Signal Generator (MXG)와 89601A VSA를 이용한 LTE 신호 분석 한글 Guide



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Part 1

1. Signal Studio를 이용한 LTE 신호 만들기

1-1 Agilent Connection Expert를 이용한 장비 연결하기

√ Signal Generator를 PC와 LAN cable로 연결합니다.





Add Instrument를 선택합니다.

Auto Find Discover local instruments	Add Address Manually add a hown PP address range tent - TCPIPIC:hosthname.net.com::in X e properties of this LAN device	there anests
Ther devi This conr devi or th Advanced >>	Find Instruments	Search for an instrument that is connected to the LAN indirectly through a gateway device or a LAN server.
Som acce supp instr The: conr dentify Instrum Both the a VISA address:	TCPIPO::10.10.30:inst0::INSTR The instrument was successfully opened Aglient Technologies, IK5182A, MY48180424, A daress check and the identification were done thils instrument.	
Instrument We	binterface	

MXG에 설정된 LAN Address를 "Auto Find" Tap으로 찾거나 "Add Other" Tap으로 입력 합니다.



• MXG가 녹색으로 표시되면 정상입니다.

1-2 N7624B Signal Studio for 3GPP LTE S/W를 이용하여 LTE 신호 생성하기

🛃 Agilent Signal Studio for	3GPP LTE - RF Output (for Signal Generator)	X
File View Control System 1		
D 📽 🖬 1 🏗 📝		
Quick Setups		Rename Quick Setup
└─ Instrument └─ Licenses ⊡ Waveform Setup ⊡ Carrier 1 □ eNB Setup	Welcome to Agilent Signal Studio for 3GPP LTE	
- Transport Channel - Physical Channel - Resource Block	Would you like to run the application using C Simulated hardware	
	RF Output (for Signal Generator) 2x2 MIMO Tx (for Signal Generator) 4x4 MIMO Tx (for Signal Generator) 1 Ant Tx (for PXB) 2x2 MIMO Tx (for PXB) 4x2 MIMO Tx (for PXB)	
	 Most recently used hardware configuration New hardware configuration 	
	T Don't show this dialog box again	
L L	UK Cancel	
• •		
Ready		

● 이제, N7624B Signal Studio for 3GPP LTE를 실행시킵니다.

New hardware configuration을 선택 합니다.

Agilent Signal Studio fo	r 3GPP LTE - RF Output (for Signal Generator)	
	System Configuration Wizard	1
Hardware Hardware Licenses Waveform Setup Carrier 1	Step 1 of System Configuration Wizard: Select a function	Rename Quick Setup
⊢ erds Setup Transport Channel Physical Channel Resource Block	Select a function to perform from the list below: 1 Antenna 2 Antennas 4 Antennas	
	Next > Cancel	
•		_

1 Antenna를 선택 합니다.

🚡 Agilent Signal Studio for	3GPP LTE - RF Output (for Signal Generator)	
Pile View Control System		
Quick Setups Hardware Instrument Ucenses Waveform Setup Carrier 1	System Configuration Wizard	Rename Quick Setup
ews setup Transport Channel Physical Channel Resource Block	Choose a hardware configuration from the list of supported configurations: <u>BSG/RSG/NXG + Internal Arb</u> PXB 16800/16900 Logic Analyzer	
	ESO/PSO/MXO Signal Generator	
	< Back Next > Cancel	
A Daadu	1	

ESG/PSG/MXG + Internal Arb를 선택 합니다.



< New >를 선택 합니다.

	Sustem Configuration Wizard	
← Quick Setups ← Hardware ← Instrument ← Licenses ← Waveform Setup ⊖ Carrier 1	Step 4 of System Configuration Wizard: Select an ESG/PSG/HXG Signal Generator	Rename Quick Setup
E Carrier 1	Enter the ESG/PSG/MXG Signal Generator connection information below:	s n
	< Back Next > Cancel	

창에서 LAN을 선택하고 MXG에 설정된 IP Address를 입력 합니다.

🖪 Agilent Signal Studio fo		
File View Control System	Tools Help	
D 🚅 🖬 🐻 1 🎞 🚿		
Quick Setups	😼 System Configuration Wizard	
E Hardware		Rename Quick Setup
Instrument	Step 5 of System Configuration Wizard:	
Licenses	Test I/O connection for ESG/PSG/MXG Signal	
E-Waveform Setup	Generator	
- Carrier I		
Transport Channel		
Physical Channel		
Resource Block		
	Testing I/O connection for ESG/PSG/MXG Signal	
	Generator at TCPIP0::10.10.10.30::INSTR	
	ESC/BSC/MVC Signal Consister connected	
	ESG/FSG/HXG Signal Generator connected.	
	Proce the Next button to continue	
	Press die Wext button to continue.	
		1
	< Back Next > Cancel	1
	1)	
Ready		

Next를 선택합니다.

🚮 Agilent Signal Studio fo	r 3GPP LTE - RF Output (for Signal Generator)	- - X
File View Control System	Tools Help	
Quick Setups Hardware Licenses Waveform Setup Carrier 1	System Configuration Wizard Image: Configuration Wizard Step 6 of System Configuration Wizard: Enter system Configuration Wizard Enter system name and start using the hardware system. Start using the hardware system.	Rename Quick Setup
B eNB Setup ⊢ Transport Channel Physical Channel Resource Block	Enter the name of the hardware system: [LTE Test] Summary of System Details: - ESG/RSG/MXG Signal Generator: TCPIP0::10.10.10.30:INSTR	
	< Back Finish Cancel	
•	1	
Ready		

아무 이름이나 입력합니다.

(다음부터는 System configuration list에서 이 이름을 선택하면 설정 시간이 단축 됩니다) 앞에서 Finish를 선택하면 아래와 같은 창이 나타납니다.

🙍 Agilent Signal Studio for	3GPP LTE -	Untitled							
File View Control System	Tools Help								
D 😅 🖬 🚮 1 🎞 🛃									
Quick Setups	Configuration : L1	E DL 1 Carrier (2008-03)							
Hardware									
- Instrument									
Eletises	Carrier State	Radio Format	Configuration	Frequency Offset	Power				
E-Carrier 1	Carrier 1 On	Basic LTE FDD Downlink (2008-03)	Full filled QPSK 5MHz (25 RB)	0.000000 Hz	0.00 dB				
eNB Setup									
- Transport Channel									
- Physical Channel - Resource Block	Waveform Attribut	es			Hint				
	🖻 1. Basic								
	Waveform Nar	ne	Untitled						
	Comment								
	Total Sample I	'oints		· New al					
	I/Q Map		Noma						
	Marker 1 Sour	CPR	Frame						
	Marker 2 Sour	ce	None						
	Marker 3 Sour	ce	None						
	Marker 4 Sour	ce	None						
	Wavefo	om							
Ready Connected									



📆 Agilent Signal Studio for	3GPP LTE - Untitled	
File View Control System	Tools Help	
D 🚅 🖬 🐻 1 🖬 📰		
Quick Setups	Run Self-Tests Test I/O Connections	
E-Hardware		
Instrument	1. System Details	
- Licenses	Name	LIE lest
E- waveform Setup	Description	ESG/PSG/MXG + Internal Arb
E-Carrier 1	2. ESG/PSG/MXG Signal Generator Details: N5182A	-MY48180424
E eNB Setup	Connection	TCPIP0::10.10.30::INSTR
Iransport Channel	Model Number	N5182A
- Physical Channel	Serial Number	MY48180424
- Resource Block	Firmware Revision	A.01.44
	2.1. Options: N5182A-MY48180424	
	506	6 GHz frequency range, permanent
	UNZ	Fast switching, permanent
	1EQ	Low Power (less than -110 dBm), permanent
	UNW	Narrow pulse modulation, permanent
	UNT	Analog modulation (AM/FM/Phase Modulation), permanent
	006	Instrument security, permanent
	1ER	Flexible reference input (1-50 MHz), permanent
	654	Internal baseband generator (125 MSa/s), permanent
	019	Increase baseband generator memory to 64MSa, permaner
	UNV	Enhanced dynamic range, permanent
	1EL	Differential IQ outputs, permanent
	403	Calibrated AWGN, permanent
	430	Multitone and two-tone, permanent
	431	Custom digital modulation, permanent
	432	Phase Noise Impairment, permanent
	221	5-Pack #1, permanent
	222	5-Pack #2, permanent
	1EA	High power output, permanent
	012	Phase coherency, permanent
I F	N7699A-D24	Software utility, 08-SEP-2010
Ready Connected		

	oolo lioip						
Quick Setups	Licenses						
Hardware Instrument							Γı
Licenses	#	State	Feature	Description		Instrument Licer	nse
-Carrier 1	2	On	N7624B-F**	Basic 3GPP LT	E(2007-09)	Valid	
eNB Setup	3	On	N7624B-Q**	Advanced 3GF	P LTE(2007-09)	Valid	
- Transport Channel	4	On	N7624B-G**	Basic 3GPP L1	E(2008-03)	Valid	
Resource Block	5	On	N76248-R**	Advanced 3GF	P LTE(2008-03)	Valid	
	6	On	N76248-H**	Basic 3GPP L1	E(2008-09)	Valid	
	7	On	N7624B-S**	Advanced 3GPP LTE(2008-09)		Valid	
	8	On	N76248-n**	Instrument Cor	nectivity	Valid	
	Carrier 1	lame		State	Required Fe	sture 1	Required Feature 2
	Basic L	E FDD U	plink (2008-03)	Available	Basic 3GPP	LTE(2008-03)	N/A
	Basic LTE FDD PRACH (2008-03)			Available	Basic 3GPP I	LTE(2008-03)	N/A
	Advanc	ed LTE FC	D Downlink (2008	-03) Available	Advanced 30	SPP LTE(2008-03)	Basic 3GPP LTE(2008-03)
	Advanced LTE FDD Uplink (2008-03)) Available	Advanced 30	SPP LTE(2008-03)	Basic 3GPP LTE(2008-03)
	Basic L	E FDD D	ownlink (2008-09)	Available	Basic 3GPP I	LTE(2008-09)	N/A
	Basic L	E FDD U	plink (2008-09)	Available	Basic 3GPP I	LTE(2008-09)	N/A
	Basic L	E FDD PI	RACH (2008-09)	Available	Basic 3GPP I	LTE(2008-09)	N/A
	Advanc	ed LTE FC	D Downlink (2008	-09) Available	Advanced 30	SPP LTE(2008-09)	Basic 3GPP LTE(2008-09)
	Advanc	ed LTE FC	D Uplink (2008-09) Available	Advanced 30	SPP LTE(2008-09)	Basic 3GPP LTE(2008-09)
	Basic W	-CDMA FE	D Downlink	Available	Basic 3GPP I	LTE(2007-09)	N/A
	Basic W	CDMA F	DD Holink	Available	Basic 3GPP I	TE(2007-09)	N/A

Tree의 Licenses에서는 Install된 License status를 확인 하실 수 있습니다.

왼쪽 창에서 Waveform Setup을 먼저 선택한 후, 오른쪽 창 상단에 있는 Predefined Configuration을 클릭합니다.

🚮 Agilent Signal Studio fe	or 3GPP LTE - U	Intitled				>
File View Control System						
D 📽 🖬 🔯 1 🏥 🛃	4					
Quick Setups Hardware		DL 1 Carrier (2008-03)				
Licenses	Carrier State	Radio Format		Configuration	Frequency Offset	Power
- waveform Setup	Carrier 1 On	Basic LTE FDD Downlink	(2008-03)	Full filled QPSK 5MHz (25 RB)	0.000000 Hz	0.00 dB
eNB Setup Base	e Channel Configu	uration				8
- Transport C Conf	iguration		Contents			
Resource BI LIE LTE LTE LTE LTE LTE LTE LTE LTE LTE LT	DL 1 Camer (2007-07) DL 1 Camier (2007-07) DL 1 Carrier (2008-03) UL 1 Carrier (2008-03) UL 1 Carrier (2008-03) DL 1 Carrier (2008-03) DL 1 Carrier (2008-03) UL 1 Carrier (2008-09) UL 1 Carrier (2008-09) UL 1 Carrier (2008-09) DL 1 Carr	AA DL 1 Carrier (2007-07) AA UL 1 Carrier (2007-07) 03) AA DL 1 Carrier (2008-03) AA UL 1 Carrier (2008-03) 19) IA DL 1 Carrier (2008-09) AA UL 1 Carrier (2008-09)	l carrier conhi l carrier config Carriers config L carrier confi l carrier confi l carrier config Carriers config Carriers config I carrier confi l carrier confi Carrier config Carriers config Carriers config Carriers config	pared with LIE Uowrink (2007-07) pared with LIE Uowrink (2007-07) and with LIE Uowrink (2007-07) and with LIE Uowrink (2007-07) pared with LIE Upink (2008-03) pared with LIE Upink (2008-03) and with (2008-03) and with (2008-03) and with LIE Upink (2008-03) and with (2008-03) and	nd W-CDMA Downlink W-CDMA Uplink HSPA nble (2008-03) nd W-CDMA Downlink W-CDMA Uplink HSPA nble (2008-09) nd W-CDMA Downlink W-CDMA Uplink HSPA	TM1 64DPCH
					0)	Cancel

'Predefined Configuration' 창에서 "LTE DL 1 Carrier (2008-03)"을 선택합니다.

😼 Agilent Signal Studio for	3GPP L	TE -	Untitled					
File View Control System	Tools H	elp						
D 😂 🖬 🔯 1 🎞 👿 🗌								
Quick Setups	Configura	tion : LT	E DL 1 Carrier (2008-03)					
Instrument	III +·	X						
Licenses	Carrier	State	Radio Format	Configu	Iration	Frequency Offset	Power	
E- Waverorm Setup	Carrier 1	On	Basic LTE FDD Downlink (2008-03)	Full file	d QPSK 5MHz (25 RB)	0.000000 Hz	0.00 dB	
eNB Setup								
- Transport Channel								
- Physical Channel Resource Block	Waveform Attributes					□ Hint		
	🖃 1. Ba:	sic						
	Wave	form Nar	ne	Un	titled			
	Comm	ent						
	I otal S	ample H	foints	-	- Manual			
	E 2 Ma	ap rkor		No	mal			
	Marke	r 1 Souri	7e	Fra	me			
	Marker 2 Source			None				
	Marke	r 3 Souri	ce	None				
	Marke	r 4 Souri	ce	No	ne			
₹	CCDF	Wavefo	m					
Ready Connected							_	

Agilent Signal Studio for	3GPP LTE - Untitle Tools Help	ed*							
D 😅 🖬 👪 1 🎞 🛃									
Quick Setups	Configuration : LTE DL 1	Carrier (2008-03)							
Instrument	- ×								
Licenses	Carrier State Radio	Format	Configuration	Frequency Offset	Power				
Waveform Setup Carrier 1	Carrier 1 On Basic	LTE FDD Downlink (2008-03)	Full filled QPSK 5MHz (25 RB)	0.000000 Hz	0.00 dB				
eNB Setup									
- Transport Channel									
- Physical Channel - Resource Block	Waveform Attributes				🗐 Hint				
🗉 1. Basic									
	Waveform Name		LTE5MDL						
	Total Sample Points								
	I/Q Map		Normal						
	2. Marker								
	Marker 1 Source		Frame						
Marker 2 Source None									
	Marker 5 Source		None						
	manter roouree								
•	CCDF Waveform								
Ready Connected									

'Waveform Properties'에서 Waveform Name (예, LTE5MDL)을 입력합니다.

√ Note: 설정해준 이름으로 Waveform 파일이 MXG에 저장이 됩니다.

🗓 Agilent Signal Studio for 3GPP LTE - Untitled*								
File View Control System Tools Help								
D 😅 🖬 🛛 👪 1 🎞 🖉 🖉								
Quick Setups	Instrument							
- Hardware								
Instrument	Update to Instrument Update from Instrument	Local Preset DC Cal Power Search						
Licenses		E ur i						
E-Carrier 1	Instrument Controls	I Hint						
- eNB Setup	1. Configuration	×						
Transport Channel		N5162A/N5182A						
- Physical Channel	Retrieve Instrument Model Number	Auto						
Resource Block	Parameter Optimization	Auto						
	Perform DC I/Q Calibration	On						
	2. Basic							
	Frequency	1.000 000 000 000 GHz						
	Amplitude	-10.00 dBm						
	RF Output	On						
	□ 3.1/Q							
	I/U Adjustments	Uff						
	I Uffset	0.000 %						
	U Uffset	0.000 %						
	1/U Gain Balance	0.000 dB						
	Uuadrature Angle Adjustment	U.UU Deg						
4 F	1/U Timing Skew Path	HF T						
Ready Connected	1/11 Orrection Untimization Path	IBE Humut						

왼쪽 창에서 Instrument를 선택하고 Frequency와 Amplitude를 변경합니다.

√ Note: Frequency와 Amplitude는 이후에 MXG 장비에서도 변경 가능합니다.

File View Control System	Tools Help				
D 😅 🖬 👼 1 🎞 🜌					
Quick Setups	Instrument				
- Hardware					
Licenses	Update to Instrument	Update from Instrument	Local	et DC Cal	Power Search
- Waveform Setup	Instrument Cantrals				T Him
- Carrier 1	Instrument Controls) HIN
eNB Setup	1. Configuration				-
- Transport Channel	Instrument Model Number		N5162A/N5182A		
- Physical Channel	Retrieve Instrument Mode	Number	Auto		
Resource Block	Parameter Optimization		Auto		
	Perform DC I/Q Calibration	1	On		
	2. Basic				
	Frequency		2.400 000 000 U	IUU GHZ	
	Amplitude RE Output		-10.00 dbm		
	E 3 1/0		on		
	1/0 Adjustments		Off		
	I Offset		0.000 %		
	Q Offset		0.000 %		
	1/Q Gain Balance		0.000 dB		
	Quadrature Angle Adjustm	ent	0.00 Deg		
	I/Q Timing Skew Path		RF		
	1/0 Correction Ontimization	Path	BEQuitaut		

왼쪽 Carrier1을 선택하고 Channel configuration에서 18가지 경우 중 하나를 선택합니다.

e view Control System	Tools He					
🛎 🖬 🛃 1 🎞 🛃						
Quick Setups	Configurati	ion : LT	E DL 1 Carrier (2008-03)			
Instrument	III +-	X				
Licenses	Carrier	State	Radio Format	Configuration	Frequency Offset	Power
Waveform Setup	Carrier 1	On	Basic LTE FDD Downlink (2008-03)	Full filled QPSK 5MHz (25 RB)	0.000000 Hz	0.00 dB
- Carrier 1						
- eNB Setup						
- Transport Channel						
Physical Chamler	Carrier 1	Basic L	TE FDD Downlink (2008-03)			☐ Hint
Resource Brook						
	G 3GPP			0		
	State	10		UN 5-4 Ris 4 ODCK EMUs (25 DD)		-
	Charme State	arconing arm Glass	eration Length	Evil Glad OPCK 1 AMUs (C DD)		-
	E Baseb	and		Full filled 160AM 1 /MHz (6 BB)		-
	Oversa	molina F	Ratio	Full filed 640AM 1.4MHz (6 BB)		
	Pre-Filte	er Clipping	20	Full filled QPSK 3MHz (15 BB)		
	Post-Fil	ter Clinn	ing	Full filled 16QAM 3MHz (15 RB)		
	Total S	ample P	nints	Full filled 64QAM 3MHz (15 RB)		1
	Freque	ncy Offs	et	Full filled QPSK 5MHz (25 RB)		
	Power			Full filled 16QAM 5MHz (25 RB)		
	Timing	Offset		Full filled 64QAM 5MHz (25 RB)		
	Initial P	hase		Full filled QPSK 10MHz (50 RB)		
	Symbol	Bolloff I	Length	Full filled 16QAM 10MHz (50 RB)		
	Baseba	and Filter	g	Full filed 64QAM_TUMH2 (50 HB)		_
_	I CODE IN		1	Full filled QFSK TSMH2 (75 HB)		*

Generate Waveform key

]를 누르면 예상되는 CCDF값을 확인 할 수 있습니다.

🚡 Agilent Signal Studio for	3GPP LTE - Untitled∗							
File View Control System Tools Help								
D 😅 🖬 📸 1 🎞 💆								
Quick Setups	Configuration : LTE DL 1 Carrier (2008-03)							
Instrument								
- Licenses	Carrier State Radio Format	Configuration Frequency Offset Power						
E-Carrier 1	Carrier 1 On Basic LTE FDD Downlink (2008-03)	Full filled QPSK 5MHz (25 RB) 0.000000 Hz 0.00 dB						
- Transport Channel	Waveform Attributes	Hint						
- Physical Channel	🗉 1. Basic							
Resource Block	Waveform Name	LTE5MDL						
	Comment							
	I otal Sample Points							
	Rumap Noma							
	Marker 1 Source	Frame						
	Marker 2 Source	None						
	Marker 3 Source	RF ALC Control						
	Marker 4 Source	RF Blanking Control						
	CCDF Waveform							
	🖬 Gaussian 📓 Reference 🙆 Acquire Ref.							
	10% 3.60 dB Baussian Curren	at						
	1% 6.66 dB 100%							
	0.1% 8.50 dB 1%							
	0.001% 11 10 dB 0.1%							
	0.0001% 11.72 dB 0.001%							
	Peak 11.73 dB 0.0001% 0.00 dB	20.00 dB						
Ready Connected								

File Control Spane Tools 메뉴상단에 있는 'Generate and Download'키 [□ ☞ 묘 國 집 ፲표] 를 누르면 Waveform 이 MXG로 다운로드 됩니다.

위와 같은 방법으로 Downlink 및 Uplink 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz 신호들을 QPSK, 16QAM, 64QAM 변조에 따라 선택하여 신호를 만들어 다운로드 하시면 됩니다.

🚡 Agilent Signal Studio for	3GPP LTE - Untitled∗		
File View Control System	Tools Help		
- Quick Setups	Configuration : Full filled QPSK 5MHz (25 RB)		
🖻 Hardware			
Instrument			
Licenses	ND 0 1		—
🖻 Waveform Setup	eNB Setup		E Hint
🖃 Carrier 1	1. Cell Parameters		
eNB Setup	Physical Layer Cell ID Group	0	
- Transport Channel	Physical Layer Cell ID Sector	0	
Physical Channel	First M-Sequence for Scrambling Code Generator	1	
- Resource Block	BNTI	0	
	Antenna Port	0	
	Total number of Antennas	1 Antenna	
	System Bandwidth	5 MHz (25RB)	
	Total number of Resource Blocks	25	
	Total number of Occupied Sub-carriers	301	
	Subcarrier Spacing	15 kHz	
	Cyclic Prefix	Normal	
		12	
	Number of Symbols for Resource Block	7	
	Pre-clocking number for PRBS	1600	
	2. Cell specific Reference Signal		
	Cell specific Reference Signal Power	2.50 dB	
	Cell specific Reference Signal Frequency Shift	Cell ID mod 6	
	3. Synchronization Signals		
	Primary Synch Signal State	On	
	Primary Synch Signal Power	0.65 dB	
	Secondary Synch Signal State	On	
4 I D	Secondary Synch Signal Power	0.65 dB	
Ready Connected			

왼쪽 eNB Setup Tree을 선택하고 필요한 기지국 Parameter들을 설정할 수 있습니다.

1-3 .scp file 만들기

1-3-1 .	scp file은	Signal studio의	Setup file의	확장자명	입니다.	
---------	-----------	----------------	-------------	------	------	--

- 1-3-2 Signal Studio의 Setup이 끝나면 "Generate Waveform" button 💆을 누릅니다.
- 1-3-3 메뉴에서 File을 선택하고 "Save as..."를 선택합니다.
- 1-3-4 확장자명이 .scp 인 것을 확인 하시고 저장 합니다.
- 1-3-5 .scp 로 저장된 파일을 Open 하여 불러오면 .scp로 저장되었던 형태 대로 다시 Signal Studio가 Setup이 됩니다. 따라서 .scp 파일만 서로 공유한 다면 Signal Studio를 다시 설정하는 번거로움을 덜 수가 있습니다.

1-4 .wfm file 만들기

- 1-4-1 .wfm file은 Signal Studio가 만들 수 있는 Waveform file입니다.
- 1-4-2 .wfm file은 Signal Studio 사용 없이 MXG에 바로 넣어서 사용할 수 있는 파 일입니다.
- 1-4-3 .wfm file을 만들기 위해서는 Signal Studio의 Setup이 끝나면 "Generate Waveform" button [6]을 누릅니다.
- 1-4-4 "File"에 "Export Waveform Data"를 선택 합니다.
- 1-4-5 확장자명이. wfm으로 저장이 됨을 확인 하실 수 있습니다.

1-5 .wfm file을 USB Memory를 사용하여 MXG에 Copy 하기

- 1-5-1 저장된 .wfm 파일을 USB Memory stick에 저장을 합니다.
- 1-5-2 USB Memory Stick을 MXG 전면의 USB Port에 삽입합니다.



1-5-3 ↑↓ 키를 이용하여 Copy할 File을 찾아 선택하고 "Copy File to Instrument" 를 선택 합니다.

FREQUENCY	AMPLITUDE		Copy File As
1.000 000 000 00 GHz	-10.00	dBm	Sweep List
1/4 F	IKB	ERR	
USB Directory: /	6	71MB Free	Instrument State
File Name Type WCDMA_GSMGPRS_SPTA_DB_English.mdb Wibecies use	Size No 2118 06/03/08 97748 05/17/08	dified 3 12:30	User Flatness Corrections
	3///0 00/1//0	. 13.20	µaveform∎
			Sequence
	02/27/20	09 17:51	

1-5-3 "Waveform"을 선택 합니다.



1-5-4 "BBG Memory" 혹은 "Internal Memory"를 선택합니다.

FREQUENC	CY		AMPLITUDE		Anh UsusCons
	1.000 000	000 00 GHz	-10.00	dBm	Select Waveform (WFM1:Wibro_1FA_U
-		1/0	ARB	ERR	
					Display Waveform
Select (1/1)	Segment On BBG Nedia	Points	Sequence On Int Nedia	Segs	And Markers
	RAMP_TEST_UFM SINE_TEST_UFM UNTITLED WIBROIFA.UFM UIBRO_1FA WIBRO_1FA_UL	200 200 100000 200000 100000 100000	STREAMSEQ	1	Wave form Segments►
					Goto Roµ⊅
			02/27/20	09 17:55	

1-5-5 USB Memory를 제거하고 MXG에서 Copy된 File을 선택합니다.

Part 2

- 2. 89601A VSA를 이용한 LTE downlink 신호 분석하기
 - 아래의 세 단계로 신호를 분석 합니다.



√ 기본 설정

- SA의 'TRIGGER 1 In'와 MXG의 'Event 1'을 BNC 케이블로 연결합니다.
- 89601A VSA S/W를 실행합니다.

Instructions: 89600 VSA software	Toolbar menus
Change the RBW filter and increase the frequency points for better resolution. The auto frequency points selection chooses the best resolution for the given time capture. You can change this if you prefer.	Meas Setup > ResBW > ResBW Mode > Arbitrary (pull down menu) Frequency Points >Auto Time (tab) > Main Time Length > 900 usec Click Close
Auto scale Trace A and Trace B	Right click in Trace A. Click Y Auto Scale Right click in Trace B. Click Y Auto Scale
🙀 Agilent 89600 Vector Signal Analyzer	
Eile Edit Control Source Input TestSetup MeasSe	tup <u>D</u> isplay <u>Trace</u> Mar <u>k</u> ers <u>U</u> tilities <u>H</u> elp
▶ II ● ▲ ⑧ C ⑨ E F Stacked 2 ▼	🖹 🐑 🔶 M 📘 50% Color Normal 👻
dBm LogMag /dbm 10 10 /db /db	
dom Center: 2.4 GHz RBW: 4.24373 kHz B: Ch1 Main Tis	Spart 5 MHz TrieLen: 500 USe Warner 316 2278 pt
dBVpk de rolate tit data data di la sela concerna da solaritme en	n tribuin scríbena fabria i nachtánaía. Ca fra ar cui mi dí Casharia i Beatradh i chairte a Bh
LogMap 10 10	n i ma kalini kalina kalika antika photon (da da lini ku ku kalika pina
-90 dBVpk Start: 0. Sec	
Measurement running	INT REF CAL: OK A F E (abs)

Center 주파수를 2.4 GHz로, SPAN을 5MHz로, Range를 0V1이 뜨지 않는 Level로 설정합니다.

1.1 [Measuring OWB]

• Occupied Bandwidth(OBW)를 측정하기 위해 아래와 같이 설정 합니다.

Instructions: 89600 VSA software	Toolbar menus
Display OBW trace	Right-click Trace A Select Show OBW
Activate OBW Summary table	Double click the Trace B title (B: Ch1 Main Time) Select Marker from the Type menu on the left-hand side of the box Select Obw Summary TrcA from the Data menu on the right-hand side of the box. Click OK

• 아래와 같이 Summary data table을 통해 OBW를 측정할 수 있습니다.



• 다른 측정을 위해 OBW를 아래와 같이 Clear합니다.

Instructions: 89600 VSA software	
Clear OBW display	Double click the Trace B title (B: TrcA OBW Summary Data) Select Channel 1 from the Type menu on the left-hand side of the box that appears. Select Main Time from the Data menu on the right-hand side of the box. Click OK Right-click Trace A De-select Show OBW

1.2 [Measuring Band Power]

- Band Power 측정을 위해 아래와 같이 설정 합니다.
- 먼저, SPAN을 6MHz로 변경 합니다.
- Toolbar의 Marker에서 Calculation을 선택 합니다.
- Band Power의 Center 주파수, Width를 선택 합니다.



위 그림의 하단에서 측정되고 있는 Channel의 Power를 확인 할 수 있습니다.

1.3 [Basic Demodulation]

Instructions: 89600 VSA software	Toolbar menus
Change the display to show four traces in a 2x2 grid	Display > Layout > Grid 2x2 (Or alternatively, Click on the drop down menu near the top of the menu. Stacked 2 Stacked 2 Stacked 3 Stacked 4 Stacked 6 Grid 2x2 Grid 2x3 Grid 2x3 Select Grid 2x2 from the available options.)
Select the LTE demodulator	MeasSetup > Demodulator > 3G Cellular > LTE
Set up the demodulator for downlink analysis See below for descriptions of each tab and the parameters available	MeasSetup > Demod Properties > Format (tab) Click Downlink from the Direction: drop down menu. Click the Preset to Standard box and select 5 MHz (25 RB) from the drop down menu Go to Profile (tab) Click the Edit Control Params box Make sure the PDCCH Allocation field is set to 3 for each Subframe (Sf) Sf0 thru Sf9 Subframe (Sf) Sf0 thru Sf9 Subframe (Sf) Sf0 thru Sf9 Click OK. Go to Format (tab) Make sure Auto is selected under Cell ID CellD Manuel
Select automatic detection of Resource Blocks (RB)	Go to Profile (tab) Check RB Auto Detect (Note: This setting is checked by default) Click Close
Begin demodulation	Press Restart Your display should look similar to Figure 6

● 입력되는 5MHz Downlink LTE signal을 Demodulation하기 위해 아래와 같이 설정합니다.

• 위 설정을 통해 아래와 같은 Default LTE Demodulation 결과를 얻을 수 있습니다.



• 측정 Data를 이용하여 Frame Summary를 보기 위해 아래와 같이 설정 합니다.

Instructions: 89600 VSA software	Toolbar menus
Change Trace C to show the frame summary	Double click the Trace C trace title (C: Ch1 OFDM Err Vect Spectrum) In the Data: column select Frame Summary Click OK
Auto scale Trace B	Right click on Trace B Select Y Auto Scale



추가적으로 RB, Sub carrier, Slot, Symbol 별 EVM을 분석 하기 위해서는 아래와 같이 설정합니다.

Instructions: 89600 VSA software	Toolbar menus
Change the display to show six traces	Select Grid 3x2 from the layout drop down menu
Change Trace B to show EVM per Resource Block (RB)	Double click the Trace B title (B: Ch1 Spectrum) In the Data: column select RB Error Mag Spectrum Click OK
Change Trace C to show EVM per subcarrier	Double click the Trace C title (C: Ch1 Frame Summary) In the Data: column select Error Vector Spectrum Click OK
Change Trace D to show the frame summary	Double click the Trace D title (D: Ch1 Error Summary) In the Data: column select Frame Summary Click OK
Change Trace E to show EVM per time slot	Double click the Trace E title (E: Ch1 OFDM Err Vect Time) In the Data: column select RB Error Mag Time Click OK
Change Trace F to show EVM per symbol	Double click the Trace F title (F: Ch1 Frame Summary) In the Data: column select Error Vector Time Click OK
Auto scale all traces (except Trace D)	Right click on each trace and click Y Auto Scale



1.4 [Measuring EVM on specific symbols]

- 아래 그림처럼 특정 Slot, 특정 Symbol에 대한 분석을 할 수 있습니다.
- Demodulation Properties에서 Time을 선택 합니다.
- 첫 Slot안에 있는 1번 Symbol에 대한 분석을 하기 위해서는 아래와 같이 설정합니다.
- Result length 20, Measurement Slot offset 0, Measurement Symbol offset 0, Measurement Slot Interval 0, Measurement Symbol Interval 1로 설정 합니다.

🛱 Agilent 89600 Vector Signal Analyzer		
Elle Edit Control Source Input TestSetup MeasSetup Display Trace Markers Utilities Hell	lp	
▶ ■ ● ⑧ ⑧ ⑧ ⑨ ⑨ ⑨ ⑤ Grid 3×2 ▼ ▶ □ ◆ 11 🗧 50% Color N	lormal 👻	
A: Ch1 OFDM Meas Range: 0 dBm 1.667	D: Ch1 Frame Summary Range: 316.22	78 mV
	Channel EVM(%ms) Power(dB) Mod.Fmt. Num.RB	
	P-SS Z-Chu S-SS BPSK	
Lonst – –	PBCH	
333.4	PHICH 0.70785 -0.01030 BPSK (CDM) 9 PDCCH 0.64691 -0.01140 DPSK 20	
m /de	RS 0.53911 2.5 QPSK 25	
· · · · · · · · · · · · · · · · · · ·	PDSCH_16QAM	
-1.67	Non-alloc	
-4.214 4.2143	🙀 LTE Demod Properties	
RBW: 15 kHz TimeLen: 1 Sym B: Ch1 Spectrum Respective Address 0.48m	Format Profile Time ådvanced	79 mJ/
-15		ro iliv
and total the start of the second start of the	Result Length: 20 Slots	
LogMag	Slots Symbols	
www.w	Measurement Offset: 0.Slots 0 symbol-times	
15 1	Measurement Interval: JU Slots JI symbol-times	
/div	Analysis Start Boundary	
	Frame C Sub-rame	
-165	C Har-rame C Slot	
Center: 2.4 GHz Span: 6 MHz RBW: 53.1871 kHz TimeLen: 71.875 uSec	Timing Diagram	
C: Ch1 OFDM Eir Vect Spectrum Range: 0 dBm	Res. Len.: 20 Slots	78 mV
2		
	Meas. Int. 0:1	
LinMag	Meas. Off. 0.0	
	Frame Bdry	
ATT and and ATA WAY AN ARA WAY AND A TO TO A HIMAN AND AND AND AND AND AND AND AND AND A		
Start 150 carrier	Close F Keep Open Help	
RBW: 15 kHz TimeLen: 1 Sym		
Measurement running	LTE INT REF CAL: OK A F E (a	bs]

