FCC Test Report

(Part 22 – GSM, Cat-M1 B5/B26, NB-IoT B5)

Report No.:	RFBBDJ-WTW-P23050444
FCC ID:	PPQ202005BG95M5
Test Model:	BG95-M5
Received Date:	May 17, 2023
Test Date:	May 27 ~ Jun. 14, 2023
Issued Date:	Jul. 20, 2023
Applicant:	LITE-ON Technology Corp.
Address:	Bldg. C, 90, Chien 1 Rd., Chung-Ho, New Taipei City 23585, 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 (1):	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
Test Location (2):	No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)
FCC Registration / Designation Number:	788550 / TW0003 281270 / TW0032

Testing Laboratory
2021

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Release Control Record

Issue No.	Description	Date Issued
RFBBDJ-WTW-P23050444	Original Release	Jul. 20, 2023

1 Certificate of Conformity

Product:	Quectel BG95-M5
Brand:	LITEON
Test Model:	BG95-M5
Sample Status:	Engineering Sample
Applicant:	LITE-ON Technology Corp.
Test Date:	May 27 ~ Jun. 14, 2023
Standards:	FCC Part 22, Subpart H

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 : Lena Wang , **Date:** Jul. 20, 2023

Lena Wang / Specialist

Approved by : Jeremy Lin , **Date:** Jul. 20, 2023

Jeremy Lin / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 22 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 22.913 (a)	Effective radiated power	Pass	Meet the requirement of limit.
2.1047	Modulation Characteristics	N/A	Refer to Note
22.913 (d)	Peak To Average Ratio	N/A	Refer to Note
2.1055 22.355	Frequency Stability	N/A	Refer to Note
2.1049	Occupied Bandwidth	N/A	Refer to Note
22.917	Band Edge Measurements	N/A	Refer to Note
2.1051 22.917	Conducted Spurious Emissions	N/A	Refer to Note
2.1053 22.917	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -16.15 dB at 38.73 MHz.

Note:

1. Only test item of Effective Isotropic Radiated Power & Radiated Emissions were performed for this report. Other testing data please refer to TA Technology (Shanghai) Co., Ltd. report no.: R2005A0283-R1V1 and R2005A0283-R5.
2. 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	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~1000MHz	2.93 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Rohde & Schwarz	N9038A	MY55420137	May 03, 2023	May 02, 2024
Spectrum Analyzer KEYSIGHT	N9020B	MY60110440	Mar. 16, 2023	Mar. 15, 2024
Loop Antenna TESEQ	HLA 6121	45745	Jul. 27, 2022	Jul. 26, 2023
BILOG Antenna SCHWARZBECK	VULB9168	1213	Oct. 20, 2022	Oct. 19, 2023
HORN Antenna RF SPIN	DRH18-E	210103A18E	Nov. 13, 2022	Nov. 12, 2023
HORN Antenna SCHWARZBECK	BBHA 9170	9170	Nov. 13, 2022	Nov. 12, 2023
Loop Antenna EMCI	EM-6879	269	Sep. 19, 2022	Sep. 18, 2023
Preamplifier EMCI	EMC330N	980782	Jan. 16, 2023	Jan. 15, 2024
Preamplifier EMCI	EMC118A45SE	980808	Dec. 29, 2022	Dec. 28, 2023
Preamplifier EMCI	EMC184045SE	980788	Jan. 16, 2023	Jan. 15, 2024
RF signal cable EMCI	EMC104-SM-SM-(9000+2000+1000)	201243+ 201231+ 210102	Jan. 16, 2023	Jan. 15, 2024
RF signal cable EMCI	EMCCFD400-NM-NM-(9000+300+500)	201236+ 201235+ 201233	Jan. 16, 2023	Jan. 15, 2024
RF signal cable EMCI	EMC101G-KM-KM-(5000+3000+2000)	201260+201257+201254	Jan. 16, 2023	Jan. 15, 2024
Software BV ADT	ADT_Radiated_V7.6.15.9.5	NA	NA	NA
Antenna Tower Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Max-Full	MF-7802BS	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208674	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/MY55190007/MY55210005	Jul. 13, 2022	Jul. 12, 2023
Radio Communication Analyzer Anritsu	MT8821C	6201462755	Mar. 03, 2023	Mar. 02, 2024

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in WM Chamber 8.

3 General Information

3.1 General Description of EUT

Product	Quectel BG95-M5		
Brand	LITEON		
Test Model	BG95-M5		
Sample Status	Engineering Sample		
Power Supply Rating	208-240 Vac		
Modulation Type	GSM/GPRS: GMSK EDGE: GMSK, 8PSK Cat-M1: QPSK, 16QAM NB-IoT: BPSK, QPSK (Subcarrier Spacing: 3.75kHz,15kHz)		
Operating Frequency	GSM850	824.2MHz ~ 848.8MHz	
	Cat-M1		
	Cat-M1 Band 5 (Channel Bandwidth 1.4MHz)	824.7MHz ~ 848.3MHz	
	Cat-M1 Band 5 (Channel Bandwidth 3MHz)	825.5MHz ~ 847.5MHz	
	Cat-M1 Band 5 (Channel Bandwidth 5MHz)	826.5MHz ~ 846.5MHz	
	Cat-M1 Band 5 (Channel Bandwidth 10MHz)	829.0MHz ~ 844.0MHz	
	Cat-M1 26 (Channel Bandwidth: 1.4 MHz)	824.7 ~ 848.3 MHz	
	Cat-M1 26 (Channel Bandwidth: 3 MHz)	825.5 ~ 847.5 MHz	
	Cat-M1 26 (Channel Bandwidth: 5 MHz)	826.5 ~ 846.5 MHz	
	Cat-M1 26 (Channel Bandwidth: 10 MHz)	829 ~ 844 MHz	
	Cat-M1 26 (Channel Bandwidth: 15 MHz)	831.5 ~ 841.5 MHz	
	NB-IoT Standalone		
	NB-IoT Band 5	824.2MHz ~ 848.8MHz	
Max. ERP Power	GSM	1428.894mW (31.55dBm)	
	Cat-M1		
		QPSK	16QAM
	Cat-M1 Band 5 (Channel Bandwidth 1.4MHz)	223.357mW (23.49dBm)	169.044mW (22.28dBm)
	Cat-M1 Band 5 (Channel Bandwidth 3MHz)	228.560mW (23.59dBm)	179.061mW (22.53dBm)
	Cat-M1 Band 5 (Channel Bandwidth 5MHz)	214.289mW (23.31dBm)	213.304mW (23.29dBm)
	Cat-M1 Band 5 (Channel Bandwidth 10MHz)	229.087mW (23.60dBm)	211.836mW (23.26dBm)
	Cat-M1 26 (Channel Bandwidth: 1.4 MHz)	226.986mW (23.56dBm)	217.771mW (23.38dBm)
	Cat-M1 26 (Channel Bandwidth: 3 MHz)	224.388mW (23.51dBm)	218.273mW (23.39dBm)
	Cat-M1 26 (Channel Bandwidth: 5 MHz)	223.872mW (23.50dBm)	220.800mW (23.44dBm)
	Cat-M1 26 (Channel Bandwidth: 10 MHz)	226.464mW (23.55dBm)	224.388mW (23.51dBm)

