MU181000A
12.5GHz Synthesizer
MU181000B
12.5GHz 4 port Synthesizer
Operation Manual

12th Edition

- **For safety and warning information, please read this manual before attempting to use the equipment.**
- **Additional safety and warning information is provided within the MP1800A Signal Quality Analyzer Installation Guide, the MP1900A Signal Quality Analyzer-R Operation Manual, and the MT1810A 4 Slot Chassis Installation Guide. Please also refer to them before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W2750AE-12.0

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols used in manual

⚠ DANGER This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

⚠ WARNING This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

⚠ CAUTION This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.

This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

MU181000A 12.5GHz Synthesizer
MU181000B 12.5GHz 4 port Synthesizer
Operation Manual

27 November 2006 (First Edition)
25 August 2020 (12th Edition)

Printed in Japan

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories, including the National Institute of Advanced Industrial Science and Technology, and the National Institute of Information and Communications Technology, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within one year after shipment due to a manufacturing fault, and software bug fixes will be performed in accordance with the separate Software End-User License Agreement, provide, however, that Anritsu Corporation will deem this warranty void when:

- The fault is outside the scope of the warranty conditions separately described in the operation manual.
- The fault is due to mishandling, misuse, or unauthorized modification or repair of the equipment by the customer.
- The fault is due to severe usage clearly exceeding normal usage.
- The fault is due to improper or insufficient maintenance by the customer.
- The fault is due to natural disaster, including fire, wind or flood, earthquake, lightning strike, or volcanic ash, etc.
- The fault is due to damage caused by acts of destruction, including civil disturbance, riot, or war, etc.
- The fault is due to explosion, accident, or breakdown of any other machinery, facility, or plant, etc.
- The fault is due to use of non-specified peripheral or applied equipment or parts, or consumables, etc.
- The fault is due to use of a non-specified power supply or in a non-specified installation location.
- The fault is due to use in unusual environments(Note).
- The fault is due to activities or ingress of living organisms, such as insects, spiders, fungus, pollen, or seeds.

In addition, this warranty is valid only for the original equipment purchaser. It is not transferable if the equipment is resold.

Anritsu Corporation shall assume no liability for damage or financial loss of the customer due to the use of or a failure to use this equipment, unless the damage or loss is caused due to Anritsu Corporation’s intentional or gross negligence.

Note:
For the purpose of this Warranty, "unusual environments" means use:

- In places of direct sunlight
- In dusty places
- Outdoors
- In liquids, such as water, oil, or organic solvents, and medical fluids, or places where these liquids may adhere
- In salty air or in places where chemically active gases (sulfur dioxide, hydrogen sulfide, chlorine, ammonia, nitrogen dioxide, or hydrogen chloride, etc.) are present
- In places where high-intensity static electric charges or electromagnetic fields are present
- In places where abnormal power voltages (high or low) or instantaneous power failures occur
- In places where condensation occurs
- In the presence of lubricating oil mists
- In places at an altitude of more than 2,000 m
- In the presence of frequent vibration or mechanical shock, such as in cars, ships, or airplanes

Anritsu Corporation Contact

In the event of this equipment malfunctions, please contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

Notes On Export Management

This product and its manuals may require an Export License/Approval by the Government of the product's country of origin for re-export from your country.

Before re-exporting the product or manuals, please contact us to confirm whether they are export-controlled items or not.

When you dispose of export-controlled items, the products/manuals need to be broken/shredded so as not to be unlawfully used for military purpose.

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   ii) If this Software has been used in conjunction with other non-Anritsu-approved software.
   iii) If this Software or the Equipment has been modified, repaired, or otherwise altered without Anritsu's prior approval.
   iv) For any other reasons out of Anritsu's direct control and responsibility, such as but not limited to, natural disasters, software virus infections, or any devices other than this Equipment, etc.
2. Expenses incurred for transport, hotel, daily allowance, etc., for on-site repairs or replacement by Anritsu engineers necessitated by the above faults shall be borne by you.
3. The warranty period for faults listed in Section 1 of this Article shall be either 6 months from the date of purchase of this Software or 30 days after the date of repair or replacement, whichever is longer.

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Article 5. Change of Terms

Anritsu may change without your approval the terms of this EULA if the changes are for the benefit of general customers, or are reasonable in light of the purpose of this EULA and circumstances of the changes. At the time of change, Anritsu will inform you of those changes and its effective date, as a general rule 45 days, in advance on its website, or in writing or by e-mail.

Article 6. Termination

1. Anritsu may terminate this EULA immediately if you violate any conditions described herein. This EULA shall also be terminated immediately by Anritsu if there is any good reason that it is deemed difficult to continue this EULA, such as your violation of Anritsu copyrights, patents, etc. or any laws and ordinances, or if it turns out that you belong to an antisocial organization or has a socially inappropriate relationship with members of such organization.
2. You and Anritsu may terminate this EULA by a written notice to the other party 30 days in advance.

Article 7. Damages

If Anritsu suffers any damages or loss, financial or otherwise, due to your violation of the terms of this EULA, Anritsu shall have the right to seek proportional damages from you.

Article 8. Responsibility after Termination

Upon termination of this EULA in accordance with Article 6, you shall cease all uses of this Software immediately and shall as directed by Anritsu either destroy or return this Software and any backup copies, full or partial, to Anritsu.

Article 9. Negotiation for Dispute Resolution

If matters of interpretational dispute or items not covered under this EULA arise, they shall be resolved by negotiations in good faith between you and Anritsu.

Article 10. Governing Law and Court of Jurisdiction

This EULA shall be governed by and interpreted in accordance with the laws of Japan without regard to the principles of the conflict of laws thereof, and any disputes arising from or in relation to this EULA that cannot be resolved by negotiation described in Article 9 shall be subject to and be settled by the exclusive agreed jurisdiction of the Tokyo District Court of Japan.

Revision History:

February 29th, 2020

CE Conformity Marking

Anritsu affixes the CE Conformity marking on the following product(s) in accordance with the Decision 768/2008/EC to indicate that they conform to the EMC, LVD and RoHS directive of the European Union (EU).

CE marking

1. Product Model

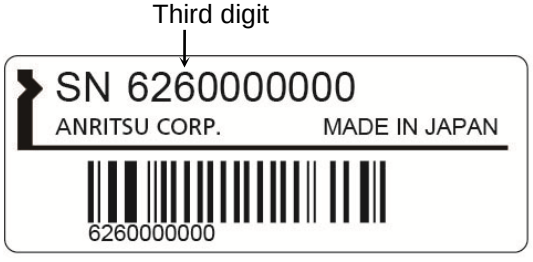
Plug-in Units: MU181000A 12.5GHz Synthesizer
MU181000B 12.5GHz 4 port Synthesizer

2. Applied Directive and Standards

When the MU181000A 12.5GHz Synthesizer or MU181000B 12.5GHz 4 port Synthesizer is installed in the MP1800A, MT1810A or MP1900A the applied directive and standards of this unit conform to those of the MP1800A, MT1810A or MP1900A main frame.

PS: About main frame
Please contact Anritsu for the latest information on the main frame types that MU181000A/B can be used with.

If the third digit of the serial number is "7", the product complies with Directive 2011/65/EU as amended by (EU) 2015/863.
(Pb,Cd,Cr6+,Hg,PBB,PBDE,DEHP,BBP,DBP,DIBP)
If the third digit of the serial number is "6", the product complies with Directive 2011/65/EU.
(Pb,Cd,Cr6+,Hg,PBB,PBDE)



Serial number example

RCM Conformity Marking

Anritsu affixes the RCM mark on the following product(s) in accordance with the regulation to indicate that they conform to the EMC framework of Australia/New Zealand.

RCM marking

1. Product Model

Plug-in Units: MU181000A 12.5GHz Synthesizer
MU181000B 12.5GHz 4 port Synthesizer

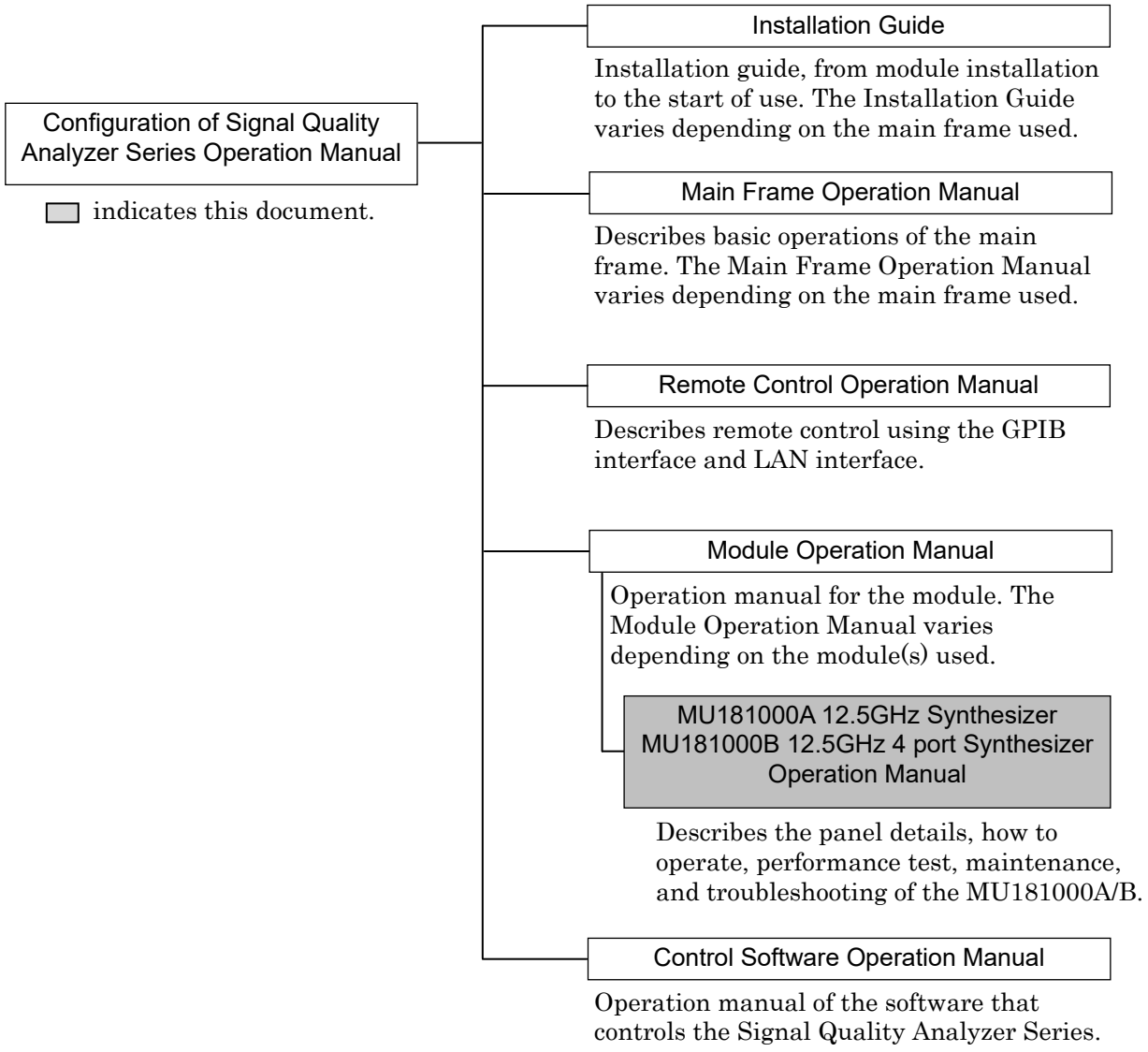
2. Applied Standards

When the MU181000A 12.5GHz Synthesizer or MU181000B 12.5GHz 4 port Synthesizer is installed in the MP1800A, MT1810A or MP1900A the applied directive and standards of this unit conform to those of the MP1800A, MT1810A or MP1900A main frame.

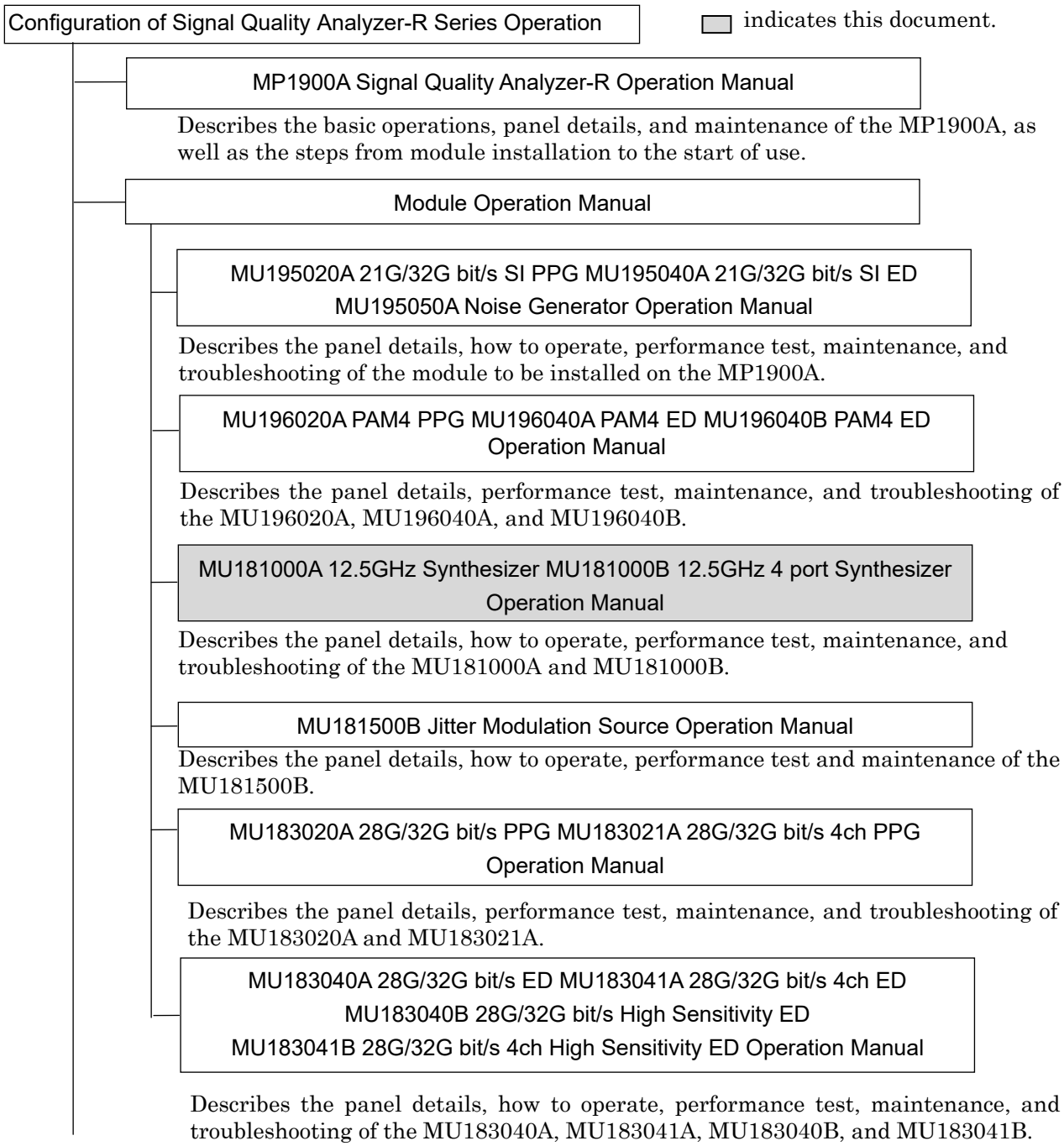
PS: About main frame
Please contact Anritsu for the latest information on the main frame types that MU181000A/B can be used with.

About This Manual

A testing system combining an MP1800A Signal Quality Analyzer or MT1810A 4 Slot Chassis mainframe, module(s), and control software is called a Signal Quality Analyzer Series. The operation manuals of the Signal Quality Analyzer Series consist of separate documents for the installation guide, the mainframe, remote control operation, module(s), and control software, as shown below



A test system combining an MP1900A Signal Quality Analyzer-R, module(s), and control software is called a Signal Quality Analyzer-R Series. The operation manuals of the Signal Quality Analyzer-R Series consist of separate documents for the MP1900A, module(s), and control software as shown below.



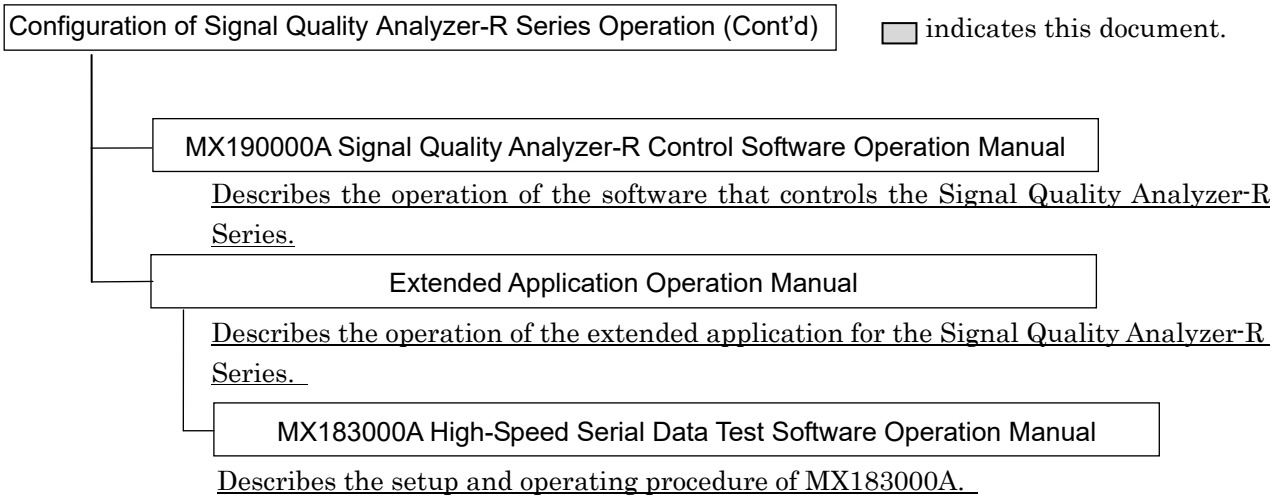

Configuration of Signal Quality Analyzer-R Series Operation (Cont'd)
indicates this document.
MX190000A Signal Quality Analyzer-R Control Software Operation Manual
Describes the operation of the software that controls the Signal Quality Analyzer-R Series.
Extended Application Operation Manual
Describes the operation of the extended application for the Signal Quality Analyzer-R Series.
MX183000A High-Speed Serial Data Test Software Operation Manual
Describes the setup and operating procedure of MX183000A.

Table of Contents

Chapter 1 Overview

This section provides an overview and the specifications of the MU181000A 12.5GHz Synthesizer and the MU181000B 12.5GHz 4 port Synthesizer (hereinafter referred to as MU181000A/B).

1.1 Product Overview

The MU181000A/B is a plug-in module that can be built into the models of Signal Quality Analyzer Series or Signal Quality Analyzer-R Series. It outputs clock signals of 100 MHz to 12.5 GHz to be input to the MU181020A 12.5 Gbit/s PPG or the MU181800A 12.5 GHz Clock Distributor.

The MU181000A/B outputs a 10 MHz reference signal to synchronize an external device with it. The MU181000A/B can also be synchronized with an external device by inputting a 10 MHz reference signal output from that device.

Also, when MU181000B-x02 is installed, test signals synchronized with 100 MHz reference clock from PCI Express Host can be output. (MU181000B-x02 is usable only when MU181000B is installed in MP1900A.)

1.2 Product Configuration

1.2.1 Standard Configuration

Table 1.2.1-1 and Table 1.2.1-2 show the standard configuration of the MU181000A/B.

Table 1.2.1-1 Standard Configuration of MU181000A

Item	Model name/symbol	Product name	Q'ty	Remarks
Main unit	MU181000A	12.5GHz Synthesizer	1	
Accessory	J1624A	Coaxial cable, 0.3 m	1	SMA connector
	Z0897A	Operation Manual*	1	CD-ROM version
	Z0918A	MX180000A Software CD*	1	CD-ROM version

*: Not supplied when the MU181000A is installed on the MP1900A.

Table 1.2.1-2 Standard Configuration of MU181000B

Item	Model name/symbol	Product name	Q'ty	Remarks
Main unit	MU181000B	12.5 GHz 4 port Synthesizer	1	
Accessory	J1624A	Coaxial cable, 0.3 m	4	SMA connector
	Z0897A	Operation Manual*	1	CD-ROM version
	Z0918A	MX180000A Software CD*	1	CD-ROM version

*: Not supplied when the MU181000B is installed on the MP1900A.

1.2.2 Option

Table 1.2.2-1 and 1.2.2-2 show the options for the MU181000A/B. All options are sold separately.

