

MX370107A

Fading IQproducer™

MG3700A

Vector Signal Generator

For MG3700A Vector Signal Generator

MX370107A

Fading IQproducer™

Product Introduction



Version 4.00

ANRITSU CORPORATION

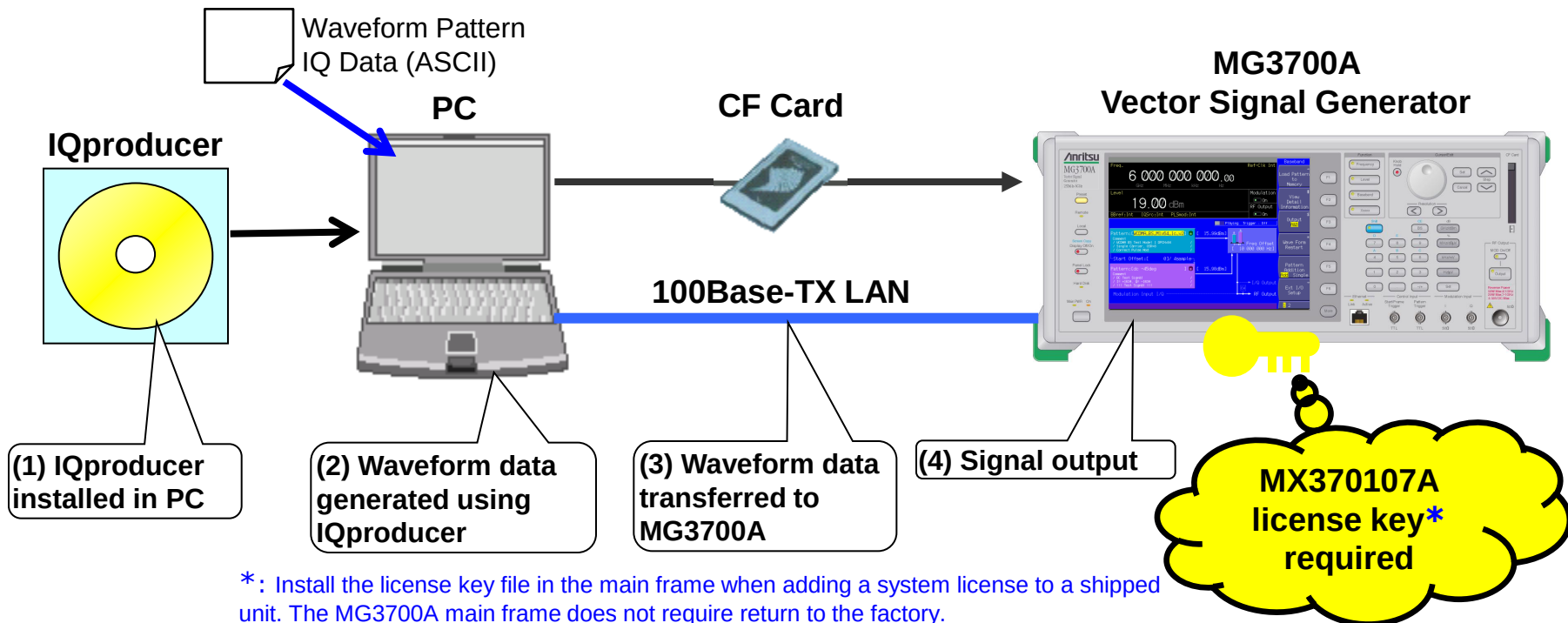
Ordering Information

Model/ Order No.	Name	Remarks	
— Mainframe —			
MG3700A	Vector Signal Generator		Required
— Options —			
MG3700A-002	Mechanical Attenuator	Standard Electron Attenuator is changed into Mechanical Attenuator.	
MG3700A-011	Upper Frequency 6 GHz	Standard “250 kHz to 3 GHz” is extended to “250 kHz to 6 GHz.”	
MG3700A-021	ARB Memory Upgrade 512 M sample	Standard “128 Msample/channel × 2” is extended to “256 Msample/channel × 2.”	Recommendation
MG3700A-031	High Speed BER Test Function	Standard “1 kbps to 20 Mbps” is extended to “100 bps to 120 Mbps.”	
— Softwares (License Key for IQproducer system) —			
MX370107A	Fading IQproducer		Required
— Optional accessories —			
W2495AE	MG3700A operation manual	Booklet	Recommendation The PDF manual is on the software CD. Order this when a booklet is required.
W2496AE	MG3700A IQproducer operation manual	Booklet	
W2539AE	MG3700A standard waveform pattern operation manual	Booklet	
W2995AE	MX370107A Fading IQproducer operaton manual	Booklet	
J1261D	Ethernet Cable (Shield Type)	Cross, 3 m	Recommendation Required when PC connected directly to MG3700A by LAN.
Z0777	Standard waveform pattern upgrade kit	DVD set of pre-install wave form pattern of latest version	
G0141	HDD ASSY	Exchange HDD when built-in HDD break.	
J1277	IQ Output Conversion Adapter	Cable that converts IQ output connector (D-sub) of mainframe into BNC	Recommendation Converts IQ output connector on back of MG3700A from D-sub to BNC.

What is Fading IQproducer?

The MX370107A Fading IQproducer™ is GUI-driven PC application software to set fading parameters and generate waveform patterns by reading waveform patterns for the MG3700A.

The generated waveform patterns are downloaded to the MG3700A and used to output fading baseband signals and RF signals using the MG3700A ARB generation function.



What is Fading IQproducer?

The MX370107A supports the processes inside the dotted line of the block diagram on the right (fading of each IQ channel, calculation of correlation line, AWGN combination). [A]

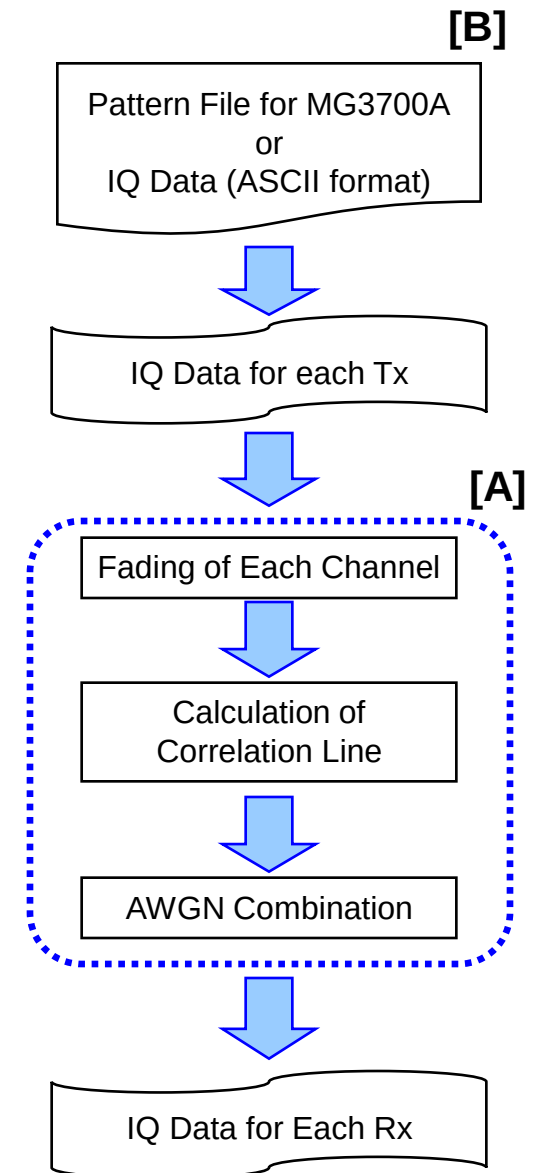
Either waveform patterns created by another IQproducer or IQ data (ASCII) created by general simulation tools can be selected as the input data file. [B]

- Generating waveform patterns using MX3701xxA

=> **The main frame requires a license.**

The unlicensed software will run on the PC to test waveform pattern generation but an unlicensed MG3700A cannot output signals because it does not recognize the waveform patterns.

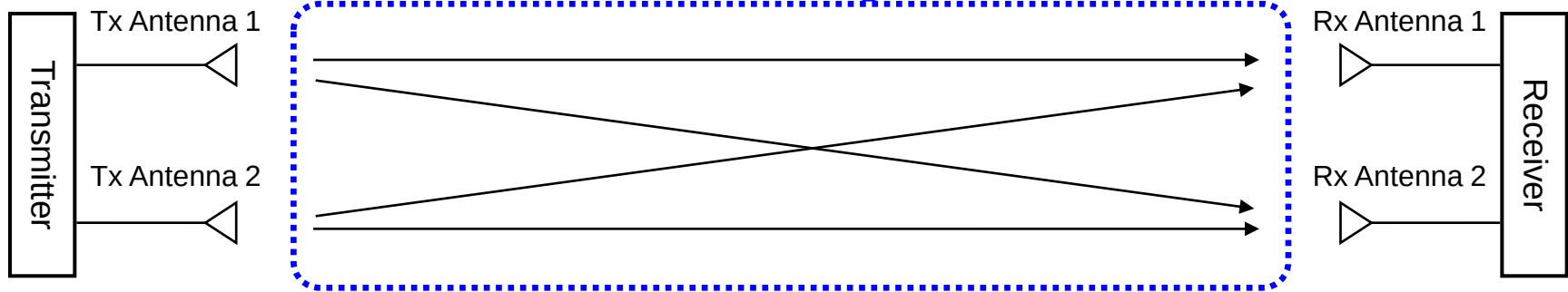
- Generating waveform patterns using EDA Tools (C, MATLAB, Microwave Office) => **Free license**



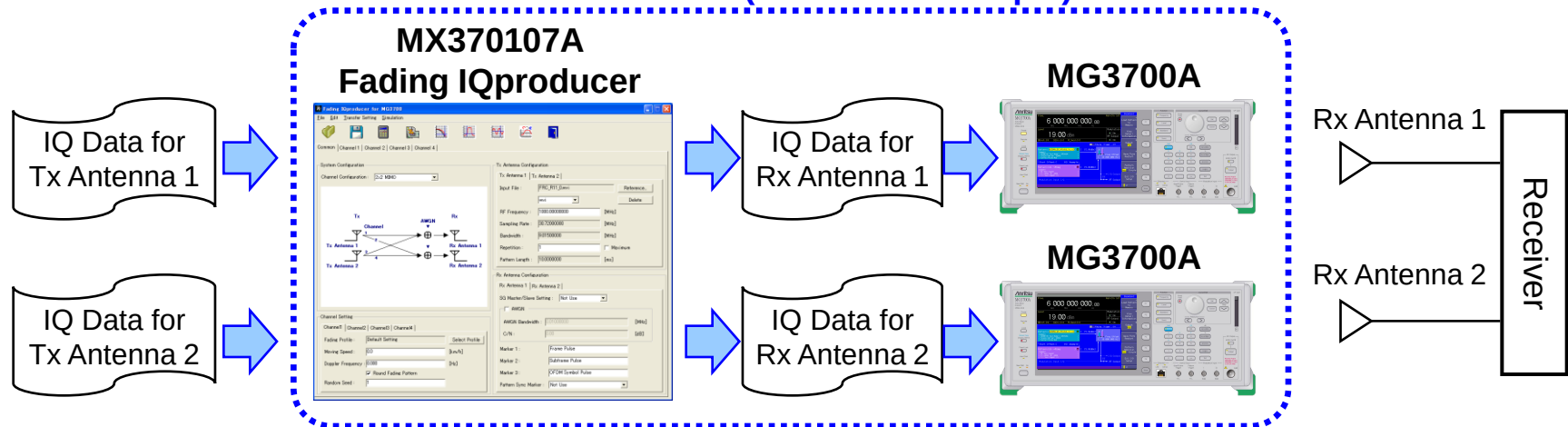
What is Fading IQproducer?

Fading IQproducer supports testing of Rx characteristics in a fading environment.

Fading



Evaluation of Fading Environment using MG3700A (2x2 MIMO Example)



What is Fading IQproducer?

