



Testing O-RAN Fronthaul 5G Base Station Rx Characteristics

ORAN Test Platform MX772000PC

O-DU Emulator Platform Software MX773000PC

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1. Introduction

The 3GPP TS38.141-1 7.2 Reference sensitivity level specification is the expected 5G base station test standard for achieving a minimum throughput of 95% (maximum 5% BLER) at the Reference sensitivity power level using FRC (Fixed Reference Channels).

This FRC test includes many definitions, depending on the band, bandwidth, sub-carrier spacing, etc., causing difficulties in creating all FRC waveforms.

The MX773000PC software facilitates easy creation of FRC waveforms using the IQproducer Easy Setup function. Additionally, settings can be changed based on the FRC waveform to create actual operation waveforms as well as FRC waveforms.

Since the MX773000PC also supports real-time BLER analysis, it can also measure BLER during faults to confirm 5G base station operating conditions.

The MX772000C software controls the MX773000PC and MX800046A to measure BLER automatically as the level changes. Measured results are displayed graphically to easily measure and confirm sensitive points (UL level vs reference BLER).

This application note explains how to measure the BLER of 5G base stations using the MX772000PC and MX773000PC.

2. Preparations

2.1 Required Software

The following software are required to measure BLER.

Model	Name
MX772000PC	ORAN Test Platform
MX772000PC-TL001	MX773000PC Control Plugin (1 year)
MX772000PC-TL002	MT8000A Control Plugin (1 year)
MX773000PC	O-DU Emulator Platform Software
MX773000PC-TL001	ORU Test Suite (1 year)
MX773000PC-TL040	UL U-Plane Analyzer (1 year)
MX800046A	MX800046A Base Station Test Suite for NR sub-6 GHz

This BLER measurement function is supported by the June 2024 beta test version. The later official release will require separate software purchase.

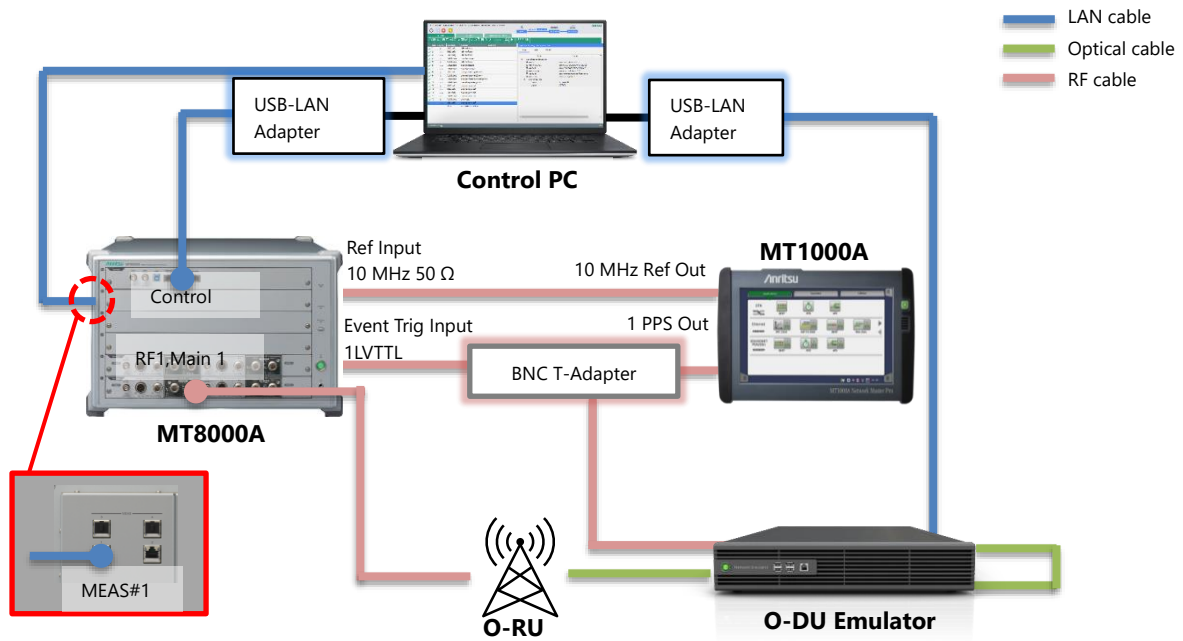
2.2 Required Hardware

The following hardware are required to measure BLER.

Model	Name
MT8000A	Radio Communication Test Station
MT8000A-001	Control Module
MT8000A-020	RF Base Module
MT8000A-021	0.4GHz-6GHz RF Sub Module
MT1000A	Network Master Pro
MT1000A-005	AUX I/O
MU100010A1	10G Multirate Module
MU100010A-001	Up to 2.7G Dual Channel
MU100090B	High Performance GNSS Disciplined Oscillator
G0437A	Server for O-DU Emulator
G0438A	Accelerator Card for O-RAN Fronthaul

2.3 Equipment Connections

Connect the test equipment as shown below to measure BLER.



3. BLER Measurement Using MX773000PC

Use the following procedure to measure BLER with the MX773000PC software. Refer to sections 3.1 to 3.7 to check the actual procedure.

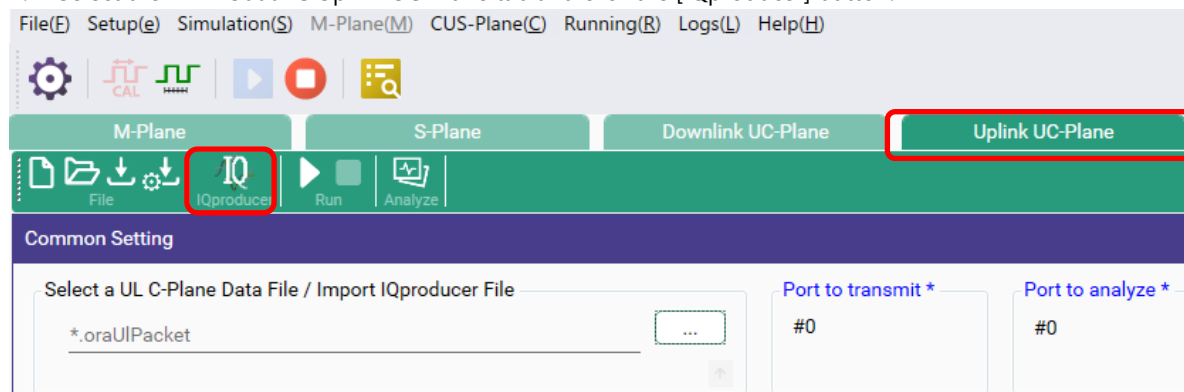
Step 1	Create waveform
↓	Create Waveform using IQproducer
Step 2	Create waveform installer and install
↓	Create MT8000A Waveform Installer Using IQproducer
↓	Install Install MT8000A
Step 3	Set measurement parameters
↓	Set Set MX800046A Uplink
↓	Set Set MX773000PC Uplink UC-Plane Parameters and Create Uplink C-Plane Data File
Step 4	Execute measurement and check results
↓	Execute Measurement
↓	Confirm Measurement Results

3.1 Create Waveform using IQproducer

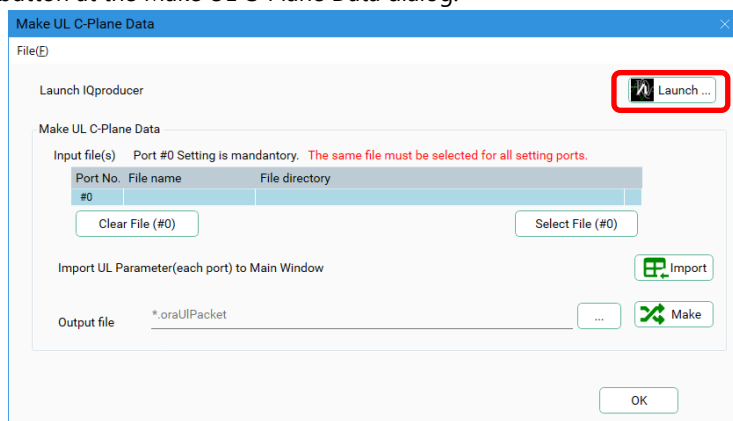
Use IQproducer to create the Uplink waveform used by the MX773000PC and MX800046A.