Table 1.2.2-1 Options for MU181000A

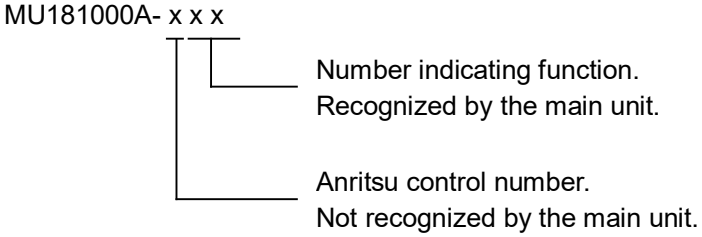
Model name/symbol	Product name	Q'ty	Remarks
MU181000A-x01	Jitter Modulation	1	

Table 1.2.2-2 Options for MU181000B

Model name/symbol	Product name	Q'ty	Remarks
MU181000B-x01	Jitter Modulation	1	
MU181000B-x02	SSC Extension	1	

Notes:

- Option name format



- MU181000B-x02 is usable only when it is installed in MP1900A. If installed in MP1800A, the MP1800A shows no presence of this option on the screen and operates without it.

1.2.3 Application parts

Table 1.2.3-1 shows the application parts for the MU181000A/B. All application parts are sold separately.

Table 1.2.3-1 Application parts for MU181000A/B

Model name/symbol	Product	Q'ty	Remarks
J1625A	Coaxial cable, 1 m	1	SMA connector
J0127B	Coaxial cable, 2 m	1	SMA connector
J1137	Terminator	1	50 Ω SMA
W2750AE	Operation Manual	1	Printed version

1.3 Specifications

Table 1.3-1 Specifications

Item		Specifications
Electrical performance Clock Output	Frequency range	0.1 to 12.5 GHz
	Setting resolution	1 kHz, 1 MHz switchable Offset function: –1000 to +1000 ppm Resolution: 1 ppm steps, 1 Hz minimum
	Frequency stability	±1 ppm When Reference Clock Source is set to Internal
	Output level	MU181000A: 0.632 to 2 Vp-p (AC) MU181000B, MU181000A/B-x01: 0.4 to 1 Vp-p (AC)
	Phase noise	≤–61 dBc/Hz at 1 kHz offset
		≤–80 dBc/Hz at 10 kHz offset
		≤–90 dBc/Hz at 100 kHz offset
	Residual wander	MU181000A/B: ≤20 ps (p-p)
		MU181000A/B-x01: When Fc >400 MHz: ≤20 ps (p-p) When Fc ≤400 MHz: ≤0.02/Fc (Hz) ×10^12 ps (p-p)
		Measurement conditions: Overwrite for 10 s using Buff Output (when Internal is selected) as trigger signal of sampling oscilloscope. Measurement points: 100 MHz/150 MHz/600 MHz/1.25 GHz/2.5 GHz/10 GHz/12.5 GHz
	Duty	50 ± 10%
	Output wavelength	<1 GHz Rectangular wave
		≥1 GHz Sine wave or rectangular wave
		Definition of rectangular wave lower than 1 GHz: ≤350 ps at tr, tf = 20 to 80%
	Clock output Channel skew	≤10 ps (12.5 GHz) Applied to the MU181000B and MU181000B-x01.
	Output impedance	50 Ω/GND
	Connector	SMA

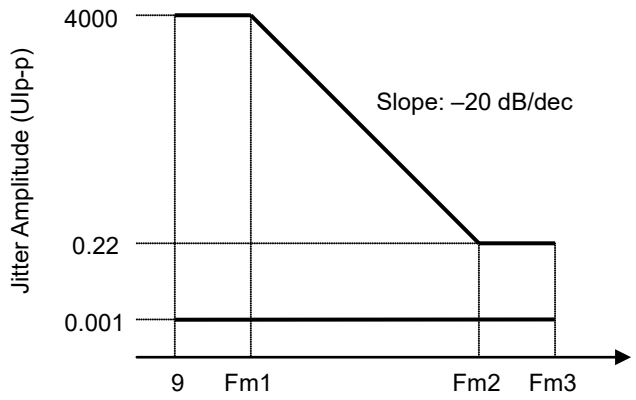
Table 1.3-1 Specifications (Cont'd)

Item		Specifications
10 MHz reference signal Ref. Input	Frequency	10 MHz±10 ppm
	Level	0.5 to 2.0 Vp-p (AC)
	Impedance	50 Ω/GND
	Waveform	Sine wave or rectangular wave
	Duty	50 ± 10%
	Connector	BNC
Buff Output	Frequency stability	Internal: 10 MHz±1 ppm External: Depends on reference input to Ref. Input
	Level	1.0 Vp-p±30% (AC)
	Impedance	50 Ω/GND
	Waveform	Rectangular wave
	Duty	50±10%
	Connector	BNC
Trigger Output When MU181000A/B-x01 is installed	Effective range	800 MHz < Fc ≤ 12.5 GHz Fc: Clock output frequency
	Output frequency	When 6.4 GHz < Fc ≤ 12.5 GHz: 1 or 64 division selectable When 800 MHz < Fc ≤ 6.4 GHz: Fixed to 64 divisions
	Output level	0.4 to 1.1 Vp-p (AC)
	Output impedance	50 Ω/GND
	Connector	SMA
External modulation input (Jitter Ext Input) When MU181000A/B-x01 is installed	Refer to 2.2 "How to Operate Application" and 2.3 "Preventing Damage" for functions and performance.	
	Frequency range	9 Hz to 1 GHz
	Input waveform	Sine wave
	Input level range	3 Vp-p max, 0 Vdc max.
	Input impedance	50 Ω/GND
	Connector	SMA

Table 1.3-1 Specifications (Cont'd)

Item		Specifications	
External I,Q When MU181000A/B-x01 is installed	Frequency band	DC to 320 MHz max. (–3 dB) Note that the maximum band is limited, depending on the set bit rate. 2.4 GHz < Fc ≤ 12.5 GHz: 320 MHz 1.4 GHz < Fc ≤ 2.4 GHz: 100 MHz 0.65 GHz < Fc ≤ 1.4 GHz: 20 MHz 0.4 GHz < Fc ≤ 0.65 GHz: 10 MHz 0.1 GHz ≤ Fc ≤ 0.4 GHz: 5 MHz	
	Input level range	±0.5 V	
	Input impedance	50 Ω/GND	
	Connector	BNC	
100 MHz reference signal input (100 MHz Ref Input) When MU181000A/B-x01 or x02 is installed	When MU181000A/B-x01 is installed: Outputs the clock signal from the clock output connector with frequency and phase deviation multiplied from 100 MHz by 25 or 50. When MU181000B-x02 or MU181000B-x01 and x02 is installed: Outputs the clock signal from the clock output connector with frequency and phase deviation multiplied from 100 MHz by 25, 50, or 80.		
	Input signal	Carrier frequency:	100 MHz
		Modulation frequency:	30 to 33 kHz
		Frequency deviation amount:	500 kHz p-p max.
	Level	1 Vp-p ± 30% (AC) When MU181000B-x01 is installed 0.15 to 1.3 Vp-p (AC) When MU181000B-x02 or MU181000B-x01 and x02 is installed	
	Waveform	Sine wave or rectangular wave	
	Duty	50±10%	
	Input impedance	50 Ω/GND	
	Connector	BNC	

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
Modulation function (Internal Jitter) When MU181000A/B-x01 is installed	Jitter mask	

Fc range (GHz)	Fm1 (Hz)	Fm2 (Hz)	Fm3 (Hz)
6.4 < Fc ≤ 12.5	220	4 M	80 M
3.2 < Fc ≤ 6.4	110	2 M	40 M
1.6 < Fc ≤ 3.2	55	1 M	20 M
0.8 < Fc ≤ 1.6	27.5	500 k	10 M
0.1 ≤ Fc ≤ 0.8	13.75	250 k	5 M

Table 1.3-1 Specifications (Cont'd)

<table>
<tr><th colspan="2">Item</th><th colspan="2">Specifications</th></tr>
<tr><td rowspan="24">Modulation function (Internal Jitter) (Cont'd)
When MU181000A/B-x01 is installed</td><td rowspan="5">Modulation frequency range</td><td>6.4 GHz < Fc ≤ 12.5 GHz:</td><td>9 Hz to 80 MHz</td></tr>
<tr><td>3.2 GHz < Fc ≤ 6.4 GHz:</td><td>9 Hz to 40 MHz</td></tr>
<tr><td>1.6 GHz < Fc ≤ 3.2 GHz:</td><td>9 Hz to 20 MHz</td></tr>
<tr><td>0.8 GHz < Fc ≤ 1.6 GHz:</td><td>9 Hz to 10 MHz</td></tr>
<tr><td>0.1 GHz ≤ Fc ≤ 0.8 GHz:</td><td>9 Hz to 5 MHz</td></tr>
<tr><td rowspan="8">Modulation frequency setting resolution</td><td>9 Hz ≤ Fm ≤ 10 Hz:</td><td>0.001 Hz steps</td></tr>
<tr><td>10 Hz < Fm ≤ 100 Hz:</td><td>0.01 Hz steps</td></tr>
<tr><td>100 Hz < Fm ≤ 1 kHz:</td><td>0.1 Hz steps</td></tr>
<tr><td>1 kHz < Fm ≤ 10 kHz:</td><td>1 Hz steps</td></tr>
<tr><td>10 kHz < Fm ≤ 100 kHz:</td><td>10 Hz steps</td></tr>
<tr><td>100 kHz < Fm ≤ 1 MHz:</td><td>100 Hz steps</td></tr>
<tr><td>1 MHz < Fm ≤ 10 MHz:</td><td>1 kHz steps</td></tr>
<tr><td>10 MHz < Fm ≤ 80 MHz:</td><td>10 kHz steps</td></tr>
<tr><td>Modulation frequency accuracy</td><td colspan="2">±100 ppm</td></tr>
<tr><td rowspan="5">Jitter amplitude Setting resolution</td><td>0.000 to 0.999 UIp-p:</td><td>0.001 UI steps</td></tr>
<tr><td>1.00 to 32.00 UIp-p:</td><td>0.01 UI steps</td></tr>
<tr><td>32.1 to 256.0 UIp-p:</td><td>0.1 UI steps</td></tr>
<tr><td>257 to 2049 UIp-p:</td><td>1 UI steps</td></tr>
<tr><td>2050 to 4000 UIp-p:</td><td>10 UI steps</td></tr>
<tr><td>Jitter amplitude accuracy</td><td colspan="2">Fc < 1 GHz
0.001 to 2.19 UIp-p: ±0.01 UI±Q%
2.2 to 21.99 UIp-p: ±0.2 UI±Q%
22 to 4000 UIp-p: ±2 UI±Q%
Fc ≥ 1 GHz
0.001 to 2.19 UIp-p: ±0.02 UI±Q%
2.2 to 21.99 UIp-p: ±0.2 UI±Q%
22 to 4000 UIp-p: ±2 UI±Q%

<table><tr><th>Fm (Hz)</th><th>Q</th></tr><tr><td>9 ≤ Fm ≤ 500 k</td><td>7</td></tr><tr><td>500 k < Fm ≤ 2 M</td><td>12</td></tr><tr><td>2 M < Fm ≤ 80 M</td><td>15</td></tr></table></td></tr>
</table>

Table 1.3-1 Specifications (Cont'd)

<table>
<tr><th colspan="2">Item</th><th>Specifications</th></tr>
<tr><td rowspan="4">External Jitter 1
When MU181000A/B-x01 is installed</td><td>Modulation frequency range</td><td>When Operation is Variable;
4.0 GHz ≤ Fc ≤ 12.5 GHz: 9 Hz to 1 GHz
2.4 GHz < Fc < 4.0 GHz: 9 Hz to 500 MHz
1.4 GHz < Fc ≤ 2.4 GHz: 9 Hz to 100 MHz
0.65 GHz < Fc ≤ 1.4 GHz: 9 Hz to 20 MHz
0.4 GHz < Fc ≤ 0.65 GHz: 9 Hz to 10 MHz
0.1 GHz ≤ Fc ≤ 0.4 GHz: 9 Hz to 5 MHz</td></tr>
<tr><td>Input waveform</td><td>Sine wave</td></tr>
<tr><td>FM frequency range</td><td>275 Hz/550 Hz/1 kHz/1.1 kHz/2.2 kHz/2.75 kHz/4.4 kHz/
5.5 kHz/11 kHz/22 kHz/27.5 kHz/44 kHz/55 kHz/
100 kHz/110 kHz/220 kHz/250 kHz/440 kHz/500 kHz/
1 MHz/2 MHz/4 MHz/80 MHz/500 MHz/1 GHz/Full
Full Range is supported when UI Range is 0.22 UI while Input Freq. is 4 MHz or more.</td></tr>
<tr><td>Jitter amplitude range</td><td>0.22 UI/2.0 UI/20 UI/200 UI/4000 UI</td></tr>
<tr><td>Modulation sensitivity</td><td>For 0.22 UI Range
When input level is 0.5 Vp-p:
<table>
<tr><th>FM Frequency Range</th><th>Input Frequency</th><th>Jitter Amplitude</th></tr>
<tr><td>4 MHz</td><td>9 Hz to 4 MHz</td><td rowspan="4">0.1 UIp-p±0.03 UI</td></tr>
<tr><td>80 MHz</td><td>4 M to 80 MHz</td></tr>
<tr><td>500 MHz*1</td><td>80 M to 500 MHz</td></tr>
<tr><td>1 GHz*2</td><td>500 MHz to 1 GHz</td></tr>
</table>
*1: 500 MHz Range is not applied at 0.1 G≤Fc≤1.4 GHz.
*2: 1 GHz Range is not applied at 2.4 G≤Fc≤4 GHz.
The upper limit modulation frequency is listed above.

When the input level at 0.1 UIp-p is Vin, and jitter amplitude is UIx:
Relationship between Vin and UIx is approximated as follows.
Unit of Vin is Vp-p while UIp-p for UIx
When UIx ≤ 0.1 UIp-p:
UIx = 0.2 × Vin
Vin = Uix / 0.2
When 0.1 UIp-p < UIx ≤ 0.22 UIp-p:
UIx = 0.2 × Vin × (1 – 0.22 × (Vin – 0.5))
Vin = 2.5 – root (6.25 – 22.73 × UIx)</td></tr>
</table>

Table 1.3-1 Specifications (Cont'd)

<table>
<tr><th colspan="2">Item</th><th>Specifications</th></tr>
<tr><td>External Jitter 1 (Cont'd)
When MU181000A/B-x01 is installed</td><td>Modulation sensitivity (Cont'd)</td><td>
For 2 UI/20 UI/200 UI/4000 UI Range
When input level is 0.5 Vp-p:
Clock output frequency: 6.4 GHz < Fc ≤ 12.5 GHz
<table>
<tr><th>Jitter Amplitude Range</th><th>FM Frequency Range</th><th>Input Frequency</th><th>Jitter Amplitude</th></tr>
<tr><td>2 UI</td><td>4 MHz</td><td>440 kHz</td><td>1 UIp-p±0.3 UI</td></tr>
<tr><td>20 UI</td><td>440 kHz</td><td>44 kHz</td><td>10 UIp-p±3 UI</td></tr>
<tr><td>200 UI</td><td>44 kHz</td><td>4.4 kHz</td><td>100 UIp-p±30 UI</td></tr>
<tr><td>4000 UI</td><td>4.4 kHz</td><td>220 Hz</td><td>1000 UIp-p±300 UI</td></tr>
</table>
Clock output frequency: 3.2 GHz < Fc ≤ 6.4 GHz
<table>
<tr><th>Jitter Amplitude Range</th><th>FM Frequency Range</th><th>Input Frequency</th><th>Jitter Amplitude</th></tr>
<tr><td>2 UI</td><td>2 MHz</td><td>220 kHz</td><td>1 UIp-p±0.3 UI</td></tr>
<tr><td>20 UI</td><td>220 kHz</td><td>22 kHz</td><td>10 UIp-p±3 UI</td></tr>
<tr><td>200 UI</td><td>22 kHz</td><td>2.2 kHz</td><td>100 UIp-p±30 UI</td></tr>
<tr><td>4000 UI</td><td>2.2 kHz</td><td>110 Hz</td><td>1000 UIp-p±300 UI</td></tr>
</table>
Clock output frequency: 1.6 GHz < Fc ≤ 3.2 GHz
<table>
<tr><th>Jitter Amplitude Range</th><th>FM Frequency Range</th><th>Input Frequency</th><th>Jitter Amplitude</th></tr>
<tr><td>2 UI</td><td>1 MHz</td><td>110 kHz</td><td>1 UIp-p±0.3 UI</td></tr>
<tr><td>20 UI</td><td>110 kHz</td><td>11 kHz</td><td>10 UIp-p±3 UI</td></tr>
<tr><td>200 UI</td><td>11 kHz</td><td>1.1 kHz</td><td>100 UIp-p±30 UI</td></tr>
<tr><td>4000 UI</td><td>1.1 kHz</td><td>55 Hz</td><td>1000 UIp-p±300 UI</td></tr>
</table>
Clock output frequency: 0.8 GHz < Fc ≤ 1.6 GHz
<table>
<tr><th>Jitter Amplitude Range</th><th>FM Frequency Range</th><th>Input Frequency</th><th>Jitter Amplitude</th></tr>
<tr><td>2 UI</td><td>500 kHz</td><td>55 kHz</td><td>1 UIp-p±0.3 UI</td></tr>
<tr><td>20 UI</td><td>55 kHz</td><td>5.5 kHz</td><td>10 UIp-p±3 UI</td></tr>
<tr><td>200 UI</td><td>5.5 kHz</td><td>550 Hz</td><td>100 UIp-p±30 UI</td></tr>
<tr><td>4000 UI</td><td>550 Hz</td><td>27.5 Hz</td><td>1000 UIp-p±300 UI</td></tr>
</table>
Clock output frequency: 0.1 GHz < Fc ≤ 0.8 GHz
<table>
<tr><th>Jitter Amplitude Range</th><th>FM Frequency Range</th><th>Input Frequency</th><th>Jitter Amplitude</th></tr>
<tr><td>2 UI</td><td>250 kHz</td><td>27.5 kHz</td><td>1 UIp-p±0.3 UI</td></tr>
<tr><td>20 UI</td><td>27.5 kHz</td><td>2.75 kHz</td><td>10 UIp-p±3 UI</td></tr>
<tr><td>200 UI</td><td>2.75 kHz</td><td>275 Hz</td><td>100 UIp-p±30 UI</td></tr>
<tr><td>4000 UI</td><td>275 Hz</td><td>13.75 Hz</td><td>1000 UIp-p±300 UI</td></tr>
</table>
Jitter amplitude range
2 UI Range: 0.22 to 2 UIp-p (0.11 to 1 Vp-p)
20 UI Range: 2 to 20 UIp-p (0.1 to 1 Vp-p)
200 UI Range: 20 to 200 UIp-p (0.1 to 1 Vp-p)
4000 UI Range: 200 to 4000 UIp-p (0.1 to 2 Vp-p)
</td></tr>
</table>

Table 1.3-1 Specifications (Cont'd)

<table>
<tr><th colspan="2">Item</th><th>Specifications</th></tr>
<tr><td>External Jitter 1 (Cont'd)
When MU181000A/B-x01 is installed:</td><td>Jitter Mask</td><td>When FM Freq.Range is 500 MHz/1 GHz:
<table>
<tr><th>Fc [GHz]</th><th>FM Frequency [Hz]</th><th>Jitter Amplitude [UIp-p] (Max.)</th></tr>
<tr><td rowspan="2">11.3<Fc≤12.5</td><td>500 M to 1 G</td><td>0.1</td></tr>
<tr><td>80 M to 500 M</td><td>0.22</td></tr>
<tr><td>4.0<Fc≤11.3</td><td>80M to 1 G</td><td>0.22</td></tr>
<tr><td>2.4<Fc≤4.0</td><td>80 M to 500 M</td><td>0.22</td></tr>
<tr><td>1.4<Fc≤2.4</td><td>80 M to 100 M</td><td>0.22</td></tr>
</table></td></tr>
<tr><td rowspan="3">External Jitter 2
When MU181000A/B-x01 is installed:</td><td colspan="2">When Operation is S-ATA (clock output frequency is fixed to 6 GHz)</td></tr>
<tr><td>Modulation frequency</td><td>600 MHz</td></tr>
<tr><td>Modulation accuracy</td><td>0.455 UIp-p ± 0.091 UI when input level is 2 Vp-p</td></tr>
<tr><td rowspan="5">Triangle Wave Modulation
When MU181000A/B-x01 or MU181000B-x02 is installed:</td><td colspan="2">When Operation is PCIe – Gen1 (2.5 GHz), PCIe – Gen2 (5 GHz), or PCIe-Gen3/4/5 (8 GHz)*3</td></tr>
<tr><td>Clock output frequency</td><td>PCIe – Gen1 (2.5 GHz)
When Spread Method is Center: 2500 MHz
When Spread Method is Down: 2493.75 MHz
PCIe – Gen2 (5 GHz)
When Spread Method is Center: 5000 MHz
When Spread Method is Down: 4987.5 MHz
PCIe – Gen3/4/5 (8 GHz) *3
When Spread Method is Center: 8000 MHz
When Spread Method is Down: 7980 MHz
Offset function –1000 to +1000 ppm/1 ppm step is effective.</td></tr>
<tr><td>Modulation frequency accuracy</td><td>31.25 kHz±1000 ppm
33 kHz±1000 ppm*3</td></tr>
<tr><td>Frequency deviation</td><td>When set to 5000 ppm:
PCIe – Gen1 (2.5 GHz): ±6.25 MHz
PCIe – Gen2 (5 GHz): ±12.5 MHz
PCIe – Gen3/4/5 (8 GHz) *3: ±20 MHz
When set to 3000 ppm:
PCIe – Gen1 (2.5 GHz): ±3.75 MHz
PCIe – Gen2 (5 GHz): ±7.5 MHz
PCIe – Gen3/4/5 (8 GHz)*3: ±12 MHz</td></tr>
<tr><td>Deviation accuracy</td><td>±10%</td></tr>
<tr><td>Deviation options</td><td>5000 ppm or 3000 ppm*4</td></tr>
</table>

*3: Available only when the MU181000B-x02 is installed.