◆ Channel Configuration

1x1 SISO

1x2 SIMO

1x3 SIMO

1x4 SIMO

2x1 MISO

2x2 MIMO

2x3 MIMO

2x4 MIMO

3x1 MISO

3x2 MIMO

3x3 MIMO

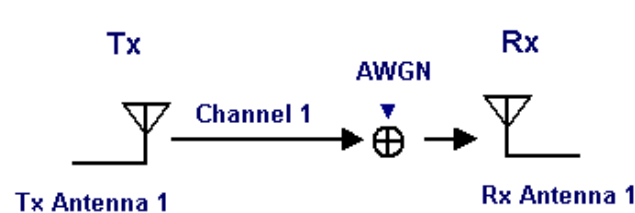
3x4 MIMO

4x1 MISO

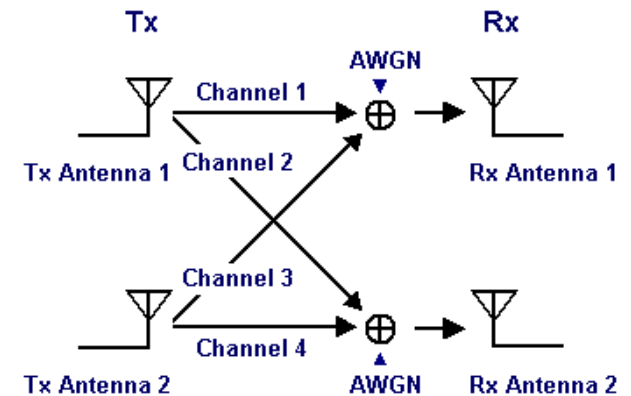
4x2 MIMO

4x3 MIMO

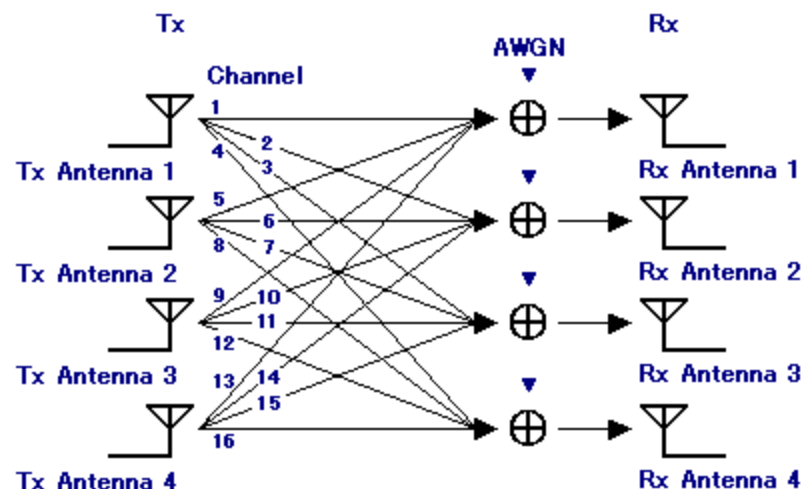
4x4 MIMO



1x1 SISO



2x2 MIMO



4x4 MIMO

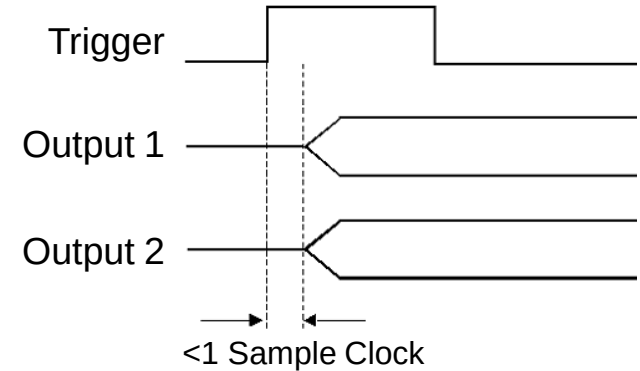
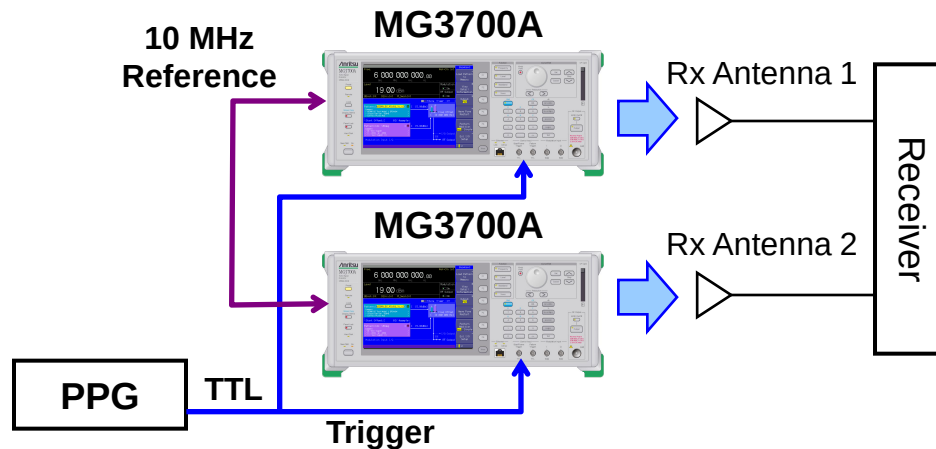
What is Fading IQproducer?

◆ Fading Profile

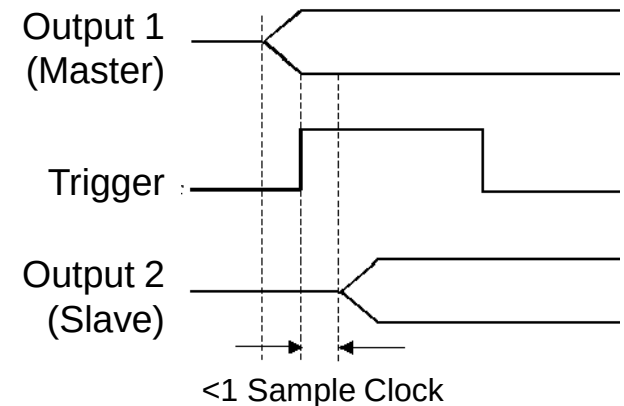
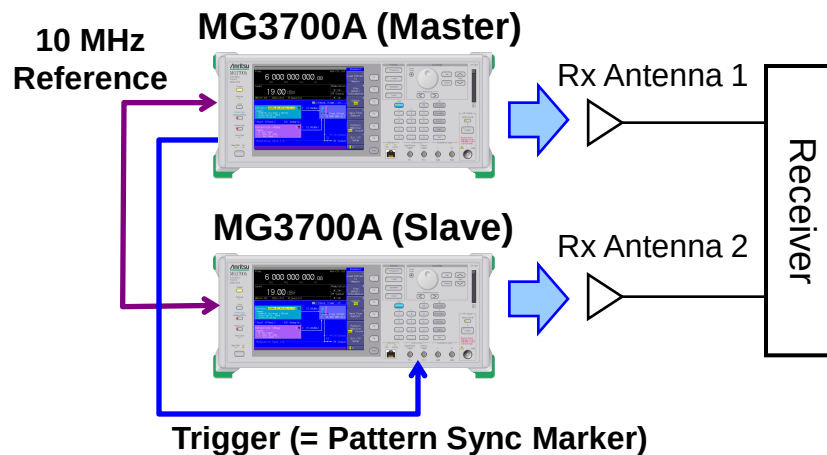
System	Channel Model
GSM	Rural Area 6tap, Rural Area 4tap, Hilly Terrain 12 tap-1, Hilly Terrain 12 tap-2, Hilly Terrain 6 tap-1, Hilly Terrain 6 tap-2, Urban Area 12 tap-1, Urban Area 12 tap-2, Urban Area 6 tap-1, Urban Area 6 tap-2, Equalisation Test 6 tap, Typical small cell 2 tap
W-CDMA (MS)	Case1, Case2, Case3, Case4, Case5, Case6, Moving propagation, Birth-Death propagation, High Speed Train
W-CDMA (BS)	Case1, Case2, Case3, Case4, Moving propagation, Birth-Death propagation, High Speed Train
HSDPA	Case1, Case2, Case3, Case4, Case5, Case6, Case8, ITU Pedestrian A, ITU Pedestrian B, ITU Vehicular A
HSUPA	Case1, Case2, Case3, Case4, ITU Pedestrian A, ITU Pedestrian B, ITU Vehicular A
CDMA2000 (MS)	Case1, Case2, Case3, Case4, Case5, Case6
CDMA2000 (BS)	Case1, Case2, Case3, Case4
TD-SCDMA	Case1, Case2, Case3, ITU Pedestrian A, ITU Pedestrian B, ITU Vehicular A
1xEV-DO	Configuration1, Configuration2, Configuration3, Configuration4, Configuration5
WLAN	Model A, Model B, Model C, Model D, Model E
Mobile WiMAX	ITU Pedestrian B, ITU Vehicular A, Large delay spread
MIMO Mobile WiMAX	2x2 MIMO(ITU Pedestrian B, ITU Vehicular A, Large delay spread)
DVB-T	Typical Urban (TU6), Typical Rural Area (RA6)
LTE (MS)	EPA 5Hz, EVA 5Hz, EVA 70Hz, ETU 70Hz, ETU 300Hz, High Speed Train
LTE (BS)	EPA 5Hz, EVA 5Hz, EVA 70Hz, ETU 70Hz, ETU 300Hz, High Speed Train
MIMO LTE	1x2 SIMO(EPA 5Hz, EVA 5Hz, EVA 70Hz, ETU 70Hz, ETU 300Hz), 2x2 MIMO(EPA 5Hz, EVA 5Hz, EVA 70Hz, ETU 70Hz, ETU 300Hz), 4x2 MIMO(EPA 5Hz, EVA 5Hz, EVA 70Hz, ETU 70Hz, ETU 300Hz)

2x2MIMO Connection Example

◆ Using EXT-Trigger



◆ Using Master/Slave



Operation Images

Setup	Slide 10
Starting IQproducer	Slide 11
IQproducer Main Screen	Slide 11
Editing Parameters	Slide 12–16
Generating Waveform	Slide 17
Transferring Waveform Pattern	Slide 18–19
Saving/Recalling Parameters	Slide 20
Appendix: Parameter Setting Range	Slide 21–24
Appendix: Example of Fading Characteristics	Slide 25–30
Waveform Pattern Playback Time	Slide 31-36
Time Required to Generate Waveform Patterns	Slide 37-38

Setup

Connect the MG3700A and PC as shown below.

Install IQproducer in the PC.

Install the MX370107A license key in the MG3700A.

IQproducer



**MG3700A Vector Signal Generator
+ MX370107A License key**



**100Base-TX LAN
Crossover cable**



IQproducer™ Operating Environment

CPU	Pentium III, 1 GHz or faster
Memory	> 512 Mbytes
HDD	> 5 Gbytes
Display	> 1024 x 768 pixels
OS	Windows2000 ^(R) Professional, Windows XP ^(R)

***Read the appended [IQproducer Upgrade Procedure] for the IQproducer installation method.**

***Read the appended [LAN Connection] for the LAN connection method between the PC and MG3700A.**

Starting IQproducer

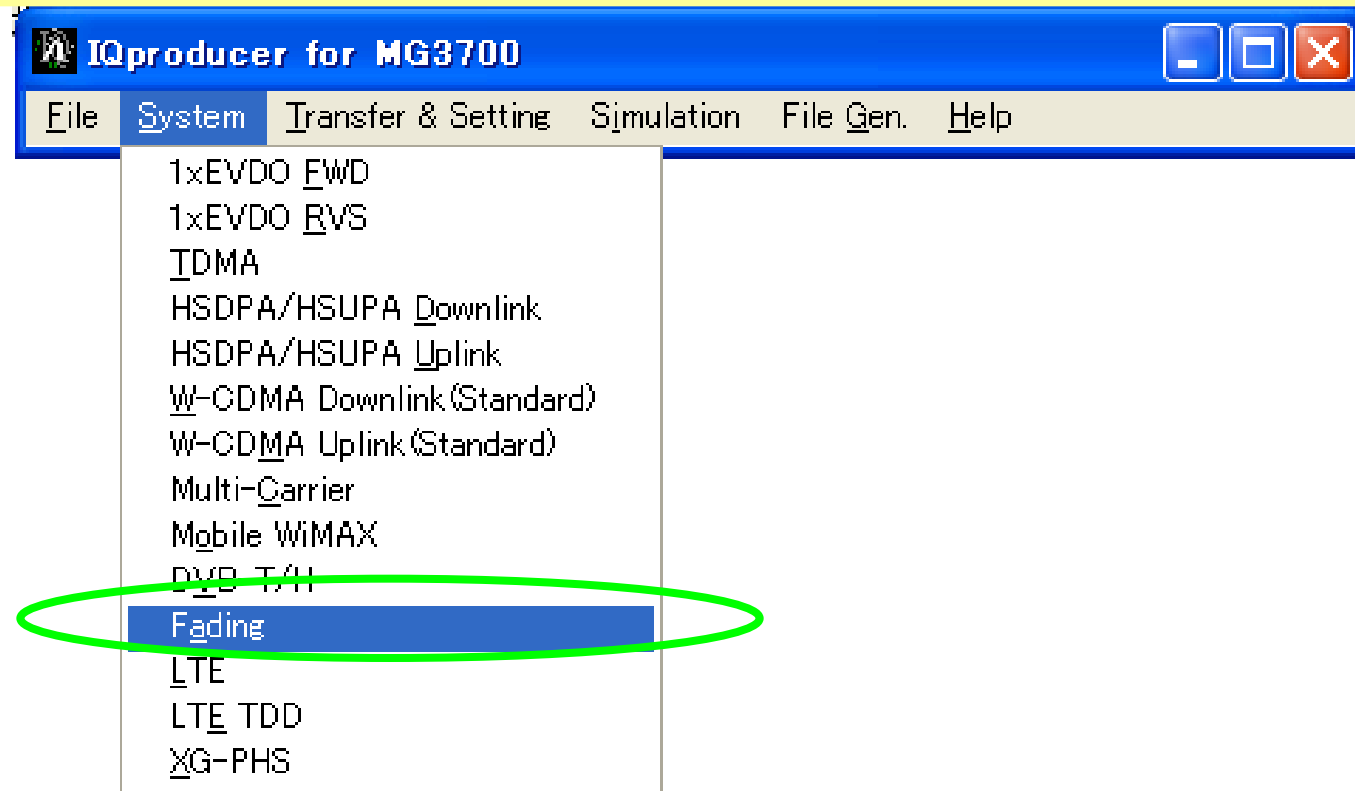
Start IQproducer as follows:

Start > Programs > Anritsu Corporation > IQproducer for MG3700A

IQproducer Main Screen

When IQproducer starts, the following screen is displayed.

