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APPLICATION NOTE

MP1777A

10 GHz Jitter Analyzer

MEASUREMENT GROUP
ANRITSU CORPORATION

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1. Preface

This application note describes jitter measurement for the components and transmission equipment that make up STM-64/OC-192 (9.95328 Gbit/s) and submarine transmission system that are currently being extensively developed and installed. This application note explains jitter definition, what jitter measurement includes, and the features of jitter measuring instrument MP1777A, which conforms to new ITU-T recommendation O.172. It also describes examples of measurement using the equipment.

2. Jitter Definition

2.1 Jitter and Wander

In a digital network, the symptom in which the noise and transmission pattern on the transmission line disturb the timing of signals to be transmitted and put pulse waveforms out of phase before and after the average position is called jitter or wander (see Figure 2-1). There is no clear boundary between jitter and wander. However, generally, frequencies lower than a phase change frequency (phase modulation frequency) of 10 Hz are called wander frequencies. Frequencies higher than 10 Hz are called jitter frequencies (see Figure 2-2).

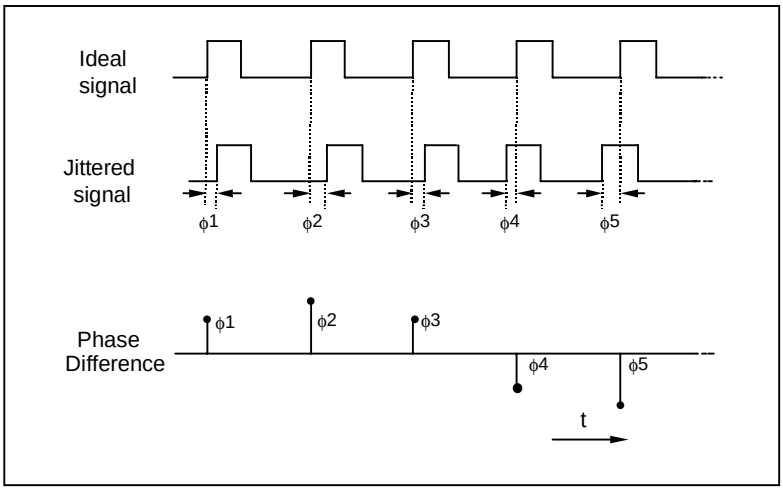


Figure 2-1 Jitter

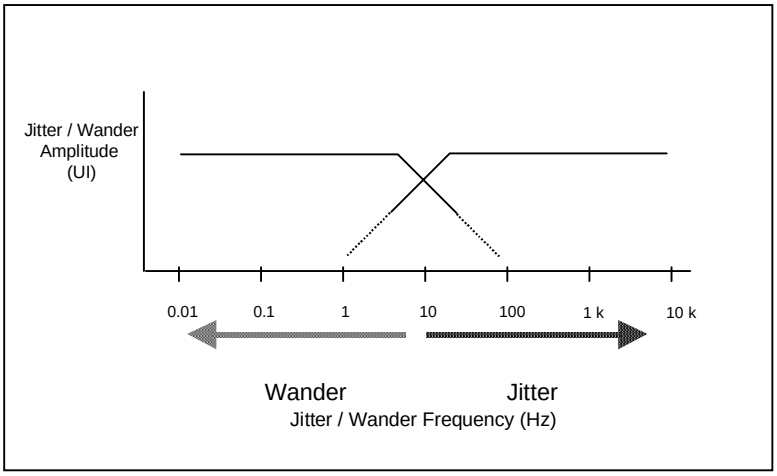


Figure 2-2 Jitter and wander

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2.2 Quantity of Jitter

The quantity of jitter is represented as the amount of phase difference between the measured signal and reference signal. Figure 2-3 (a) and (b) show the waveforms of a reference signal and measured signals observed using an oscilloscope. The shaded areas near the rising and falling edges of the jittered signal shown in (b) of Figure 2-3 show the areas within which the edges momentarily fall as the signal enters and exits the phase states shown in (c) and (d) of Figure 2-3. The jitter difference between (c) and (d) is called the jitter amplitude, and the reciprocal of repetitive cycle (Tm) is called the jitter frequency (fm).

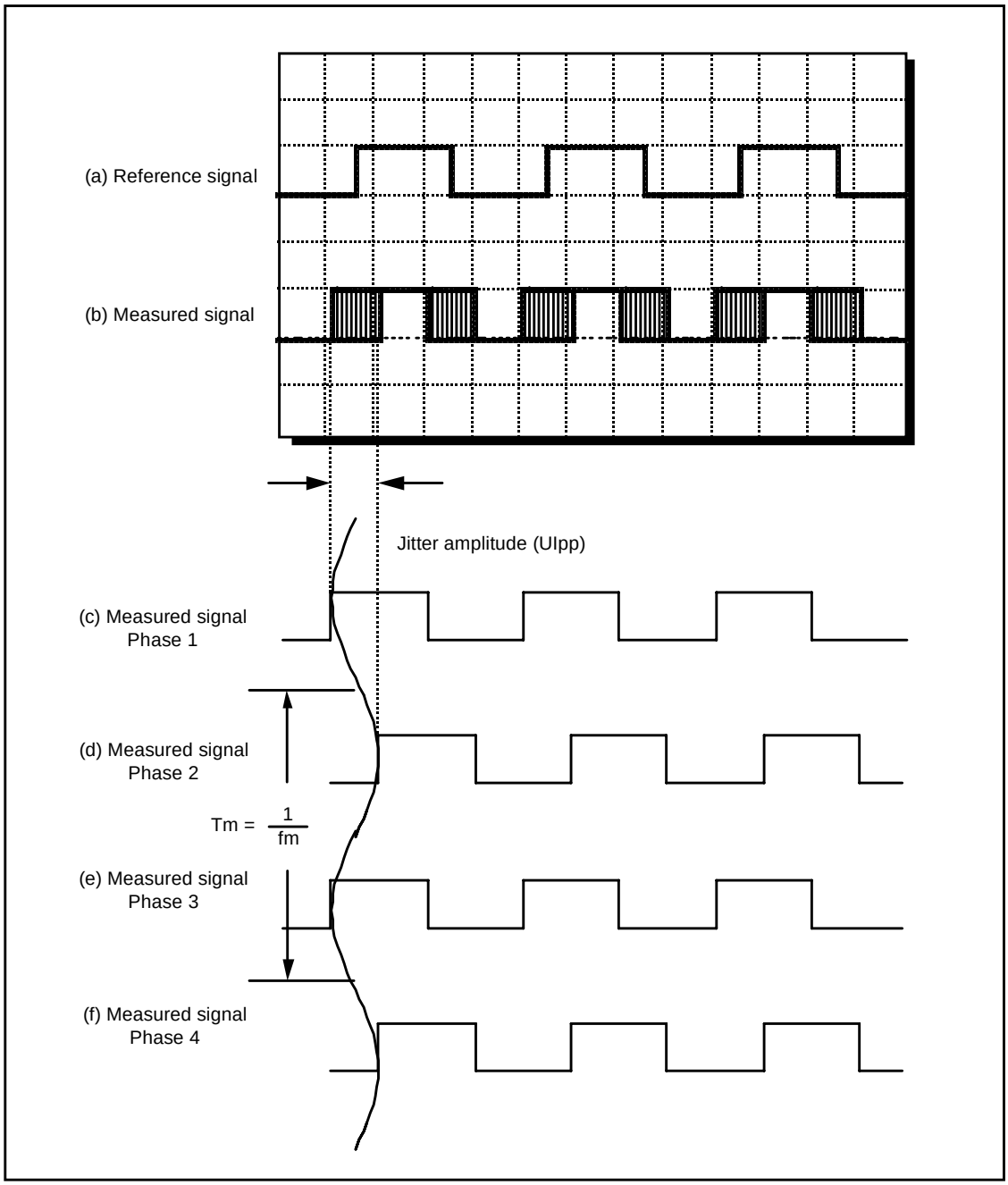


Figure 2-3 Jitter waveform

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2.3 Unit of Jitter

Jitter is the phase change of a digital signal, and the quantity of jitter is an index for evaluating the transmission quality. All transmission codes require a common unit. Unit Interval (UI) is used as a unit that indicates the jitter amplitude. One UI is defined as one cycle of bit clock (see Figure 2-4). Two types of units: UIpp (peak to peak of phase change width) and UIrms (effective value of phase change width) are actually used. Since these units are standardization parameters that are bit rate independent, the quantity of jitter can be compared at different bit rates (see Figure 2-5).

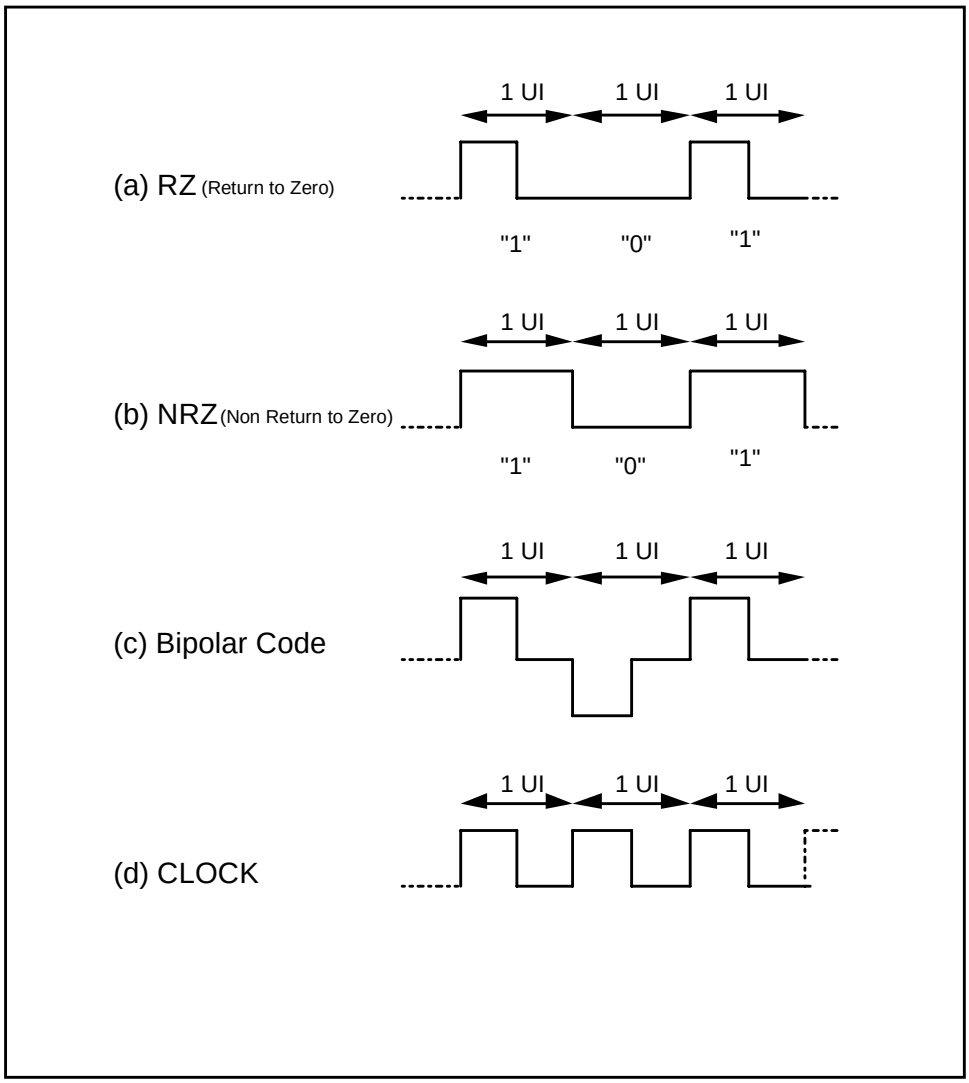


Figure 2-4 Unit of jitter (1)

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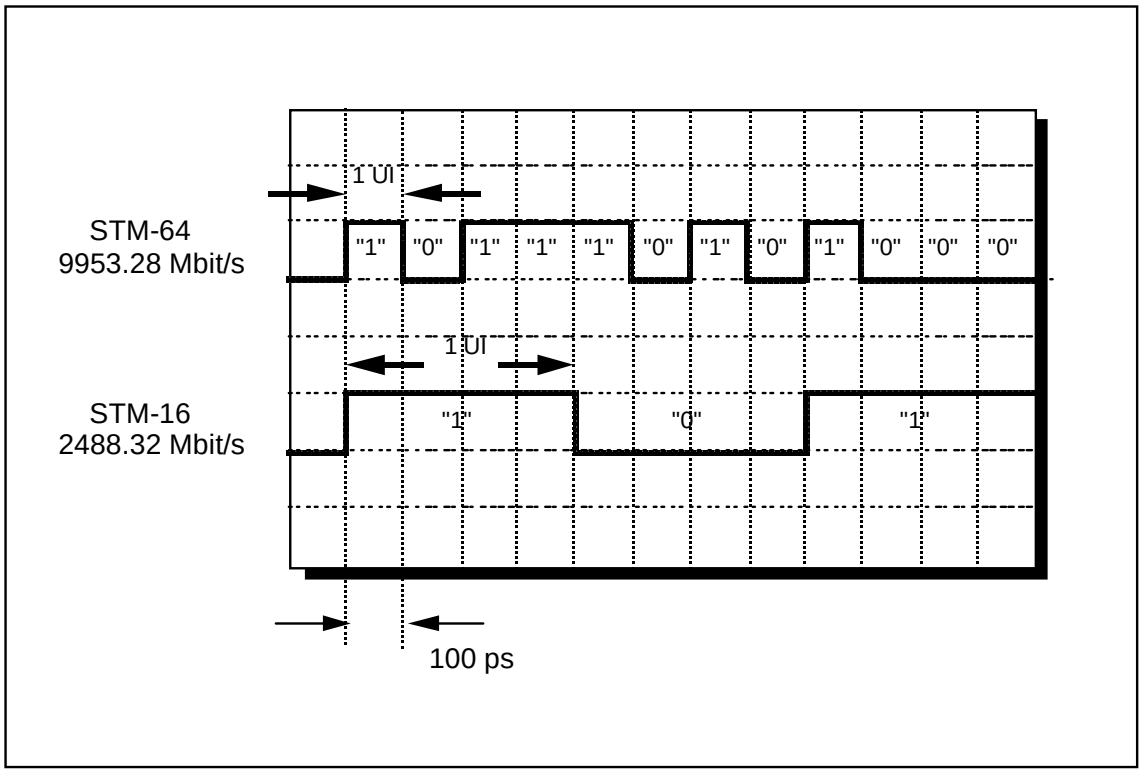


Figure 2-5 Unit of jitter (2)

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3. Jitter Measurement

3.1 Basic Jitter Test

Since jitter significantly affects the network transmission quality, quantitative evaluation of jitter is required. The jitter performance test includes the following three basic tests:

1. Jitter tolerance measurement
2. Jitter transfer characteristics measurement
3. Jitter generation measurement

3.2 Jitter Tolerance Measurement

Jitter tolerance measurement evaluates to what extent a DUT operates without causing an error when the signal to be input to the DUT is sine-wave jitter modulated (sine-wave phase modulated) and the jitter amplitude is increased. The jitter tolerance of the DUT is evaluated by changing the jitter modulation frequency to repeat measurement and link the measurement results at measurement points as shown in Figure 3-1.

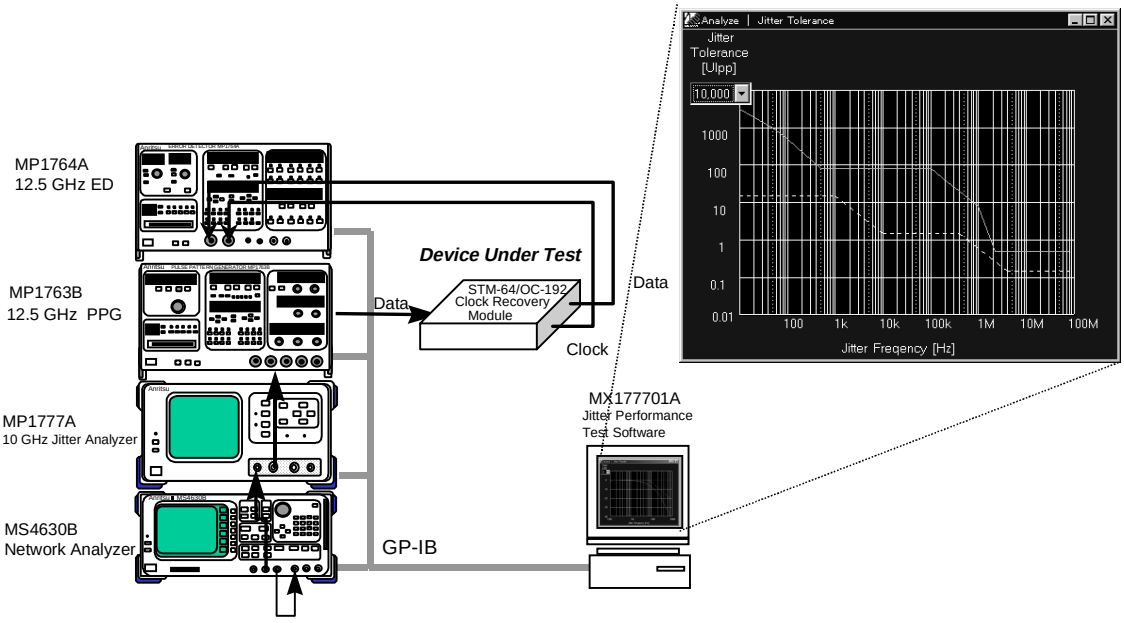


Figure 3-1 Jitter tolerance measurement

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3.3 Jitter Transfer Characteristics Measurement

Jitter transfer characteristics measurement evaluates to what extent the jitter amplitude is transferred to the output side when the sine-wave modulated (sine-wave phase modulated) signal is input to a DUT. The measurement results are obtained from the jitter amplitude (Jin) added to the input side and the jitter amplitude (Jout) measured in the output side by expression (1). This measurement is very important for restricting jitter accumulation.

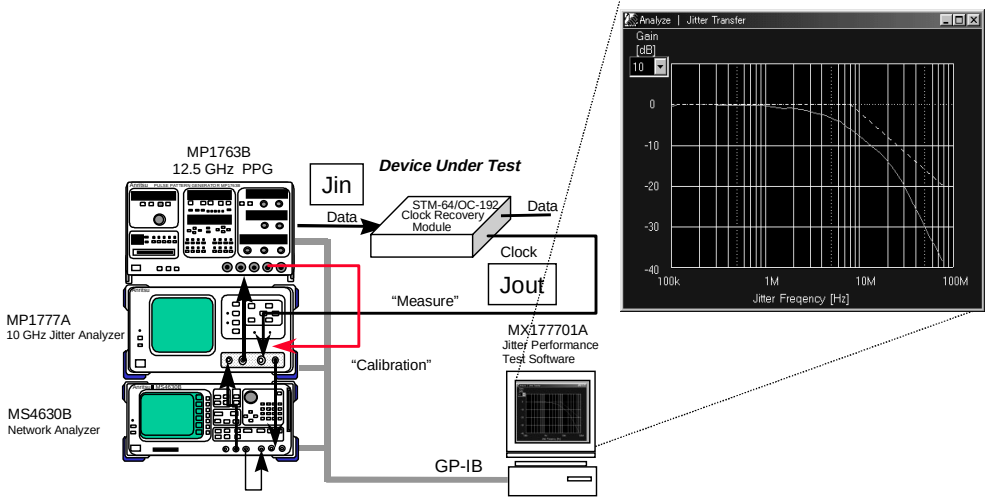


Figure 3-2 Jitter transfer characteristics measurement

Jitter Gain (dB) = 20 LOG (Jout / Jin) ----------Expression (1)

3.4 Jitter Generation Measurement

Jitter generation measurement requires that the quantity of jitter generated by a DUT be 0.01 UIrms or less at all STM-1 to 16/OC-1 to OC-48 bit rates. However, ITU-T has recently considered reviewing jitter generation measurement.

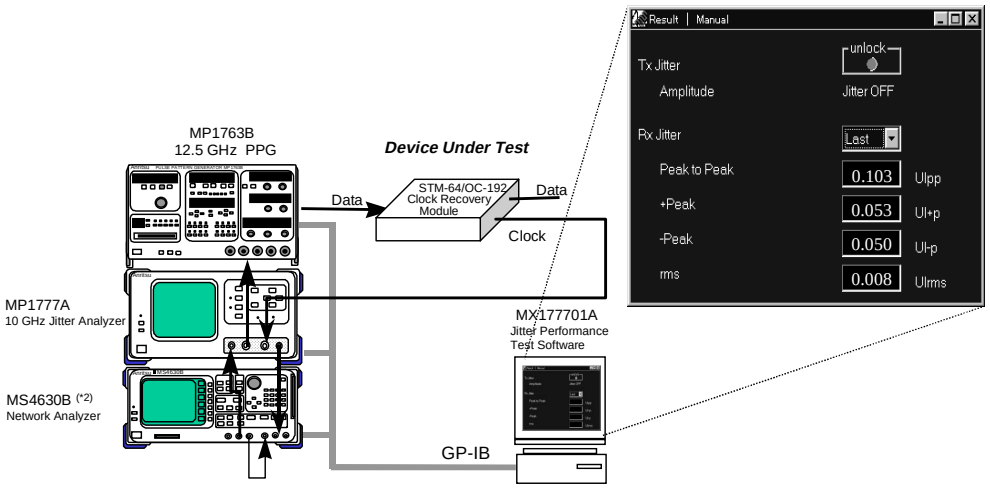


Figure 3-3 Jitter Generation Measurement

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4. MP1777A 10 GHz Jitter Analyzer

The MP1777A 10 GHz Jitter Analyzer is the world-first measurement instrument that conforms to new ITU-T recommendation O.172 (SDH jitter measuring instrument standard) and supports jitter measurement at 10 Gbit/s. This jitter analyzer can be used in various applications such as development and production of STM-64/OC-192 transmission equipment and optical modules that are currently being installed in submarine transmission systems and main land network lines.

Features

- Jitter measurement that conforms to new ITU-T recommendation O.172 (March. 1999) is possible.
- Jitter bandwidth: 80 MHz
- Maximum jitter modulation amplitude: 3200 UIpp
- Bit rates that support the two-system submarine transmission system can be added.