[Setting Procedure]

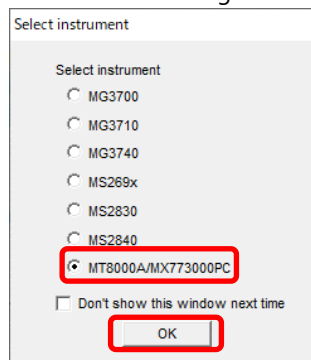
1. Select the MX773000PC Uplink UC-Plane tab and click the [IQproducer] button.



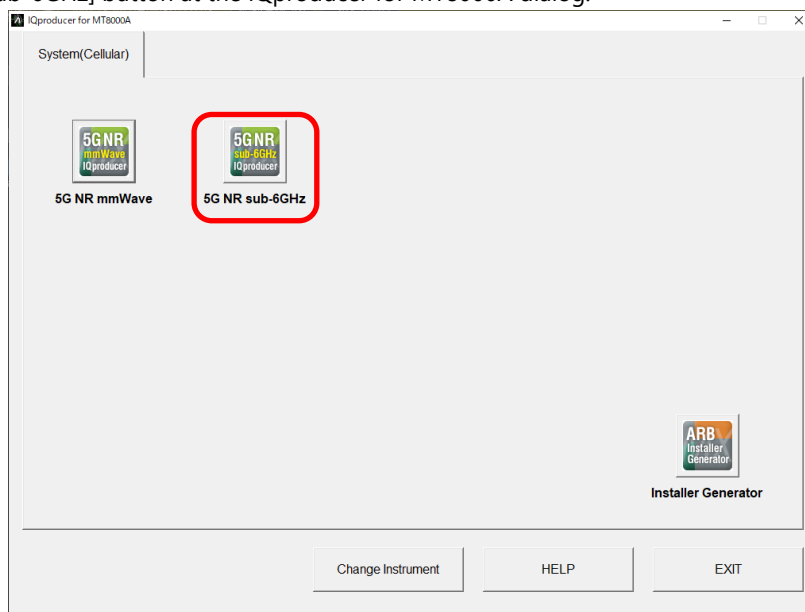
2. Click the [Launch] button at the Make UL C-Plane Data dialog.



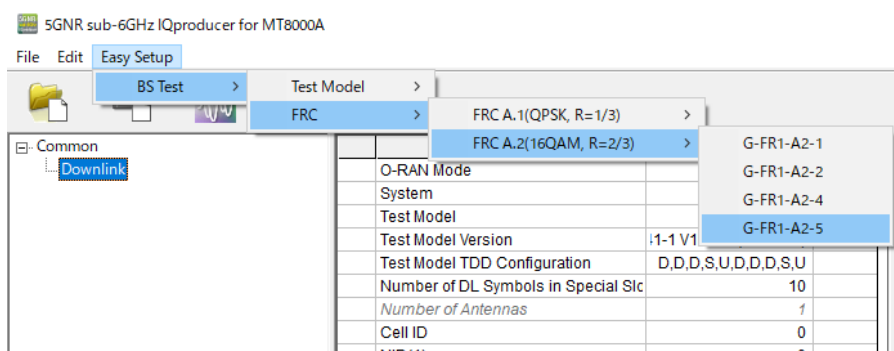
3. Select MT8000A/MX773000PC at the Select instrument dialog and click the [OK] button.



4. Click the [5G NR sub-6GHz] button at the IQproducer for MT8000A dialog.

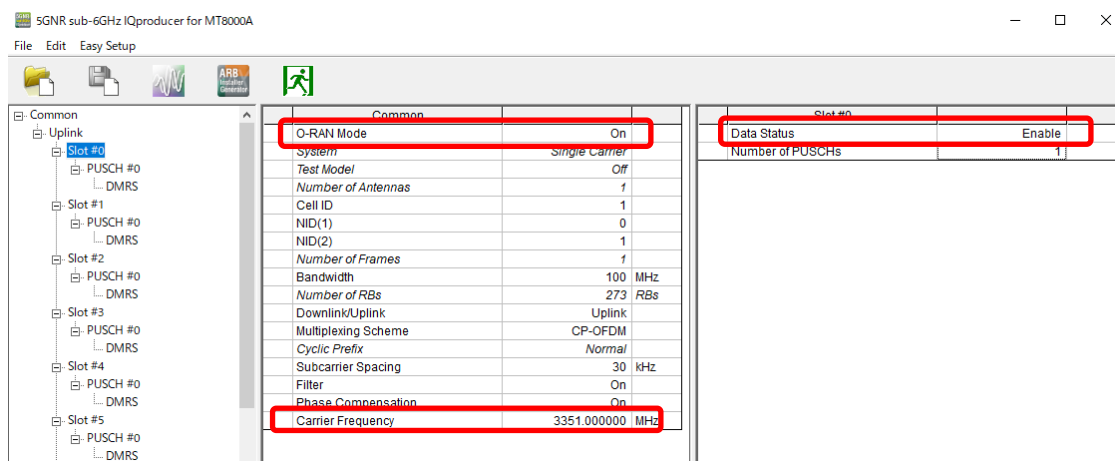


5. Select [Easy Setup] → [BS Test] → [FRC] in sequence at the 5G NR sub-6GHz IQproducer for MT8000A dialog and select the target FRC measurement.

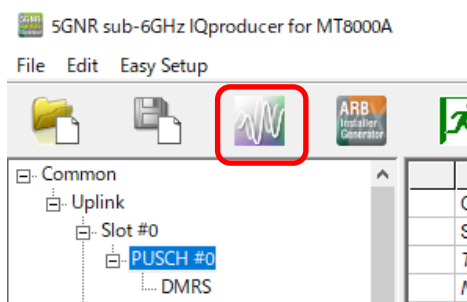


6. Set the following parameters at the 5GNR sub-6GHz IQproducer for MT8000A dialog.

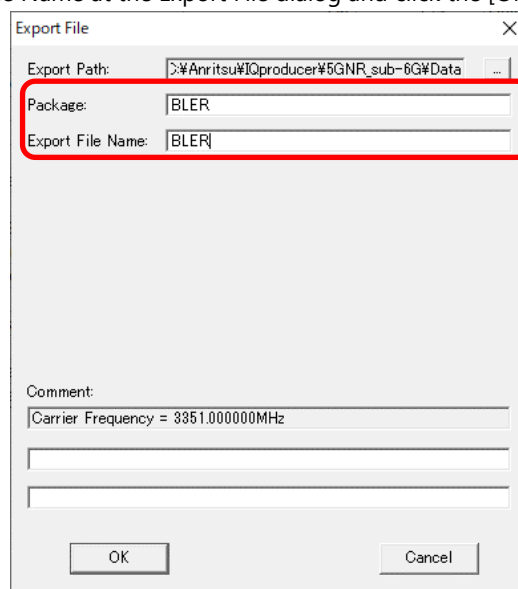
O-RAN Mode	On
Carrier Frequency	O-RU Frequency Example: 3351.000000[MHz]
Data Status	Enable for Uplink Slot; Disable for Downlink Slot



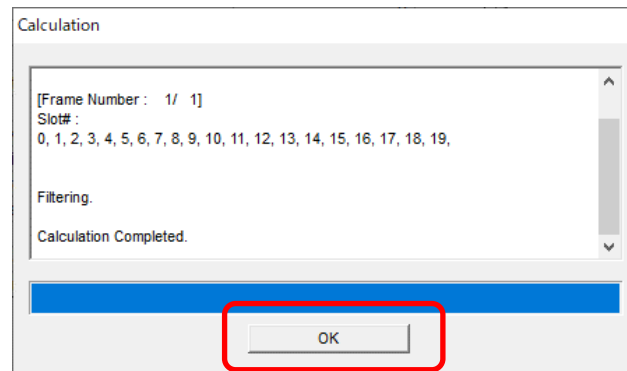
7. Click the [Calculation] button at the 5GNR sub-6GHz IQproducer for MT8000A dialog.