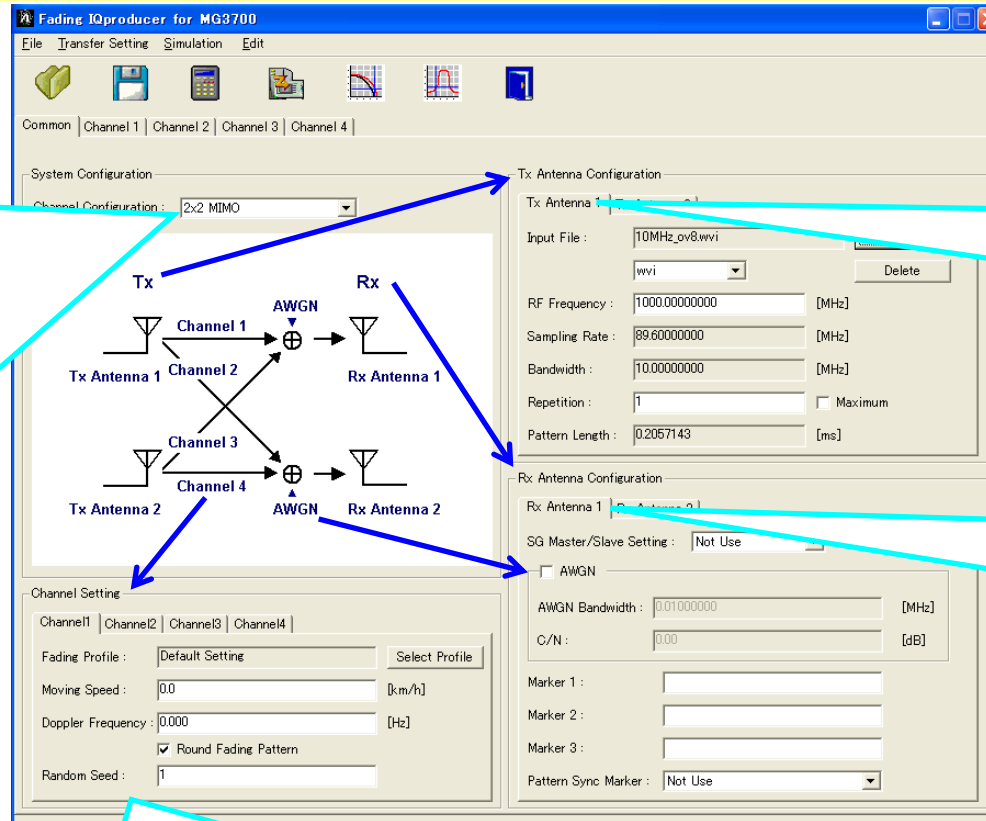
Choose **F**ading from the [**S**ystem] pull-down menu.



Editing Parameters: Common

The following screen is displayed by selecting **Fading** at [**System**]. Tx Antenna, Rx Antenna, Channel, AWGN are set at the Common tab. Channel Configurations 1x1 SISO to 4x4 MIMO can be selected in Channel Configuration.

1x1 SISO
1x2 SIMO
1x3 SIMO
1x4 SIMO
2x1 MISO
2x2 MIMO
2x3 MIMO
2x4 MIMO
3x1 MISO
3x2 MIMO
3x3 MIMO
3x4 MIMO
4x1 MIMO
4x2 MIMO
4x3 MIMO
4x4 MIMO



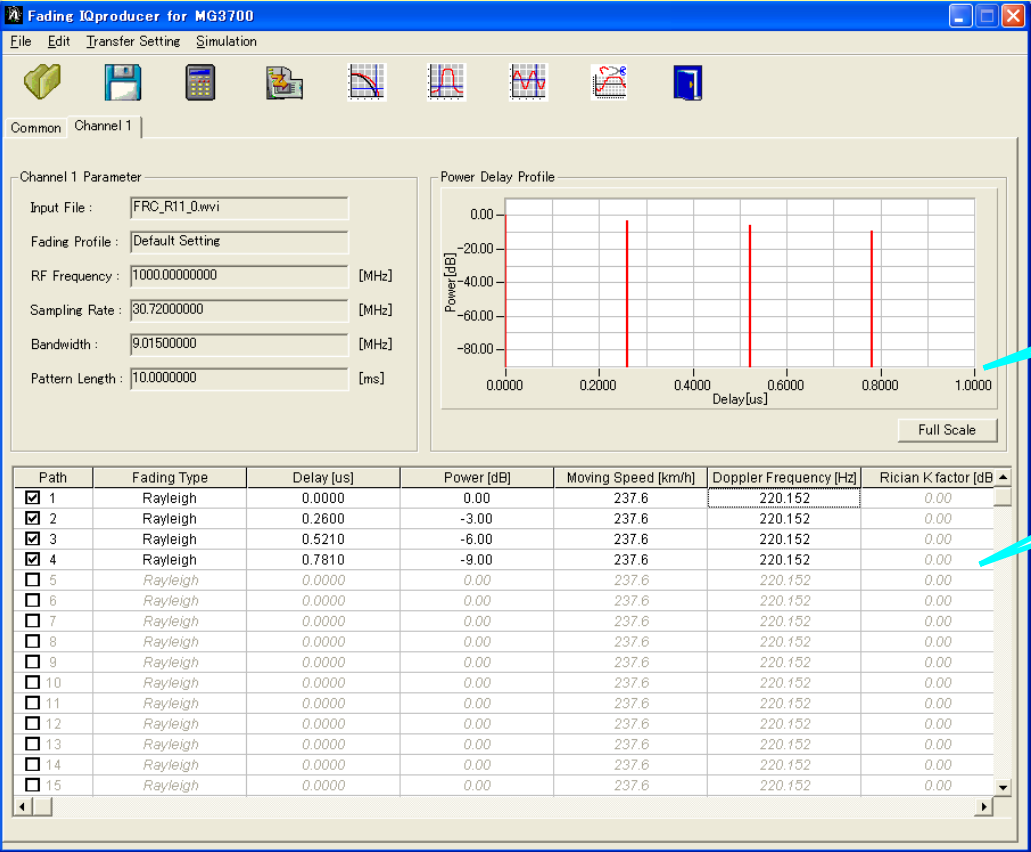
Tx Antenna Settings
Settings for Tx signal:
Either MG3700A waveform pattern or arbitrary IQ data (ASCII) can be selected.

Rx Antenna Settings
Settings for AWGN combine:
Master or Slave can be selected when there are two Rx systems.

Channel Settings
Settings for Fading Profile of each channel, Moving Speed, and Doppler Frequency

Editing Parameters: Channel

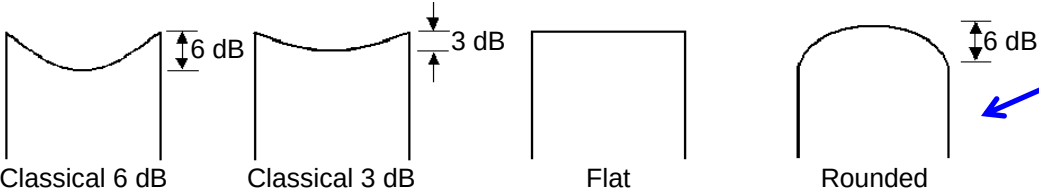
Multi-path settings for each channel



Power Delay Profile
The state of each path is displayed on the horizontal axis (delay) and vertical axis (power).

Multi-path Settings
The settings are listed in the below table.

Path	1 to 20
Fading Type	Rayleigh, Rice, Constant
Delay	0.0000 to 2000.0000 us
Power	-80.00 to 0.00 dB
Moving Speed	0.0 to 5000.0 km/h
Doppler Frequency	0.000 to Sampling Rate/2
Rician K factor	-40.00 to 40.00 dB
Angle of Arrival	0.0 to 180.0 deg
Phase shift	0.0 to 359.9 deg
Spectrum Shape	Classical 6 dB, Classical 3 dB, Flat, Rounded
Correlation Setting	Edit, Not Use, Path number setting at Edit



Editing Parameters: Correlation Matrix Sheet

Sets All Valid Paths. Using the diagonal components of the Correlation Matrix as the border, the bottom-left element is set automatically so the top-right and bottom-left elements form a complex conjugation.

Save File...:

Saves Valid Path Correlation Matrix parameters as .csv file.

Recall File...:

Loads .csv file to set Correlation Matrix parameters.

Kronecker Method

Sets Kronecker Method ON and OFF.

At ON, the Kronecker result of multiplying the Tx Correlation Matrix and Rx Correlation Matrix is reflected in the Correlation Matrix.

	Tx Antenna 1	Tx Antenna 2	Tx Antenna 3	Tx Antenna 4
Tx Antenna 1	1	0.0	0.0	0.0
Tx Antenna 2	0.0	1	0.0	0.0
Tx Antenna 3	0.0	0.0	1	0.0
Tx Antenna 4	0.0	0.0	0.0	1

	Rx Antenna 1	Rx Antenna 2	Rx Antenna 3	Rx Antenna 4
Rx Antenna 1	1	0.0	0.0	0.0
Rx Antenna 2	0.0	1	0.0	0.0
Rx Antenna 3	0.0	0.0	1	0.0
Rx Antenna 4	0.0	0.0	0.0	1

	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5
Channel 1	1	0.89990 + j 0.04312	0.98830 + j 0.03210	0.88940 + j 0.45200	0.95420 + j 0.76400
Channel 2	0.89990 - j 0.04312	1	0.88940 + j 0.02340	0.98830 + j 0.63400	0.85800 + j 0.96300
Channel 3	0.98830 - j 0.03210	0.88940 - j 0.02340	1	0.89990 + j 0.62300	0.95420 + j 0.72300
Channel 4	0.88940 - j 0.45200	0.98830 - j 0.63400	0.89990 - j 0.62300	1	0.88940 + j 0.71300
Channel 5	0.95420 - j 0.76400	0.85800 - j 0.96300	0.98830 - j 0.72300	0.88940 - j 0.71300	1
Channel 6	0.85800 + j 0.00000	0.95400 + j 0.00000	0.88900 + j 0.00000	0.98800 + j 0.00000	0.89900 + j 0.00000
Channel 7	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 8	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 9	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 10	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 11	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 12	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 13	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000
Channel 14	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000	0.85800 + j 0.00000

Copy To All Paths:
Copies set Path parameter to other All Valid Paths.

Select each element value:
When an element is selected, the window shown below is displayed to input numeric values.

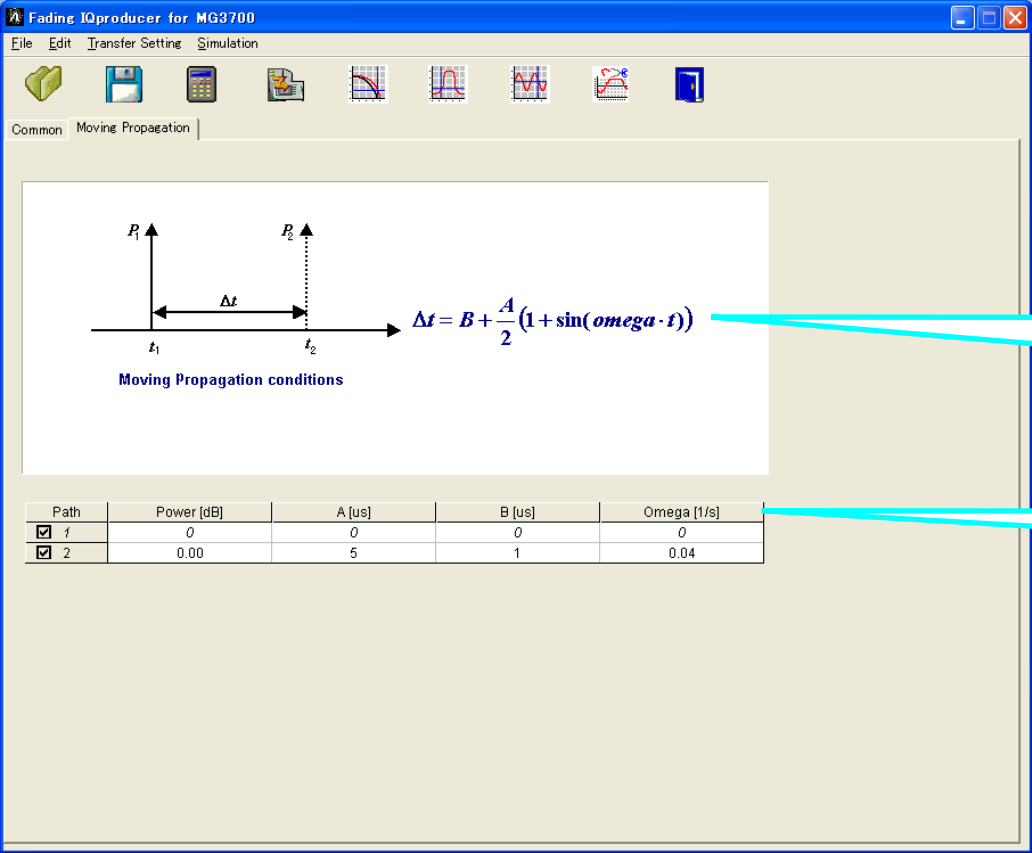
Input Complex Data

0.89990 + j 0.62300

OK

Editing Parameters: Moving Propagation

Moving Propagation can be set when
System Configuration = 1x1 SISO,
and Fading Profile = Moving Propagation (W-CDMA)