*4: Switchable only when MP1900A is used. Fixed to 5000 ppm in other cases.

Table 1.3-1 Specifications (Cont'd)

Item		Specifications
Alarm detection function		PLL unlock, temperature detection (judgement temperature +78.5°C)
Environmental performance When MU181000A/B-x01 is installed:	Operating temperature range	+5 to +40°C (Main unit ambient temperature)
	Operating humidity range	20 to 80%
	Storage temperature range	–20 to +60°C
	Storage humidity range	20 to 80%
Mechanical dimensions	Dimensions	234 mm (W) × 41 mm (H) × 175 mm (D) (Compact-PCI 2 slots), excluding protruding parts
	Mass	≤3.0 kg

Chapter 2 Preparation before Use

This section describes preparations required before using the MU181000A/B.

2.1 Installation to Signal Quality Analyzer

For information on how to install the MU181000A/B to the signal quality analyzer and how to turn on the power, refer to 2.3 "Installing and Removing Modules" in the *MP1800A Signal Quality Analyzer Installation Guide* or Chapter 3 " Preparation before Use" in the *MP1900A Signal Quality Analyzer-R Operation Manual.*

2.2 How to Operate Application

The modules connected to the Signal Quality Analyzer are controlled by operating the MX180000A Signal Quality Analyzer Control Software (hereinafter, referred to as “MX180000A”) or MX190000A Signal Quality Analyzer-R Control Software (hereinafter, referred to as “MX190000A”).

For information on how to start up, shut down, and operate the MX180000A, refer to the *MX180000A Signal Quality Analyzer Control Software Operation Manual or MX190000A Signal Quality Analyzer-R Control Software Operation Manual.*

2.3 Preventing Damage

Be sure to observe the rating voltage ranges when connecting input and output of the MU181000A/B. Otherwise, the MU181000A/B may become damaged.

⚠ CAUTION

- **When signals are input to the MU181000A/B, avoid excessive voltage beyond the rating. Otherwise, the circuit may be damaged.**
- **Use a 50 Ω/GND terminator at the output. Never feed any current to the output.**
- **As a countermeasure against static electricity, ground other devices to be connected (including experimental circuits) with ground wires before connecting the I/O connector.**
- **The outer conductor and core of the coaxial cable may become charged as a capacitor. Use metal like a copper wire to discharge electricity between the outer conductor and core before use.**
- **Never open the MU181000A/B. If you open it and sufficient performance cannot be obtained, we may decline to repair the MU181000A/B.**
- **To protect the MU181000A/B from electrostatic discharge failure, a conductive sheet should be placed onto the workbench, and the operator should wear an electrostatic discharge wrist strap. Connect the ground connection end of the wrist strap to the conductive sheet or to the ground terminal of the mainframe.**

Chapter 3 Panel Layout and Connectors

This section describes the panels and connectors of the MU181000A/B.

3.1 Panel Layout

3.1.1 Panel layout of MU181000A/B

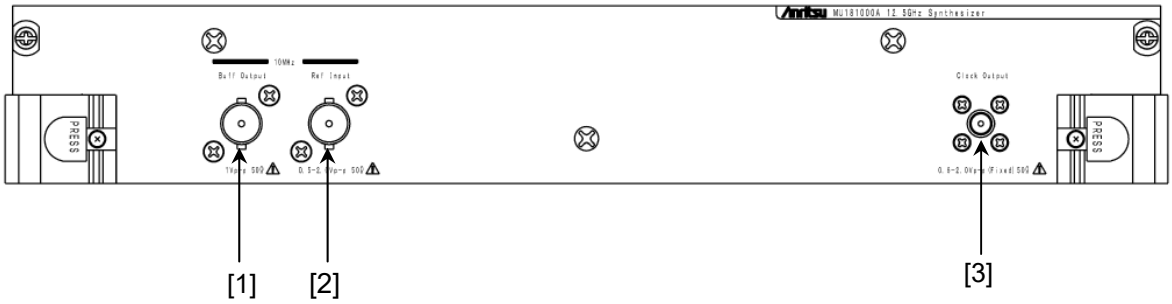


Figure 3.1.1-1 Panel of MU181000A

Figure 3.1.1-2 Panel of MU181000B

Table 3.1.1-1 Name and Function of Each Part

No.	Name	Function
[1]	Buff Output (10 MHz)	Connector to output 10 MHz buffer.
[2]	Ref. Input (10 MHz)	Connector to input a 10-MHz reference input signal. Clock output of the MU181000A/B is synchronized with the clock input from this connector.
[3]	Clock Output (100 MHz to 12.5 GHz)	Connector to output a clock signal generated within the MU181000A/B.

3.1.2 Panel layout of MU181000A/B-x01

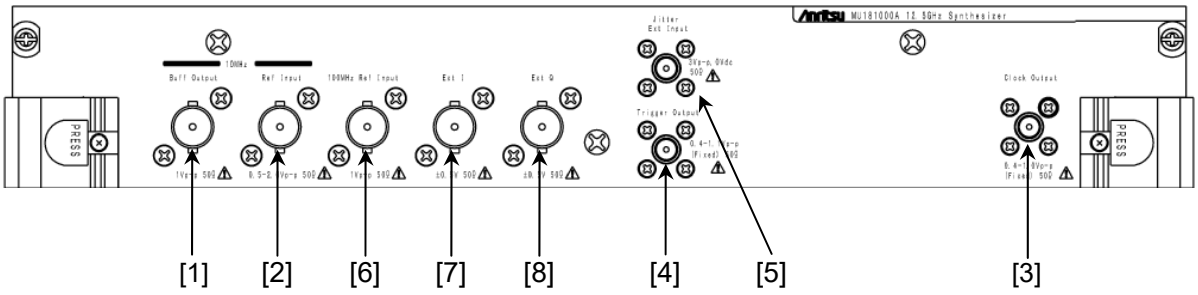


Figure 3.1.2-1 Panel of MU181000A-x01

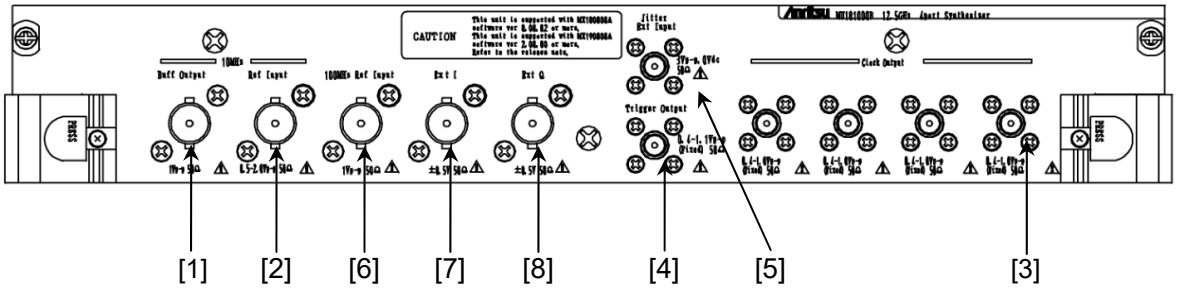


Figure 3.1.2-2 Panel of MU181000B-x01

Table 3.1.2-1 Name and Function of Each Part

<table>
<tr><th>No.</th><th>Name</th><th>Function</th></tr>
<tr><td>[1]</td><td>Buff Output
(10 MHz)</td><td>Connector to output 10 MHz buffer.</td></tr>
<tr><td>[2]</td><td>Ref. Input
(10 MHz)</td><td>Connector to input a 10-MHz reference input signal. Clock output of the MU181000A/B is synchronized with the reference clock input from this connector.</td></tr>
<tr><td>[3]</td><td>Clock Output
(100 MHz to 12.5 GHz)</td><td>Connector to output a clock signal generated within the MU181000A/B.</td></tr>
<tr><td>[4]</td><td>Trigger Output</td><td>Connector to output a signal generated by dividing the clock signal output frequency by 1 or 64.
<table>
<tr><th>Jitter Source</th><th>Jitter Amplitude</th><th>Output Signal</th></tr>
<tr><td rowspan="2">Internal</td><td>≤ 0.22 UIp-p</td><td>Unmodulated</td></tr>
<tr><td>> 0.22 UIp-p</td><td>Jitter added</td></tr>
<tr><td rowspan="2">External</td><td>Range: 0.22 UI</td><td>Unmodulated</td></tr>
<tr><td>Range: 2 UI / 20 UI / 200 UI / 4000 UI</td><td>Jitter added</td></tr>
</table></td></tr>
<tr><td>[5]</td><td>Jitter Ext Input</td><td>Connector to supply the modulation signal source externally.
A sine wave from 9 Hz to 1 GHz can be input.
The jitter amplitude can be controlled by the signal amplitude and by setting Amplitude Range on the screen.</td></tr>
<tr><td>[6]</td><td>100 MHz Ref Input</td><td>Connector to input a 100 MHz reference signal.
A clock signal is generated from this reference signal by multiplying the frequency and the phase deviation of the signal by 25 or 50, and then the generated clock signal is output from the clock signal output connector.
Also, when the MU181000B-x02 is installed, the signal multiplied by 80 is output.</td></tr>
<tr><td>[7]</td><td>Ext I</td><td>Connector to input the I signal.</td></tr>
<tr><td>[8]</td><td>Ext Q</td><td>Connector to input the Q signal.</td></tr>
</table>

3.1.3 Panel layout of MU181000B-x02

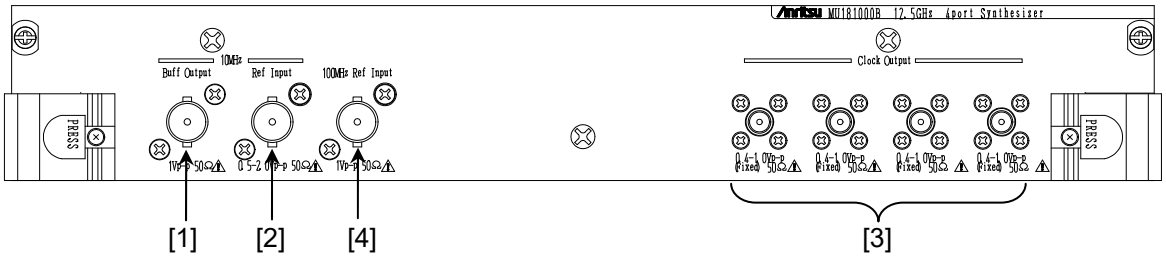


Figure 3.1.3-1 Panel of MU181000B-x02

Table 3.1.3-1 Name and Function of Each Part

No.	Name	Function
[1]	Buff Output (10 MHz)	Connector to output 10 MHz buffer.
[2]	Ref. Input (10 MHz)	Connector to input a 10-MHz reference input signal. Clock output of the MU181000A/B is synchronized with the reference clock input from this connector.
[3]	Clock Output (100 MHz to 12.5 GHz)	Connector to output a clock signal generated within the MU181000A/B.
[4]	100 MHz Ref Input	Connector to input a 100 MHz reference signal. A clock signal is generated from this reference signal by multiplying the frequency and the phase deviation of the signal by 25, 50, or 80, and then the generated clock signal is output from the clock signal output connector.

3.2 Inter-Module Connection

This section shows an example of connecting the MU181000A/B, MU181020A 12.5Gbit/s PPG (hereinafter, referred to as "MU181020A"), and MU181800A 12.5GHz Clock Distributor (hereinafter, referred to as "MU181800A") that are inserted into a mainframe. Connect these modules using the procedure below and referring to Figure 3.2-1 through 3.2-3. In this section, drawings of the MU181000A are used for explanation, while the contents are common to the MU181000B.

1. Connecting power supply
   Connect the 3-pin power cord of the mainframe to the power receptacle. Be sure to use the 3-pin power cord supplied with the mainframe and a 3-pin receptacle.
2. Connecting to MU181020A
   Connect the Clock Output connector of the MU181000A/B and the Ext. Clock Input connector of the MU181020A, using a coaxial cable.

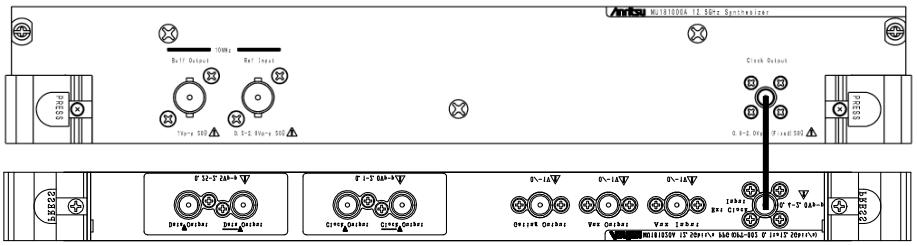


Figure 3.2-1 Connecting to MU181020A

3. Connecting to MU181800A
   Connect the Clock Output connector of the MU181000A/B and the Clock Input connector of the MU181800A, using a coaxial cable.

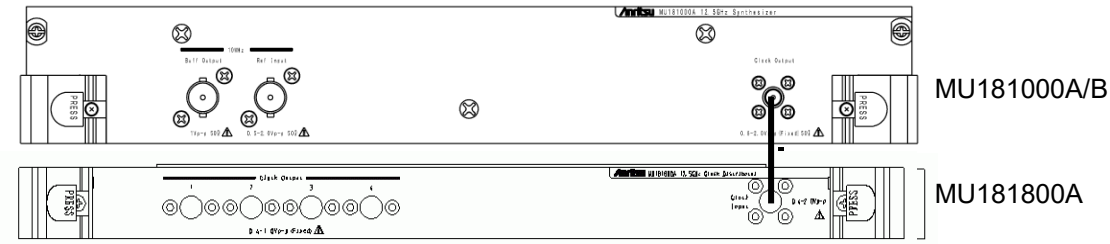


Figure 3.2-2 Connecting to MU181800A

4. Connecting to external device
   Connect the Ref. Input connector of the MU181000A/B and the Ref. Output connector of an external device, using a coaxial cable.

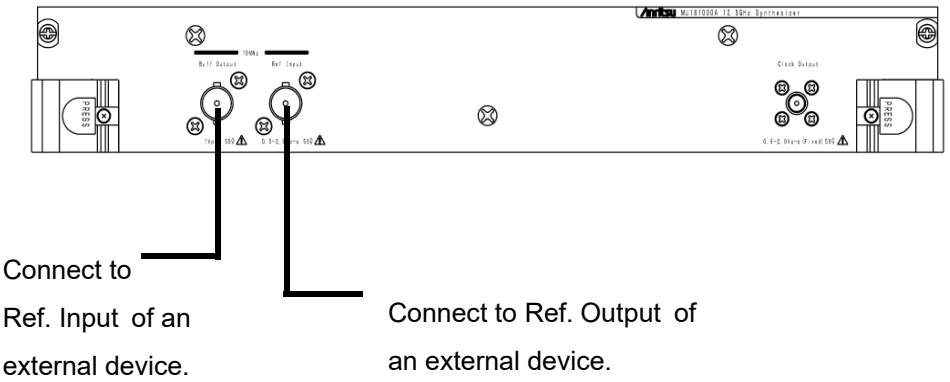


Figure 3.2-3 Connecting to external device

5. Connect the MU181000A/B with MU181000A/B-x01 installed and an external device in accordance with the intended use. The connection method is as follows.
   (1) To synchronize the MU181000A/B with a 10-MHz reference signal of an external device, connect the Ref. Input connector of the MU181000A/B and the Ref. Output connector of an external device, using a 50 Ω coaxial cable.
   (2) To synchronize an external device to the 10-MHz reference signal of the MU181000A/B, connect the Buff. Output connector of the MU181000A/B and the Ref. Input connector of an external device, using a 50 Ω coaxial cable.
   (3) To use the trigger output signal (output clock frequency divided by 1 or 64) as a trigger of an oscilloscope, connect the Trigger Output connector of the MU181000A/B to the trigger input of the oscilloscope, using a 50 Ω coaxial cable.
   (4) To add jitters using an external signal source, connect the signal source to the Jitter Ext Input connector of the MU181000A/B, using a 50 Ω coaxial cable.
   (5) To output a clock signal obtained by multiplying the frequency of the 100 MHz signal input from an external signal source by 25 or 50, connect the signal source to the 100 MHz Ref Input connector of the MU181000A/B, using a 50 Ω coaxial cable.
   (6) To add jitters using an external arbitral waveform signal generator, connect the signal generator to the Ext I and Ext Q connectors of the MU181000A/B, using a 50 Ω coaxial cable.

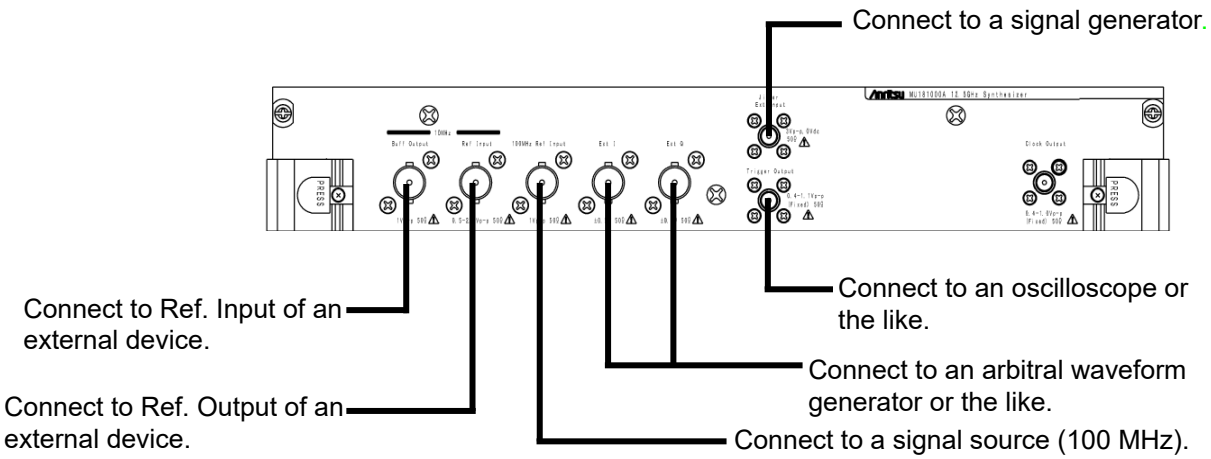


Figure 3.2-4 Connecting to external device (when MU181000A-x01 installed)

⚠ CAUTION

If an excessive voltage is applied to the input connector, the protective circuit may be damaged. Avoid any input beyond the rating. If there is any possibility of the rating being exceeded, check that the input signal is within the rating before connection.

To prevent damage due to static electricity charged inside the coaxial cable, ground the core of the coaxial cable in contact to discharge it before connection.

Chapter 4 Configuration of Setup Dialog Box

This section describes the configuration of the setup dialog box for the MU181000A/B.
The operations in the case where the MU181000A/B is installed to the MP1800A are explained here. For the case where the MU181000A/B is installed to the MP1900A, refer to the *MX190000A Signal Quality Analyzer-R Control Software Operation Manual*.

4.1 Configuration of Entire Setup Dialog Box

The figure below shows the configuration of the setup dialog box when the MU181000A/B is inserted into the MP1800A.