	Cat-M1 26 (Channel Bandwidth: 15 MHz)	229.087mW (23.60dBm)	226.464mW (23.55dBm)
	NB-IoT Standalone		
		BPSK	QPSK
	NB-IoT Band 5	141.906mW (21.52dBm)	141.579mW (21.51dBm)
Antenna Type	Refer to Note		
Antenna Connector	Refer to Note		
Accessory Device	Refer to Note		
Cable Supplied	N/A		

Note:

1. The EUT is authorized for use in specific End-product. Please refer to below for more details. The model of 'EX-1193-MFD-80' was chosen for final test.

Brand	Model	WWAN	RFID	WIFI	Difference
LITEON	EX-1193-MFD-80	FCC ID: PPQ202005BG95M5	FCC ID: PPQRYORR2L	FCC ID: PPQLILYW131	The difference between EX-1193-MFD-80 and EX-1193-MFD-48 in the rated current (80A/48A)
	EX-1193-MFD-48				

2. The End-product contains following accessory devices.

Product	Brand	Model	Description
holster	Liteon	N/A	-

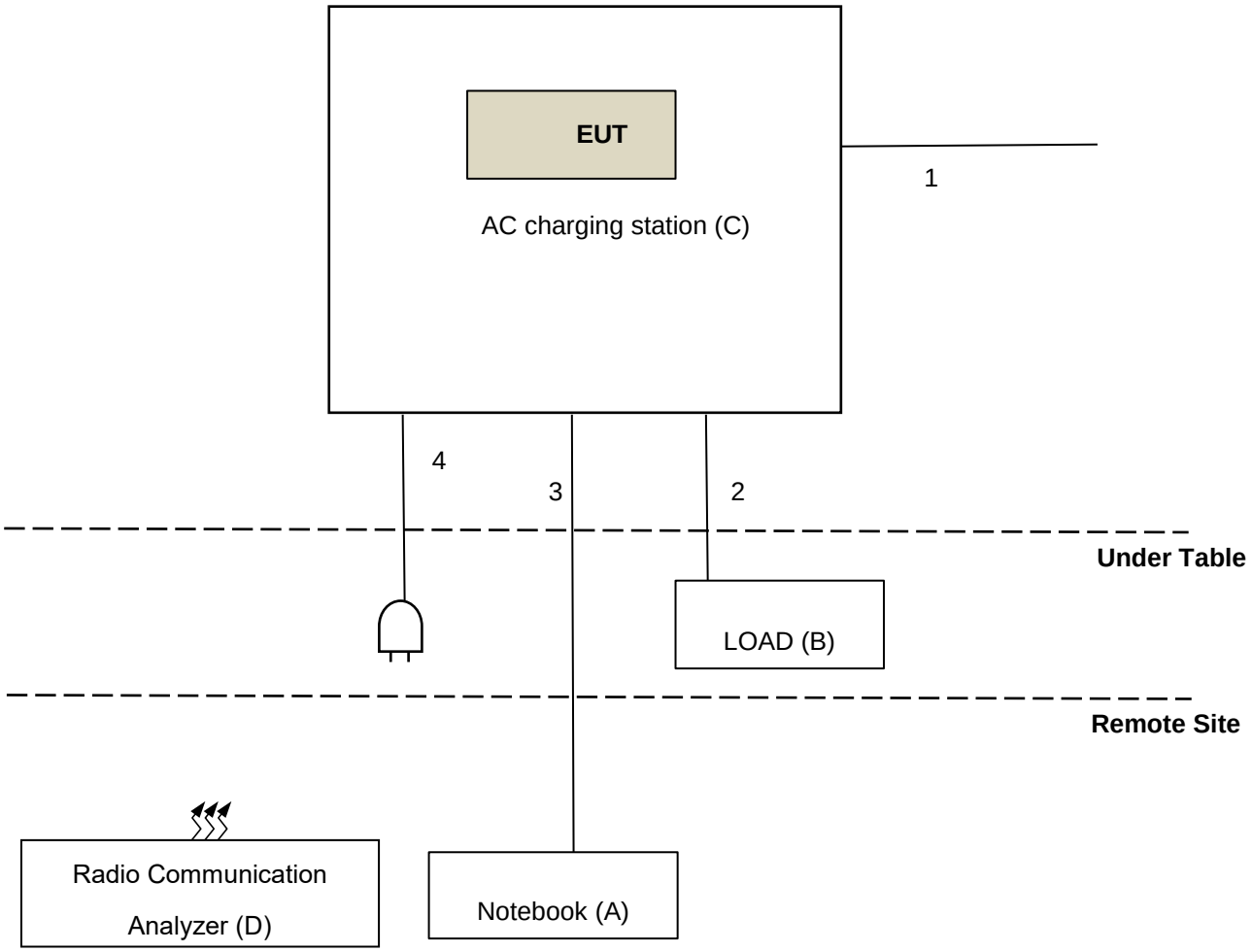
3. The antenna information for host is listed as below.

