Jitter Generation Measurement

Note

Occasionally the high-sensitivity mode may fail. If this happens, the measurement will default to the normal-sensitivity mode. The measurement results screen will show the mode used during the measurement.

Change the Number of Sweeps

2 Change the number of traces used in the measurement.

- If you are making a jitter generation measurement, press:

  GENERAT SWEEPS, # of sweeps, ENTER

- If you are making an output jitter measurement, press:

  OUT JIT SWEEPS, # of sweeps, ENTER

The number of sweeps to be averaged can be entered using the knob, step keys, or numeric keypad. A larger value gives more accuracy, but increases the data acquisition time.

3 Measure the jitter using the new sweep value.

- If you are making a jitter generation measurement, press *MEASURE GEN-ERAT*

- If you are making an output jitter measurement, press *MEASURE OUT JIT*

Tutorial 4: Diagnostic Measurements

For diagnostic purposes, the Agilent 71510D has the ability to display the demodulatd or “base-band” jitter spectrum and waveform of a phase modulated clock signal. Also, similar to using a high-frequency spectrum analyzer and high-speed oscilloscope, the clock spectrum and waveform can be displayed. This measurement useful in understanding and solving jitter-related problems.

What you will learn in this tutorial:

- Configure the system for diagnostic measurements.
- Measure and analyze the demodulated jitter signal in the frequency domain.
- Measure and analyze the demodulated jitter in the time domain.
- Measure and analyze the jittered clock signal in the frequency domain.
- Measure and analyze the jittered clock signal in the time domain.
- Set arbitrary values for jitter amplitude and jitter frequency.

Step 1. Connect the Equipment

Note

The connections for jitter transfer, jitter generation, and jitter diagnostic are the same.

1 Connect the front and rear panel cables in the configuration that matches the device test-frequency and your system equipment.

2 Determine if the device test-frequency is within the following ranges:

- 2.4 to 3.2 GHz with 20 MHz modulation (71501D options 300, 305)
- 9.8 to 13 GHz with 80 MHz modulation (71501D options 310, 305)

- If the device test-frequency is within the ranges listed above, use a configuration that includes the N1015A modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-5 on page 3-12.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-7 on page 3-16.
- If the device test-frequency is outside the ranges listed above, use a configuration that **does not** include the modulation test set.
  - For stand-alone error performance analyzers (70843A/B/C and 86130A), refer to Figure 3-1 on page 3-6.
  - For modular error performance analyzers (70841A/B and 70842A/B), refer to Figure 3-3 on page 3-10.

For each type of configuration (with and without the test set) there is a connection diagram for stand-alone clock source and error performance analyzer (70843A/B/C, 86130A), and a connection diagram for modular clock source and error performance analyzer (70841A/B, 70842A/B).

Also, refer to the list of connections that corresponds to the type of configuration (with or without the test set). See Table 3-1 on page 3-8 and Table 3-2 on page 3-14.

Note

If you reconfigure the equipment after the jitter personality has been loaded, refer to "Rescan the Equipment after Reconfiguring" on page 4-19. All GPIB and MSIB connections must be made prior to turning on the system.

CAUTION

To prevent damage to the 70820A microwave transition analyzer, always have either a bandpass filter or a dc block connected to the analyzer input channels. Make sure that the bandpass filter matches the frequency range that you will be measuring.

3 Connect filters to the 70820A inputs.

- If you are performing SONET/SDH testing with the 86130A or 71612/70843 combination of instruments use these filters:

  2.488 Gb/s bandpass (Opt. 420) plus 4 GHz low pass (Opt. 435)
  2.66 Gb/s bandpass (Opt. 430) plus 4 GHz low pass (Opt. 435)
  622 Mb/s bandpass (Opt. 410) plus 800 MHz low pass (Opt. 412)

Note

In the testing conditions mentioned, the lowpass filter is required to prevent the higher clock harmonics emanating from the pattern generator clock output.

- If you are performing SONET/SDH testing with the 71603/71841/70842 combination of instruments, only a band pass filter is required.
- If you are performing 10 Gb/s testing using the 71612/70843 combination of instruments, the band pass filter guard band is adequate.

Note

When using clock frequencies where bandpass filters are not available, a low pass filter plus a DC block (11742A) can be substituted for the bandpass filter. The DC block protects the 70820 sampling input from the DC level of the pattern generator clock output.

- For 622 Mb/s testing, use an 800 MHz low pass filter (Opt. 412).
- For 1 to 1.25 Gb/s testing, use a 1.5 GHz low pass filter (Opt. 417).
- For 2.4 to 3.3 Gb/s testing, use a 4.0 GHz low pass filter (Opt. 435).
- For 9 to 11.5 Gb/s testing, use a 12.4 GHz low pass filter (Opt. 467).

4 Set the GPIB and MSIB addresses for the system instruments.

5 Refer to "To Use Two Displays" on page 2-10 if you have more than one 70004A display in your equipment configuration.

Step 2. Set Up the Measurement Conditions

1 Insert the jitter personality card into the front-panel card slot of the microwave transition analyzer, facing the metal strip on the card downward and toward the instrument. Make sure the card is fully inserted into the card slot.

2 Switch on the power to all of the equipment. Switch on the power to the 70820A last. The start up process takes about 6 minutes.

Note If you have reconfigured the equipment after the jitter personality has been loaded, refer to “Rescan the Equipment after Reconfiguring” on page 4-19.

3 Select the clock frequency by pressing:

Setup, *INclock FREQ*

The clock frequency you selected must be compatible with any bandpass filters used in the signal paths. The clock frequency can also be selected by choosing a standard template in the Setup menu, as shown in the next step.

4 Select a template by pressing *Setup*, *INtmplt*, then select one of the templates: *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*.

- If you want to review the test point frequencies and levels for a template that you selected, press *Setup*, *Edit Template*. To adjust the measurement conditions specified in the available templates, refer to “Creating and Editing Templates” on page 4-21.
- If the data is at an FEC rate or is at a rate other than 155 Mb/s, 622 Mb/s, 2488 Mb/s, 9953 Mb/s, select the desired input data rate by pressing *INclock FREQ*, and entering the data rate (for OC48FEC enter 2.66606 Gb/s, for OC192FEC enter 10.7092 Gb/s).
- If the device under test has different data rates between the input and output, the 71501D must be in the MUX/DEMUX mode. Refer to “To Use Different Input/Output Data Rates” on page 4-24.

The clock source and error performance analyzer selected must be capable of operating at the input data rate you specify. The signal level from the pattern generator clock out to channel 2 of the 70820A must be 0.5 to 1.0 V peak-to-peak. The signal level from the device under test output, to either the N1015A or channel 1 of the 70820A, must be -2 to +4 dBm (0.5 to 1V peak-to-peak). If signals exceed this level, use the 6 dB attenuator to reduce voltage levels.

Step 3. Perform a Diagnostic Measurement

5 Select diagnostic measurement by pressing:

Diagnos

A single-point calibration is performed.

6 Set the jitter rate to be applied to the clock signal to 100 kHz by pressing:

JITTER FREQ, 100 *kHz*

A single-point initial calibration is performed.

7 Set the amplitude of the jitter applied to the clock signal to two unit intervals peak-to-peak by pressing:

JITTER AMPL, 2 *ENTER*

In the following measurements, waveforms to both Channel 1 and Channel 2 are displayed.

Jitter Waveform and Jitter Spectrum are useful only for signals whose total bandwidth is less than 10 MHz, since the maximum sampling frequency of the 70820A is 20 MHz.

Signal bandwidth is approximately:

$2 \times \text{modulation frequency} \times (1 + \rho \times UI_{p\text{-}p})$

- For broader signals, some of the sidebands may be viewed and measured using Clock Spectrum.
- Jitter Waveform and Jitter Spectrum may be used for modulating frequencies below about 300 kHz, and jitter levels below about 6 $UI_{p\text{-}p}$.
- Additionally, Jitter Spectrum may be used for low jitter signals up to a few MHz; Jitter Waveform may be used for lower frequency jitter at magnitudes up to about 63 $UI_{p\text{-}p}$.

For higher frequencies, the number of cycles displayed increases. If too many cycles are shown, use Jitter Spectrum. With the Jitter Spectrum display, as the jitter level (and signal bandwidth) increases, a higher sampling frequency must be used, which pushes the modulation peak left, into the DC term. For higher jitter level, shift to Jitter Waveform.

8 To view the frequency spectrum of the demodulated jitter signal, press:

JITTER SPECTRA

9 Change the jitter rate and jitter amplitude by pressing:

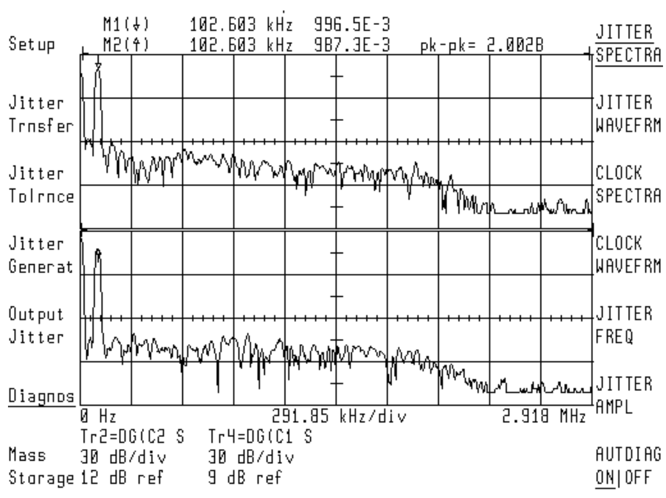
JITTER FREQ > new value ENTER

JITTER AMPL > new value ENTER

As the jitter frequency is changed, the analyzer adjusts the frequency span for the optimum display. To disable this feature and maintain a constant span, press:

AUTODIAG ON OFF OFF

If the AUTODIAG function is on, the sweep rate is automatically set so the selected jitter frequency lies within the leftmost tenth of the screen, unless the jitter frequency is above 300 kHz. If the jitter frequency is above 300 kHz, the jitter spectrum displayed extends to 5 MHz (the center of the screen). The highest jitter frequency measurable in the Diagnostics menu is 5 MHz.



Viewing the Jitter Spectrum

10 To determine the amplitude of a signal in this display format, press:

MENU, *Markers*, select a marker

Use the knob to adjust the position of the selected marker. Marker values are displayed in UI_{pk}. (The peak-to-peak value sometimes displayed in the top right area of the screen refers to previous measurements.)

View the Jitter Waveform in Time Domain

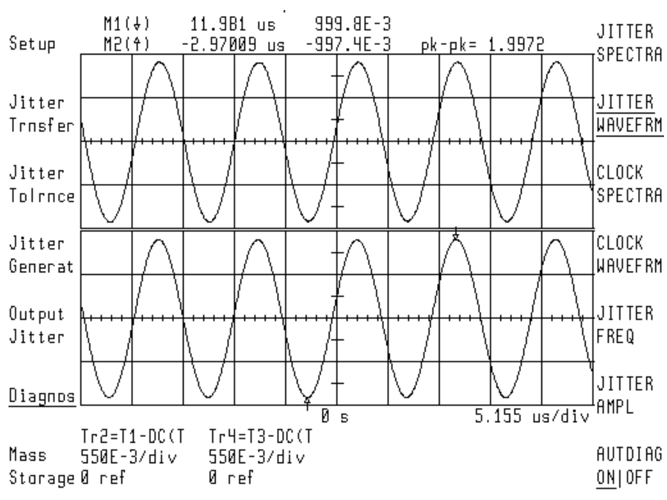
11 To view the demodulated waveform in the time domain, press:

JITTER WAVEFRM

If the `AUTODIAG` function is on, the sweep rate is set so a few cycles of the modulation are displayed, unless the jitter frequency is above 300 kHz. When the jitter frequency exceeds 300 kHz, more cycles will be displayed. At high jitter levels, fewer cycles are displayed.

Note When the `AUTODIAG` is on, the jitter application automatically sets the 70820A sampling rate for a useful display, if possible. When device input and output frequencies differ, if the higher one is an integer multiple of the lower one, Clock Waveform will show correspondingly more cycles of the higher frequency one.

The displayed modulation waveform may be distorted if the appropriate band-pass filter is not used, or if the jitter amplitude is excessive.



View the Jitter Waveform

12 Measure the peak-to-peak amplitude of the jitter by pressing:

MENU, *Pg 1 of 2*, *Measure*, *Msr Trc Tr*

Select TR4 for `CHANNEL 1` and TR2 for `CHANNEL 2`.

13 Perform the measurement by pressing:

More 3/3, PK-PK

View the Clock Spectrum

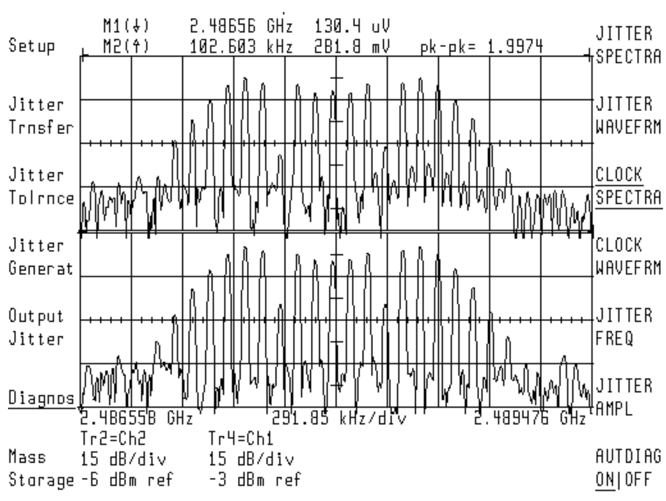
14 To view the frequency spectrum of the jittered clock signal, press:

CLOCK SPECTRA

The displayed frequency scale is centered around the clock frequency.

Note

In MUX/DEMUX mode, when input and output clock frequencies are different, the Clock Spectrum of the higher frequency signal will be centered in the display, while the lower frequency signal will be offset slightly from the center. Marker frequencies will be correctly displayed for the lower frequency signal. Markers placed on the higher frequency clock trace will have marker frequency values as if that clock signal has been frequency shifted to the lower clock frequency (70820A limitation).



Viewing the Clock Spectrum

15 Change the jitter rate and jitter amplitude by pressing:

JITTER FREQ > *new value* ENTER

JITTER AMPL > *new value* ENTER

As the jitter frequency is changed, a one-point jitter amplitude calibration is performed, and the analyzer adjusts the frequency span for the optimum display. To disable this feature and maintain a constant span, press:

AUTODIAG ON OFF <u>OFF</u>

16 To display a single channel, press:

MENU > *TRACES*

17 Normally, `CHANNEL 1` is displayed as trace 4 (TR4), and `CHANNEL 2` is displayed as trace 2 (TR2). To turn off `CHANNEL 2`, press:

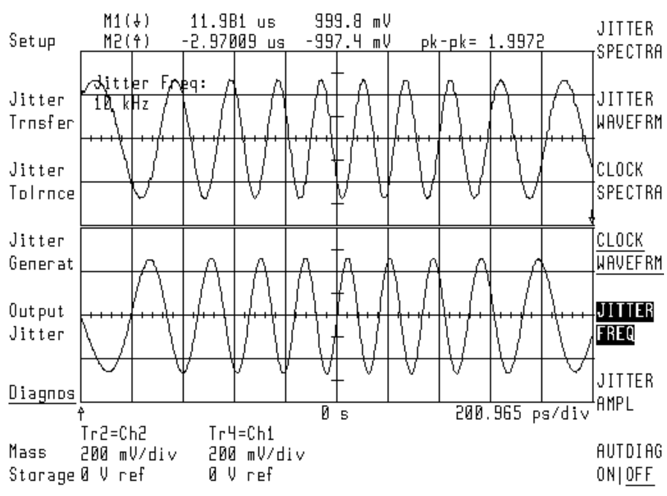
Select > *TR2* > *display on off* <u>off</u> > **USER** > **USER**

View the Clock Waveform

18 To view the jittered clock waveform in the time domain, press:

CLOCK WAVEFRM

Notice how the clock period varies during the measurement.



Viewing the Clock Waveform

19 Change the jitter rate and jitter amplitude by pressing:

JITTER FREQ > *new value* ENTER

JITTER AMPL > *new value* ENTER

As the jitter frequency is changed, the analyzer adjusts the time span for the optimum display. Low jitter rates and/or amplitudes provide the most meaningful measurements of the jittered clock waveform. At high jitter amplitudes, the clock waveform will appear quite distorted.

20 Use the `AUTODIAG` function.

When the `AUTODIAG` function is on, the analyzer calibrates the signal and adjusts the frequency or time span to optimize the display of the signals. To maintain a fixed span, turn the `AUTODIAG` function off. To disable this feature and maintain a constant span, press:

AUTODIAG ON OFF OFF

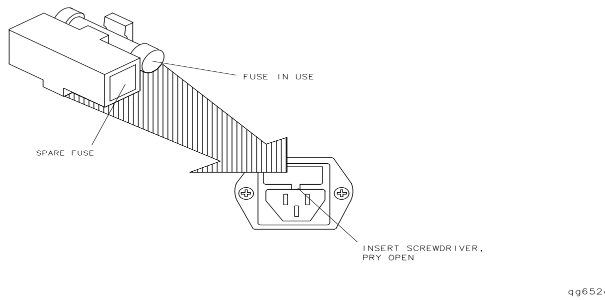
Troubleshooting the Jitter Analyzer System

Troubleshooting Checklist

- ❐ Do the bandpass or lowpass filters match the selected template frequencies? If the frequency ranges do not match, the 70820A will not find a signal.
- ❐ Do all of the system instruments have AC power supplied?
- ❐ Are all of the system instruments switched on?
- ❐ Does each system instrument have a unique address?
- ❐ Are the MMS instruments on the private bus?
- ❐ Are the remotely controlled instruments on the GPIB bus?
- ❐ Have you pushed a number of buttons in a rapid succession? If you have done this it can sometimes cause the 70820A to operate incorrectly. Restart the 70820A by switching the power off and then on.
- ❐ If the 70820A is not responding to the menu keys, switch the power off and then on to restart the instrument.
- ❐ Have you pushed the 70820A **INSTR PRESET** button? If you have, the 70820A displays a Microwave Transition Analyzer menu and signal display. Press **USER** and select the desired jitter measurement (*Jitter Trnsfer*, *Jitter Tolrnce*, *Jitter Generat*, *Output Jitter*), and press the measurement key (*MEASURE TRNSFER, TOLRNCE, GENERAT, OUT JIT)* to generate new results. The measurement will be done with the previously set jitter measurement conditions. Pressing the 70820A **INSTR PRESET** is not recommended. It is also not recommended to customize and use the instrument preset function. If you did customize the instrument preset, follow the instruction below to restore the factory instrument preset.

  To Restore the Factory Instrument Preset
  Press **MENU** > *page 1 of 2* > *States* > *more 1 of 2* > *preset: FAC|USR* <u>FAC</u>

❐ Have you repeatedly pushed the front panel ON/OFF power switch on the N1015A modulation test set? If you have, check the modulation test set fuse. Disconnect the power cord and remove the fuse from the test set power module on the rear panel. See the graphic below. Use a continuity light or an ohmmeter to check the fuse. An ohmmeter should read very close to zero ohms if the fuse is good. If the fuse is bad, replace it with the spare fuse (2110-1320).



❐ If there has been a low supply voltage, due to brown out conditions, check the modulation test set fuse. Refer to the above item for directions and fuse part number.

❐ Ensure that the GPIB connections are to the correct connector. On the rear panel of the 70004A/70820A instrument combination, there are two GPIB connectors. The 70004A GPIB connector is used for remote programming. The 70820A GPIB connector is a private GPIB used for the equipment setup to allow 70820A, jitter personality to control the required instruments.

❐ If the jitter personality does not load it may be because the display is assigned to an instrument other than the HP 70820A. It may also be because the display mass storage is assigned to the GPIB device.

Verify the Settings and Connections

1. In the **Setup** menu, set the input clock frequency. If the device output clock rate is different, turn on **MUX/DMX** mode and set the output clock frequency.
2. Enter the **Diagnos** menu. The jitter application will perform a jitter magnitude calibration at the current jitter frequency and magnitude. The default is 10 kHz and 0.15 UI. If a jittered clock signal is present on channel 2 the calibration will finish in a few seconds. If *no* jittered clock signal is present at channel 2 the calibration attempt will repeat up to eight times before the application stops and displays an error message. You can cancel the calibration attempt by pressing **EXIT**.

Select each of the four displays in turn, and verify the waveforms are as described below.