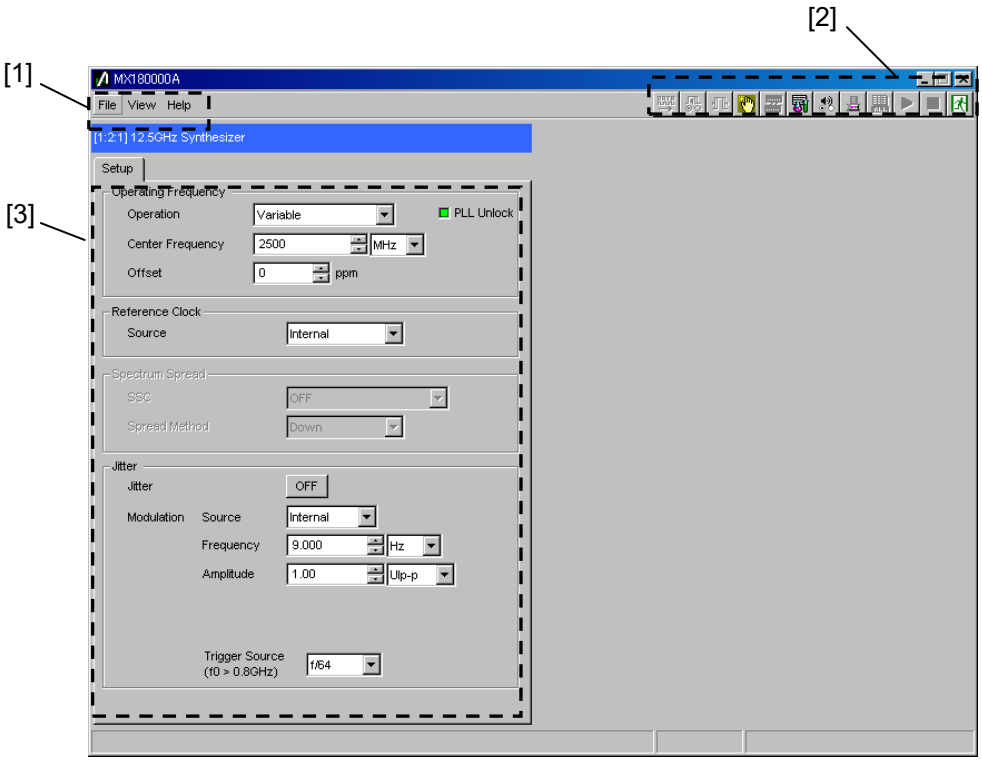


Figure 4.1-1 Configuration of entire setup dialog box for MU181000A/B (MP1800A)

The figure below shows the configuration of the setup dialog box when the MU181000A/B is inserted into the MP1900A.

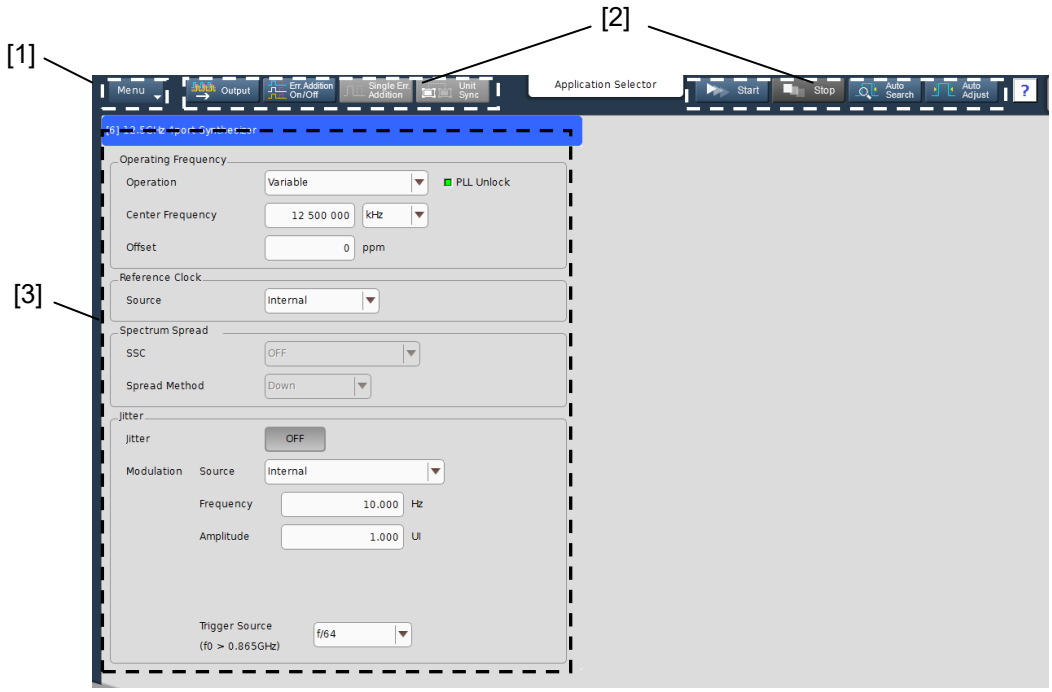


Figure 4.1-2 Configuration of entire setup dialog box for MU181000A/B (MP1900A)

The setup dialog box consists of three blocks as shown in Figure 4.1-1. The following table describes each of the blocks.

Table 4.1-1 Functions of blocks

No.	Block	Function
[1]	Menu bar	Selects the settings related to the entire device. Refer to the *MX180000A Signal Quality Analyzer Control Software Operation Manual* or *MX190000A Signal Quality Analyzer-R Control Software Operation Manual* for details.
[2]	Module function buttons	Shortcut buttons for the function items specific to the displayed module. Users can customize the pre-defined function buttons according to their own applications. Refer to the *MX180000A Signal Quality Analyzer Control Software Operation Manual* or *MX190000A Signal Quality Analyzer-R Control Software Operation Manual* for details.
[3]	Operation window	Configures settings specific to each module.

4.2 Configuration of Operation Window

4.2.1 Operation window for MU181000A/B

The operation window for the MU181000A/B is shown below.

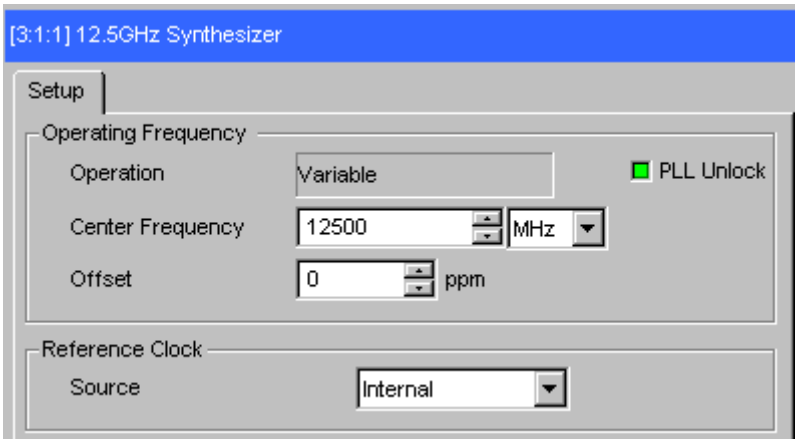


Figure 4.2.1-1 Operation window

Table 4.2.1-1 Items in operation window

Item		Functions
Operating Frequency	Center Frequency	Sets the frequency of the clock signal output from the Clock Output connector (when Offset = 0 ppm). In MHz units: Can be set in the range from 100 to 12,500 MHz. Digits below MHz that are not displayed are set to 0. In kHz units: Can be set in the range from 100,000 to 12,500,000 kHz.
	Offset	Sets the offset value from Center Frequency for the frequency of the clock signal output from the Clock Output connector. Unit: ppm Setting range: –1,000 to +1,000 ppm, in 1 ppm steps
	PLL Unlock	Green: PLL lock state Red: PLL unlock state
Reference Clock	Source	Internal: Synchronizes the clock signal output from the Clock Output connector with the 10 MHz reference signal in the main frame. External 10 MHz: Synchronizes the clock signal output from the Clock Output connector with the 10 MHz clock signal input to the Ref. Input (10 MHz) connector from an external device.

4.2.2 Operation window when MU181000A/B-x01 is installed

The operation window for the MU181000A/B with MU181000A/B-x01 installed is shown below.

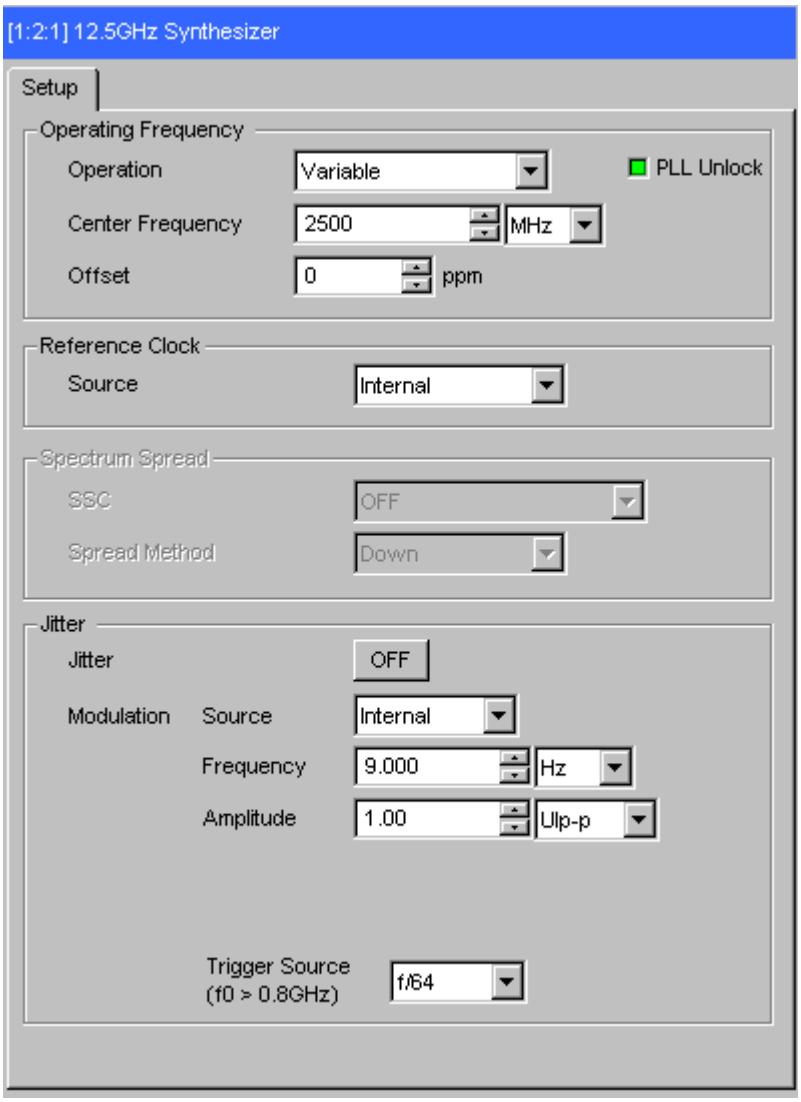


Figure 4.2.2-1 Operation window (MU181000A/B-x01 installed)

Table 4.2.2-1 Items in operation window when MU181000A/B-x01 is installed

Item		Functions
Operating Frequency	Operation	Select Variable, PCIe-Gen1 (2.5 GHz), PCIe-Gen2 (5 GHz), or SATA (6 GHz).
	Center Frequency	When Operation is set to Variable: Sets the frequency of the clock signal output from the Clock Output connector (when Offset = 0 ppm). In MHz units: Can be set in the range from 100 to 12,500 MHz. Digits below MHz that are not displayed are set to 0. In kHz units: Can be set in the range from 100,000 to 12,500,000 kHz. When Operation is set to PCIe-Gen1 (2.5 GHz): Fixed to 2500 MHz. When Operation is set to PCIe-Gen2 (5 GHz): Fixed to 5000 MHz. When Operation is set to SATA (6 GHz): Fixed to 6000 MHz.
	Offset	Sets the offset value from Center Frequency for the frequency of the clock signal output from the Clock Output connector. Unit: ppm Setting range: –1,000 to +1,000 ppm, in 1 ppm steps This item is disabled when Operation is set to PCIe-Gen1 (2.5 GHz) or PCIe-Gen2 (5 GHz) and SSC is set to ON (Ext Ref 100 MHz).
	PLL Unlock	Green: PLL lock state Red: PLL unlock state
Reference Clock	Source	Internal: Synchronizes the clock signal output from the Clock Output connector with the 10 MHz reference signal in the main frame. External 10 MHz: Synchronizes the clock signal output from the Clock Output connector with the 10 MHz clock signal input to the Ref. Input (10 MHz) connector from an external device. This item is disabled when Spectrum Spread / SSC is set to “ON (Int Ref)” or “ON (Ext Ref 10 MHz)” or “ON (Ext Ref 100 MHz)”.

Table 4.2.2-1 Items in operation window when MU181000A/B-x01 is installed (Cont'd)

Item		Functions
Spectrum Spread	SSC	This item is enabled only when Operation is set to PCIe-Gen1 (2.5 GHz) or PCIe-Gen2 (5 GHz). OFF: An unmodulated clock signal is output. ON (Int Ref): A triangular wave modulated clock signal is output. The carrier is synchronized with the internal 10 MHz reference signal. ON (Ext Ref 10 MHz): A triangular wave modulated clock signal is output. The carrier is synchronized with an externally input 10 MHz clock signal. ON (Ext Ref 100 MHz): A clock signal that is obtained by multiplying the frequency of the 100 MHz signal input from the 100 MHz Ref Input connector by 25 or 50 is output.
	Spread Method	This item is enabled only when SSC is set to OFF, ON (Int Ref), or ON (Ext Ref 10 MHz). Down: When Operation is set to PCIe-Gen1 (2.5 GHz), a 2493.75 MHz signal is output, synchronized with the selected 10-MHz reference signal. When Operation is set to PCIe-Gen2 (5 GHz), a 4987.5 MHz signal is output, synchronized with the selected 10-MHz reference signal. Center: When Operation is set to PCIe-Gen1 (2.5 GHz), a 2500 MHz signal is output, synchronized with the selected 10 MHz reference signal. When Operation is set to PCIe-Gen2 (5 GHz), a 5000 MHz signal is output, synchronized with the selected 10 MHz reference signal.
Jitter	Jitter	This item is enabled only when SSC is set to OFF. ON: A clock signal is output with jitter added. OFF: An unmodulated clock signal is output.
	Modulation Source	Internal: Select when adding jitter with the internal modulation signal source. When Internal is selected, the Frequency and Amplitude spin boxes are displayed as shown in Figure. 4.2.2-2, to set the frequency and amplitude depth of the sine wave jitter. External: Select when adding jitter with an external signal source. When External is selected, the Frequency Range and Amplitude Range spin boxes are displayed as shown in Figure 4.2.2-3. Select the ranges of the frequency and amplitude depth to be modulated by referring to Figure 4.2.2-5 through 4.2.2-9, and set in these spin boxes. Note that Amplitude is fixed to 0.22 UI when Frequency Range is set to Full. External I/Q: Select when using the I and Q signals for modulation. The Jitter field becomes as shown in Figure. 4.2.2-4, which does not provide any items for setting the frequency and amplitude depth.

Table 4.2.2-1 Items in operation window when MU181000A/B-x01 is installed (Cont'd)

Item		Functions
Jitter	Trigger Source	When Fc is set to greater than 800 MHz, a signal obtained by dividing the clock output frequency (Fc) by 1 or 64 is output from the Trigger Out connector. F/1: A signal with Fc divided by 1 is output. This can be selected only when Fc is set to greater than 6400 MHz. F/64: A signal with Fc divided by 64 is output.