Type	Monopole Coupling											
Connector	ipex(MHF)											
Antenna gain (dBi)												
GSM 850	GSM 1900	Cat-M1 Band 26 (Part 22)	Cat-M1 Band 26 (Part 90)	NB-IoT Band 71	Cat-M1 / NB-IoT Band							
					2	4	5	12	13	25	66	85
1.9	1.7	1.9	1.1	1.3	1.7	1.5	1.9	1.1	0.7	1.7	1.5	1.1

* Detail antenna specification please refer to antenna datasheet or an antenna gain measurement report.

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.
5. NB-IoT test method refers to 3GPP TS 36.521-1 V17.4.0 (2022-09) section 6.1. For NB-IoT tests in all operating frequency bands, standalone is used as the default operating mode unless otherwise specified by the test case.

3.2 Configuration of System under Test



3.2.1 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	Notebook	Lenovo	L440	R9-0GFJKK	N/A	Provided by Lab
B	LOAD	NA	NA	NA	N/A	Provided by Lab
C	AC charging station	LITEON	X-1193-MFD-80	NA	N/A	Provided by Client
D	Radio Communication Analyzer	Anritsu	MT8821C	6201462755	N/A	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	POWER CABLE(DC out)	1	5	Y	0	Accessory of EUT
2	RJ-45 Cable	1	1.8	N	0	Provided by Lab
3	LAN Cable	1	10	N	0	Provided by Lab
4	POWER CABLE(AC in)	1	1.8	Y	0	Accessory of EUT

3.3 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 axis. Following channel(s) was (were) selected for the final test as listed below:

GSM850

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Mode
-	ERP	128 to 251	128 (824.2MHz), 189 (836.4MHz), 251 (848.8MHz)	GSM, GPRS, EDGE
-	Radiated Emission Below 1GHz	128 to 251	251 (848.8MHz)	GSM
-	Radiated Emission Above 1GHz	128 to 251	251 (848.8MHz)	GSM

Note: For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.

Cat-M1

Cat-M1 Band 5

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	RB #
-	ERP	20407 to 20643	20407 (824.7MHz), 20525 (836.5MHz), 20643 (848.3MHz)	1.4MHz	QPSK / 16QAM	1 Full
		20415 to 20635	20415 (825.5MHz), 20525 (836.5MHz), 20635 (847.5MHz)	3MHz	QPSK / 16QAM	1 Full
		20425 to 20625	20425 (826.5MHz), 20525 (836.5MHz), 20625 (846.5MHz)	5MHz	QPSK / 16QAM	1 Full
		20450 to 20600	20450 (829.0MHz), 20525 (836.5MHz), 20600 (844.0MHz)	10MHz	QPSK / 16QAM	1 Full
-	Radiated Emission Below 1GHz	20450 to 20600	20525 (836.5MHz),	10MHz	QPSK	1
-	Radiated Emission Above 1GHz	20450 to 20600	20525 (836.5MHz),	10MHz	QPSK	1

Note:
1. This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation. Therefore, only ERP had been tested under QPSK, 16QAM mode, the other items were performed under QPSK mode only.
2. For radiated emissions, select the worst channel with the maximum power for final testing.

Cat-M1 Band 26

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	RB #
-	ERP	26797 to 27033	26797 (824.7MHz), 26915 (836.5MHz), 27033 (848.3MHz)	1.4MHz	QPSK / 16QAM	1 Full
		26805 to 27025	26805 (825.5MHz), 26915 (836.5MHz), 27025 (847.5MHz)	3MHz	QPSK / 16QAM	1 Full
		26815 to 27015	26815 (826.5MHz), 26915 (836.5MHz), 27015 (846.5MHz)	5MHz	QPSK / 16QAM	1 Full
		26840 to 26990	26840 (829.0MHz), 26915 (836.5MHz), 26990 (844.0MHz)	10MHz	QPSK / 16QAM	1 Full
		26865 to 26965	26865 (831.5MHz), 26915 (836.5MHz), 26965 (841.5MHz)	15MHz	QPSK / 16QAM	1 Full
-	Radiated Emission Below 1GHz	26865 to 26965	26915 (836.5MHz)	15MHz	QPSK	1
-	Radiated Emission Above 1GHz	26865 to 26965	26915 (836.5MHz)	15MHz	QPSK	1

Note:
1. This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation. Therefore, only ERP had been tested under QPSK, 16QAM mode, the other items were performed under QPSK mode only.
2. For radiated emissions, select the worst channel with the maximum power for final testing.

NB-IoT Band 5

EUT Configure Mode	Test item	Available channel		Tested Channel	Channel Bandwidth	Subcarrier Spacing	Modulation	Number of Subcarrier / Starting Subcarrier
-	ERP	Standalone	20402 to 20648	20402 (824.2MHz), 20525 (836.5MHz), 20648 (848.8MHz)	-	3.75kHz	BPSK	1@0 1@47
							QPSK	1@0 1@47
					-	15kHz	BPSK	1@0 1@11
							QPSK	1@0 1@11 12@0
-	Radiated Emission Below 1GHz	Standalone	20450 to 20600	20525 (836.5MHz),	-	15kHz	BPSK	1@0
-	Radiated Emission Above 1GHz	Standalone	20450 to 20600	20525 (836.5MHz),	-	15kHz	BPSK	1@0

Note: For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	22deg. C, 67%RH	120 Vac, 60 Hz	Noah CHANG
Radiated Emission Below 1GHz	22deg. C, 67%RH	120 Vac, 60 Hz	Greg Lin
Radiated Emission Above 1GHz	22deg. C, 67%RH	120 Vac, 60 Hz	Greg Lin

3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency.

3.5 General Description of Applied Standards and References

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

Test Standard:

FCC 47 CFR Part 2

FCC 47 CFR Part 22

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

References Test Guidance:

KDB 971168 D01 Power Meas License Digital Systems v03r01

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

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

Mobile / Portable station are limited to 7 watts e.r.p.