Jitter Spectra

A signal peak at the current sinusoidal jitter frequency is displayed. Normally AUTO DIAG mode is on, so the peak is positioned one-half division from the left. Measure the jitter magnitude using the marker function on the 70820 by pressing:

MENU, *Markers, M1, mkr→ HIGHEST PEAK*

The marker is placed on the signal peak, and the marker readout shows the jitter frequency and peak magnitude. Multiply peak magnitude by two the get $UI_{pk\text{-}pk}$. Press **USER** to return to the jitter measurement application menus.

Jitter Waveform

The demodulated phase of the clock signal is displayed as four or five cycles of a sinusoidal waveform. More cycles will be shown for jitter frequencies above a few hundred kilohertz, fewer for high amplitude or low frequency jitter. At low jitter levels you may see a significant amount of noise accompanying the sinusoidal jitter. Increase the signal-to-noise ratio to clean up the display of the signal by pressing:

JITTER AMPL, 2, **ENTER**

The jitter magnitude is increased to 2 $UI_{pk\text{-}pk}$.

At a jitter frequency of 10 kHz most 71501D-compatible clock sources can produce at least 10 $UI_{pk\text{-}pk}$. At this high jitter level, the displayed jitter waveform should be nearly a pure sinusoid.

If the displayed waveform is tilted, either a sloping sinusoid or a sloping line, you're seeing a continuous phase advance or retard. This indicates either the frequency of the clock does not match the frequency entered in the Setup menu, or the clock source is not phase-locked to the frequency reference in the 70820. Verify the clock source and the 70820 frequency reference are phase-locked via their rear-panel 10 MHz reference connectors. Also verify the frequency entered on the Setup menu Inclk FREQ function is exact. If MUX/ DMX is on, the Setup menu OUTclk FREQ function must also be set precisely.

Use the 70820 menus to measure the magnitude of the jitter displayed in the time domain by pressing:

MENU, *Measure, update:, CONT, PK-PK*

The jitter in $UI_{pk\text{-}pk}$ will be displayed.

Clock Spectra

The frequency spectrum of the clock signal, the carrier and jitter sidebands, is displayed. At low jitter levels the carrier is the highest peak in the spectrum, with a single sideband in each side. As the jitter level is increased, the magnitude of the first pair of sidebands increases and additional sidebands appear. At high jitter levels there are so many sidebands it's difficult to see the carrier. The amplitude of the carrier and its sidebands increase and decrease according to Bessel functions with modulation index (that is, jitter level) as argument.

Clock Waveform

The waveform of the phase-modulated clock is displayed. Disconnect the cable between the synthesized function/ sweep generator output and the clock source FM input to view the clock waveform undistorted by phase modulation. At high modulation levels, the waveform may appear very distorted.

When no filters are present at the 70820A inputs, this view provides an oscilloscope-like capability. It can be used to check the rejection of the bandpass filters used on the 70820A inputs. If the filter stopbands provide adequate attenuation of the clock signal harmonics a sinusoid is displayed. Significant distortions can indicate inadequate harmonic rejection, which decreases the precision of the jitter measurements. Good jitter transfer measurements require the harmonics be suppressed to at least –30 dBc.

Filter stopband rejection can usually be improved by cascading the bandpass filters with lowpass filters whose cutoff frequency is below that at which the bandpass filters exhibit spurious passbands.

The Diagnos menu provides four ways of viewing jittered clock signals. You can use these views to verify the connections, signals and settings are correct before you begin to make jitter measurements, such as those described in the following tutorials.

If clock signals are connected to both inputs of the 70820, the descriptions apply to both traces. The top trace corresponds to input 1, the bottom trace to input 2.

The following table shows the minimum required connections to the inputs of the 70820A.

Table 3-5. Required Connections to the Inputs of the 70820A.

Measurement	70820A	
	Channel 1 (top input)	**Channel 2 (bottom input)**
Setup / CAL INPUT	None required	Pattern generator clock out or $\overline{\text{clock out}}$
Jitter Trnsfer	Recovered clock of test device	Pattern generator clock out or $\overline{\text{clock out}}$
Jitter Generat or Output Jitter	Recovered clock of test device	None required for normal-sensitivity mode Pattern generator clock for high-sensitivity mode
Jitter Tolrnce	None required	None required

The four views of the clock signal have limitations, especially at high jitter frequencies and high jitter levels. Refer to “Specifications and Characteristics” on page 6-1 for more information.

4

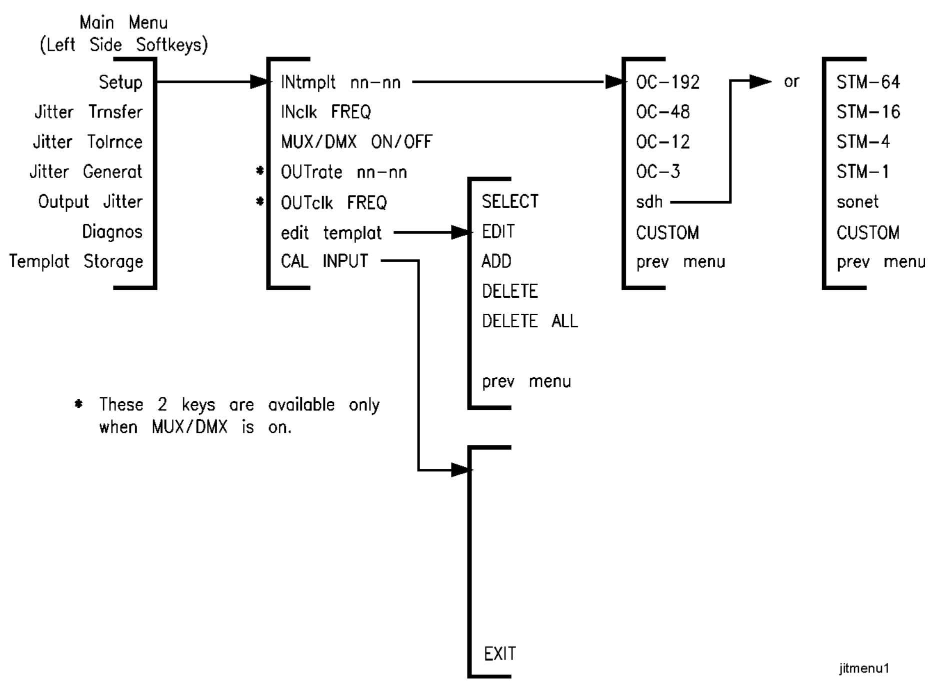
Jitter Analyzer Reference

Jitter Analyzer Reference

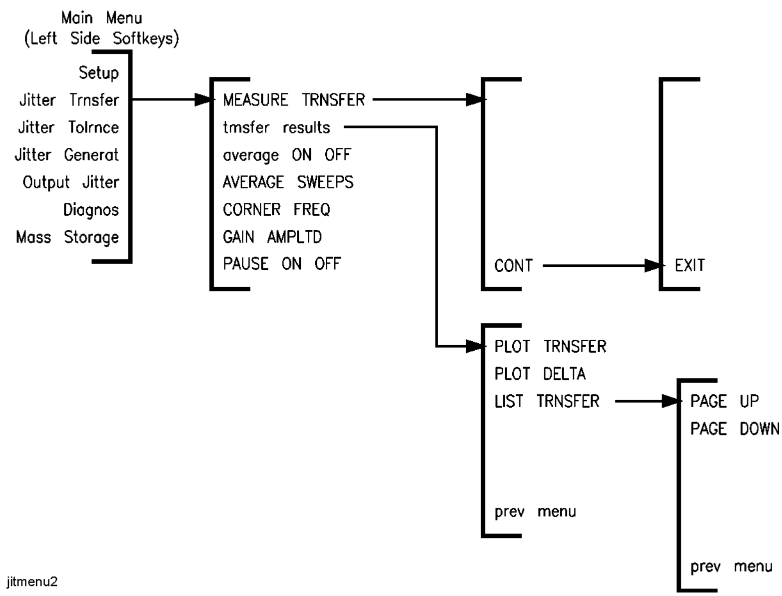
In this chapter, you will find information that is helpful for understanding the jitter measurement system. Besides showing the jitter menus, this chapter also explains the jitter applications, some components of system configuration and measurement conditions, and describes the calibrations, file storage and hardcopy possibilities. You will find information on the following topics:

Menu Maps

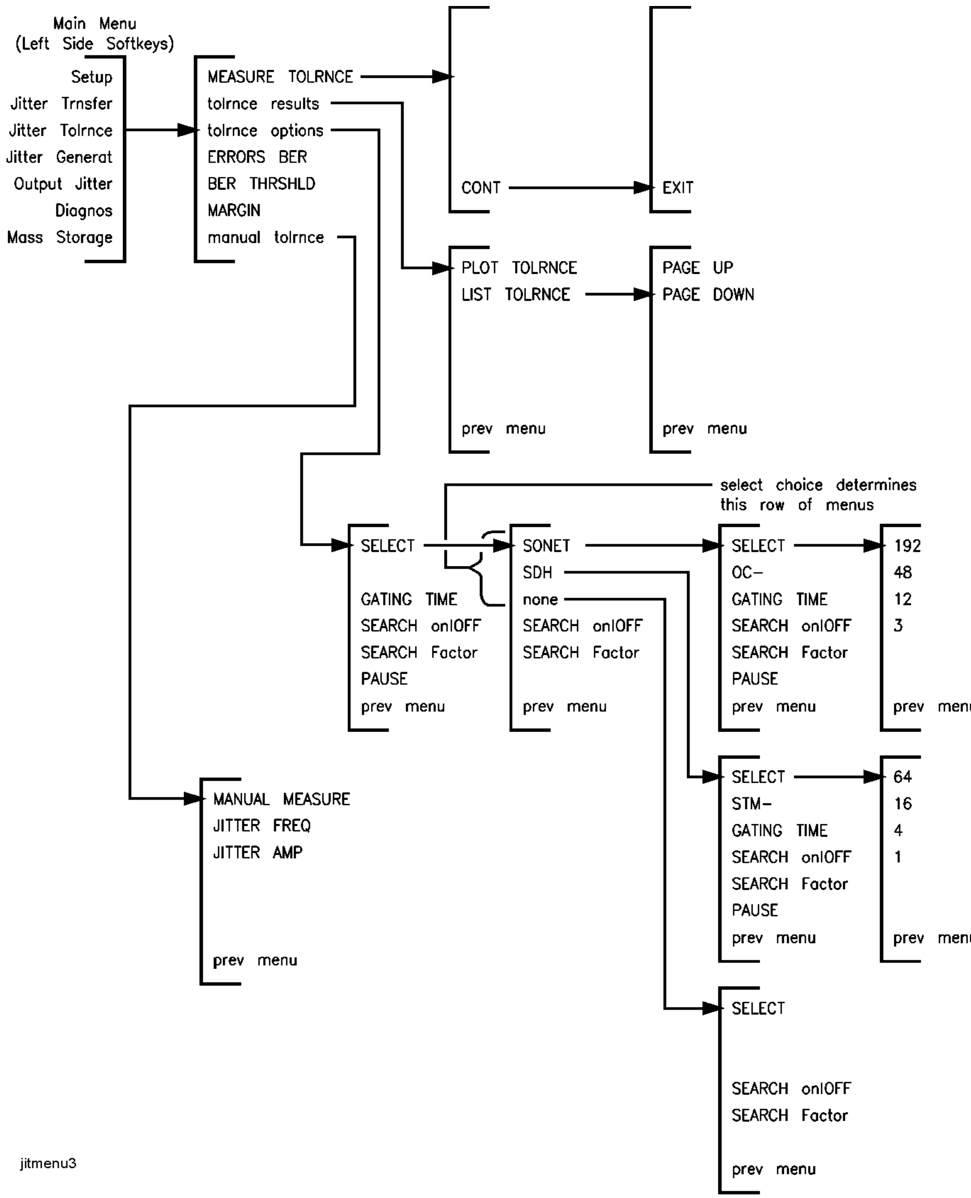
The menu maps in this section graphically represent the softkey menus associated with the jitter measurement application (presented when **USER** is pressed).



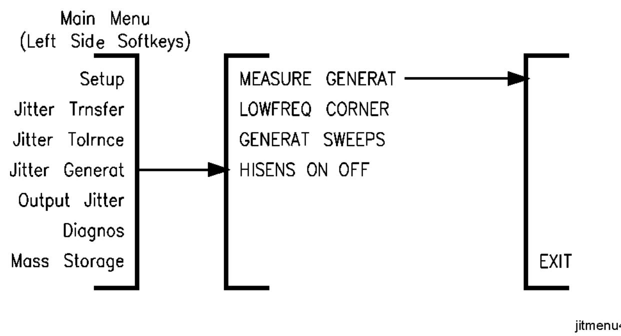
Setup Menu



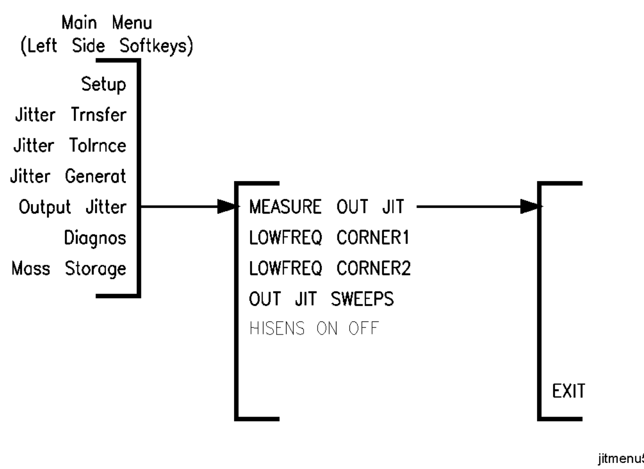
Jitter Transfer Menu



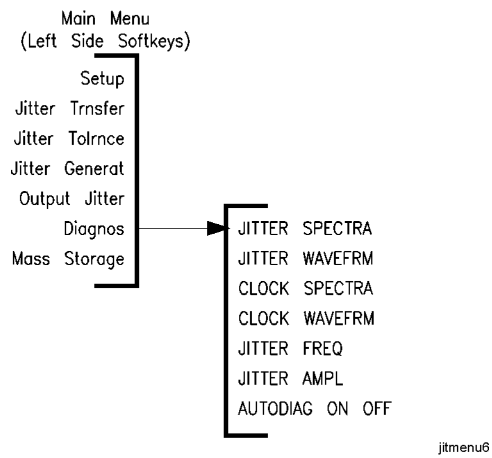
Jitter Tolerance Menu



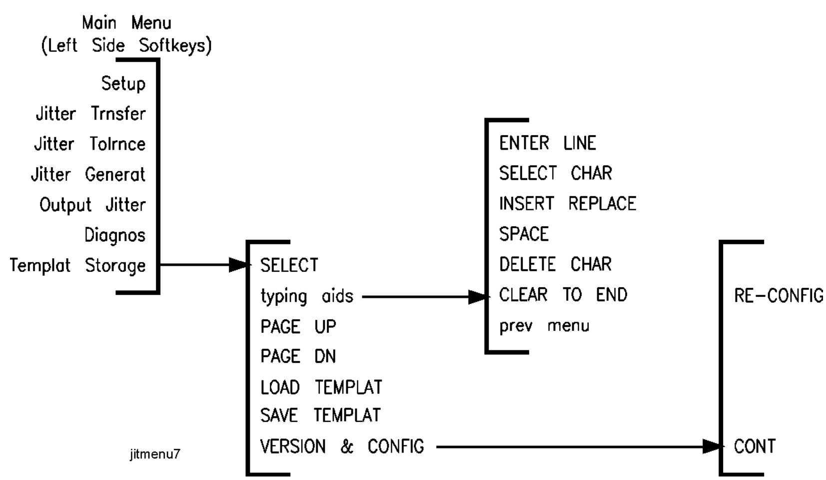
Jitter Generation Menu



Output Jitter Menu



Diagnostic Measurements Menu



Template Storage Menu

Jitter Measurements

High-speed digital transmission systems are often required to receive or regenerate data using a clock signal that is recovered or extracted from the data waveform. Variation in the data rate, commonly known as jitter can complicate the clock recovery and data regeneration process. To guarantee a high level of performance in the presence of jitter, components and systems are typically required to adhere to a rigorous set of jitter performance standards. The Agilent 71501D system allows you to do a thorough jitter characterization of your devices with the following measurement applications:

- Jitter transfer
- Jitter tolerance
- Jitter generation and output jitter
- Jitter diagnostics

Jitter Transfer

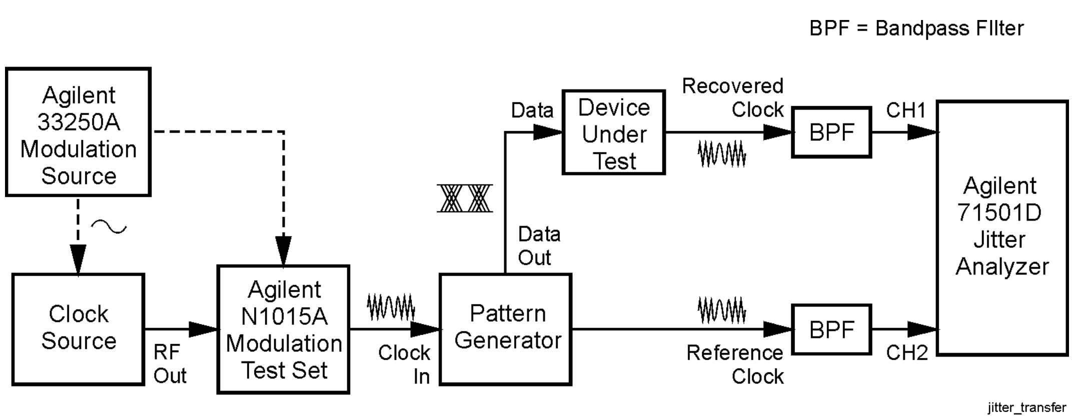
The 71501D controls the clock source to produce a data waveform with the specific input jitter levels and frequency range required by SONET, SDH, or custom standards. Jitter transfer is typically used to describe how a clock recovery module or repeater locks and tracks data as the data has jitter placed upon it.

In this measurement, the jitter modulation, at a specific modulation rate or frequency, is impressed upon the data. To determine the jitter transfer, the analyzer measures the jitter on the clock output of the pattern generator (proportional to the jitter on the pattern generator data output) and the jitter of the recovered clock signal from the device-under-test.The jitter at the input to the device-under-test (DUT), as well as the jitter at the output of the DUT are measured simultaneously. The jitter transfer at this jitter rate is then computed. The jitter frequency is incremented and the measurement is repeated. This process continues until the device has been characterized over the full bandwidth of interest.

The measurement results in a ratio of the jitter on the output of the device or system compared to the jitter on the data going into the device.

Because the measurement is a ratio, the results are unitless, and expressed in decibels. (The magnitude of the jitter is typically set at levels specified for a jitter tolerance test, discussed later.)

The signal flow diagram for a jitter transfer measurement is shown below.



Jitter transfer measurement accuracy is enhanced if signal harmonic content is suppressed. Therefore, low pass or bandpass filters are typically used in the measurement paths. Refer to “Bandpass Filters” on page 4-19.

The results of the jitter transfer measurement can be displayed in one of three ways.

- Transfer plot
- Delta plot
- Numerical listing

Transfer Plot

The transfer plot mode shows the jitter transfer function is displayed on a 10 dB/division scale, usually against the SDH/SONET specification line.

Delta Plot

The delta plot mode shows the results as the difference between actual performance and specified performance. For example, if the maximum allowable value of the jitter transfer is 0.1 dB, and the actual performance is 0 dB, the delta plot will show this as being a value of -0.1 dB, as it is 0.1 dB below or within specification. In the delta plot, the vertical scale is 2 dB/division, presenting a much higher resolution display than the transfer plot.

Numerical Listing

The numerical listing shows a listing of the jitter transfer measurement results. The measured response, the maximum allowed response, the difference between actual and specified performance, and a pass/fail status are all listed.

Jitter Transfer Measurement Uncertainties

The Agilent 71501D jitter analysis system has a two channel simultaneous measurement technique. Therefore, system drift is common to both channels and is not a significant factor in the measurement. Jitter transfer measurement uncertainty is then a function of the inherent ability of the 71501D to measure jitter. The uncertainty of a jitter transfer measurement is ±0.05 dB. This assumes that both measurement channels are filtered to reject harmonic signal content.