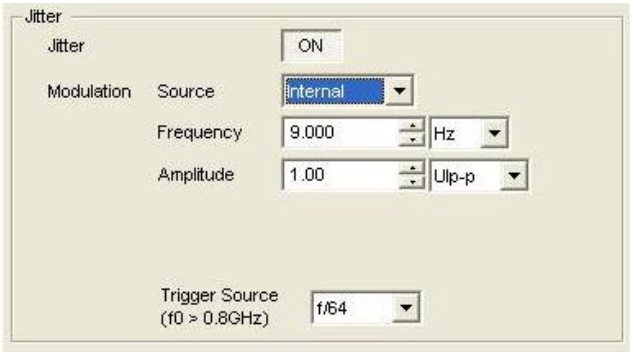


Figure 4.2.2-2 Jitter setting field when Internal is selected

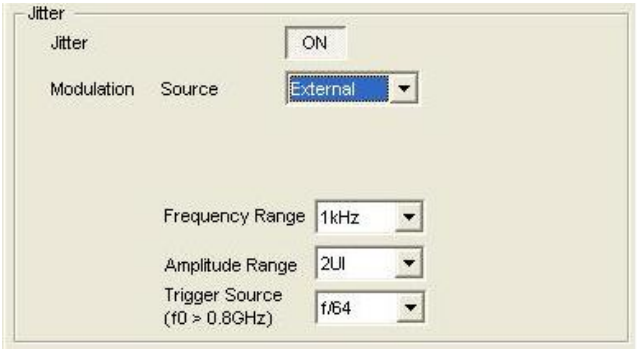


Figure 4.2.2-3 Jitter setting field when External is selected

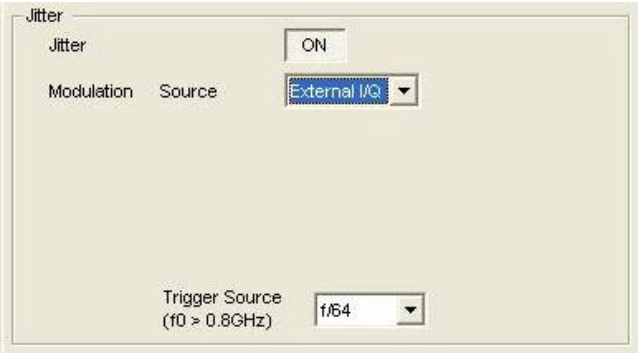


Figure 4.2.2-4 Jitter setting field when External I/Q is selected

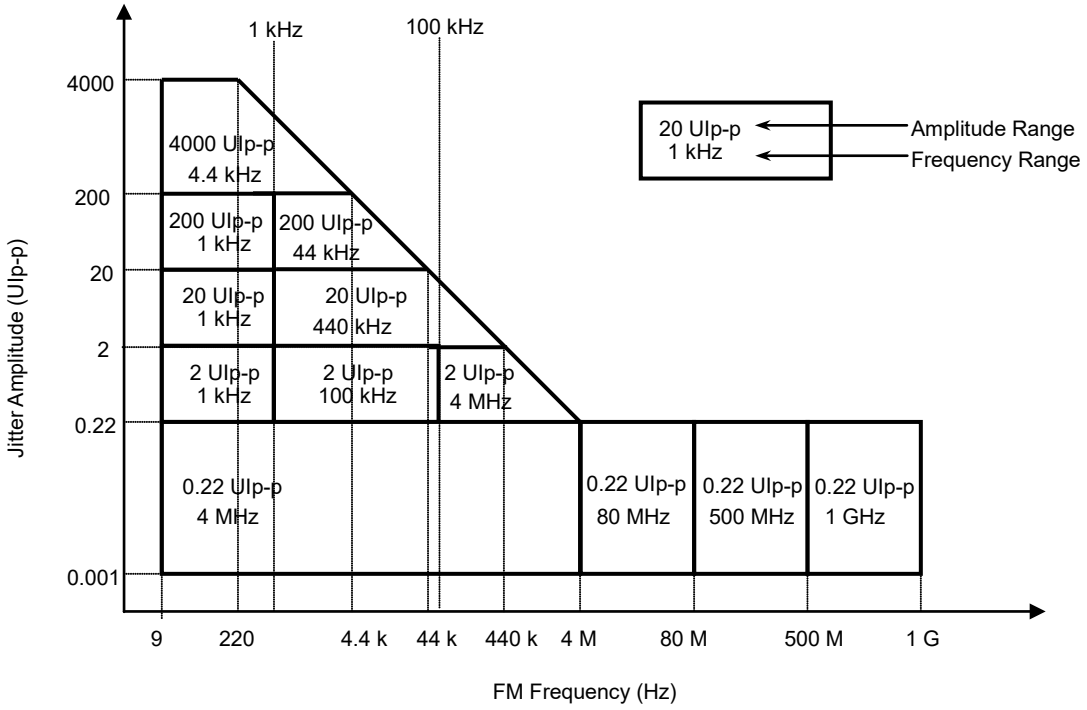


Figure 4.2.2-5 Range selection when 6.4 GHz < Fc ≤ 12.5 GHz

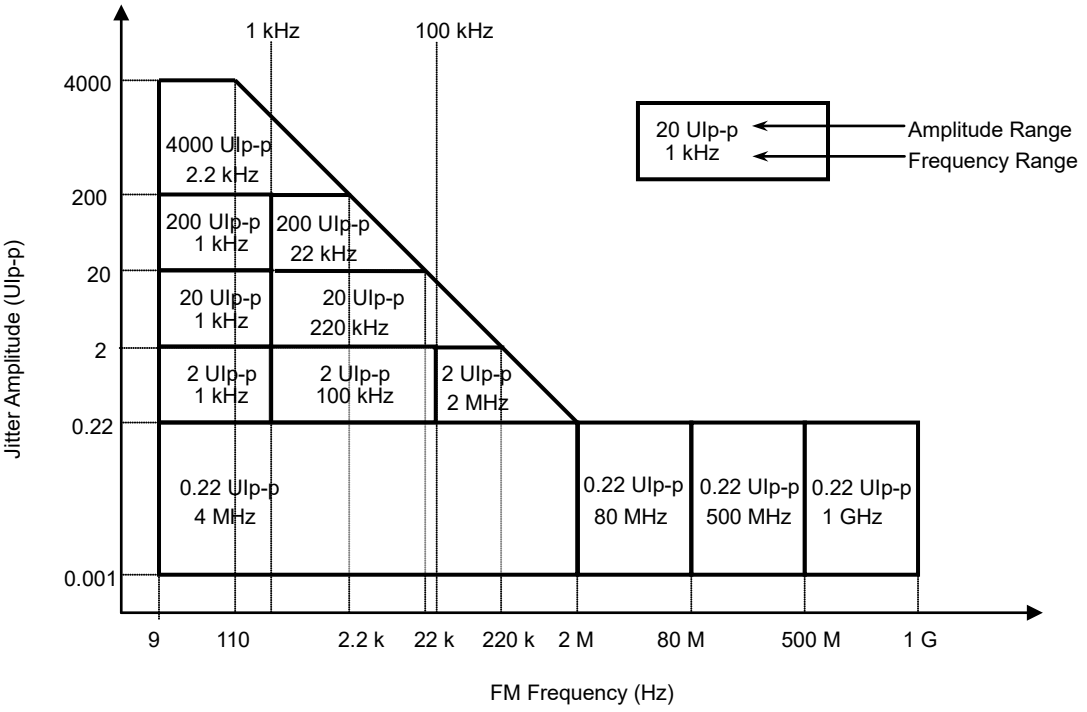


Figure 4.2.2-6 Range selection when 3.2 GHz < Fc ≤ 6.4 GHz

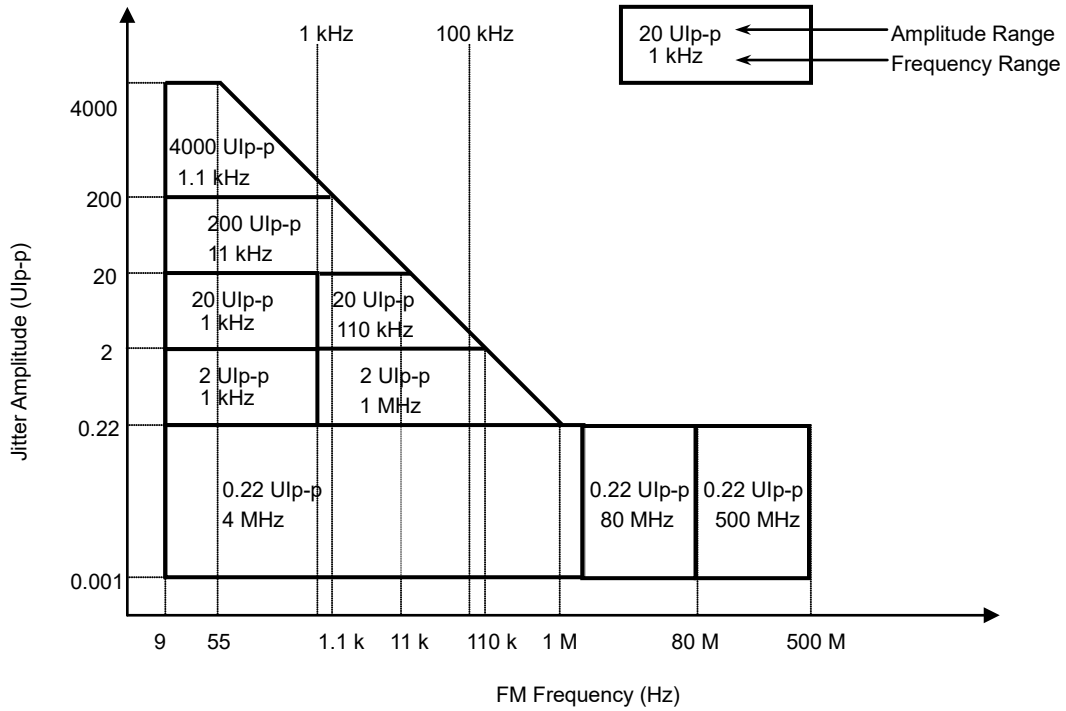


Figure 4.2.2-7 Range selection when 1.6 GHz < Fc ≤ 3.2 GHz

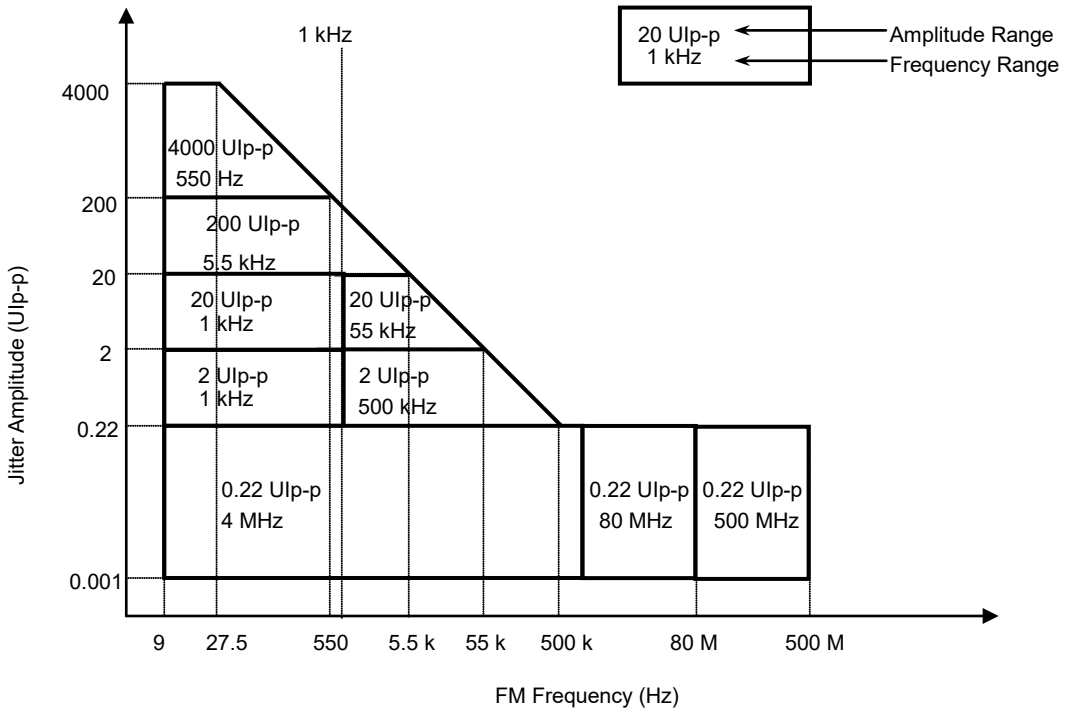


Figure 4.2.2-8 Range selection when 0.8 GHz < Fc ≤ 1.6 GHz

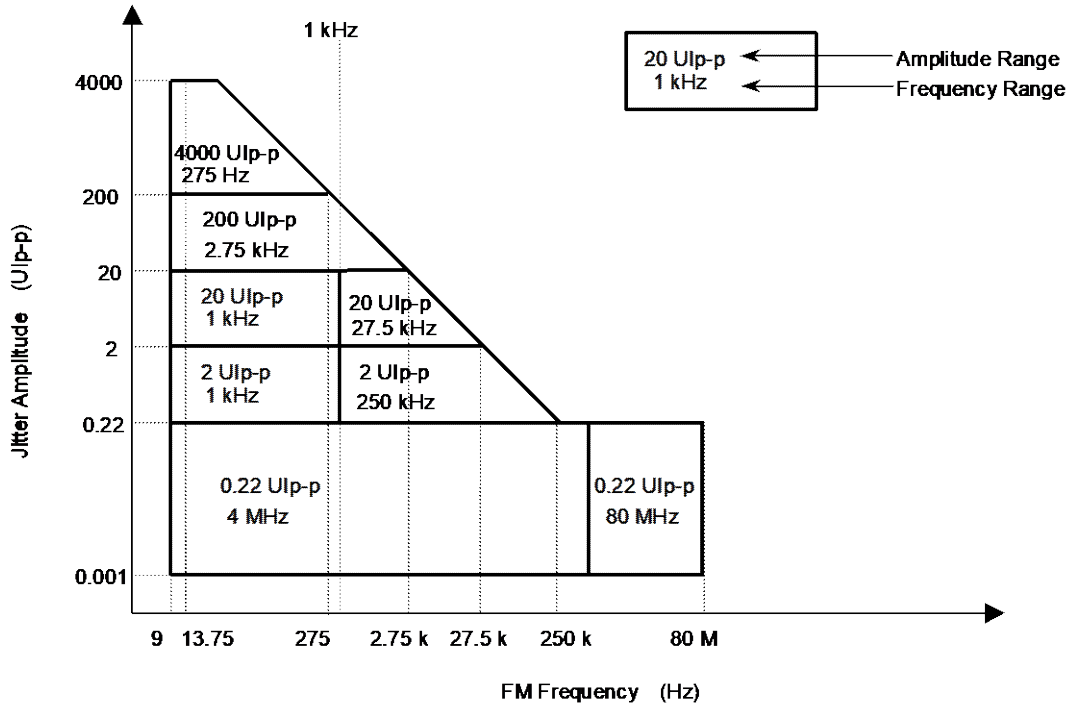


Figure 4.2.2-9 Range selection when 0.1 GHz ≤ Fc ≤ 0.8 GHz

Note:

For details of the operation method and cautions when inputting a jitter-modulated signal to the MU181020A 12.5Gbit/s PPG (with Option x30 Variable Data Delay installed) or the MU181040A 12.5Gbit/s ED (with Option x30 Variable Clock Delay), see 5.1.5 "When setting jitter-modulated signals" of the *MU181020A 12.5Gbit/s PPG Operation Manual* or 5.1.9 "When setting jitter-modulated signals" of the *MU181040A 12.5Gbit/s ED Operation Manual*.

4.2.3 Operation window when MU181000B-x02 is installed

The operation window for the MU181000A/B with MU181000B-x02 installed is shown below.
If the MU181000B-x01 is also installed, refer to the operation window in Section 4.2.2.

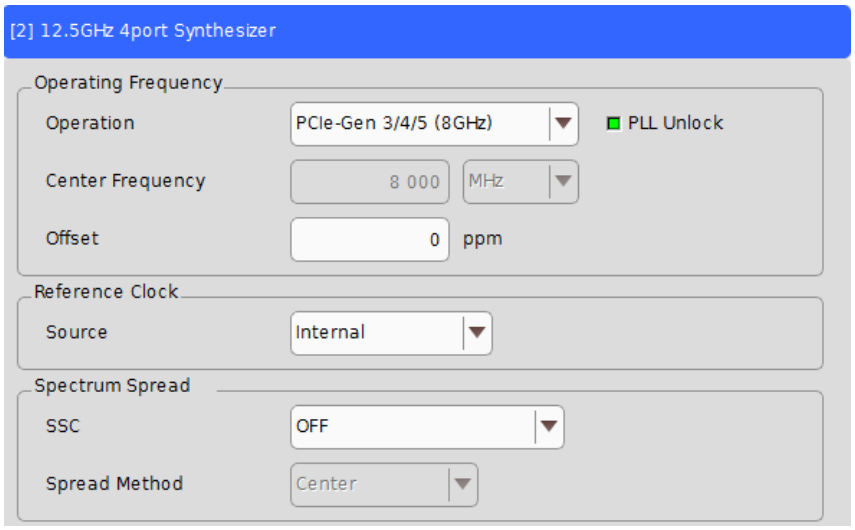


Figure 4.2.3-1 Operation window (MU181000B-x02 installed)

Note:

MU181000B-x02 is usable only when it is installed in MP1900A. If installed in MP1800A, the MP1800A shows no presence of this option on the screen and operates without MU181000B-x02.

Table 4.2.3-1 Items in operation window when MU181000B-x02 is installed

Item		Functions
Operating Frequency	Operation	Select Variable, PCIe-Gen1 (2.5 GHz), PCIe-Gen2 (5 GHz), PCIe-Gen3/4/5 (8 GHz), or SATA (6 GHz).
	Center Frequency	When Operation is set to Variable: Sets the frequency of the clock signal output from the Clock Output connector (when Offset = 0 ppm). In MHz units: Can be set in the range from 100 to 12,500 MHz. Digits below MHz that are not displayed are set to 0. In kHz units: Can be set in the range from 100,000 to 12,500,000 kHz. When Operation is set to PCIe-Gen1 (2.5 GHz): Fixed to 2500 MHz. When Operation is set to PCIe-Gen2 (5 GHz): Fixed to 5000 MHz. When Operation is set to PCIe-Gen3/4/5 (8 GHz) Fixed to 8000 MHz When Operation is set to SATA (6 GHz) Fixed to 6000 MHz
	Offset	Sets the offset value from Center Frequency. Unit: ppm Setting range: –1000 to +1000 ppm, in 1 ppm steps This item is disabled when Operation is set to PCIe-Gen1 (2.5 GHz), PCIe-Gen2 (5 GHz), or PCIe-Gen3/4/5 (8 GHz) and SSC is set to ON (Ext Ref 100 MHz).
	PLL Unlock	Green: PLL lock state Red: PLL unlock state
Reference Clock	Source	Internal: Synchronizes the clock signal output from the Clock Output connector with the 10 MHz reference signal in the main frame. External 10 MHz: Synchronizes the clock signal output from the Clock Output connector with the 10 MHz clock signal input to the Ref. Input (10 MHz) connector from an external device. This item is disabled when Spectrum Spread / SSC is set to "ON (Int Ref)" or "ON (Ext Ref 10 MHz)" or "ON (Ext Ref 100 MHz)".

Table 4.2.3-1 Items in operation window when MU181000B-x02 is installed (Cont'd)

Item		Functions
Spectrum Spread	SSC	This item is enabled only when Operation is set to PCIe-Gen1 (2.5 GHz), PCIe-Gen2 (5 GHz), or PCIe-Gen3/4/5 (8 GHz) OFF: An unmodulated clock signal is output. ON (Int Ref): A triangular wave modulated clock signal is output. The carrier is synchronized with the internal 10 MHz reference signal. ON (Ext Ref 10 MHz): A triangular wave modulated clock signal is output. The carrier is synchronized with an externally input 10 MHz clock signal. ON (Ext Ref 100 MHz): A clock signal that is obtained by multiplying the frequency of the 100 MHz signal input from the 100 MHz Ref Input connector by 25, 50, or 80 is output.
	Spread Method	This item is enabled only when SSC is set to OFF, ON (Int Ref), or ON (Ext Ref 10 MHz). Down: When Operation is set to PCIe-Gen1 (2.5 GHz), a 2493.75 MHz signal is output, synchronized with the selected 10-MHz reference signal. When Operation is set to PCIe-Gen2 (5 GHz), a 4987.5 MHz signal is output, synchronized with the selected 10-MHz reference signal. When Operation is set to PCIe-Gen3/4/5 (8 GHz) a 7980 MHz signal is output, synchronized with the selected 10-MHz reference signal. Center: When Operation is set to PCIe-Gen1 (2.5 GHz), a 2500 MHz signal is output, synchronized with the selected 10 MHz reference signal. When Operation is set to PCIe-Gen2 (5 GHz), a 5000 MHz signal is output, synchronized with the selected 10 MHz reference signal. When Operation is set to PCIe-Gen3/4/5 (8 GHz) a 8000 MHz signal is output, synchronized with the selected 10 MHz reference signal.

Chapter 5 Use Example

This section provides an MU181000A/B usage example.

5.1 MU181000A/B Usage Example

5.1.1 Example when using the MU181000A/B as a clock signal source

The following shows an example of how to use the MU181000A/B as the clock signal source for the MU181020A. In this section, drawings of the MU181000A are used for explanation, while the contents are common to the MU181000B.

1. Connect the Clock Output connector of the MU181000A/B and the Ext. Clock Input connector of the MU181020A, using a coaxial cable.

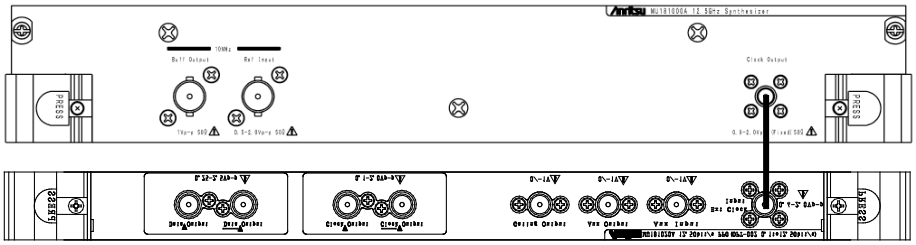


Figure 5.1.1-1 Connection with MU181020A

2. Generate Data and Clock signals by referring to the MU181020A 12.5Gbit/s PPG Operation Manual.

5.1.2 Example when using an external modulation signal source

1. When inputting a modulation signal to the Jitter Ext Input connector

   The jitter amplitude is determined depending on the Frequency Range and Amplitude Range settings in the operation window and the amplitude of the input signal. Adjust the amplitude of the signal source when more accurate jitter amplitude than the guaranteed accuracy level is required. The jitter amplitude can be obtained by measuring the carrier and sideband power using the spectrum analyzer. In this event, however, if the jitter amplitude is more than 0.4 UIp-p, be sure to divide the frequency so that the jitter amplitude is lowered to 0.4 UIp-p or less before performing measurement with the spectrum analyzer.

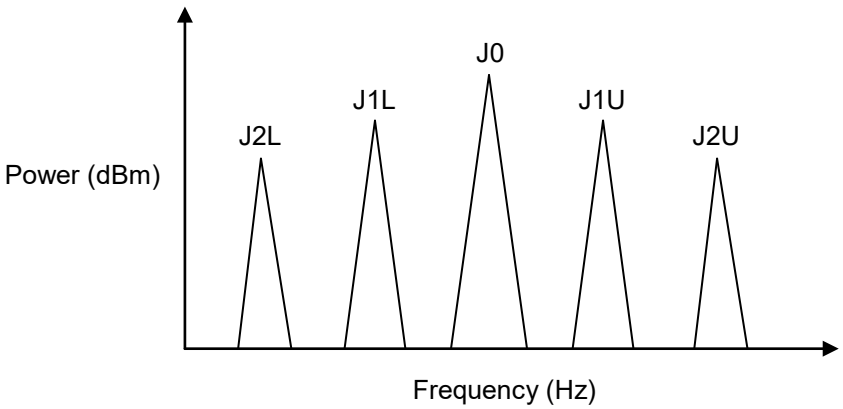


Figure 5.1.2-1 Spectrum waveform

J0: Carrier power (dBm)

J1U: Power of the upper frequency of the first sideband (dBm)

J1L: Power of the lower frequency of the first sideband (dBm)

J2U: Power of the upper frequency of the second sideband (dBm)

J2L: Power of the lower frequency of the second sideband (dBm)

Jitter amplitude calculation method

J1 = (J1U + J1L)/2

J2 = (J2U + J2L)/2

j0 = 10^ (J0/20)

j1 = 10^ (J1/20)

2 = 10^ (J2/20)

Jitter amplitude = (2 × j1/(j0 + j2))/π × Division ratio (UIp-p)

When the amplitude is set to 0.22 UI, the waveform may be distorted for an amplitude of more than 0.1 UIp-p. In order to adjust the peak-to-peak value of the phase deviation more precisely, correct the calculated jitter amplitude (obtained from the expression above) as follows:

UIm: Jitter amplitude (UIp-p) calculated from the spectrum power described above

Jitter amplitude = UIm × (1 – (0.03 × UIm – 0.0024) × 10 (UIp-p))

2. When executing modulation by inputting a signal to the Ext IQ connector

When adding a sine wave jitter, generate the I and Q signals as shown below, using an arbitrary waveform generator, and input them.
Calculate the actual modulation amount from the spectrum power, and check the difference from the set modulation amount before using this unit.

I signal = 0.5 × sin (UIs × π × sin (2 × π × t/T)) (V)

Q signal = 0.5 × cos (UIs × π × sin (2 × π × t/T)) (V)

UIs: Set jitter amplitude (UIp-p)

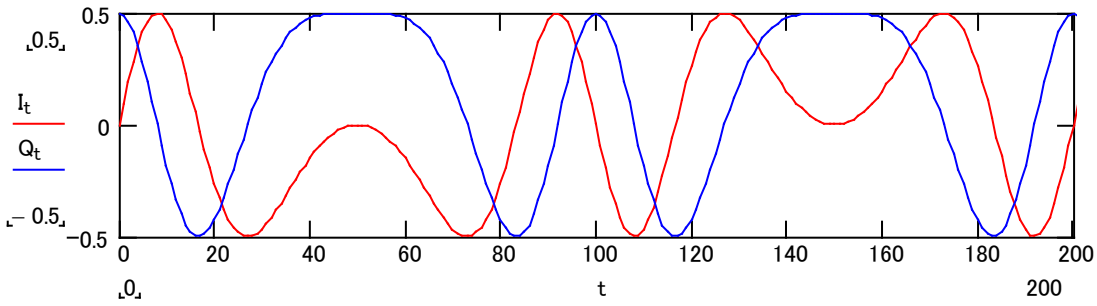


Figure 5.1.2-2 Example of waveforms of I and Q signals when jitter amplitude is 2 UIp-p

Chapter 6 Performance Test

This section describes the performance testing of the MU181000A/B.

6.1 Overview

Performance tests are executed to check that the major functions of the MU181000A/B meet the required specifications. Execute performance tests at acceptance inspection, operation check after repair, and periodic (once every six months) testing.