8. Input the Package and Export File Name at the Export File dialog and click the [OK] button.



9. At the opened Calculation dialog, wait until the displayed [OK] button is enabled and click it.

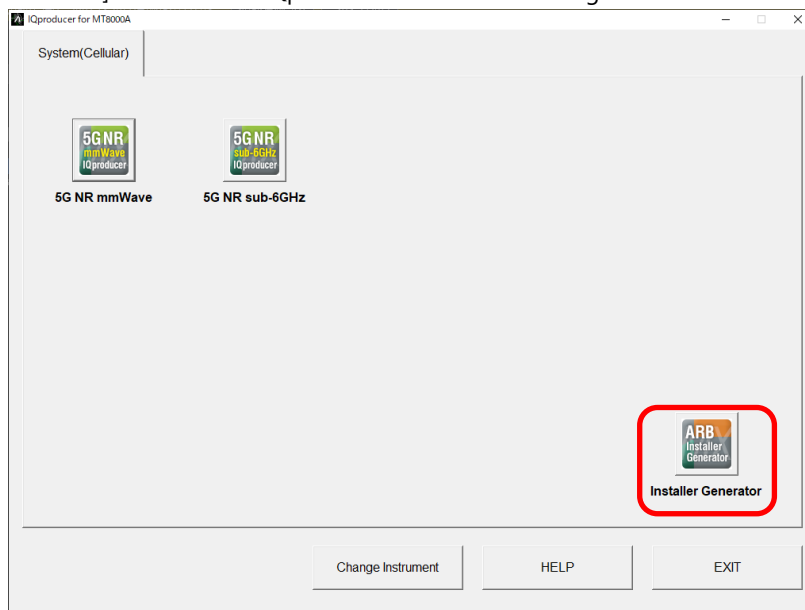


3.2 Create MT8000A Waveform Installer Using IQproducer

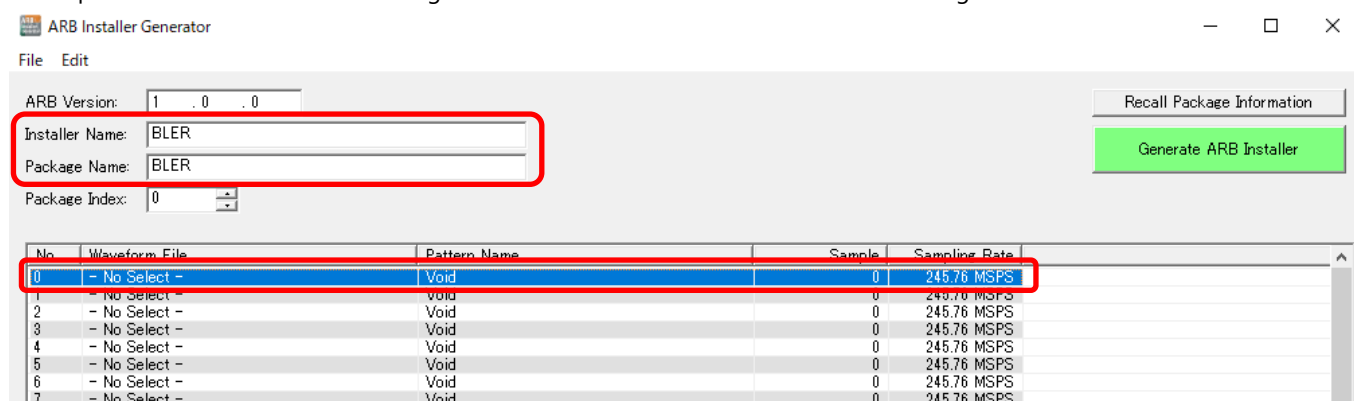
Use IQproducer to create the waveform installer for outputting the Uplink signal from the MT8000.

[Setting Procedure]

1. Click the [Installer Generator] button at the IQproducer for MT8000A dialog.

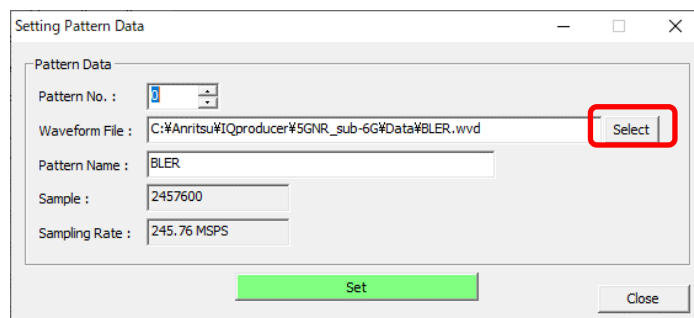


2. Input the Installer Name and Package Name data at the ARB Installer Generator dialog and double-click the No. 0 row.

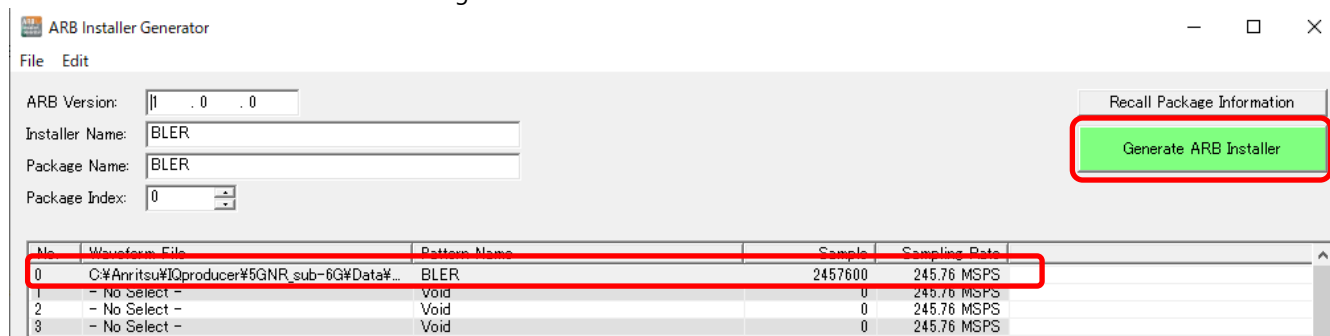


3. Click the [Select] button at the Setting Pattern Data dialog. At the displayed file selection dialog, select the wvd file created as described in section 3.1.

After selecting the wvd file, click the [Set] button and then click the [Close] button.



- At ARB Installer Generator dialog, confirm the file set at No. 0 and click the [Generate ARB Installer] button.
The file name set at the file save dialog is saved.