  Option 01: 2494.16 MHz, 4988.32 MHz, 9976.64 MHz

  Option 02: 2666.0571 MHz, 5332.1142 MHz, 10664.2284 MHz (ITU-T G.975)
- Automatic jitter tolerance measurement

  [Example of configuration]

  MP1763B 12.5 GHz Pulse Pattern Generator

  MP1764A 12.5 GHz Error Detector

  MS4630B Network Analyzer

  MX177701A Jitter Performance Test Software
- Automatic jitter transfer measurement

  [Example of configuration]

  MP1763B 12.5 GHz Pulse Pattern Generator

  MS4630B Network Analyzer

  MX177701A Jitter Performance Test Software



Figure 4-1 MP1777A

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5. Examples of Jitter Measurement and Configuration of Measuring Instrument

5.1 Measurement Items

(1) Jitter tolerance measurement for STM-64/OC-192 clock recovery module
(2) Jitter transfer characteristics measurement for STM-64/OC-192 clock recovery module
(3) Jitter generation measurement for STM-64/OC-192 clock recovery module
(4) Jitter sweep measurement for clock recovery module for submarine transmission system
(5) Jitter transfer characteristics measurement for clock recovery module for submarine transmission system
(6) Jitter generation measurement for clock recovery module for submarine transmission system
(7) Jitter tolerance measurement for FEC encoder and decoder module
(8) Jitter transfer characteristics measurement for FEC encoder and decoder module
(9) Jitter generation measurement for FEC encoder and decoder module
(10) Jitter sweep measurement for MUX/DEMUX module
(11) Jitter generation measurement for MUX/DEMUX module
(12) Frequency tolerance measurement for SDH/SONET transmission equipment
(13) Jitter tolerance measurement for SDH/SONET transmission equipment
(14) Frequency tolerance measurement for submarine transmission equipment
(15) Jitter tolerance measurement for submarine transmission equipment

5.2 Jitter Measurement Items and Configured Measuring Instrument

	Measurement item														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
MP1777A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Option 01 2494M / 4988M / 9977M				(✓)[4]	(✓)[4]	(✓)[4]		✓	✓	(✓)[6]	(✓)[6]				
Option 02 2494M / 4988M / 9977M				✓	✓	✓		(✓)	(✓)	(✓)[6]	(✓)[6]				
Option 10 High-Sensitivity Input		(✓)[2]	(✓)[2]		(✓)[2]	(✓)[2]		(✓)[2]	(✓)[2]		(✓)[2]				
MP1763B 12.5 GHz PPG	✓	✓	✓	✓	✓	✓	(✓)[5]	(✓)[5]	(✓)[5]	✓	✓				
MP1764A 12.5 GHz ED	✓			✓			(✓)[5]			✓					
MP3630A (Tx)* SDH/SONE Analyzer	(✓)[1]	(✓)[1]	(✓)[1]	(✓)[1]	(✓)[1]	(✓)[1]	✓	✓	✓	(✓)[1]	(✓)[1]	✓	✓	(✓)[7]	(✓)[7]
MP3630A (Rx)* SDH/SONE Analyzer	(✓)[1]			(✓)			✓			(✓)[1]		✓	✓	(✓)[7]	(✓)[7]
MS4630B Network Analyzer	✓	✓	(✓)[3]	✓	✓	(✓)[3]	✓	✓	(✓)[3]	✓	✓				
MP9659B 10 G E/O, O/E Converter												✓	✓	✓	✓
MX177701A Automatic jitter measurement software	✓	✓	(✓)[3]	✓	✓	(✓)[3]	✓	✓	(✓)[3]	✓	✓	✓	✓	✓	✓

(✓)[1] : This device can be used instead of MP1763B/MP1764A.
(✓)[2] : This option is used when the DUT output level is less than 0.7 Vpp.
(✓)[3] : This device is not required when MX177701A Jitter Performance Test Software is not used.
(✓)[4] : This option is used for evaluation for 2494M/4988M/9974M submarine transmission.
(✓)[5] : The programmable pattern enables this device to be used instead of ME3630A.
(✓)[6] : This option is used for evaluation at the submarine transmission bit rate.
(✓)[7] : Only SDH/SONET interface can be used.
* ME3630A requires jitter tolerance options such as option 24 (TX) and option 34 (RX).

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6. Examples of Measurement

6.1 Example of Jitter Tolerance Measurement for STM-64/OC-192 Clock recovery Module

This jitter tolerance measurement measures the jitter tolerance point at which an error occurs when a jitter-modulated data signal is input to an STM-64/OC-192 clock recovery module.

The MX177701A Jitter Performance Test Software enables use of a measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point. This software also enables use of a measurement method (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs. The former method (jitter tolerance measurement) is suitable for applications such as performance evaluation for a DUT in research and development departments. The latter method (jitter sweep measurement) is suitable for the applications such as shipment inspection during mass production of the DUT in manufacturing departments.

6.1.1 Example of measurement connection

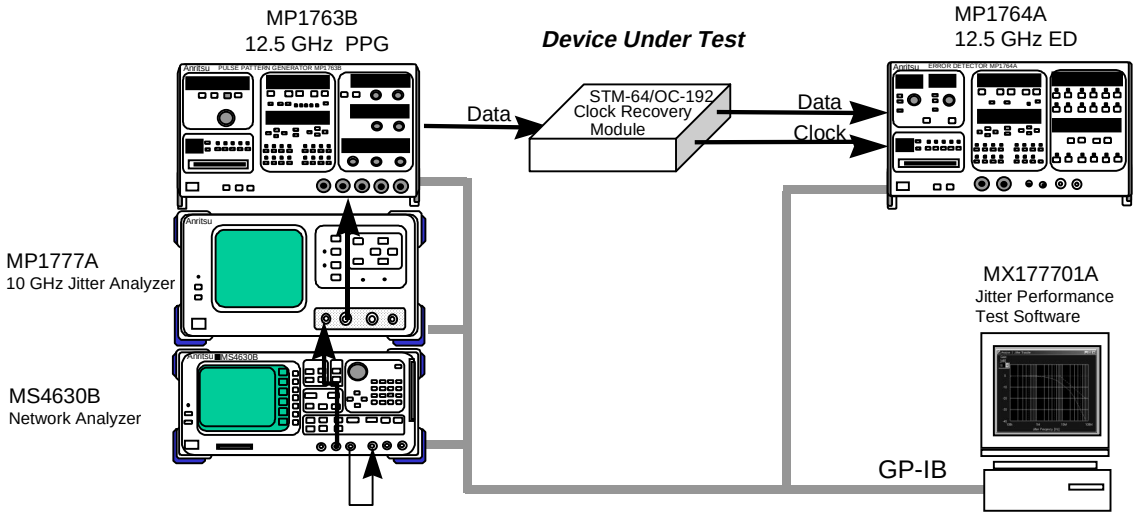


Figure 6-1-1 Connection for jitter tolerance measurement

Note: The MX177701A Jitter Performance Test Software does not exercise control related to the interfaces with the MP1763B 12.5 GHz Pulse Pattern Generator and MP1764A 12.5 GHz Error Detector. Before automatic jitter measurement is started, they must be set to the optimum condition.

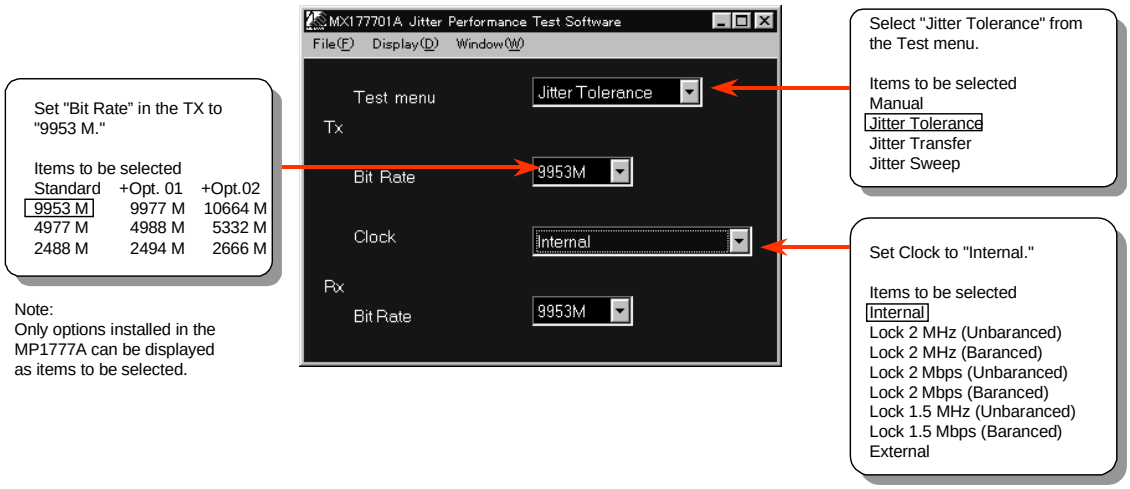
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6.1.2 Measurement procedure

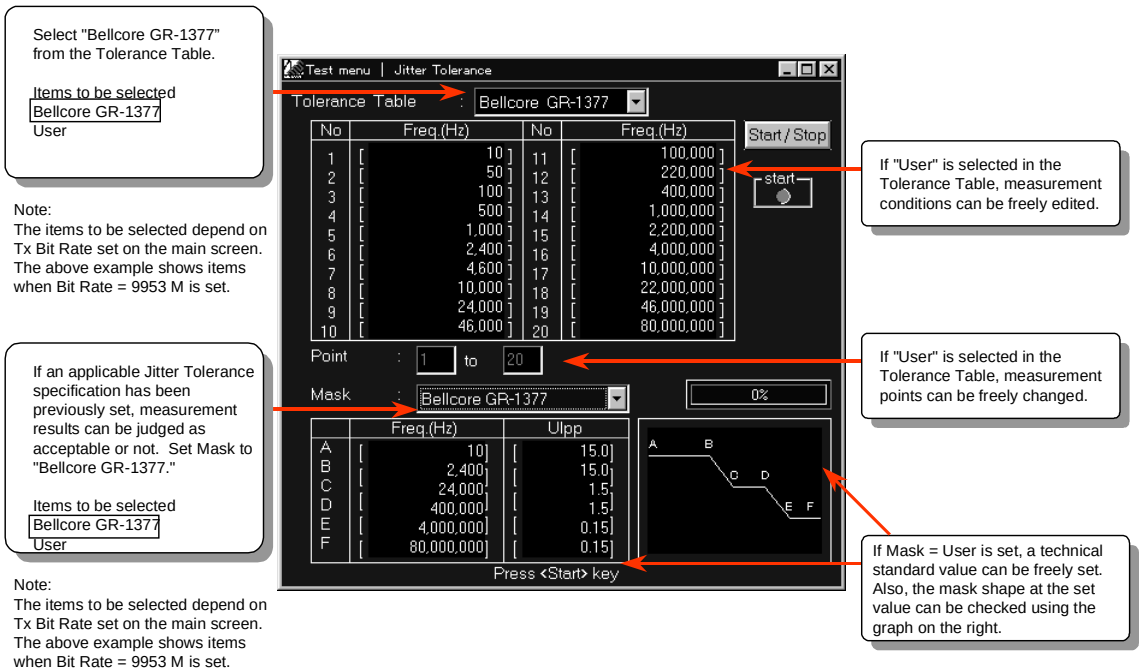
This section explains the measurement procedure for the measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

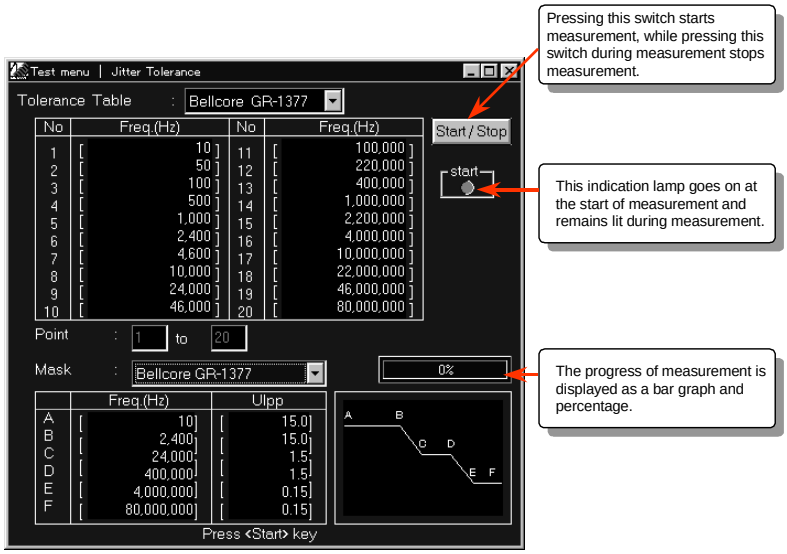


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen of the MX177701A Jitter Performance Test Software.

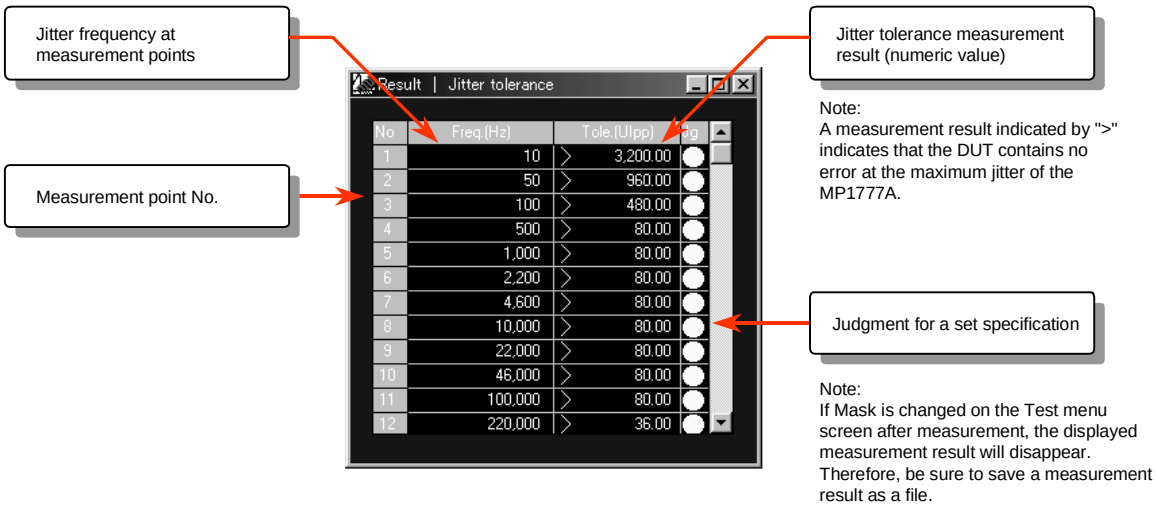


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



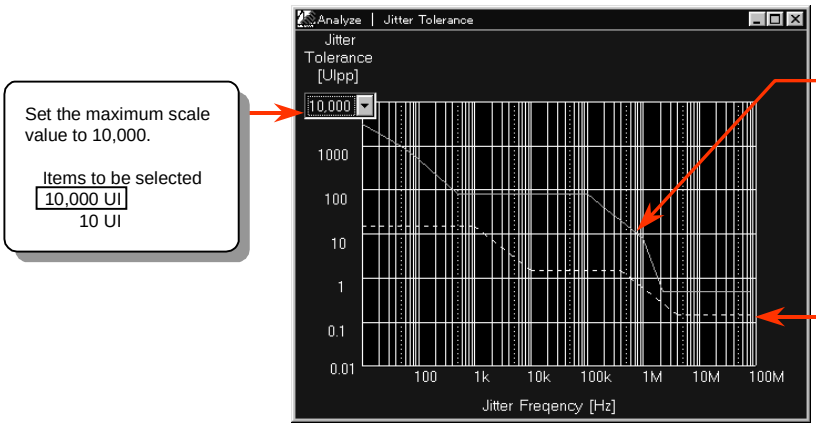
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Note:
If Mask is changed on the Test menu screen after measurement, the displayed measurement result will disappear. Therefore, be sure to save a measurement result as a file.

Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.2 Example of Jitter Transfer Characteristics Measurement for STM-64/OC-192 Clock recovery Module

This jitter transfer characteristics measurement measures to what extent a DUT attenuates the jitter component of a jitter-modulated data signal at each jitter frequency when a signal is input to an STM-64/OC-192 clock recovery module.

The MX177701A Jitter Performance Test Software automatically controls the MP1777A 10 GHz Jitter Analyzer and MS4630B Network Analyzer for the measurement. This software enables jitter transfer measurement at 55 points for only 100 seconds, and is suitable for the applications in research and development departments and manufacturing and inspection departments.

6.2.1 Example of measurement connection

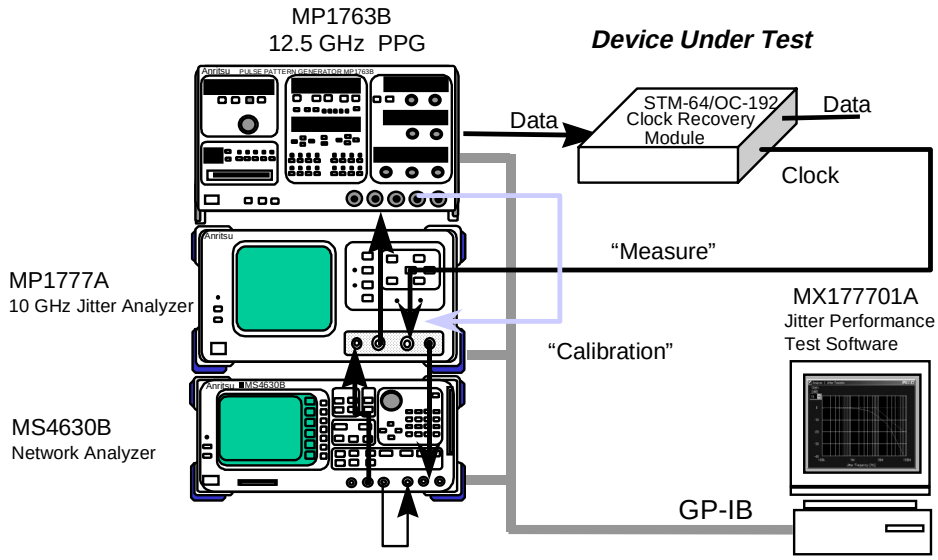


Figure 6-2-1 Connection for jitter transfer characteristics measurement

---

Note: The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the MP1763B 12.5 GHz Pulse Pattern Generator. Before automatic jitter measurement is started, it must be set to the optimum condition.

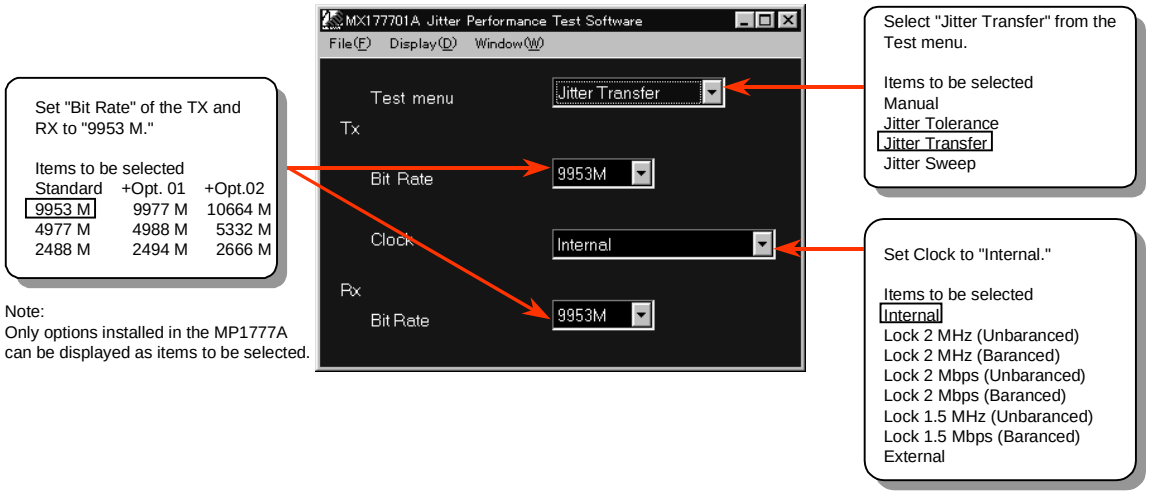
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6.2.2 Measurement procedure

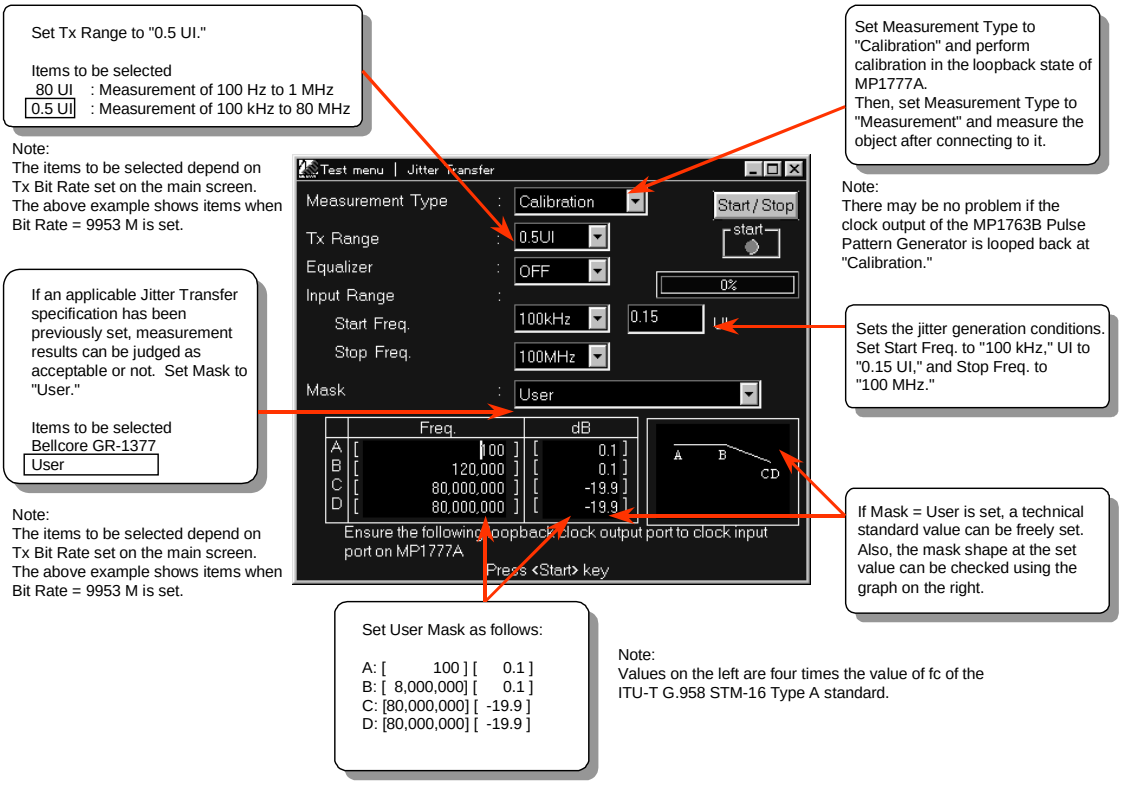
This section explains the procedure for jitter transfer measurement for a STM-64/OC-192 clock recovery module.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

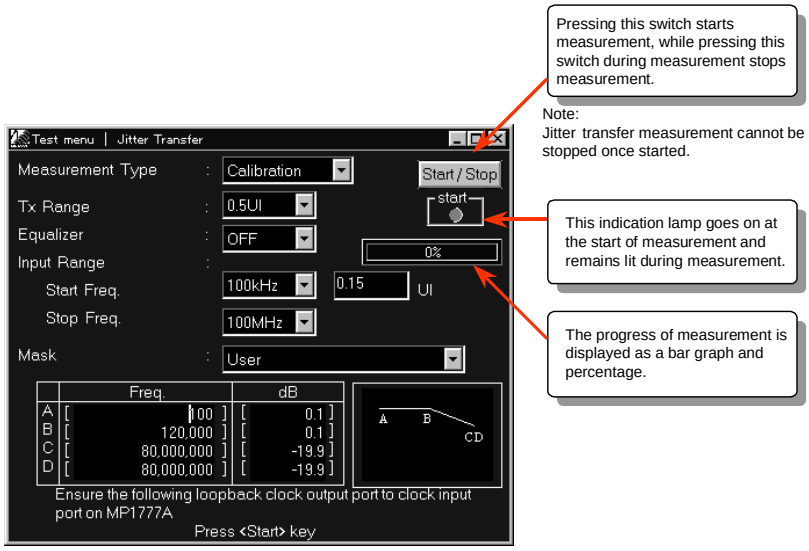


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen of the MX177701A Jitter Performance Test Software.