6.2 Devices Required for Performance Tests

Before starting performance tests, warm up the MU181000A/B and the measuring instruments for at least 30 minutes. Table 6.2-1 shows the devices required for performance tests.

Table 6.2-1 Devices required for MU181000A/B performance test

Device	Required Performance
Sampling oscilloscope	50 GHz or more band
Spectrum analyzer	50 GHz or more band
Divider	10,000 or more divisions
Signal generator	2 GHz or more
Function generator	9 Hz or less

Note:

Before starting the performance tests, warm up the device under test and the measuring instruments for at least 30 minutes and wait until they become sufficiently stabilized, unless otherwise specified. Additional conditions are required for maximum measurement accuracy: measurements must be performed at room temperature, fluctuations of AC power supply voltage must be small, and noise, vibration, dust, and humidity must be insignificant.

6.3 Performance Test Items

This section describes the following test items. In this section, drawings of the MU181000A are used for explanation, while the contents are common to the MU181000B.

(1) Waveform
(2) Phase noise
(3) Internal sine wave jitter
(4) External sine wave jitter
(5) Triangular wave modulation
(6) Trigger output waveform

Note:

MU181000A/B-x01 must be installed when executing test items (3) to (6).

6.3.1 Measuring waveform

Measure the waveform at the Clock Output connector. Connection with the measuring instruments is shown in Figure 6.3.1-1.

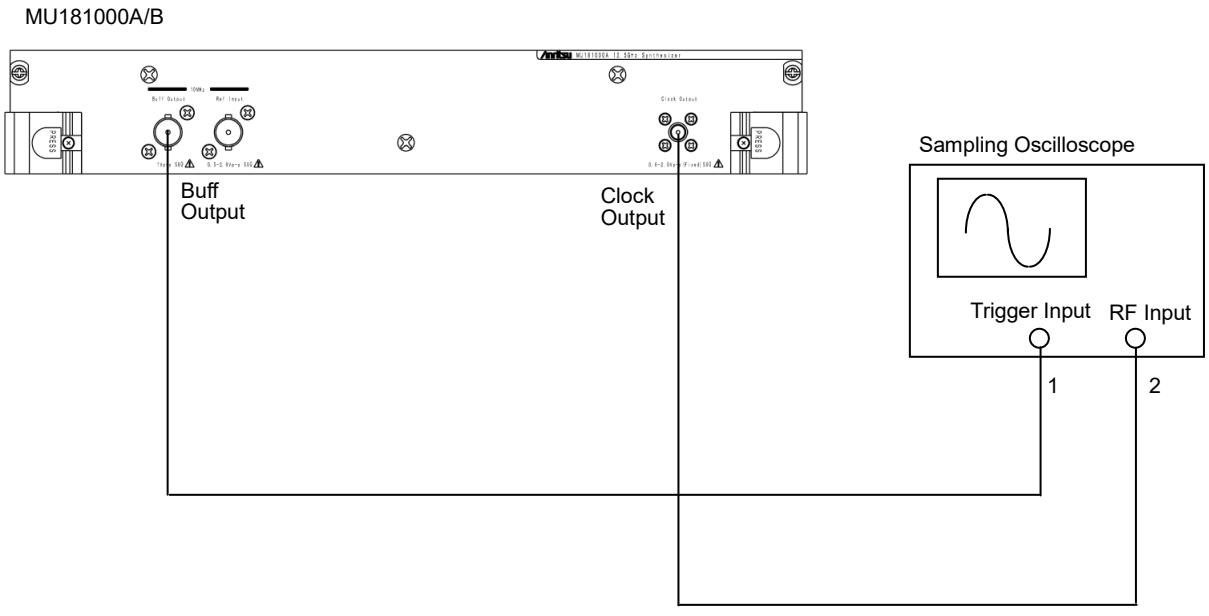


Figure 6.3.1-1 Connection diagram for waveform measurement

1. Connect the signal output from the Buff Output connector to the Trigger Input connector of the sampling oscilloscope.

2. Connect the clock signal output from the Clock Output connector to the RF Input connector of the sampling oscilloscope. Set the averaging to 64 (times) for the sampling scope.

⚠ CAUTION

Use an appropriate attenuator for each input connector when connecting to the input connector of the sampling oscilloscope. Improper connection may damage the sampling oscilloscope.

3. Set as follows in the MU181000A/B operation window:
   Center Frequency: 12,500 MHz
   Offset: 0 ppm
   Reference Clock Source: Internal
4. Use the averaging function of the sampling oscilloscope to measure the waveform, and then check that the level of the measured waveform falls within the range shown in Figure 6.3.1-2.

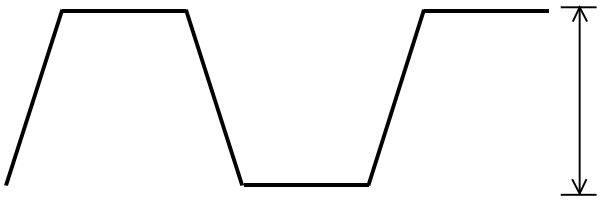


Figure 6.3.1-2 Example of waveform measured by sampling oscilloscope

5. Change the Center Frequency value in the MU181000A/B operation window as shown below, and perform measurement in the same way. Check that the waveform level falls within the range shown in Figure 6.3.1-2.
   Center Frequency: 10,000 MHz, 5,000 MHz, 1,000 MHz, 100 MHz

6.3.2 Measuring phase noise

Measure the phase noise at the Clock Output connector. Connection with the measuring instruments is shown in Figure 6.3.2-1.

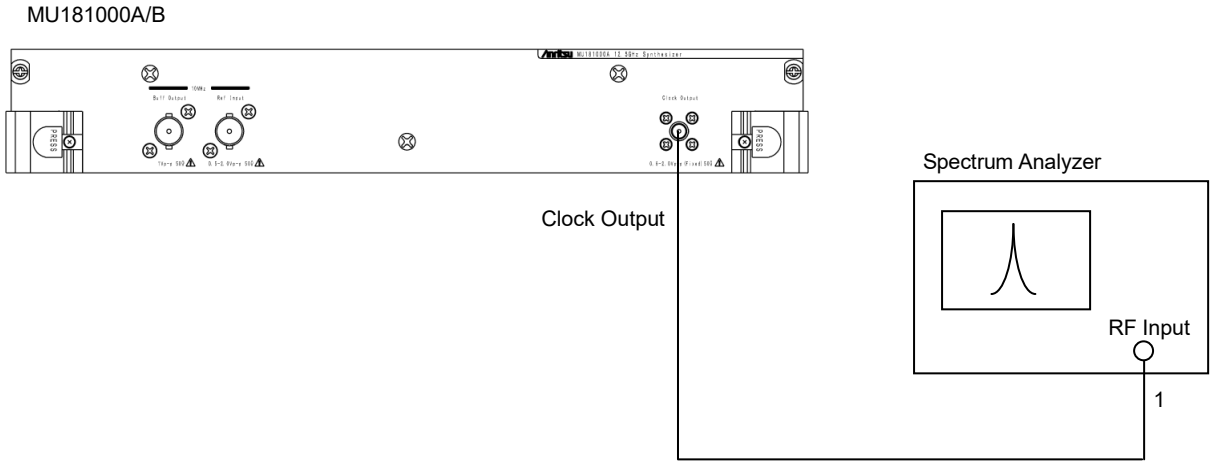


Figure 6.3.2-1 Connection diagram for phase noise measurement

1. Connect the clock signal output from the Clock Output connector to the RF Input connector of the spectrum analyzer.
2. Set as follows in the MU181000A/B operation window:
   Center Frequency: 12,500 MHz
   Offset: 0 ppm
   Reference Clock Source: Internal
3. Check that the phase noise measured by the spectrum analyzer falls within one of the ranges shown below:
   ≤–61 dBc/Hz at 1 kHz offset
   ≤–81 dBc/Hz at 10 kHz offset
   ≤–90 dBc/Hz at 100 kHz offset
4. Change the Center Frequency value in the MU181000A/B operation window as shown below, and perform measurement in the same way. Check that the phase noise falls within the range shown in Step 3 above.
   Center Frequency: 10,000 MHz, 5,000 MHz, 1,000 MHz, 100 MHz

⚠ CAUTION

Use an appropriate attenuator for each input connector when connecting to the input connector of the spectrum analyzer. Improper connection may damage the spectrum analyzer.

6.3.3 Measuring internal sine wave jitter

Measure the jitter amplitude at the Clock Output connector. Connection with the measuring instrument is shown in Figure 6.3.3-1 and Figure 6.3.3-2.

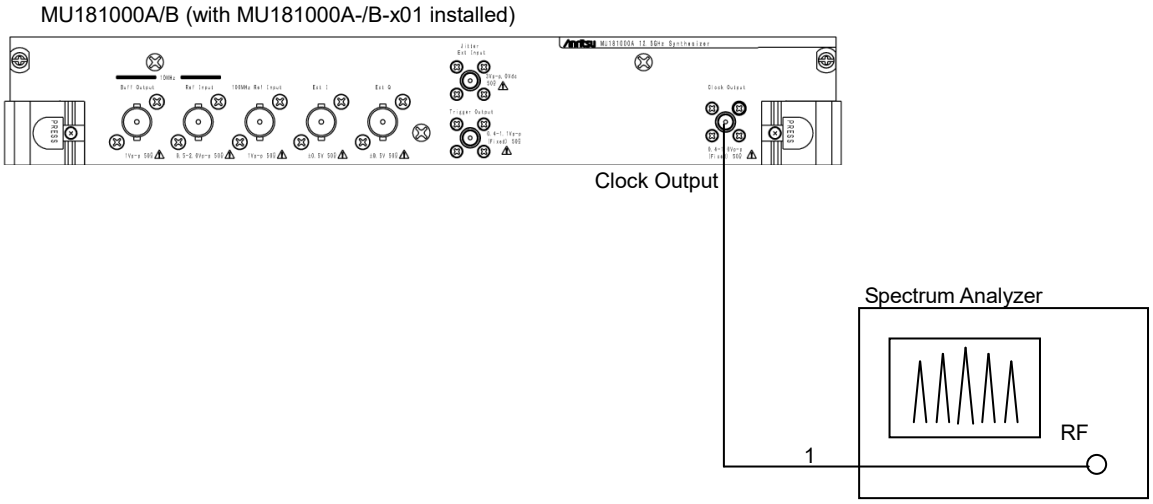


Figure 6.3.3-1 Connection diagram for internal sine wave jitter measurement of 0.4 UIp-p or less

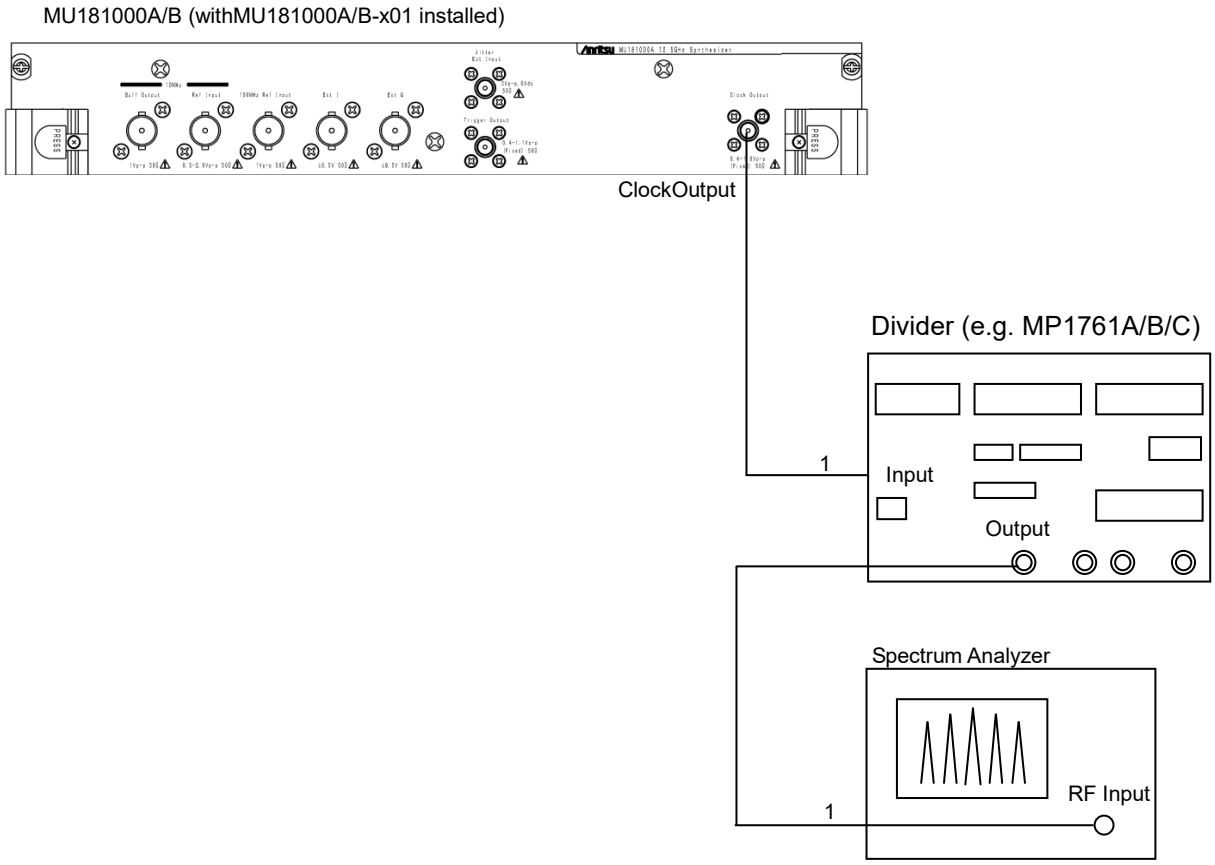


Figure 6.3.3-2 Connection diagram for internal sine wave jitter measurement of more than 0.4 UIp-p

1. When the jitter amplitude is set to 0.4 UIp-p or less, connect the clock signal output from the Clock Output connector to the RF Input connector of the spectrum analyzer.
   When the jitter amplitude is set to more than 0.4 UIp-p, connect the clock signal output from the Clock Output connector to the Input connector of the divider, and connect the Output connector of the divider and the RF Input connector of the spectrum analyzer.
2. Set as follows in the MU181000A/B operation window:

Operation:	Variable
Center Frequency:	See Table 6.3.3-1.
Offset:	0 ppm
Reference Clock Source:	Internal
Jitter:	ON
Modulation Source:	Internal
Frequency:	See Table 6.3.3-1.
Amplitude:	See Table 6.3.3-1.

Table 6.3.3-1 Setting points for internal jitter measurement

Center Frequency	Frequency	Jitter Amplitude
12500 MHz	9 Hz	4000 UIp-p
	220 Hz	4000 UIp-p
	1 kHz	880 UIp-p
	10 kHz	88 UIp-p
	100 kHz	8.8 UIp-p
	1 MHz	0.88 UIp-p
	4 MHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
	20 MHz	0.22 UIp-p
	50 MHz	0.22 UIp-p
	80 MHz	0.22 UIp-p
9953.28 MHz	10 Hz	22 UIp-p
	40 kHz	22 UIp-p
	4 MHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
	80 MHz	0.22 UIp-p
6400 MHz	9 Hz	4000 UIp-p
	110 Hz	4000 UIp-p
	1 kHz	440 UIp-p
	10 kHz	44 UIp-p
	100 kHz	4.4 UIp-p
	1 MHz	0.44 UIp-p
	2 MHz	0.22 UIp-p
	5 MHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
	20 MHz	0.22 UIp-p
	40 MHz	0.22 UIp-p
3200 MHz	9 Hz	4000 UIp-p
	55 Hz	4000 UIp-p
	100 Hz	2200 UIp-p
	1 kHz	220 UIp-p
	10 kHz	22 UIp-p
	100 kHz	2.2 UIp-p
	1 MHz	0.22 UIp-p
	5 MHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
2488.32 MHz	10 Hz	22 UIp-p
	10 kHz	22 UIp-p
	1 MHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
	20 MHz	0.22 UIp-p

Table 6.3.3-1 Setting points for internal jitter measurement (Cont'd)

Center Frequency	Frequency	Jitter Amplitude
1600 MHz	9 Hz	4000 UIp-p
	27.5 Hz	4000 UIp-p
	100 Hz	1100 UIp-p
	1 kHz	110 UIp-p
	10 kHz	11 UIp-p
	100 kHz	1.1 UIp-p
	500 kHz	0.22 UIp-p
	1 MHz	0.22 UIp-p
	2 MHz	0.22 UIp-p
	5 MHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
1244.16 MHz	10 Hz	22 UIp-p
	5 kHz	22 UIp-p
	500 kHz	0.22 UIp-p
	10 MHz	0.22 UIp-p
800 MHz	9 Hz	4000 UIp-p
	13.75 Hz	4000 UIp-p
	100 Hz	550 UIp-p
	1 kHz	55 UIp-p
	10 kHz	5.5 UIp-p
	100 kHz	0.55 UIp-p
	250 kHz	0.22 UIp-p
	1 MHz	0.22 UIp-p
	2 MHz	0.22 UIp-p
	5 MHz	0.22 UIp-p
622.08 MHz	10 Hz	22 UIp-p
	2.5 kHz	22 UIp-p
	250 kHz	0.22 UIp-p
	5 MHz	0.22 UIp-p
155.52 MHz	10 Hz	22 UIp-p
	2.5 kHz	22 UIp-p
	250 kHz	0.22 UIp-p
	5 MHz	0.22 UIp-p
100 MHz	10 Hz	22 UIp-p
	200 Hz	22 UIp-p
	20 kHz	0.22 UIp-p
	1 MHz	0.22 UIp-p
	5 MHz	0.22 UIp-p

3. Measure the carrier and sideband power using the spectrum analyzer, and calculate the jitter amplitude by referring to the description in 5.1.2 “Example when using an external modulation signal source” Next, check that the calculation result falls within one of the ranges shown below.

   When Center Frequency is less than 1 GHz:

   ±0.01 UI±Q% when the set amplitude is 0.001 to 2.19 UIp-p
   ±0.2 UI±Q% when the set amplitude is 2.2 to 21.99 UIp-p
   ±2 UI ±Q% when the set amplitude is 22 to 4000 UIp-p

   When Center Frequency is 1 GHz or higher:

   ±0.02 UI±Q% when the set amplitude is 0.001 to 2.19 UIp-p
   ±0.2 UI±Q% when the set amplitude is 2.2 to 21.99 UIp-p
   ±2 UI±Q% when the set amplitude is 22 to 4000 UIp-p

   Note that the value of Q differs depending on the modulation frequency, as follows:

   9 Hz ≤ Frequency ≤ 500 kHz: 7
   500 kHz < Frequency ≤ 2 MHz: 12
   2 MHz < Frequency ≤ 80 MHz: 15

⚠ CAUTION

Use an appropriate attenuator for each input connector when connecting to the input connector of the spectrum analyzer. Improper connection may damage the spectrum analyzer.

6.3.4 Measuring external sine wave jitter

Measure the jitter amplitude at the Clock Output connector. Connection with the measuring instruments is shown in Figure 6.3.4-1 and Figure 6.3.4-2.