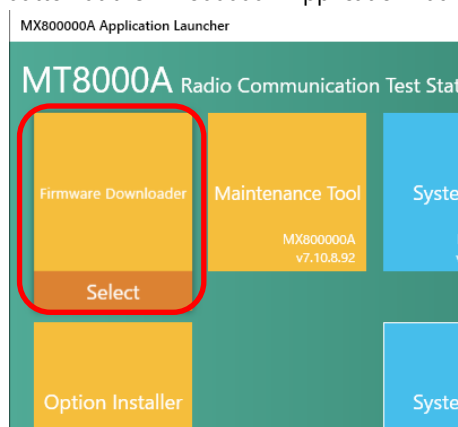


3.3 Install MT8000A Waveform

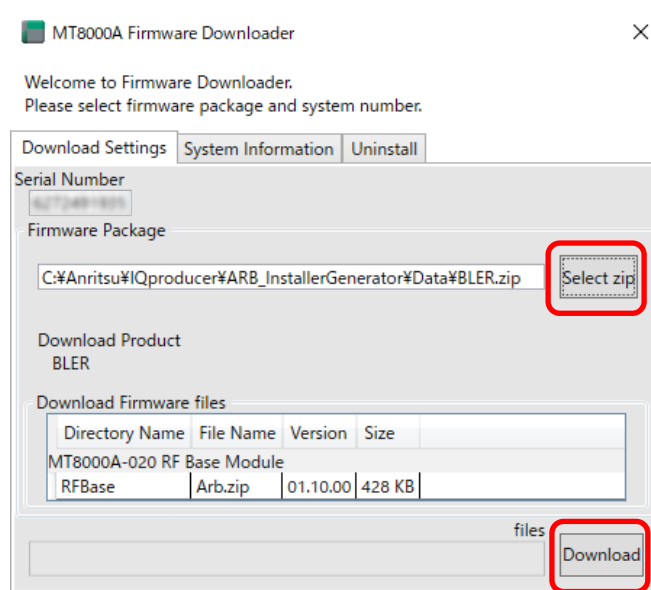
Install the waveform created in section 3.2 in the MT8000A.

[Setting Procedure]

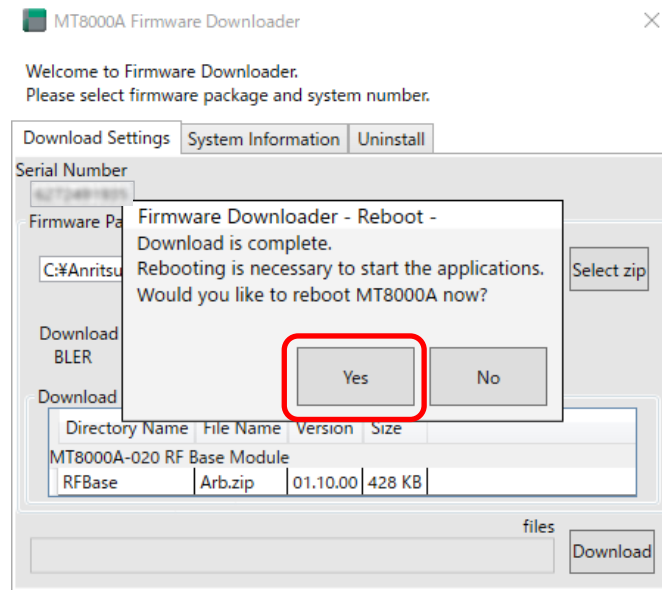
- Click the [Firmware Downloader] button at the MX800000A Application Launcher.



- Click the [Select zip] button at the MT8000A Firmware Downloader dialog and select the ARB Installer created in section 3.2. Then click the [Download] button.



- When the download completes, the Firmware Downloader – Reboot – dialog is displayed. Click the [Yes] button to reboot the MT8000A.



3.4 Set MX800046A Uplink

Set the Uplink parameters using the MX800046A and output the Uplink signal from the MT8000A.

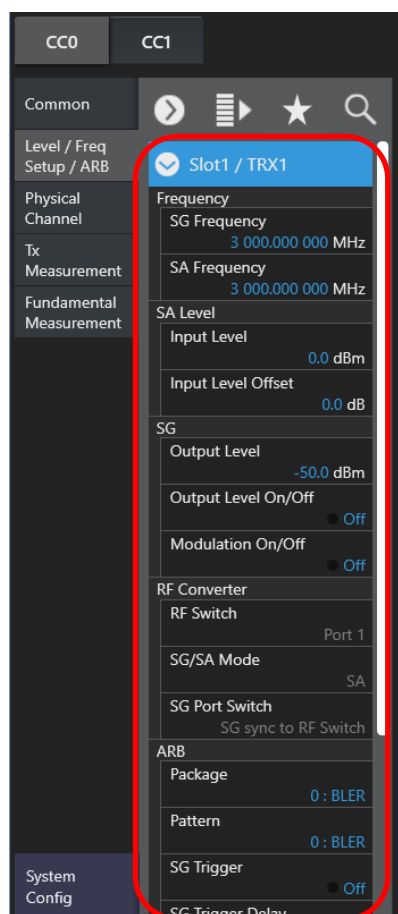
[Setting Procedure]

1. Select Level/Freq Setup/ARB at the MX800046A menu and set Slot1/TRX1 to the following settings.

Frequency	
SG Frequency	O-RU Frequency Example: 3351.000000 [MHz]
SG	
Output Level	O-RU Level Example: -10.0 [dBm]
Output Level On/Off	On
Modulation On/Off	On
ARB	
Package	Output Waveform Package Number Example: 0
Pattern	Output Waveform Pattern Number Example: 0
SG Trigger	On
SG Trigger Delay	Value calculated from O-RUn-ta-offset Example: -2604

Example: SG Trigger Delay Settings when -ta-offset = 25600

n-ta-offset	25600	
Timing Advance [ns]	13021	n-ta-offset/1.96608
SG Trigger Delay [Sample@200MSPS]	-2604	-200 x Timing Advance x 10 ⁻³

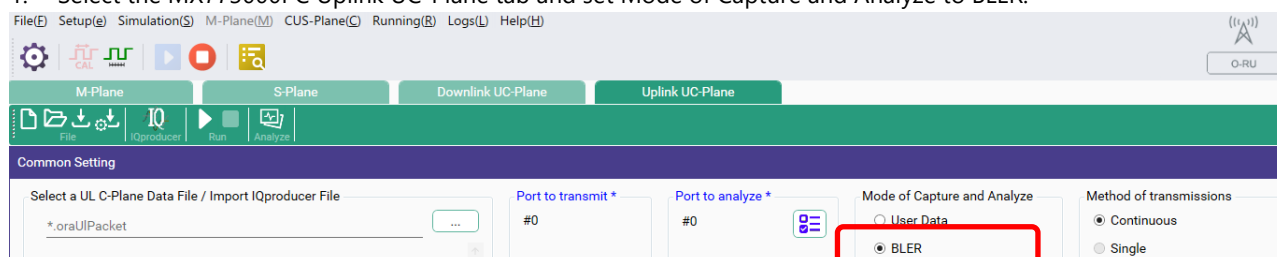


3.5 Set MX773000PC Uplink UC-Plane Parameters and Create Uplink C-Plane Data File

Set and save the Uplink parameters using the MX773000PC.

[Setting Procedure]

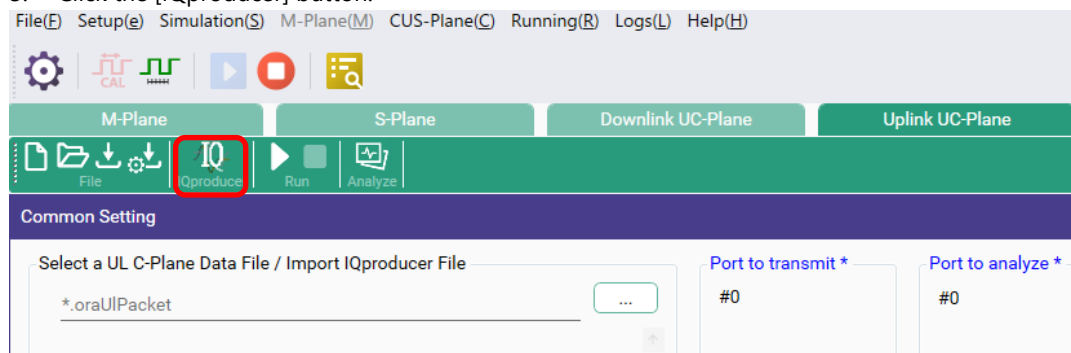
1. Select the MX773000PC Uplink UC-Plane tab and set Mode of Capture and Analyze to BLER.