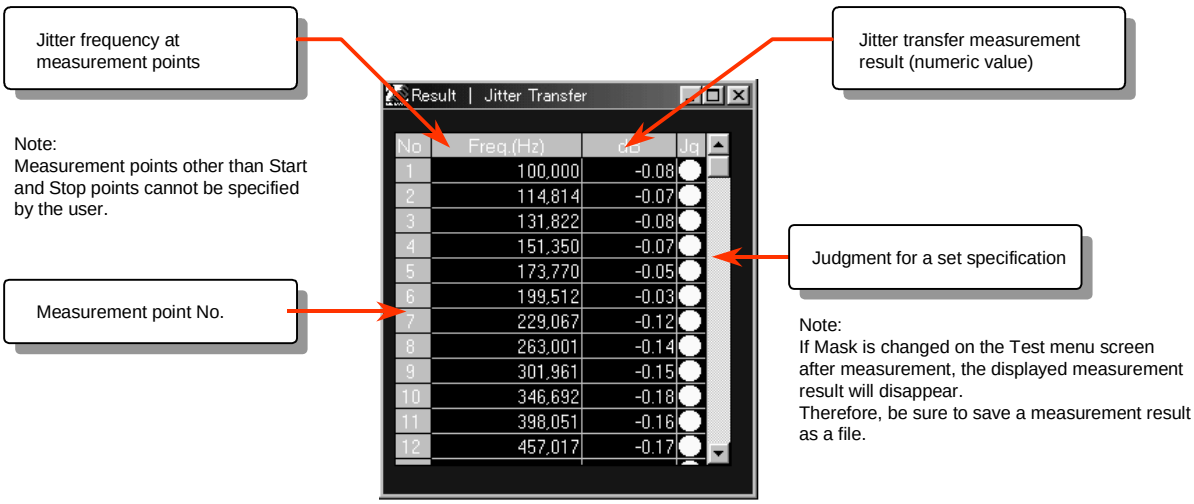


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



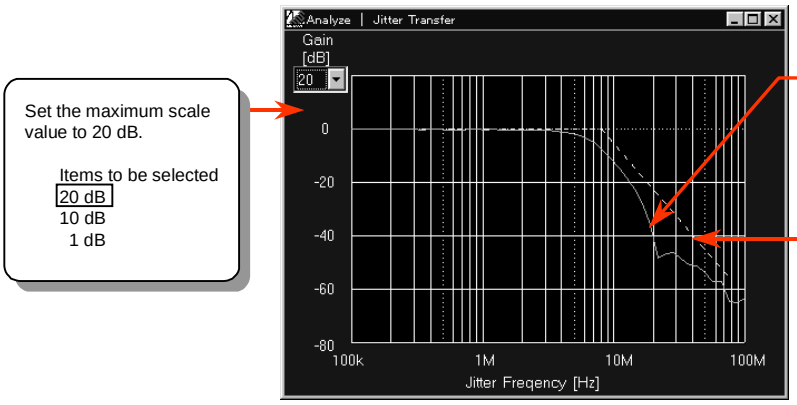
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Set the maximum scale value to 20 dB.

Items to be selected
20 dB
10 dB
1 dB

Jitter transfer measurement result (graph)

Set standard value (Mask)

Note:
If Mask is changed on the Test menu screen after measurement, the displayed measurement result will disappear. Therefore, be sure to save a measurement result as a file.

Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.3 Example of Jitter Generation Measurement for STM-64/OC-192 Clock recovery Module

This Jitter generation measurement measures the jitter of a DUT when a data signal without jitter (Jitter = OFF) is input to an STM-64/OC-192 clock recovery module.

Jitter generation measurement has generally been done using UIrms units. However, ITU-T has recently reviewed jitter generation measurement, and measurement using UIpp units is also requested. The MP1777A enables measurement that satisfies a jitter band of 80 MHz in UIpp and UIrms units.

6.3.1 Example of measurement connection

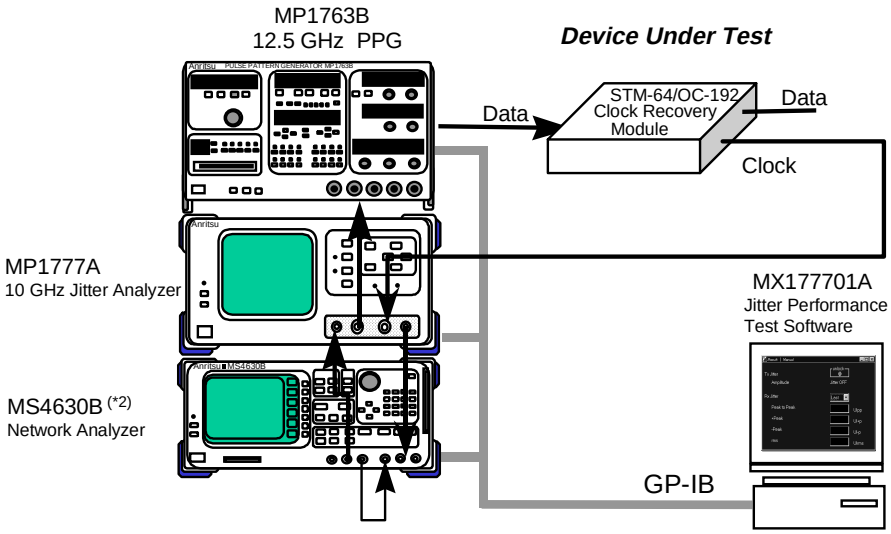


Figure 6-3-1 Connection for jitter generation measurement

Note:

(1) The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the MP1763B 12.5 GHz Pulse Pattern Generator. Before automatic jitter measurement is started, it must be set to the optimum condition.

(2) For jitter generation measurement, the jitter generator does not require a modulated signal. When the MX177701A Jitter Performance Test Software is not used, the MS4630B Network Analyzer is not required for measurement.

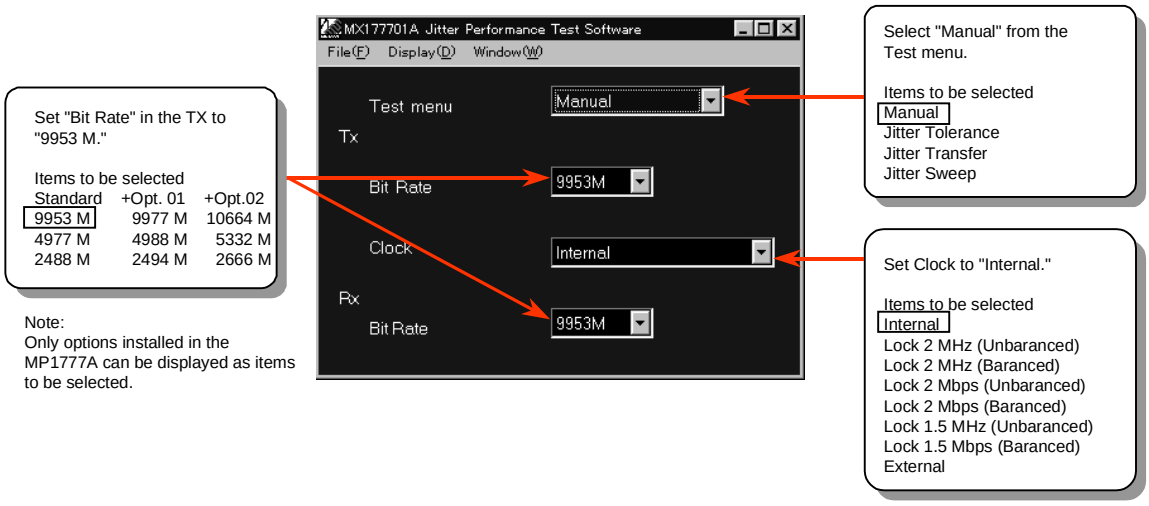
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6.3.2 Measurement procedure

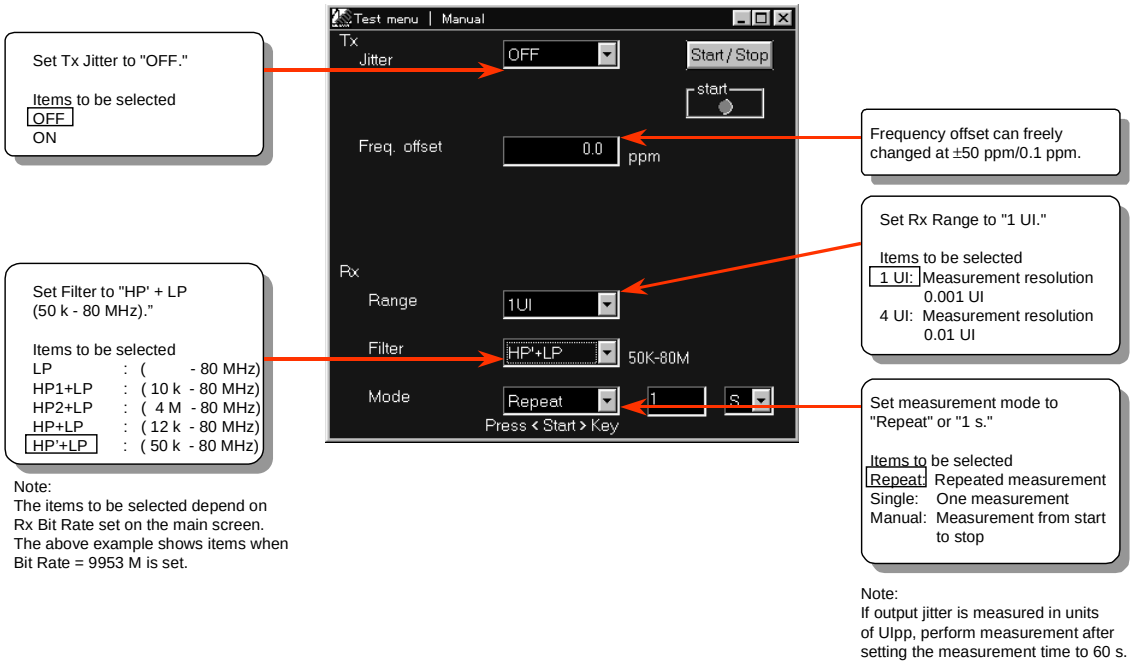
This section explains the procedure for jitter generation measurement for a STM-64/OC-192 clock recovery module (reference standard Bellcore GR-1377).

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

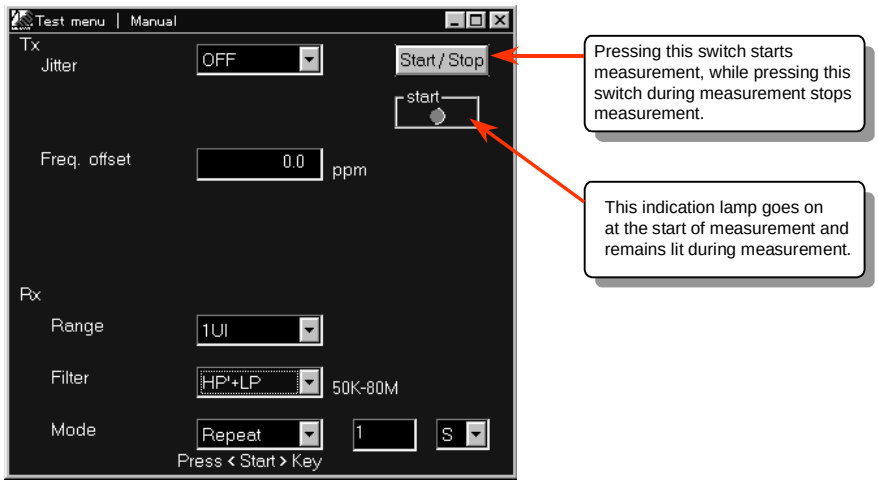


(2) Set the measurement conditions on the Test menu screen for the MX177701A Jitter Performance Test Software.

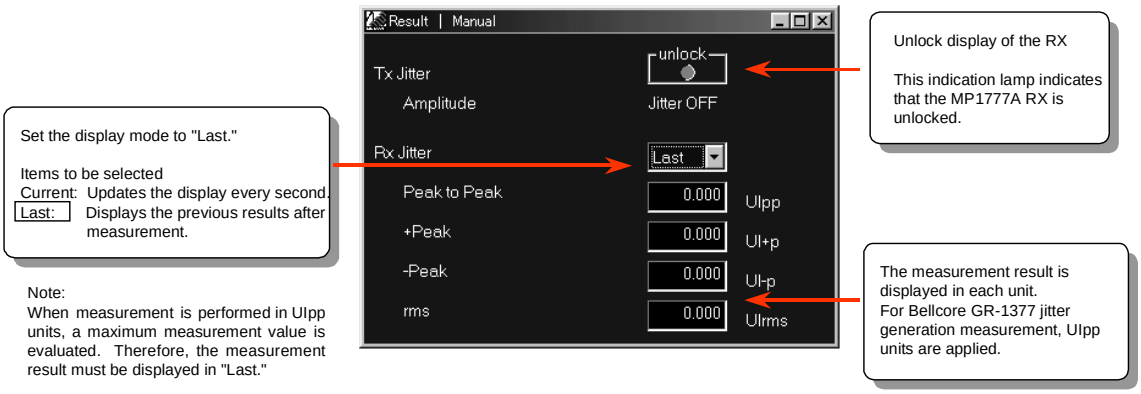


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(3) Press the Start/Stop button on the Test menu screen for the MX177701A Jitter Performance Test Software to start measurement.



(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.4 Example of Jitter Sweep Measurement for Clock recovery Module for Submarine Transmission System

This jitter sweep measurement checks whether an error occurs when a jitter-modulated data signal is input to a clock recovery module for submarine transmission systems.

MX177701A Jitter Performance Test Software enables use of a measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point. This software also enables use of a measurement method (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs. The former method (jitter tolerance measurement) is suitable for the applications such as performance evaluation for the DUT in research and development departments. The latter method (jitter sweep measurement) is suitable for the applications such as shipment inspection during mass production of the DUT in the manufacturing departments.

6.4.1 Example of measurement connection

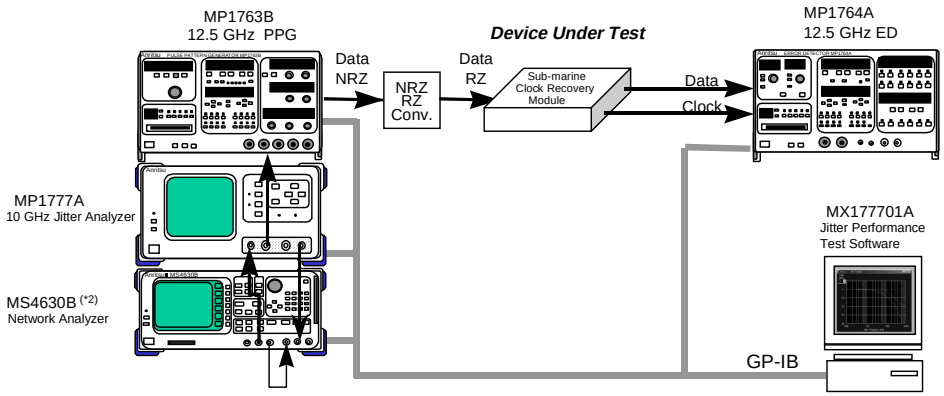


Figure 6-4-1 Connection for jitter sweep measurement

Notes:

(1) The signal input to the clock recovery module for submarine transmission system is generally RZ. An NRZ/RZ converter is required for the output of the MP1763B Pulse Pattern Generator.

(2) The MX177701A Jitter Performance Test Software does not exercise control related to the interfaces with the MP1763B Pulse Pattern Generator and MP1764A Error Detector. Before measurement, they must be set to the optimum condition.

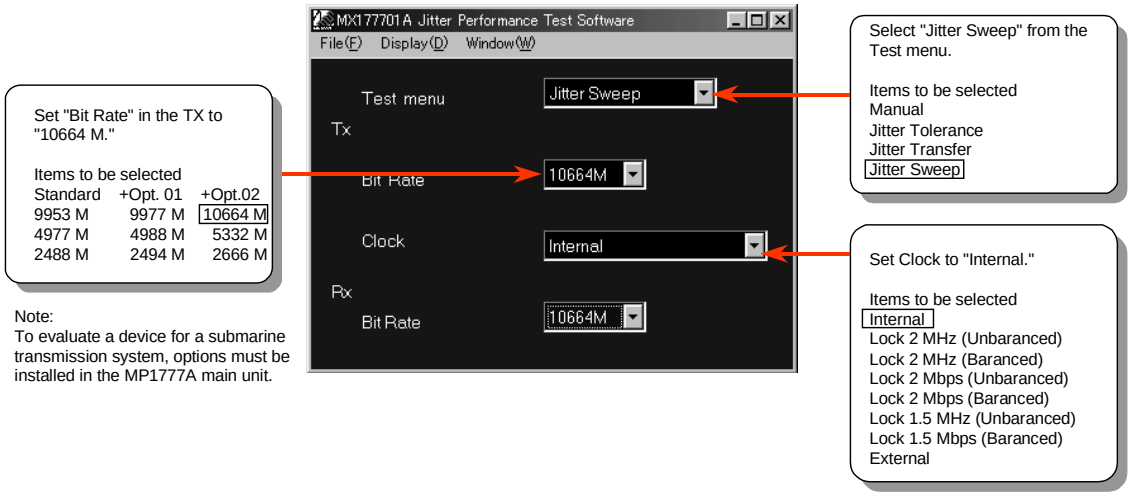
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6.4.2 Measurement procedure

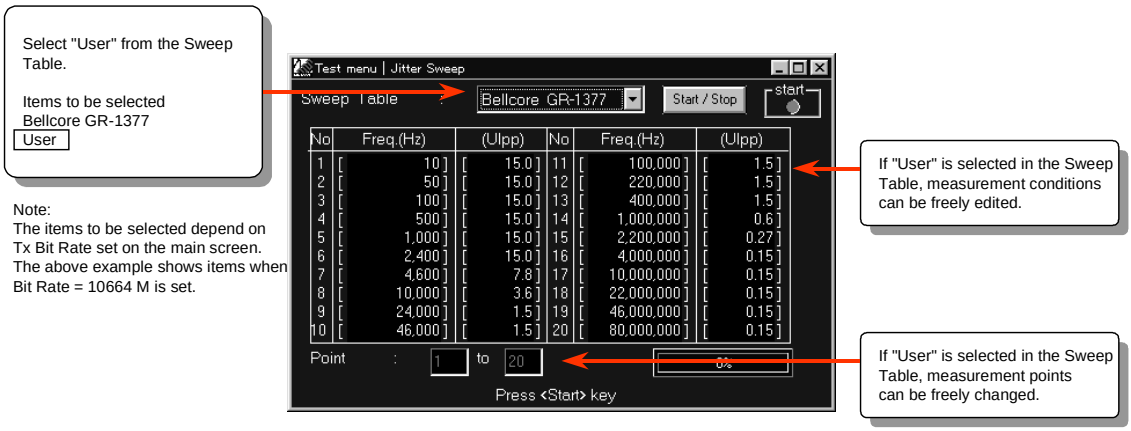
This section explains an example of measurement (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

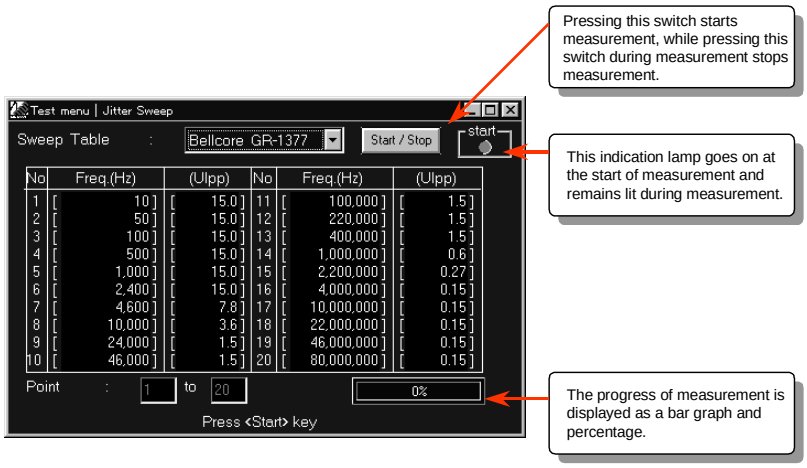


(2) Set the measurement point (Sweep Table) on the Test menu screen of the MX177701A Jitter Performance Test Software.

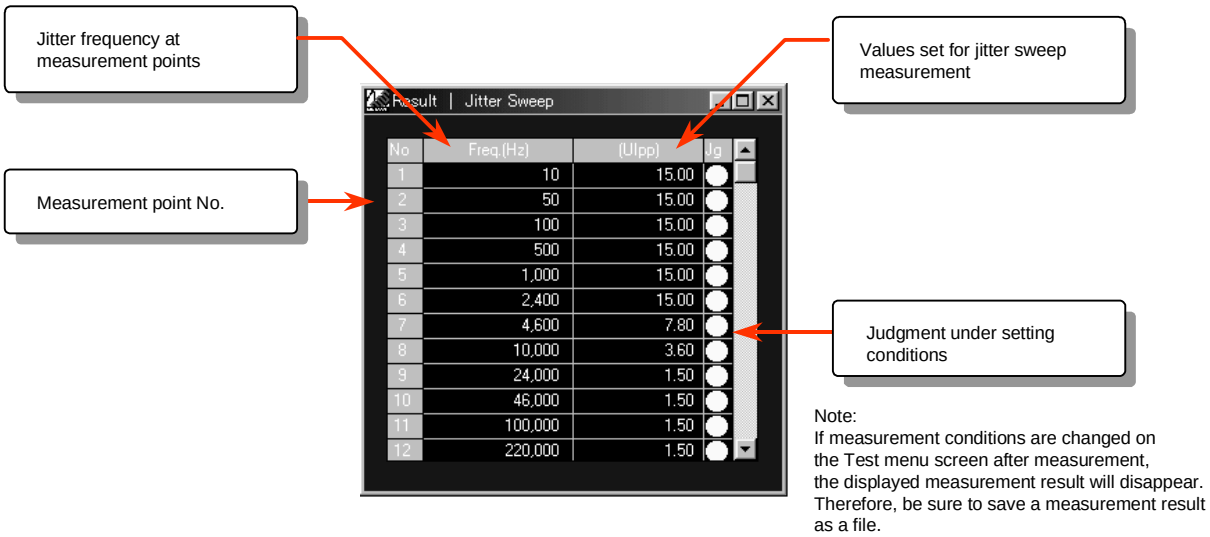


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right end is an abbreviation of Judge and indicates whether an error occured when the quantity of jitter with the Sweep Table value set on the Test menu screen is generated. "○" means that no error occurs, and "●" means that an error occurs.

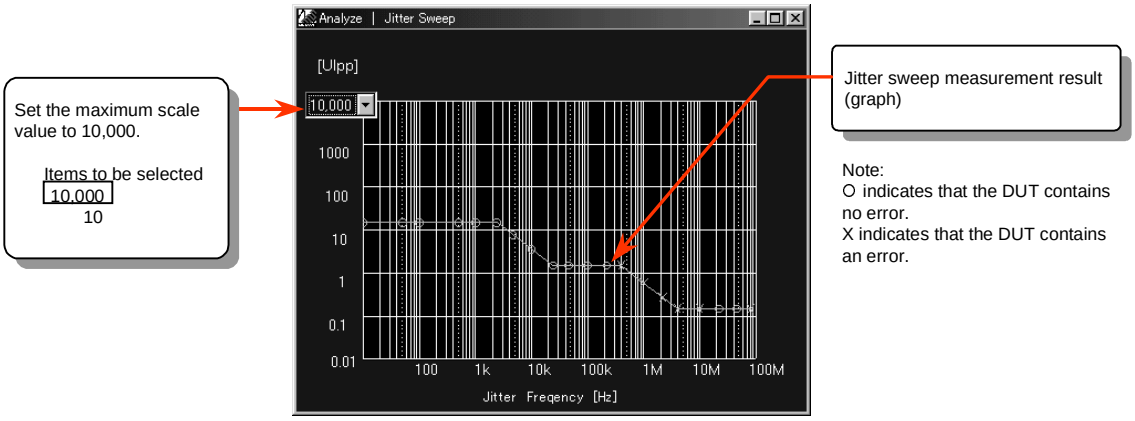


Note:
If measurement conditions are changed on the Test menu screen after measurement, the displayed measurement result will disappear. Therefore, be sure to save a measurement result as a file.

Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. ○ or × indicates the measurement point. ○ indicates that no error occurs, and × indicates that an error occurs.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.5 Example of Jitter Transfer Characteristics Measurement for Clock recovery Module for Submarine Transmission System

This jitter transfer characteristics measurement measures to what extent the DUT attenuates the jitter component of a jitter-modulated data signal at each jitter frequency when a signal is input to a clock recovery module for submarine transmission systems.

The MX177701A Jitter Performance Test Software automatically controls the MP1777A 10 GHz Jitter Analyzer and MS4630B Network Analyzer for the measurement. This software enables jitter transfer measurement at 55 points for only 100 seconds, and is suitable for the applications in research and development departments and manufacturing and inspection departments.