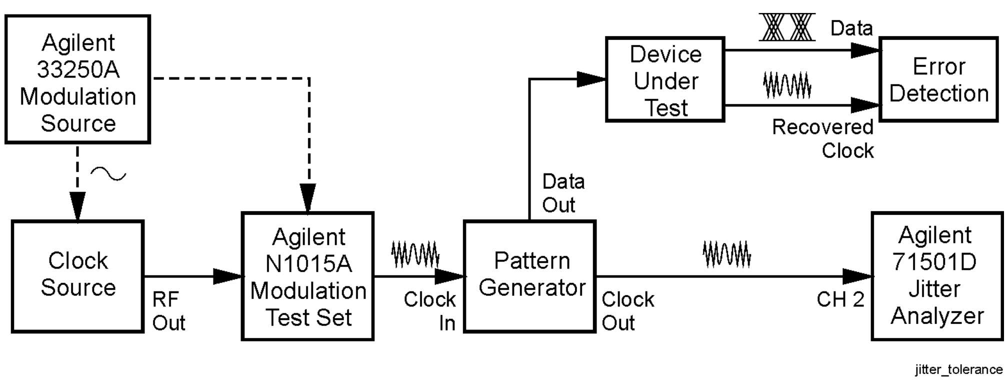
Jitter Tolerance

Jitter tolerance is the ability of a device or system to maintain communication quality in the presence of jitter. The test can be done in two ways:

- A standards based compliance test that requires the equipment to maintain a specific bit-error-ratio (BER) level at predefined jitter levels and jitter frequencies.
- A test that determines the actual jitter levels where the DUT can no longer maintain a desired BER.

Similar to a jitter transfer test, a jitter tolerance test is performed at several jitter frequencies. The jitter magnitudes are normally defined by the standard against which the test is being performed.

The signal flow diagram for a jitter tolerance measurement is shown below.



Both SDH and SONET test templates are available in the 71501D. If jitter levels and frequencies other than those defined by the standard based tests are desired, you can develop custom templates. Refer to “Creating and Editing Templates” on page 4-21.

The jitter tolerance measurement process is as follows:

a Perform a BER measurement of the DUT with jitter-free data.

b Attenuate the signal power until the onset of errors or a specific BER is achieved.

c Reduce the attenuation 1 dB.

d The results of the BER test are monitored by the 71501D, where the 71501D compares the actual BER performance to the desired level (defined by you) to determine the pass or fail status.

e This process is repeated for each test point as defined by the test template.

Margin Testing

The above method is used to verify compliance to a given test standard. If the DUT passes the test, it is still unknown just what level of tolerance is achievable. You can perform a margin test by selecting a percentage margin by which to increase the jitter magnitude at each test point.

Tolerance Searching

You could also use another technique where you perform a tolerance search. In this mode the 71501D initially performs the BER test with the jitter level set to that of the template. The jitter will then be systematically increased by a factor that you define and a BER test performed until the desired BER limit is exceeded, or the test system generation capability is exceeded. If the DUT is not capable of achieving basic compliance levels, the search factor can be set to a negative level. In this mode, the jitter level will be decreased until a level is reached where the DUT can maintain the desired BER.

Single-Point Testing

For single point testing, the jitter frequency and magnitude can be arbitrarily selected and a BER test performed.

All of these jitter tolerance tests may also be performed on multiplexing and de-multiplexing devices.

Jitter Tolerance of Devices with No Clock Output Signal

If the DUT has no recovered clock output, the source of the clock signal for the error performance analysis would be the same as what would be used for a conventional BER test (as if no jitter were applied to the data). For example, the clock output of the pattern generator might be used as an input to the error detector.

Jitter Tolerance Measurement Uncertainties and Accuracies

The key measurement in a jitter tolerance test is BER. The uncertainty of a BER measurement is dictated by the error performance analyzer and how it is configured. Accuracy of the 71501D jitter analysis system involves precision in setting a specific jitter level. The 71501D will typically set jitter to within ±2% of the desired level.

Gating Time for Jitter Tolerance Measurements

Gating time is the time window during which the BER or the errored bits are monitored at each test point in a jitter tolerance test. In a BER test, the higher the number of errors, the more accurate the test. If the BER is very low a long gating time will be required. Refer to "Change the Default Gating Time" on page 4-13, and "Step 2. Set Up the Measurement Conditions" on page 3-59 to see how you can set the gating time for the following situations:

- Default gating value for all measurements.
- Specific gating value for a single measurement.

Gating time is calculated as follows:

$$Gating\ Time = \frac{number\ of\ errors}{(BER)(Data\ Rate)}$$

If you want to measure at least 100 errored bits and the data rate is 2488 Mbits/s, and the BER threshold is 1×10–9 then,

$$Gate\ Time = \frac{number\ of\ errors}{(BER)(Data\ Rate)} = \frac{100}{(1 \times 10^{-9})(2488 \times 10^{6})} = 40.2\ seconds$$

The gating time is set on the error detector.

Use the *tolerance options*, *GATING TIME* key to set the default gating time. The value set will be used for all jitter tolerance measurements until the value is changed or until the program is restarted. To change the gating time for a single measurement across a template without affecting the default use the procedure described below.

Change the Default Gating Time

Each time a jitter tolerance measurement begins the error detector gating time is set to the default value, which is initially one second.

Set the default gating time by pressing:

tolrnce options, GATING TIME

To change the gating time for the current measurement without changing the default, use the refer to "Perform Clock and Data Alignment and Set the Gating Time" on page 3-47.

Jitter Generation and Output Jitter

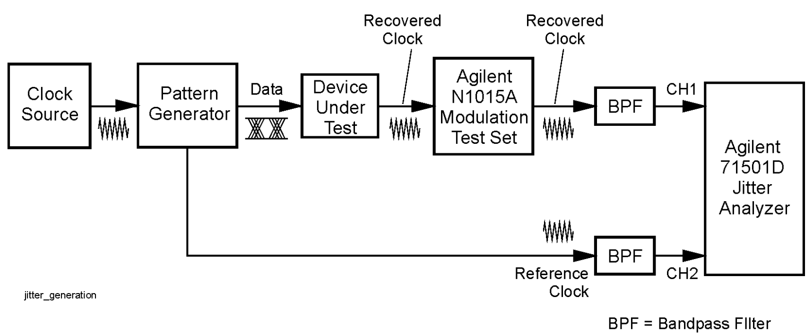
Jitter generation and output jitter are measurements which determine the amount of jitter a component or system adds to an input data signal.

Output jitter measurements are almost identical to jitter generation measurements. The only difference is that the frequency position of the software high-pass filter is set for two values.

The measurement process is as follows:

1. The jitter modulation source is disabled, keeping the data jitter free.
2. The jitter-free data coming from the error performance analyzer is routed to the DUT .
3. The DUT output clock signal is received and measured by the 71501D.

   Because this is essentially a noise measurement, it is defined over a specific bandwidth.
4. The bandwidth limiting process is achieved in two stages.
   a. The signal is sent through a hardware bandpass filter centered at the data rate frequency. By passing the signal through the hardware filter, the high end of the jitter spectrum is determined.
   b. The signal is then demodulated to extract the jitter modulation.
   c. The baseband jitter is passed through a user-defined software filter to reject the low frequency spectrum.
   d. Several “traces” of the intrinsic jitter are recorded. The peak-to-peak extremes of the signal are monitored to yield the required measurement of peak-to-peak and RMS jitter.



Jitter Generation Measurements with No Clock Output Signal

If only a data signal is available from the DUT, it would first need to pass through a clock recovery scheme which would not add a significant amount of jitter while extracting a clock signal. This clock recovery scheme would also need to have a jitter transfer function that was flat over the spectrum of interest so as not to degrade the measurement results.

Jitter Generation and Output Jitter Measurement Accuracy

The factors which dominate jitter measurement accuracy are the jitter of the test system itself and its ability to accurately characterize jitter "noise" signals. Test system jitter is dictated to a large extent by the clock source used to time the pattern generator. This then sets a minimum or baseline level of jitter that can be measured. The uncertainty in making intrinsic jitter measurements, not accounting for the baseline jitter is ±10% of the measured value. Therefore, measurement uncertainty is ±10% + baseline.

Jitter Generation and Output Jitter Sensitivity Modes

The 71501D can measure jitter generation and output jitter in two sensitivity modes; high-sensitivity mode and normal mode. The high-sensitivity mode allows you to make measurements with a lower noise floor. For example:

High-sensitivity mode at 10 Gb/s has 0.02 UI peak-to-peak

Normal-sensitivity mode at 10 Gb/s has 0.08 UI peak-to-peak

The high-sensitivity mode is automatically selected when the following conditions exist:

- ❒ N1015A test set with a 10 GHz modulator is in the equipment configuration
- ❒ Clock source frequency is set in the range of 9.8 to 13 GHz
- ❒ Input and output clock rates are the same
- ❒ MUX/DEMUX is set to OFF

If any of the above conditions is not met, the normal-sensitivity mode is selected.

When the 71501D is in the high-sensitivity mode, the measurement algorithm measures the difference in phase between the clock source (70820A channel 2) and the DUT clock output (70820A channel 1). When you start the measurement, a search algorithm first attempts to line up the clock phase between the two channels, then the jitter measurement is made. This search might fail if the jitter is too large or the DUT clock phase is drifting. In this case, the analyzer will automatically revert to the normal-sensitivity measurement mode.

When the 71501D is in the normal-sensitivity mode, the DUT jitter is measured with the 70820A channel 1. The 70820A channel 2 is not used. In the normal mode, the measurement is insensitive to slow phase drifts and can tolerate larger amounts of total jitter.

Jitter Diagnostic Capabilities

For diagnostic purposes, the Agilent 71501D has the ability to display the demodulated or “base-band” jitter spectrum and waveform of a phase modulated clock signal. Also, similar to using a high-frequency spectrum analyzer and high-speed oscilloscope, the clock spectrum and waveform can be displayed.

For troubleshooting purposes, the system can provide data signals with arbitrary jitter magnitudes and frequencies. For example, if a data stream with 2UI of jitter at 15 kHz is desired, enter in these values and the system will automatically produce the desired signal.

Analyzer System Configuration and Setup

This section has information on some aspects of configuring the jitter system and setting up the measurement conditions.

Loading the Jitter Personality

Automatically Loading the Personality

1 Set up the system equipment.

2 Insert the jitter personality card into the front-panel card slot of the microwave transition analyzer, facing the metal strip on the card downward and toward the instrument. Make sure the card is fully inserted into the card slot.

3 Switch on the power to all of the equipment. Switch on the power to the 70820A last. The start up process takes about 6 minutes.

Note

If you reconfigure the equipment after the jitter personality has been loaded, refer to "Rescan the Equipment after Reconfiguring" on page 4-19.

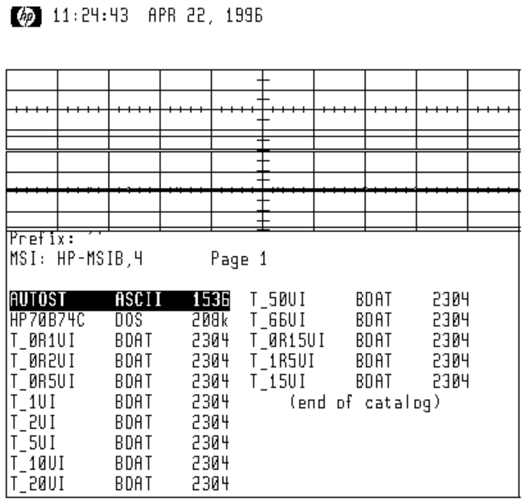
Manually Loading the Personality

1 Assign the display to the 70820A.

2 Verify the jitter program card is fully inserted into the card slot and then press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage*

The display should show a listing of the files on the memory card.



Example Listing of Memory Card Files

3 If the screen does not resemble the above figure, press:

msi, HP-MSIB CARD

DISPLAY, Mass Storage, msi, MEMORY CARD

MENU

The list of files should now be displayed.

4 Turn the front-panel knob to highlight the file "`AUTOST`".

5 Load the highlighted file by pressing:

LOAD FILE

If you load the "`HP70874B` file by mistake, instead of "`AUTOST`", the message "`7386 memory overflow`" may be displayed. This error message is a result of the manual loading process and, in this instance, does not indicate a problem. The program should still be properly loaded.

Rescan the Equipment after Reconfiguring

If you have changed the equipment in the system, you can perform the following procedure so that the analyzer rescans the GPIB and MSIB instruments.

1. On the 70820A, press **USER**, *Templat Storage, VERSION & CONFIG.*

   The list of instruments in the current configuration is displayed on the screen.

2. Press RE-CONFIG to rescan the GPIB and MSIB instruments.
3. *Press CONT* to return to the main menu.

Bandpass Filters

Narrow bandpass filters are generally used at each of the microwave transition analyzer inputs. The filters establish the upper frequency limit on the measurement band for jitter generation and output jitter and attenuate noise, harmonics, and other spurious signals which might interfere with sinusoidal jitter measurement. Both jitter tolerance and jitter transfer measurement benefit from the presence of these filters. Bandpass filters are available for 155 Mb/s, 622 Mb/s, 2488 Mb/s, 2666 Mb/s, 9953 Mb/s, 10.66423 Gb/s, 10.7092 Gb/s, and 12.4416 Gb/s. Low pass filters are available for 800 MHz, 1.5 GHz, 4.0 GHz, and 12.4 GHz.

Filter Characteristics

Pass bandwidth	± 0.8% of center frequency
Passband ripple	± 0.1 dB max
Passband flatness	± 0.5 dB max
Passband return loss	20 dB min
Insertion loss	< 3 dB (typically 1.5 dB)
Stopband attenuation	> 20 dB farther than 1.6% of center frequency from center > 30 dB farther than 2.4% of center frequency from center: to DC on the low frequency side, to at least 3 times center frequency on high frequency side.

If you use purchased filters when performing tests with signals at rates other than those for which filters are supplied, ensure the filters have characteristics similar to those described above.

The RLC corporation is one possible source for custom filter designs. Their address is:

RLC Electronic
83 Radio Circle
Mt. Kisco, NY 10549

Phone: (914) 241-1334

Fax: (914) 241-1753

Note It may be necessary to cascade a low-pass filter (3 or 4 GHz) with the bandpass filter if the bandpass filter has spurious passbands at frequencies where the clock signal has significant harmonic content.

For jitter transfer measurements, best results will be obtained when filters are used on both 70820A microwave transition analyzer input channels, and when the filters are closely matched. When jittered clock signal bandwidths exceed about 10 MHz, the application measures the power in the first pair of sidebands. If the two filters differ in attenuation at the jitter frequency, measurement error is increased. For narrower jittered clock signals, it is group delay mismatch between the two filters which increases the measurement error.

Creating and Editing Templates

There may be times when you need to measure a device with a different frequency range or jitter level than is available through a standard template. For example if, to accurately characterize the jitter transfer function, you may need to perform an analysis over a frequency range that is narrower than that provided by the default test setup. You can achieve this characterization by generating a custom template to define the test over the region of interest. For instance, if the jitter transfer function exhibits some peaking, you can alter the test to zoom in on the region of peaking.

This section includes information on:

- Loading a template
- Saving a template
- Creating a custom template
- Using data rates other than 155 Mb/s, 622 Mb/s, 2488 Mb/s, or 9953 Mb/s
- Creating custom jitter transfer specifications

To Load a Previously Saved Template

1. Insert the memory card containing the desired template (and possible calibration files) into the 70820A card slot.
2. Retrieve and load a previously saved custom template by pressing:

   USER, *Templat Storage*

   After the analyzer reads the card, a catalog of the jitter analyzer measurement files on the card will be shown. The prefix “T_” identifies jitter analyzer measurement files.
3. Select a file by pressing: *Select*.
4. Use the front panel knob or step keys to highlight the desired file, then press: LOAD TEMPLAT

   The highlighted file and any associated calibration data and test parameters will be loaded.

To Save a Template

1. Insert a formatted memory card into the card slot of the 70820A. Refer to "To Initialize (format) a Memory Card" on page 4-42.
2. Save the template (and any associated calibration data) by pressing:

   USER, Templat Storage, typing aids

3. Use the alpha-numeric typing aids, knob, and SELECT CHAR function or an external keyboard to enter a filename (eight characters maximum), and then press:

   ENTER LINE, SAVE TEMPLAT

   To identify jitter analyzer files, the prefix "T_" is added to the eight-character filename.

To Create a Custom Template

1. To modify a standard template, select the template to be modified by pressing:

   Setup, *INtmplt*, *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*, *edit template*

2. The selected template values are displayed in two data columns. The left column displays the frequency points to be tested. The right column displays the jitter test levels for each frequency point.
3. To modify a value, first select it by pressing:

   Select

4. Use the knob or step keys to highlight the value to be modified. The numeric keypad can also be used to select a value to be modified.

   The integer portion specifies the row number:

   - A fractional part less than 0.5 selects the jitter frequency column.
   - A fractional part equal to or greater than 0.5 selects the jitter amplitude (UI_{p-p}) column.

5 Change the selected value by pressing:

Edit

Use the numeric keypad, step keys or knob to alter the value. For example, to change the seventh jitter value (row 7, column 2) to 4 UI, press:

Select, 7.5 *ENTER*, *Edit* 4, ENTER

You can edit other values by following the same procedure. Be sure to press *Select* prior to editing another value, otherwise the last value edited will still be selected and may be unintentionally modified.

6 A template can contain a maximum of 28 test points. If the template already has 28 test points, you will have to delete a test point before adding a new one. Highlight the test point to be deleted by pressing:

Select, row, ENTER, *Delete*

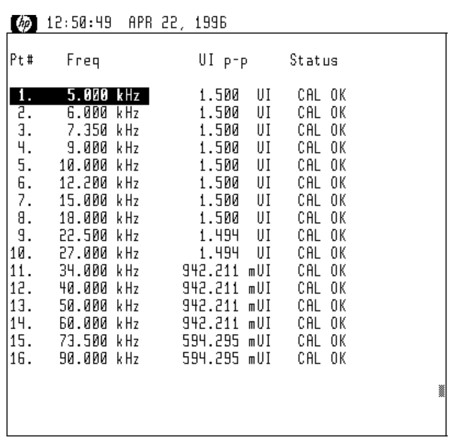
If you delete the last line on the current page, select the previous line before pressing *Delete* again.

7 Add a new jitter test point by selecting the frequency test point closest, but less than or equal to, the value to be added by pressing:

Add

A new test point, identical to the one selected, will be added beneath it. The new point can be edited using the procedure described earlier in Step 3.

Jitter frequencies cannot be entered in decreasing order.


12:50:49 APR 22, 1996

Pt#	Freq	UI p-p	Status
1.	5.000 kHz	1.500 UI	CAL OK
2.	6.000 kHz	1.500 UI	CAL OK
3.	7.350 kHz	1.500 UI	CAL OK
4.	9.000 kHz	1.500 UI	CAL OK
5.	10.000 kHz	1.500 UI	CAL OK
6.	12.200 kHz	1.500 UI	CAL OK
7.	15.000 kHz	1.500 UI	CAL OK
8.	18.000 kHz	1.500 UI	CAL OK
9.	22.500 kHz	1.494 UI	CAL OK
10.	27.000 kHz	1.494 UI	CAL OK
11.	34.000 kHz	942.211 mUI	CAL OK
12.	40.000 kHz	942.211 mUI	CAL OK
13.	50.000 kHz	942.211 mUI	CAL OK
14.	60.000 kHz	942.211 mUI	CAL OK
15.	73.500 kHz	594.295 mUI	CAL OK
16.	90.000 kHz	594.295 mUI	CAL OK

Example Custom Template, after Calibration

If requested jitter levels lie outside system capabilities (either too high or too low), the analyzer will force the jitter level template values to be within system capabilities. Refer to "Specifications and Characteristics" on page 6-1 for additional information.

8 After creating a template, perform a calibration to ensure the desired levels are being achieved.

9 Save the template and calibration information. Refer to "To Save a File" on page 4-45.

To Use Different Input/Output Data Rates

1 If the device input data rate and output data rate are different, you must set the analyzer in the MUX/DEMUX mode by pressing:

Setup, MUX/DMX ON OFF ON, *OUTrate*

OUTclk FREQ, data rate

The *OUTclk FREQ* softkey allows you to enter any non-standard clock rate for the output of the DUT. The output data rate is not limited by the clock source instrument frequency range, but may be any value up to 40 GHz less the maximum modulation frequency.

n the `MUX/DEMUX` mode, jitter generation and output jitter are measured on Input 1 of the 70820A at the output clock frequency.

Jitter transfer measurements are scaled by the ratio of the input clock frequency to the output clock frequency. This ensures the reported jitter transfer value is 0 dB for a perfect frequency multiplier or divider.

Note Input and output rates do not need to be harmonically related.

The jitter analyzer assumes the device-under-test input clock signal at input 2 of the 70820A is the same as the clock source frequency. That is, at the same frequency as the Inclk FREQ value. The path between the clock source and input 2 of the 70820A cannot include any frequency dividers, multipliers, or translators. The signal at input 1 of the 70820A should be the same as the *OUTrate* value. Use appropriate bandpass filters on both inputs of the 70820A.

When measurements are made at low jitter modulation frequencies, and when the measurements are made in the time domain, the specified clock rate must be accurate.