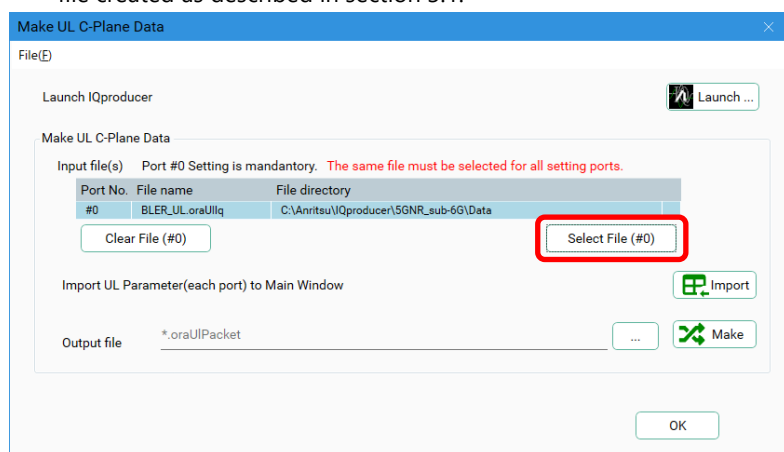
2. Set the following Capture/Analyze Parameters.

Common	
t1a-max-cp-ul	Value matching O-RU setting Example: 500000 [ns]
ta4-max	Value matching O-RU setting Example: 250000[ns]
eAxC_ID	Value matching O-RU setting Example: 0
Highest Subcarrier Spacing Supported by O-RU	Value matching O-RU setting Example: 30 [kHz]
Downlink Radio Frame Offset	Value matching O-RU setting Example: 0
Downlink SFN Offset	Value matching O-RU setting Example: 0
Compression Parameters	
Compression Type	Value matching O-RU setting Example: Static
IQ Bitwidth	Value matching O-RU setting Example: 9
Compression Method	Value matching O-RU setting Example: 0001b_block floating point
C-Plane Common Header	
startSymbolId	Value matching O-RU setting Example: 0
C-Plane Section Parameters	
rb	Value matching O-RU setting Example: 0
symInc	Value matching O-RU setting Example: 0
numPrbc Flag	Value matching O-RU setting Example: 0:all PRBs
reMask	0xFFFF
beamId	Value matching O-RU setting Example: 0
Uplink Analysis Parameters	
gain-correction	Value matching O-RU setting Example: 0
FS_Offset	Value matching O-RU setting Example: 0
Number of TBs	Example: 100 *Uplink Slot Number equivalent to number of TBs/Frame = Measured Frame Number

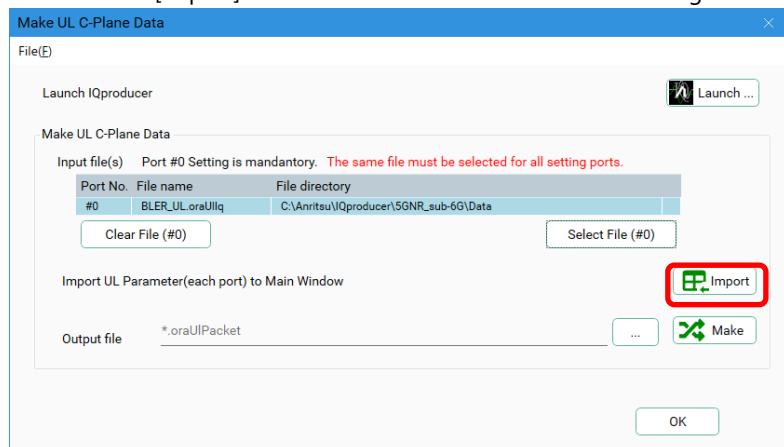
3. Click the [IQproducer] button.



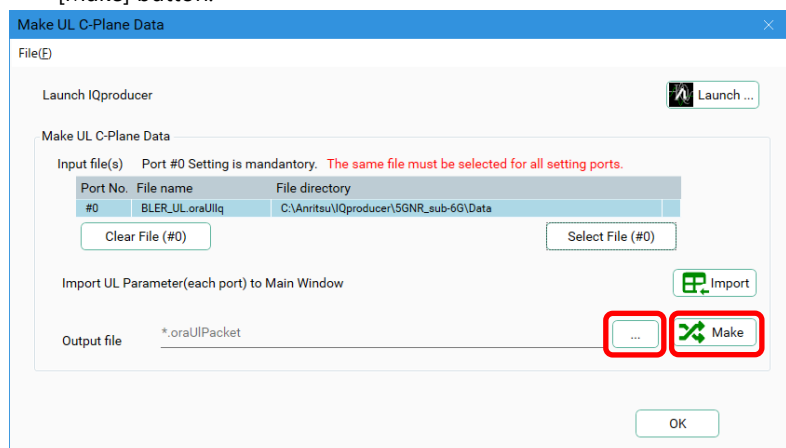
4. Click the [Select File] button at the Make UL C-Plane Data dialog to open the file selection dialog and select the oraUllq file created as described in section 3.1.



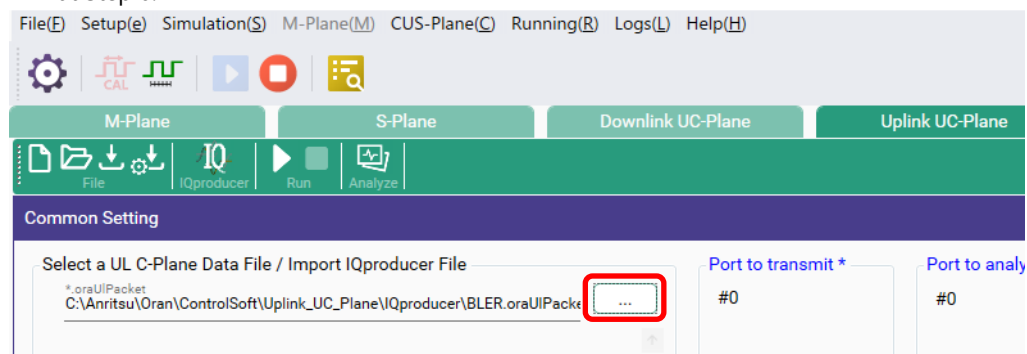
5. Click the [Import] button at the Make UL C-Plane Data dialog.



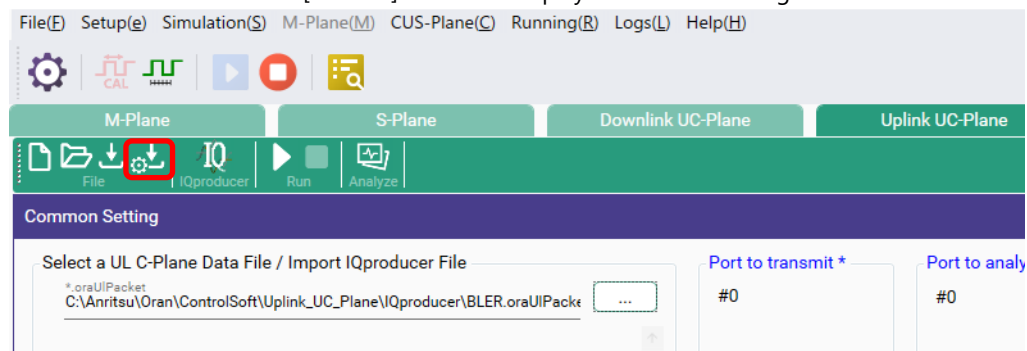
6. Click the [...] button at the Make UL C-Plane Data dialog to open the file save dialog, set the file name, and click the [Make] button.