6.5.1 Example of measurement connection

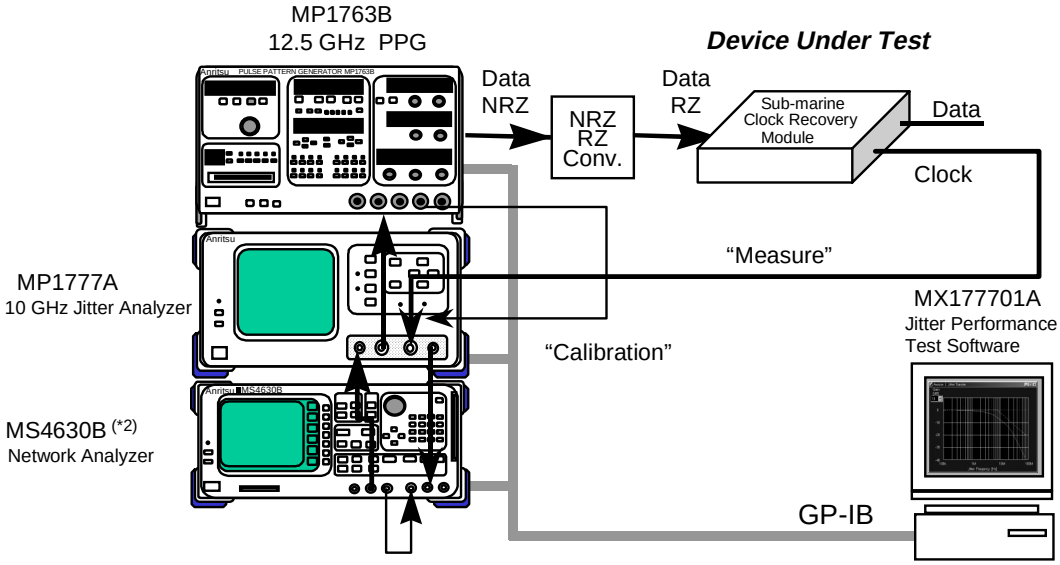


Figure 6-5-1 Connection for jitter transfer characteristics measurement

---

Notes:

(1) The signal input to the clock recovery module for submarine transmission system is generally RZ. The NRZ/RZ converter is required for the output of the MP1763B Pulse Pattern Generator.

(2) The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the MP1763B Pulse Pattern Generator. Before measurement, it must be set to the optimum condition.

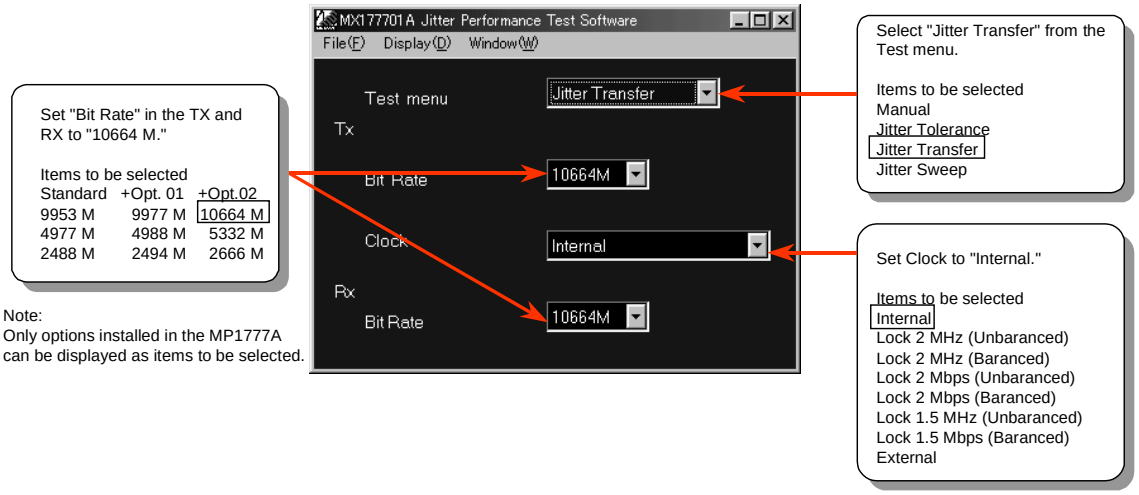
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6.5.2 Measurement procedure

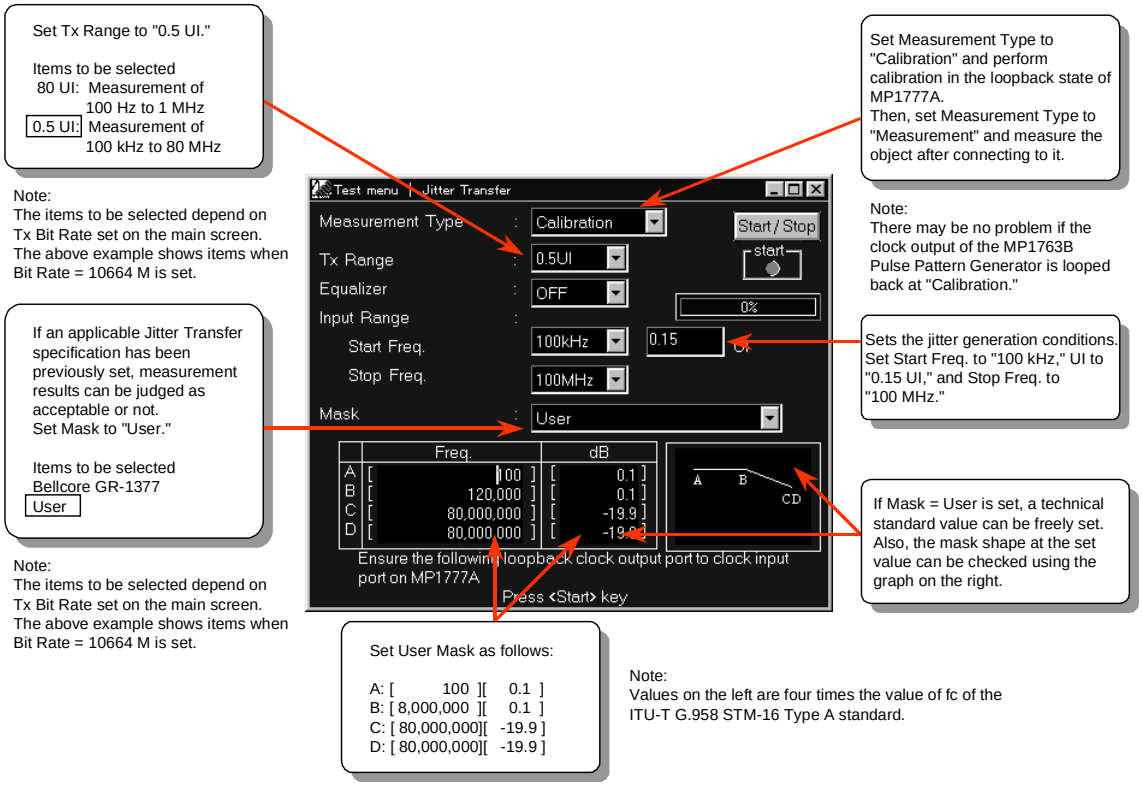
This section explains the procedure for jitter transfer measurement for a clock recovery module for submarine transmission systems.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

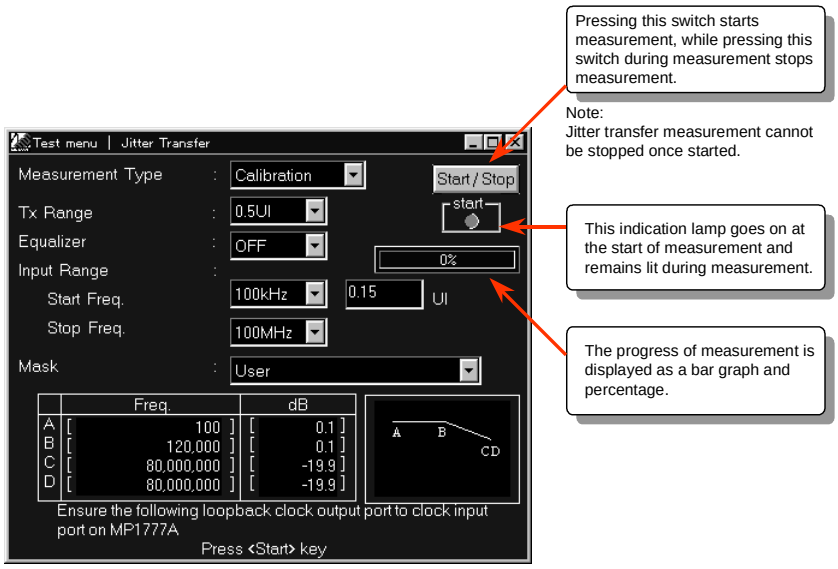


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen of the MX177701A Jitter Performance Test Software.

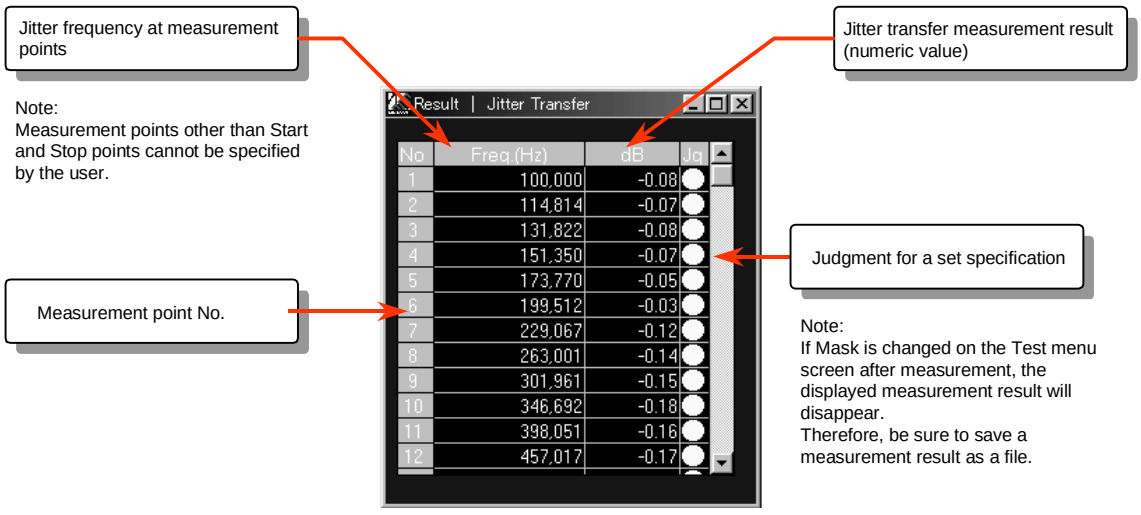


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



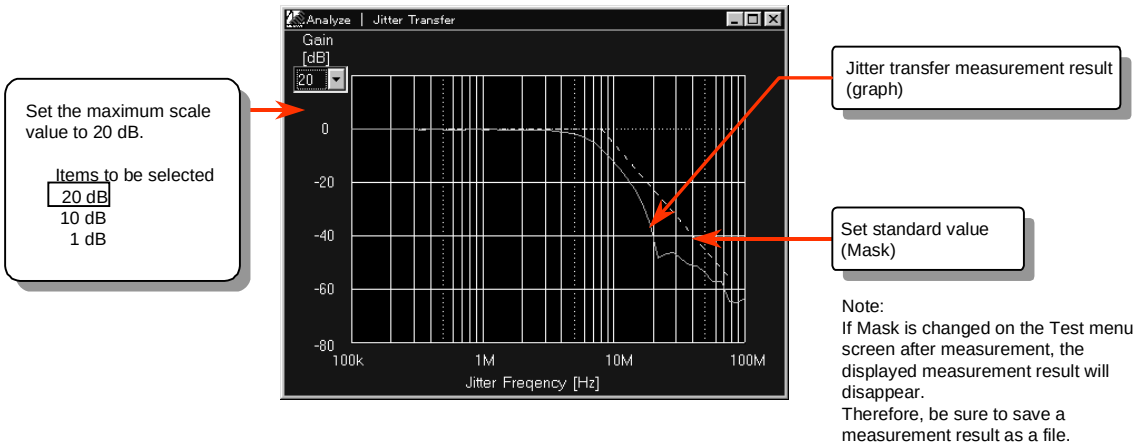
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.6 Example of Jitter Generation Measurement for Clock recovery Module for Submarine Transmission System

This jitter generation measurement measures the jitter of a DUT when a data signal without jitter (Jitter = OFF) is input to a clock recovery module for submarine transmission systems.

The jitter standard related to submarine transmission equipment is not available. However, this section explains an example of measurement to which the SDH standard is applied based on conversion with SDH. Jitter generation measurement has generally been made using UIrms units. However, ITU-T has recently reviewed jitter generation measurement, and measurement using UIpp units is also requested. The MP1777A enables measurement that satisfies a jitter band of 80 MHz in UIpp and UIrms units.

6.6.1 Example of measurement connection

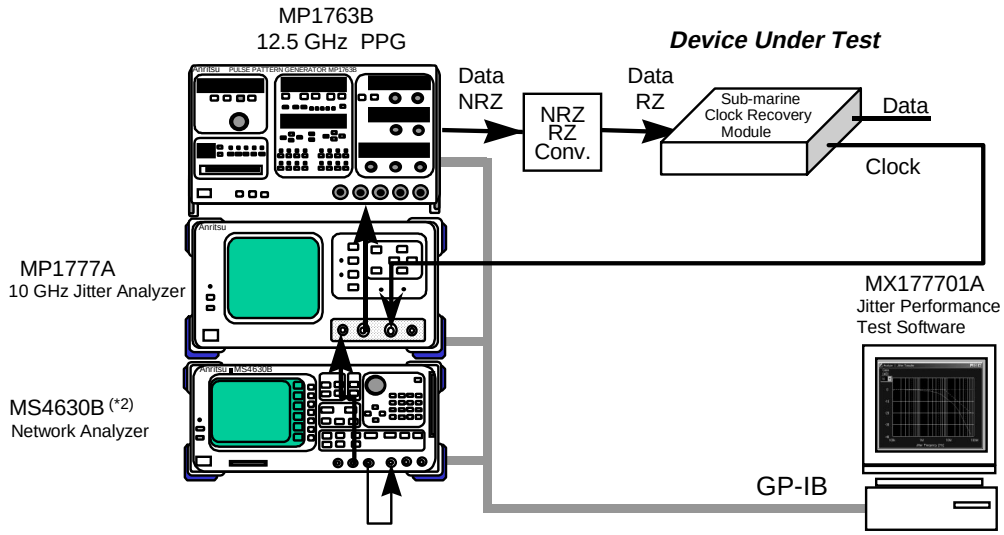


Figure 6-6-1 Connection for jitter generation measurement

Notes:

(1) The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the MP1763B 12.5 GHz Pulse Pattern Generator. Before automatic jitter measurement is started, it must be set to the optimum condition.

(2) For jitter generation measurement, the jitter generator does not require the modulated signal. When the MX177701A Jitter Performance Test Software is not used, the MS4630B Network Analyzer is not required for measurement.

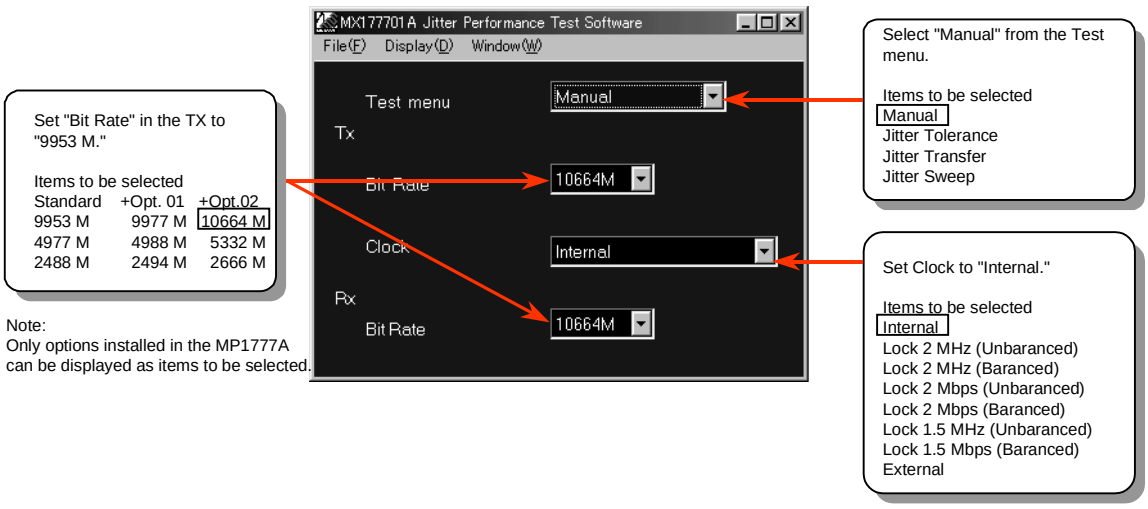
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6.6.2 Measurement procedure

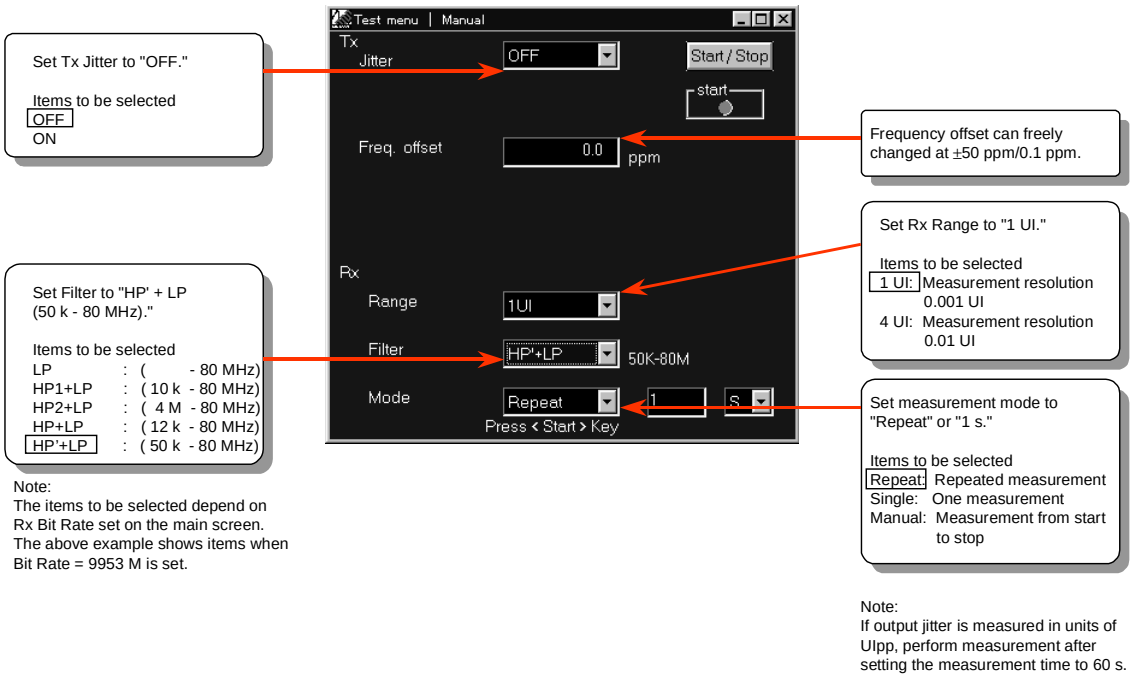
This section explains the procedure for jitter generation measurement for a clock recovery module for submarine transmission systems (reference standard Bellcore GR-1377).

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

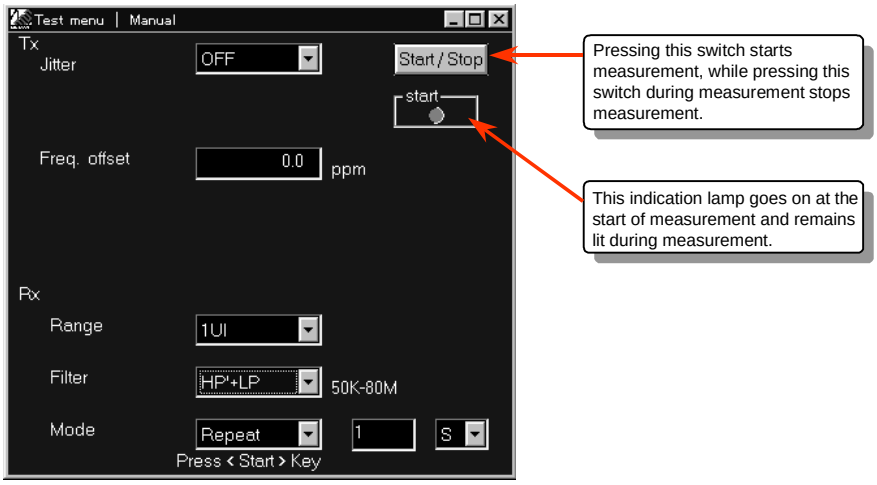


(2) Set the measurement conditions on the Test menu screen of the MX177701A Jitter Performance Test Software.

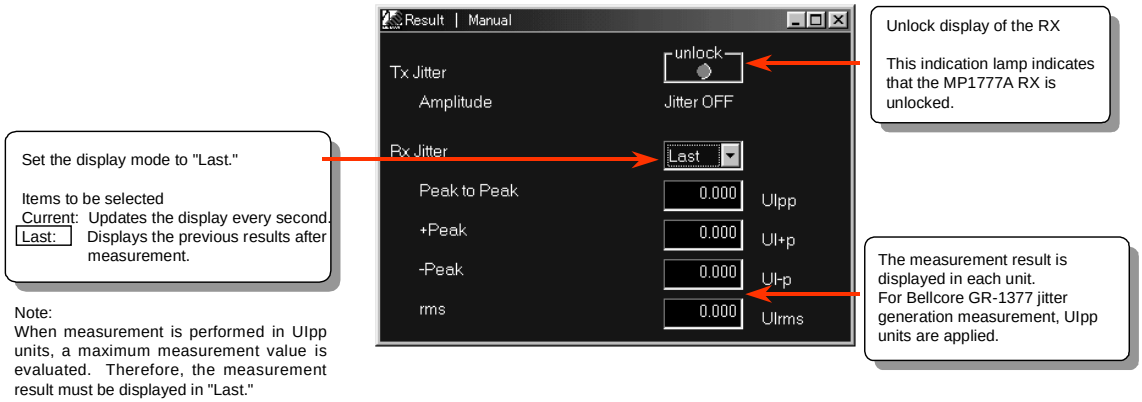


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.7 Example of Jitter Tolerance Measurement for FEC (Forward Error Correction) Encoder and Decoder Module

This jitter tolerance measurement measures the jitter tolerance point at which an error occurs when a jitter-modulated data signal is input to an FEC encoder and decoder module.

The MX177701A Jitter Performance Test Software enables use of a measurement method (jitter tolerance measurement) that finds and evaluates the actual jitter tolerance point. This software also enables use of a measurement method (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs. The former method (jitter tolerance measurement) is suitable for applications such as performance evaluation for the measured in research and development departments. The latter method (jitter sweep measurement) is suitable for applications such as shipment inspection during mass production of the DUT in manufacturing departments.