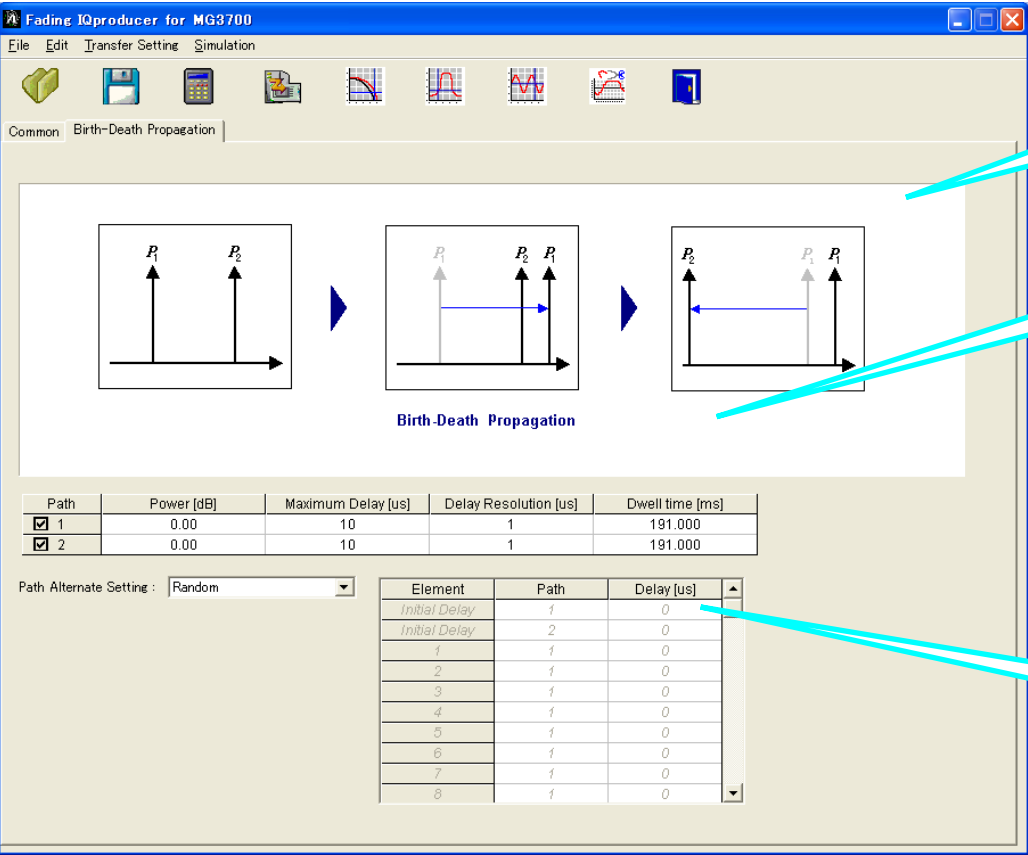
The delay of Path 2 to Path 1 changes according to the expression.

The setting items are listed in the table below.

Path	2
Power	-80.00 to 0.00 dB
A (Offset)	0 to 500 us
B (Variation)	0 to 500 us
Omega	0.00 to 1.00 Hz

Editing Parameters: Birth-Death Propagation

Birth-Death Propagation can be set when
System Configuration = 1x1 SISO,
and Fading Profile = Birth-Death Propagation (W-CDMA)



The delay of Path 1 and Path 2 is switched at random.

The setting items are listed in the table below.

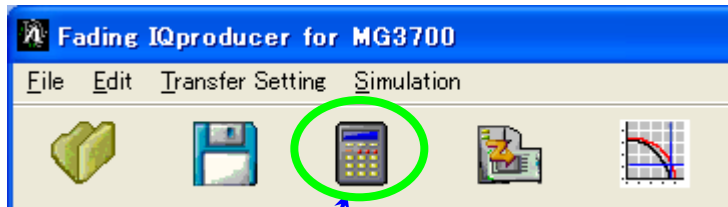
Path	2
Power	-80.00 to 0.00 dB
Maximum Delay	1 to 400 us
Delay Resolution	1 to Maximum Delay us
Dwell time	0.001 to 200.000 ms
Path Alternate setting	Random, Sequence

The setting items are listed in the table below.

Path	1, 2, Termination
Delay	0 to Maximum Delay

Generating Waveform: Calculation

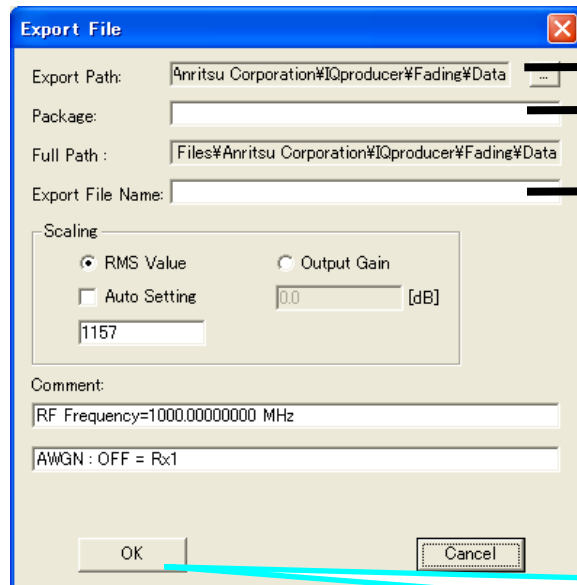
Click the [Calculation] icon to start creation of the waveform pattern after setting the parameters.



Calculation: Creates waveform pattern



Calculation: Creates waveform pattern



File export destination folder

Name of waveform pattern package: 31 characters max.

Name of waveform pattern file: 20 characters max.

RMS Value Auto Setting: ON/OFF

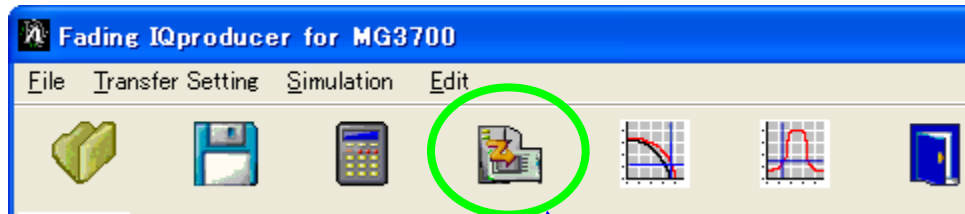
RMS Value: 1 to 1634

Comment on MG3700A screen:
38 characters max. per line

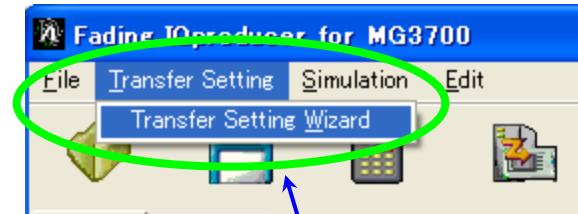
Generate the waveform pattern by clicking the [OK] button.

Transferring Waveform Pattern

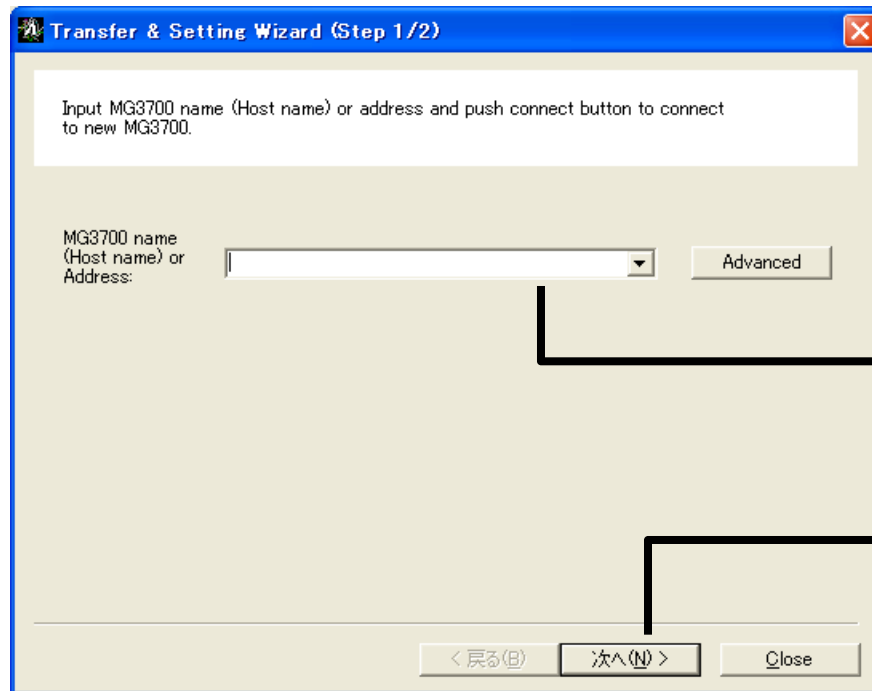
Connect the MG3700A and PC via a LAN.



Transfer & Setting
Wizard



Transfer & Setting
Wizard

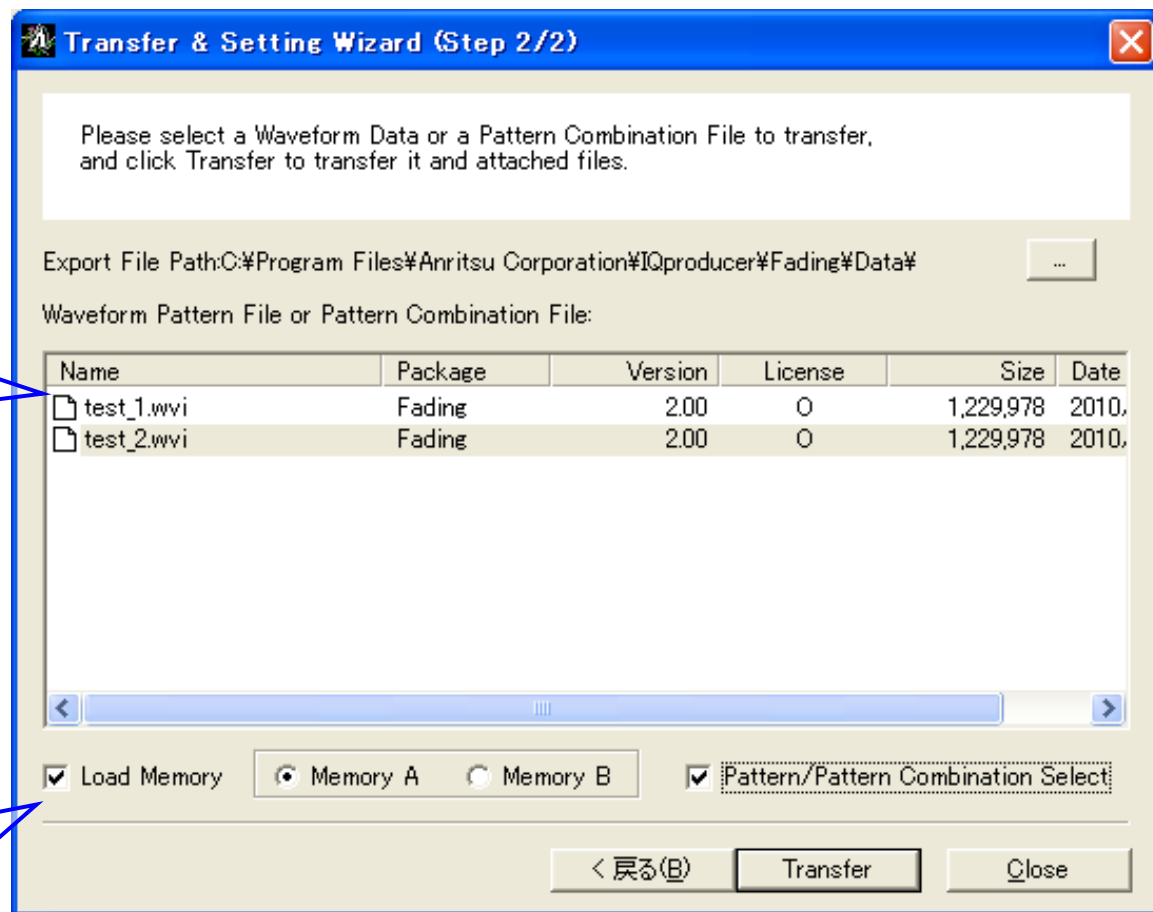


Input name or IP address of
MG3700A.

Connects to LAN

*Read the appended [LAN Connection] for the LAN connection method between the PC and MG3700A.

Transferring Waveform Pattern



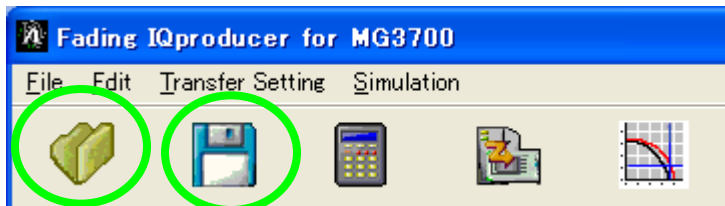
Select waveform pattern saved on MG3700A HDD.