For example, if 2 UI is to be measured to within 0.1 UI at 10 Hz, the clock frequency must be entered accurately to within 2 x 0.1 x 10= 2 Hz. This required frequency accuracy also mandates that the 70820A and clock source instruments have their 10 MHz frequency references locked together.

Making measurements with bandpass filters provides the greatest accuracy.

If a template has previously been selected, this template will be used at the new rate.

2 Perform a calibration before making measurements. "Step 4. Perform a Calibration" on page 2-16.

To Create Templates for Data Rates Other than 155 Mb/s, 622 Mb/s, 2488 Mb/s, or 9953 Mb/s

1 Select the template closest to your desired clock frequency by pressing:

Setup, *INtmplt*, *OC-192*, *OC-48*, *OC-12*, *OC-3*, or *sdh*, *CLOCK FREQ*

When the *sdh* softkey is selected, the key choices will be standard rates *STM-64*, *STM-16, STM-4, and STM-1*. The initial selection will be the SDH standard at the same clock rate as the previously selected SONET standard.

2 Follow the procedure described in "To Create a Custom Jitter Transfer Specification" on page 4-26.

3 Calibrate the system.

4 Save the template using the procedure described in "To Save a File" on page 4-45.

To Create a Custom Jitter Transfer Specification

For margin testing, or to create a custom specification, you can set the magnitude and the location of the corner frequency of the specification limit. The 71501D enables you to customize the jitter transfer specification by adjusting the corner roll-off frequency and the magnitude of the jitter gain (the height of the mask before the corner frequency).

- Change the corner roll-off frequency of the specification by pressing:

  Jitter Trnsfer, CORNER FREQ

  Use the knob, step keys or keypad to adjust the roll-off. Values between 5.0 Hz and 20.0 MHz are allowed.

- Change the magnitude (height) of the transfer specification by pressing:

  Jitter Trnsfer, Gain Amplitude

  Use the knob, step keys or keypad to adjust the roll-off. Values between +15 dB and –30 dB are allowed. The default is 0.1 dB.

To Restore the Factory Instrument Preset

Restore the factory instrument preset by pressing:

MENU > *page 1 of 2* > *States* > *more 1 of 2* > *preset: FAC|USR* FAC

Calibrating the Analyzer

This section explains the calibration for the 71501D system setup that you should perform before making jitter transfer and tolerance measurements. The 70820A instrument calibrations and corrections are also explained.

Agilent 71501D System Calibration for Jitter Transfer or Tolerance Measurements

If you choose a template that exceeds the modulation capabilities of the clock source, the system will adjust the template to modulation levels that are compatible with the source. For example, the minimum modulation rate of the 83752A is about 300 Hz. The templates for 155 Mb/s and 622 Mb/s start below 300 Hz. The 71501D will not attempt to operate the 83752A below 300 Hz. In this case, the starting point of the template will be adjusted to 316 Hz. If a template is loaded containing points at jitter frequencies outside the capability of the clock source, these points will be skipped during calibration. When viewed in the template editor, these points will show the status as SKIPPED. Rather than editing the values on these lines, delete them and add new lines at frequencies within the clock source modulation frequency range. Refer to “Specifications and Characteristics” on page 6-1. The magnitude of the jitter amplitude may be limited due to the data rate. If the level you entered exceeds system capability, the analyzer automatically sets it to the highest attainable level.

System Calibration

1 Load a standard or custom template as described in “Step 3. Select Template and Measurement Conditions” on page 2-13 or “To Load a Previously Saved Template” on page 4-21.

2 Calibrate the system by pressing:

Setup, CAL

The system determines the exact settings for the 33250A so the jitter levels required by the selected template can be generated. If the template was saved with calibration data, it is automatically loaded with the template and no calibration is required.

CAUTION

If the clock frequency, the template values, or the clock source are changed, a new calibration must be performed.

Error Messages

- If the clock signal is not connected to input 2 of the 70820A, or if the modulation signal is not connected to the clock source, errors will occur when a calibration is attempted.
- During calibration, several types of error or warning messages can appear on the display. If either of the following two messages appear, the input signal to the indicated channel of the 70820A is too large. To correct the condition, reduce the signal and restart the calibration.

  Error 6211, channel 1 hardware overrange
  Error 6212, channel 2 hardware overrange

  Error messages 480 and 490 can also appear. These errors normally indicate a condition that does not need to be corrected. The calibration routine automatically corrects these conditions as they occur.

  Error 480, Vco fll ool transient error.
  Error 490, Nf pll ool transient error.

- Some modulation frequencies, for example jitter, produce spurious sidebands on the output signal from some clock sources. These sidebands may cause measurement or calibration errors:

  70311A Option H08 modulation frequencies within 40 kHz of an integer multiple of 200 kHz

  83752 Modulation frequency near 3.98 MHz

- When the 33250A output voltage and frequency are changed, a switching transient can cause the clock source frequency synthesizer to momentarily unlock. The jitter application ensures that phase lock is re-established before proceeding with a measurement. It also clears the error condition reported by the clock source. However, sometimes an error message is displayed, such as, on the 70340A:

  ```
  712 slave at 0,23. Frequency loop went out of lock.
  ```

  Or the ERR LED on the 70311A Option H08 may light.

Agilent 70820A Instrument Calibration

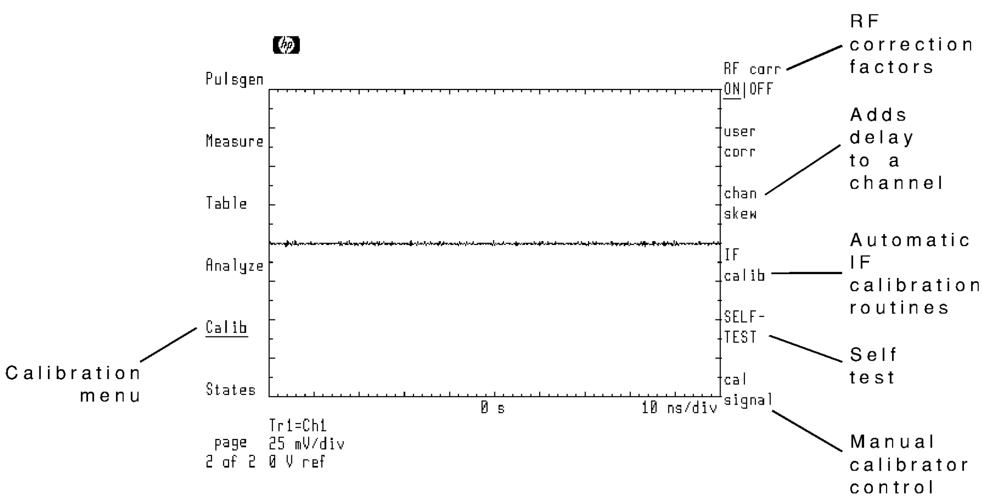
You should perform a weekly calibration on the 70820A.

To access features available in the 70820A menus, press MENU.

Use the Calibration menu to perform the following tasks:

- Calibrate the IF
- Match delay between channels
- Initiate an instrument self-test routine
- Turn off RF correction
- Verify the calibrator signal

Calibration Menu



The Calibration Menu

Calibrating the IF

The microwave transition analyzer module provides separate automatic IF calibration routines for channel 1 and channel 2. Each requires approximately 30 minutes to run. For optimum performance, you should perform the calibrations when at least one of the following is true:

- The temperature has changed ±5° Centigrade since the last calibration was performed
- More than one week has passed since the last calibration
- Before any critical measurement

To Calibrate the IF

1. Warm up time Allow the microwave transition analyzer module to warm up for at least one hour before performing a calibration.
2. Connect a low-loss cable between the front-panel CALIBRATOR OUTPUT and channel 1 connector.
3. To calibrate the IF, press:

   MENU, *page 1 of 2, Calib, IF calib, CAL CH1, CAL CH1*

   The calibration routine takes about 30 minutes to complete.
4. Disconnect the cable from channel 1, and connect it to the channel 2 connector.
5. Repeat the previous steps for channel 2.

Turning Off RF Correction

The microwave transition analyzer module applies RF correction factors to all measurements. These correction factors are loaded into nonvolatile memory at the factory . You can prevent the use of RF correction factors during measurements.

To Turn Off RF Correction

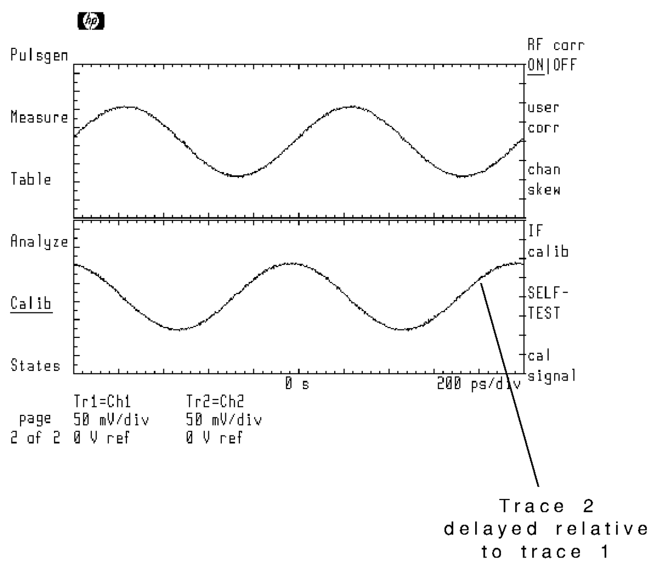
Turn off RF correction by pressing:

MENU, *page 1 of 2, Calib, RF corr ON|OFF* OFF

Match Delay Between Channels

Significant delays can occur between the signals on channel 1 and channel 2 when the electrical lengths of external cabling varies. This results in a phase offset between the two channels. The microwave transition analyzer module offers the capability to add delay to either channel 1 or channel 2.

The following figure shows added delay on channel 2.



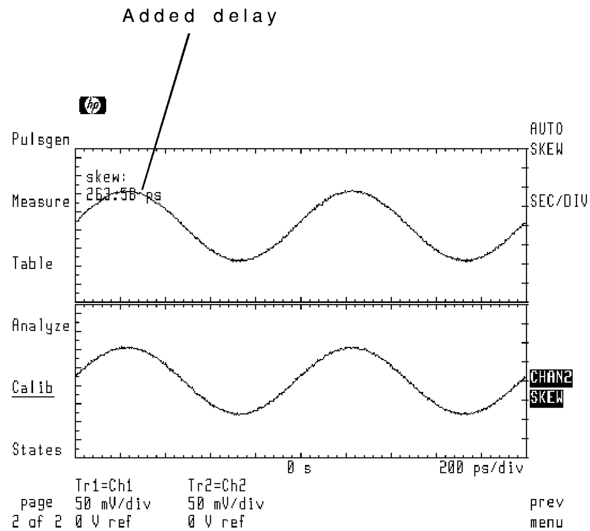
Use the AUTO SKEW softkey to automatically compensate the delay on channel 2. Automatic skewing assumes two equal phase signals input to channels 1 and 2. If measurements are to be performed at multiple frequencies, it is recommended that the AUTO SKEW function be performed first at a low frequency and then at higher frequencies to ensure better resolution.

Delay can be manually compensated using the CHAN2 SKEW softkey. For convenience, the SEC/DIV softkey is provided so that the time scale can be changed.

To Delay a Channel

Automatically compensate channel 2 by pressing:

MENU, *page 1 of 2, Calib, chan skew, AUTO SKEW*



Example of Trace 2 Delay Compensated

View the Calibration Data

1 Display the Traces menu by pressing:

MENU, *Traces*

2 To make viewing the calibration date easier, turn all displayed traces off by pressing:

select: display ON OFF OFF

3 Continue by pressing:

MENU, *page 1 of 2, Calib, IF calib, cal debug, show*

- If you want to view channel 1 data, press:

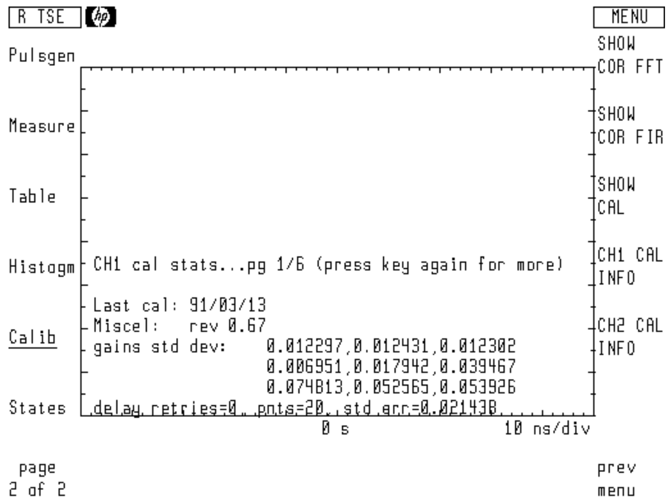
  CH1 CAL INFO

- If yo want to view channel 2 data, press:

  CH2 CAL INFO

4 To view additional pages of information, continue pressing:

CH1 CAL INFO or *CH2 CAL INFO*



Example of Calibration Data

Viewing the IF Calibration Data Traces

The ability to view the IF calibration data is mainly intended for service purposes.

IF Correction Data Traces

1. Display the Traces menu by pressing:

   MENU, *Traces*

2. Turn on both trace 1 and trace 2. Set the input to trace 1 as channel 1. Set the input to trace 2 as channel 2.

3. Display the IF correction data for each channel by pressing:

   page 1 of 2, Calib, IF calib, cal debug, show

   SHOW COR FFT or *SHOW COR FIR*

4. Scale the traces by pressing:

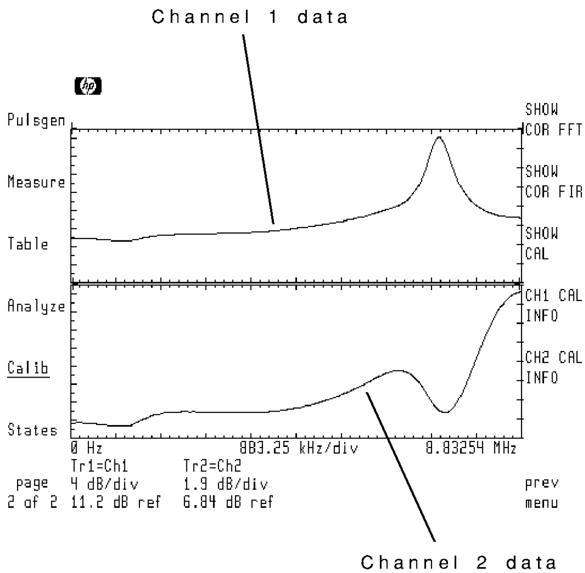
   page 2 of 2, Scale

5 Select trace 1, and press:

AUTOSCALE

6 Select trace 2, and press:

AUTOSCALE



Example of IF Calibration Data Traces

Hardware Response Traces

1 Display the traces menu by pressing:

MENU, *Traces*

2 Turn on both trace 1 and trace 2. Set the input to trace 1 as channel 1. Set the input to trace 2 to channel 2.

3 Display the 100 kHz filter response of stage 0 by pressing:

page 1 of 2, Calib, IF calib, cal debug, show, SHOW CAL

4 Scale the traces by pressing:

page 2 of 2, Scale

5 Select trace 1, and press:

AUTOSCALE

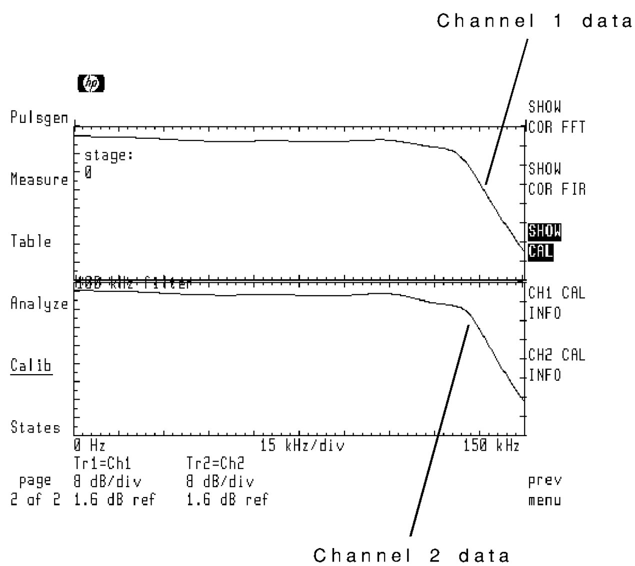
6 Select trace 2, and press:

AUTOSCALE

7 To display the various hardware responses, press:

page 1 of 2, SHOW CAL

Use the front-panel step keys to scroll through the various hardware responses.



Example of Hardware Response Traces

Performing a Self-Test

You can initiate an automatic self-test routine that checks the internal condition of all major circuits. The self-test takes approximately 30 seconds to run. (This routine automatically runs whenever the microwave transition analyzer is turned on.)

Perform the self-test by pressing: **MENU,** *page 1 of 2, Calib, SELF-TEST*

Controlling the Calibrator Signal

For verification purposes, the Calibrator Output signal can be manually controlled. This includes changing its amplitude and frequency. The signal has the following characteristics:

Shape	square wave
Frequency	153 Hz to 5 MHz
Amplitude	5 positions

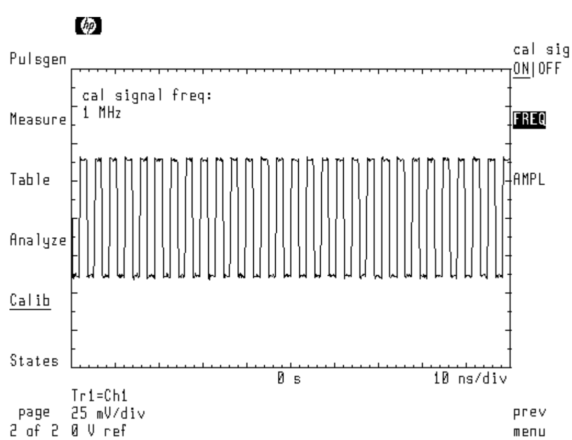
The signal's amplitude can be set to one of five positions: 0 through 4. Zero represents the smallest available amplitude. Four represents the largest amplitude. These settings do not correlate to any specific amplitude and may vary between instruments.

1 To turn the calibrator signal on, press:

MENU, *page 1 of 2, Calib, cal signal, cal sig ON|OFF* ON

2 To change the calibrator frequency and amplitude, press:

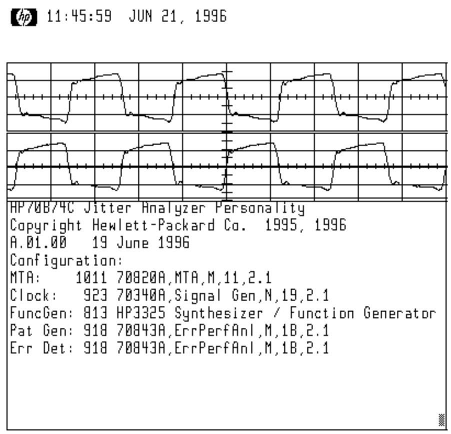
MENU, *Calib, cal signal, FREQ,* (156 Hz–5 MHz), *AMPL,* (0–4)



To Display the Program Version and Hardware Configuration

To display the jitter analyzer personality code version, date and hardware configuration, press:

USER, *Template Storage, VERSION & CONFIG*



Pressing *RE-CONFIG* initiates a search for system instruments on GPIB and MSIB. If more than one clock source is present, such as a modular clock source and an external clock source, you can select the one to be used. Press *CONT* to return to the Template Storage menu.

Memory Cards, Disks, and RAM

This section documents features available with the 70820A menus. To access these menus, press MENU. If the eye diagram analyzer personality (or jitter analyzer personality) is loaded, you can return to the eye diagram (or jitter) menus by pressing USER.

The 70820A menus provide the ability to store data as files on the following media:

- Memory cards
- GPIB disk drive
- Internal random-access memory (RAM) disk

Learning how to manage this memory is essential to obtaining the most benefit from your system. Memory cards are inserted into the front-panel card slot. RAM disks can be used as temporary storage for copying the contents of one memory card to another memory card.

The following list shows the types of data that can be saved as files:

- traces
- measurement states
- histograms
- masks
- limit lines
- calibrations
- user corrections
- user menus
- downloadable programs (DLPs)
- jitter template and calibration files

Selecting and Formatting Memory

When first turned on, the microwave transition analyzer module automatically selects the memory card as the mass-storage device. You can format memory and save, recall, erase, and list (catalog) files using the mass-storage menu located in the States menu.

RAM Disks

RAM disks offer a convenient method of duplicating memory cards. Refer to "To duplicate a memory card" in this section. Up to 16 internal RAM disks can be created. (These are numbered 0 through 15.) The default size of each RAM disk is 32 kilobytes.