6.7.1 Example of measurement connection

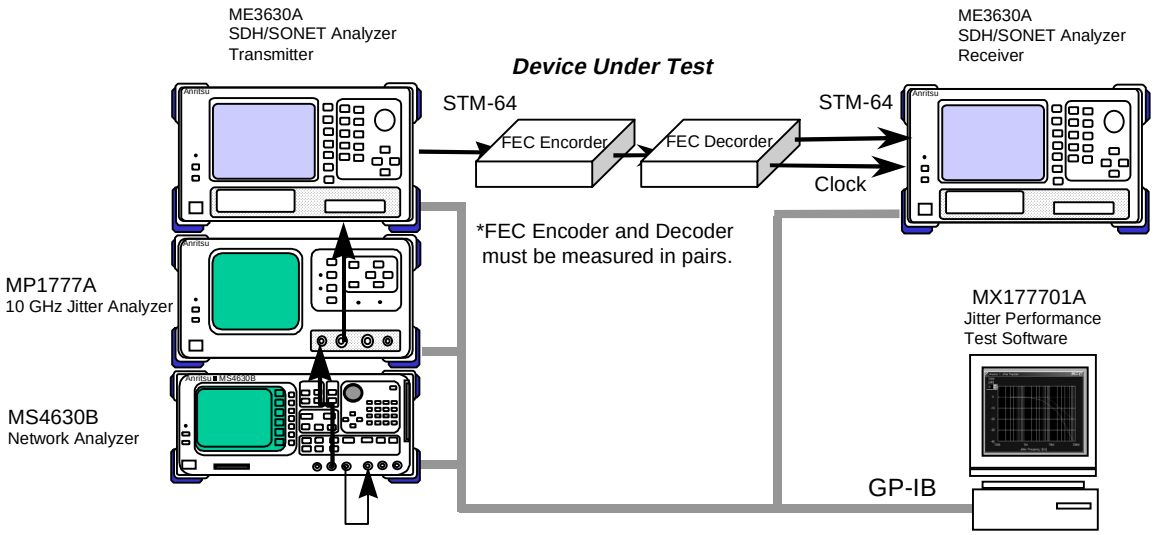


Figure 6-7-1 Connection for jitter tolerance measurement

Note: The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the ME3630A SDH/SONET Analyzer. Before automatic jitter measurement is started, it must be set to the optimum condition.

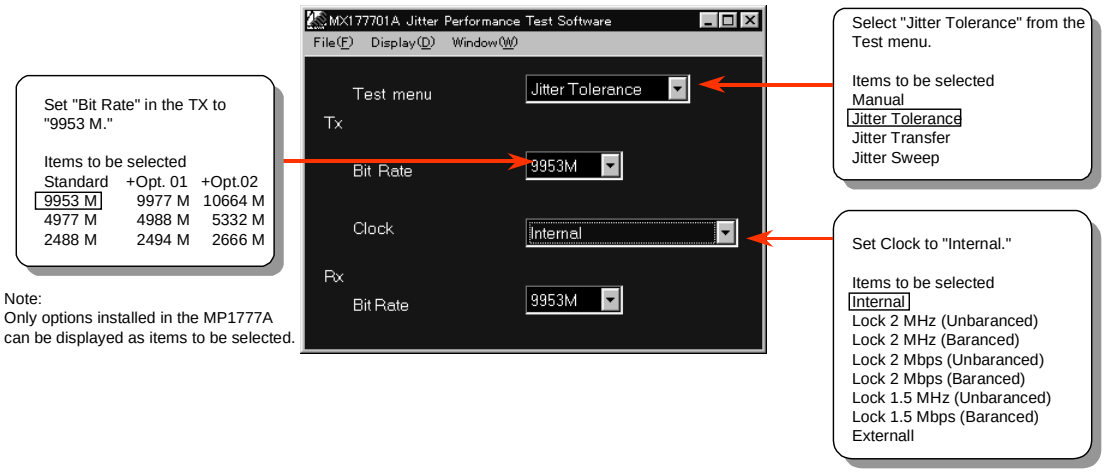
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6.7.2 Measurement procedure

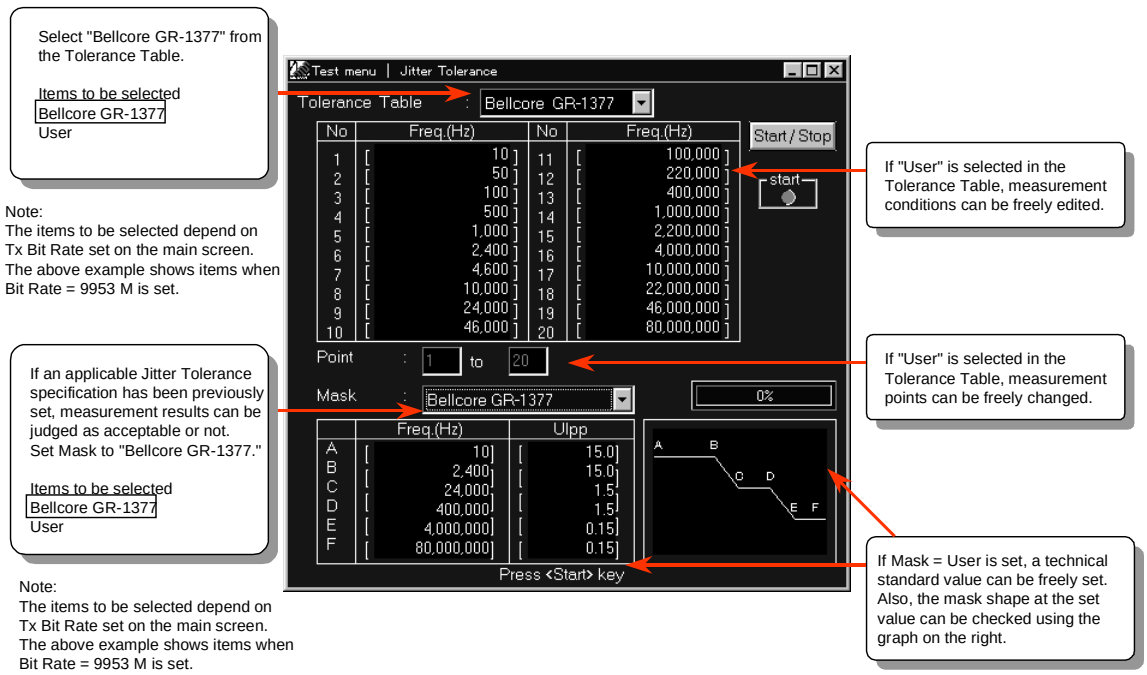
This section explains the measurement procedure for the measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

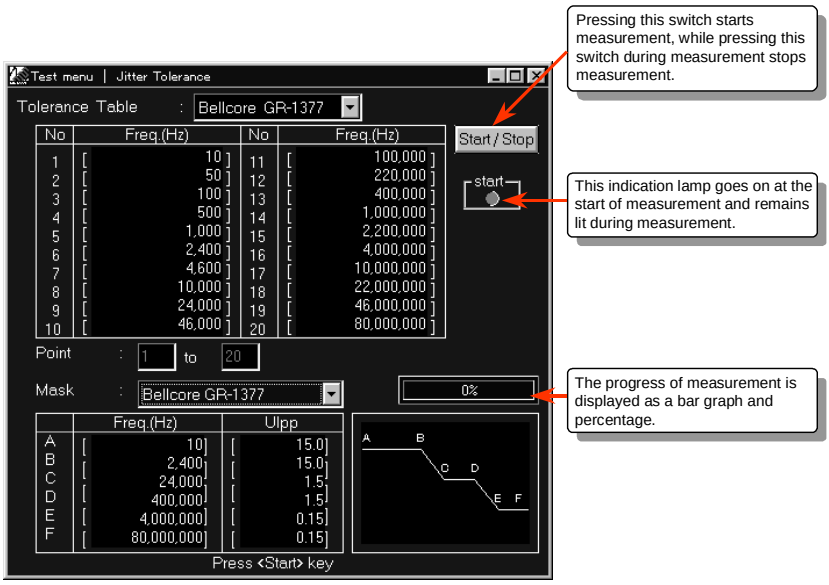


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen for the MX177701A Jitter Performance Test Software.

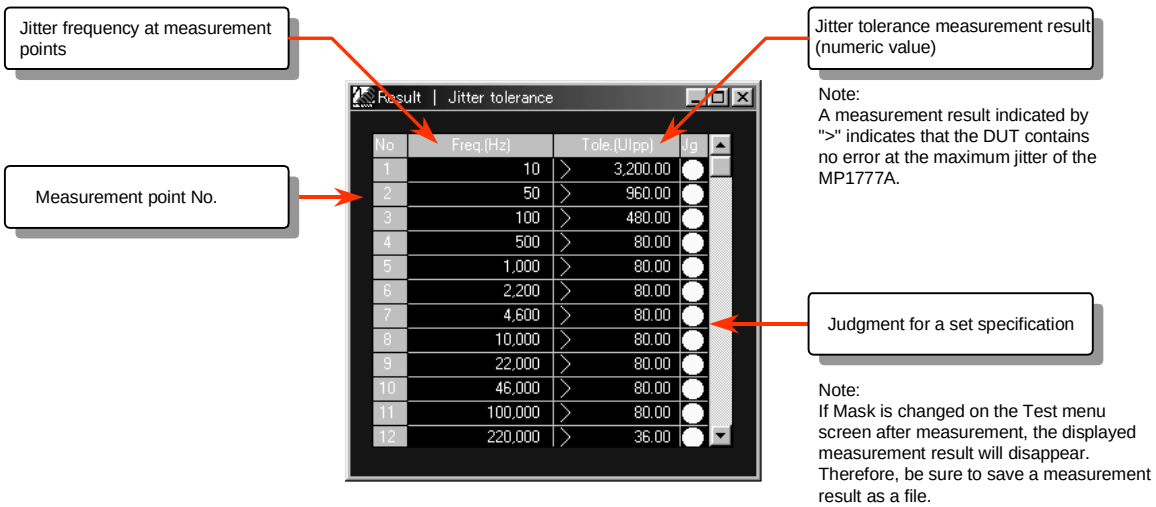


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



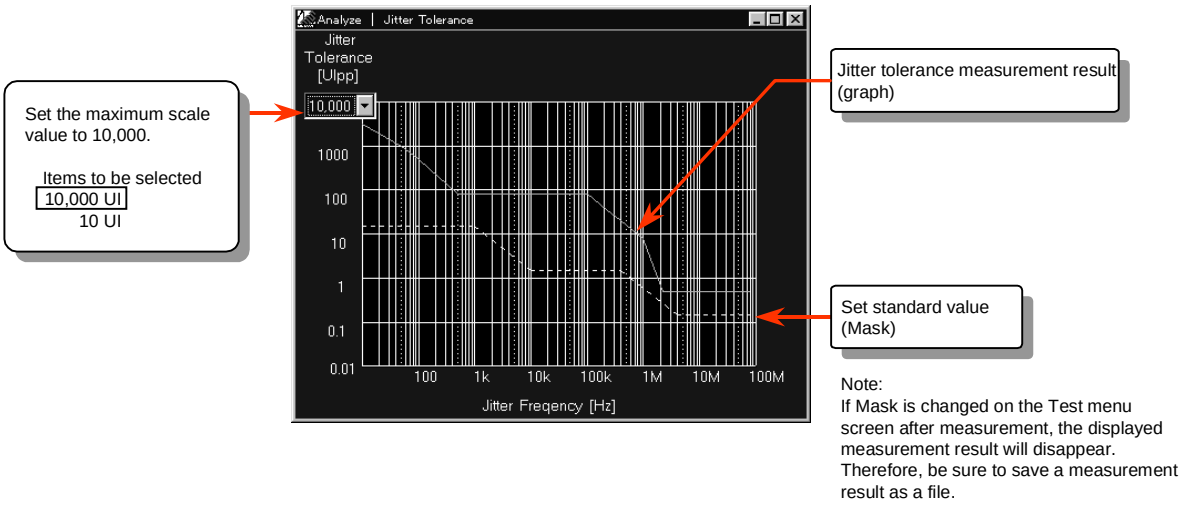
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.8 Example of Jitter Transfer Characteristics Measurement for FEC Encoder and Decoder Module

This jitter transfer characteristics measurement measures to what extent the DUT attenuates the jitter component of the jitter-modulated data signal at each jitter frequency when the signal is input to an FEC encoder and decoder module.

The MX177701A Jitter Performance Test Software automatically controls the MP1777A 10 GHz Jitter Analyzer and MS4630B Network Analyzer for the measurement. This software enables jitter transfer measurement at 55 points for only 100 seconds, and is suitable for applications in research and development departments and manufacturing and inspection departments.

6.8.1 Example of measurement connection

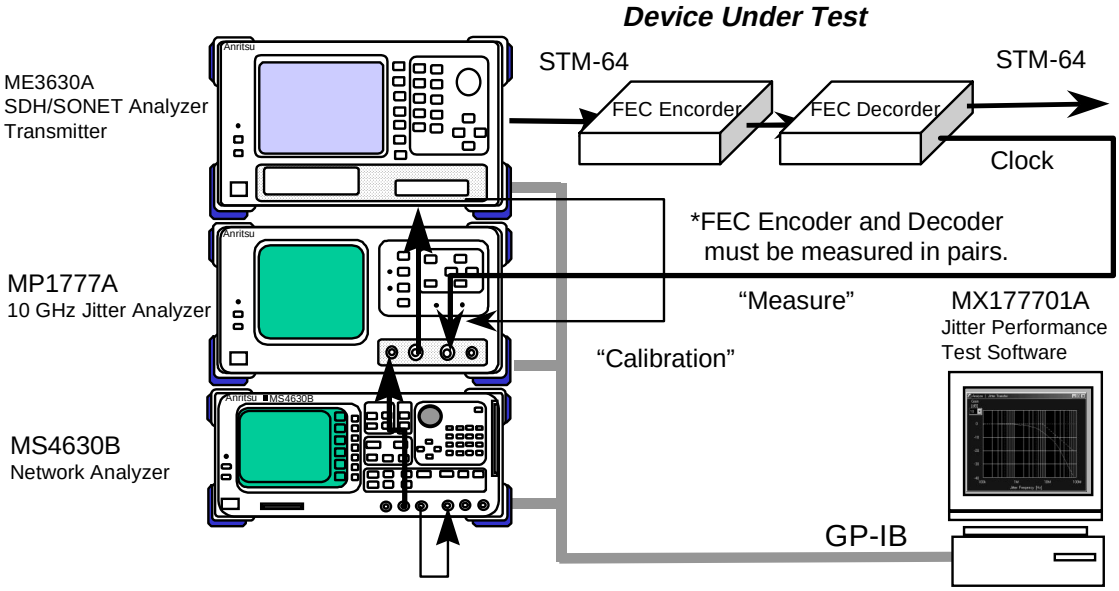


Figure 6-8-1 Connection for jitter transfer characteristics measurement

---

Notes:

(1) The signal input to a clock recovery module for submarine transmission systems is generally RZ. An NRZ/RZ converter is required for the output of the ME3630A SDH/SONET Analyzer.

(2) The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the ME3630A SDH/SONET Analyzer. Before measurement, it must be set to the optimum condition.

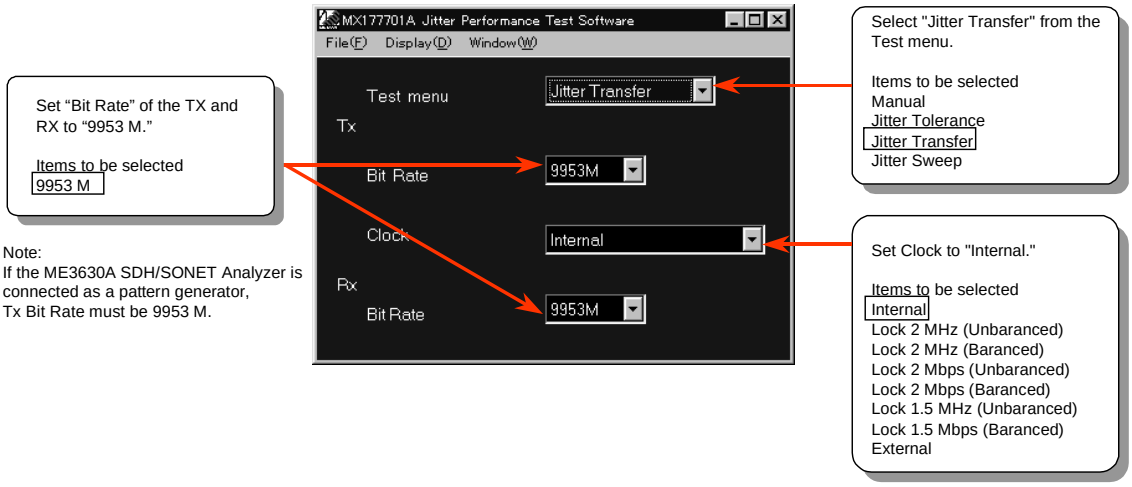
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6.8.2 Measurement procedure

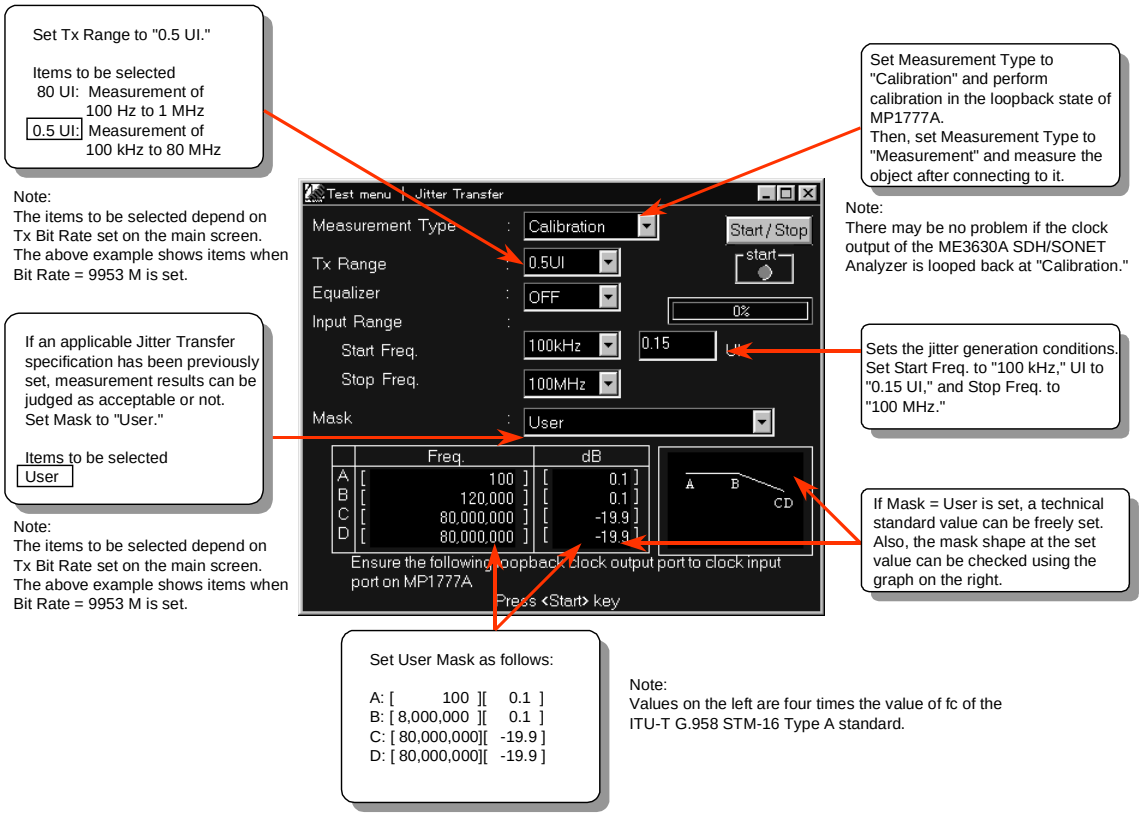
This section explains the procedure for jitter transfer measurement for an FEC encoder/decoder module.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

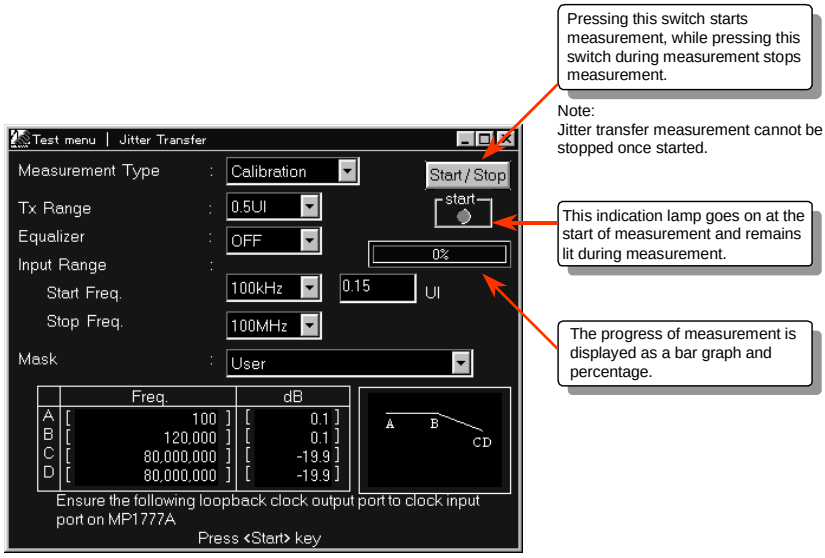


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen of the MX177701A Jitter Performance Test Software.

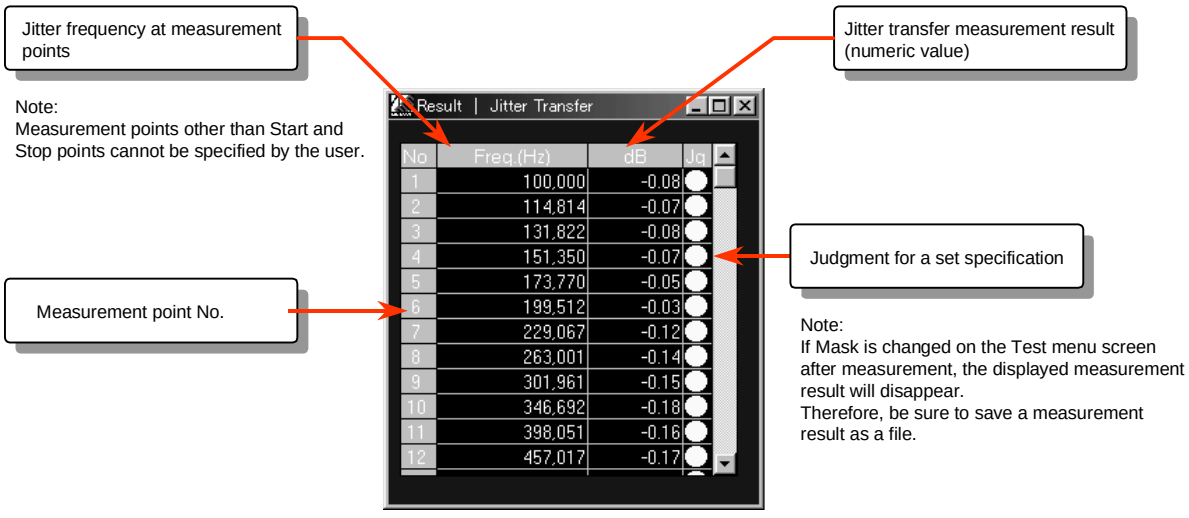


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



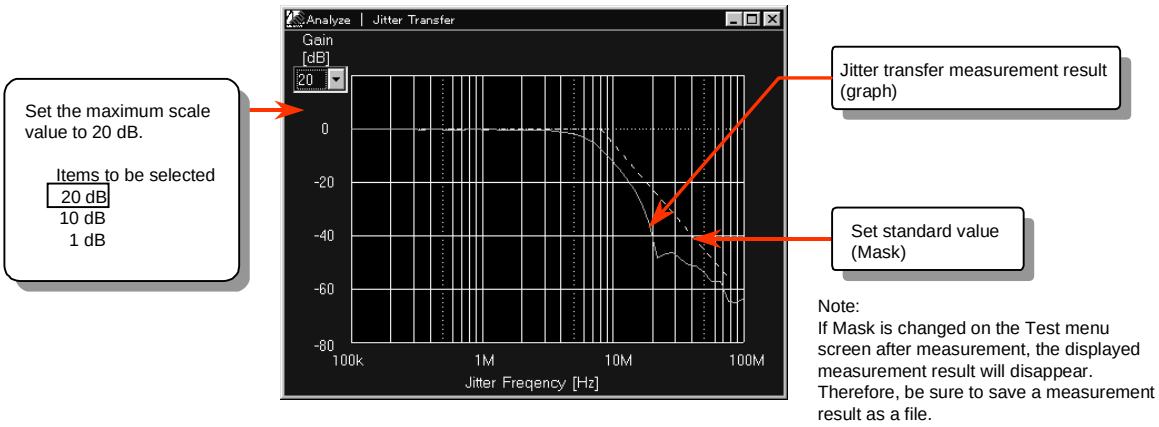
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.9 Example of Jitter Generation Measurement for FEC Encoder/Decoder Module

This jitter generation measurement measures the jitter of the DUT when a data signal without jitter (Jitter = OFF) is input to an FEC encoder/decoder module.