Select when loading waveform pattern into memory at same time as transferring.

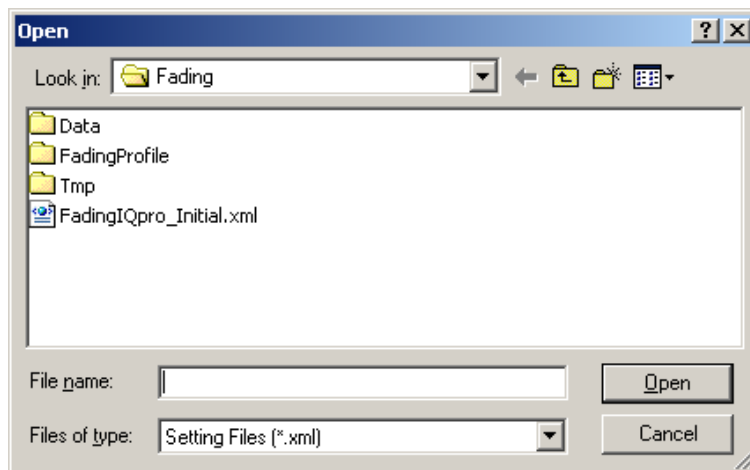
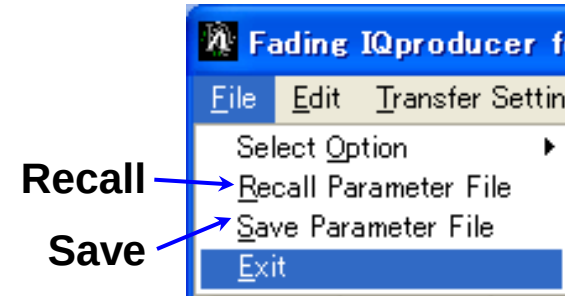
Starts transfer

Saving/Recalling Parameters

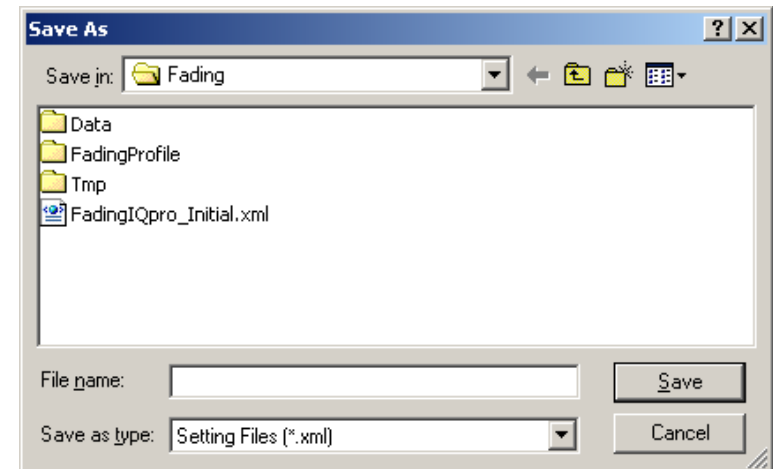
The numerical values and settings for each item can be saved as a parameter file for instant recall.



Recall
Save



File Save Screen



File Recall Screen

Appendix

MX370107A Fading IQproducer Parameter Setting Range

Parameter Setting Range (1/3)

Items	Outline	Setting Range
System Configuration		
Channel Configuration	Number of I/O antenna	1x1 SISO, 1x2 SIMO, 1x3 SIMO, 1x4 SIMO, 2x1 MISO, 2x2 MIMO, 2x3 MIMO, 2x4 MIMO, 3x1 MISO, 3x2 MIMO, 3x3 MIMO, 3x4 MIMO, 4x1 MISO, 4x2 MIMO, 4x3 MIMO, 4x4 MIMO
Tx Antenna Configuration		
Input File	Input pattern file	Display only
Input file type	Input file type	w vi, ASCII1, ASCII2, ASCII3
RF Frequency	Center frequency	0.25000000 to 6000.00000000 MHz, Resolution: 0.00000001 MHz
Sampling Rate		When w vi file selected: Display only When ASCII1/ASCII2/ASCII3 selected: 0.02000000 to 160.00000000 MHz, Resolution: 0.00000001 MHz
Bandwidth	Bandwidth of waveform pattern	When w vi file selected: Display only When ASCII1/ASCII2/ASCII3 selected: 0.02000000 to Sampling Rate MHz, Resolution: 0.00000001 MHz
Repetition	Repetition number of waveform pattern	1 to maximum, Maximum (at maximum, waveform patterns repeated up to memory size)
Pattern Length	Pattern length of waveform pattern	Display only
Channel Setting		
Fading Profile	Display	<Table 1>
Moving Speed		0.0 to 5000.0 km/h, Resolution: 0.1 km/h
Doppler Frequency		0.000 to "Sampling Rate/2 or Following Equation: smaller" Resolution: 0.001 Hz Equation: $5000 \times 1000/3600 \times [\text{RF Frequency}]/c$ (c: velocity of light)
Round Fading Pattern	Continuity of faded waveform pattern	with/without check (setting check makes sequential)
Random Seed	Random seed for fading	1 to 255, Resolution: 1
Rx Antenna Configuration		
SG Master/Slave Setting	Master/Slave setting when connecting two SG units at SIMO/MIMO	Not Use, Master, Slave
AWGN	ON/OFF	with check (= ON)/without check (= OFF)
AWGN Bandwidth	Bandwidth	0.01000000 to Sampling Rate/2 MHz, Resolution: 0.00000001 MHz
C/N	Setting	-40.00 to +40.00 dB, Resolution: 0.01 dB
Marker 1 to 3	Name	31 characters max
Pattern Sync Marker	Marker for output of Pattern Sync Marker	Not Use, Marker1, Marker2, Marker3

Parameter Setting Range (2/3)

Items	Outline	Setting Range
Channel n parameters (n = 1 to 16)		
Input File		Display only
Fading Profile		Display only
RF Frequency	Center frequency	Display only
Sampling Rate		Display only
Bandwidth	Bandwidth of waveform pattern	Display only
Pattern Length	Pattern length of waveform pattern	Display only
Path (1 to 20)		
Path	Display of Path No., ON/OFF	with check (= ON)/without check (OFF)
Fading Type	Kinds of single path fading	Rayleigh, Rice, Constant Rayleigh: Environment in which many scattering waves arrive. The Rx level is changed according to the Rayleigh distribution. Rice: Environment in which many scattering and direct waves arrive. The Rx level is changed according to the Rice distribution. Constant: Rx level not changed
Delay		0.0000 to 2000.0000 μ s, Resolution: 0.0001 μ s
Power	Power of path	0.00 to -80.00 dB, Resolution: 0.01 dB
Moving Speed		0.0 to 5000.0 km/h, Resolution: 0.1 km/h
Doppler Frequency		0.000 to Sampling Rate/2 or smaller, Resolution: 0.001 Hz Equation: $5000 \times 1000/3600 \times [\text{RF Frequency}]/c$ (c: velocity of light)
Rician K factor	Power ratio between direct wave and scattering wave	-40.00 to 40.00 dB, Resolution: 0.01 dB Set when Fading Type = Rice
Angle of Arrival	Direct wave arrival angle	0.0° to 180.0°, Resolution: 0.1° Set when Fading Type = Rice
Phase Shift		0.0° to 359.9°, Resolution: 0.1°
Spectrum Shape	Doppler spectrum shape	Classical 6 dB, Classical 3 dB, Flat, Rounded Cannot be set when Fading Type = Constant
Correlation Setting	Setting correlation matrix	Edit, Not Use, Path number setting at Edit
Path Correlation Matrix		-1.0000 - j1.0000 to 1.0000 + j1.0000 Resolution: both real and imaginary parts = 0.0001 Set when Correlation Setting = Edit Only top-right elements of opposite angle can be edited

Parameter Setting Range (3/3)

Moving Propagation		
Set when System Configuration = 1x1 SISO and Fading Profile = Moving Propagation		
Items	Outline	Setting Range
Power	Power of Path	0.00 to -80.00 dB, Resolution: 0.01 dB
A (Offset)	Offset of Path 2	0 to 500 μ s, Resolution: 1
B (Variation)	Change of delay at Path 2	0 to 500 μ s, Resolution: 1
Omega	Setting of Omega	0.00 to 1.00 Hz, Resolution: 0.01 Hz

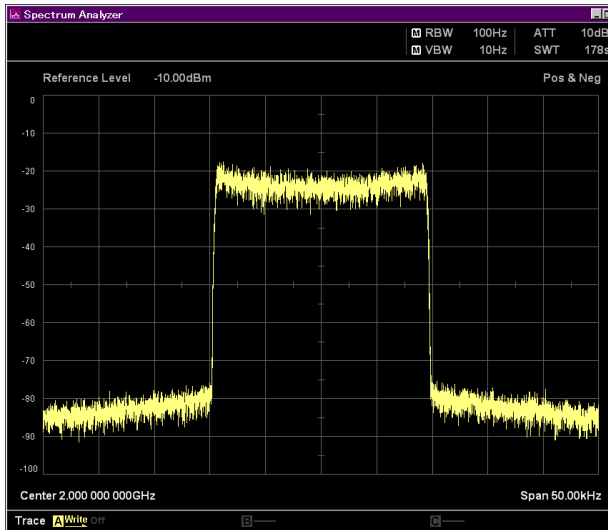
Birth-Death propagation		
Set when System Configuration = 1x1 SISO and Fading Profile = Birth-Death Propagation		
Items	Outline	Setting Range
Power	Power of path	0.00 to -80.00 dB, Resolution: 0.01 dB
Maximum Delay		1 to 400 μ s, Resolution: "Delay Resolution"
Delay Resolution		1 to Maximum Delay μ s, Resolution: 1
Dwell Time		0.001 to 200.000 ms, Resolution: 0.001
Path Alternate Setting		Random, Sequence Random: Path 1 and Path 2 switched randomly Sequence: Delay and path switched by setting sequence
Path	Path setting	1, 2, Termination Set when Path Alternate Setting = Sequence
Delay	Delay of path	0 to Maximum Delay Enabled when Path Alternate = Sequence and previous element $\neq$ Termination

High Speed Train		
Set when System Configuration = 1x1 SISO and Fading Profile = High Speed Train		
Items	Outline	Setting Range
Ds	Setting of (the default value of the distance between BS and train) x 2	0 to 2000 m, Resolution: 1 m
Dmin	Setting of the distance between BS and rail	1 to 100 m, Resolution: 1 m
Rician K factor	Power ratio between direct wave and scattering wave	-40.00 to 40.00 dB, Resolution: 0.01 dB
Moving Speed		0.0 to 5000.0 km/h, Resolution: 0.1 km/h
Maximum Doppler Frequency		0.000 to 2000.000 Hz, Resolution: 0.001 Hz

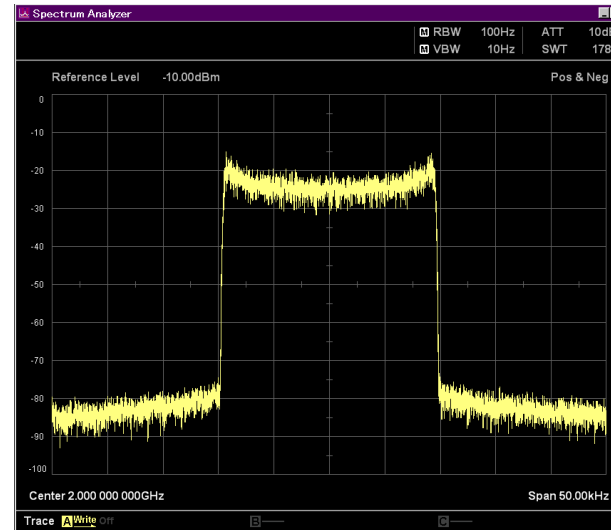
Appendix

MX370107A Fading IQproducer Example of Fading Characteristics

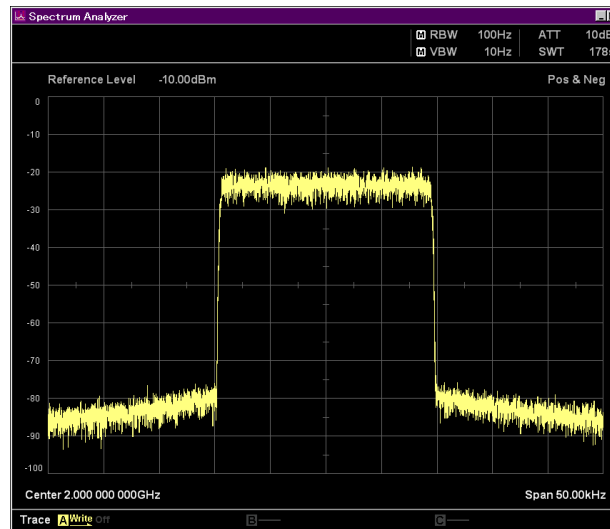
Doppler Spectrum [Rayleigh]