Use Instrument BASIC's INITIALIZE statement to create each disk. The following example creates RAM disk zero:

```
INITIALIZE ":MEMORY,0,0",128
```

The second integer, 0, determines the RAM disk number. The value 128 represents the size of the RAM disk in sectors. Each sector consists of 256 bytes. So, a value of 128 sectors creates a RAM disk of 32 kilobytes. A value of 512 sectors creates a RAM disk of 128 kilobytes.

Use the following command to create RAM disk 1 with a size of 128 kilobytes:

```
INITIALIZE ":MEMORY,0,1",512
```

RAM is volatile

Because internal RAM is volatile, all RAM disks are deleted when the power is turned off. When this happens, all files are lost and each RAM disk must be recreated.

To Use an Internal RAM Disk

1 To invoke Instrument BASIC, press:

USER

If the eye diagram personality is loaded, press USER again.

2 Enter an `INITIALIZE` statement to create a RAM disk. For example, enter the following BASIC statement:

```
INITIALIZE ":MEMORY,0,0",128
```

3 Select the internal RAM disk by pressing:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, msi: MEMORY*

The RAM disk number is shown on the screen. Use the front-panel knob to change the RAM disk number.

GPIB Disk Drives

Measurement data and files can be saved on an external GPIB disk drive. The disk drive must be a 3.5 inch, CS80 compatible, such as an 9122. To use the drive, you must connect it and enter its GPIB address using DISPLAY menu softkeys. The procedure in this section shows you how to do this. You will need to know the disk drive's GPIB address, unit number, and volume number.

The GPIB address is represented by a digit from 1 through 7. The unit number indicates an individual slot in the disk drive. Although unit numbers can range from 0 through 9, they are typically 0 or 1. The volume number is used for hard disk drives. For reading diskettes, the volume number should be 0.

To Use an GPIB Disk Drive

1 Connect the GPIB disk drive to the 70004A color display using an GPIB cable.

2 Determine or set the GPIB address of the disk drive. Refer to the disk drive's user's manual for information on determining the disk drive's address.

3 Set the GPIB address of the disk drive by pressing:

DISPLAY, *Mass Storage, msi: GPIB disk, GPIB ADDRESS*
enter the address of the disk drive

This value is between 1 and 7.

4 Enter the disk drive's unit number by pressing:

UNIT NUMBER

This number is typically a 0 or 1. Zero usually indicates the disk drive's left side slot.

5 Enter the disk drive's volume number by pressing:

VOLUME NUMBER

The volume number should be left at the default value of zero for floppy disk drives.

6 Continue by pressing:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, msi: MSIB CARD*

Although CARD is selected, the display's GPIB disk softkey, pressed in Step 3 , redirected communications to the GPIB disk drive.

Memory Cards

Memory cards must be formatted before use. Formatting erases any previously stored files and initializes memory for storing data. Refer to “To Initialize (format) a Memory Card” on page 4-42. RAM memory cards have a built-in battery to retain memory data. Data stored in the card remain as long as the card’s battery has sufficient power. You should change the battery every two years using the procedure in this section. Refer to “To Change a Memory Card Battery” on page 4-42.

Error Message: catalog open failed.

If no card is inserted in the front-panel card slot, and you attempt to catalog a memory card, the display shows the message catalog open failed. Place a card in the card slot, and retry the operation. The HP-MSIB address for the card is the same address as the display’s GPIB address and is normally set to 4. If the address is not correct, enter the correct address using the numeric keypad.

Memory Card Write-Protect Switch

Memory cards have a write-protect switch, on the end which is not inserted into the display’s card slot. If this switch is slid toward the edge of the card (marked "SAFE"), no changes may be made to the card’s content. If you wish to write a new file to a card, or remove a file, slide its write-protect switch toward the center of the card.

To Use a Memory Card

1. Locate the arrow printed on one end of the card.
2. Insert the card with the arrow facing up into the front-panel card slot. The card’s arrow should match the arrow printed above the card slot.
3. Select the memory card as the mass storage device by pressing:

   DISPLAY, *Mass Storage, msi: MEMORY CARD*

4. To display a catalog of the files on the memory card, press:

   MENU, *page 1 of 2, States, more 1 of 2, mass storage, msi: MSIB CARD*

To Initialize (format) a Memory Card

CAUTION The following steps erase any files stored on the card.

5 If the memory card is new and needs to be formatted, press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, more, FORMAT*

6 To use the LIF format, press:

FORMAT as LIF

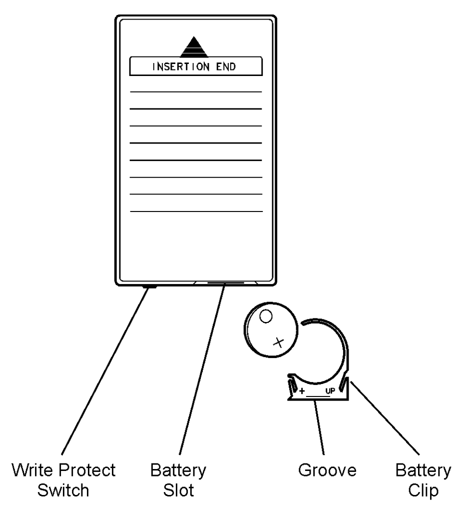
7 To format as DOS, press:

FORMAT as DOS

To Change a Memory Card Battery

The memory card battery is a lithium commercial CMOS type, part number CR 2016.

CAUTION The memory card should be installed when the battery is removed. If the battery is removed while the card is not installed, all data in the card will be lost. Store memory-card files on another device before changing the battery, when extra care is appropriate.



1. Install the memory card into the 70004A display.
2. On the front edge of the card, locate the groove of the battery clip.
3. Gently pry the battery clip out of the card. The battery fits inside the clip.
4. Replace the battery, making sure the plus (+) sign on the battery is on the same side as the plus sign on the clip.
5. Insert the battery clip into the memory card, holding the clip as oriented in the figure. (Face the open edge of the clip toward the memory card's write-protect switch.)
6. Write the date the battery was replaced on the card.

To Duplicate a Memory Card

Instrument BASIC provides the ability to mass copy all the files from one memory card to another memory card. This allows you to easily reproduce copies without having to copy the files one at a time. Use the following steps:

1. Refer to "To Use a Memory Card" on page 4-41 to select the memory card for use.
2. Insert the memory card with the files into the front-panel card slot.
3. Press USER. (If the eye diagram analyzer personality is loaded, press USER twice.)
4. Use a keyboard to enter the following Instrument BASIC commands. These commands initialize a RAM disk and copy the files from the card to the RAM disk. If you don't have a keyboard, Instrument BASIC has an editor for creating these commands.

   ```
   INITIALIZE ":MEMORY,0,0"
   WILDCARDS DOS
   COPY "*" TO ":MEMORY,0,0"
   ```

5. Remove the card from the card slot and insert a blank formatted card in the slot.
6. Issue the following Instrument BASIC command to copy the files from the RAM disk to the new card:

   ```
   COPY "*:MEMORY,0,0" TO ":EXTERNAL,904"
   ```

Measurement Setup and Results Storage

Files are identified by a prefix and a name. The eye diagram analyzer assigns a prefix according to the type of data, as shown in the following table. You enter the file name. When cataloged, the file listings show the file's data type and size in bytes.

File Prefixes

File Type	File Prefix
Calibration data	c_
Histograms	h_
Instrument registers	r_
Instrument state	s_
Mask/Limit line	m_
Program	d_
Trace	t_
User corrections	a_
User menu	k_
Jitter template	T-

Filenames

You can create additional prefix text for your file names. The text, appended to the standard prefixes, allows you to indicate files that have similar data. For example, you may want to only see a catalog of mask files.

Each filename has the additional prefix of "Shape." The prefix appears, regardless of the type of file you are saving.

The total length of your filename cannot exceed 10 characters for LIF and 8 characters for DOS. This includes prefix and filename.

To Catalog all Files

Use this procedure to catalog default memory. To select default memory, refer to "Selecting and Formatting Memory" on page 4-39.

1 If you plan to catalog the files on a memory card, insert the card in the front-panel card slot.

2 Display a catalog of the files by pressing:

MENU, *page 1 of 2, States, more 1 of 2, mass storage*

Remember to insert the card before cataloging a memory card. If the message "`6218 catalog open failed`" is displayed, the card is missing. The HP-MSIB address for the card is the same address as the display's GPIB address and is normally set to 4. If the address is not correct, enter the correct address using the numeric keypad.

To Save a File

Use this procedure to save a file in the default memory. To select default memory, refer to "Selecting and Formatting Memory" on page 4-39.

1 Display the Mass Storage menu by pressing:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, save*

2 Perform one of the following:

- If you are saving an instrument state, user-correction, or histogram, press the appropriate softkey.
- If you are saving a trace, press save trace. Select the trace and then use the VEC|FMT softkey to determine if the trace data is saved as complex data (VEC) or scalar data (FMT). Press save.
- If you are saving a channel calibration, mask, limit line, user-defined key, all recall registers, press save misc and then the appropriate softkey.

3 Enter the desired file name.

4 To save the file, press:

ENTER LINE

Agilent recommends using a keyboard

An HP-IL keyboard is recommended to simplify the task of entering alphanumeric information. This keyboard plugs into the jack provided on the display's front panel. Order the keyboard using the following part numbers:

Keyboard	Agilent 46021A
HP-IL cable	pn 46020-60001

Entering a file name without a keyboard

- Turn the front-panel knob to move the character-select cursor.
- Press SELECT CHAR to enter a character at the character-select cursor.
- Press the numeric keypad to enter numbers or a minus sign.
- The INSERT or softkey determines the action of the SELECT CHAR softkey. Choices are INSERT a character, REPLACE an existing character, or DELETE a character.
- Press the ⇑ and ⇓ keys (beneath the front-panel knob) to move the command-entry cursor.
- Use the CLEAR TO END softkey to remove characters from the command-entry cursor to the end of the command.

To Recall a File

Use this procedure to recall a file from the default memory. To select default memory, refer to "Selecting and Formatting Memory" on page 4-39.

1 To recall a file, press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage*

Rotate the front-panel knob to select (highlight) the desired file.

2 Load the file by pressing:

LOAD FILE

To Erase a File

Use this procedure to erase a file in the default memory. To select default memory, refer to "Selecting and Formatting Memory" on page 4-39.

1 To erase a file, press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage*

Rotate the front-panel knob to select (highlight) the desired file.

2 To erase the file, press: *more, PURGE FILE, ENTER LINE*

To Erase all Files

CAUTION This procedure erases all files stored in default memory.

To erase *all* files in default memory, press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, more, FORMAT*

To Change the Prefix

1 To modify the prefix, press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, more, CHANGE PREFIX*

Enter the desired text.

2 To enter the prefix, press: *ENTER LINE*

Entering the prefix without a keyboard

- Turn the front-panel knob to move the character-select cursor.
- Press SELECT CHAR to enter a character at the character-select cursor.
- Press the numeric keypad to enter numbers or a minus sign.
- The INSERT or ... softkey determines the action of the SELECT CHAR softkey. Choices are INSERT a character, REPLACE an existing character, or DELETE a character.
- Press the ⇑ and ⇓ keys (beneath the front-panel knob) to move the command-entry cursor.
- Use the CLEAR TO END softkey to remove characters from the command-entry cursor to the end of the command.

To Erase a Custom Prefix

1 To erase a custom prefix, press:

MENU, *page 1 of 2, States, more 1 of 2, mass storage, more, CHANGE PREFIX*

Repeatedly press the ⇓ step key until the cursor is located at the start of the custom text.

2 Clear the text by pressing: *CLEAR TO END, ENTER LINE*

Print or Plot Measurement Results

Often, it is important to get hard copies of the display for reports or records. The display can be printed on any Hewlett-Packard graphics printer. These printers support the Hewlett-Packard PCL printer language and include the following:

- ThinkJet
- PaintJet
- LaserJet

The printer must have a GPIB interface.

To Create a Print

1 Connect the printer to the display via a GPIB cable.

Be sure to connect the GPIB to the display's connector, not to the connector on the 70820A microwave transition analyzer module.

2 The first time the printer is used, enter the printer type and address by pressing:

DISPLAY , *Hard Copy, printer address*

GPIB TLK/LSN (to configure the printer in talk/listen mode on the GPIB).

or:

GPIB L ONLY (to configure the printer in listen only mode on the GPIB).

To configure the printer via the MSIB, use the MSIB COLUMN and MSIB ROW softkeys to enter the printer address.

3 To select the type of printer used, press:

← *printer config*

Use the softkeys along the right side of the display to select the printer type.

4 Select the print option by pressing:

← *copy options, COPY IS PRT/PLT* <u>PRT</u>

5 Create the print by pressing: **USER,** *PRINT*

To Create a Plot

1 Connect the plotter to the display via a GPIB cable.

Be sure to connect the GPIB to the display's connector, not to the connector on the 70820A microwave transition analyzer module.

2 The first time the plotter is used, enter the plotter type and address by pressing:

DISPLAY, *Hard Copy, plotter address,*

GPIB TLK/LSN (to configure the plotter in talk/listen mode on the GPIB).

or:

GPIB L ONLY (to configure the plotter in listen only mode on the GPIB).

To configure the plotter via the MSIB, use the *MSIB COLUMN* and *MSIB ROW* softkeys to enter the plotter address.

3 To select the type of plotter used, press:

← *plotter config*

Use the softkeys along the right side of the display to select the plotter type.

4 Select the plot option by pressing:

← *copy options, COPY IS PRT/PLT* PRT

5 Create the plot by pressing:

USER, PLOT

5

Jitter Analyzer Programming

Programming

In this chapter you will find information on the following programming commands:

Introduction

Remote programming commands can be initiated *after*:

- the jitter analyzer program has been loaded
- the instrument configuration has been determined
- the menus and traces have been built
- the instrument is waiting for the user to press a front-panel key.

Before communicating with the jitter application, the Instrument BASIC system must be queried for the name of the program and told we wish to communicate with this program. The following example shows how to do this.

```
OUTPUT Mta;"PROG:CAT?"              !Request list of currently loaded programs
ENTER Mta;Name$                     !There can only be one
OUTPUT Mta;"PROG:NAME ";Name$       !Send program name
```

Use variables to pass commands and data

All commands and strings can be sent in upper, lower, or mixed case. Everything is converted to upper case.

Because the 70874C is an Instrument BASIC program, normal instrument programming techniques are not employed. Instead, program control is achieved by manipulating five 70874C program variables:

Variable Name	Type
Param	numeric or string
Command	string
Response	string
Rpts	two-dimensional numeric array: 28 rows of 4 columns
Rnoise	one-dimensional numeric array: 7 values

Each value returned consists of 19 characters. Values are separated by commas. These variables may be set using the PROG:STRing or PROG:NUMber commands. Their values may be obtained by using the query form: PROG:STRing? or PROG:NUMBer?.

The `Command` string variable directs the 70874C to perform an action.

In some programming languages it is possible to read in the entire Rpts array and pause it later, rather than enter each value separately.

The jitter application checks for the arrival of a command only at the top level in the menu tree. Therefore, it will not see a command if the left-side menus are not visible.

Load the Param variable with a parameter for the selected Command variable string. Because execution begins immediately after Command is loaded, load values into Param and Rpts before setting Command. Param is actually two variables with the same name; one is a string variable—the other is a numeric variable. Therefore, the name Param can be used with both PROG:STRing and PROG:NUMber commands.

After execution of a command, the `Response` string variable contains `DONE`, `ERROR` or another indication of failure. The following program shows how to turn on trace averaging. Notice how the `Param` variable is loaded before the `Command` variable.

```
OUTPUT Mta;"PROG:STR ‘Param’,‘ON’"
OUTPUT Mta;"PROG:STR ‘Command’,‘AVERAGEFLAG’"
```

Use PROG:STR? to read response

The 70874C pauses execution twice after completion of each command. This provides a mechanism for synchronization between the issuance of a command and the retrieval of a response. In your controlling program, use the `PROG:WAIT?` query to determine when the 70874C has paused. Then, retrieve the response using the `PROG:STR?` query. Use `PROG:STATe CONT` to continue program execution. (Notice the lower case letter `e` in `PROG:STATe`. This indicates the letter is optional.)

Before sending the next command or its parameters, wait until the jitter application has cleared the remote programming variables by sending `PROG:WAIT?` a second time, and by sending `PROG:STATe CONT` when the waiting is over.

The following example shows how to return response after a tolerance measurement. Notice that the `TOLERANCE` command does not use the `Param` variable.

```
OUTPUT Mta;"PROG:STR ’Command’,‘TOLERANCE’"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? ’Response’"
ENTER Mta;Response$
!After reading Response, also read Rpts or Rnoise,
!as appropriate for the command used.
OUTPUT Mta;"PROG:STAT CONT"
!Acknowledge receipt of all results.
OUTPUT Mta;"PROG:WAIT?"
!Wait for variables to be cleared.
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
!Now ready for the next command.
```

When the first PROG:STAT CONT is sent, the program sets the string variables `Command`, `Response`, and `Param` to the null string. The program also sets the numeric variables `Param`, `Rpts`, and `Rnoise` to zero. It then `PAUSE`s again. The second PROG:STAT CONT allows the program to continue. To help maintain synchronization between the external program and the Instrument BASIC program, make sure the program is not paused immediately after sending each command:

```
OUTPUT Mta;"PROG:STAT?"
ENTER Mta;Status$
IF Status$="PAUS" THEN OUTPUT Mta;"PROG:STAT CONT"
```

Alternative to PROG:WAIT?

The PROG:WAIT? query freezes the GPIB until the command has completed. If the external program needs to use the GPIB to control other instruments on the bus while the command is in progress, it may periodically check for command completion by using PROG:STAT?.

```
WHILE Curstate$<>"PAUS"
  WAIT 10
  OUTPUT Mta;"PROG:STAT?"
  ENTER Mta;Curstate$
END WHILE                          !Value will be "PAUS" on command complete
```

If this query is made frequently, the execution of the command will be significantly slowed. Wait between sucessive polls.

This method may be useful for programming languages other than Basic.

Sending a GPIB general device clear

Executing a general GPIB device clear to an 70841B pattern generator can cause the GPIB to lock-up. If a remote program needs to clear the bus using an GPIB general device clear command, `CLEAR 7`, the 70841B pattern generator must be on row zero. The remote program must send a specific device clear, such as `CLEAR 718`, to the pattern generator *before* sending the general device clear command. Sending the specific device clear *before* sending a general device clear keeps the bus from locking up.

Instead of sending the specific device clear almost any pattern generator SCPI command, such as `source2:voltage 0.5`, can be sent to the pattern generator. These commands execute as expected *and* prevent the bus from hanging when the remote computer sends a general device clear.

Interaction between the Jitter Application and the Remote Computer

Remote Computer	Jitter Application
	While waiting for a menu key press, frequently checks to see if *`Command`* has become non-NULL.
Set values of *`Param`* (string or numeric), and *`Rpts`*, as required by command to be issued. Set *`Command`*	
	Parse command, fetch parameter values; execute command; *`PAUSE`*
Wait for command completion by using *`PROG:WAIT?`* or *`PROG:STAT?`* When jitter application has paused, read results from *`Response`*, *`Rnoise`*, and *`Rpts`*, as appropriate for the command. Allow jitter application to resume operation by sending *`PROG:STAT CONT`*	
	Clear variables, in order: *`Rnoise`*, *`Rpts`*, *`Response`*, *`Param`* (numeric and string), *`Command`*, *`PAUSE`* It takes about 1 second for all the variables to be cleared after the remote computer sends the first *`PROG:STAT`*
Wait for completion of variable clearing by using *`PROG:WAIT?`* or *`PROG:STAT?`*. Allow jitter application to resume operation by sending *`PROG:STAT CONT`*.	

AVERAGE

The AVERAGE command string sets the number of sweeps to be averaged in a jitter transfer measurement

Values of Program Variables

Variable	Data Type	Value
Command	string	AVERAGE
Param	floating-point number	1 TO 1000
Response	string	DONE or ERROR[a]

a. ERROR is returned if the Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',25"
OUTPUT Mta;"PROG:STR 'Command','AVERAGE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

AVERAGEFLAG

The AVERAGEFLAG command string turns the Average function on or off in a jitter transfer measurement.

Values of Program Variables

Variable	Data Type	Value
Command	string	AVERAGEFLAG
Param	string	ON OFF
Response	string	DONE or ERROR[a]

a. ERROR is returned if the Param is not ON or OFF.