The jitter standard related to submarine transmission equipment is not available. However, this section explains an example of measurement to which the SDH standard is applied based on conversion with SDH. Jitter generation measurement has generally been done using UIrms units. However, ITU-T has recently reviewed jitter generation measurement, and measurement using UIpp units is also requested. The MP1777A enables measurement that satisfies a jitter band of 80 MHz in UIpp and UIrms units.

6.9.1 Example of measurement connection

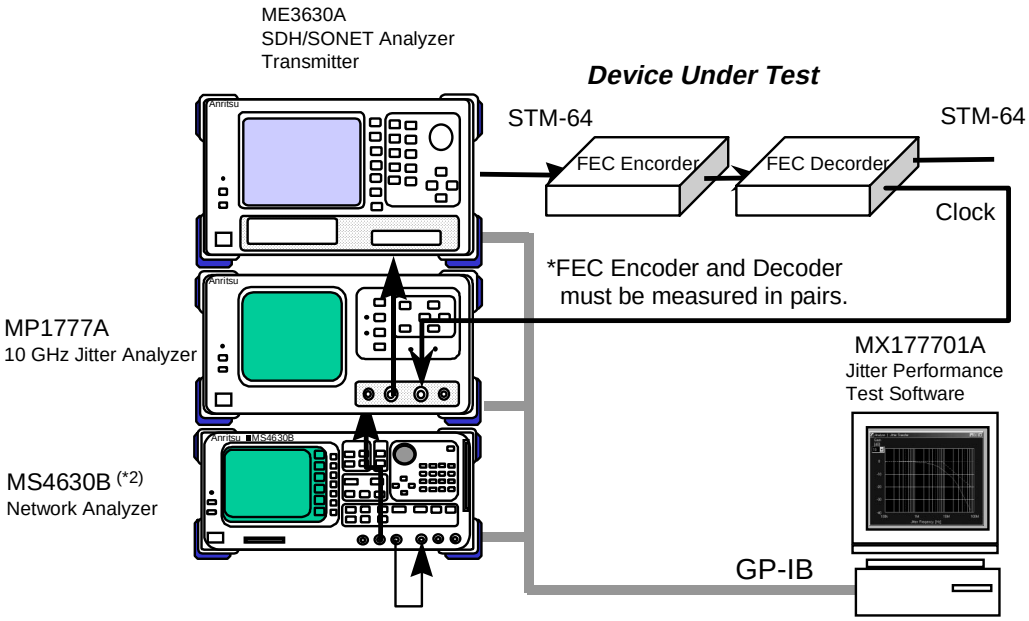


Figure 6-9-1 Connection for jitter generation measurement

Notes:

(1) The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the ME3630A SDH/SONET Analyzer. Before automatic jitter measurement is started, it must be set to the optimum condition.

(2) For jitter generation measurement, the jitter generator does not require a modulated signal. When the MX177701A Jitter Performance Test Software is not used, the MS4630B Network Analyzer is not required for measurement.

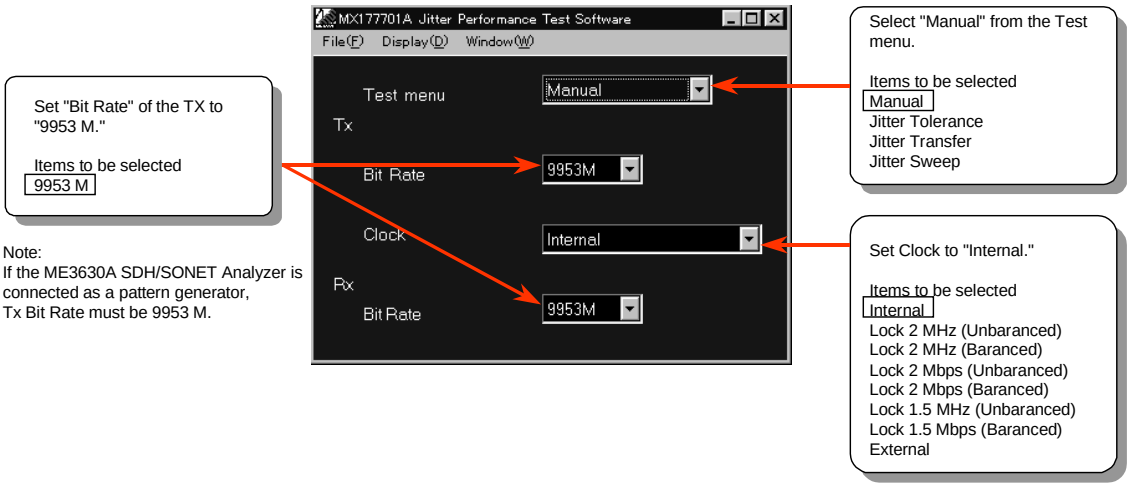
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6.9.2 Measurement procedure

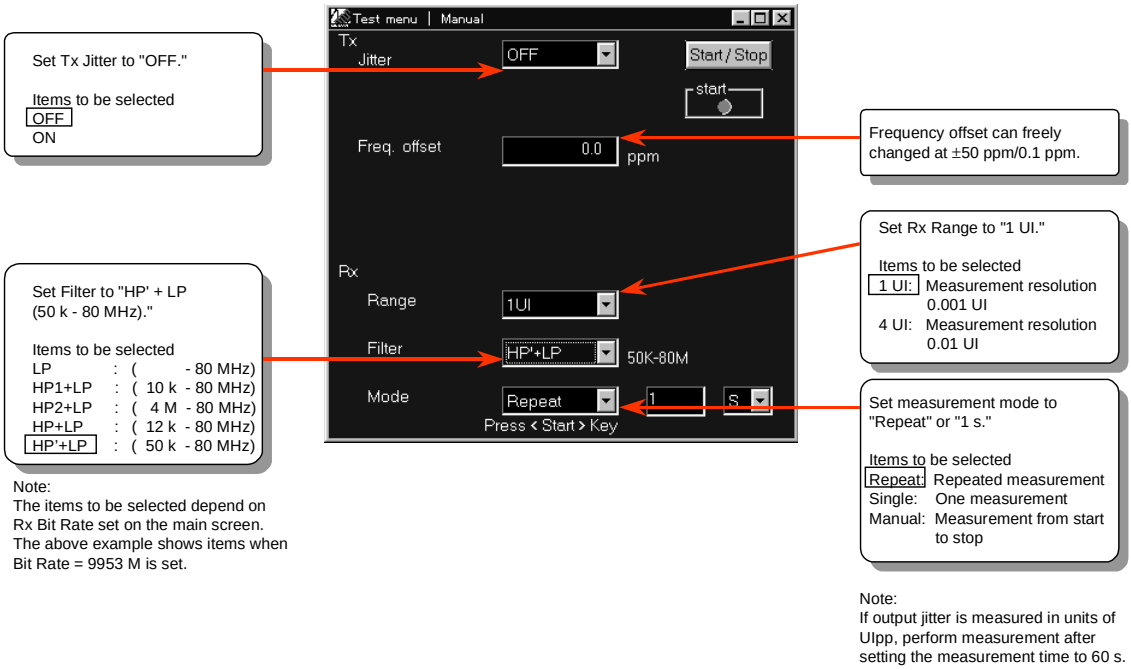
This section explains the procedure for jitter generation measurement for an EFC encoder and decoder module (reference standard Bellcore GR-1377).

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

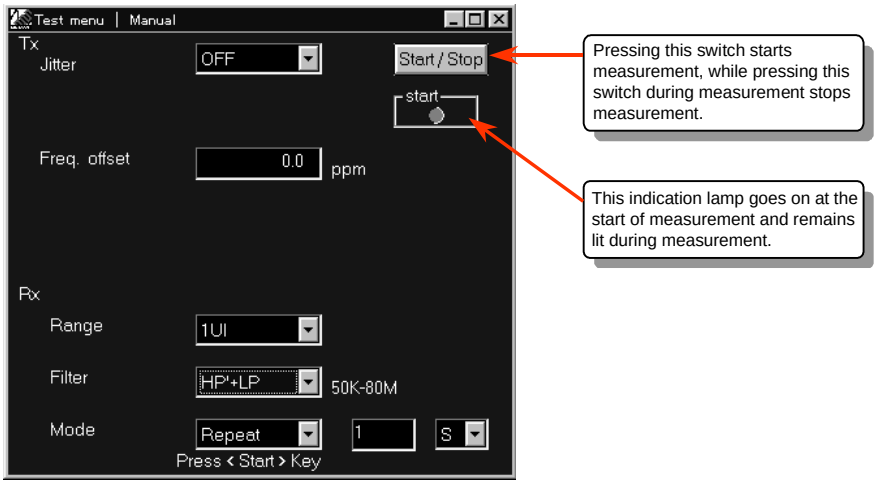


(2) Set the measurement conditions on the Test menu screen of the MX177701A Jitter Performance Test Software.

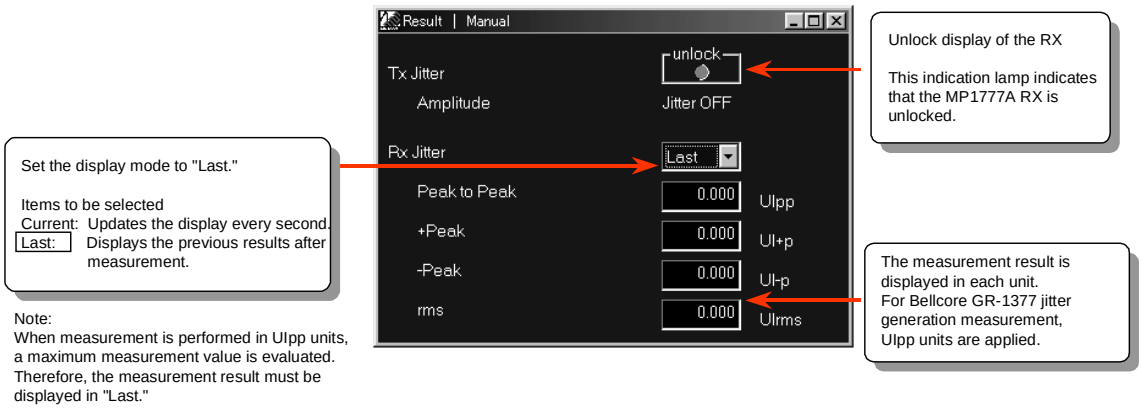


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.10 Example of Jitter Sweep Measurement for MUX/DEMUX Module

This jitter sweep measurement checks the jitter tolerance point at which an error occurs when a jitter-modulated data signal is input to a MUX/DEMUX module.

The MX177701A Jitter Performance Test Software enables use of a measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point. This software also enables use of a measurement method (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs. The former method (jitter tolerance measurement) is suitable for applications such as performance evaluation for the DUT in research and development departments. The latter method (jitter sweep measurement) is suitable for applications such as shipment inspection during mass production of the DUT in manufacturing departments.

6.10.1 Example of measurement connection

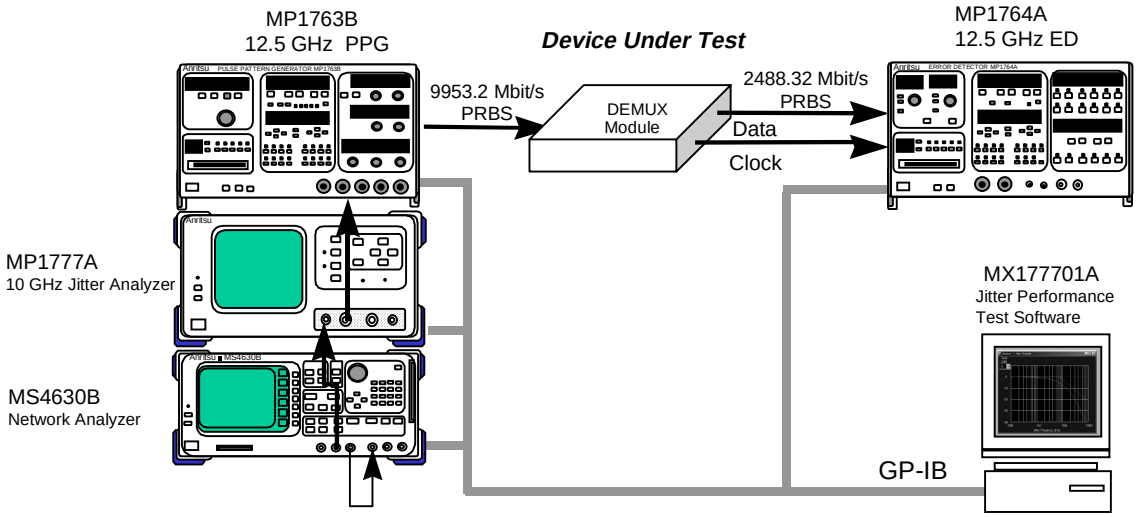


Figure 6-10-1 Connection for jitter sweep measurement

Note: The MX177701A Jitter Performance Test Software does not exercise control related to the interfaces with the MP1763B Pulse Pattern Generator and MP1764A Error Detector. Before measurement, they must be set to the optimum condition.

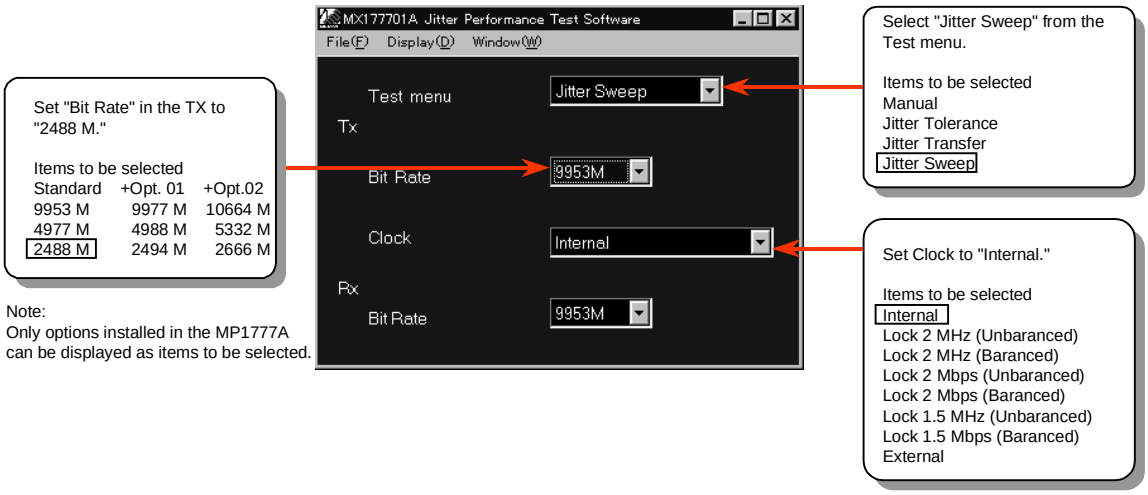
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6.10.2 Measurement procedure

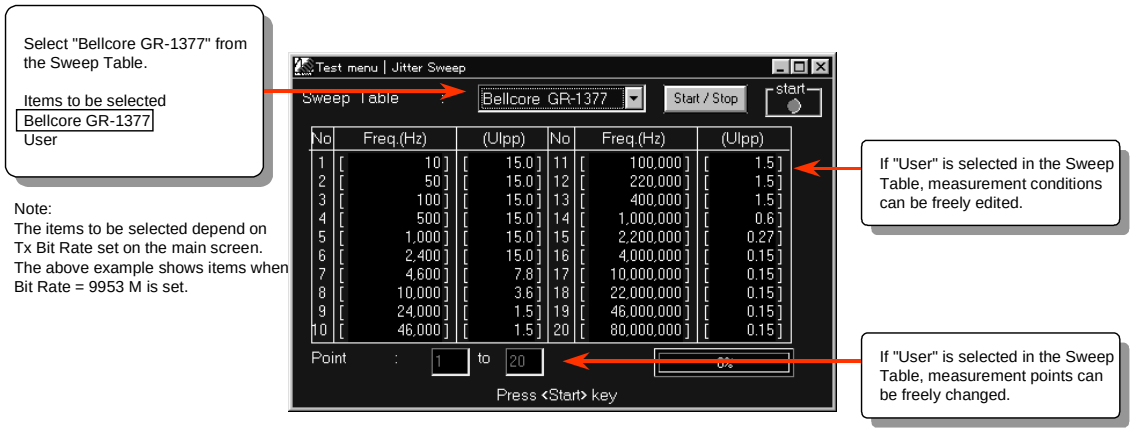
This section explains an example of measurement (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

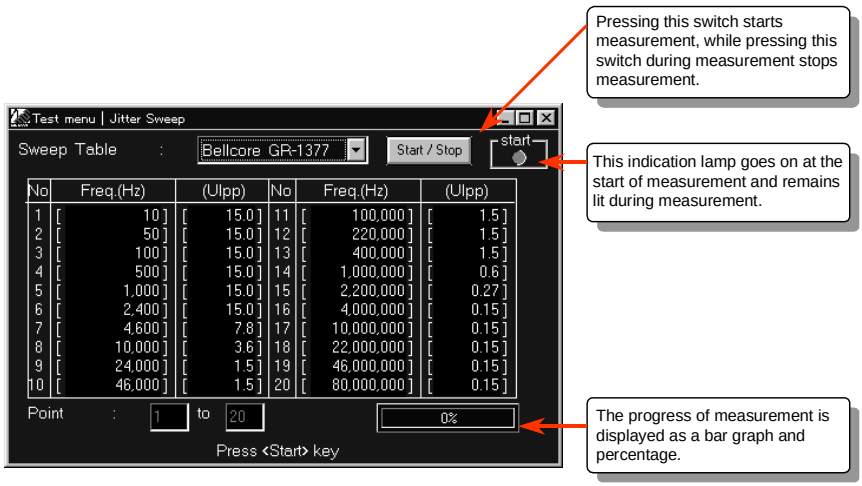


(2) Set the measurement point (Sweep Table) on the Test menu screen of the MX177701A Jitter Performance Test Software.

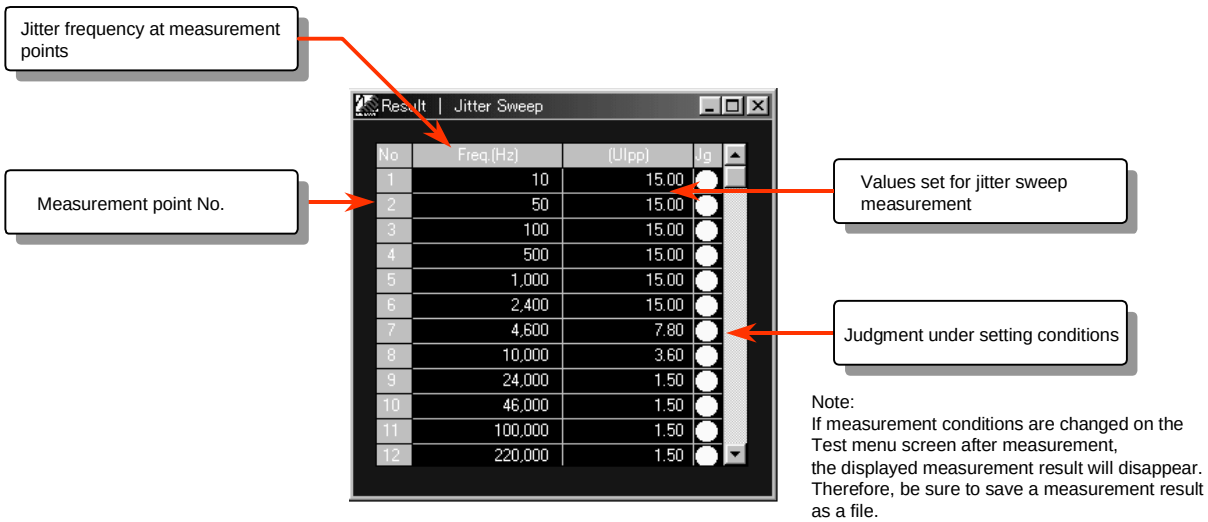


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



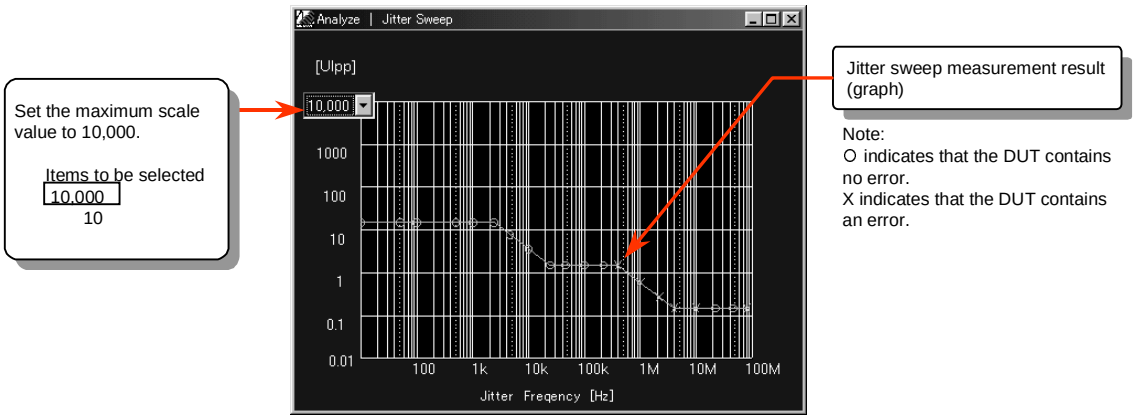
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates whether an error occurs when the quantity of jitter with the Sweep Table value set on the Test menu screen is generated. "○" means that no error occurs, and "●" means that an error occurs.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. ○ or × indicates the measurement point. ○ indicates that no error occurs, and × indicates that an error occurs.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.11 Example of Jitter Generation Measurement for MUX/DEMUX Module

This jitter generation measurement measures the jitter of the DUT when a data signal without jitter (Jitter = OFF) is input to a MUX/DEMUX module.

When the module has different input and output bit rates, jitter generation measurement evaluates jitter in the jitter band specified by the output bit rate. Jitter generation measurement has generally been done using UIrms units. However, ITU-T has recently reviewed jitter generation measurement, and measurement using UIpp units is also required. The MP1777A enables measurement that satisfies a jitter band of 80 MHz in UIpp and UIrms units.

6.11.1 Example of measurement connection

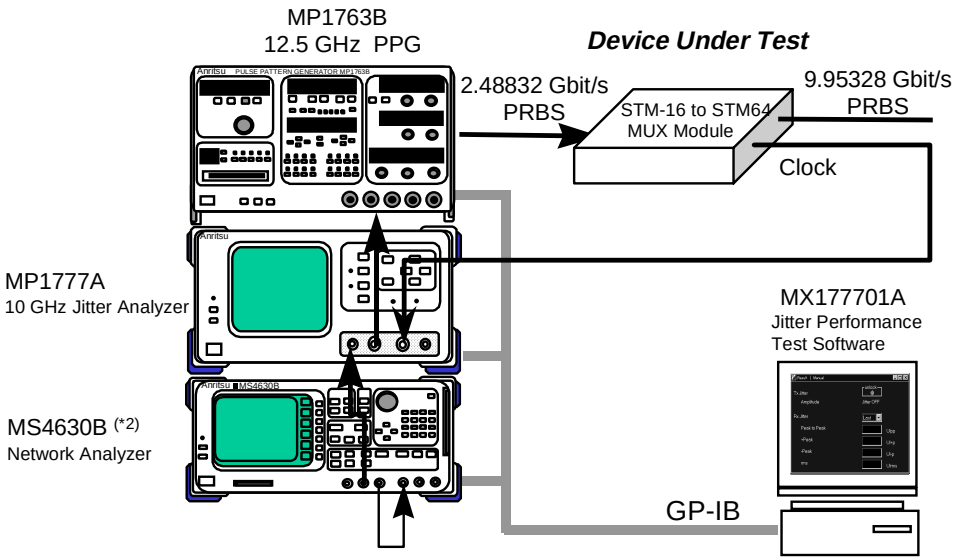


Figure 6-11-1 Connection for jitter generation measurement

Notes:

(1) The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the MP1763B 12.5 GHz Pulse Pattern Generator. Before automatic jitter measurement is started, it must be set to the optimum condition.