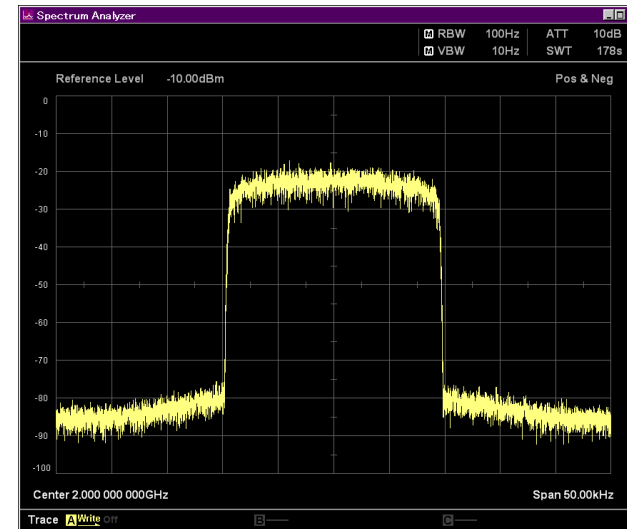
Rayleigh with Classical 3 dB



Rayleigh with Classical 6 dB

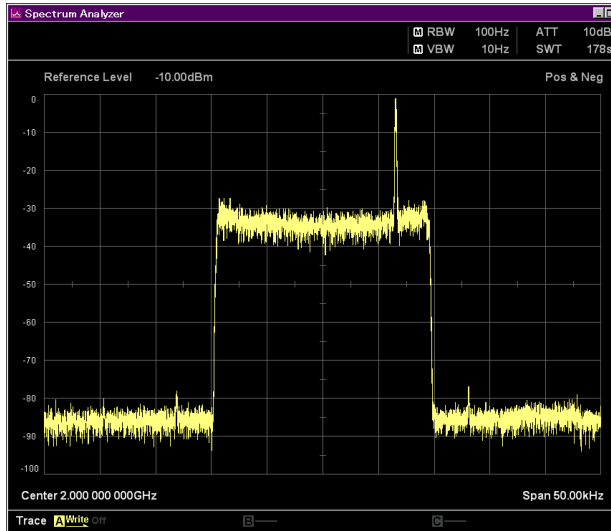


Rayleigh with Flat

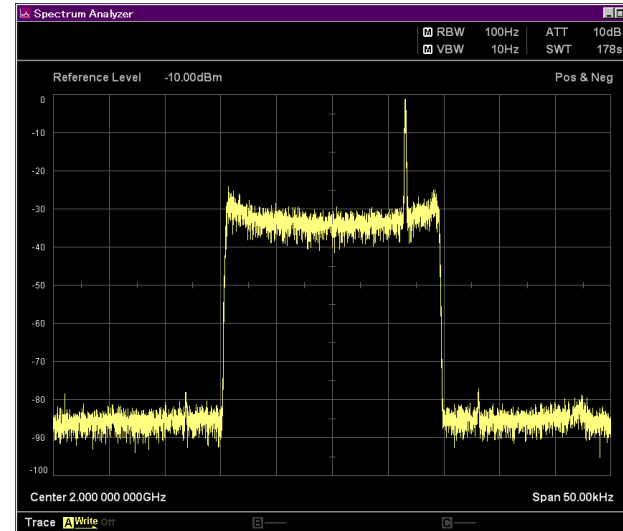


Rayleigh with Rounded

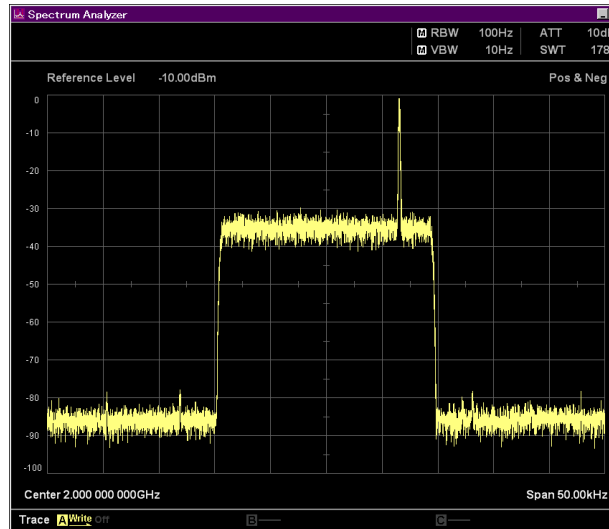
Doppler Spectrum [Rice]



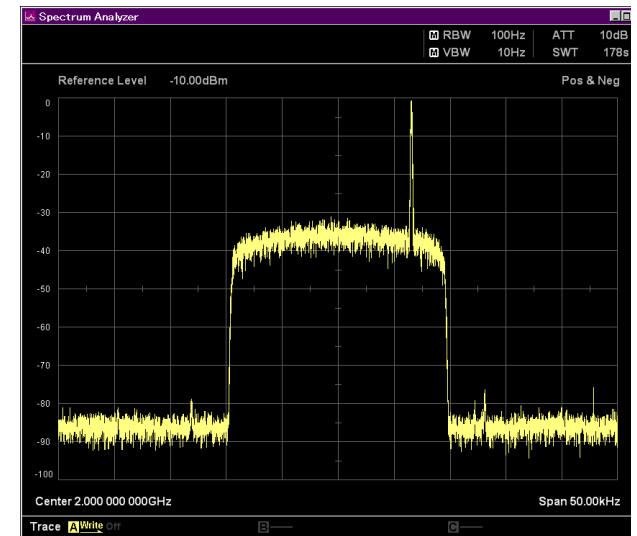
Rice with Classical 3 dB



Rice with Classical 6 dB



Rice with Flat

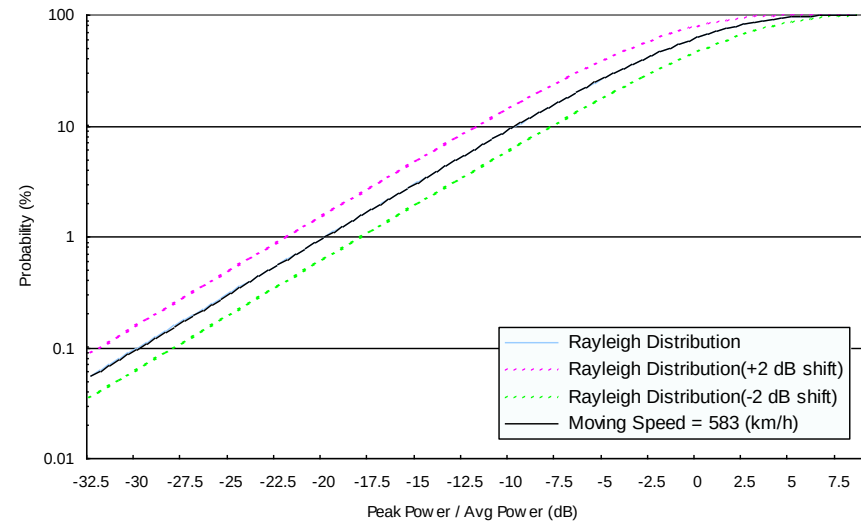


Rice with Rounded

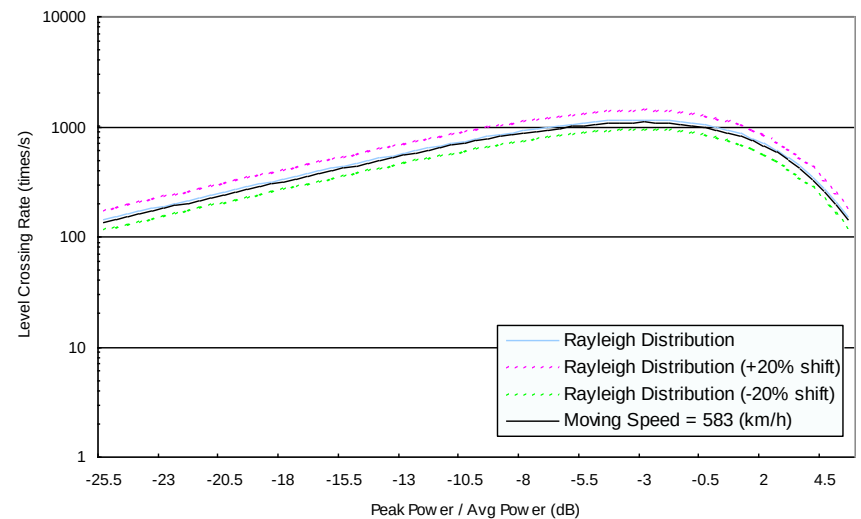
Cumulative Distribution and Level Crossing Rate (1/3)

Example: Calculated cumulative distribution and level crossing rate for following parameters

System Configuration	
Channel Configuration	1x1 SISO
Tx Antenna Configuration (Tx Antenna 1)	
RF Frequency	2000.00000000 MHz
Sampling Rate	11.52 MHz
Repetition	1
Pattern Length	10220 ms
Channel Setting (Channel 1)	
Moving Speed	2.3, 50, 120, 250, 583 km/h
Doppler Frequency	4.262, 92.657, 222.376, 463.283, 1080.377 Hz
Round Fading Pattern	without check
Random Seed	1
Rx Antenna Configuration (Rx Antenna 1)	
AWGN	without check

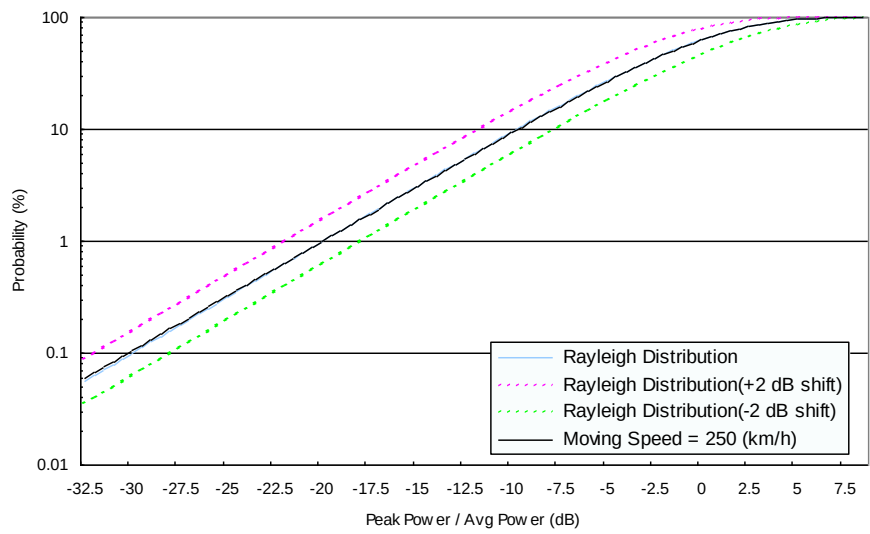


Cumulative Distribution (Moving Speed = 583 km/h)

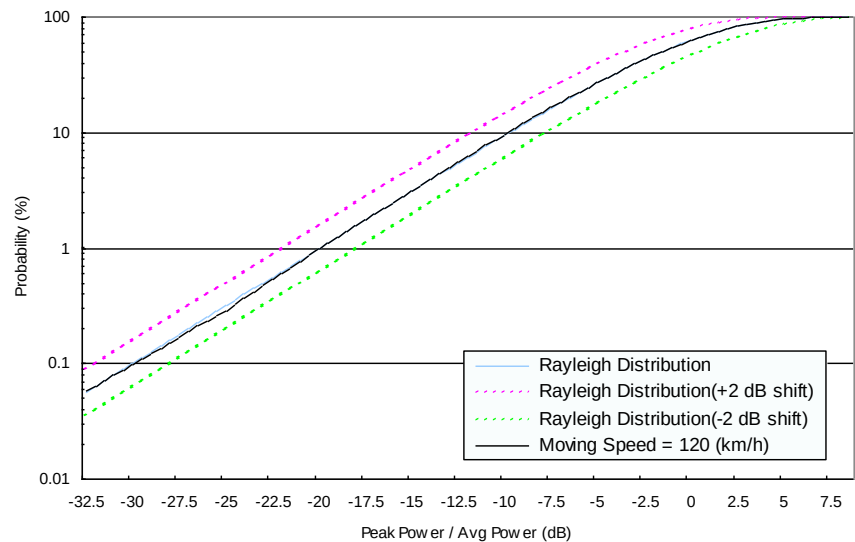


Level Crossing Rate (Moving Speed = 583 km/h)

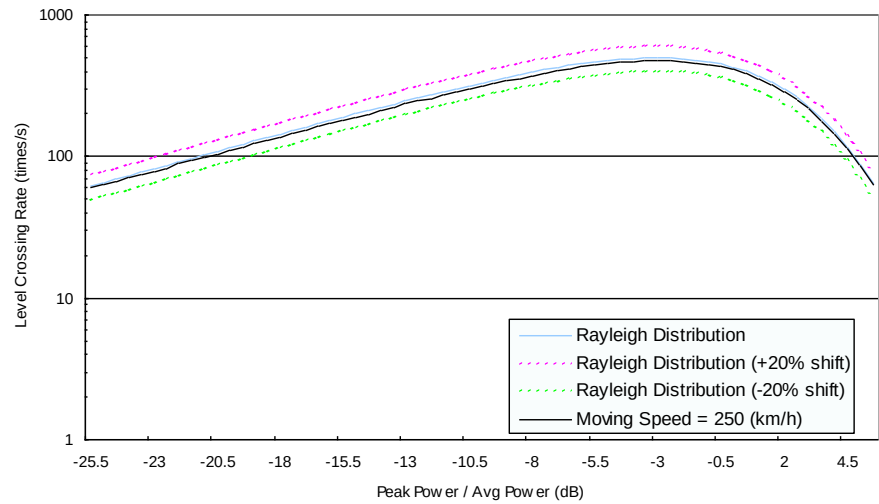
Cumulative Distribution and Level Crossing Rate (2/3)