Example

```
OUTPUT Mta;"PROG:STR 'Param','ON'"
OUTPUT Mta;"PROG:STR 'Command','AVERAGEFLAG'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

BERTHRS

The BERTHRS command string sets the error ratio threshold for the jitter tolerance test.

Values of Program Variables

Variable	Data Type	Value
Command	string	BERTHRS
Param	floating-point number	1 to 1E-20
Response	string	DONE or ERROR[a]

a. ERROR is returned if the Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',1E-9"
OUTPUT Mta;"PROG:STR 'Command','BERTHRS'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

CALINP

The CALINP command string calibrates the previously specified input template (refer to the CUSTOM or TEMPLATE commands). A 28-point calibration takes about 3.5 minutes.

A bandpass filter, designed for jitter measurement at the current INCLOCKFREQ, should be in place on the 70820 input 2.

Values of Program Variables

Variable	Data Type	Value
Command	string	CALINP
Param	*There are no parameters for this command*	
Response	string	DONE or ERROR[a]
Rpts	floating-point array of 28 rows and 4 columns	see below

a. ERROR is returned if an input template has not been specified (Refer to 'TEMPLATE" and "CUSTOM" commands).

Result is Rpts array. For each frequency in the template, four values are sent:

- jitter frequency in Hz
- jitter amplitude in unit intervals, peak-to-peak
- modulation synthesizer output voltage, peak-to-peak
- calibration result flag, where:

  1 = cal ok
  –1 = failed (value didn't converge in five iterations)
  –99 = measurement error (algorithm failure, such as, divide by zero)
  –512 = jitter amplitude was changed due to hardware limitations

Example

```
OUTPUT Mta;"PROG:STR 'Command','CALINP'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:NUMB? 'Rpts'"
FOR Point= 1 to 28 !Must ENTER all 28 rows of 4 values
ENTER Mta USING "%,K";Jitfreq,Jitampl,Volts,Flag
```

```
NEXT Point
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

In this example, the values are converted from character string to floating-point numbers as they are received. A program might, instead, read everything into one long string variable and then extract the individual values.

The values are sent 19 characters per value, such as, +1.27778184201E-002, separated by commas.

CUSTOM

The CUSTOM command string defines the custom template.

Values of Program Variables

Variable	Data Type	Value
Command	string	CUSTOM
Rpts	floating-point array of 28 rows and 4 columns	see below
Response	string	DONE or ERROR[a]

a. ERROR is returned if any positive jitter frequency is outside the clock source FM frequency range, or if any jitter amplitude is <0.025 or >100.

Although `Param` is not used for this command, an array of values, Rpts, *must* be sent before sending the command. For each of the 28 points in the template, send:

- jitter frequency, 5 to 20E6 Hz (If the frequency is zero, or negative, the point is skipped without an error.)
- Jitter amplitude, unit intervals, peak-to-peak
- zero
- zero

A template consists of 28 points. If the points are sent with non-decreasing frequency, the template editor can be used to modify them.

Example

```
OUTPUT Mta;"PROG:NUMB 'Rpts'"
FOR Point= 1 to 28 !Must send all 28 rows
OUTPUT Mta;",";Jitfreq(Point);",";Jitampl(Point);",0,0";
NEXT Point
OUTPUT Mta;""
OUTPUT Mta;"PROG:STR 'Command','CUSTOM'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

GAIN

The GAIN command string sets the transfer gain for the jitter transfer measurement.

Values of Program Variables

Variable	Data Type	Value
Command	string	GAIN
Param	floating-point number	–30 to +15 dB
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',10.0"
OUTPUT Mta;"PROG:STR 'Command','GAIN'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

GENERATE

The GENERATE command string measures the jitter generation.

Values of Program Variables

Variable	Data Type	Value
Command	string	GENERATE
Param	*There are no parameters for this command.*	
Response	string	DONE or ABORT[a]
Rnoise	floating-point array of 7 values	see below

a. ABORTed if user presses EXIT key during measurement.

Note

Measurement time is dependent on the device under test and the sensitivity mode used.

The result is a seven value, one-dimensional, numeric array, Rnoise.

- Peak-to-peak jitter, unit intervals
- RMS jitter, unit intervals
- High-pass filter cutoff frequency
- 0
- 0
- 0
- 0=low sensitivity, 1=high sensitivity

Example

```
OUTPUT Mta;"PROG:STR 'Command','GENERATE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:NUMB? 'Rnoise'"
FOR I= 1 to 7 !Must read all 7 values
ENTER Mta USING "%,K";Value(I)
NEXT I
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

GENFC1

The GENFC1 command string sets the corner frequency.

Values of Program Variables

Variable	Data Type	Value
Command	string	GENFC1
Param	floating-point number	10 Hz to 4.5 MHz(10 to 4.5E6 Hz)
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',1000"
OUTPUT Mta;"PROG:STR 'Command','GENFC1'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

GENSWEEPS

The GENSWEEPS command string sets the number of generation sweeps.

Values of Program Variables

Variable	Data Type	Value
Command	string	GENSWEEPS
Param	floating-point number	1 to 1000
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',10"
OUTPUT Mta;"PROG:STR 'Command','GENSWEEPS'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

INCLOCKFREQ

The INCLOCKFREQ command string sets the clock rate for the input of the device under test. Standard clock rates are set when a standard input template is selected.

Values of Program Variables

Variable	Data Type	Value
Command	string	INCLOCKFREQ
Param	floating-point number	see below[a]
Response	string	DONE or ERROR[b]

a. The jitter application allows use of the 70841, 70842, and 70843 down to 1 MHz to accommodate specially ordered instruments which can operate, with some performance degradation, below 100 MHz.

b. ERROR is returned if Param is outside the acceptable value range.

Note

If the 71501D is not operating in the MUX/DEMUX mode, you must set the input clock and the output clock to the same frequencies.

The lowest acceptable *Param* value is the highest of the lower frequency limits of the clock source, pattern generator and error detector.

The highest acceptable *Param* value is the lowest of the upper frequency limits of the clock source, pattern generator and error detector.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',2.48832E9"
OUTPUT Mta;"PROG:STR 'Command','INCLOCKFREQ'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

LOAD_TEMPLATE

The LOAD_TEMPLATE command string loads an input jitter template from the current template storage device, such as, a memory card. If a calibration was performed before saving the template, the calibration will also be recalled. All the parameters listed below are recalled from the template file.

Values of Program Variables

Variable	Data Type	Value
Command	string	LOAD_TEMPLATE
Param	string	*filename* 1 to 10 characters[a]
Response	string	DONE FILE NOT FOUND DISK NOT PRESENT NOT INITIALIZED DISK I/O ERROR # xxx[b]

a. Only filenames beginning with "T_" will be displayed when using the Template Storage function from the front panel. All filenames will be displayed when using the remote PROG:CAT? query.

b. May be caused by illegal characters in the filename.

The characters in the filename are restricted to numbers, letters and the underscore. The first character of the filename must be a letter. All characters in the filename are converted to uppercase.

When using the front-panel Template Storage, Load Template and Save Template functions the prefix "*T_*" is added to the eight character filename entered by the user. When using the remote programming commands the prefix is not added and the user may enter all ten characters. However, only filenames beginning with "*T_*" will be displayed when using the Template Storage function from the front panel. All filenames will be displayed when using the remote PROG:CAT? query.

Example

```
OUTPUT Mta;"PROG:STR 'Param','filename'"
OUTPUT Mta;"PROG:STR 'Command','LOAD_TEMPLATE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

The following parameters are saved and recalled:

- INCLOCKFREQ
- OUTCLOCKFREQ
- TEMPLATE
- (OC-3, OC-12, OC-48, OC-192, STM-1, STM-4, STM-16, STM-64, or custom)
- Calibration valid flag
- Template
  the number of points in the template
  for each point:
    jitter frequency
    jitter amplitude
    jitter modulation source output voltage from calibration
    jitter amplitude adjusted flag from calibration
- Jitter transfer
  AVERAGEFLAG
  AVERAGE (number of sweeps)
  GAIN
  TRANSFER_FC
  limit line type
    (OC-3, OC-12, OC-48, OC-192, STM-1, STM-4, STM-16, STM-64, or OFF)
- Jitter tolerance
  TOLMODE
  BERTHRS
  MARGIN
  margin limits based on calibration
- Jitter generation
  GENFC1
  GENSWEEPS
- Output jitter
  OUTFC1
  OUTFC2
  OUTSWEEPS

The following parameters are *NOT* saved:

- SEARCH ON|OFF
- Search Factor
- Sensitivity mode for jitter generation and output measurements

MARGIN

The MARGIN command string sets the jitter amplitude used in jitter tolerance testing relative to the current template. For example, a margin of 25 sets the jitter amplitude 25% higher than the value specified by the template. A margin of –10 sets it 10% lower than the value specified by the template

Values of Program Variables

Variable	Data Type	Value
Command	string	MARGIN
Param	floating-point number	–99.9 to 500%[a]
Response	string	DONE or ERROR[b]

a. The calibration determines the actual margin range. If no calibration has been performed, the range is –99.9 to 500%.

b. ERROR is returned if Param is outside the allowed range.

Example

```
OUTPUT Mta;"PROG:NUMB ’Param’,25.6"
OUTPUT Mta;"PROG:STR ’Command’,’MARGIN’"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? ’Response’"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

OUTCLOCKFREQ

The OUTCLOCKFREQ command string sets the clock rate for the output of the device under test, if it is different from the input clock rate of the device under test

Values of Program Variables

Variable	Data Type	Value
Command	string	OUTCLOCKFREQ
Param	floating-point number	100E5 to 40E9 Hz
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Note

If the 71501D is not operating in the MUX/DEMUX mode, you must set the input clock and the output clock to the same frequencies.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',2.48832E9"
OUTPUT Mta;"PROG:STR 'Command','OUTCLOCKFREQ'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

OUTFC1

The OUTFC1 command string sets the first measurement's high-pass corner frequency for the jitter output measurement.

Values of Program Variables

Variable	Data Type	Value
Command	string	OUTFC1
Param	floating-point number	10 Hz to 4.5 MHz(10 to 4.5E6 Hz)
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',15.5"
OUTPUT Mta;"PROG:STR 'Command','OUTFC1'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

OUTFC2

The OUTFC2 command string sets the second measurement's high-pass corner frequency for the jitter output measurement.

Values of Program Variables

Variable	Data Type	Value
Command	string	OUTFC2
Param	floating-point number	10 Hz to 4.5 MHz(10 to 4.5E6 Hz)
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',15.5"
OUTPUT Mta;"PROG:STR 'Command','OUTFC2'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

OUTPUT

The OUTPUT command initiates an output jitter measurement, consisting of two measurements of RMS and peak-to-peak jitter, using the two high-pass cutoff frequencies previously set by the *OUTFC1* and *OUTFC2* commands.

Values of Program Variables

Variable	Data Type	Value
Command	string	OUTPUT
Param	*There are no parameters for this command*	
Response	string	DONE or ABORT[a]
Rnoise	floating-point array of seven values	see below

a. ABORTed if user presses EXIT key during measurement.

Note

Measurement time is dependent on the device under test and the sensitivity mode used.

The result is Rnoise, a seven value, one-dimensional, numeric array.

First high-pass filter cutoff frequency

peak-to-peak jitter, unit intervals
RMS jitter, unit intervals
high-pass filter cutoff frequency

Second high-pass filter cutoff frequency

peak-to-peak jitter, unit intervals
RMS jitter, unit intervals
high-pass filter cutoff frequency
sensitivity flag, 0=normal, 1=high

Example

```
OUTPUT Mta;"PROG:STR 'Command','OUTPUT'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:NUMB? 'Rnoise'"
FOR I= 1 to 7
ENTER Mta USING "%,K";Value(I)
NEXT I
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

OUTSWEEPS

The OUTSWEEPS command string sets the number of output jitter sweeps.

Values of Program Variables

Variable	Data Type	Value
Command	string	OUTSWEEPS
Param	floating-point number	1 to 1000 (*example:* 75)
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',75"
OUTPUT Mta;"PROG:STR 'Command','OUTSWEEPS'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

PAUSE

The PAUSE command enables or disables a jitter application pause just before each measurement of jitter transfer or jitter tolerance. When the application pauses, it has set up the clock source and sinusoidal jitter modulation. Any clock source phase transients have already occurred. Either the user or the remote program can ensure the device being tested has properly recovered from any phase transient. To continue the jitter application to continue with the measurement press the *CONT* key or send the PROG:STAT CONT command.

When PAUSE is ON, the remote program can check the value of 'Response' obtained after the first PROG:WAIT? command.

If the value is PAUSE, send PRG:STAT CONT when ready.
If the value is DONE, read the measurement results from 'Rpts'.

Values of Program Variables

Variable	Data Type	Value
Command	string	PAUSE
Param	string	ON OFF
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is not ON or OFF.

Example

```
DIM Rpts((1:28,1:4),Status$[10],Response$[10],A$[10]
OUTPUT Mta;"PROG:STR'Param','ON'"
OUTPUT Mta;"PROG:STR'Command','PAUSE'"
OUTPUT Mta:"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:STR 'Command','TRANSFER'"
! Send TRANSFER command
OUTPUT Mta;"PROG:STAT?"
! Check IBASIC status
ENTER Mta;Status$
IF Status$="PAUS" THEN OUTPUT Mta;"PROG:STAT CONT"
! if PAUSED, send CONTINUE
!
```

```
LOOP
! Need LOOP if PAUSE ON
OUTPUT Mta;"PROG:WAIT?"
! Wait for jitter app pause.
ENTER Mta;A$
! GPIB hangs until done; returns +1
OUTPUT Mta;"PROG:STR? 'Response'"
! Fetch Response$
ENTER Mta;Response$
EXIT IF Response$"""PAUSE"""
! (will get "DONE" at end of measurement)
! Phase transients are past; ensure DUT PLL's are ok, then
OUTPUT Mta;"PROG:STAT CONT"
! CONTINUE measurement at this frequency
END LOOP
!
OUTPUT Mta;"PROG:NUMB? 'Rpts'"
! Fetch numeric result array
ENTER Mta USING "%,K";Rpts(*)
OUTPUT Mta;"PROG:STAT CONT"
! Acknowledge result receipt
OUTPUT Mta;"PROG:WAIT?"
! Wait for second jitter app pause
ENTER Mta;A$
! GPIB hangs until done; returns +1
OUTPUT Mta;"PROG:STAT CONT"
! CONTINUE jitter app operation
```

QUIT

The QUIT command string causes the Jitter Analyzer Personality to terminate. This command does not pause upon completion; program execution stops immediately. To restart it, press:

USER > *Control* > *RUN*.

Values of Program Variables

Variable	Data Type	Value
Command	string	QUIT
Param	*There are no parameters for this command.*	
Response	*There is no response from this command.*	

Example

```
OUTPUT Mta;"PROG:STR 'Command','QUIT'"
```

REMOTEGATESEC

The REMOTEGATESEC command string causes the error detector gating time (in seconds) to be used for a jitter tolerance measurement. It may be anywhere from 1 to 8.639999E6 (99 days, 23 hours, 59 minutes, and 59 seconds). If this command is not used, a value of one second is used.

Values of Program Variables

Variable	Data Type	Value
Command	string	REMOTEGATESEC
Param	floating-point number	1 to 8.639999E6
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed value range.

Example

```
OUTPUT Mta;"PROG:NUMB ’Param’,15"
OUTPUT Mta;"PROG:STR ’Command’,’REMOTEGATESEC’"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? ’Response’"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

SAVE_TEMPLATE

The SAVE_TEMPLATE command string saves the current input jitter template on the current template storage device, such as, a memory card. *If a file of the same name already exists, it will be overwritten.* If valid, the calibration data is saved, as well as all the parameters listed on the following pages.

Values of Program Variables

Variable	Data Type	Value
Command	string	SAVE_TEMPLATE
Param	floating-point number	*filename* 1 to 8 characters
Response	string	DONE DISK FULL WRITE PROTECT DISK NOT PRESENT NOT INITIALIZED DISK 1 I/O ERROR # xxx[a]

a. May be caused by illegal characters in the filename.

The characters in the filename are restricted to numbers, letters and the underscore. The first character of the filename must be a letter. All characters in the filename are converted to uppercase.

When using the front-panel Template Storage, Load Template and Save Template functions the prefix "T_" is added to the eight character filename entered by the user. When using the remote programming commands, the prefix is not added and the user may enter all ten characters. However, only filenames beginning with "T_" will be displayed when using the Template Storage function from the front panel. All filenames will be displayed when using the remote PROG:CAT? query.

Example

```
OUTPUT Mta;"PROG:STR 'Param','filename'"
OUTPUT Mta;"PROG:STR 'Command','SAVE_TEMPLATE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

The following parameters are saved and recalled:

- INCLOCKFREQ
- OUTCLOCKFREQ
- TEMPLATE
  (OC-3, OC-12, OC-48, OC-192, STM-1, STM-4, STM-16, STM-64, or custom)
- Calibration valid flag
- Template
  the number of points in the template
  for each point:
    jitter frequency
    jitter amplitude
    jitter modulation source output voltage from calibration
    jitter amplitude adjusted flag from calibration
- Jitter transfer
  AVERAGEFLAG
  AVERAGE (number of sweeps)
  GAIN
  TRANSFER_FC
  limit line type
    (OC-3, OC-12, OC-48, OC-192, STM-1, STM-4, STM-16, STM-64, or OFF)
- Jitter tolerance
  TOLMODE
  BERTHRS
  MARGIN
  margin limits based on calibration
- Jitter generation
  GENFC1
  GENSWEEPS
- Output jitter
  OUTFC1
  OUTFC2
  OUTSWEEPS

The following parameters are *NOT* saved:

- SEARCH ON|OFF
- Search Factor
- Sensitivity mode for generation and output measurements

TEMPLATE

The TEMPLATE command string selects one of the standard templates (requires approximately 10 seconds).

Values of Program Variables

Variable	Data Type	Value
Command	string	TEMPLATE
Param	string	OC-192 OC-48 OC-12 OC-3 STM-64 STM-16 STM-4 STM-1
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is not one of the eight listed.

Example

```
OUTPUT Mta;"PROG:STR 'Param','STM-16'"
OUTPUT Mta;"PROG:STR 'Command','TEMPLATE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

The TEMPLATE command sets both input and output clock frequencies, the jitter amplitude versus jitter frequency template, and default values for all parameters listed under SAVE_TEMPLATE.

TOLERANCE

The TOLERANCE command string performs the jitter tolerance measurement.

Before performing a TOLERANCE measurement, specify a template using TEMPLATE or CUSTOM, set the clock frequency using INCLOCKFREQ, and perform a calibration using CALINP. The commands MARGIN, REMOTEGATESEC, TOLMODE BERTHRS, TOLSEARCHFACTOR, and TOLSEARCHFLAG may also be used to set up the TOLERANCE measurement.

Values of Program Variables

Variable	Data Type	Value
Command	string	TOLERANCE
Param	*There are no parameters for this command.*	
Response	string	DONE ABORT[a] ERROR[b]
Rpts	floating-point array of 28 rows and 4 columns	see below

a. ABORTed if user presses EXIT key during measurement.
b. ERROR is returned if a template has not been selected or if a calibration is required.

Result is Rpts array. For each frequency in the template, four values are sent:

- jitter frequency in Hz
- jitter amplitude in unit intervals, peak-to-peak
- error count or error ratio, depending on setting of “TOLMODE”
- tolerance test flag result, where:

  1 = pass
  –1 = fail
  –128 = this point skipped (if, for example, calibration failed at this frequency or error detector is not present.)

If TOLSEARCHFLAG is OFF, the jitter amplitude values will be the template values, modified by MARGIN, and the error count or error ratio and the tolerance test flag result will correspond to tests made at the template jitter level, adjusted by MARGIN.

If TOLSEARCHFLAG is ON, the jitter amplitude values will be the highest jitter amplitude at which the DUT met the error criterion, and the error count or ratio and tolerance test flag result will reflect test results at this jitter amplitude.

Example

```
OUTPUT Mta;"PROG:STR 'Command','TOLERANCE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:NUMB? 'Rpts'"
FOR Point= 1 to 28 !Must read all 28 rows of 4 values
ENTER Mta USING "%,K";Jitfreq,Jitampl,Errorcount,Flag
NEXT Point
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

In this example, the values are converted from character string to floating-point numbers as they are ENTERed. A program might, instead, read everything into one long string variable and then extract the individual values.

The values are sent 19 characters per value, such as, +1.27778184201E-002, separated by commas.

TOLMODE

The TOLMODE command string sets the criterion for passing the jitter tolerance test. If TOLMODE is set to BER, set the error threshold using BERTHRS.

Values of Program Variables

Variable	Data Type	Value
Command	string	TOLMODE
Param	string	BER ERRORS
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is not BER or ERRORS.

Example

```
OUTPUT Mta;"PROG:STR 'Param','BER'"
OUTPUT Mta;"PROG:STR 'Command','TOLMODE'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

TOLSEARCHFACTOR

The TOLSEARCHFACTOR command string sets the value by which the jitter level is to be multiplied each time the jitter tolerance test is redone at a given jitter frequency, if TOLSEARCHFLAG is ON.