4.1.2 Test Procedures

Conducted Power Measurement:

The EUT was set up for the maximum power with GPRS, EDGE, NB-IoT and eMTC link data modulation and link up with simulator (Built-in power meter). Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator. The average (rms) power measurement was performed on emulator and power value was measured from power function on emulator. Power measurements use detector average (rms).

Maximum EIRP / ERP

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

$EIRP = P_{Meas} + G_T$

$ERP = P_{Meas} + G_T - 2.15$

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)

4.1.3 Test Setup

Conducted Power Measurement:

4.1.4 Test Results

Conducted Output Power (dBm)

Band	GSM850		
Channel	128	189	251
Frequency (MHz)	824.2	836.4	848.8
GSM	31.72	31.79	**31.80**
GPRS	31.71	31.76	31.79
EDGE	25.63	25.64	25.62

Cat-M1

Cat-M1 Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20450	20525	20600
		Frequency (MHz)		829	836.5	844
10M	QPSK	1	0	23.60	**23.85**	23.60
		1	5	23.42	23.63	23.36
		6	0	22.50	22.60	22.51
	16QAM	1	0	23.40	23.51	23.38
		1	5	23.29	23.31	23.20
		6	0	21.65	21.69	21.58
BW	MCS Index	Channel		20425	20525	20625
		Frequency (MHz)		826.5	836.5	846.5
5M	QPSK	1	0	23.43	23.56	23.49
		1	5	23.44	23.55	23.46
		6	0	22.67	22.79	22.76
	16QAM	1	0	23.41	23.54	23.42
		1	5	23.46	23.52	23.44
		6	0	21.69	21.86	21.80
BW	MCS Index	Channel		20415	20525	20635
		Frequency (MHz)		825.5	836.5	847.5
3M	QPSK	1	0	23.73	23.83	23.73
		1	5	23.76	23.75	23.84
		6	0	21.95	21.98	21.85
	16QAM	1	0	22.75	22.78	22.75
		1	5	22.36	22.41	22.37
		6	0	20.99	21.03	20.89
BW	MCS Index	Channel		20407	20525	20643
		Frequency (MHz)		824.7	836.5	848.3
1.4M	QPSK	1	0	23.63	23.74	23.73
		1	5	23.38	23.47	23.35
		6	0	21.73	21.76	21.73
	16QAM	1	0	22.47	22.53	22.46
		1	5	22.39	22.45	22.35
		6	0	20.73	20.79	20.86

Cat-M1 Band 26						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26865	26915	26965
		Frequency (MHz)		831.5	836.5	841.5
15M	QPSK	1	0	23.79	**23.85**	23.79
		1	6	23.64	23.70	23.61
		6	0	22.91	23.01	22.94
	16QAM	1	0	23.73	23.80	23.72
		1	6	23.56	23.65	23.58
		6	0	21.93	22.01	21.89
BW	MCS Index	Channel		26840	26915	26990
		Frequency (MHz)		829	836.5	844
10M	QPSK	1	0	23.75	23.80	23.75
		1	6	23.55	23.63	23.53
		6	0	22.88	22.94	22.87
	16QAM	1	0	23.64	23.76	23.71
		1	6	23.47	23.52	23.43
		6	0	21.84	21.94	21.84
BW	MCS Index	Channel		26815	26915	27015
		Frequency (MHz)		826.5	836.5	846.5
5M	QPSK	1	0	23.67	23.75	23.64
		1	6	23.56	23.64	23.57
		6	0	22.91	23.01	22.91
	16QAM	1	0	23.62	23.69	23.63
		1	6	23.49	23.56	23.44
		6	0	21.87	21.98	21.88
BW	MCS Index	Channel		26805	26915	27025
		Frequency (MHz)		825.5	836.5	847.5
3M	QPSK	1	0	23.70	23.76	23.64
		1	6	23.62	23.68	23.60
		6	0	22.82	22.91	22.81
	16QAM	1	0	23.54	23.64	23.57
		1	6	23.49	23.55	23.48
		6	0	21.86	21.97	21.92

Cat-M1 Band 26						
BW	MCS Index	Channel		26797	26915	27033
		Frequency (MHz)		824.7	836.5	848.3
1.4M	QPSK	1	0	23.74	23.81	23.70
		1	6	23.53	23.62	23.50
		6	0	22.83	22.92	22.85
	16QAM	1	0	23.57	23.63	23.55
		1	6	23.47	23.52	23.43
		6	0	21.78	21.85	21.76

NB-IoT Band 5

NB-IoT Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20402	20525	20648
		Frequency (MHz)		824.2	836.5	848.8
Stand-alone	3.75k BPSK	1	0	20.89	20.99	20.88
		1	47	21.05	21.19	21.07
	3.75k QPSK	1	0	20.84	20.96	20.86
		1	47	20.95	21.06	20.93
	15k BPSK	1	0	21.63	**21.77**	21.64
		1	11	21.61	21.71	21.57
	15k QPSK	1	0	21.65	21.76	21.61
		1	11	21.32	21.45	21.33
		12	0	19.33	19.48	19.33

ERP Power (dBm)

Band	GSM850		
Channel	128	189	251
Frequency (MHz)	824.2	836.4	848.8
GSM	31.47	31.54	**31.55**
GPRS	31.46	31.51	31.54
EDGE	25.38	25.39	25.37