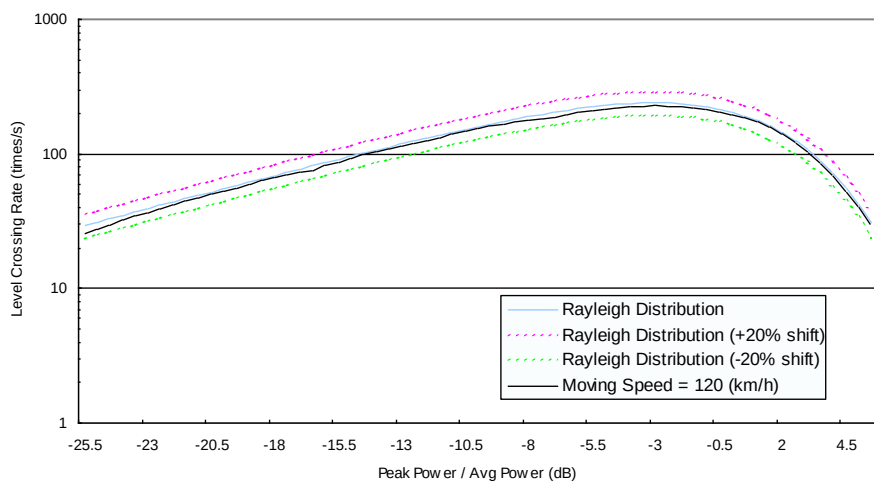
Cumulative Distribution (Moving Speed = 250 km/h)



Cumulative Distribution (Moving Speed = 120 km/h)

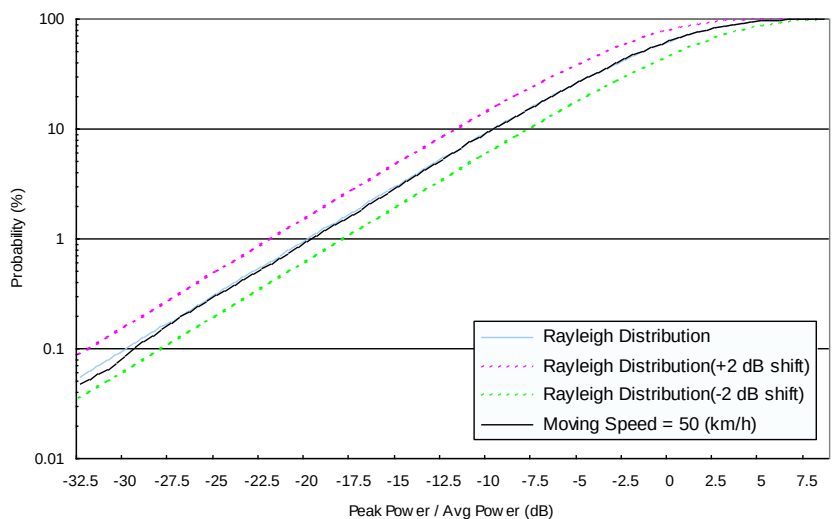


Level Crossing Rate (Moving Speed = 250 km/h)

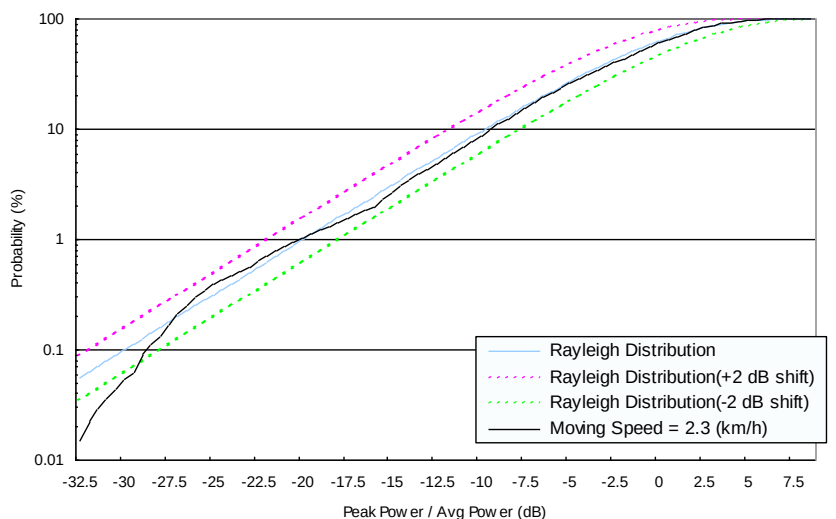


Level Crossing Rate (Moving Speed = 120 km/h)

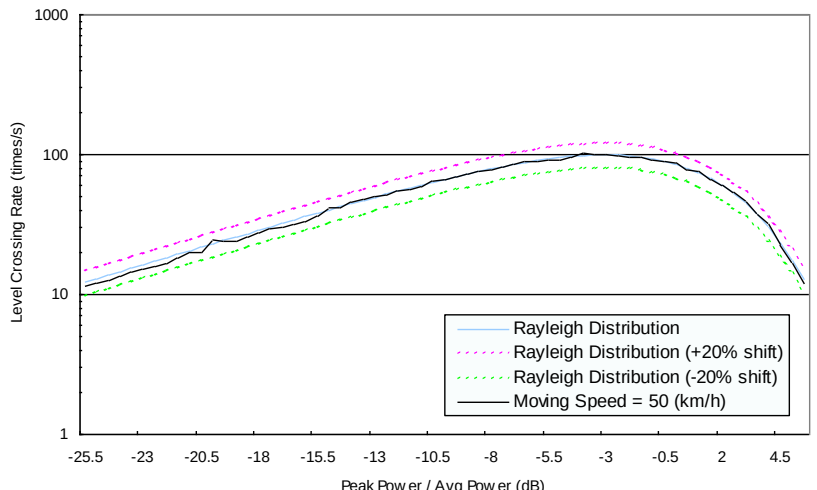
Cumulative Distribution and Level Crossing Rate (3/3)



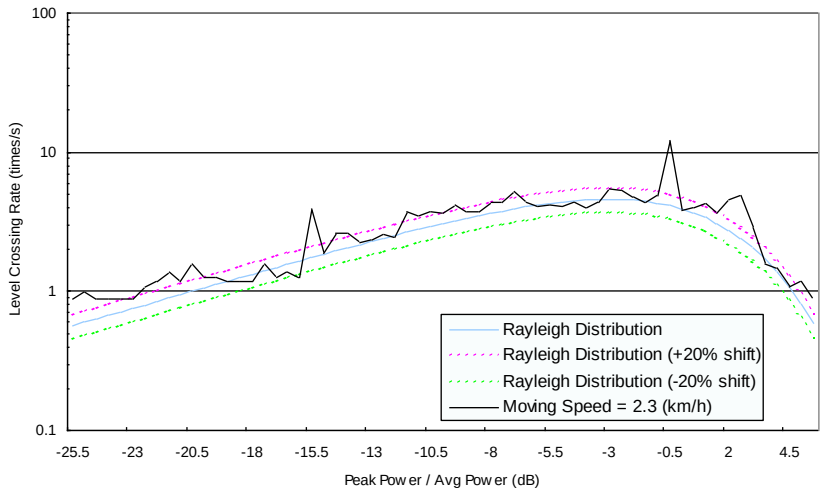
Cumulative Distribution (Moving Speed = 50 km/h)



Cumulative Distribution (Moving Speed = 2.3 km/h)



Level Crossing Rate (Moving Speed = 50 km/h)



Level Crossing Rate (Moving Speed = 2.3 km/h)

Waveform Pattern Playback Time (1/6)

The MG3700A has a built-in 256 Msample arbitrary waveform memory as standard, plus a 512 Msample memory as an option. The waveform pattern playback time is limited by the memory size. The following shows examples of replay times with LTE(MS).

***These values are not guaranteed because the playback time depends on the conditions.**

BW	Sampling Rate	Maximum Playback Time[s]	
		256MSample	512MSample
1.4M	3.84M	69.91	139.81
3.0M	7.68M	34.96	69.91
5.0M	15.36M	17.48	34.95
10.0M	30.72M	8.74	17.48
15.0M	30.72M	8.74	17.48
20.0M	61.44M	4.37	8.74

UE Conformance testing (3GPP 36521-1-840)

Minimum Test time for PDSCH Single Antenna Port Performance

Minimum Test time for PDSCH Single Antenna Port Performance with 1 PRB

Minimum Test time for PDSCH Transmit diversity 2x2

Minimum Test time for PDSCH Transmit diversity 4x2

Minimum Test time for PDSCH Open Loop Spacial Multiplexing 2x2

Minimum Test time for PDSCH Open Loop Spacial Multiplexing 4x2

Minimum Test time for PDSCH Closed Loop Single/Multilayer Spacial Multiplexing 2x2

Minimum Test time for PDSCH Closed Loop Single/Multilayer Spacial Multiplexing 4x2

Waveform Pattern Playback Time (2/6)

Table G.3.5-1: Minimum Test time for PDSCH Single Antenna Port Performance

Test number	Demodulation scenario plain text:	Minimum number of subframes(MNS) to reach target +/-2%	Without Option21 (256 Msample)	Minimum number of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[1.1]	1 R.2(10 MHz, full, QPSK, 1/3) (1x2 Low) EVA5	7482	O	9000	x
			O		O
[1.2]	2 R.2(10 MHz, full, QPSK, 1/3) (1x2 Low) ETU,70	682	O	2000	O
			O		O
[1.3]	3 R.2(10 MHz, full, QPSK, 1/3) (1x2 Low) ETU,300	174	O	2000	O
			O		O
[1.4]	4 R.2(10 MHz, full, QPSK, 1/3) (1x2 Low) HST	96	O	tbd	-
			O		-
[2.1]	5 R.4(1.4 MHz, full, QPSK, 1/3) (1x2 Low) EVA5	17789	O	19000	O
			O		O
[1.5]	6 R.3(10 MHz, full, 16QAM, 1/2) (1x2 Low) EVA5	9041	x	11000	x
			O		O
[1.6]	7 R.3(10 MHz, full, 16QAM, 1/2) (1x2 Low) ETU,70	243	O	2000	O
			O		O

Table G.3.5-1: Minimum Test time for PDSCH Single Antenna Port Performance

Test number	Demodulation scenario plain text:	Minimum number of subframes(MNS) to reach target +/-2%	Without Option21 (256 Msample)	Minimum number of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[1.7]	8 R.3(10 MHz, full, 64 QAM, 1/2) (1x2 High) ETU,300	1346	O	3000	O
			O		O
[2.2]	9 R.5(3 MHz, full, 64QAM, 3/4) (1x2 Low) EVA5	28159	O	30000	O
			O		O
[2.3]	10 R.6(5 MHz, full, 64QAM, 3/4) (1x2 Low) EVA5	17448	O	19000	x
			O		O
[1.8]	11 R.7(10 MHz, full, 64QAM, 3/4) (1x2 Low) EVA5	3039	O	5000	O
			O		O
[1.9]	12 R.7(10 MHz, full, 64QAM, 3/4) (1x2 Low) ETU,70	896	O	2000	O
			O		O
[1.10]	13 R.7(10 MHz, full, 64 QAM, 3/4) (1x2High) EVA5	7697	O	9000	x
			O		O
[2.4]	14 R.8(15 MHz, full, 64QAM, 3/4) (1x2 Low) EVA5	4919	O	6000	O
			O		O

Waveform Pattern Playback Time (3/6)

Table G.3.5-1: Minimum Test time for PDSCH Single Antenna Port Performance

Test number	Demodulation scenario plain text:	Minimum number of subframes(MNS) to reach target +-2%	Without Option21 (256 Msample)	Minimum number of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[2.5]	15 R.9(20 MHz, full, 64QAM, 3/4) (1x2 Low) EVA,5	5730	x	7000	x
			O		O
[3.1]	16 R.0(3 MHz, 1PRB, 16QAM,1/2) (1x2 Low) ETU,70	2379	O	4000	O
			O		O
[3.2]	17 R.1(10 MHz, 1PRB, 16QAM, ½) (1x2 Low) ETU,70	2373	O	4000	O
			O		O
[3.3]	18 R.1(20 MHz, 1PRB, 16QAM, ½) (1x2 Low) ETU,70	9173	x	11000	x
			x		x

Table G.3.5-2: Minimum Test time for PDSCH Single Antenna Port Performance with 1 PRB

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[3.4]	1 R.29(10MHz, 1PRB, 16QAM, ½) (1x2 Low) ETU,70 [MBFSN]	3779	O	5000	O
			O		O

Table G.3.5-3: Minimum Test time for PDSCH Transmit diversity 2x2

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[7.1]	1 R11(10MHz, full, 16QAM ½) (2x2 Med) EVA,5 [SFBC, Space Frequency Block Code]	14321	x	16000	x
			O		O
[7.2]	2 R.10(10MHz, Full, QPSK, 1/3) (2x2 low) HST [SFBC]	94	O	tbd	-
			O		-