7. Select the MX773000PC Uplink UC-Plane tab and click the [...] button. At the file selection dialog, select the file created at Step 6.



8. Click the MX773000PC [Save As] button to display the file save dialog and set and save the file name.

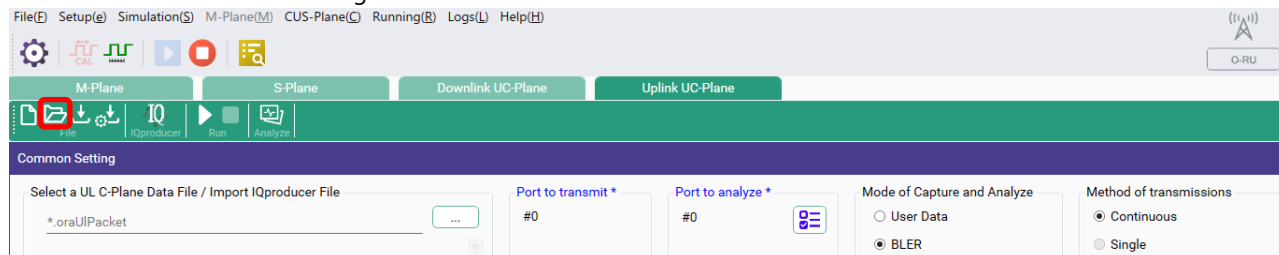


3.6 Execute Measurement

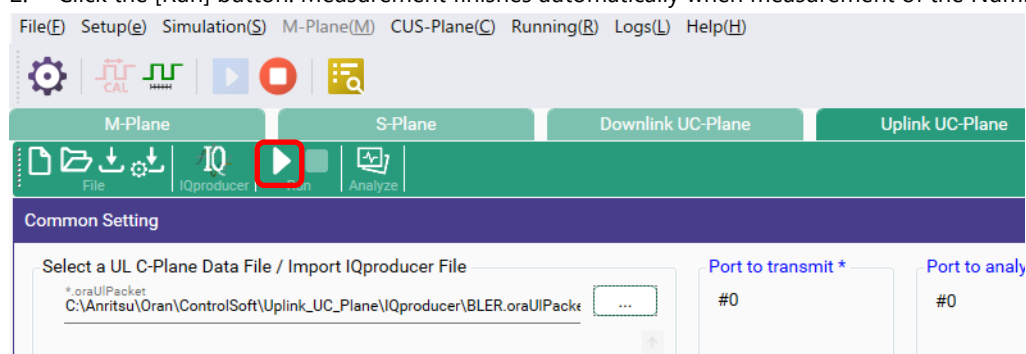
Send the Uplink C-Plane Packet from the MX773000PC and measure the Uplink BLER.

[Setting Procedure]

1. Select the MX773000PC Uplink UC-Plane tab and click the [Open] button. Select the file created as described in section 3.5 at the file selection dialog.

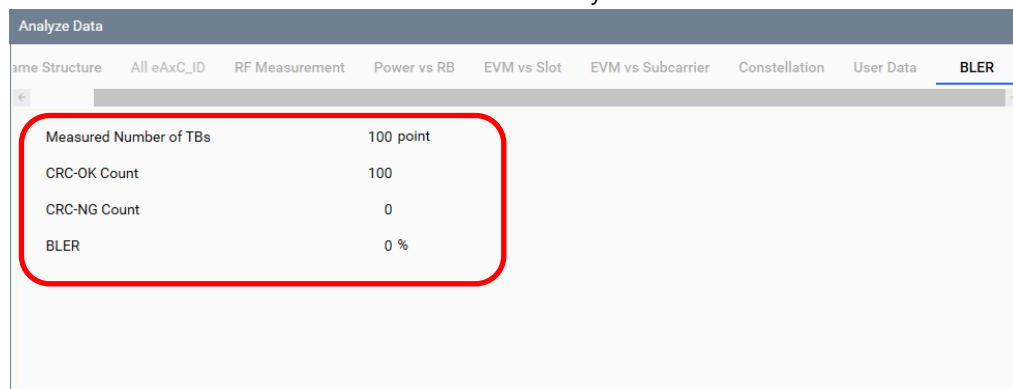


2. Click the [Run] button. Measurement finishes automatically when measurement of the Number of TBs part completes.



3.7 Confirm Measurement Results

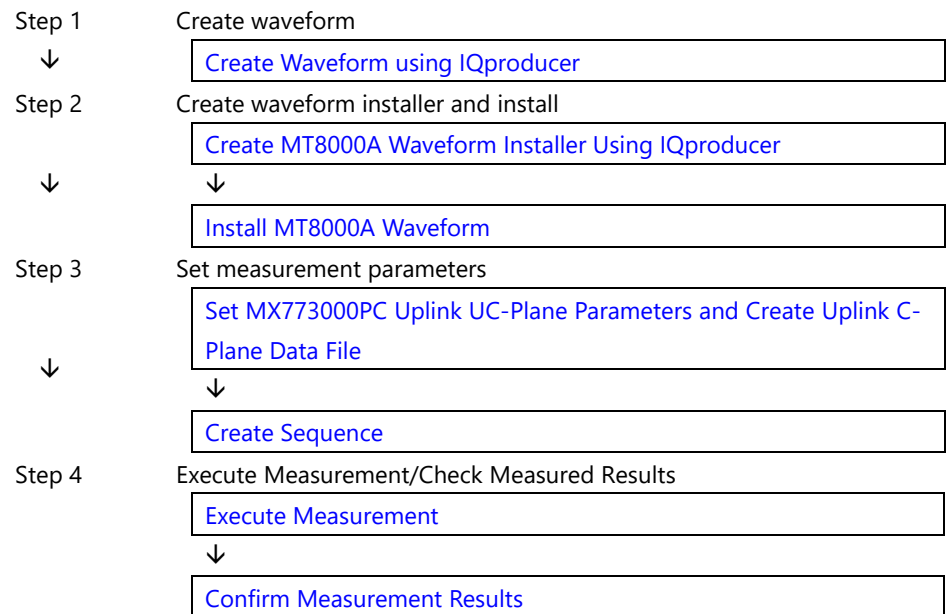
Confirm the measured results at the MX773000PC Analyze Data field.



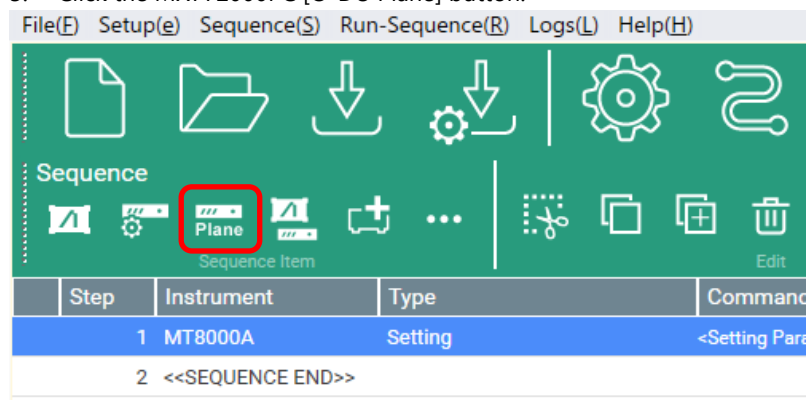
4. BLER Measurement Using MX772000PC

The MX772000PC software measures BLER automatically by controlling the MX773000PC and MX800046A externally.