*ERP = Conducted + antenna gain (1.9dBi) - 2.15

Cat-M1

Cat-M1 Band 5

Cat-M1 Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20450	20525	20600
		Frequency (MHz)		829	836.5	844
10M	QPSK	1	0	23.35	**23.60**	23.35
		1	5	23.17	23.38	23.11
		6	0	22.25	22.35	22.26
	16QAM	1	0	23.15	23.26	23.13
		1	5	23.04	23.06	22.95
		6	0	21.40	21.44	21.33
BW	MCS Index	Channel		20425	20525	20625
		Frequency (MHz)		826.5	836.5	846.5
5M	QPSK	1	0	23.18	23.31	23.24
		1	5	23.19	23.30	23.21
		6	0	22.42	22.54	22.51
	16QAM	1	0	23.16	23.29	23.17
		1	5	23.21	23.27	23.19
		6	0	21.44	21.61	21.55
BW	MCS Index	Channel		20415	20525	20635
		Frequency (MHz)		825.5	836.5	847.5
3M	QPSK	1	0	23.48	23.58	23.48
		1	5	23.51	23.50	23.59
		6	0	21.70	21.73	21.60
	16QAM	1	0	22.50	22.53	22.50
		1	5	22.11	22.16	22.12
		6	0	20.74	20.78	20.64

*ERP = Conducted + antenna gain (1.9dBi) - 2.15

Cat-M1 Band 5						
BW	MCS Index	Channel		20407	20525	20643
		Frequency (MHz)		824.7	836.5	848.3
1.4M	QPSK	1	0	23.38	23.49	23.48
		1	5	23.13	23.22	23.10
		6	0	21.48	21.51	21.48
	16QAM	1	0	22.22	22.28	22.21
		1	5	22.14	22.20	22.10
		6	0	20.48	20.54	20.61

*ERP = Conducted + antenna gain (1.9dBi) - 2.15

Cat-M1 Band 26

Cat-M1 Band 26						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26865	26915	26965
		Frequency (MHz)		831.5	836.5	841.5
15M	QPSK	1	0	23.54	**23.60**	23.54
		1	6	23.39	23.45	23.36
		6	0	22.66	22.76	22.69
	16QAM	1	0	23.48	23.55	23.47
		1	6	23.31	23.40	23.33
		6	0	21.68	21.76	21.64
BW	MCS Index	Channel		26840	26915	26990
		Frequency (MHz)		829	836.5	844
10M	QPSK	1	0	23.50	23.55	23.50
		1	6	23.30	23.38	23.28
		6	0	22.63	22.69	22.62
	16QAM	1	0	23.39	23.51	23.46
		1	6	23.22	23.27	23.18
		6	0	21.59	21.69	21.59
BW	MCS Index	Channel		26815	26915	27015
		Frequency (MHz)		826.5	836.5	846.5
5M	QPSK	1	0	23.42	23.50	23.39
		1	6	23.31	23.39	23.32
		6	0	22.66	22.76	22.66
	16QAM	1	0	23.37	23.44	23.38
		1	6	23.24	23.31	23.19
		6	0	21.62	21.73	21.63

*ERP = Conducted + antenna gain (1.1dBi) - 2.15

Cat-M1 Band 26						
BW	MCS Index	Channel		26805	26915	27025
		Frequency (MHz)		825.5	836.5	847.5
3M	QPSK	1	0	23.45	23.51	23.39
		1	6	23.37	23.43	23.35
		6	0	22.57	22.66	22.56
	16QAM	1	0	23.29	23.39	23.32
		1	6	23.24	23.30	23.23
		6	0	21.61	21.72	21.67
BW	MCS Index	Channel		26797	26915	27033
		Frequency (MHz)		824.7	836.5	848.3
1.4M	QPSK	1	0	23.49	23.56	23.45
		1	6	23.28	23.37	23.25
		6	0	22.58	22.67	22.60
	16QAM	1	0	23.32	23.38	23.30
		1	6	23.22	23.27	23.18
		6	0	21.53	21.60	21.51

*ERP = Conducted + antenna gain (1.1dBi) - 2.15

NB-IoT Band 5

NB-IoT Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20402	20525	20648
		Frequency (MHz)		824.2	836.5	848.8
Stand-alone	3.75k BPSK	1	0	20.64	20.74	20.63
		1	47	20.80	20.94	20.82
	3.75k QPSK	1	0	20.59	20.71	20.61
		1	47	20.70	20.81	20.68
	15k BPSK	1	0	21.38	21.52	21.39
		1	11	21.36	21.46	21.32
	15k QPSK	1	0	21.40	21.51	21.36
		1	11	21.07	21.20	21.08
		12	0	19.08	19.23	19.08

*ERP = Conducted + antenna gain (1.9dBi) - 2.15

4.2 Radiated Emission Measurement

4.2.1 Limits of Radiated Emission Measurement

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit equal to –13dBm.

4.2.2 Test Procedure

a. In the semi-anechoic chamber, EUT placed on the 0.8m(below or equal 1GHz) and/or 1.5m(above 1GHz) 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. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

c. Perform a field strength measurement and record the worse read value, is the field strength value via a spectrum reading obtained corrected for antenna factor, cable loss and pre-amplifier factor and then mathematically convert the measured field strength level to EIRP/ERP level.

d. Following C63.26 section 5.5 and 5.2.7
   - EIRP (dBm) = E (dBμV/m) + 20log(D) - 104.8; where D is the measurement distance (in the far field region) in m.
   - ERP (dBm) = E (dBμV/m) + 20log(D) - 104.8 - 2.15; where D is the measurement distance (in the far field region) in m.

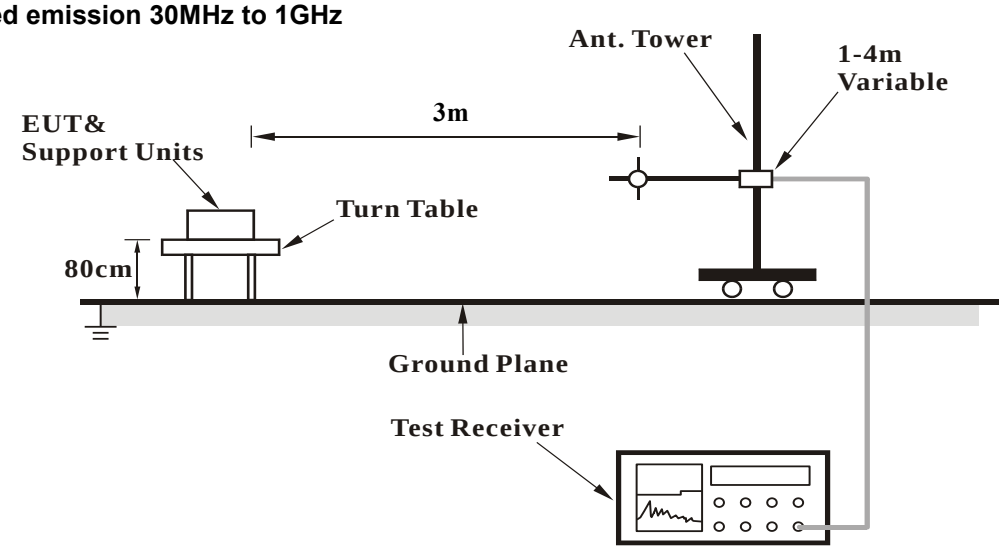
Note:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz. Set detector = average.
2. The emission levels were against the limit of frequency range 9 kHz ~ 30 MHz:
   The amplitude of spurious emissions attenuated more than 20 dB below the permissible value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

4.2.3 Deviation from Test Standard

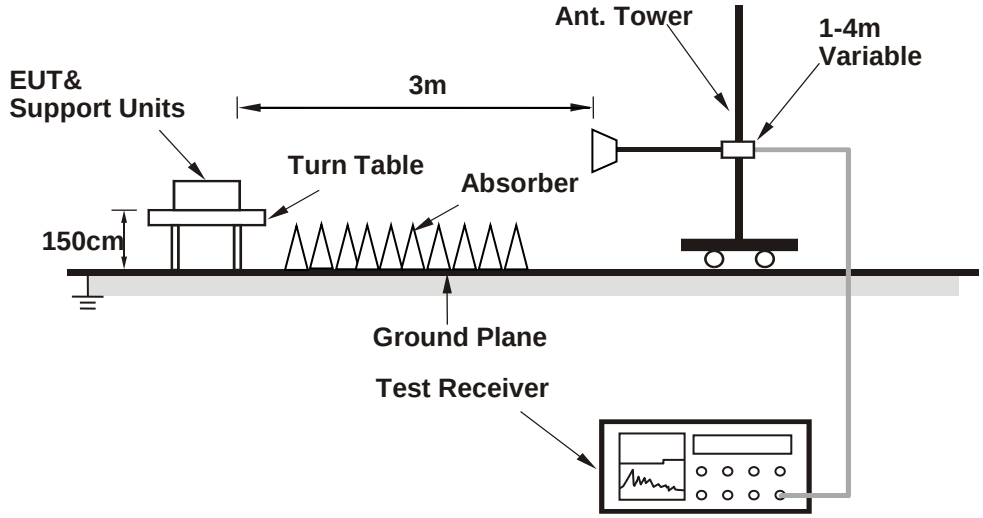
No deviation.

4.2.4 Test Setup

For radiated emission 30MHz to 1GHz



For radiated emission above 1GHz



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

4.2.5 Test Results

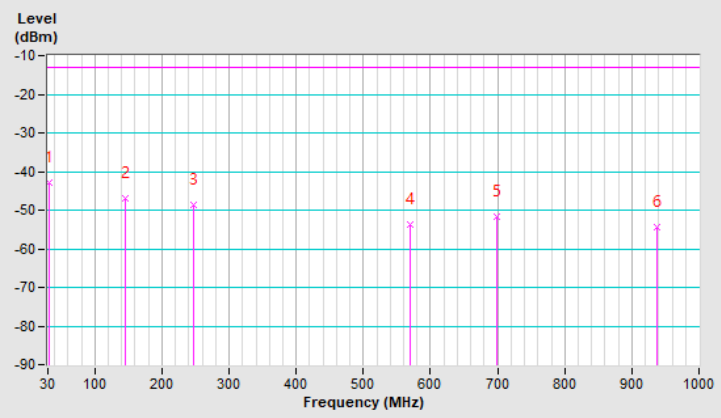
Below 1GHz
GSM850

RF Mode	TX GSM850	Channel	CH 251：848.8MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	32.91	-42.83	-13.00	-29.83	1.00 H	96	69.02	-111.85
2	144.46	-47.09	-13.00	-34.09	1.50 H	18	63.58	-110.67
3	246.31	-48.79	-13.00	-35.79	1.25 H	247	63.26	-112.05
4	570.29	-53.64	-13.00	-40.64	1.00 H	18	50.33	-103.97
5	699.30	-51.59	-13.00	-38.59	1.50 H	359	49.84	-101.43
6	936.95	-54.41	-13.00	-41.41	2.00 H	222	43.84	-98.25

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

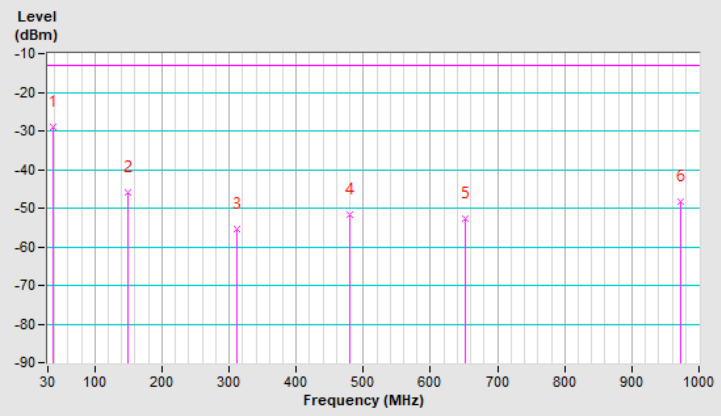


RF Mode	TX GSM850	Channel	CH 251：848.8MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	**38.73**	**-29.15**	**-13.00**	**-16.15**	**1.25 V**	**98**	**81.95**	**-111.10**
2	149.31	-46.07	-13.00	-33.07	1.00 V	271	64.40	-110.47
3	311.30	-55.38	-13.00	-42.38	1.50 V	210	54.38	-109.76
4	479.11	-51.55	-13.00	-38.55	1.00 V	33	54.06	-105.61
5	652.74	-52.66	-13.00	-39.66	1.25 V	9	49.56	-102.22
6	971.87	-48.20	-13.00	-35.20	1.00 V	2	49.49	-97.69

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.



Cat-M1

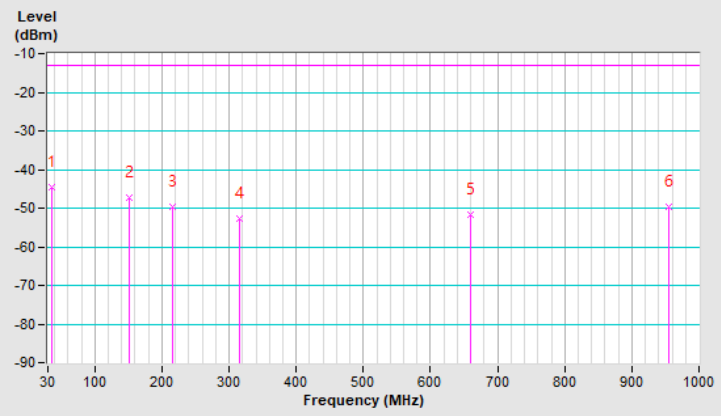
Cat-M1 Band 5, Channel Bandwidth 10MHz

RF Mode	TX Cat-M1 Band 5	Channel	CH 20525：836.5MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	36.79	-44.63	-13.00	-31.63	1.00 H	157	66.69	-111.32
2	152.22	-47.21	-13.00	-34.21	1.50 H	327	63.24	-110.45
3	215.27	-49.51	-13.00	-36.51	1.25 H	327	64.72	-114.23
4	316.15	-52.71	-13.00	-39.71	1.00 H	18	56.87	-109.58
5	659.53	-51.61	-13.00	-38.61	2.00 H	24	50.55	-102.16
6	954.41	-49.50	-13.00	-36.50	1.00 H	95	48.44	-97.94

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

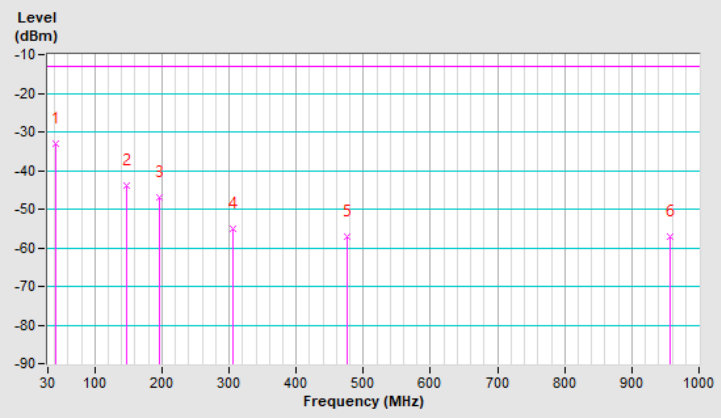


RF Mode	TX Cat-M1 Band 5	Channel	CH 20525：836.5MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	42.61	-33.18	-13.00	-20.18	1.25 V	104	77.63	-110.81
2	147.37	-43.81	-13.00	-30.81	1.00 V	68	66.69	-110.50
3	196.84	-47.07	-13.00	-34.07	1.50 V	120	67.03	-114.10
4	305.48	-55.14	-13.00	-42.14	1.25 V	162	54.81	-109.95
5	476.20	-56.97	-13.00	-43.97	1.00 V	57	48.68	-105.65
6	957.32	-57.20	-13.00	-44.20	2.00 V	207	40.69	-97.89

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.



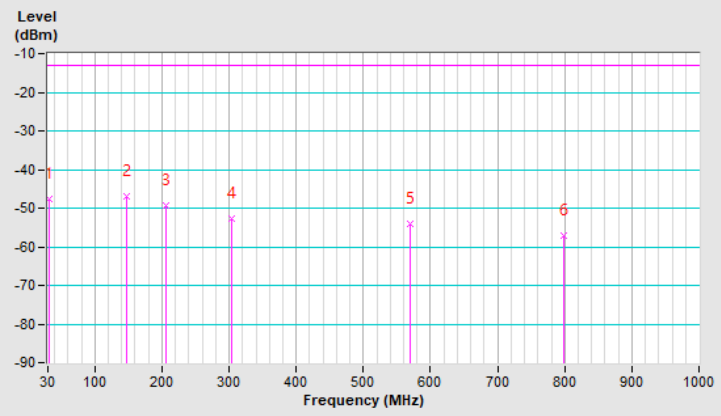
Cat-M1 Band 26, Channel Bandwidth 15MHz

RF Mode	TX Cat-M1 Band 26	Channel	CH 26915：836.5MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	31.94	-47.55	-13.00	-34.55	1.00 H	168	64.25	-111.80
2	146.40	-46.85	-13.00	-33.85	1.25 H	350	63.67	-110.52
3	205.57	-49.36	-13.00	-36.36	1.00 H	335	64.95	-114.31
4	304.51	-52.55	-13.00	-39.55	1.50 H	44	57.42	-109.97
5	569.32	-54.19	-13.00	-41.19	1.00 H	10	49.80	-103.99
6	799.21	-57.15	-13.00	-44.15	1.25 H	18	42.75	-99.90

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

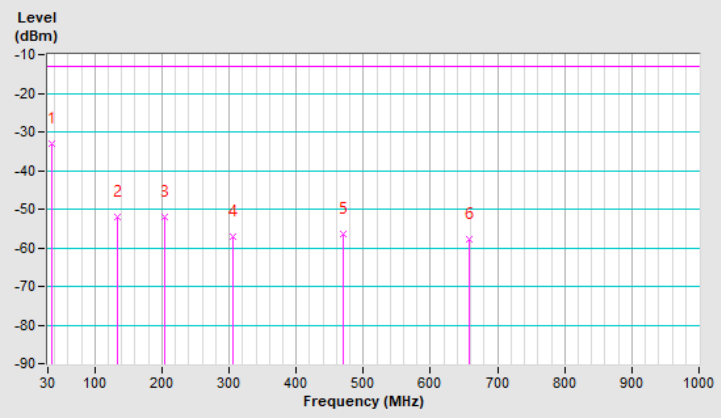


RF Mode	TX Cat-M1 Band 26	Channel	CH 26915：836.5MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	36.79	-33.19	-13.00	-20.19	1.00 V	292	78.13	-111.32
2	132.82	-52.15	-13.00	-39.15	1.25 V	131	59.40	-111.55
3	204.60	-51.90	-13.00	-38.90	1.00 V	131	62.42	-114.32
4	305.48	-56.96	-13.00	-43.96	2.00 V	143	52.99	-109.95
5	469.41	-56.48	-13.00	-43.48	1.50 V	39	49.31	-105.79
6	657.59	-57.77	-13.00	-44.77	1.25 V	294	44.41	-102.18

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.