(2) For jitter generation measurement, the jitter generator does not require a modulated signal. When the MX177701A Jitter Performance Test Software is not used, the MS4630B Network Analyzer is not required for measurement.

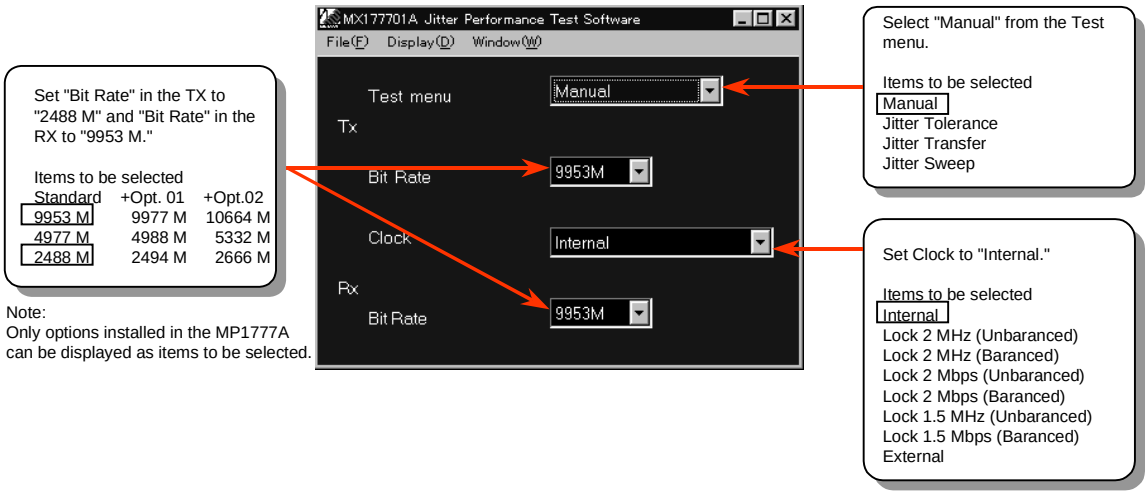
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6.11.2 Measurement procedure

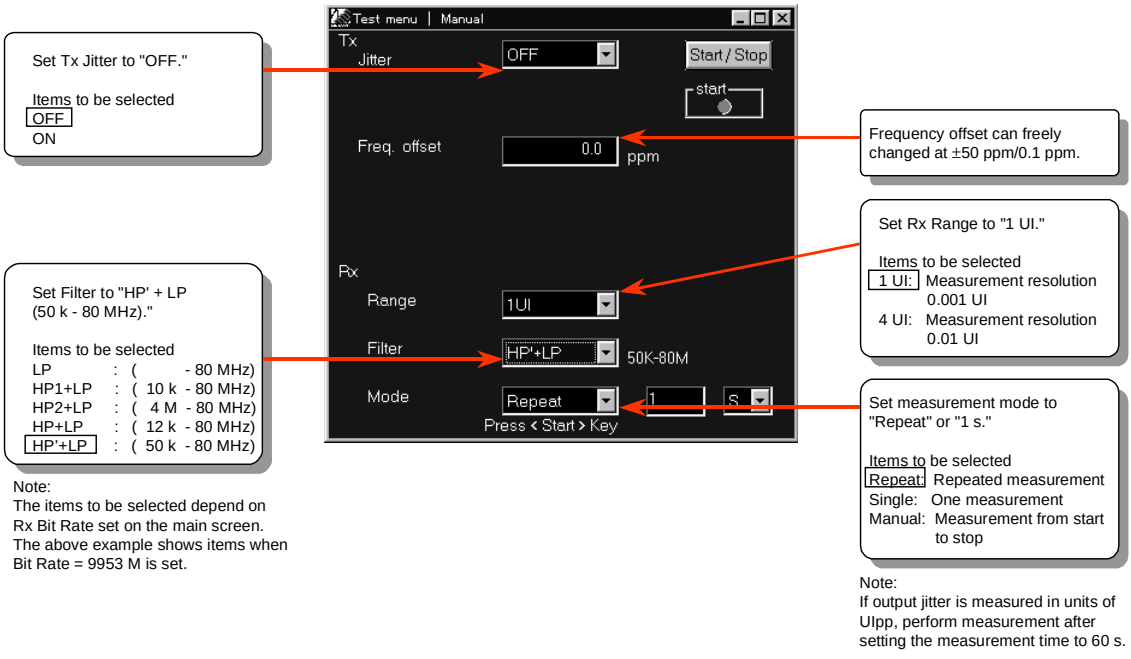
This section explains the procedure for jitter generation measurement for a MUX/DEMUX module (reference standard Bellcore GR-1377).

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.

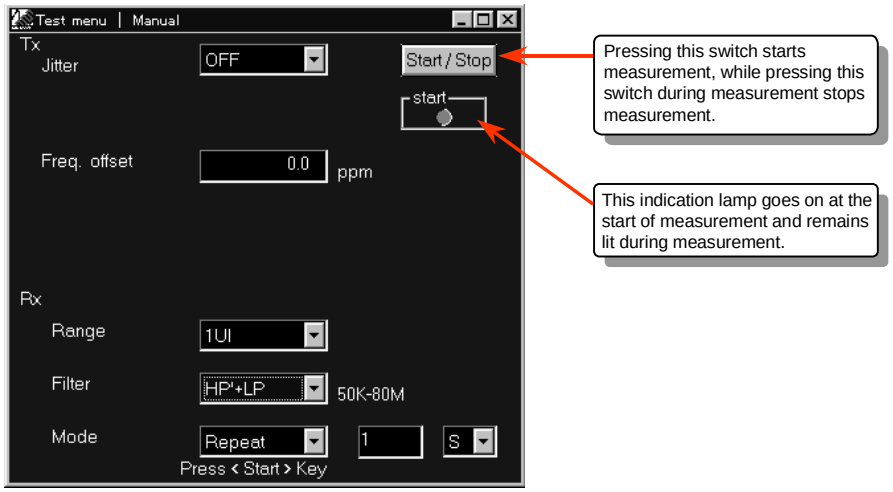


(2) Set the measurement conditions on the Test menu screen of the MX177701A Jitter Performance Test Software.

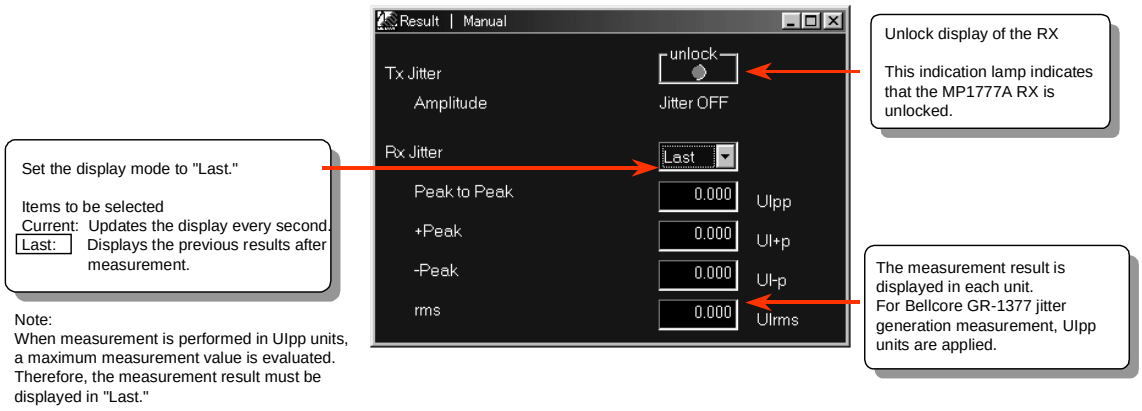


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.12 Example of Frequency Tolerance Measurement for SDH/SONET Transmission Equipment

This frequency tolerance measurement checks whether an error occurs when a frequency-offset data signal is input to SDH/SONET transmission equipment.

The MP1777A 10 GHz Jitter Analyzer can be adjusted to a ±50 ppm frequency offset in steps of 0.1 ppm. This function enables checking of the frequency tolerance of transmission equipment.

6.12.1 Example of measurement connection

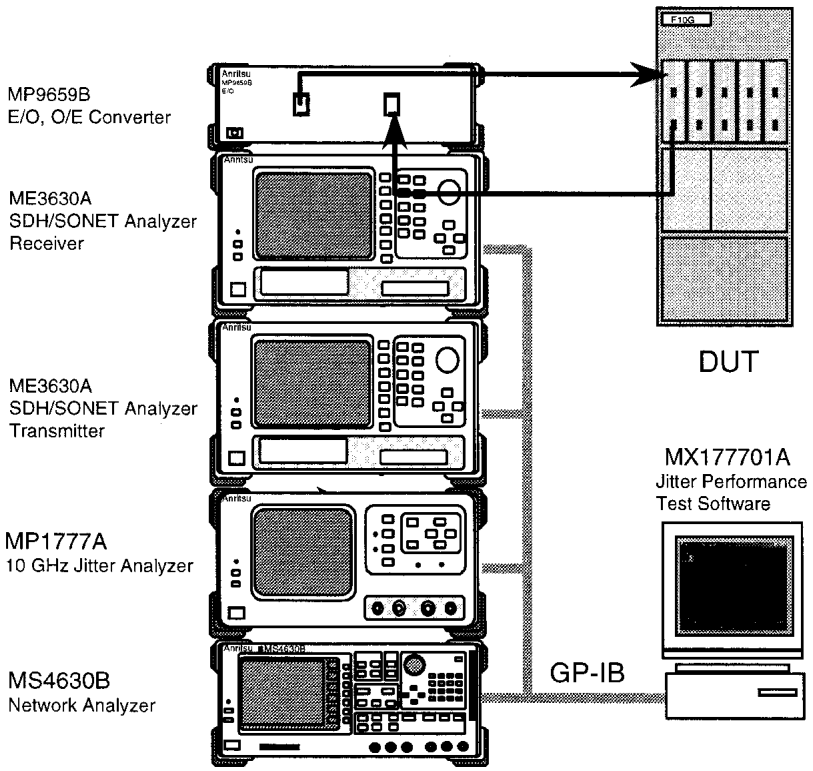


Figure 6-12-1 Connection for frequency tolerance measurement

Note: The MX177701A Jitter Performance Test Software does not control the setting related to the interfaces with the ME3630A SDH/SONET Analyzer and the MP9659B E/O O/E Converter. Before measurement, it must be set to the optimum condition.

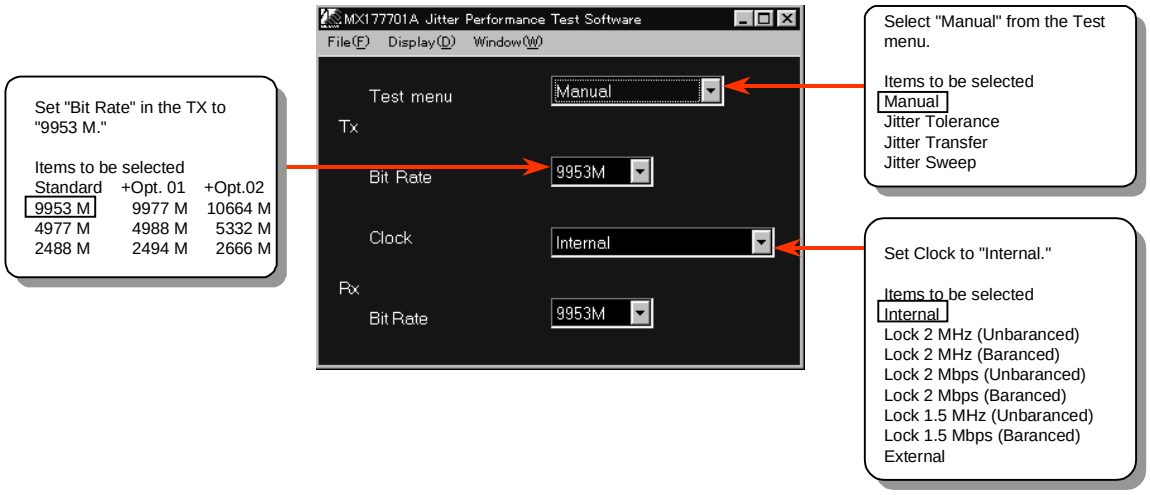
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6.12.2 Measurement procedure

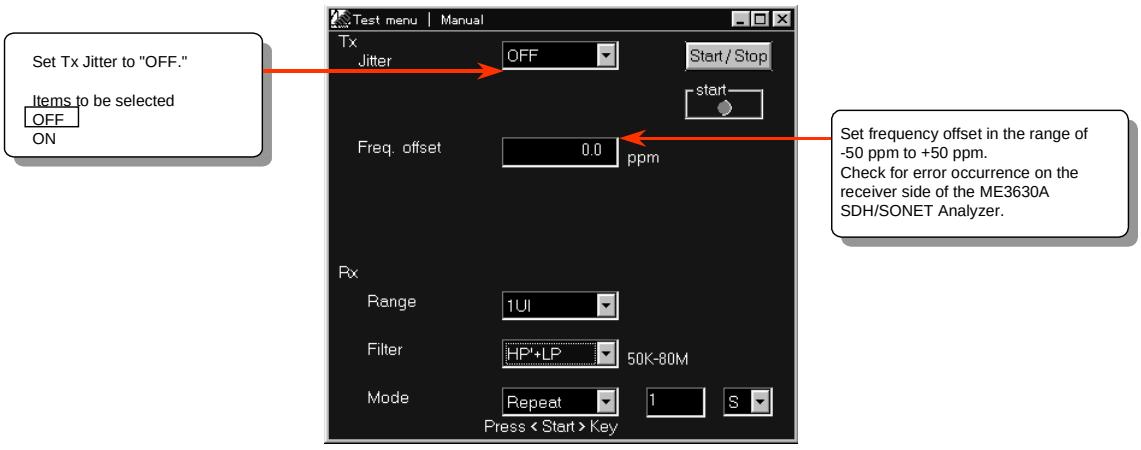
This section explains an example of frequency tolerance measurement that checks whether an error occurs when a frequency-offset data signal is input to SDH/SONET transmission equipment.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.



(2) Change the frequency offset, and check whether an ME3630A SDH/SONET Analyzer receiver error occurs on the Test menu screen of the MX177701A Jitter Performance Test Software.



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6.13 Example of Jitter Tolerance Measurement for SDH/SONET Transmission Equipment

This jitter tolerance measurement measures the jitter tolerance point at which an error occurs when a jitter-modulated data signal is input to SDH/SONET transmission equipment.

The MX177701A Jitter Performance Test Software enables use of a measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point. This software also enables use of a measurement method (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs. The former method (jitter tolerance measurement) is suitable for applications such as performance evaluation for the DUT in research and development departments. The latter method (jitter sweep measurement) is suitable for applications such as shipment inspection during mass production of the DUT in manufacturing departments.

6.13.1 Example of measurement connection

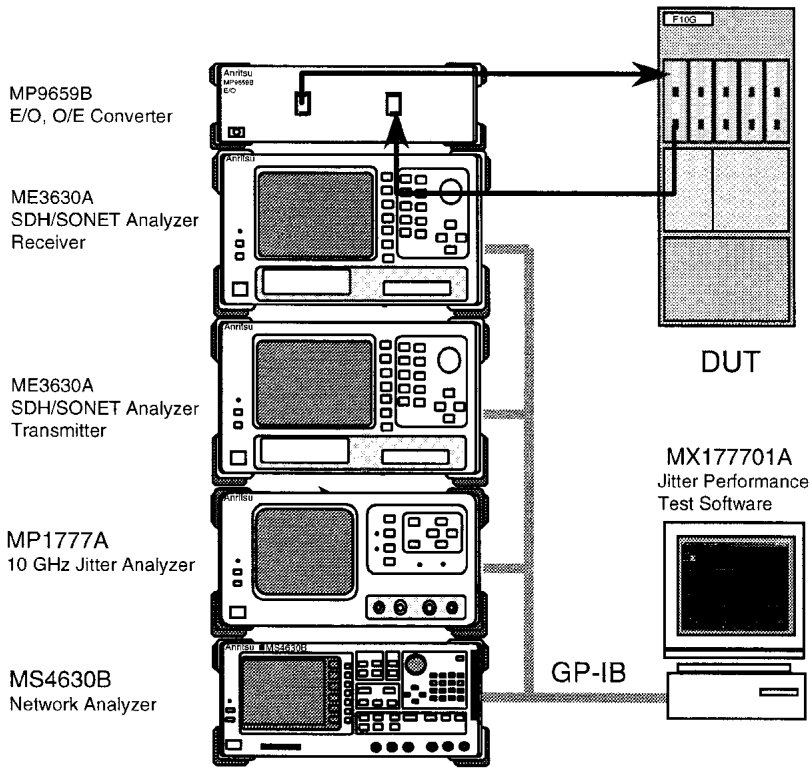


Figure 6-13-1 Connection for jitter tolerance measurement

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Note: The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the ME3630A SDH/SONET Analyzer. Before automatic jitter measurement is started, it must be set to the optimum condition.

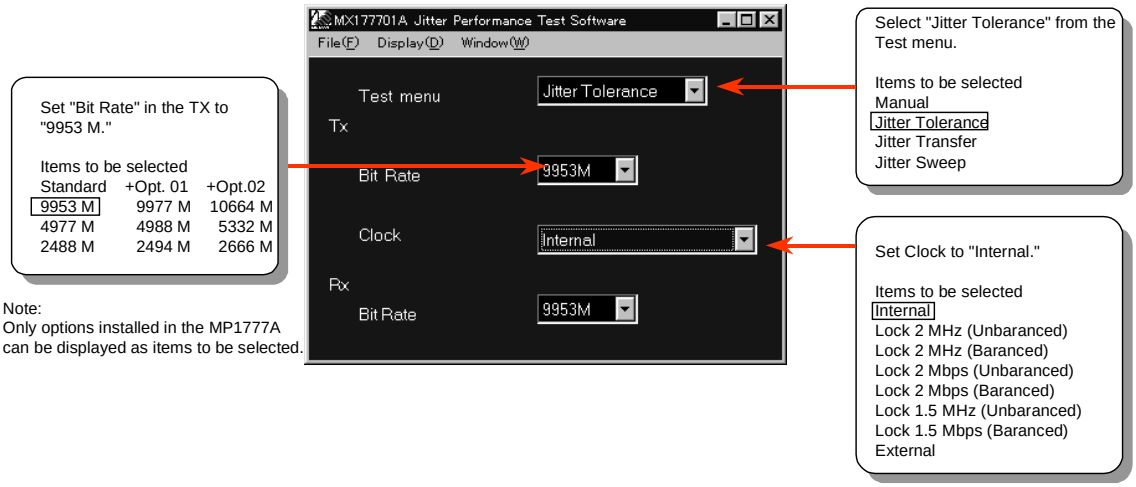
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6.13.2 Measurement procedure

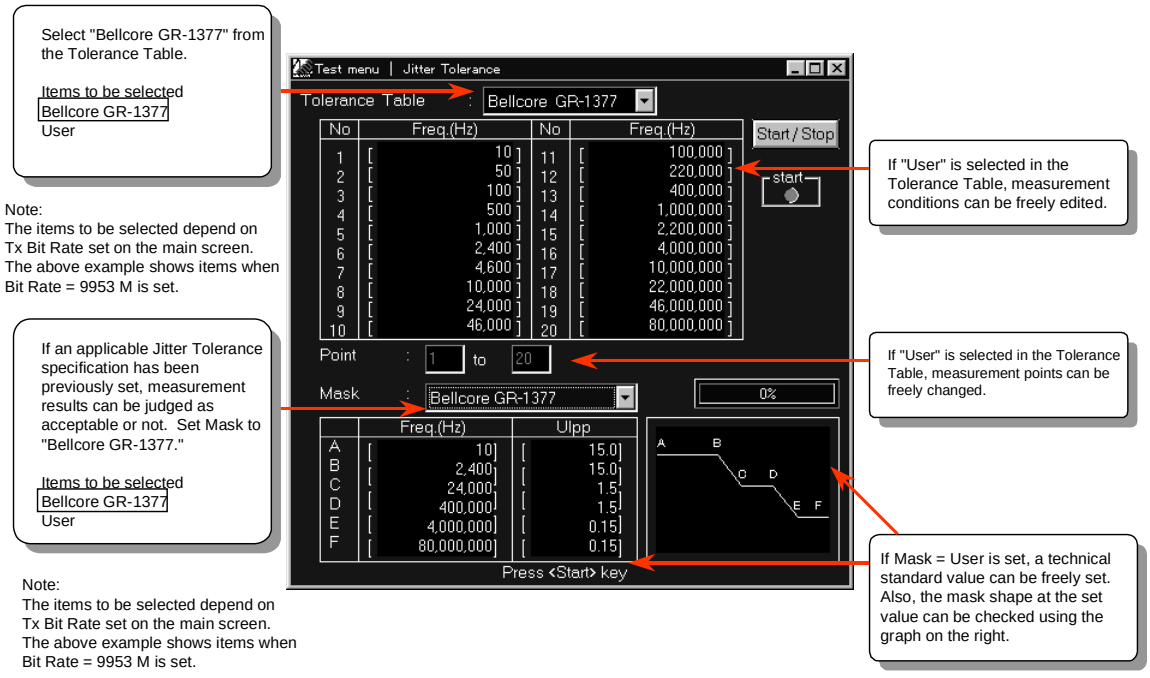
This section explains the measurement procedure for the measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the Set-up screen of the MX177701A Jitter Performance Test Software.

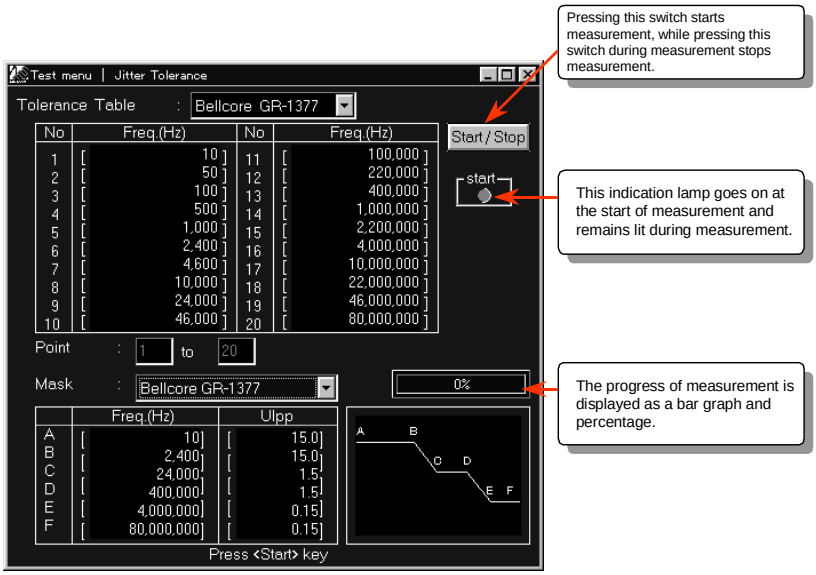


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen of the MX177701A Jitter Performance Test Software.