Use the following procedure to measure BLER using the MX772000PC software. Refer to sections 3.1 to 3.7 to check the actual procedure.



3. Click the MX772000PC [O-DU Plane] button.



4. Set the following at the O-DU Plane (New) dialog and click the [OK] button.

Plane	UC-Plane:Uplink (BLER)
Uplink UC-Plane Setting File (checkbox section)	Set checkmark to On
Uplink UC-Plane Setting File (file setting section)	orasa file saved previously using MX773000PC
Result Check	
BLER Upper Limit	Measured result BLER PASS threshold Example: 5.0 [%]

O-DU Plane(New)

Instrument

Anritsu O-DU

Plane

UC-Plane:Uplink (BLER)

Type

Setting-Response

Command Name

0 / 32

Uplink UC-Plane Setting File

...

Launch Software

0 / 256

Controlled Ports

Port

#0

Result Check

BLER [%]

Upper Limit

0.0 + -

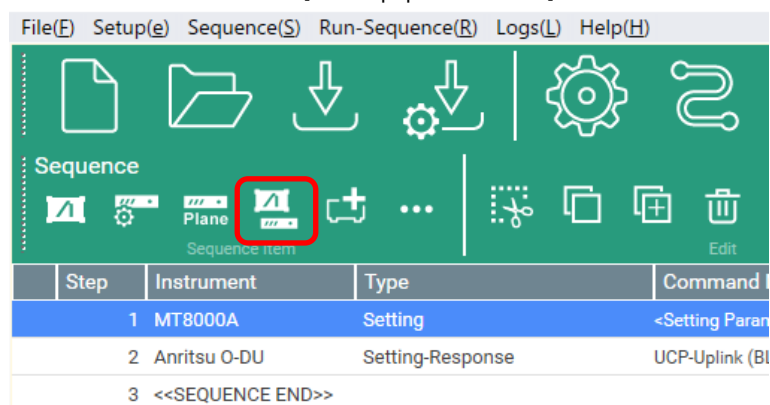
Note

0 / 200

OK

Cancel

5. Click the MX772000PC [Test Equipment–O-DU] button.



6. Set the following at the Test Equipment–O-DU (New) dialog and click the [OK] button.

Uplink UC-Plane Setting File (checkbox section)	Set checkmark to On
Uplink UC-Plane Setting File (file settings section)	orasa file saved previously using MX773000PC
Controlled Ports	
Port	Slot1/TRX1 – Port #0
Execution Target	Set checkmark to On
Setting	
Start SG Output Level	SG Output Level Start Level output from MX800046A Example: –50.0 [dBm]
SG Output Level Range	SG Output Level Range output from MX800046A Example: –10.0 [dBm]
SG Output Level Interval	SG Output Level 1 Measurement Level change output from MX800046A Example: 0.1 [dBm]
BLER Result Check	
Start of Limit Range	BLER Limit Level Range (Lower) Example: –60.0 [dBm]
End of Limit Range	BLER Limit Level Range (Upper) Example: –50.0 [dBm]
BLER Upper Limit	Measured result BLER PASS threshold Example: 5.0 [%]

Test Equipment - ODU(New)

Instrument
MT8000A - Anritsu O-DU
Type
BLER
Command Name
<Setting-Response>

Uplink UC-Plane Setting File
C:\Anritsu\Oran\ControlSoft\Uplink_UC_Plane\BLER.orasa
Launch Software

Controlled Ports
Port
Slot1/TRX1 - Port #0
Execution target

Setting
Start SG Output Level [dBm]
-50.0
Sample.oraloss" : "C:\Anritsu\Oran\TestPlatform\Conf\PathLoss"
The uplink value of the pathloss is automatically added to the MX800046A "Start SG Output Level".
SG Output Level Range [dB]
-10.0
SG Output Level Interval [dB]
0.1

BLER Result Check
Add
Delete

Start of limit range [dBm] <=	< End of limit range [dBm]	BLER Upper limit [%]
-60.0	-50.0	5.0

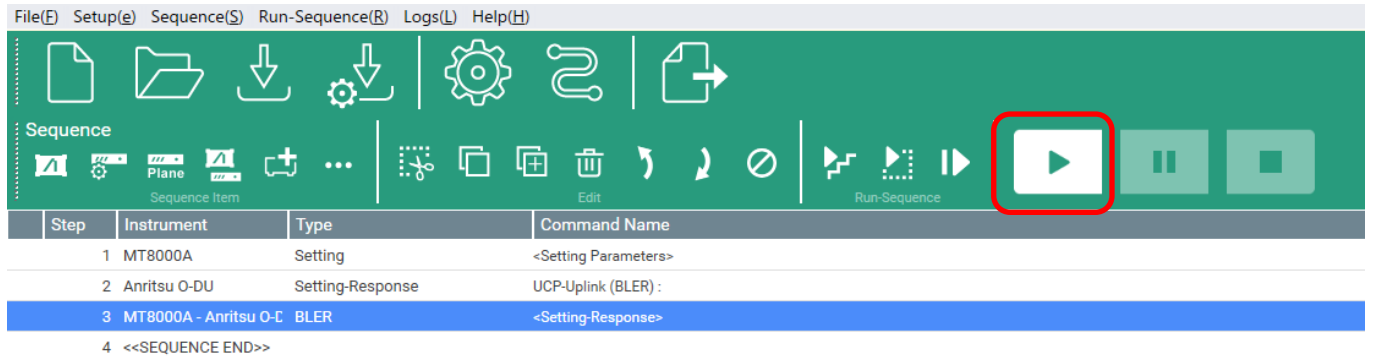
Note

OK
Cancel

4.2 Execute Measurement

1. Click the MX772000PC [Run (all)] button.

File(E) Setup(e) Sequence(S) Run-Sequence(R) Logs(L) Help(H)



The screenshot shows the MX772000PC software interface. The top menu bar includes File(E), Setup(e), Sequence(S), Run-Sequence(R), Logs(L), and Help(H). Below the menu is a toolbar with various icons. The 'Run-Sequence' button, which is a play icon, is highlighted with a red box. Below the toolbar is a table showing the sequence of steps:

Step	Instrument	Type	Command Name
1	MT8000A	Setting	<Setting Parameters>
2	Anritsu O-DU	Setting-Response	UCP-Uplink (BLER) :
3	MT8000A - Anritsu O-DU	BLER	<Setting-Response>
4	<<SEQUENCE END>>		

4.3 Confirm Measurement Results

1. Confirm the BLER measured values and results at the MX772000PC Execution Log.

12:26:02.704		OK				Sequence Start. "New_test-platform.oratps" : "C:\Anritsu\Oran\TestPlatform\SequenceFile" (2024/04/16_12:26:02.704)
12:26:09.104	1	OK	MT8000A	Setting	<Setting Parameters>	Port [Slot1/TRX1], PathLoss Uplink [0.0dB] / Downlink [0.0dB]
12:26:15.641	2	OK	Anritsu O-DU	Setting-Response	UCP-Uplink (BLER) :	Uplink UC-Plane Setting File "1Pass_G_FR1_A2_5_BLER_1Port.orasa" : "C:\Anritsu\Oran\ControlSoft\Uplink_UC_Plane"
	2	Pass				Port [#0] Uplink Packet Level [-79.7dBm] BLER [%]=0.0 : spec <= 5.0