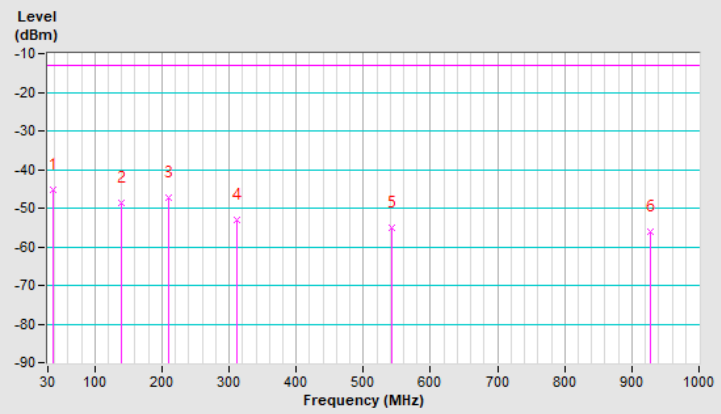
NB-IoT Band 5, Subcarrier Spacing 15kHz

RF Mode	TX NB-IoT Band 5, Subcarrier Spacing 15kHz	Channel	CH 20525：836.5MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	37.76	-45.18	-13.00	-32.18	1.00 H	345	66.07	-111.25
2	138.64	-48.72	-13.00	-35.72	1.25 H	18	62.32	-111.04
3	209.45	-47.27	-13.00	-34.27	1.00 H	230	67.03	-114.30
4	312.27	-52.95	-13.00	-39.95	2.00 H	79	56.76	-109.71
5	542.16	-54.95	-13.00	-41.95	1.25 H	351	49.66	-104.61
6	927.25	-55.98	-13.00	-42.98	2.00 H	98	42.39	-98.37

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

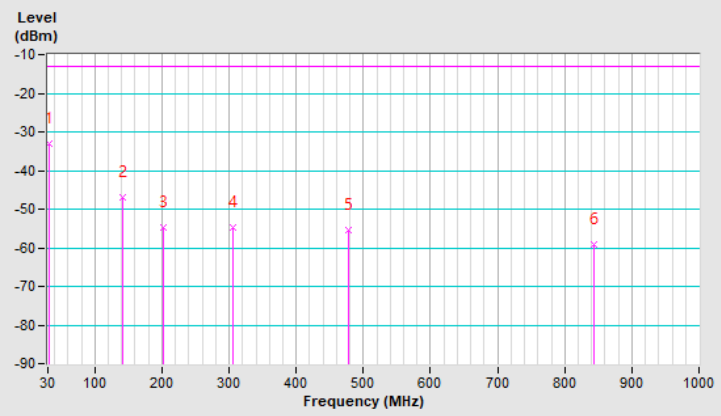


RF Mode	TX NB-IoT Band 5, Subcarrier Spacing 15kHz	Channel	CH 20525：836.5MHz
Frequency Range	30MHz ~ 1GHz		

Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	31.94	-33.12	-13.00	-20.12	1.00 V	134	78.68	-111.80
2	140.58	-46.96	-13.00	-33.96	1.25 V	13	64.00	-110.96
3	201.69	-54.68	-13.00	-41.68	1.00 V	112	59.58	-114.26
4	306.45	-54.76	-13.00	-41.76	1.50 V	179	55.16	-109.92
5	477.17	-55.40	-13.00	-42.40	1.00 V	25	50.23	-105.63
6	843.83	-59.28	-13.00	-46.28	2.00 V	31	40.05	-99.33

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.



Above 1GHz

GSM850

RF Mode	TX GSM850	Channel	CH 251：848.8MHz
Frequency Range	1GHz ~ 18GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1697.60	-38.52	-13.00	-25.52	1.16 H	97	64.87	-103.39
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1697.60	-38.25	-13.00	-25.25	1.48 V	44	65.14	-103.39

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

Cat-M1

Cat-M1 Band 5, Channel Bandwidth 10MHz

RF Mode	TX Cat-M1 Band 5	Channel	CH 20525：836.5MHz
Frequency Range	1GHz ~ 18GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1673.00	-40.99	-13.00	-27.99	1.11 H	97	62.46	-103.45
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1673.00	-40.86	-13.00	-27.86	1.38 V	43	62.59	-103.45

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

Cat-M1 Band 26, Channel Bandwidth 15MHz

RF Mode	TX Cat-M1 Band 26	Channel	CH 26915：836.5MHz
Frequency Range	1GHz ~ 18GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1673.00	-39.59	-13.00	-26.59	1.02 H	72	63.86	-103.45
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1673.00	-39.31	-13.00	-26.31	2.51 V	43	64.14	-103.45

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

NB-IoT Band 5, Subcarrier Spacing 15kHz

RF Mode	TX NB-IoT Band 5, Subcarrier Spacing 15kHz	Channel	CH 20525：836.5MHz
Frequency Range	1GHz ~ 18GHz		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1673.00	-41.31	-13.00	-28.31	1.26 H	112	62.14	-103.45
Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1673.00	-41.12	-13.00	-28.12	1.53 V	31	62.33	-103.45

Remarks:

1. ERP(dBm) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + 20log(D) – 104.8 - 2.15
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.

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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