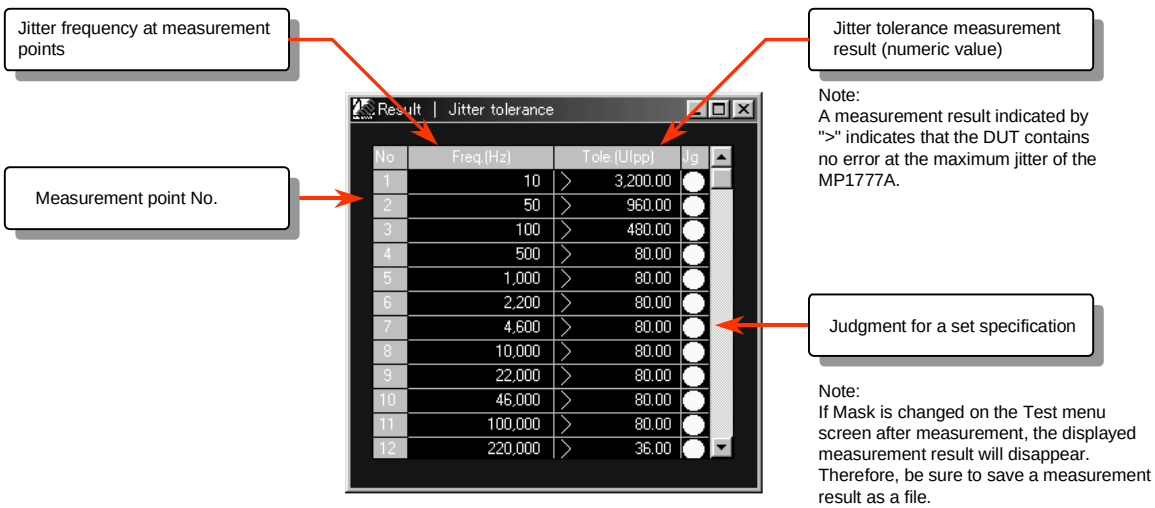


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



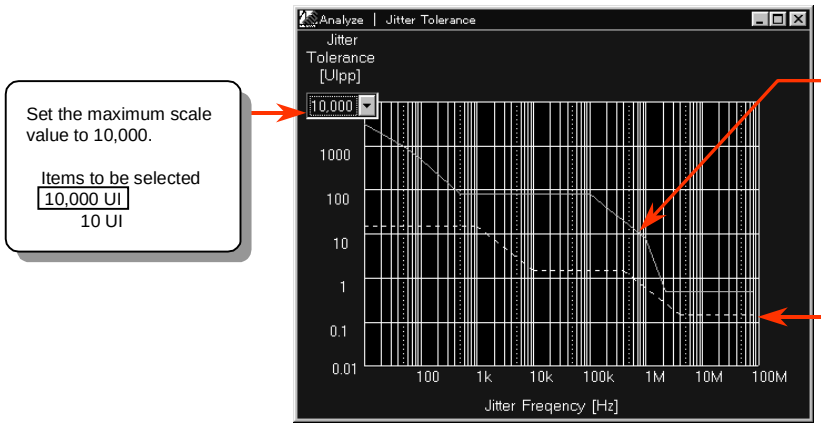
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software. JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Note:
If Mask is changed on the Test menu screen after measurement, the displayed measurement result will disappear. Therefore, be sure to save a measurement result as a file.

Note: To display the Result screen, the Test menu screen must be opened in advance.

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6.14 Example of Frequency Tolerance Measurement for Submarine Transmission Equipment

This frequency tolerance measurement checks whether an error occurs when a frequency-offset data signal is input from the SDH side to submarine transmission equipment and returned to the SDH.

The MP1777A 10 GHz Jitter Analyzer can be adjusted to a ±50 ppm frequency offset in steps of 0.1 ppm. This function enables checking of the frequency tolerance of transmission equipment.

6.14.1 Example of measurement connection

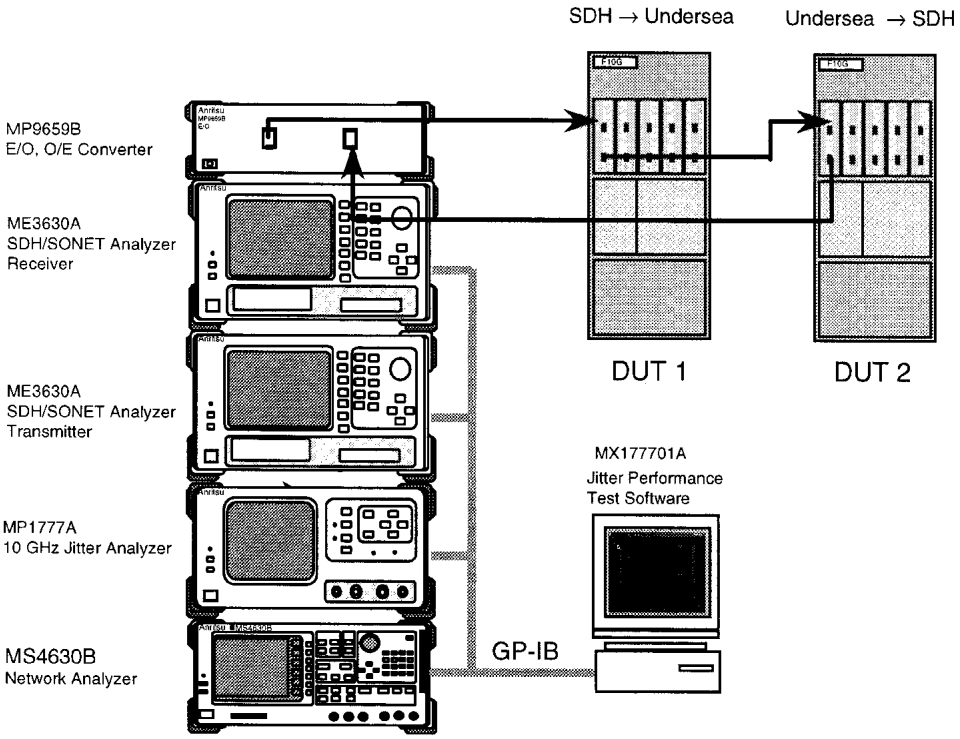


Figure 6-14-1 Connection for frequency tolerance measurement

Note: The MX177701A Jitter Performance Test Software does not control the setting related to the interfaces with the ME3630A SDH/SONET Analyzer and MP9659B E/O O/E Converter. Before measurement, they must be set to the optimum condition.

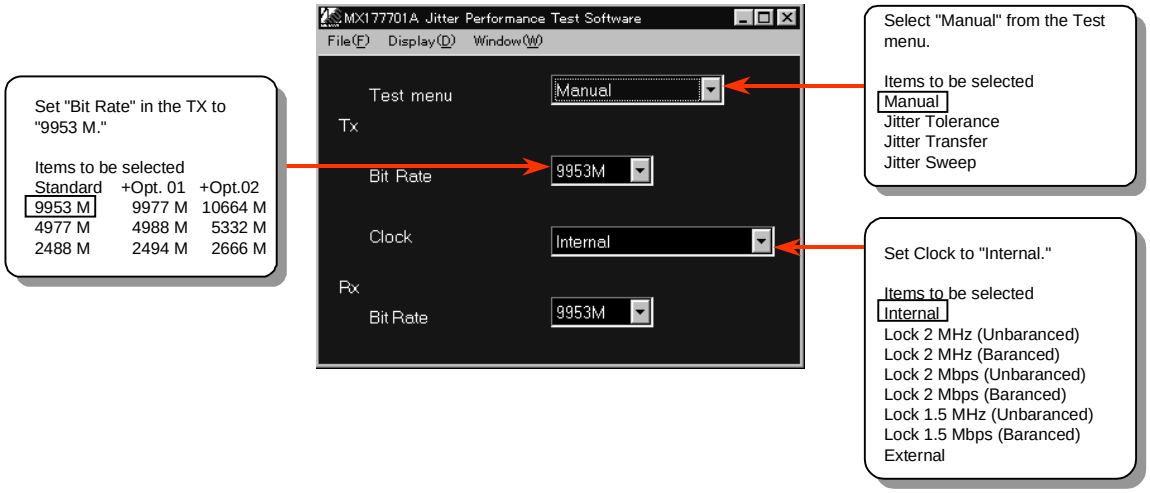
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6.14.2 Measurement procedure

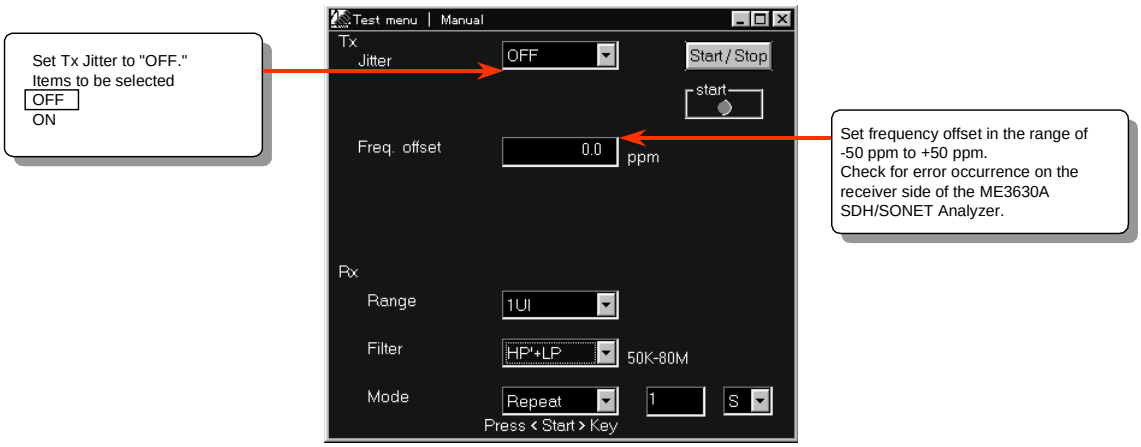
This section explains an example of frequency tolerance measurement that checks whether an error occurs when a frequency-offset data signal is input from the SDH side to submarine transmission equipment and returned to the SDH.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the main screen of the MX177701A Jitter Performance Test Software.



(2) Change the frequency offset, and check whether an ME3630A SDH/SONET Analyzer receiver error occurs on the Test menu screen of the MX177701A Jitter Performance Test Software.



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6.15 Example of Jitter Tolerance Measurement for Submarine Transmission Equipment

This jitter tolerance measurement measures the jitter tolerance point at which an error occurs when a jitter-modulated data signal is input from the SDH side to the submarine transmission equipment and returned to the SDH.

The MX177701A Jitter Performance Test Software enables use of a measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point. This software also enables use of a measurement method (jitter sweep measurement) that adds a preset jitter value to check only whether an error occurs. The former method (jitter tolerance measurement) is suitable for applications such as performance evaluation for the DUT in research and development departments. The latter method (jitter sweep measurement) is suitable for applications such as shipment inspection during mass production of the DUT in manufacturing departments.

6.15.1 Example of measurement connection

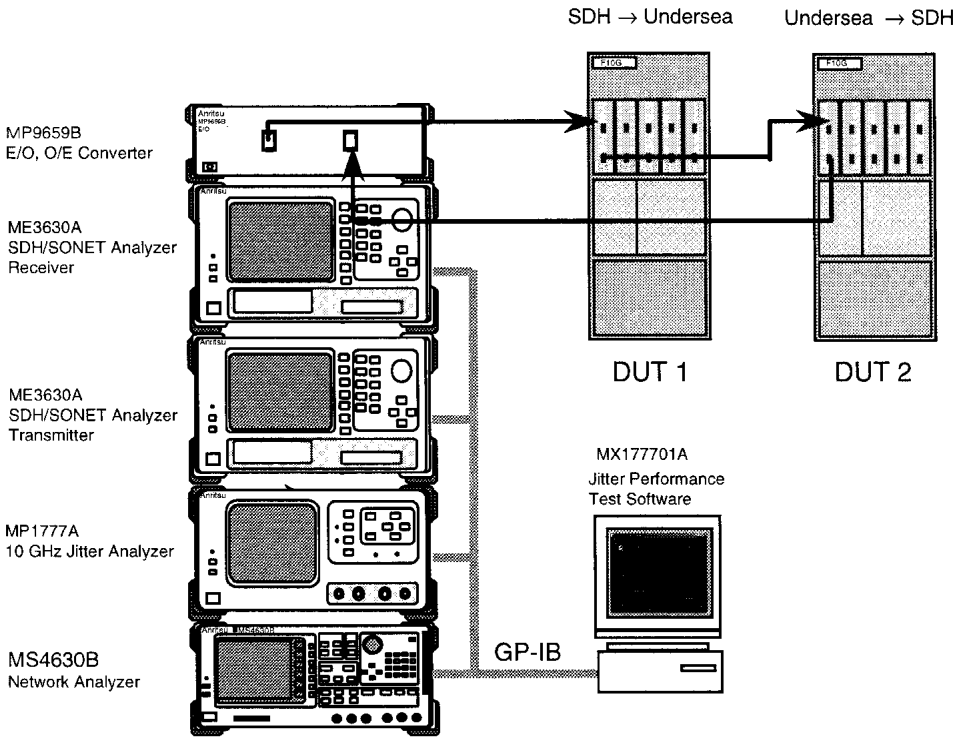


Figure 6-15-1 Connection for jitter tolerance measurement

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Note: The MX177701A Jitter Performance Test Software does not exercise control related to the interface with the ME3630A SDH/SONET Analyzer. Before automatic jitter measurement is started, it must be set to the optimum condition.

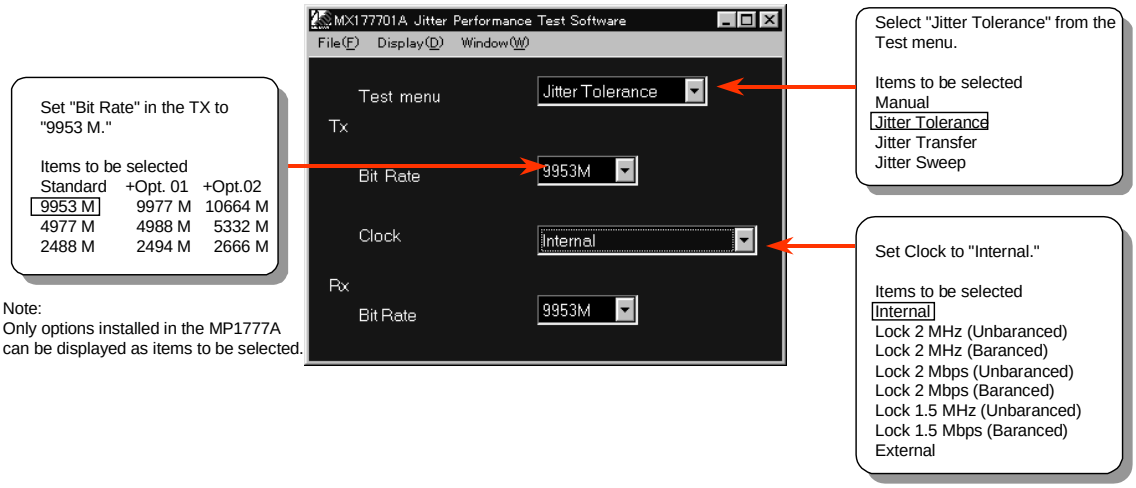
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6.15.2 Measurement procedure

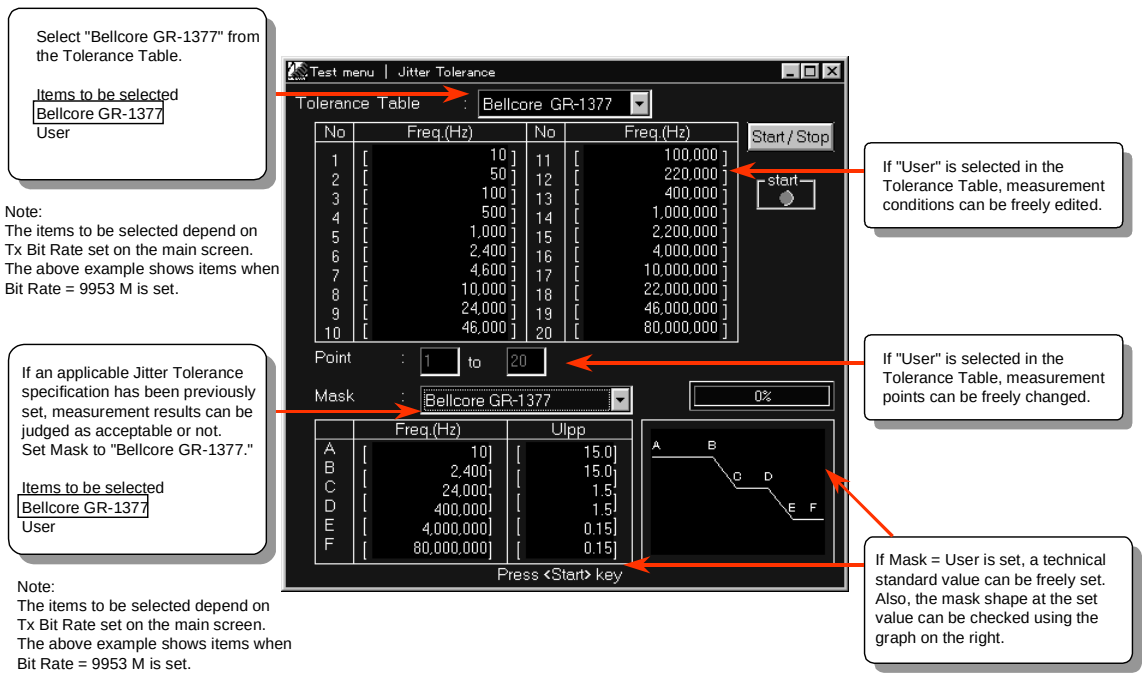
This section explains the measurement procedure for the measurement method (jitter tolerance measurement) that finds and evaluates the jitter tolerance point.

[Measurement procedure]

(1) Set the bit rate and clock conditions on the Set-up screen of the MX177701A Jitter Performance Test Software.

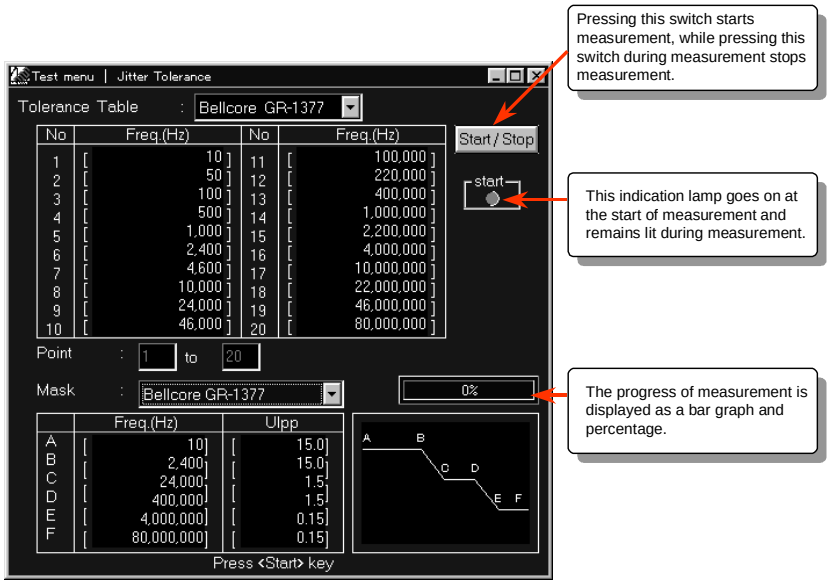


(2) Set the measurement point (Tolerance Table) and applicable standard (Mask) on the Test menu screen of the MX177701A Jitter Performance Test Software.

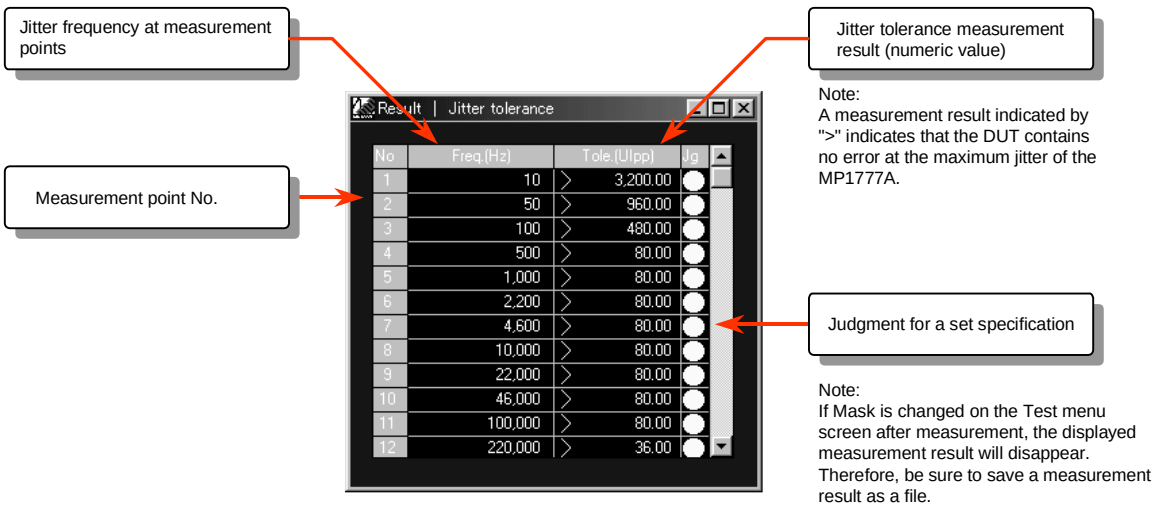


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(3) Press the Start/Stop button on the Test menu screen of the MX177701A Jitter Performance Test Software to start measurement.



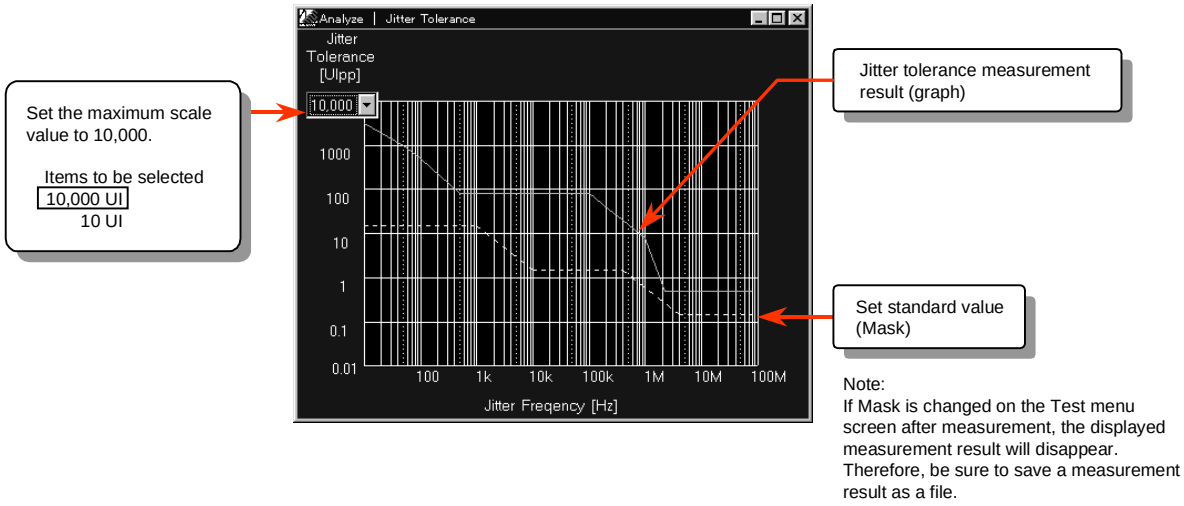
(4) Check the numeric measurement results on the Result screen of the MX177701A Jitter Performance Test Software JG at the right is an abbreviation of Judge and indicates the acceptance/rejection decision for the Mask (standard value) set on the Test menu screen. "○" means acceptance, and "●" means rejection.



Note: To display the Result screen, the Test menu screen must be opened in advance.

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(5) Display the measurement results as graphic data on the Analyze screen of the MX177701A Jitter Performance Test Software. The solid line indicates the measurement results, and the dotted line indicates the standard value (Mask).



Note: To display the Result screen, the Test menu screen must be opened in advance.

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Specifications are subject to change without notice.

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