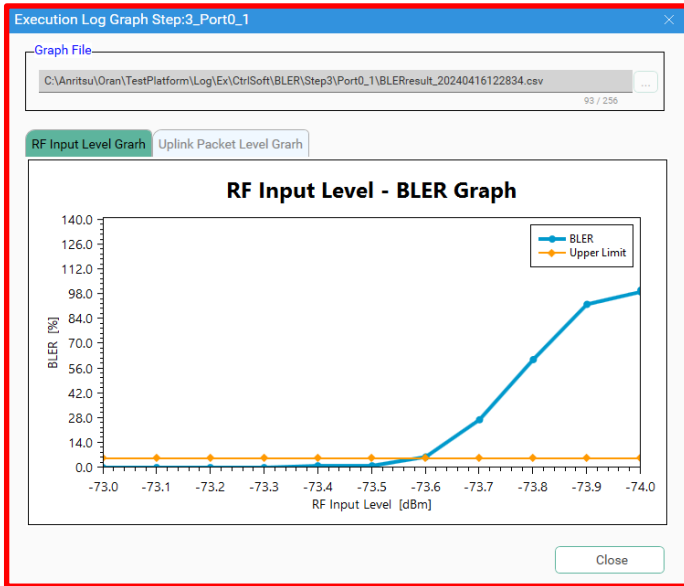
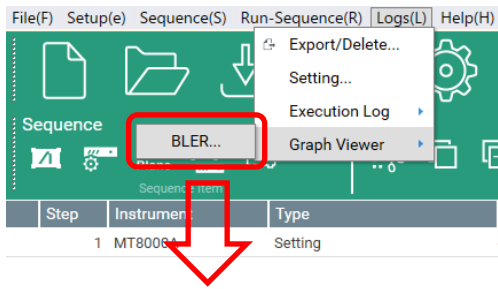
2. Confirm the BLER measured values and results at Step 2 at the MX772000PC Execution Log.

12:26:02.704		OK				Sequence Start. "New_test-platform.oratps" : "C:\Anritsu\Oran\TestPlatform\SequenceFile" (2024/04/16_12:26:02.704)
12:26:09.104	1	OK	MT8000A	Setting	<Setting Parameters>	Port [Slot1/TRX1], PathLoss Uplink [0.0dB] / Downlink [0.0dB]
12:26:15.641	2	OK	Anritsu O-DU	Setting-Response	UCP-Uplink (BLER) :	Uplink UC-Plane Setting File "1Pass_G_FR1_A2_5_BLER_1Port.orasa" : "C:\Anritsu\Oran\ControlSoft\Uplink_UC_Plane"
	2	Pass				Port [#0] Uplink Packet Level [-79.7dBm] BLER [%]=0.0 : spec <= 5.0

3. Confirm the BLER measured values and results at Step 3 at the MX772000PC Execution Log.

	3	Fail				Port [Slot1/TRX1 - Port #0] RF Input Level [-73.8dBm] BLER [%]=61.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] Uplink Packet Level [-80.2dBm] BLER [%]=61.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] RF Input Level [-73.9dBm] BLER [%]=92.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] Uplink Packet Level [-80.2dBm] BLER [%]=92.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] RF Input Level [-74.0dBm] BLER [%]=99.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] Uplink Packet Level [-80.3dBm] BLER [%]=99.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] RF Input Level [-74.0dBm] BLER [%]=100.0 : spec <= 5.0
	3	Fail				Port [Slot1/TRX1 - Port #0] Uplink Packet Level [-80.3dBm] BLER [%]=100.0 : spec <= 5.0
	3	OK				Port [Slot1/TRX1 - Port #0] "BLERresult_20240416122834.csv" : "C:\Anritsu\Oran\TestPlatform\Log\Ex\CtrlSoft\BLER\Step3\Port0"

4. Select [Logs] → [Graph Viewer] → [BLER] in sequence at the MX772000PC menu and confirm the BLER graph measured at Step 3.



5. Troubleshooting Example

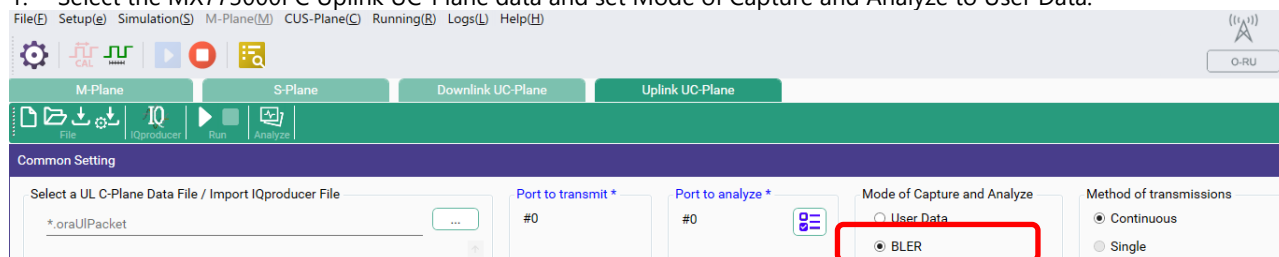
If BLER Measurement Error Displayed

If the [NR_MEAS_FrameSync()] error is displayed at BLER measurement, there a high possibility that Timing Offset drift has occurred.

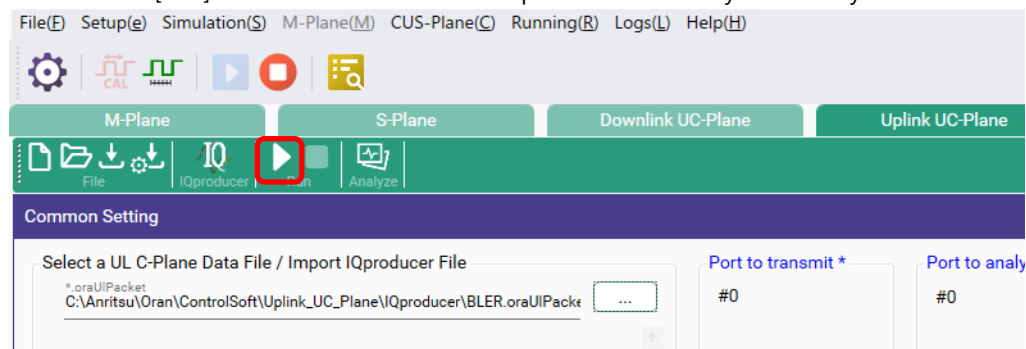
Confirm the Timing Offset by analyzing the User Data as follows and adjust the Timing Offset to about ± 10 ns.

[Adjustment Procedure]

1. Select the MX773000PC Uplink UC-Plane data and set Mode of Capture and Analyze to User Data.



2. Click the [Run] button. Measurement is completed automatically when analysis finishes.



3. Confirm the measured Timing Offset result at the Analyze Data field.

Analyze Data	
Radio Frame Structure	All eAxC_ID
RF Measurement	
Frequency Error	-19.8 Hz
Interface resolution	-168.58 dBFS
Configured UL gain	-16.6 dB
RF input level (On the calculation)	-86.79 dBm
IQ Output Level	-103.39 dBFS
Total EVM	24.9 %
Origin Offset	-30.2 dB
Timing Offset	293 ns

4. Set the MX800046A SG Trigger Delay parameter.

Example: When SG Trigger Delay = -2604, Timing Offset = 293 ns

- Timing Offset x 10^{-3} calculation

$$293 \times -200 \times 10^{-3} = -58.6 \approx -59$$

- Set the new SG Trigger Delay calculated as SG Trigger Delay + calculated value

$$-2604 - 59 = -2663$$

6. Conclusion

This application note explains how to test the Rx characteristics of 5G base stations using the O-DU Emulator. The MX72000PC/MX773000PC software packages facilitate 5G base station development and production by simplifying and cutting the time required to measure BLER.



Specifications are subject to change without notice.

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