Table G.3.5-4: Minimum Test time for PDSCH Transmit diversity 4x2

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[7.3]	1 R.12(1.4MHz, full, QPSK 1/3) (4x2 med) EPA,5 [SFBC-FSTD, SFBC-Frequency Shifted Transmit Diversity]	13449	O	15000	O
			O		O

Waveform Pattern Playback Time (4/6)

Table G.3.5-5: Minimum Test time for PDSCH Open Loop Spatial Multiplexing 2x2

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[6.1]	1 R.11(10MHz, Full, 16QAM, ½) (2x2 Low) EVA,70 [LD-CDD, Large Delay-Cyclic Delay Diversity]	3439	O	5000	O
			O		O

Table G.3.5-6: Minimum Test time for PDSCH Open Loop Spatial Multiplexing 4x2

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[6.2]	1 R.14(10MHz, full, 16 QAM, ½) (4x2 low) EVA,70 [LD-CDD]	674	O	2000	O
			O		O

Table G.3.5-7: Minimum Test time for PDSCH Closed Loop Single/Multilayer Spatial Multiplexing 2x2

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[4.1]	1 R.10(10MHz, 6PRB, QPSK, 1/3) (2x2 Low) EVA,5 [SCW, Single Code Word]	2390	O	4000	O
			O		O
[4.2]	2 R.10(10MHz, Full, QPSK, 1/3) (2x2 High) EPA,5 [SCW]	23892	x	25000	x
			x		x
[5.1]	3 R.11(10MHz,full, 16QAM ½) (2x2Low) EVA,5 [MCW, Multiple Code Word]	2032	O	4000	O
			O		O
[5.2]	4 R.11(10MHz, full, 16QAM ½) (2x2Low) ETU,70 [MCW]	86	O	2000	O
			O		O

Table G.3.5-8: Minimum Test time for PDSCH Closed Loop Single/Multilayer Spatial Multiplexing 4x2

Test No	Demod Scenario (info)	Target, Simulation	Without Option21 (256 Msample)	Min No of active subframes	Without Option21 (256 Msample)
			With Option21 (512 Msample)		With Option21 (512 Msample)
[4.3]	1 R.13(10 MHz, 6PRB, QPSK 1/3) (4x2 Low) EVA,5 [SCW]	1693	O	3000	O
			O		O
[5.3]	2 R.14(10MHz, MCW, 6PRB, 16QAM ½) (4x2low) EVA5 [MCW]	8229	O	10000	x
			O		O

Waveform Pattern Playback Time (5/6)

The MG3700A has a built-in 256 Msample arbitrary waveform memory as standard, plus a 512 Msample memory as an option. The waveform pattern playback time is limited by the memory size. The following shows examples of replay times with other systems.

***These values are not guaranteed because the playback time depends on the conditions.**

System	Mximum Playback Time of MG3700A [s]		Waveform Generation Condition (part)		
	without Option 21 (256 Msample)	with Option 21 (512 Msample)	Tx Waveform pattern	Sampling Rate [Hz]	Data Points
GSM	-	122.64	DL_MCS-9_1SLOT, (Frame Length = 1875, Gap Length = 13125)	3,250,000	49,822,500
W-CDMA(MS)	20.44	40.88	Generation by W-CDMA Downlink IQproducer (Channel Edit → SFN Cycle = Short)	11,520,000	117,734,400
W-CDMA(BS)	20.44	40.88	UL_RMC_12_2 kbps	11,520,000	117,734,400
HSDPA	23.28	46.56	Generation by HSDPA/HSUPA Downlink IQproducer (Easy Setup = H-Set 1 (QPSK), Channel Edit → SFN Cycle = Short, HS-SCCH1 → Edit → Payload Data = PN9fix)	11,520,000	1,382,400
HSUPA	20.44	40.88	Uplink	11,520,000	235,468,800
CDMA2000(MS)	52.08	104.16	FWD_RC1-2_9channel	4,915,200	393,216
CDMA2000(BS)	52.08	104.16	RVS_RC1_FCH	4,915,200	393,216
TD-SCDMA	40.88	81.76	rmc12_2k_ue_dl	5,120,000	104,652,800
1xEVDO	52.05	104.11	FWD_38_4kbps_16slot	4,915,200	524,288
WLAN	5.01	10.03	11b_DSSS_2Mbps_PN9 (Frame Length = 188848, Gap Length = 27192)	44,000,000	96,501,328
Mobile WiMAX	11.98	23.96	Generation by Mobile WiMAX IQproducer (BandWidth = 10MHz, FFT Size = 1024, Frame Duration = 5 ms)	22,400,000	
DVB	13.93	27.95	Generation by DVB-T/H IQproducer	18,285,714	1,392,640

Waveform Pattern Playback Time (6/6)

◆ Comparison with W-CDMA 3GPP Specifications

Most 3GPP fading frequencies are 800 to 900 times.

The table on the right shows the moving speed when the fading frequency is 1000 times and does not exceed memory size.

The frequency becomes more than 1000 times when setting faster than the moving speed in the table.

Doppler Frequency is directly proportional to RF, and the size of the waveform pattern file becomes small.

System	Minimum Moving Speed [km/h]	
	without Option 21 (256 Msample)	with Option 21 (512 Msample)
GSM	-	8.8
W-CDMA (MS)	52.8	26.4
W-CDMA (BS)	52.8	26.4
HSDPA	42.9	21.5
HSUPA	52.8	26.4
CDMA2000 (MS)	20.7	10.4
CDMA2000 (BS)	20.7	10.4
TD-SCDMA	26.4	13.2
1xEVDO	20.7	10.4
WLAN	215.4	107.6
Mobile WiMAX	90.1	45
DVB	77.5	38.6

*RF = 1 GHz

Time Required to Generate Waveform Patterns (1/2)

The times required when generating waveforms using the following spectrum are shown below.

Sometimes, the time is very long, However, generated patterns can be stored in the MG3700A hard disk and quickly recalled.

PC Specification and Waveform Generation Conditions

CPU	Intel Core i7 2.67GHz (number of processors: 4)
Memory	2.85GB
OS	Windows XP Professional (32-bit operating system)
Waveform Pattern	Pattern created with LTE IQproducer FRC_R_14_FDD_0-3.wvd RF = 2GHz Bandwidth = 10MHz FFT Size = 1024 Frame Duration = 10ms Sampling Rate = 30.72 MHz Repetition = Maximum (Fading Profile) MIMO LTE/4x4 MIMO/ETU 300Hz/High Correlation(9Path) MIMO LTE/2x2 MIMO/ETU 300Hz/High Correlation(9Path) LTE(MS)/ETU 300Hz(9Path) Without Opt-21(256 Msamples)

Calc. Result	Pattern Size (1GB×number of output patterns)
4x4MIMO	52 h 11 min
2x2MIMO	11 h 51 min
1x1SISO	2 h 58 min

PC Specification and Waveform Generation Conditions

CPU	Intel Core i7 2.67GHz (number of processors: 4)
Memory	2.85GB
OS	Windows XP Professional
Waveform Pattern	ISDBT_2layer_movie2.wvd RF = 500MHz Sampling Rate = 16.25MHz Bandwidth = 5.57MHz Pattern Length = 9253.44ms (Fading Profile) DVB-T/Typical Urban(TU6) 30km/h Without Opt-21(256 Msamples)

Calc. Result	Pattern Size (588MB×number of output patterns)	
Path	1Path	6Path
1x2SIMO	47 min	2 h 25 min
1x4SIMO	1 h 32 min	4 h 59 min

Time Required to Generate Waveform Patterns (2/2)

PC Specification and Waveform Generation Conditions

CPU	Intel Core i7 2.67GHz (number of processors: 4)
Memory	2.85GB
OS	Windows XP Professional
Waveform Pattern	ISDBT_2layer_Coded.wvd RF = 500MHz Sampling Rate = 16.25MHz Bandwidth = 5.57MHz Repetition = Maximum Pattern Length = 15730.85ms (Fading Profile) DVB-T/Typical Urban(TU6) 30km/h Without Opt-21(256 Msamples)

Calc. Result	Pattern Size (1GB×number of output patterns)	
Path	1Path	6Path
1x2SIMO	1 h 15 min	4 h 5 min
1x4SIMO	2 h 32 min	8 h 44 min

PC Specification and Waveform Generation Conditions

CPU	Intel Core i7 2.67GHz (number of processors: 4)
Memory	2.85GB
OS	Windows XP Professional
Waveform Pattern	ISDBT_2layer_Coded.wvd RF = 500MHz Sampling Rate = 16.25MHz Bandwidth = 5.57MHz Pattern Length = 15730.85ms (Fading Profile) DVB-T/Typical Urban(TU6) 30km/h Without Opt-21(256 Msamples)

Calc. Result	Pattern Size (59MB×number of output patterns)	
Path	1Path	6Path
1x2SIMO	4 min	15 min
1x4SIMO	9 min	30 min

• **United States**

Anritsu Company

1155 East Collins Blvd., Suite 100, Richardson,
TX 75081, U.S.A.
Toll Free: 1-800-267-4878
Phone: +1-972-644-1777
Fax: +1-972-671-1877

• **Canada**

Anritsu Electronics Ltd.

700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

• **Brazil**

Anritsu Eletrônica Ltda.

Praça Amadeu Amaral, 27 - 1 Andar
01327-010 - Bela Vista - São Paulo - SP - Brazil
Phone: +55-11-3283-2511
Fax: +55-11-3288-6940

• **Mexico**

Anritsu Company, S.A. de C.V.

Av. Ejército Nacional No. 579 Piso 9, Col. Granada
11520 México, D.F., México
Phone: +52-55-1101-2370
Fax: +52-55-5254-3147

• **United Kingdom**

Anritsu EMEA Ltd.

200 Capability Green, Luton, Bedfordshire, LU1 3LU, U.K.
Phone: +44-1582-433200
Fax: +44-1582-731303

• **France**

Anritsu S.A.

12 avenue du Québec, Bâtiment Iris 1- Silic 612,
91140 VILLEBON SUR YVETTE, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

• **Germany**

Anritsu GmbH

Nemetschek Haus, Konrad-Zuse-Platz 1
81829 München, Germany
Phone: +49-89-442308-0
Fax: +49-89-442308-55

• **Italy**

Anritsu S.r.l.

Via Elio Vittorini 129, 00144 Roma, Italy
Phone: +39-6-509-9711
Fax: +39-6-502-2425

• **Sweden**

Anritsu AB

Borgarfjordsgatan 13A, 164 40 KISTA, Sweden
Phone: +46-8-534-707-00
Fax: +46-8-534-707-30

• **Finland**

Anritsu AB

Teknobulevardi 3-5, FI-01530 VANTAA, Finland
Phone: +358-20-741-8100
Fax: +358-20-741-8111

• **Denmark**

Anritsu A/S (Service Assurance)

Anritsu AB (Test & Measurement)
Kay Fiskers Plads 9, 2300 Copenhagen S, Denmark
Phone: +45-7211-2200
Fax: +45-7211-2210

• **Russia**

Anritsu EMEA Ltd.

Representation Office in Russia

Tverskaya str. 16/2, bld. 1, 7th floor.
Russia, 125009, Moscow
Phone: +7-495-363-1694
Fax: +7-495-935-8962

• **United Arab Emirates**

Anritsu EMEA Ltd.

Dubai Liaison Office

P O Box 500413 - Dubai Internet City
Al Thuraya Building, Tower 1, Suit 701, 7th Floor
Dubai, United Arab Emirates
Phone: +971-4-3670352
Fax: +971-4-3688460

• **India**

Anritsu India Private Limited

2nd & 3rd Floor, #837/1, Binnamangla 1st Stage,
Indiranagar, 100ft Road, Bangalore - 560038, India
Phone: +91-80-4058-1300
Fax: +91-80-4058-1301

• **Singapore**

Anritsu Pte. Ltd.

60 Alexandra Terrace, #02-08, The Comtech (Lobby A)
Singapore 118502
Phone: +65-6282-2400
Fax: +65-6282-2533

• **P.R. China (Shanghai)**

Anritsu (China) Co., Ltd.

Room 1715, Tower A CITY CENTER of Shanghai,
No.100 Zunyi Road, Chang Ning District,
Shanghai 200051, P.R. China
Phone: +86-21-6237-0898
Fax: +86-21-6237-0899

• **P.R. China (Hong Kong)**

Anritsu Company Ltd.

Unit 1006-7, 10/F., Greenfield Tower, Concordia Plaza,
No. 1 Science Museum Road, Tsim Sha Tsui East,
Kowloon, Hong Kong, P.R. China
Phone: +852-2301-4980
Fax: +852-2301-3545

• **Japan**

Anritsu Corporation

8-5, Tamura-cho, Atsugi-shi, Kanagawa, 243-0016 Japan
Phone: +81-46-296-1221
Fax: +81-46-296-1238

• **Korea**

Anritsu Corporation, Ltd.

502, 5FL H-Square N B/D, 681
Sampyeong-dong, Bundang-gu, Seongnam-si,
Gyeonggi-do, 463-400 Korea
Phone: +82-31-696-7750
Fax: +82-31-696-7751

• **Australia**

Anritsu Pty. Ltd.

Unit 21/270 Ferntree Gully Road, Notting Hill,
Victoria 3168, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

• **Taiwan**

Anritsu Company Inc.

7F, No. 316, Sec. 1, NeiHu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817

Please Contact: