FCC Test Report (Part 96: LTE Band 42)

Report No.:	RFBEDF-WTW-P21030921-2
FCC ID:	QI3BEC-7000R28G
Test Model:	RidgeWave® BEC 7000 R28-G
Series Model:	BEC RidgeWave® 7000 R28-G, BEC 7000 R28-G, RidgeWave® BEC 7000 R28, BEC RidgeWave® 7000 R28, BEC 7000 R28 (refer to item 3.1 for more details)
Received Date:	Mar. 25, 2021
Test Date:	May 05 ~ Jul. 20, 2021
Issued Date:	Jul. 22, 2021
Applicant:	BILLION ELECTRIC CO., LTD.
Address:	8F., No. 192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Test Location:	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration/ Designation Number:	788550 / TW0003

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Release Control Record

Issue No.	Description	Date Issued
RFBEDF-WTW-P21030921-2	Original release.	Jul. 22, 2021

1 Certificate of Conformity

Product:	4G LTE-A Pro Outdoor Router
Brand:	BEC, BILLION
Test Model:	RidgeWave® BEC 7000 R28-G
Series Model:	BEC RidgeWave® 7000 R28-G, BEC 7000 R28-G, RidgeWave® BEC 7000 R28, BEC RidgeWave® 7000 R28, BEC 7000 R28 (refer to item 3.1 for more details)
Sample Status:	Engineering sample
Applicant:	BILLION ELECTRIC CO., LTD.
Test Date:	May 05 ~ Jul. 20, 2021
Standards:	47 CFR FCC Part 96

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Jul. 22, 2021

Polly Chien / Specialist

Approved by : _____ , **Date:** Jul. 22, 2021

Bruce Chen / Senior Project Engineer

2 Summary of Test Results

47 CFR FCC Part 96			
FCC Clause	Test Item	Result	Remarks
2.1046 96.41(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
2.1046 96.41(b)	Maximum Power Spectral Density	Pass	Meet the requirement of limit.
96.41(g)	Peak to Average Ration	Pass	Meet the requirement of limit.
2.1049	Emission Bandwidth	Pass	Meet the requirement of limit.
2.1055	Frequency Stability	Pass	Meet the requirement of limit.
2.1051 96.41(e)	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 96.41(e)	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -7.17dB at 199.75MHz.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	9 kHz ~ 30MHz	2.44 dB
	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	4G LTE-A Pro Outdoor Router		
Brand	BEC, BILLION		
Test Model	RidgeWave® BEC 7000 R28-G		
Series Model	BEC RidgeWave® 7000 R28-G, BEC 7000 R28-G, RidgeWave® BEC 7000 R28, BEC RidgeWave® 7000 R28, BEC 7000 R28		
Model Difference	Refer to note		
Status of EUT	Engineering sample		
Modulation Type	QPSK, 16QAM, 64QAM		
Operating Frequency	LTE Band 42	Channel Bandwidth 20MHz	TX: 3560 ~ 3590 MHz RX: 3560 ~ 3590 MHz
Max. EIRP Power	LTE Band 42C (Per 10M Power)		QPSK
		Channel Bandwidth (20MHz+20MHz)	10115.795mW(40.05dBm)
	LTE Band 42C (Full Power)	Channel Bandwidth (20MHz+20MHz)	10568.175mW(40.24dBm)
Emission Designator	LTE Band 42	Channel Bandwidth 20MHz	37M5G7D
Antenna Type	PCB antenna with 14.5dBi gain		
Antenna Connector	i-pex (MHF)		
Accessory Device	PoE		
Data Cable Supplied	NA		

Note:

1. All models are listed as below. Model RidgeWave® BEC 7000 R28-G is the representative for final test.

Brand	Model	Description
BEC, BILLION	RidgeWave® BEC 7000 R28-G	Main test (with GPS)
	BEC RidgeWave® 7000 R28-G	For marketing purpose with GPS
	BEC 7000 R28-G	
	RidgeWave® BEC 7000 R28	For marketing purpose without GPS
	BEC RidgeWave® 7000 R28	
	BEC 7000 R28	

2. The EUT consumes power from the following PoE.

Brand	BILLION
Model	BP035-560063PAX
Input Power	100-240Vac, 50/60Hz, 0.8A
Output Power	56Vdc, 0.625A
Powre cord	1.83m non-shielded without core

3.2 Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports
The worst case was found when positioned on Z-plane. Following channel(s) was (were) selected for the final test as listed below:

Test Item	Available Channel	Tested Channel	Channel Bandwidth	Modulation
Maximum Output Power	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43241 (3565.1MHz)+ 43439 (3584.9MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK, 16QAM, 64QAM
Frequency Stability	43190 to 43292 43388 to 43490	43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK
Occupied Bandwidth	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43241 (3565.1MHz)+ 43439 (3584.9MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK, 16QAM, 64QAM
Peak to Average Ratio	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43241 (3565.1MHz)+ 43439 (3584.9MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK
Conducted Emission	43190 to 43292 43388 to 43490	43190 (3560.0MHz)+ 43388 (3579.8MHz) 43241 (3565.1MHz)+ 43439 (3584.9MHz) 43292 (3570.2MHz)+ 43490 (3590.0MHz)	20MHz	QPSK
Radiated Emission	43190 to 43292 43388 to 43490	43241 (3565.1MHz)+ 43439 (3584.9MHz)	20MHz	QPSK

Note:

1. This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.
2. For radiated emission test, low, mid and high channels were pre-tested in chamber. Mid. channel in 20MHz was found to be the worst case and therefore had been chosen for final tests.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
Maximum Output Power	25deg. C, 63%RH	56Vdc	James Yang
Frequency Stability	25deg. C, 63%RH	56Vdc	James Yang
Occupied Bandwidth	25deg. C, 63%RH	56Vdc	James Yang
Peak to Average Ratio	25deg. C, 63%RH	56Vdc	James Yang
Condcudeted Emission	25deg. C, 63%RH	56Vdc	James Yang
Radiated Emission	23deg. C, 69%RH	56Vdc	Tim Chen

3.3 Description of Support Units

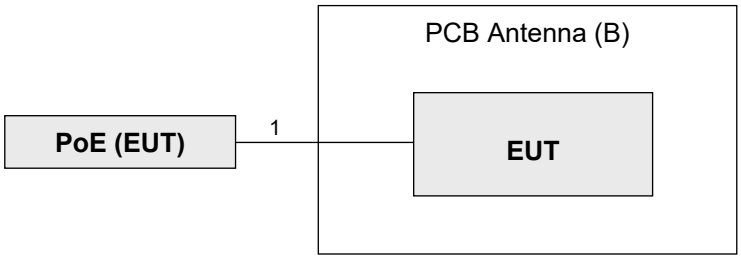
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Radio Communication Analyzer Anritsu	Anritsu	MT8821C	6261806803	N/A	-
B.	PCB Antenna	Grand-Tek Technology	DA B4243G 15 05 BL	N/A	N/A	Accessory (Gain: 14.5dBi)

Note:
1. All power cords of the above support units are non-shielded (1.8m).
2. Items A acted as communication partners to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ45 Cable	1	1.5	N	0	-

3.3.1 Configuration of System under Test



Remote site

3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC 47 CFR Part 2
FCC 47 CFR Part 96
KDB 971168 D01 Power Meas License Digital Systems v03r01
KDB 940660 D01 Part 96 CBRS Eqpt v02
ANSI/TIA/EIA-603-D-2010

All test items have been performed and recorded as per the above standards.

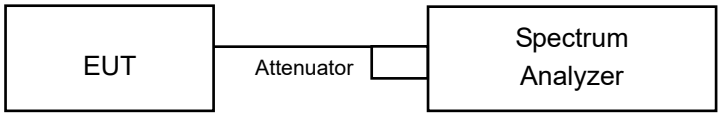
4 Test Types and Results

4.1 Maximum Output Power Measurement

4.1.1 Limits of Maximum Output Power Measurement

Device		Maximum EIRP (dBm/10 MHz)
☐	End User Device	23
☐	Category A CBSD	30
☒	Category B CBSD	47

4.1.2 Test Setup



4.1.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer KEYSIGHT	N9030B	MY60070562	Jan. 06, 2021	Jan. 05, 2022
Radio Communication Analyzer Anritsu	MT8821C	6201462755	Feb. 07, 2021	Feb. 07, 2022
RF cable	JB200	Cable-OVEN-02	NA	NA
DC-6GHz 20dB 50W Fixed attenuator Woken	MDC9331N-20	0724	Jun. 24, 2020	Jun. 23, 2022
DC power supply Keysight	U8002A	MY56330015	NA	NA
Three-phase coupling / decoupling network TESEQ	CDN 3063	4006	Mar. 10, 2021	Mar. 09, 2022

Note: 1. The calibration interval of the above test instruments is 12/24 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.1.4 Test Procedures

Conducted output power measurement

1. Connect the DUT transmitter output to the spectrum analyzer via coaxial cable while ensuring proper impedance matching.
2. Set span to at least 1.5 times the OBW.
3. Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
4. Set VBW ≥ 3 × RBW.
5. Set number of points in sweep ≥ 2 × span / RBW.
6. Sweep time = auto-couple.
7. Detector = RMS (power averaging).
8. If the EUT can be configured to transmit continuously (i.e., burst duty cycle ≥ 98%), then set the trigger to free run.
9. If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98 %), then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Ensure that the sweep time is less than or equal to the transmission burst duration.
10. Trace average at least 100 traces in power averaging (i.e., RMS) mode.
11. Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

Maximum EIRP

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation as follows:

ERP or EIRP = $P_{Meas} + G_T$
where

ERP or EIRP	effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas}, e.g., dBm or dBW)
P_{Meas}	measured transmitter output power or PSD, in dBm or dBW
G_T	gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

4.1.5 Deviation from Test Standard

No deviation.

4.1.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.1.7 Test Results

Conducted Output Power (dBm / 10MHz)

Con fugure	Com-bination	PCC							SCC							Measurement Power		
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Tx Power with UL-CA Active (dBm)		
																PCC	SCC	Total
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	18.70	18.36	25.55
					1	99						1	99			11.60	9.98	17.89
					100	0						100	0			14.69	14.06	21.41
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	17.46	17.2	24.15
					1	99						1	99			11.14	9.81	17.35
					100	0						100	0			13.37	13.05	20.03
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	15.29	15.31	22.12
					1	99						1	99			10.69	9.31	16.87
					100	0						100	0			13.47	13.05	20.09
	42C	42	20	QPSK	1	0	43241	3565.1	42	20	QPSK	1	0	43439	3584.9	18.32	18.41	25.39
					1	99						1	99			11.06	10.04	17.60
					100	0						100	0			14.65	14.21	21.46
		42	20	16QAM	1	0	43241	3565.1	42	20	16QAM	1	0	43439	3584.9	15.93	15.53	22.55
					1	99						1	99			17.59	17.74	24.49
					100	0						100	0			8.55	6.88	14.62
		42	20	64QAM	1	0	43241	3565.1	42	20	64QAM	1	0	43439	3584.9	14.74	15.28	21.84
					1	99						1	99			9.88	9.24	16.39
					100	0						100	0			13.36	13.11	20.06
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	18.32	18.12	25.24
					1	99						1	99			10.97	9.30	17.24
					100	0						100	0			14.24	13.72	21.01
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	15.98	15.40	22.52
					1	99						1	99			17.71	17.48	24.42
					100	0						100	0			8.46	6.82	14.54
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	14.76	14.87	21.64
					1	99						1	99			9.83	8.57	16.07
					100	0						100	0			12.89	12.65	19.59

Maximum EIRP (dBm/ 10MHz)

Con fugure	Com-bination	PCC							SCC							Antenna gain (dBi)
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	14.5
																EIRP
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	**40.05**
					1	99						1	99			32.39
					100	0						100	0			35.91
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	38.65
					1	99						1	99			31.85
					100	0						100	0			34.53
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	36.62
					1	99						1	99			31.37
					100	0						100	0			34.59
	42C	42	20	QPSK	1	0	43241	3565.1	42	20	QPSK	1	0	43439	3584.9	39.89
					1	99						1	99			32.10
					100	0						100	0			35.96
		42	20	16QAM	1	0	43241	3565.1	42	20	16QAM	1	0	43439	3584.9	37.05
					1	99						1	99			38.99
					100	0						100	0			29.12
		42	20	64QAM	1	0	43241	3565.1	42	20	64QAM	1	0	43439	3584.9	36.34
					1	99						1	99			30.89
					100	0						100	0			34.56
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	39.74
					1	99						1	99			31.74
					100	0						100	0			35.51
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	37.02
					1	99						1	99			38.92
					100	0						100	0			29.04
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	36.14
					1	99						1	99			30.57
					100	0						100	0			34.09

*Note: EIRP (dBm / 10MHz) = Conducted Output Power (dBm / 10MHz) + Antenna Gain (14.5dBi)

Full Conducted Output Power (dBm / 40MHz)

Con fugure	Com-bination	PCC							SCC							Measurement Power
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Tx Power with UL-CA Active (dBm)
																Total
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	23.41
					1	99						1	99			18.05
					100	0						100	0			25.74
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	22.03
					1	99						1	99			17.50
					100	0						100	0			24.32
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	22.09
					1	99						1	99			17.02
					100	0						100	0			22.24
	42C	42	20	QPSK	1	0	43241	3565.1	42	20	QPSK	1	0	43439	3584.9	23.46
					1	99						1	99			17.75
					100	0						100	0			25.51
		42	20	16QAM	1	0	43241	3565.1	42	20	16QAM	1	0	43439	3584.9	22.66
					1	99						1	99			16.62
					100	0						100	0			24.66
		42	20	64QAM	1	0	43241	3565.1	42	20	64QAM	1	0	43439	3584.9	21.95
					1	99						1	99			16.53
					100	0						100	0			22.06
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	23.01
					1	99						1	99			17.41
					100	0						100	0			25.39
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	22.64
					1	99						1	99			16.54
					100	0						100	0			24.55
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	21.59
					1	99						1	99			16.23
					100	0						100	0			21.77

Full EIRP (dBm / 40MHz)

Con fugure	Com-bination	PCC							SCC							Antenna gain (dBi)
		Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	Band	BW (MHz)	Modu lation	RB Size	RB Offset	UL Chan.	UL Freq. (MHz)	14.5
																EIRP
Intra Band Conti-guous	42C	42	20	QPSK	1	0	43190	3560	42	20	QPSK	1	0	43388	3579.8	37.91
					1	99						1	99			32.55
					100	0						100	0			**40.24**
		42	20	16QAM	1	0	43190	3560	42	20	16QAM	1	0	43388	3579.8	36.53
					1	99						1	99			32.00
					100	0						100	0			38.82
		42	20	64QAM	1	0	43190	3560	42	20	64QAM	1	0	43388	3579.8	36.59
					1	99						1	99			31.52
					100	0						100	0			36.74
	42C	42	20	QPSK	1	0	43241	3565.1	42	20	QPSK	1	0	43439	3584.9	37.96
					1	99						1	99			32.25
					100	0						100	0			40.01
		42	20	16QAM	1	0	43241	3565.1	42	20	16QAM	1	0	43439	3584.9	37.16
					1	99						1	99			31.12
					100	0						100	0			39.16
		42	20	64QAM	1	0	43241	3565.1	42	20	64QAM	1	0	43439	3584.9	36.45
					1	99						1	99			31.03
					100	0						100	0			36.56
	42C	42	20	QPSK	1	0	43292	3570.2	42	20	QPSK	1	0	43490	3590	37.51
					1	99						1	99			31.91
					100	0						100	0			39.89
		42	20	16QAM	1	0	43292	3570.2	42	20	16QAM	1	0	43490	3590	37.14
					1	99						1	99			31.04
					100	0						100	0			39.05
		42	20	64QAM	1	0	43292	3570.2	42	20	64QAM	1	0	43490	3590	36.09
					1	99						1	99			30.73
					100	0						100	0			36.27

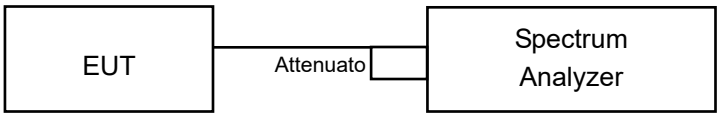
*Note: Full EIRP = Full Conducted Output Power (dBm / 40MHz) + Antenna Gain (14.5dBi)

4.2 Maximum Power Spectral Density Measurement

4.2.1 Limits of Maximum Power Spectral Density Measurement

Device	Maximum Radiated PSD (dBm/MHz)
End User Device	n/a
Category A CBSD	20
Category B CBSD	37

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.3 to get information of above instrument.

4.2.4 Test Procedure

1. Connect the transmitter to the spectrum analyzer via coaxial cable while ensuring proper impedance matching.
2. Tune the analyzer to the nominal center frequency of the emission bandwidth (EBW).
3. Set the resolution bandwidth (RBW) to 1MHZ.
4. Set the video bandwidth (VBW) to ≧3 x RBW.
5. Select the average power (RMS) display detector.
6. Set the number of measurement points to ≧ 1001.
7. Use auto-coupled sweep time.
8. Perform the measurement over an interval of time when the transmission is continuous and at its maximum power level.

Maximum EIRP (dBm/MHz)

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation as follows:

ERP or EIRP = P_{Meas} + G_T
where

ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas}, e.g., dBm or dBW)
P_{Meas} measured transmitter output power or PSD, in dBm or dBW
G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

4.2.5 Deviation from Test Standard

No deviation.

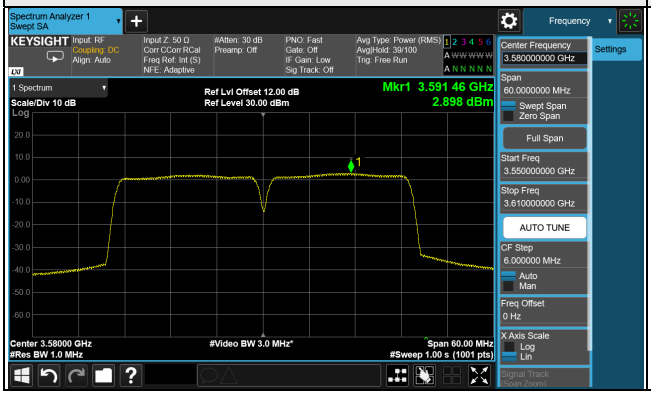
4.2.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.2.7 Test Results

LTE Band 42, Channel Bandwidth 20MHz						
Channel	Frequency (MHz)	Conducted PSD (dBm/MHz)	Antenna Gain (dBi)	Radiated PSD (dBm/MHz)	Limit (dBm/MHz)	Pass/Fail
43190+43388	3560.0+3579.8	2.540	14.5	17.040	37	Pass
43241+43439	3565.1+3584.9	2.867	14.5	17.367	37	Pass
43292+43490	3570.2+3590.0	2.898	14.5	17.398	37	Pass

*Note: Radiated PSD= Conducted PSD (dBm/ MHz) + Antenna Gain (14.5dBi)

Spectrum Plot of Worst Value	
CH 43292+43490	
	

4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stabiliity Measurement

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency band.

4.3.2 Test Procedure

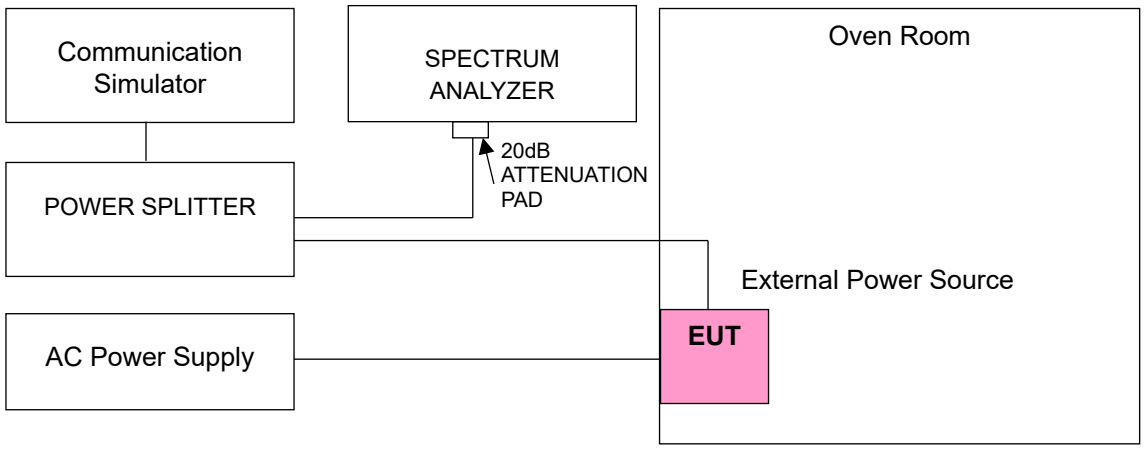
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the AC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.

c. The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ±0.5 ℃ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

NOTE: The frequency error was recorded frequency error from the communication simulator.

4.3.3 Test Setup



4.3.4 Test Results

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 42, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
50.4	3570.000015	0.004	3580.000023	0.006
56.0	3570.000020	0.006	3580.000024	0.007
61.6	3570.000018	0.005	3580.000017	0.005

Note: The applicant defined the normal working voltage is from 50.4Vdc to 61.6Vdc.

Frequency Error vs. Temperature

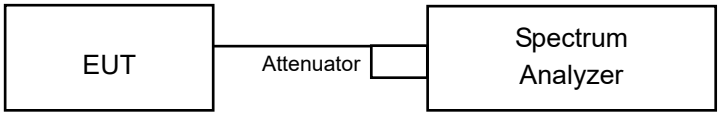
Temp. (℃)	LTE Band 42, Channel Bandwidth: 20MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	3570.000040	0.011	3580.000011	0.003
-20	3570.000015	0.004	3580.000025	0.007
-10	3570.000017	0.005	3580.000023	0.006
0	3570.000023	0.006	3580.000022	0.006
10	3570.000036	0.010	3580.000014	0.004
20	3569.999988	-0.003	3579.999962	-0.011
30	3569.999980	-0.006	3579.999966	-0.009
40	3569.999984	-0.004	3579.999975	-0.007
50	3569.999985	-0.004	3579.999990	-0.003

4.4 Emission Bandwidth Measurement

4.4.1 Limits of Emission Bandwidth Measurement

Reference only

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.3 to get information of above instrument.

4.4.4 Test Procedure

Occupied Bandwdith & 26dBc Bandwidth

1. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
2. The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.
3. Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.
   NOTE—Step 1), step 2), and step 3) may require iteration to adjust within the specified tolerances.
4. The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “−X dB” requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
5. Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
6. Determine the reference value by either of the following:
   a) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
   b) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.
7. Determine the “−X dB amplitude” as equal to (Reference Value − X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.

4.4.5 Deviation fromTest Standard

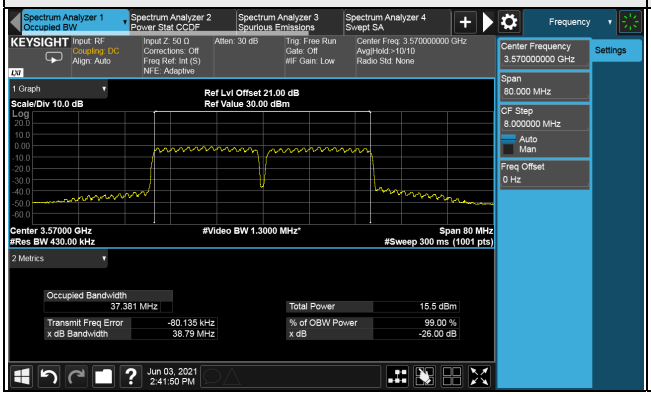
No deviation.

4.4.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.4.7 Test Result (-26dB Bandwidth)

LTE Band 42, Channel Bandwidth 20MHz		
Channel	Frequency (MHz)	26dB Bandwidth (MHz)
		QPSK
		FullRB
43190+43388	3560.0+3579.8	38.79
43241+43439	3565.1+3584.9	38.72
43292+43490	3570.2+3590.0	38.71

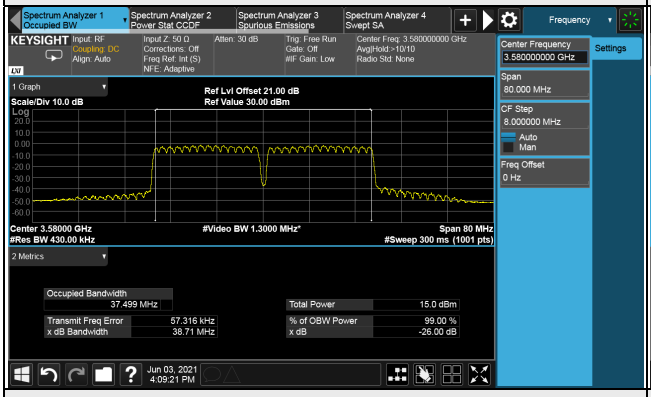
Spectrum Plot of Worst Value	
CH 43190+43388 / FullRB	
	

4.4.8 Test Result (Occupied Bandwidth)

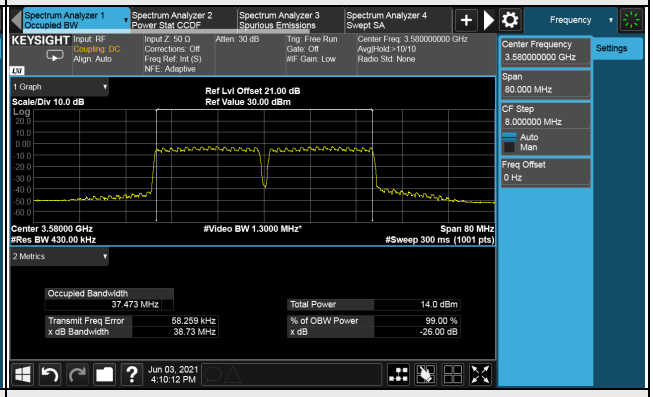
LTE Band 42, Channel Bandwidth 20MHz				
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)		
		QPSK	16QAM	64QAM
		FullRB	FullRB	FullRB
43190+43388	3560.0+3579.8	37.381	37.436	37.450
43241+43439	3565.1+3584.9	37.460	37.378	37.404
43292+43490	3570.2+3590.0	37.499	37.473	37.309

Spectrum Plot of Worst Value

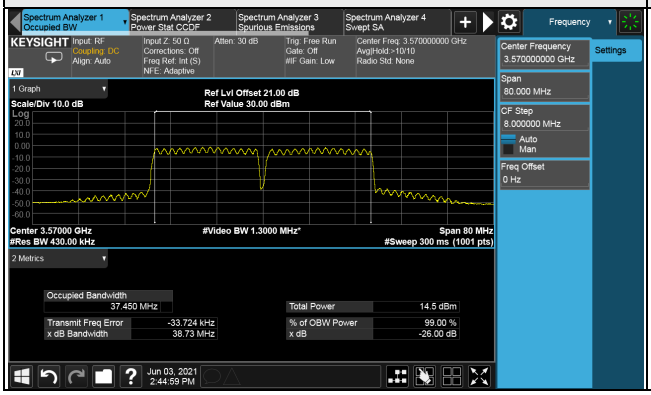
CH 43292+43490 / QPSK / FullRB



CH 43292+43490 / 16QAM / FullRB



CH 43190+43388 / 64QAM / FullRB

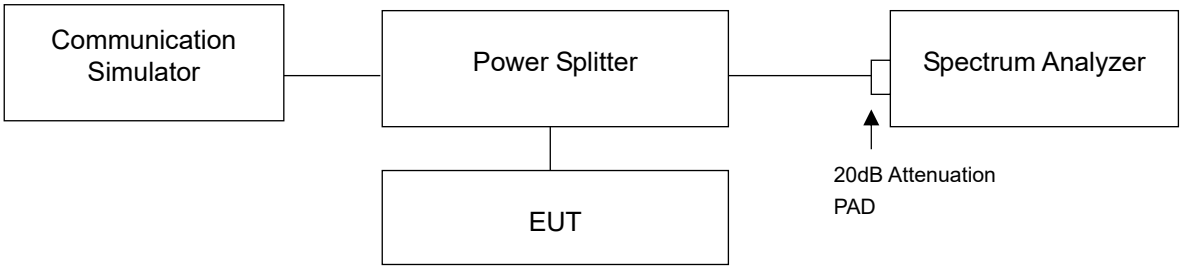


4.5 Peak to Average Ratio Measurement

4.5.1 Limits of Peak to Average Ratio Measurement

In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB

4.5.2 Test Setup

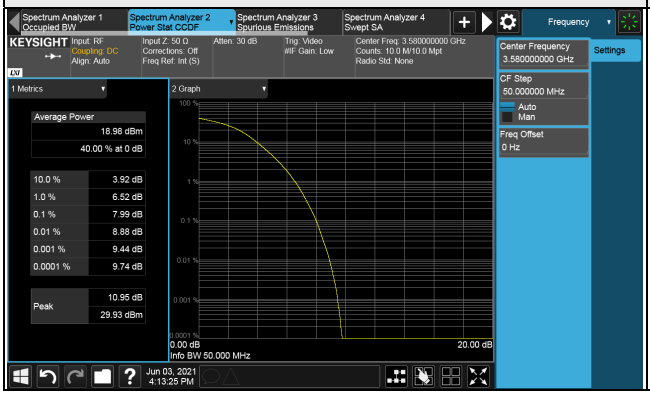


4.5.3 Test Procedures

a. Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;
b. Set the number of counts to a value that stabilizes the measured CCDF curve;
c. Record the maximum PAPR level associated with a probability of 0.1%.

4.5.4 Test Results

LTE Band 42, Channel Bandwidth 20MHz		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
		QPSK
		FullRB
43190+43388	3560.0+3579.8	7.64
43241+43439	3565.1+3584.9	7.96
43292+43490	3570.2+3590.0	7.99

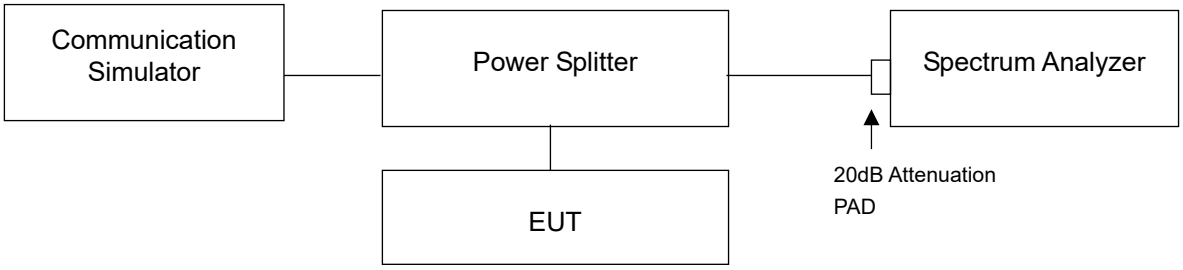
Spectrum Plot of Worst Value	
CH 43292+43490 / FullRB	
	

4.6 Conducted Spurious Emissions

4.6.1 Limits of Conducted Spurious Emissions Measurement

Power of any emissions outside the Fundamental	Limit
Within 0-10MHz above the Assigned Channel	-13 dBm/MHz
Within 0-10MHz below the Assigned Channel	
Greater than 10MHz above the Assigned Channel	-25 dBm/MHz
Greater than 10MHz below the Assigned Channel	
Power of any emission below 3530MHz	-40 dBm/MHz
Power of any emission above 3720MHz	

4.6.2 Test Setup



4.6.3 Test Procedure

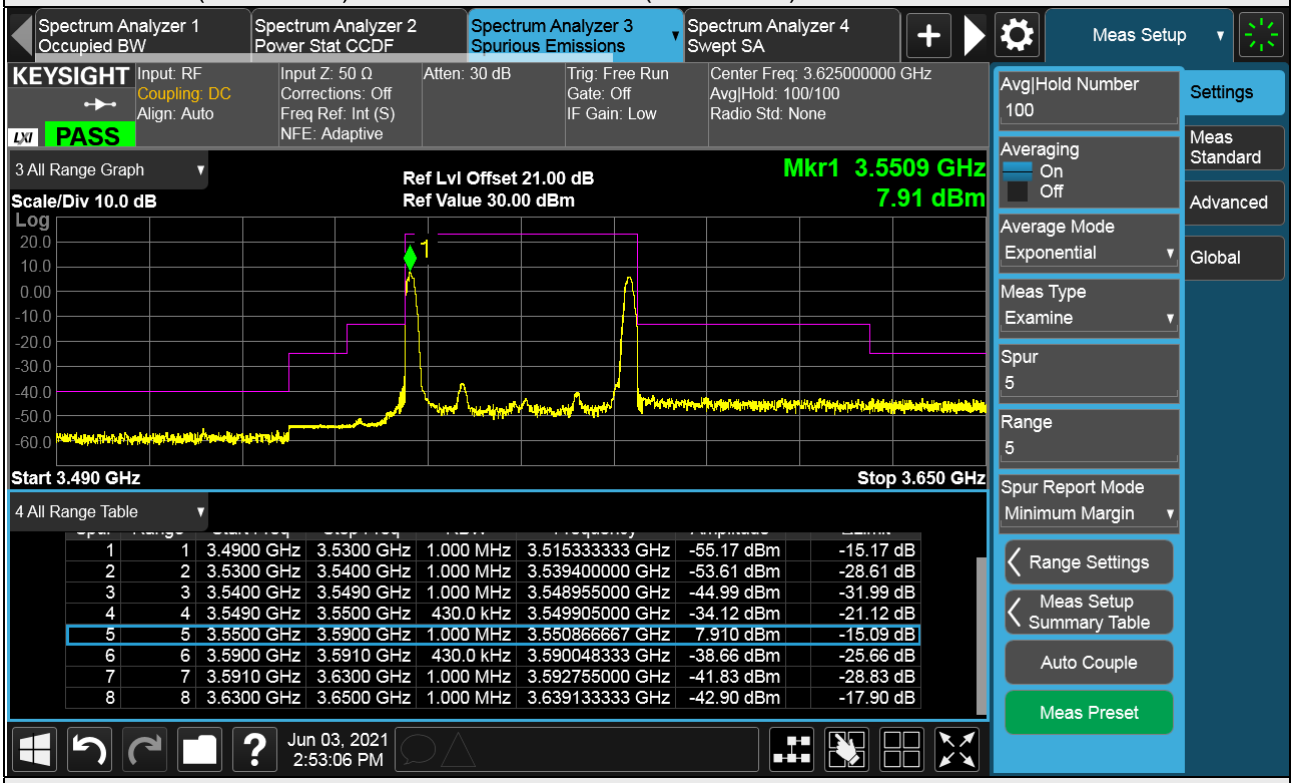
a. The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.

b. Measuring frequency range is from 9 kHz to 40 GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz is used for conducted emission measurement.

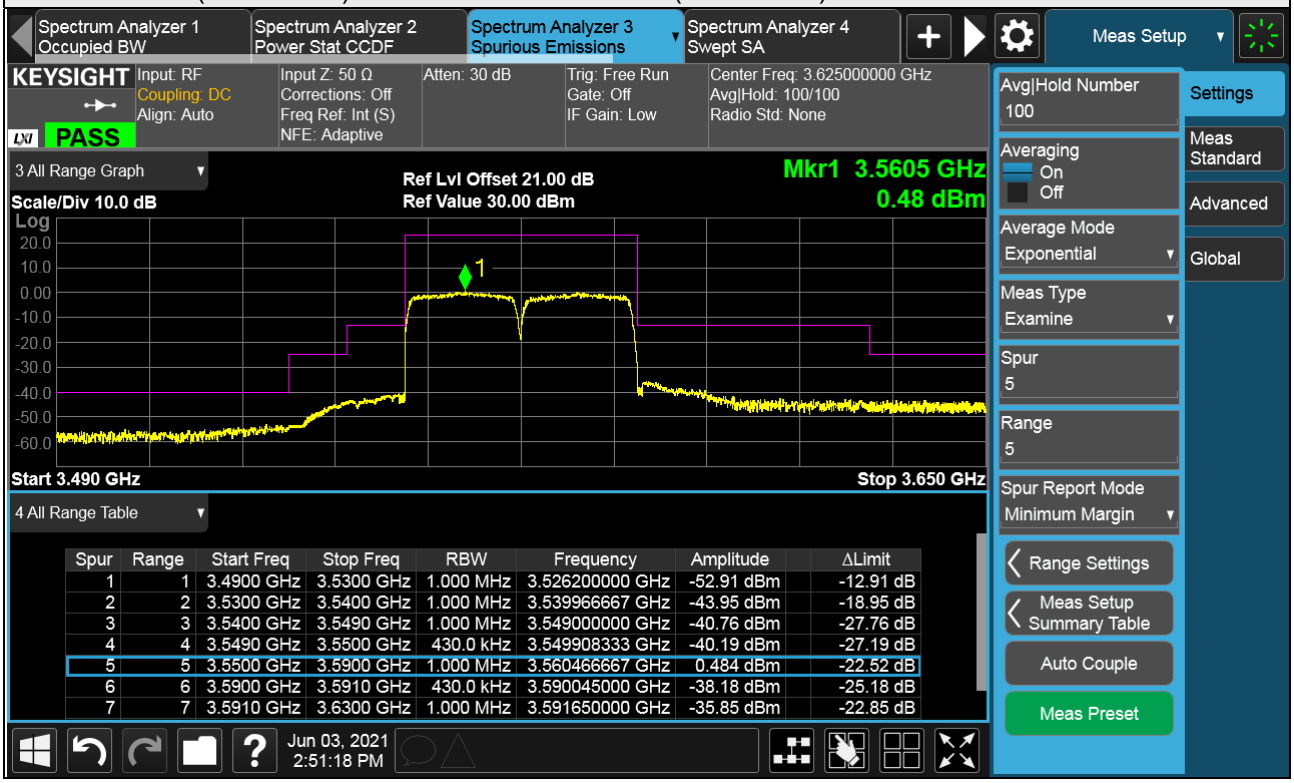
c. Measuring frequency band edge, 20dB attenuation pad is connected with spectrum. 1% of the fundamental emission bandwidth is used for conducted emission measurement.

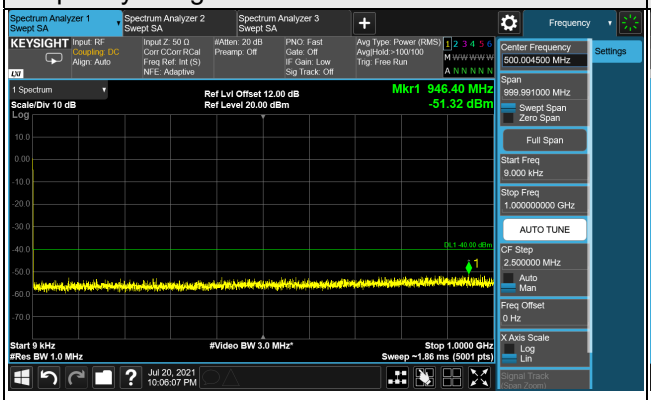
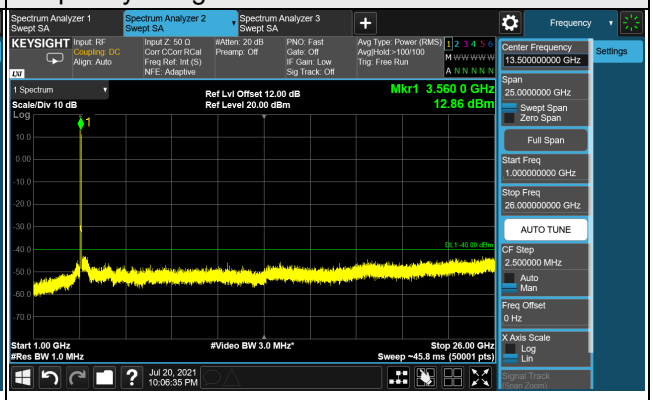
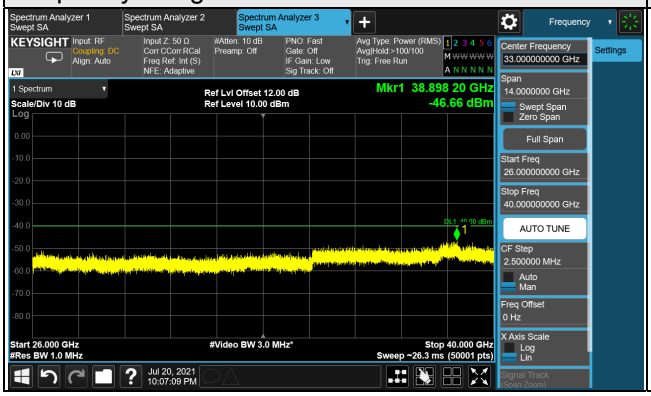
4.6.4 Test Results

LTE Band 42, Channel Bandwidth 20MHz
Channel 43190 (3560.0MHz) 1RB0 + Channel 43388 (3579.8MHz) 1RB99



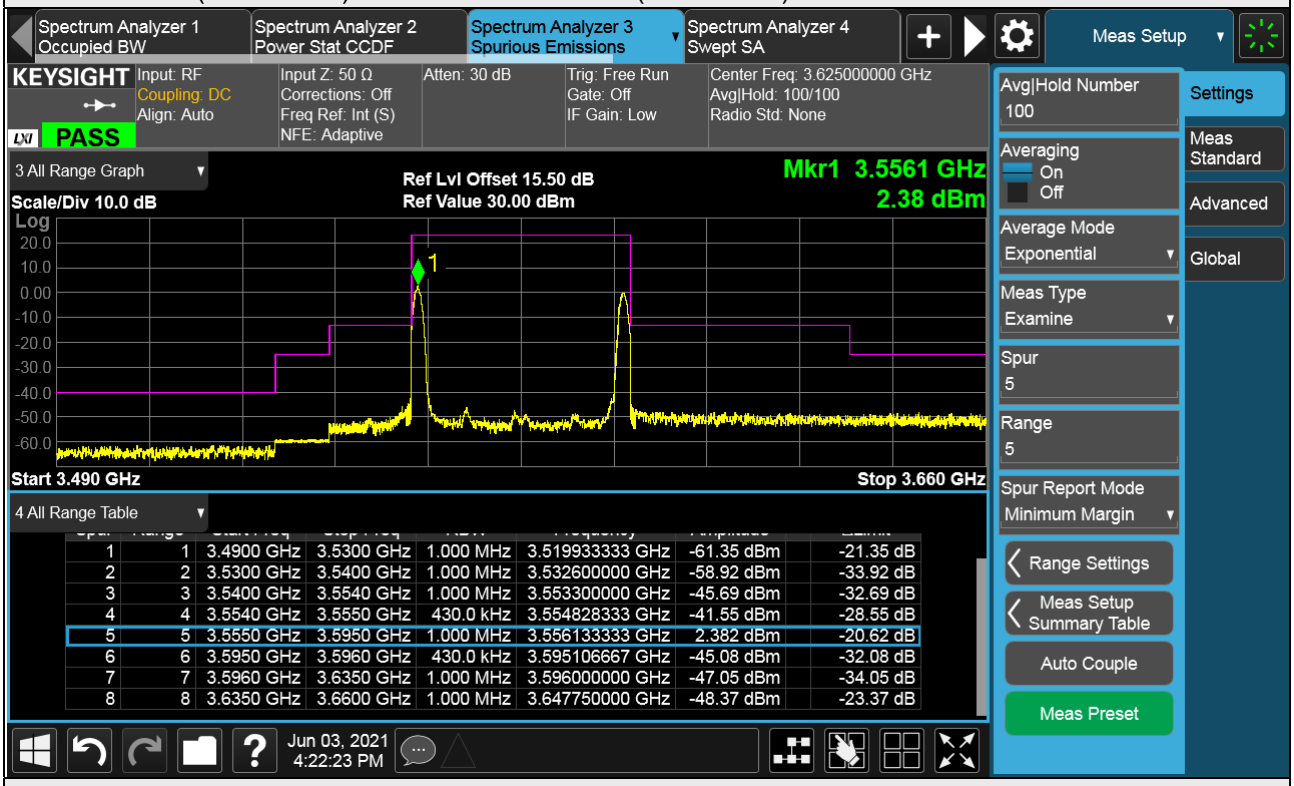
Channel 43190 (3560.0MHz) 100RB0 + Channel 43388 (3579.8MHz) 100RB0



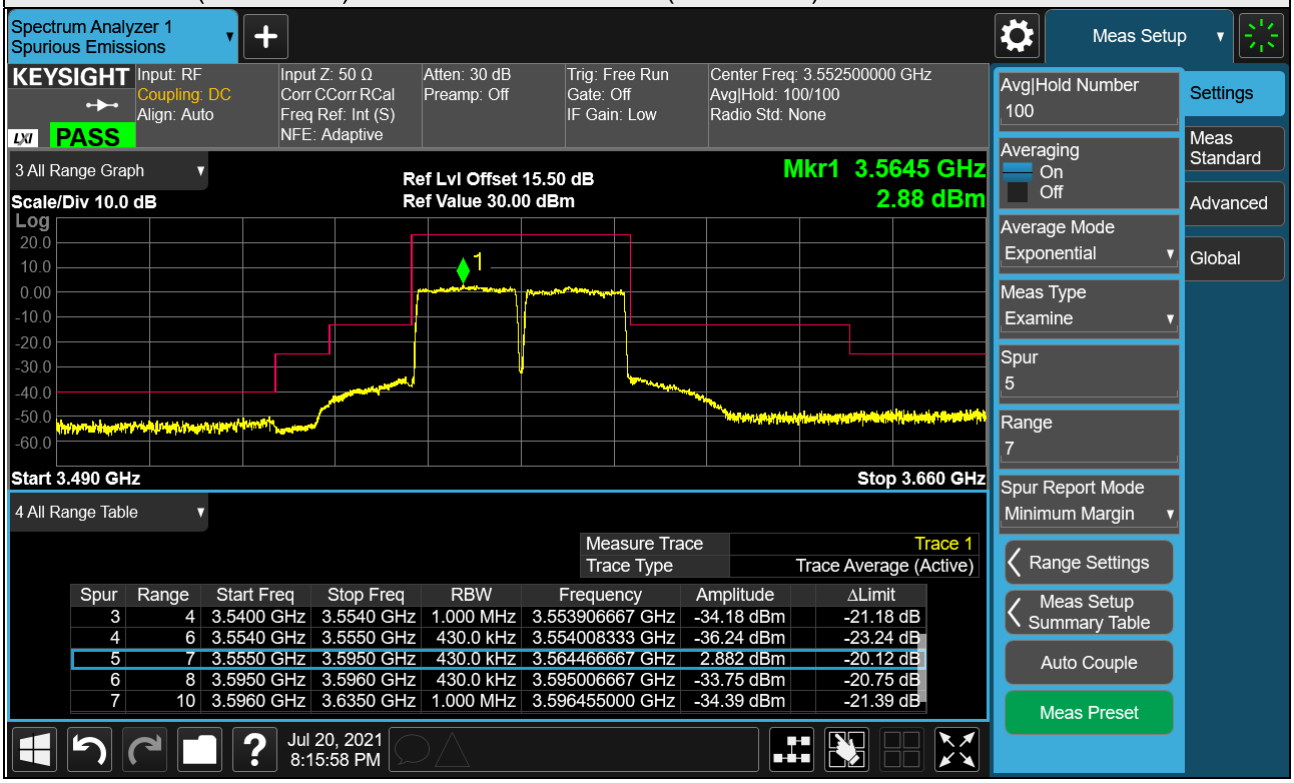
LTE Band 42, Channel Bandwidth 20MHz	
Channel 43190 (3560.0MHz)+Channel 43388 (3579.8MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~26GHz
	
Frequency Range : 26GHz~40GHz	
	

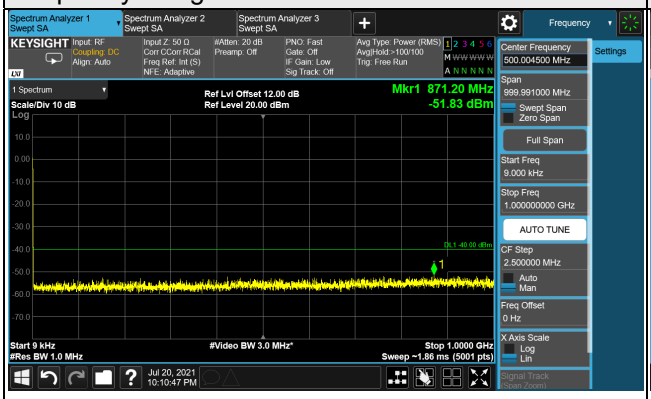
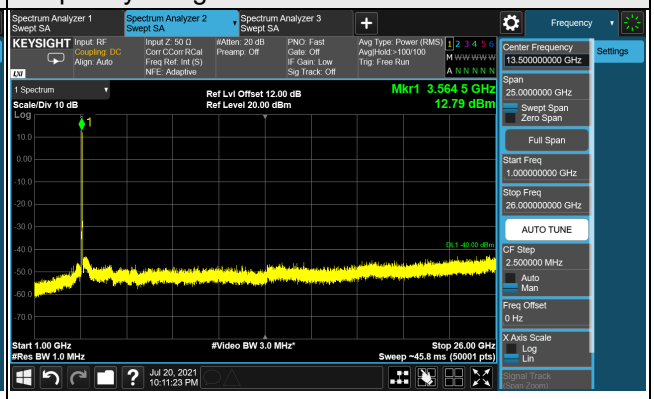
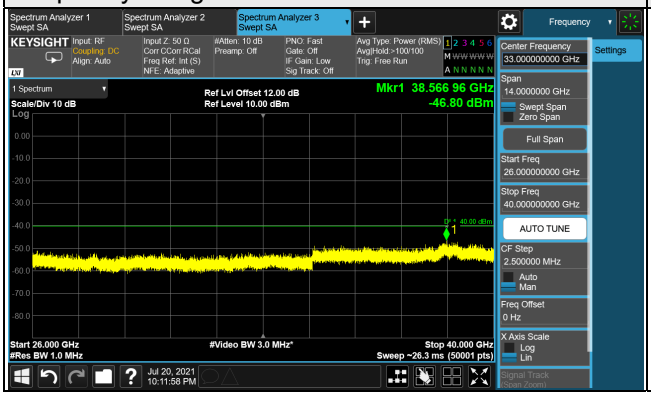
LTE Band 42, Channel Bandwidth 20MHz

Channel 43241 (3565.1MHz) 1RB0 +Channel 43439 (3584.9MHz) 1RB99



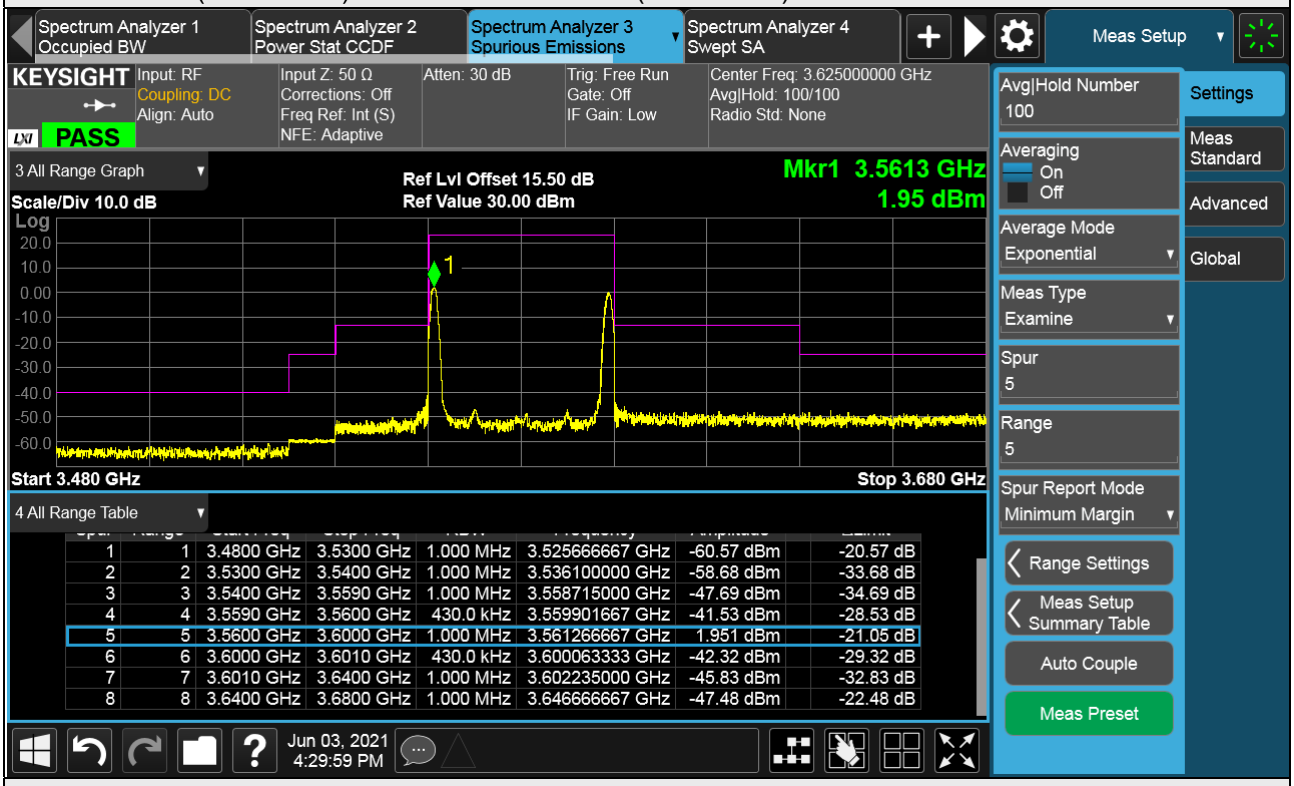
Channel 43241 (3565.1MHz) 100RB0 +Channel 43439 (3584.9MHz) 100RB0



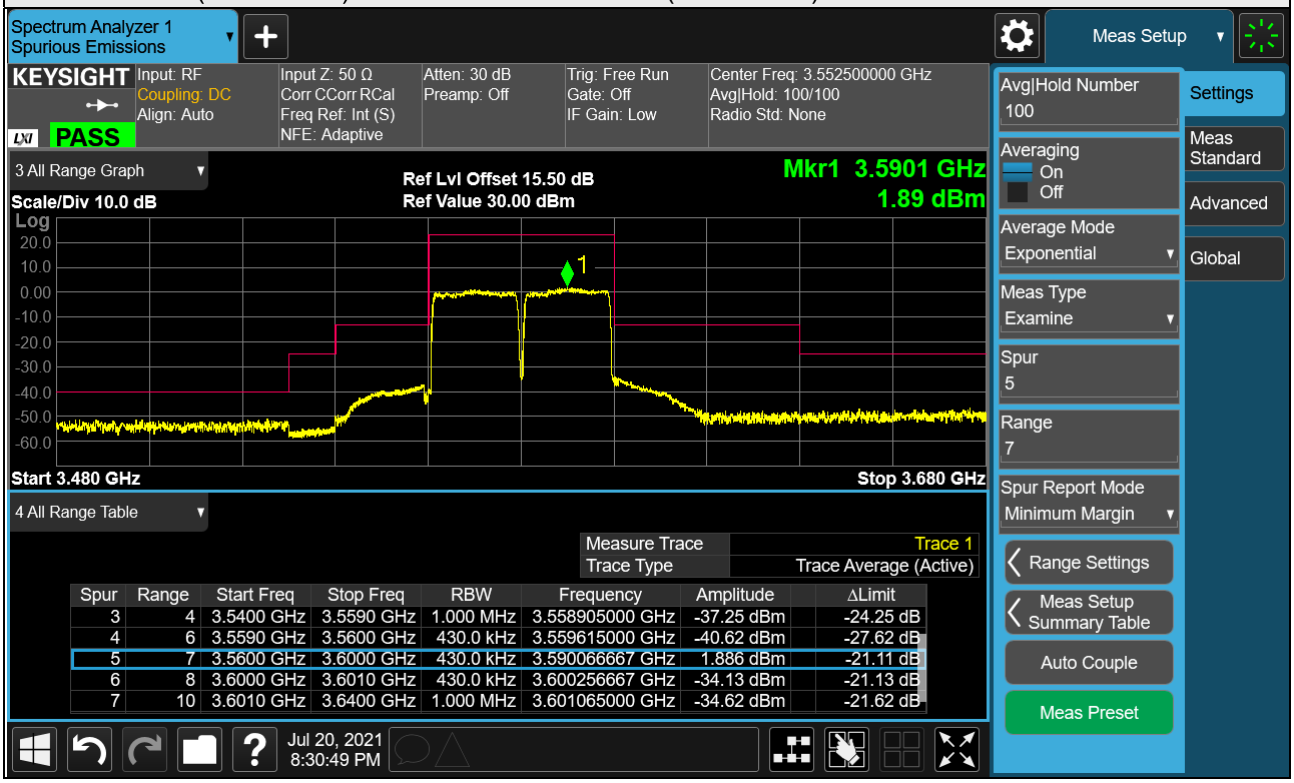
LTE Band 42, Channel Bandwidth 20MHz	
Channel 43241 (3565.1MHz)+Channel 43439 (3584.9MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~26GHz
	
Frequency Range : 26GHz~40GHz	
	

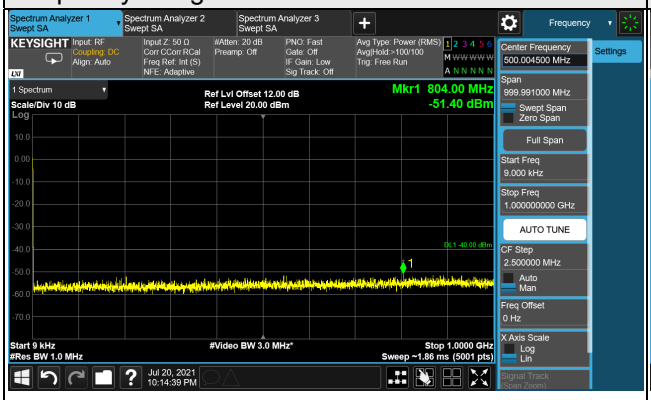
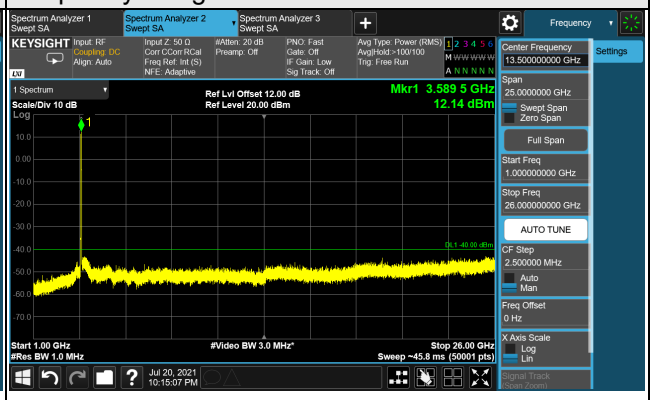
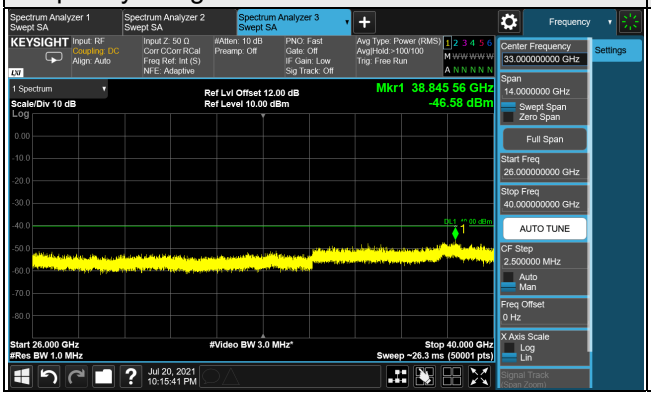
LTE Band 42, Channel Bandwidth 20MHz

Channel 43292 (3570.2MHz) 1RB0 +Channel 43490 (3590.0MHz) 1RB99



Channel 43292 (3570.2MHz) 100RB0 +Channel 43490 (3590.0MHz) 100RB0



LTE Band 42, Channel Bandwidth 20MHz	
Channel 43292 (3570.2MHz)+Channel 43490 (3590.0MHz)	
Frequency Range : 9kHz~1GHz	Frequency Range : 1GHz~26GHz
	
Frequency Range : 26GHz~40GHz	
	

4.7 Radiated Emission Measurement

4.7.1 Limits of Radiated Emission Measurement

The power of any emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

4.7.2 Test Instruments

Description & Manaufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY55420137	Apr. 09, 2021	Apr. 08, 2022
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 07, 2020	Dec. 06, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 12, 2021	Apr. 11, 2022
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 22, 2020	Nov. 21, 2021
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 06, 2020	Nov. 05, 2021
Fixed Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	Apr. 13, 2021	Apr. 12, 2022
MXG Vector signal generator Agilent	N5182B	MY53050430	Nov. 25, 2020	Nov. 24, 2021
Preamplifier EMCI	EMC001340	980201	Oct. 21, 2020	Oct. 20, 2021
Preamplifier EMCI	EMC 012645	980115	Oct. 07, 2020	Oct. 06, 2021
Preamplifier EMCI	EMC 184045	980116	Oct. 07, 2020	Oct. 06, 2021
Preamplifier EMCI	EMC 330H	980112	Oct. 07, 2020	Oct. 06, 2021
Power Meter Anritsu	ML2495A	1012010	Sep. 01, 2020	Aug. 31, 2021
Power Sensor Anritsu	MA2411B	1315050	Sep. 01, 2020	Aug. 31, 2021
RF Coaxial Cable EMCI	EMC104-SM-SM-8000	171005	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 07, 2020	Oct. 06, 2021
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower &Turn Table Controller MF	MF-7802	NA	NA	NA
Radio Communication Analyzer Anritsu	MT8821C	6201462755	Feb. 07, 2021	Feb. 07, 2022

Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HwaYa Chamber 10.

4.7.3 Test Procedures

a. Substitution method is used for EIRP measurement. In the semi-anechoic chamber, EUT placed on the 0.8m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.

b. EIRP = Output power level – TX cable loss + Antenna gain of substitution horn. Correction Factor (includes EIRP and ERP unit conversion factor) = Antenna gain of substitution horn. – Tx cable loss. Measurement method refers to ANSI C63.26 section 5.5 and 5.7.

c. ERP power can be calculated form EIRP power by subtracting the gain of dipole, ERP power = EIRP power - 2.15dBi.

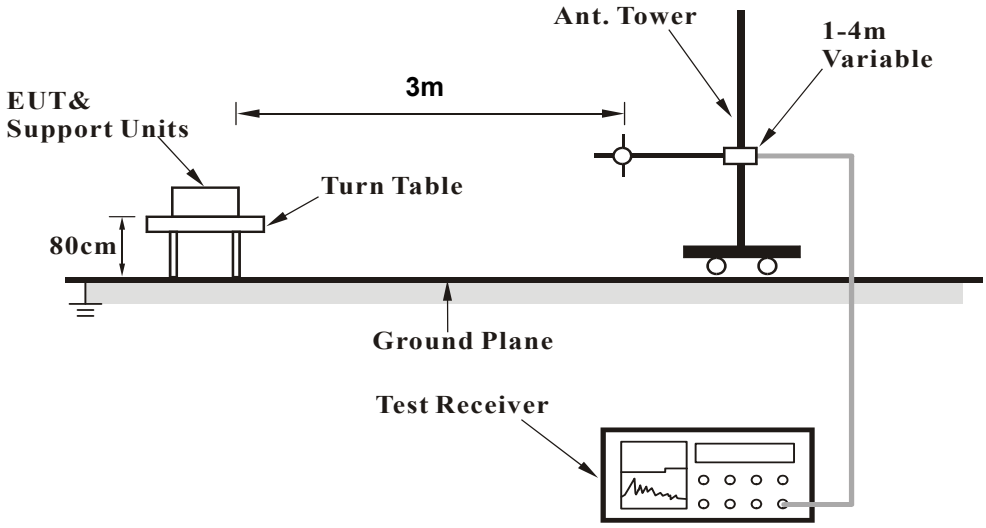
Note:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.
2. The emission levels were against the limit of frequency range 9 kHz ~ 30 MHz: The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

4.7.4 Deviation from Test Standard

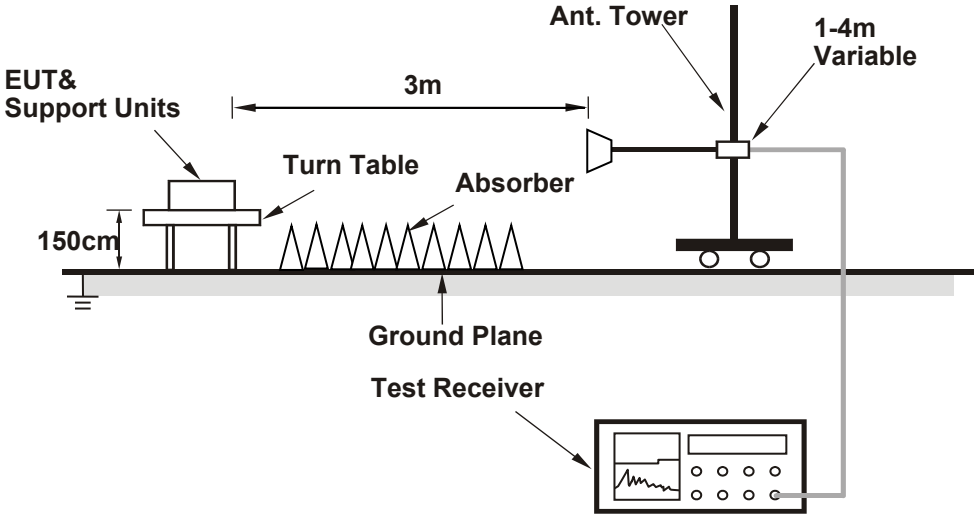
No deviation.

4.7.5 Test Set Up

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

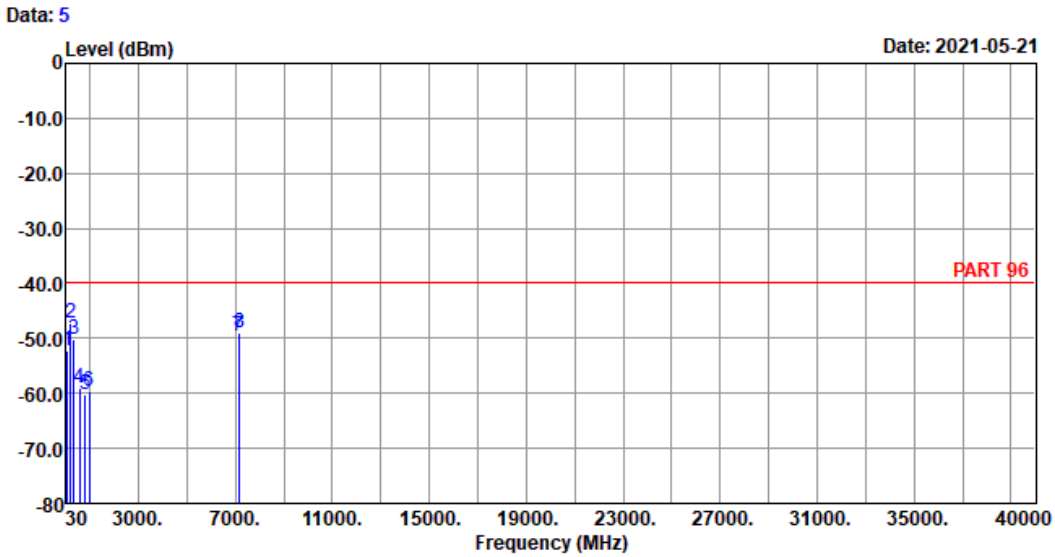
4.7.6 Test Results

Test was done with 50ohm terminator on antenna port.

Middle Channel: 43241 (3565.1MHz)+43439 (3584.9MHz)

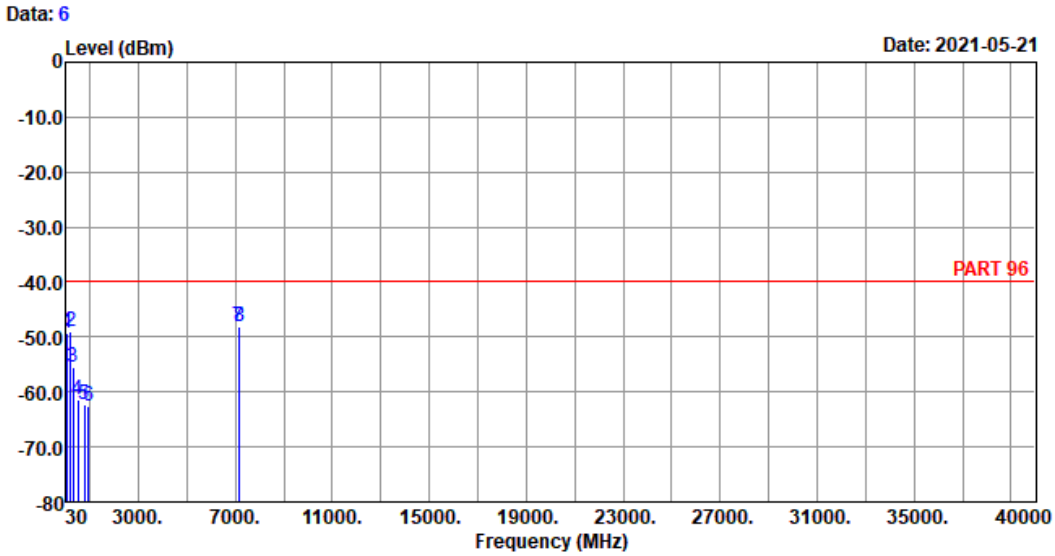
Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch

A D T



Site : 966 Chamber 5
Condition: PART 96 HORIZONTAL
Remak : LTE B42+B42 QPSK_20M Link_M-CH
Tested by: tim-chen

	Freq	Level	Read Level	Limit Line	Factor	Over Limit	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1	60.07	-52.33	-44.67	-40.00	-7.66	-12.33	Peak
2 pp	199.75	-47.17	-39.15	-40.00	-8.02	-7.17	Peak
3	325.85	-50.06	-43.45	-40.00	-6.61	-10.06	Peak
4	572.23	-59.00	-57.08	-40.00	-1.92	-19.00	Peak
5	801.15	-60.36	-61.09	-40.00	0.73	-20.36	Peak
6	967.99	-59.58	-62.03	-40.00	2.45	-19.58	Peak
7	7130.00	-49.45	-52.91	-40.00	3.46	-9.45	Peak
8	7169.60	-48.89	-52.66	-40.00	3.77	-8.89	Peak



Site : 966 Chamber 5
Condition: PART 96 VERTICAL
Remak : LTE B42+B42 QPSK_20M Link_M-CH
Tested by: tim-chen

	Freq	Level	Read Level	Limit Line	Factor	Over Limit	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1	80.44	-49.43	-38.55	-40.00	-10.88	-9.43	Peak
2	195.87	-49.00	-41.35	-40.00	-7.65	-9.00	Peak
3	323.91	-55.50	-48.86	-40.00	-6.64	-15.50	Peak
4	498.51	-61.41	-56.76	-40.00	-4.65	-21.41	Peak
5	771.08	-62.15	-62.97	-40.00	0.82	-22.15	Peak
6	935.98	-62.48	-63.94	-40.00	1.46	-22.48	Peak
7	7130.00	-48.08	-51.54	-40.00	3.46	-8.08	Peak
8 pp	7169.60	-48.06	-51.83	-40.00	3.77	-8.06	Peak

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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