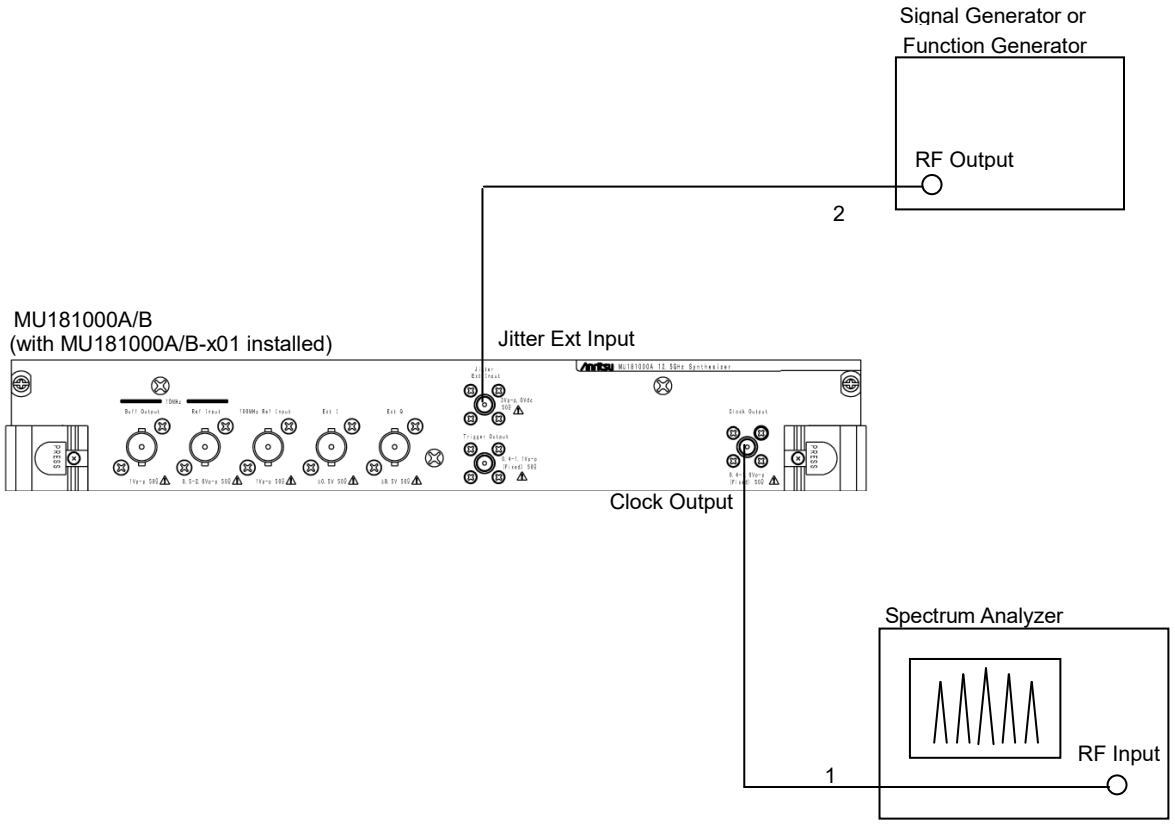


Figure 6.3.4-1 Connection diagram for external sine wave jitter measurement of 0.4 UIp-p or less

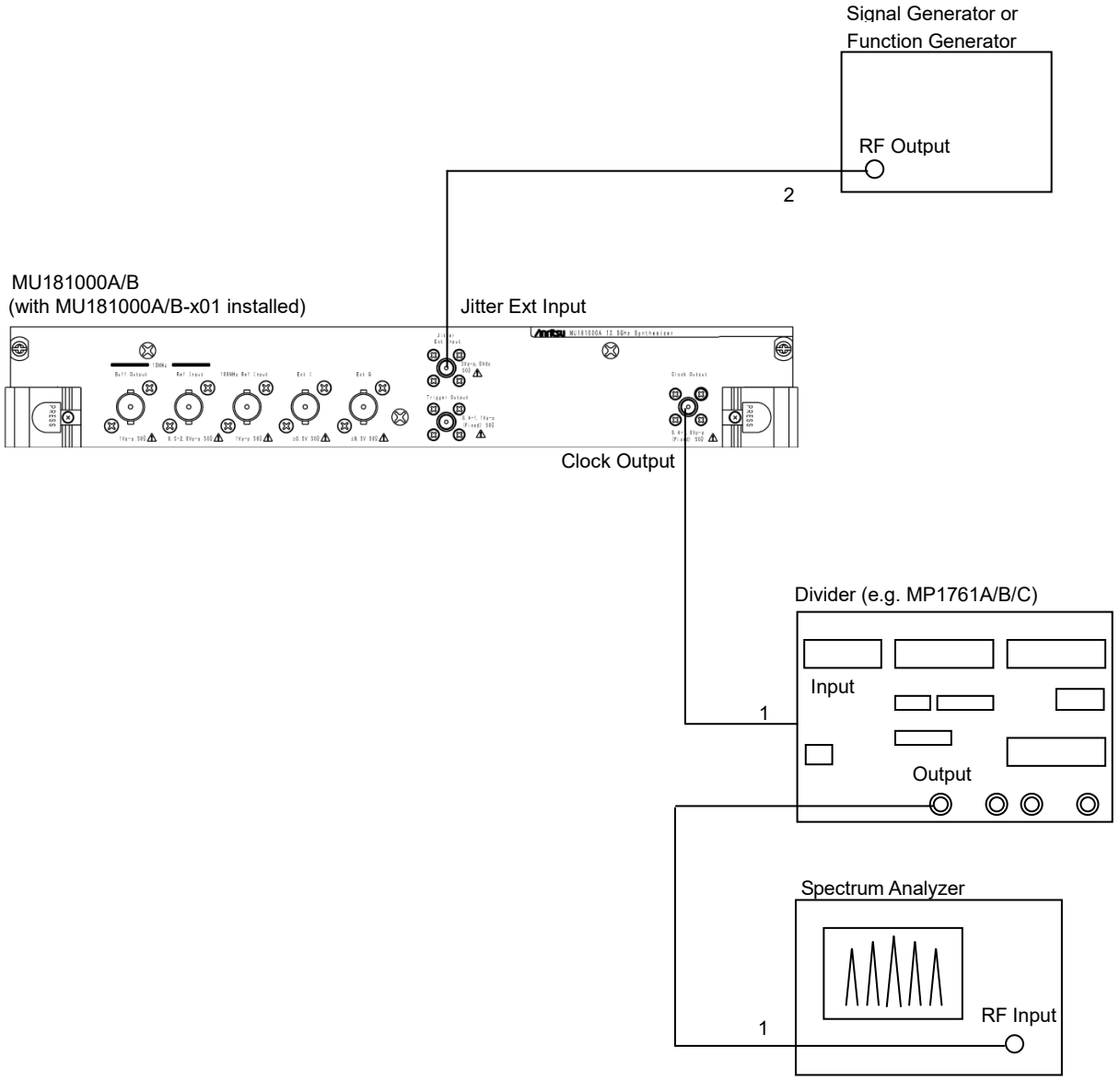


Figure 6.3.4-2 Connection diagram for external sine wave jitter measurement of more than 0.4 UIp-p

1. When the jitter amplitude is set to 0.4 UIp-p or less, connect the clock signal output from the Clock Output connector to the RF Input connector of the spectrum analyzer.
   When the jitter amplitude is set to more than 0.4 UIp-p, connect the clock signal output from the Clock Output connector to the Input connector of the divider, and connect the Output connector of the divider and the RF Input connector of the spectrum analyzer.
2. Connect the sine wave output of the external modulation signal source, signal generator or function generator, to the Jitter Ext Input connector of the MU181000A/B. When a 50-Ω load is attached to the edge of the cable on the Jitter Ext Input side, perform calibration before input so that 0.5 Vp-p is obtained. See Table 6.3.4-1 for the output frequency of the modulation signal source.
3. Set as follows in the MU181000A/B operation window:

Operation:	Variable
Center Frequency:	See Table 6.3.4-1.
Offset:	0 ppm
Reference Clock Source:	Internal
Jitter:	ON
Modulation Source:	External
Frequency:	See Table 6.3.4-1.
Amplitude:	See Table 6.3.4-1.

4. Measure the carrier and sideband power using the spectrum analyzer, and calculate the jitter amplitude by referring to the description in Section 5.1.2 “Example when using an external modulation signal source.” Then check that the calculation result falls within one of the ranges shown in Table 6.3.4-1.

Table 6.3.4-1 Setting points for external jitter measurement

Center Frequency	Frequency Range	Amplitude Range	Input Frequency	Amplitude
12500 MHz	4.4 kHz	4000 UI	220 Hz	1000 UIp-p±300 UI
	44 kHz	200 UI	4.4 kHz	100 UIp-p±30 UI
	440 kHz	20 UI	44 kHz	10 UIp-p±3 UI
	4 MHz	2 UI	440 kHz	1 UIp-p±0.3 UI
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.03 UI
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.03 UI
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.03 UI
	1 GHz	0.22 UI	1 GHz	0.1 UIp-p±0.03 UI
6400 MHz	2.2 kHz	4000 UI	110 Hz	1000 UIp-p±300 UI
	22 kHz	200 UI	2.2 kHz	100 UIp-p±30 UI
	220 kHz	20 UI	22 kHz	10 UIp-p±3 UI
	2 MHz	2 UI	220 kHz	1 UIp-p±0.3 UI
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.03 UI
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.03 UI
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.03 UI
	1 GHz	0.22 UI	1 GHz	0.1 UIp-p±0.03 UI
3200 MHz	1.1 kHz	4000 UI	55 Hz	1000 UIp-p±300 UI
	11 kHz	200 UI	1.1 kHz	100 UIp-p±30 UI
	110 kHz	20 UI	11 kHz	10 UIp-p±3 UI
	1 MHz	2 UI	110 kHz	1 UIp-p±0.3 UI
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.03 UI
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.03 UI
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.03 UI

Table 6.3.4-1 Setting points for external jitter measurement (Cont'd)

Center Frequency	Frequency Range	Amplitude Range	Input Frequency	Amplitude
1600 MHz	550 Hz	4000 UI	27.5 Hz	1000 UIp-p±300 UI
	5.5 kHz	200 UI	550 Hz	100 UIp-p±30 UI
	55 kHz	20 UI	5.5 kHz	10 UIp-p±3 UI
	500 kHz	2 UI	55 kHz	1 UIp-p±0.3 UI
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.03 UI
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.03 UI
	500 MHz	0.22 UI	100 MHz	0.1 UIp-p±0.03 UI
800 MHz	275 Hz	4000 UI	13.75 Hz	1000 UIp-p±300 UI
	2.75 kHz	200 UI	275 Hz	100 UIp-p±30 UI
	27.5 kHz	20 UI	2.75 kHz	10 UIp-p±3 UI
	250 kHz	2 UI	27.5 kHz	1 UIp-p±0.3 UI
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.03 UI
	80 MHz	0.22 UI	20 MHz	0.1 UIp-p±0.03 UI
100 MHz	275 Hz	4000 UI	13.75 Hz	1000 UIp-p±300 UI
	2.75 kHz	200 UI	275 Hz	100 UIp-p±30 UI
	27.5 kHz	20 UI	2.75 kHz	10 UIp-p±3 UI
	250 kHz	2 UI	27.5 kHz	1 UIp-p±0.3 UI
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.03 UI
	80 MHz	0.22 UI	5 MHz	0.1 UIp-p±0.03 UI

⚠ CAUTION

Use an appropriate attenuator for each input connector when connecting to the input connector of the spectrum analyzer. Improper connection may damage the spectrum analyzer.

6.3.5 Measuring triangular wave modulation

Measure the phase deviation at the Clock Output connector. Connection with the measuring instruments is shown in Figure 6.3.5-1.

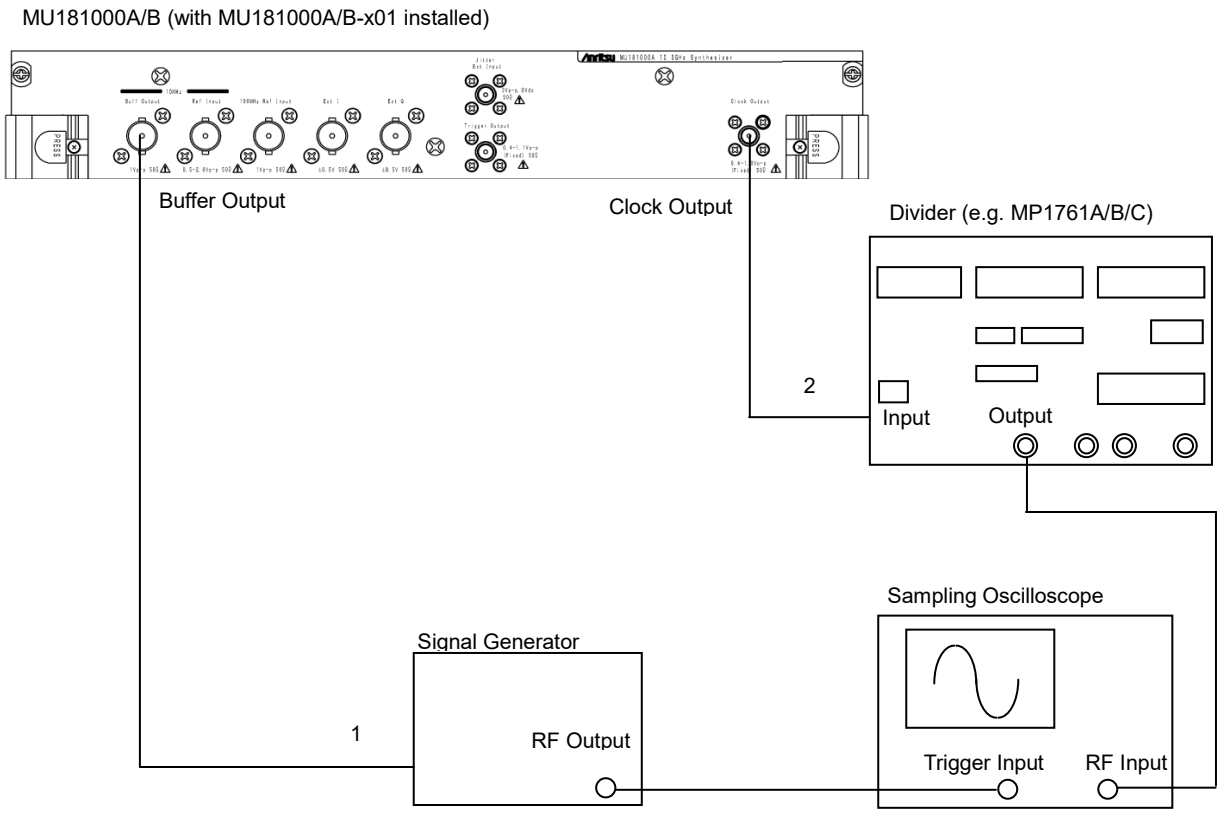


Figure 6.3.5-1 Connection diagram for triangular wave modulation measurement

1. Connect the Buff Output signal to the RF Input connector of the signal generator.
   Set the output frequency of the signal generator to 9.765625 MHz, and the output level to within the operation guaranteed range of the sampling oscilloscope. Next, connect the RF Output connector of the signal generator and the Trigger Input connector of the sampling oscilloscope.
2. Connect the Clock Output signal to the Input connector of the divider. Next, connect the Output of the divider and the RF Input connector of the sampling oscilloscope.
   See Table 6.3.5-1 for the division ratio of the divider.

⚠ CAUTION

Use an appropriate attenuator for each input connector when connecting to the input connector of the spectrum analyzer. Improper connection may damage the spectrum analyzer.

3. Set as follows in the MU181000A/B operation window:
   Operation: See Table 6.3.5-1.
   Offset: 0 ppm
   SSC: ON (Inf Ref)
   Spread Method: Center

Table 6.3.5-1 Setting for triangular wave modulation measurement

Operation	Division Ratio for Divider
PCIe-GenI (2.5 GHz)	250 divisions
PCIe-GenII (5 GHz)	500 divisions
PCIe-GenIII/IV/V (8 GHz)	800 divisions

4. Adjust the rising or falling edge of the waveform to the Center of the sampling scope, and set the span to 5 ns/Div. Trace overlapping waveforms for 10 seconds with the oscilloscope, and check that the phase deviation of the measured waveforms falls within the range shown in Figure 6.3.5-2.

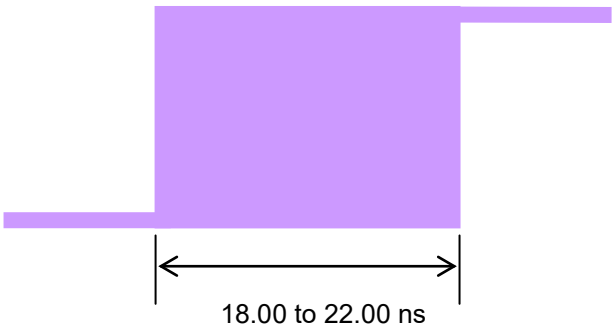


Figure 6.3.5-2 Example of waveform measured by sampling oscilloscope

6.3.6 Measuring trigger output waveform

Measure the trigger output waveform. Connection with the measuring instrument is shown in Figure 6.3.6-1.

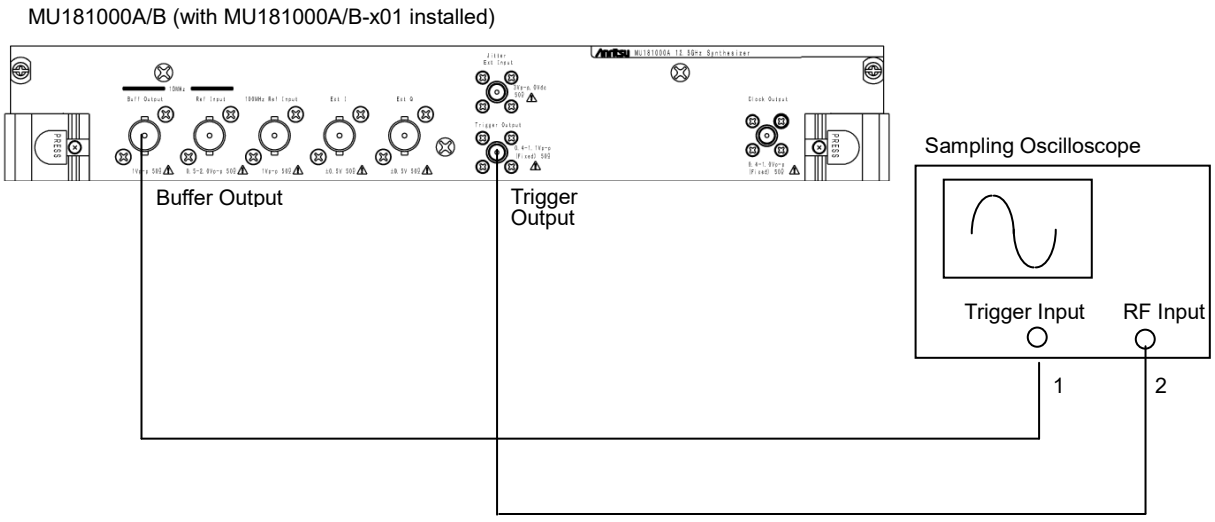


Figure 6.3.6-1 Connection diagram for trigger output waveform measurement

1. Connect the Buff Output signal to the Trigger Input connector of the sampling oscilloscope.
2. Connect the Trigger Output signal to the RF Input connector of the sampling oscilloscope.

⚠ CAUTION

Use an appropriate attenuator for each input connector when connecting to the input connector of the spectrum analyzer. Improper connection may damage the spectrum analyzer.

3. Set as follows in the MU181000A/B operation window:
   Operation: Variable
   Center Frequency: See Table 6.3.6-1.
   Offset: 0 ppm
   Reference Clock Source: Internal
   Trigger Source: See Table 6.3.6-1.

Table 6.3.6-1 Setting for trigger output waveform measurement

Center Frequency	Trigger Source
12500 MHz	F/1
10000 MHz	F/1
6410 MHz	F/1
12500 MHz	F/64
10000 MHz	F/64
6400 MHz	F/64
3200 MHz	F/64
1600 MHz	F/64
810 MHz	F/64

4. Use the averaging function of the sampling oscilloscope to measure the waveform, and then check that the level of the measured waveform falls within the range shown Figure 6.3.6-2.

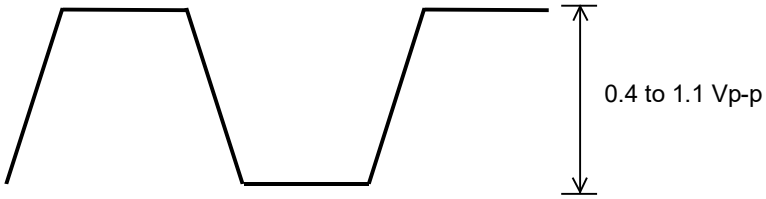


Figure 6.3.6-2 Example of waveform measured by sampling oscilloscope

Chapter 7 Maintenance

This section describes maintenance of the MU181000A/B.

7.1 Daily Maintenance

- Wipe off any external stains with a cloth damped with diluted mild detergent.
- Vacuum away any accumulated dust or dirt with a vacuum cleaner.
- Tighten any loose parts fixed with screws, using the specified tools.

7.2 Cautions on Storage

Wipe off any dust, soil, or stain on the MU181000A/B prior to storage. Avoid storing the MU181000A/B in any of the following locations:

- Where there is direct sunlight
- Where there is dust
- Where humidity is high and dew may accumulate
- Where chemically active gases are present
- Where the MU181000A/B may become oxidized
- Where strong vibrations are present
- Under the following temperature and humidity conditions:
  Temperature range of ≤–20°C or ≥60°C
  Humidity range of ≥85%

Recommended storage conditions

In addition to the abovementioned storage cautions, the following environment conditions are recommended for long-term storage.

- Temperature range of 5 to 30°C
- Humidity range of 40 to 75%
- Slight daily fluctuation in temperature and humidity

7.3 Transportation

Use the original packing materials, if possible, when packing the MU181000A/B for transport. If you do not have the original packing materials, pack the MU181000A/B according to the following procedure. When handling the MU181000A/B, always wear clean gloves, and handle it gently so as not to damage it.

<Procedure>

1. Use a dry cloth to wipe off any stain or dust on the exterior of the MU181000A/B.
2. Check for loose or missing screws.
3. Provide protection for structural protrusions and parts that can easily be deformed, and wrap the MU181000A/B with a sheet of polyethylene. Finally, cover with moisture-proof paper.
4. Place the wrapped MU181000A/B into a cardboard box, and tape the flaps with adhesive tape. Furthermore, store it in a wooden box as required by the transportation distance or method.
5. During transportation, place it under an environment that meets the conditions described in 7.2 “Cautions on Storage”.