3. 89601A VSA를 이용한 LTE Uplink 신호 분석하기

🚡 Agilent Signal Studio for	3GPP LTE - P	RF Output (for Signal Gener	rator)				
File View Control System	Tools Help						
D 🚅 🖬 🔯 1 🎞 📝 🛛							
Quick Setups	Configuration : LTI	E UL 1 Carrier (2008-03)					
Instrument	<u> +• X</u>						
Wayeform Satur	Larrier State	Hadio Format	Configuration	Frequency Offset	Power		
Carrier 1	Carrier 1 On	Basic LTE FDD Uplink (2008-03)	Full filled QPSK 5MHz (25 RB)	0.000000 Hz	0.00 dB		
E-UE Setup							
Transport Channel							
Physical Channel	1						
Resource Block	Carrier 1 Basic L	TE FDD Uplink (2008-03)			Hint		
	E 3GPP		-				
	State		On				
Chann		uration	Full filled QPSK 5MHz (25 RB)				
	Waveform Generation Length		1 frame (10ms)				
	Baseband						
	Oversampling F	latio	AUTO				
	Pre-Filter Clippin	1g	100.0 %				
	Post-Filter Clipp	ing	100.0 %				
	Total Sample P	oints	307200 Points				
	Frequency Offset Power		0.000000 Hz				
			0.00 dB				
Timing Offset Initia Phase Symbol Rolloff Length		0					
			ODeg				
		OTs					
	Baseband Filter		On		•		
	CCDF Wavefor	m					
Ready							

● 먼저, Downlink와 동일하게 N7624B LTE Signal Studio를 이용하여 LTE uplink 신호를 만듭니다.

● 89601A VSA S/W를 실행하여 Center 주파수를 2.4 GHz, SPAN을 5MHz, Range를 "0V1"이 나타 나지 않는 Level로 설정하여 아래와 같이 LTE 5MHz Uplink 신호를 찾습니다..



- \
- 아래와 같이 LTE Demodulator를 선택합니다.



● LTE Demod Properties창의 Format에서 Direction을 Uplink로 Bandwidth를 입력 신호에 맞게 설정 합니다.

📆 LTE Demod Prop	perties	
Format Profile Time Direction: Uplink Uplink • Sync Type • PUSCH DM-RS • PUCCH DM-RS • Uplink Format Paramat • IQ Offset Com •	Advanced Dandwidik 5 MHz (25 RB) 20 MHz (100 RB) 15 MHz (75 RB) 10 MHz (50 RB) 3 MHz (15 RB) 1.4 MHz (6 RB) d d pensate	Preset to Standard
Close Keep O	pen	Help

 Demod Properties창의 Profile에서 Edit User Mapping을 누르면 생기는 LTE Allocation Editor창에서 입력 신호의 RB개수에 맞게 RB End 값을 입력 합니다. (ex. 5MHz 25RB = RB Start 0, RB End 24)

🕂 LTE Demod Properties		LTE Allocati	on Editor							
Format Profile Time Advanced	Edit User Mapping Edit Control Parame	RB Auto-Detect	Name User_0* Channel Para Sync Slot DMRS P nowns ¹⁰ Ass	Cell ID 0 meters 0 arameters 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Per-slot I Per-slot I RB RB Mod DMRS 0 DMRS 0 DMRS 0 DMRS P	Group Hopping	Seq Hopping	Include PUSCH	Include PUCCH	Add Delete Add Delete Slot Up Slot Down
RB		RB Mapping for F	PUSCH							
0 Slot	Н	0 0	Court			Slot				19

- Applient 895000 Vector Signal Analyzer
 Image: 316:2278 mV

 File Edit Control Source (nput TestSetup MeasSetup Display Irace Markers Littlites Help
 Image: 316:2278 mV

 Image: 316:2278 mV
 Image: 316:2278 mV

 Image: 316:2
- 지금까지의 설정을 통해 아래와 같은 LTE uplink demodulation 결과를 얻을 수 있습니다.

- End -