Values of Program Variables

Variable	Data Type	Value
Command	string	TOLSEARCHFACTOR
Param	floating-point number	>0 ≠1 <100
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is outside the listed range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',1.2"
OUTPUT Mta;"PROG:STR 'Command','TOLSEARCHFACTOR'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

TOLSEARCHFLAG

The TOLSEARCHFLAG command string enables or disables the jitter tolerance search feature.

Values of Program Variables

Variable	Data Type	Value
Command	string	TOLSEARCHFLAG
Param	string	ON OFF
Response	string	DONE or ERROR[a]

a. ERROR is returned if Param is not ON or OFF

Example

```
OUTPUT Mta;"PROG:STR 'Param','ON'"
OUTPUT Mta;"PROG:STR 'Command','TOLSEARCHFLAG'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

TRANSFER

The TRANSFER command string performs the jitter transfer measurement.

Before performing a TRANSFER measurement, specify a jitter template using TEMPLATE or CUSTOM, set the input (and output) clock frequencies using INCLOCKFREQ (and OUTCLOCKFREQ), and perform a jitter calibration using CALINP. The commands TRANSFER_FC, GAIN, AVERAGE, and AVERAGEFLAG may also be used to set up the jitter transfer measurement. Bandpass filters, designed for jitter measurement at the clock frequencies being used, should be placed on 70820 inputs 1 and 2.

Values of Program Variables

Variable	Data Type	Value
Command	string	TRANSFER
Param	*There are no parameters for this command.*	
Response	string	DONE or ERROR[a]
Rpts	floating-point array of 28 rows and 4 columns	see below

a. ERROR is returned if a template has not been selected or if a calibration is required.

Result is Rpts array. For each frequency in the template, four values are sent:

- jitter frequency in Hz
- jitter amplitude in unit intervals, peak-to-peak
- measured jitter transfer value (dB)
- jitter transfer test result flag, where:

  1 = pass (jitter transfer is below the specification line, determined by TRANSFER_FC and GAIN)
  –1 = fail (jitter transfer value is above the specification line)
  –99 = measurement algorithm failure
  –128 = this point skipped (for example, calibration failed at this frequency)

Example

```
OUTPUT Mta;"PROG:STR 'Command','TRANSFER'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:NUMB? 'Rpts'"
FOR Point= 1 to 28 ! Must ENTER all 28 rows of 4 values
ENTER Mta USING "%,K";Jitfreq,Jitampl,Transfer_dB,Flag
NEXT Point
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

In this example, the values are converted from character string to floating-point numbers as they are received. A program might, instead, read everything into one long string variable and then extract the individual values.

The values are sent 19 characters per value, such as, +1.27778184201E-002, separated by commas.

TRANSFER_FC

The TRANSFER_FC command string sets the jitter transfer corner frequency.

Values of Program Variables

Variable	Data Type	Value
Command	string	TRANSFER_FC
Param	floating-point number	5 Hz to 80 MHz (5 to 20E6 Hz)
Response	string	DONE or ERROR[a]

a. ERROR is returned if value is outside the listed range.

Example

```
OUTPUT Mta;"PROG:NUMB 'Param',1E6"
OUTPUT Mta;"PROG:STR 'Command','TRANSFER_FC'"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STR? 'Response'"
ENTER Mta;Response$
OUTPUT Mta;"PROG:STAT CONT"
OUTPUT Mta;"PROG:WAIT?"
ENTER Mta;A$
OUTPUT Mta;"PROG:STAT CONT"
```

6

Specifications and Characteristics

Specifications and Characteristics

This chapter contains specifications and characteristics for the 71501D Jitter Analyzer.

Definitions of Terms

The distinction between specifications, *characteristics*, typical performance, and nominal values is described as follows:

- Specifications describe warranted performance over the temperature range 0°C to +55°C (unless otherwise noted). All specifications apply after the instrument's temperature has been stabilized after 1 hour continuous operation and self-calibration routines have been run. Unless otherwise noted, corrected limits are given when specifications are subject to minimization with error-correction routines.
- *Characteristics* provide useful, but nonwarranted information about the functions and performance of the instrument. *Characteristics are printed in italics.*
- Typical Performance, where listed, is not *warranted*, but indicates performance which most units will exhibit.
- Nominal Value indicates the expected, but not *warranted*, value of the parameter.

70820A Input Channel Specifications

CAUTION Input channels RF INPUT 1 and RF INPUT 2 are dc coupled.

Operation input range: (including dc offset)	<±320 mV
Maximum safe input voltage without damage:	±2 $V_{pk\text{-}pk}$
Number of input channels:	2
Input connectors[a]	2.4 mm (male)
Nominal input impedance:	50 Ω

a. Includes two 2.4 mm (f) to 3.5 mm (f) adapters.

N1015A Specifications

Input Values

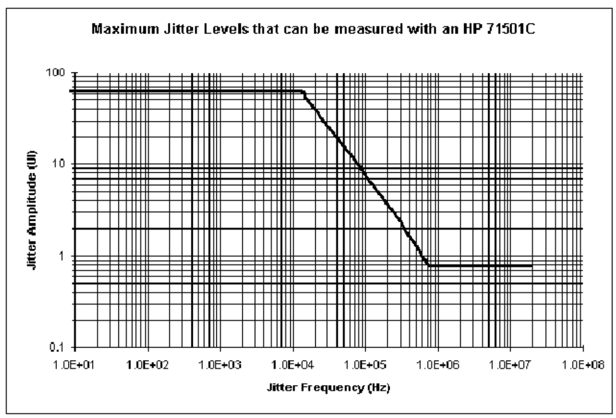
Clock Input:	
Maximum DC Offset Voltage:	±2 V_{pk-pk} [a]
Maximum RF Input Power:	< 10 dBm
Recommended Input Power:	-2 dBm to 4 dBm
Jitter Modulation Input:	
Maximum Instantaneous Voltage:	±10 V_{pk-pk}
Recommended Jitter Source Impedance:	50 Ohms DC coupled

a. This maximum DC voltage is derived from the 70820A RF Input 1 and RF Input 2 limits. In some cases, the N1015A routes the input signal directly to an output. These limits are set to avoid potential damage to the 70820A RF input or pattern generator clock input. The N1015A can withstand ±5V DC offset.

Dimensions and Weight

Cabinet Dimensions:	
Height:	88 mm
Width:	425 mm
Deep:	498 mm
Instrument Weight:	22 lbs (10 kgm)

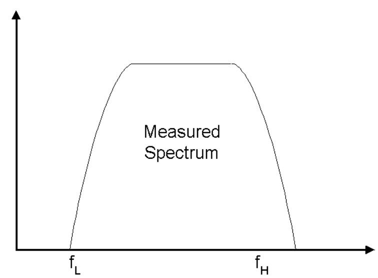
Jitter Characteristics

Sinusoidal Jitter Stimulus--used in Transfer, Tolerance, and Diagnostic Measurements	
Maximum and Minimum Values	Refer to "Jitter Modulation Capabilities of 71501D System Configurations" on page 6-8 for the values specific to a combination of generator, data rate, and occurance of test set.
Maximum Calibration Levels	
Jitter Stimulus Level Accuracy	±8% of setting ±0.02 UI; < 500 kHz Jitter Frequency ±12% of setting ±0.02 UI; 500 kHz-2 MHz Jitter Frequency ±15% of setting ±0.02 UI; 2 MHz-80 MHz Jitter Frequency Note: This accuracy is valid for settings at or below amplitude levels that were used for the jitter calibration.

Jitter Transfer Measurement	
Measurement Accuracy	±0.05 dB; < 500 kHz ±0.1 dB; 500 kHz to 4 MHz ±0.2 dB; 4 MHz to 80 MHz

Jitter Generation and Output Jitter Measurement

The following tables indicate the characteristic jitter levels produced by the test system and indicate the smallest levels of jitter that can be measured. The measured result is the integrated phase noise in the band between the software high-pass filter corner frequency and the hardware filter bandwidth as shown in the following figure where f_L is the corner frequency of the software high pass filter selected using the front-panel LOWFREQ CORNER function and f_H is the hardware band pass filter.



Hardware Filter f_H	80 MHz; 9953 Mb/s 20 MHz; 2488 Mb/s 5 MHz; 622 Mb/s 1.3 MHz; 155 Mb/s
Software Filter f_L	Settable from 10 Hz to 4.5 MHz (< 1 MHz is Recommended)
Maximum Input Random Jitter Levels for Valid Measurement	(50 kHz, OC-192 f_L Setting) 0.4 UI Peak-Peak for Components > 1 MHz 400 kHz/frequency UI Peak-Peak for Components Below 1 MHz
Maximum Valid Jitter Reading	10 UI Peak-Peak

Measurement Accuracy	Total Error Limit = ±R% of Reading ±W

R is Variable Error and W is Fixed Baseline Error
valid for f_L setting < 1 MHz

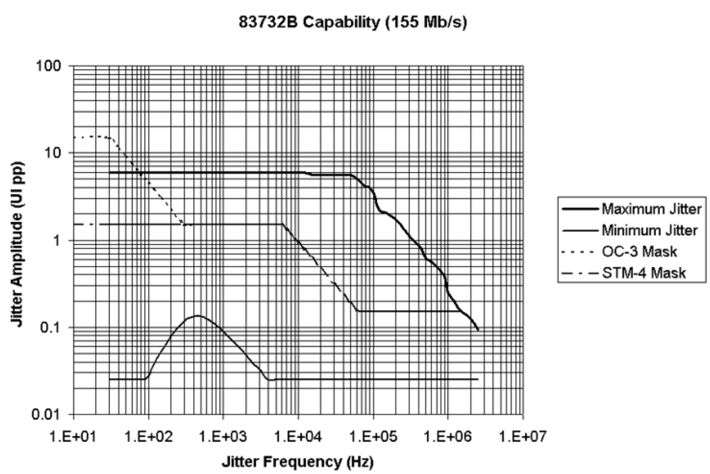
Variable Error (R):	±7%; < 1 MHz ±10%; 1 MHz to 3 MHz ±15%; 3 MHz to 10 MHz ±20%; > 10 MHz

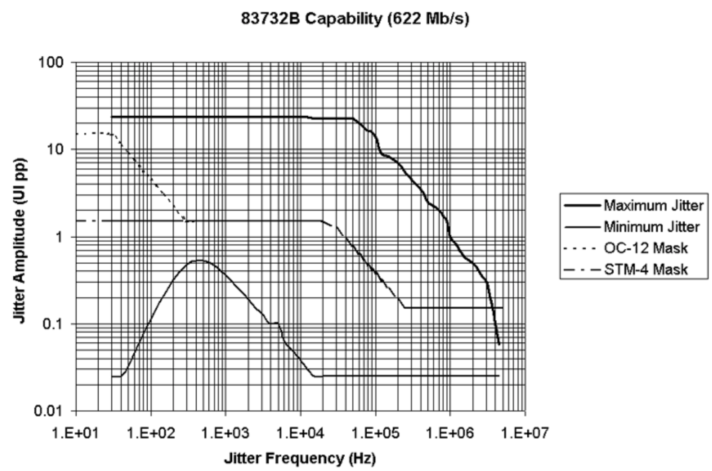
Fixed Baseline Error (W):

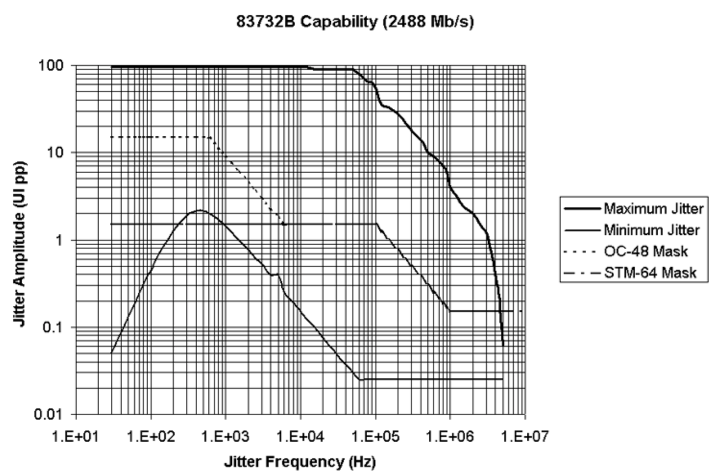
Bit Rate	Fixed Error P-P	Fixed Error rms	Sensitivity Mode
9953 Mb/s	0.02 UI	0.002 UI	High
9953 Mb/s	0.06 UI	0.008 UI	Normal
2488 Mb/s	0.02 UI	0.002 UI	Normal
622 Mb/s	0.02 UI	0.002 UI	Normal
155 Mb/s	0.02 UI	0.002 UI	Normal

Jitter Modulation Capabilities of 71501D System Configurations

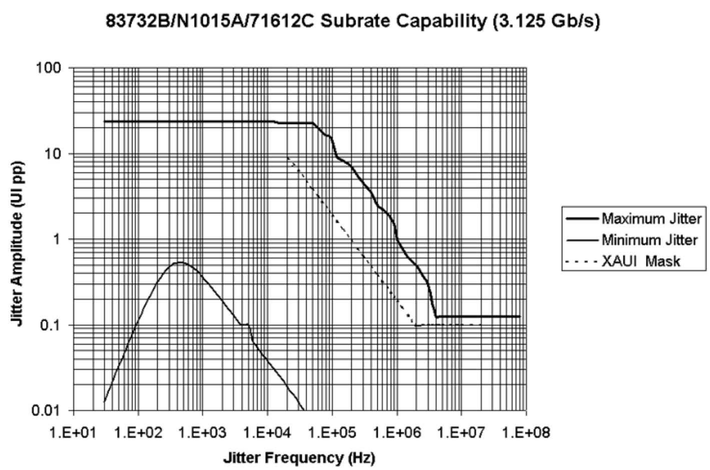
Agilent 83732B Clock Source

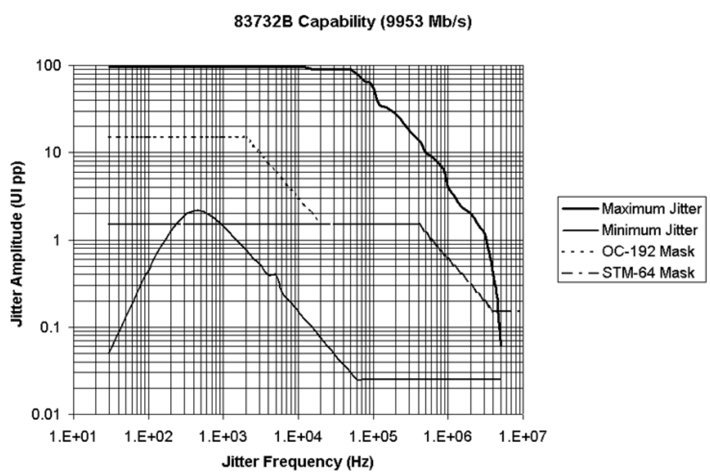


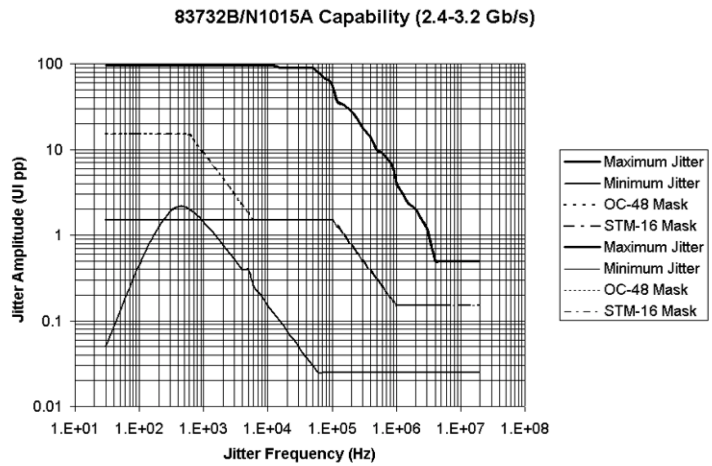

83732B Capability (622 Mb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-12 Mask
STM-4 Mask

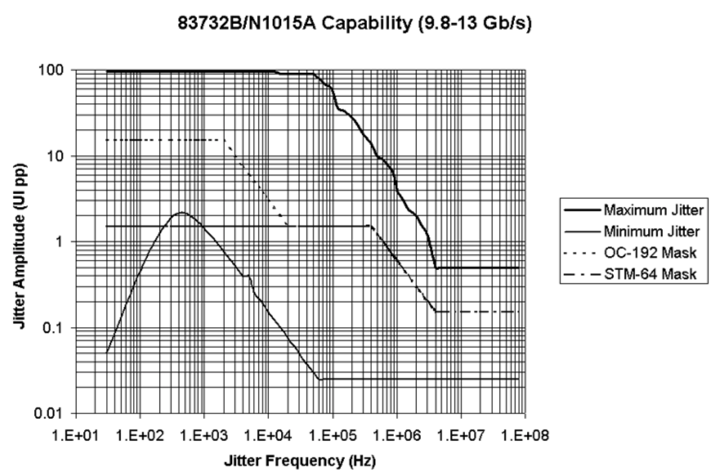

83732B Capability (2488 Mb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-64 Mask

Jitter Modulation Capabilities of 71501D System Configurations

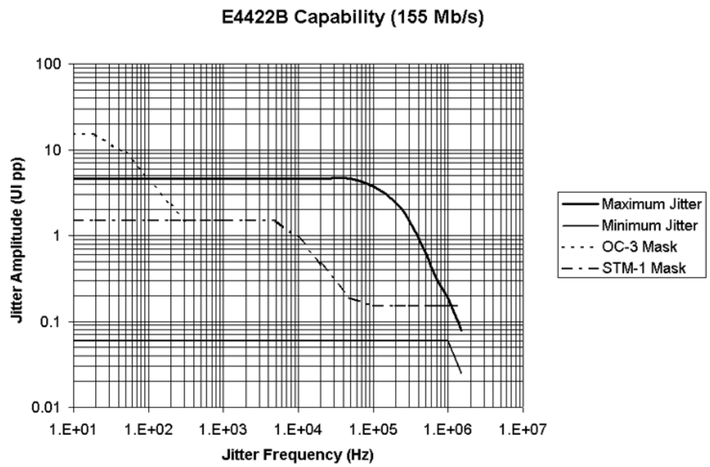


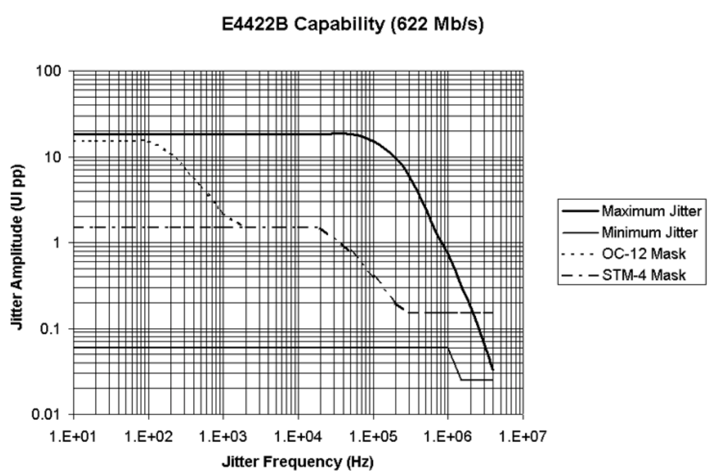


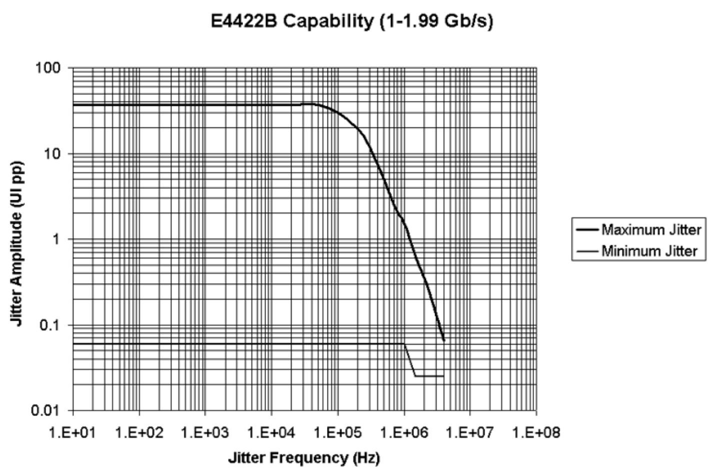

83732B/N1015A Capability (2.4-3.2 Gb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask

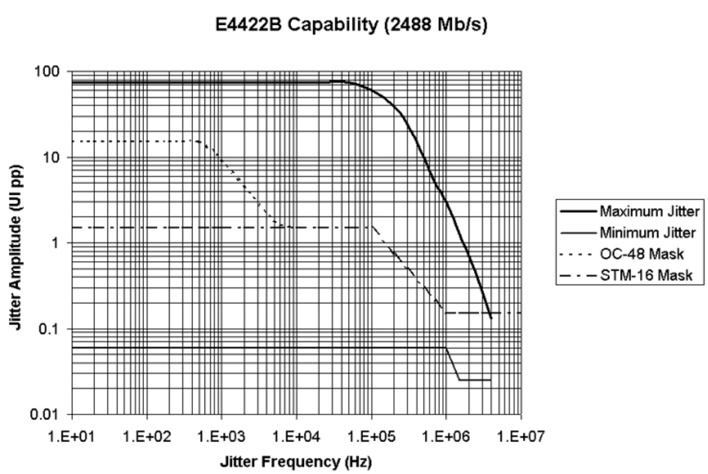

83732B/N1015A Capability (9.8-13 Gb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-192 Mask
STM-64 Mask

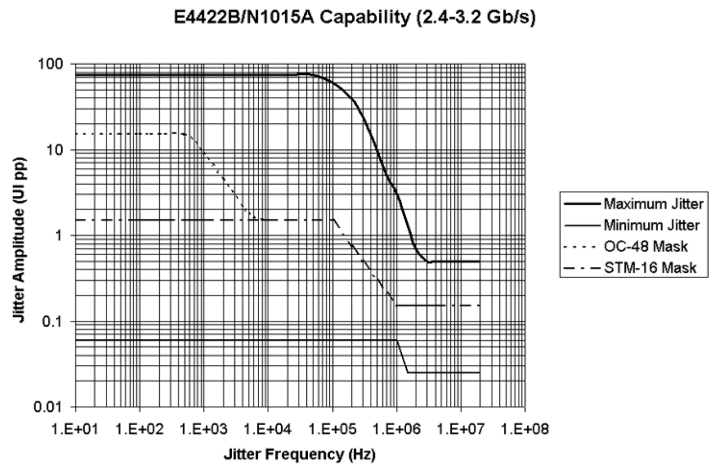
Agilent E4422B Clock Source



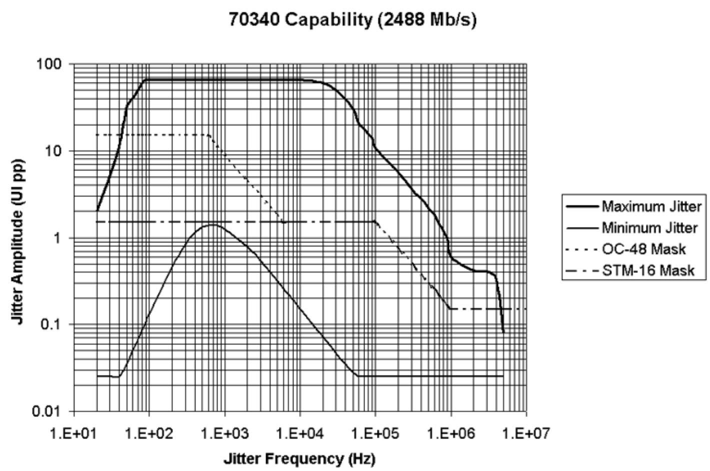


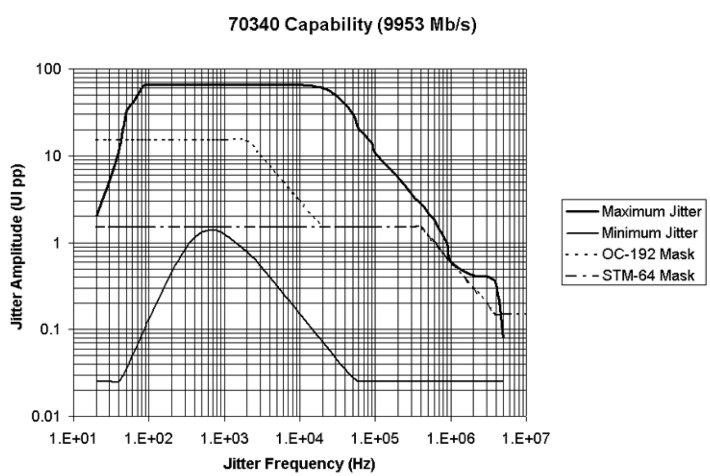

E4422B Capability (1-1.99 Gb/s)
100
10
1
0.1
0.01
Jitter Amplitude (UI pp)
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter


E4422B Capability (2488 Mb/s)
100
10
1
0.1
0.01
Jitter Amplitude (UI pp)
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask

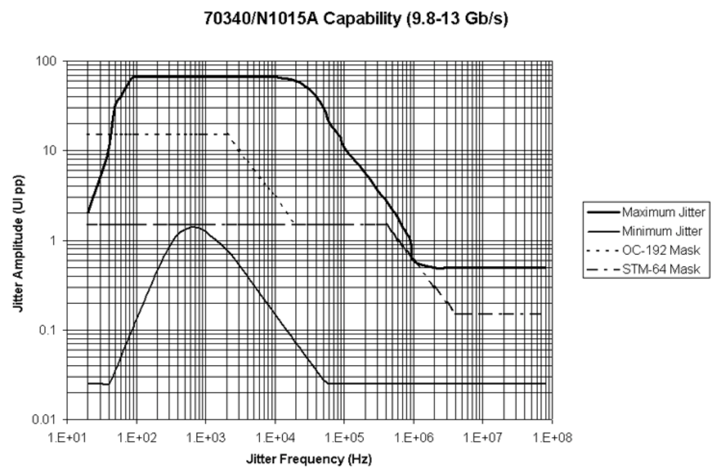

E4422B/N1015A Capability (2.4-3.2 Gb/s)
100
10
1
0.1
0.01
Jitter Amplitude (UI pp)
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask

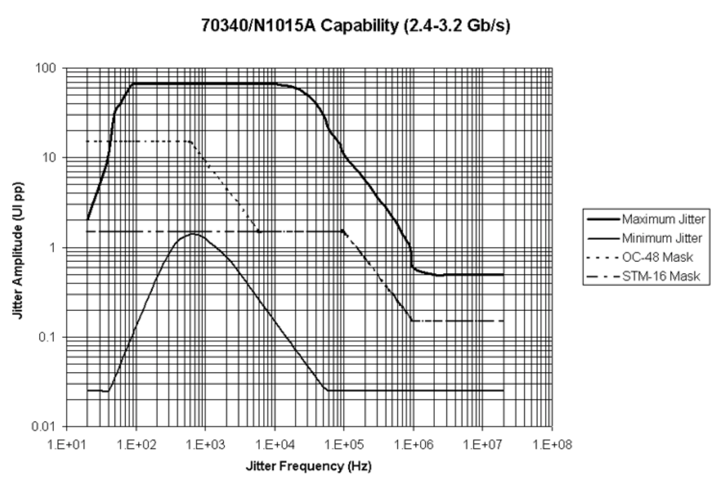
Agilent 70340 Clock Source



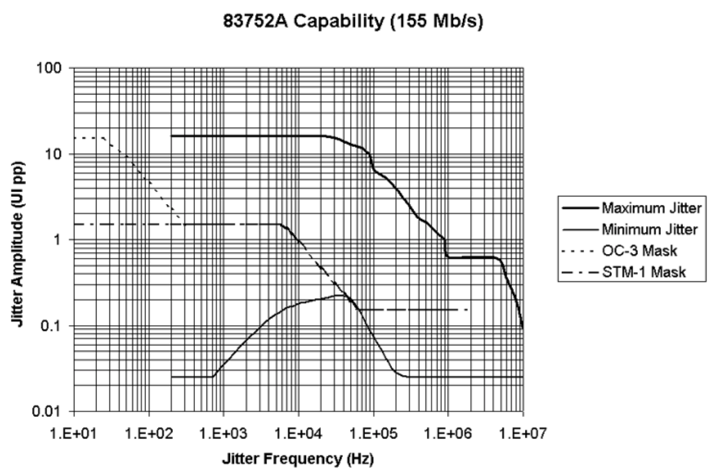


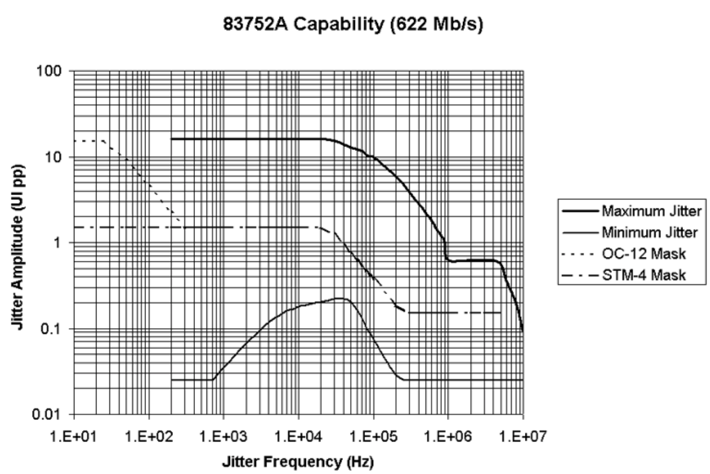
Jitter Modulation Capabilities of 71501D System Configurations

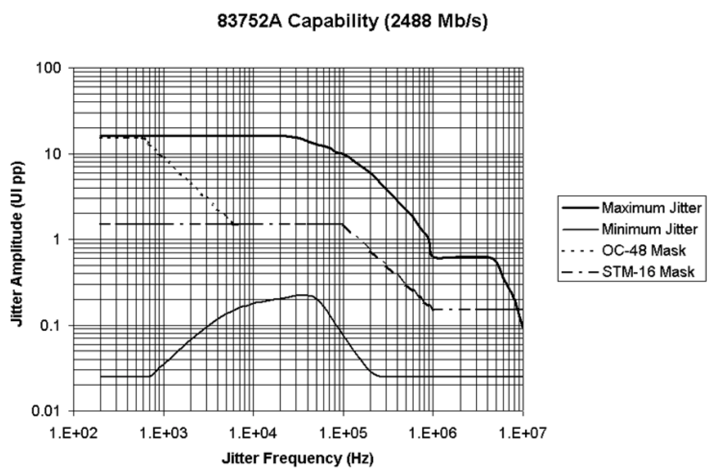


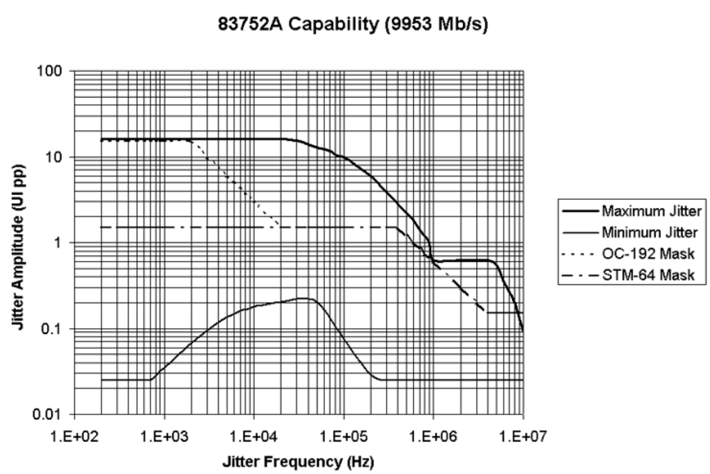


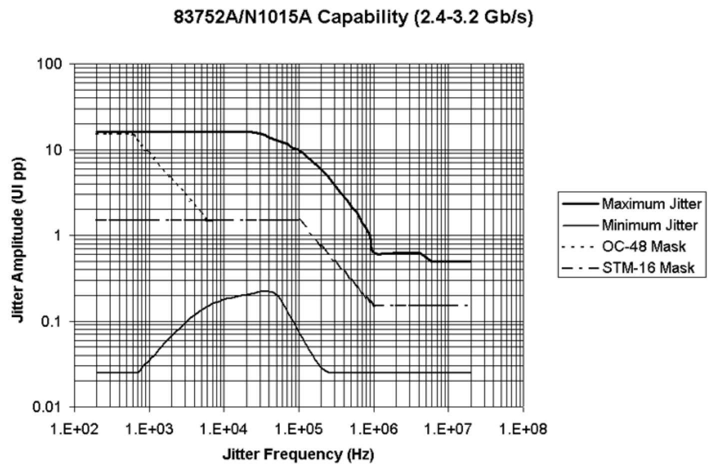
Agilent 83752 Clock Source

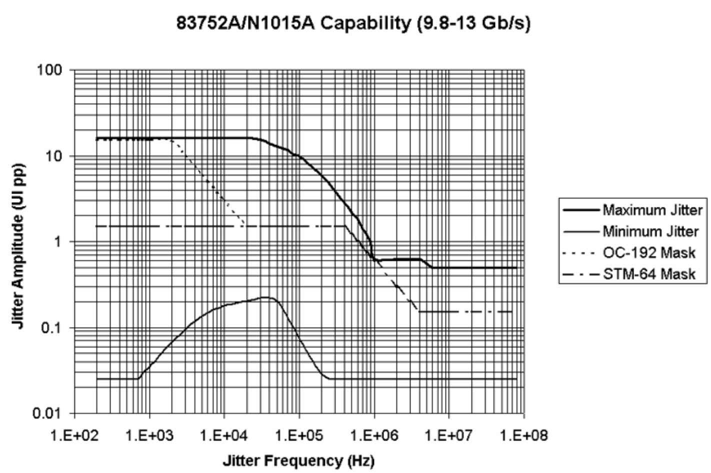




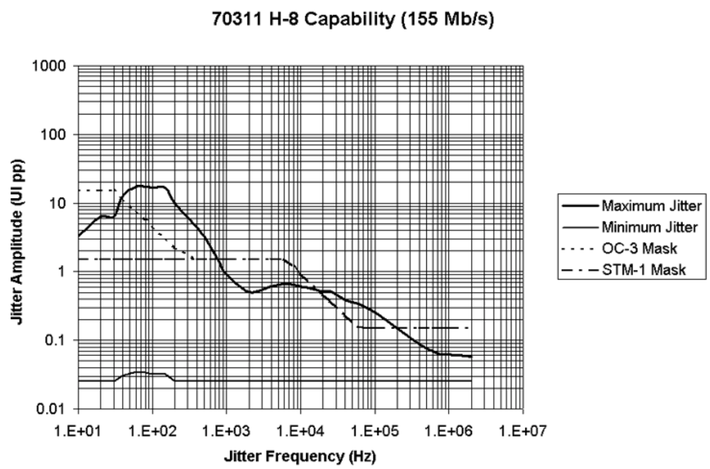

83752A Capability (2488 Mb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask

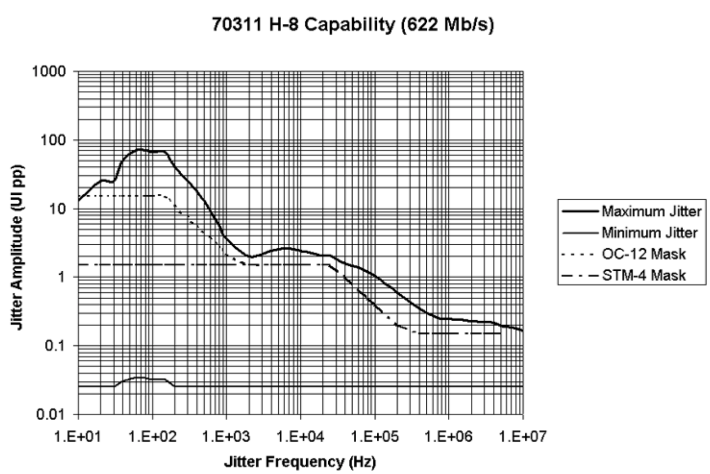

83752A Capability (9953 Mb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-192 Mask
STM-64 Mask

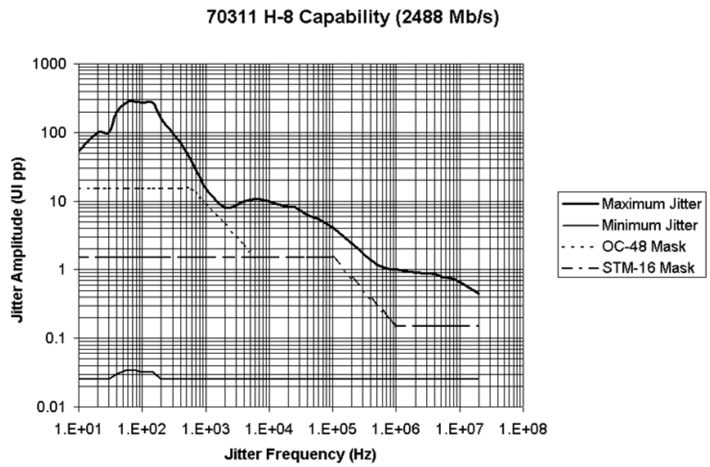

83752A/N1015A Capability (2.4-3.2 Gb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask


83752A/N1015A Capability (9.8-13 Gb/s)
Jitter Amplitude (UI pp)
100
10
1
0.1
0.01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-192 Mask
STM-64 Mask

Agilent 70311 Option H08 Clock Source






70311 H-8 Capability (2488 Mb/s)
Jitter Amplitude (UI pp)
1000
100
10
1
0.1
0.01
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
1.E+06
1.E+07
1.E+08
Jitter Frequency (Hz)
Maximum Jitter
Minimum Jitter
OC-48 Mask
STM-16 Mask

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name:	Agilent Technologies, Inc.
Manufacturer's Address:	1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA

Declares that the products:

Product Name:	Modulation Test Set
Model Number:	N1015A
Product Options:	This declaration covers all options of the above product.

Is in conformity with:

Safety: IEC 61010-1:1990 +A1:1992+A2:1995 / EN 61010-1:1994+A2:1995
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995, 4 kV CD, 8 kV AD
IEC 61000-4-3:1995 / EN 61000-4-3:1995, 3 V/m, 80-1000 MHz
IEC 61000-4-4:1995 / EN 61000-4-4:1995, 0.5 kV sig. lines, 1 kV pow. lines
IEC 61000-4-5:1995 / EN 61000-4-5:1995, 0.5 kV l-l, 1 kV l-e
IEC 61000-4-6:1996 / EN 61000-4-6:1996, 3V 80% AM, power line
IEC 61000-4-11:1994 / EN 61000-4-11:1994, 100 %, 20 ms

Supplementary Information:
The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 30 April 2002

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Co.
Manufacturer's Address:	Microwave Instruments Division 1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA

declares that the product

Product Name:	Microwave Transition Analyzer
Model Number:	HP 71500A, HP 70820A
Product Options:	This declaration covers all options of the above products.

conforms to the following Product specifications:

Safety: IEC 348:1978/HD 401 S1:1981
CAN/CSA-C22.2 No. 231 (Series M-89)

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines

IEC 555-2:1982 +A1:1985 / EN 60555-2:1987
IEC 555-3:1982 + A1:1990 / EN 60555-3:1987 + A1:1991

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

The HP 70820A Microwave Transition Analyzer was tested in HP 70004A Color Displays.

Safety qualification tests for these products were performed prior to 1 December 1993.

Santa Rosa, California, USA 28 Dec. 1995

Dixon Browder
Dixon Browder/Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Herrenberger Strasse 130, D-71034 Böblingen, Germany (FAX +49-7031-14-3143)

This is to declare that this system is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung -3.GSGV Deutschland).

Notice for Germany: Noise Declaration

Acoustic Noise Emission	Geraeuschemission
LpA < 70 dB	LpA < 70 dB
Operator position	am Arbeitsplatz
Normal position	normaler Betrieb
per ISO 7779	nach DIN 45635 t.19

COMPLIANCE WITH CANADIAN EMC REQUIREMENTS

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB du Canada.

Agilent Technologies Service Offices

Before returning an instrument for service, call the Agilent Technologies Instrument Support Center at (800) 403-0801, or call one of the numbers listed below. Ship the instruments using the original packaging materials. Returning the instruments in anything other than the original packaging may result in non-warranted damage.

Table 6-1. Agilent Technologies Service Numbers

Austria	01/25125-7171
Belgium	32-2-778.37.71
Brazil	(11) 7297-8600
China	86 10 6261 3819
Denmark	45 99 12 88
Finland	358-10-855-2360
France	01.69.82.66.66
Germany	0180/524-6330
India	080-34 35788
Italy	+39 02 9212 2701
Ireland	01 615 8222
Japan	(81)-426-56-7832
Korea	82/2-3770-0419
Mexico	(5) 258-4826
Netherlands	020-547 6463
Norway	22 73 57 59
Russia	+7-095-797-3930
Spain	(34/91) 631 1213
Sweden	08-5064 8700
Switzerland	(01) 735 7200
United Kingdom	01 344 366666
United States and Canada	(800) 403-0801

Numerics

A

B

C

F

G

H

I

J

T

U

V