7.4 Calibration

Regular maintenance such as periodic inspections and calibration is essential for the Signal Quality Analyzer Series for long-term stable performance. Regular inspection and calibration are recommended for using the Signal Quality Analyzer Series in its prime condition at all times. The recommended calibration cycle after delivery of the Signal Quality Analyzer Series is twelve months.

If you require support after delivery, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

We may not provide calibration or repair if any of the following cases apply.

- Seven or more years have elapsed after production and parts for the instrument are difficult to obtain, or it is determined that reliability cannot be maintained after calibration/repair due to significant wear.
- Circuit changes, repair, or modifications are done without our approval.
- It is determined that the repair cost would be higher than the price of a new item.

7.5 Disposal

Confirm the notes described in the Signal Quality Analyzer Series Installation Guide and observe national and local regulations when disposing of the MU181000A/B.

Chapter 8 Troubleshooting

This section describes how to check whether a failure has arisen when an error occurs during the operation of the MU181000A/B.

8.1 Problems Discovered during Module Replacement

Table 8.1-1 Remedies for problems discovered during replacement of MU181000A/B

Symptom	Location to Check	Remedy
A module is not recognized.	Is the module installed properly?	Install the module again by referring to 2.3 "Installing and Removing Modules" in the installation guide.
	Is the module supported by the main frame?	Check the supported modules and the software version of The MU181000A/B at our Web site (https://www.anritsu.com/en-us/test-measurement/products/mp1800a). If the module is supported, it may have failed. Contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

8.2 Problems Discovered during Use of MU181000A/B

Table 8.2-1 Remedies for problems discovered during use of MU181000A/B

Symptom	Location to Check	Remedy
Output waveform is defective	Is the cable loose?	Tighten the connector.
	Do the cables used have good high-frequency characteristics?	Use cables and connectors with good high-frequency characteristics.
	Is the input clock signal used within the specification range?	Connect a signal that meets the input specifications for Clock Input.
	Is the measurement system for waveforms set as shown in 6.3 "Performance Test Item?"	Check the performance test procedure again.

If a problem cannot be solved using any of the items listed above, perform initialization and check the items again. If the problem still occurs, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

Appendix A Performance Test Result Sheet

A.1 Performance Test Result Sheet

A.1.1 Performance Test Result Sheet for MU181000A

Device name: MU181000A 12.5GHz Synthesizer

Serial No.: _____

Ambient temperature: _____ °C

Relative humidity: _____ %

Table A.1.1-1 Results of waveform measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results
12500	0.632 to 2.0 Vp-p	
10000		
5000		
1000		
100		

Table A.1.1-2 Results of phase noise measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results		
		1 kHz Offset	10 kHz Offset	100 kHz Offset
12500	≤–61 dBc/Hz at 1 kHz offset			
10000	≤–80 dBc/Hz at 10 kHz offset			
5000	≤–90 dBc/Hz at 100 kHz offset			
1000				
100				

Device name: MU181000A 12.5GHz Synthesizer
(with MU181000A-x01 installed)

Serial No.: _____

Ambient temperature: _____ °C

Relative humidity: _____ %

Table A.1.1-3 Results of waveform measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results
12500	0.4 to 1 Vp-p	
10000		
5000		
1000		
100		

Table A.1.1-4 Results of phase noise measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results		
		1 kHz Offset	10 kHz Offset	100 kHz Offset
12500	≤–61 dBc/Hz at 1 kHz offset			
10000	≤–80 dBc/Hz at 10 kHz offset			
5000	≤–90 dBc/Hz at 100 kHz offset			
1000				
100				

Table A.1.1-5 Results of internal jitter accuracy measurement

Output Frequency [MHz]	Modulation Frequency [kHz]	Jitter Amplitude [UIp-p]	Specifications	Measured Results
12500	0.009	4000	3718 to 4282 UIp-p	
	0.22	4000	3718 to 4282 UIp-p	
	1	880	816.4 to 943.6 UIp-p	
	10	88	79.84 to 96.16 UIp-p	
	100	8.8	79.84 to 96.16 UIp-p	
	1000	0.88	0.754 to 1.006 UIp-p	
	4000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	20000	0.22	0.167 to 0.273 UIp-p	
	50000	0.22	0.167 to 0.273 UIp-p	
	80000	0.22	0.167 to 0.273 UIp-p	
9953.28	0.01	22	18.46 to 25.54 UIp-p	
	40	22	18.46 to 25.54 UIp-p	
	4000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	80000	0.22	0.167 to 0.273 UIp-p	
6400	0.09	4000	3718 to 4282 UIp-p	
	0.11	4000	3718 to 4282 UIp-p	
	1	440	407.2 to 472.8 UIp-p	
	10	44	38.92 to 40.08 UIp-p	
	100	4.4	389.2 to 400.8 UIp-p	
	1000	0.44	0.367 to 0.513 UIp-p	
	2000	0.22	0.174 to 0.266 UIp-p	
	5000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	20000	0.22	0.167 to 0.273 UIp-p	
	40000	0.22	0.167 to 0.273 UIp-p	
3200	0.009	4000	3718 to 4282 UIp-p	
	0.055	4000	3718 to 4282 UIp-p	
	0.1	2200	2044 to 2356 UIp-p	
	1	220	202.6 to 4282 UIp-p	
	10	22	18.46 to 25.54 UIp-p	
	100	2.2	1.846 to 2.554 UIp-p	
	1000	0.22	0.174 to 0.266 UIp-p	
	5000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	

Table A.1.1-5 Results of internal jitter accuracy measurement (Cont'd)

Output Frequency [MHz]	Modulation Frequency [kHz]	Jitter Amplitude [UIp-p]	Specifications	Measured Results
2488.32	0.01	22	20.26 to 23.74 UIp-p	
	10	22	20.26 to 23.74 UIp-p	
	1000	0.22	0.174 to 0.266 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	20000	0.22	0.167 to 0.273 UIp-p	
1600	0.009	4000	3718 to 4282 UIp-p	
	0.0275	4000	3718 to 4282 UIp-p	
	0.1	1100	1021 to 1179 UIp-p	
	1	110	100.3 to 119.7 UIp-p	
	10	11	10.03 to 11.97 UIp-p	
	100	1.1	1.003 to 1.197 UIp-p	
	500	0.22	0.185 to 0.255 UIp-p	
	1000	0.22	0.167 to 0.273 UIp-p	
	2000	0.22	0.167 to 0.273 UIp-p	
	5000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
1244.16	0.01	22	18.46 to 25.54 UIp-p	
	5	22	18.46 to 25.54 UIp-p	
	500	0.22	0.185 to 0.255 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
800	0.009	4000	3718 to 4282 UIp-p	
	0.01375	4000	3718 to 4282 UIp-p	
	0.1	550	509.5 to 590.5 UIp-p	
	1	55	49.15 to 60.85 UIp-p	
	10	5.5	4.915 to 6.085 UIp-p	
	100	0.55	0.502 to 0.599 UIp-p	
	250	0.22	0.195 to 0.245 UIp-p	
	1000	0.22	0.184 to 0.256 UIp-p	
	2000	0.22	0.184 to 0.256 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	
622.08	0.01	22	18.46 to 25.54 UIp-p	
	2.5	22	18.46 to 25.54 UIp-p	
	250	0.22	0.195 to 0.245 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	

Table A.1.1-5 Results of internal jitter accuracy measurement (Cont'd)

Output Frequency [MHz]	Modulation Frequency [kHz]	Jitter Amplitude [UIp-p]	Specifications	Measured Results
155.52	0.01	22	18.46 to 25.54 UIp-p	
	2.5	22	18.46 to 25.54 UIp-p	
	250	0.22	0.195 to 0.245 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	
100	0.01	22	18.46 to 25.54 UIp-p	
	0.2	22	18.46 to 25.54 UIp-p	
	20	0.22	0.195 to 0.245 UIp-p	
	1000	0.22	0.184 to 0.256 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	

Table A.1.1-6 Results of external jitter accuracy measurement

Output Frequency [MHz]	Frequency Range	Amplitude Range	Input Frequency	Specifications	Measured Results
12500	4.4 kHz	4000 UI	220 Hz	1000 UIp-p±300 UI	
	44 kHz	200 UI	4.4 kHz	100 UIp-p±30 UI	
	440 kHz	20 UI	44 kHz	10 UIp-p±3 UI	
	4 MHz	2 UI	440 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.02 UI	
	1 GHz	0.22 UI	1 GHz	0.1 UIp-p±0.02 UI	
6400	2.2 kHz	4000 UI	110 Hz	1000 UIp-p±300 UI	
	22 kHz	200 UI	2.2 kHz	100 UIp-p±30 UI	
	220 kHz	20 UI	22 kHz	10 UIp-p±3 UI	
	2 MHz	2 UI	220 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.02 UI	
	1 GHz	0.22 UI	1 GHz	0.1 UIp-p±0.02 UI	
3200	1.1 kHz	4000 UI	55 Hz	1000 UIp-p±300 UI	
	11 kHz	200 UI	1.1 kHz	100 UIp-p±30 UI	

Table A.1.1-6 Results of external jitter accuracy measurement (Cont'd)

Output Frequency [MHz]	Frequency Range	Amplitude Range	Input Frequency	Specifications	Measured Results
3200	110 kHz	20 UI	11 kHz	10 UIp-p±3 UI	
	1 MHz	2 UI	110 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.02 UI	
1600	550 Hz	4000 UI	27.5 Hz	1000 UIp-p±300 UI	
	5.5 kHz	200 UI	550 Hz	100 UIp-p±30 UI	
	55 kHz	20 UI	5.5 kHz	10 UIp-p±3 UI	
	500 kHz	2 UI	55 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	100 MHz	0.1 UIp-p±0.02 UI	
800	275 Hz	4000 UI	13.75 Hz	1000 UIp-p±300 UI	
	2.75 kHz	200 UI	275 Hz	100 UIp-p±30 UI	
	27.5 kHz	20 UI	2.75 kHz	10 UIp-p±3 UI	
	250 kHz	2 UI	27.5 Hz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	20 MHz	0.1 UIp-p±0.02 UI	
100	275 Hz	4000 UI	13.75 Hz	1000 UIp-p±300 UI	
	2.75 kHz	200 UI	275 Hz	100 UIp-p±30 UI	
	27.5 kHz	20 UI	2.75 kHz	10 UIp-p±3 UI	
	250 kHz	2 UI	27.5 Hz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	5 MHz	0.1 UIp-p±0.02 UI	

Table A.1.1-7 Results of phase deviation measurement of triangular wave modulation

Output Frequency [MHz]	Specifications	Measured Results
5000	18.00 to 22.00 ns	
2500	18.00 to 22.00 ns	

Table A.1.1-8 Results of trigger output waveform measurement

Output Frequency [MHz]	Trigger Source	Specifications	Measured Results
12500	F/1	0.4 to 1.1 Vp-p	
10000	F/1		
6410	F/1		
12500	F/64		
10000	F/64		
6400	F/64		
3200	F/64		
1600	F/64		
810	F/64		

A.1.2 Performance Test Result Sheet for MU181000B

Device name: MU181000B 12.5GHz 4 port Synthesizer

Serial No.: _____

Ambient temperature: _____ °C

Relative humidity: _____ %

Table A.1.2-1 Results of waveform measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results
12500	0.4 to 1.0 Vp-p	
10000		
5000		
1000		
100		

Table A.1.2-2 Results of phase noise measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results		
		1 kHz Offset	10 kHz Offset	100 kHz Offset
12500	≤–61 dBc/Hz at 1 kHz offset			
10000	≤–80 dBc/Hz at 10 kHz offset			
5000	≤–90 dBc/Hz at 100 kHz offset			
1000				
100				

Device name: MU181000B 12.5GHz 4 port Synthesizer
(with MU181000B-x01 installed)

Serial No.: _____

Ambient temperature: _____ °C

Relative humidity: _____ %

Table A.1.2-3 Results of waveform measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results
12500	0.4 to 1 Vp-p	
10000		
5000		
1000		
100		

Table A.1.2-4 Results of phase noise measurement at Clock Output

Frequency [MHz]	Specifications	Measured Results		
		1 kHz Offset	10 kHz Offset	100 kHz Offset
12500	≤–61 dBc/Hz at 1 kHz offset			
10000	≤–80 dBc/Hz at 10 kHz offset			
5000	≤–90 dBc/Hz at 100 kHz offset			
1000				
100				

Table A.1.2-5 Results of internal jitter accuracy measurement

Output Frequency [MHz]	Modulation Frequency [kHz]	Jitter Amplitude [UIp-p]	Specifications	Measured Results
12500	0.009	4000	3718 to 4282 UIp-p	
	0.22	4000	3718 to 4282 UIp-p	
	1	880	816.4 to 943.6 UIp-p	
	10	88	79.84 to 96.16 UIp-p	
	100	8.8	79.84 to 96.16 UIp-p	
	1000	0.88	0.754 to 1.006 UIp-p	
	4000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	20000	0.22	0.167 to 0.273 UIp-p	
	50000	0.22	0.167 to 0.273 UIp-p	
	80000	0.22	0.167 to 0.273 UIp-p	
9953.28	0.01	22	18.46 to 25.54 UIp-p	
	40	22	18.46 to 25.54 UIp-p	
	4000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	80000	0.22	0.167 to 0.273 UIp-p	
6400	0.09	4000	3718 to 4282 UIp-p	
	0.11	4000	3718 to 4282 UIp-p	
	1	440	407.2 to 472.8 UIp-p	
	10	44	38.92 to 40.08 UIp-p	
	100	4.4	389.2 to 400.8 UIp-p	
	1000	0.44	0.367 to 0.513 UIp-p	
	2000	0.22	0.174 to 0.266 UIp-p	
	5000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	20000	0.22	0.167 to 0.273 UIp-p	
	40000	0.22	0.167 to 0.273 UIp-p	
3200	0.009	4000	3718 to 4282 UIp-p	
	0.055	4000	3718 to 4282 UIp-p	
	0.1	2200	2044 to 2356 UIp-p	
	1	220	202.6 to 4282 UIp-p	
	10	22	18.46 to 25.54 UIp-p	
	100	2.2	1.846 to 2.554 UIp-p	
	1000	0.22	0.174 to 0.266 UIp-p	
	5000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	

Table A.1.2-5 Results of internal jitter accuracy measurement (Cont'd)

Output Frequency [MHz]	Modulation Frequency [kHz]	Jitter Amplitude [UIp-p]	Specifications	Measured Results
2488.32	0.01	22	20.26 to 23.74 UIp-p	
	10	22	20.26 to 23.74 UIp-p	
	1000	0.22	0.174 to 0.266 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
	20000	0.22	0.167 to 0.273 UIp-p	
1600	0.009	4000	3718 to 4282 UIp-p	
	0.0275	4000	3718 to 4282 UIp-p	
	0.1	1100	1021 to 1179 UIp-p	
	1	110	100.3 to 119.7 UIp-p	
	10	11	10.03 to 11.97 UIp-p	
	100	1.1	1.003 to 1.197 UIp-p	
	500	0.22	0.185 to 0.255 UIp-p	
	1000	0.22	0.167 to 0.273 UIp-p	
	2000	0.22	0.167 to 0.273 UIp-p	
	5000	0.22	0.167 to 0.273 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
1244.16	0.01	22	18.46 to 25.54 UIp-p	
	5	22	18.46 to 25.54 UIp-p	
	500	0.22	0.185 to 0.255 UIp-p	
	10000	0.22	0.167 to 0.273 UIp-p	
800	0.009	4000	3718 to 4282 UIp-p	
	0.01375	4000	3718 to 4282 UIp-p	
	0.1	550	509.5 to 590.5 UIp-p	
	1	55	49.15 to 60.85 UIp-p	
	10	5.5	4.915 to 6.085 UIp-p	
	100	0.55	0.502 to 0.599 UIp-p	
	250	0.22	0.195 to 0.245 UIp-p	
	1000	0.22	0.184 to 0.256 UIp-p	
	2000	0.22	0.184 to 0.256 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	
622.08	0.01	22	18.46 to 25.54 UIp-p	
	2.5	22	18.46 to 25.54 UIp-p	
	250	0.22	0.195 to 0.245 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	

Table A.1.2-5 Results of internal jitter accuracy measurement (Cont'd)

Output Frequency [MHz]	Modulation Frequency [kHz]	Jitter Amplitude [UIp-p]	Specifications	Measured Results
155.52	0.01	22	18.46 to 25.54 UIp-p	
	2.5	22	18.46 to 25.54 UIp-p	
	250	0.22	0.195 to 0.245 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	
100	0.01	22	18.46 to 25.54 UIp-p	
	0.2	22	18.46 to 25.54 UIp-p	
	20	0.22	0.195 to 0.245 UIp-p	
	1000	0.22	0.184 to 0.256 UIp-p	
	5000	0.22	0.177 to 0.263 UIp-p	

Table A.1.2-6 Results of external jitter accuracy measurement

Output Frequency [MHz]	Frequency Range	Amplitude Range	Input Frequency	Specifications	Measured Results
12500	4.4 kHz	4000 UI	220 Hz	1000 UIp-p±300 UI	
	44 kHz	200 UI	4.4 kHz	100 UIp-p±30 UI	
	440 kHz	20 UI	44 kHz	10 UIp-p±3 UI	
	4 MHz	2 UI	440 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.02 UI	
	1 GHz	0.22 UI	1 GHz	0.1 UIp-p±0.02 UI	
6400	2.2 kHz	4000 UI	110 Hz	1000 UIp-p±300 UI	
	22 kHz	200 UI	2.2 kHz	100 UIp-p±30 UI	
	220 kHz	20 UI	22 kHz	10 UIp-p±3 UI	
	2 MHz	2 UI	220 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.02 UI	
	1 GHz	0.22 UI	1 GHz	0.1 UIp-p±0.02 UI	
3200	1.1 kHz	4000 UI	55 Hz	1000 UIp-p±300 UI	
	11 kHz	200 UI	1.1 kHz	100 UIp-p±30 UI	

Table A.1.2-6 Results of external jitter accuracy measurement (Cont'd)

Output Frequency [MHz]	Frequency Range	Amplitude Range	Input Frequency	Specifications	Measured Results
3200	110 kHz	20 UI	11 kHz	10 UIp-p±3 UI	
	1 MHz	2 UI	110 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	500 MHz	0.1 UIp-p±0.02 UI	
1600	550 Hz	4000 UI	27.5 Hz	1000 UIp-p±300 UI	
	5.5 kHz	200 UI	550 Hz	100 UIp-p±30 UI	
	55 kHz	20 UI	5.5 kHz	10 UIp-p±3 UI	
	500 kHz	2 UI	55 kHz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	80 MHz	0.1 UIp-p±0.02 UI	
	500 MHz	0.22 UI	100 MHz	0.1 UIp-p±0.02 UI	
800	275 Hz	4000 UI	13.75 Hz	1000 UIp-p±300 UI	
	2.75 kHz	200 UI	275 Hz	100 UIp-p±30 UI	
	27.5 kHz	20 UI	2.75 kHz	10 UIp-p±3 UI	
	250 kHz	2 UI	27.5 Hz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	20 MHz	0.1 UIp-p±0.02 UI	
100	275 Hz	4000 UI	13.75 Hz	1000 UIp-p±300 UI	
	2.75 kHz	200 UI	275 Hz	100 UIp-p±30 UI	
	27.5 kHz	20 UI	2.75 kHz	10 UIp-p±3 UI	
	250 kHz	2 UI	27.5 Hz	1 UIp-p±0.3 UI	
	4 MHz	0.22 UI	4 MHz	0.1 UIp-p±0.02 UI	
	80 MHz	0.22 UI	5 MHz	0.1 UIp-p±0.02 UI	

Table A.1.2-7 Results of phase deviation measurement of triangular wave modulation

Output Frequency [MHz]	Specifications	Measured Results
5000	18.00 to 22.00 ns	
2500	18.00 to 22.00 ns	
8000*	18.00 to 22.00 ns	

*: This test can be performed only when MU181000B-x02 is installed.

Table A.1.2-8 Results of trigger output waveform measurement

Output Frequency [MHz]	Trigger Source	Specifications	Measured Results
12500	F/1	0.4 to 1.1 Vp-p	
10000	F/1		
6410	F/1		
12500	F/64		
10000	F/64		
6400	F/64		
3200	F/64		
1600	F/64		
810	F/64		

B.1 List of Initial Setting Items

Table B.1-1 Initial setting items for MU181000A/B

Item		Value
Operation Frequency	Center Frequency	12500 MHz
	Offset	0
Reference Clock	Source	Internal

Table B.1-2 Initial setting items when MU181000A/B-x01 is installed

Item		Value
Operation Frequency	Operation	Variable
	Center Frequency	12500 MHz
	Offset	0
Reference Clock	Source	Internal
Spectrum Spread	SSC	Nondisplay
	Spread Method	Nondisplay
Jitter	Jitter	OFF
	Modulation Source	Internal
	Frequency	9.000 Hz
	Amplitude	1.000 UIp-p
	Trigger Source	f/64

Appendix C List of Setting Items in Customize Screen

C.1 List of Setting Items in Customize Screen

Table C.1-1 Setting items in customize screen

Item	
Operation Frequency	Center Frequency (in the selected units)
	Offset