

FCC & ISED CERTIFICATION TEST REPORT

Project Number	: EA1912C-014
Test Report Number	: TR-W1912-002
Type of Equipment	: BLE Module
Model Name	: CRM-24B
FCC ID	: CCECRM-24B
ISED Canada ID	: 22254-CRM24B
Multiple Model Name	: N/A
Applicant	: COMMAX Co., Ltd.
Address	: 494 Dunchon-Daero, Jungwon-Gu, Seongnam-si, Gyeonggi-do, South Korea
Manufacturer	: COMMAX Co., Ltd.
Address	: 494 Dunchon-Daero, Jungwon-Gu, Seongnam-si, Gyeonggi-do, South Korea
Regulation	: FCC Part 15 Subpart C Section 15.247, ISED RSS-247 Issue2
Total page of Report	: 52 Pages
Date of Receipt	: 2019-11-12
Date of Issue	: 2019-12-05
Test Result	: PASS

This test report only contains the result of a single test of the sample supplied for the examination. It is not a generally valid assessment of the features of the respective products of the mass-production.

ENG	Co., Ltd. 135-60 Gv	/eongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942	Report Form 01 (Rev.2)
Repo	rt No.: TR-W1912-0	02	Page 1 of 52
	Reviewed by	Choi, Yeong-min / Technical Man <u>ager</u> Signature	<u>2019-12-05</u> Date
		Signature	Date
	Prepared by	Song, In-young / Senior Engineer	2019-12-05

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942 TEL: +82-31-727-8300 FAX: +82-31-746-0800



CONTENTS

Page

1. TEST SUMMARY	5
1.1 REGULATIONS AND RESULTS	5
1.2 TEST METHODOLOGY	5
1.3 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS	5
1.4 PURPOSE OF THE TEST	5
2. EUT (EQUIPMENT UNDER TEST) INFORMATION	7
2.1 GENERAL DESCRIPTION	7
2.2 ADDITIONAL MODEL	7
2.3 AVAILABLE CHANNEL NUMBER AND FREQUENCY	8
3. TEST CONDITION	9
3.1 EQUIPMENT USED DURING TEST	9
3.2 MODE OF OPERATION DURING THE TEST	9
3.3 PRELIMINARY TESTING FOR WORST CASE CONFIGURATION	9
3.4 TEST SETUP DRAWING	10
3.5 EUT MODIFICATIONS	10
4. ANTENNA REQUIREMENT	11
4.1 ANTENNA DESCRIPTION	11
4.2 CONCLUSION	11
5. TEST RESULT	12
5.1 6 DB BANDWIDTH	12
5.2 99 % BANDWIDTH	15
5.3 MAXIMUM PEAK OUTPUT POWER	18
5.4 PEAK POWER SPECTRAL DENSITY	21
5.5 OUT OF BAND EMISSION	24
5.6 RADIATED EMISSION	29
5.7 AC POWER LINE CONDUCTED EMISSION	49
Report No.: TR-W1912-002	Page 2 of 52
ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942	Report Form_01 (Rev.2)

эp n_0 1 (F 2)



APPENDIX I – T	EST INSTRUMENTATION .		
----------------	-----------------------	--	--

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Page 3 of 52 Report Form_01 (Rev.2)



Release Control Record

Issue Report No.	Issued Date	Details/Revisions	
TR-W1912-002	2019-12-05	Initial Release	
-	-	-	

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

FAX: +82-31-746-0800

Page 4 of 52 Report Form_01 (Rev.2)



1. TEST SUMMARY

1.1 Regulations and results

The sample submitted for evaluation (Hereafter referred to as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference	ISED Reference			Res	sult	
Section	Section	Description	Р	F	N.T.	Note
15.247(a)(2)	RSS-247 5.2 a)	6 dB Bandwidth Occupied Bandwidth	Р			
15.247(b)(3)	RSS-247 5.4 d)	Maximum peak output power	Р			
15.247(d)	RSS-247 5.5	Band Edge Conducted spurious emission	Р			
15.247(e)	RSS-247 5.2 b)	Power spectral density	Р			
15.205(a) 15.209(a)	RSS 247 5.5 RSS-GEN 8.9	Radiated spurious emissions	Р			
15.207(a) RSS GEN 8.8		AC power line conducted emissions	Р			
Remark:						
P means Passed		F means Failed	N.T.	means No	ot Tested	

1.2 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15 and ANSI C63.10-2013, and RSS-Gen Issue 4.

KDB 558074 D01DTS Meas. Guidance v05r02: Measurement Procedure PK is used for power measurement.

1.3 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

1.4 Purpose of the test

The test was performed to determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart C Section 15.247, RGG-Gen and RSS-247.

Page 5 of 52 Report Form_01 (Rev.2) http://www.the-eng.co.kr



1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Our test facilities are accredited as a Conformity Assessment Body (CAB) by the FCC and ISED Canada, designated by the RRA (National Radio Research Agency), and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea and approved by TUV Rheinland, TUV SÜD and Korean Register of Shipping according to the requirement of ISO/IEC 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	F©
ISED Canada	12721A	*
RRA	KR0160	National Radio Research Agency
TUV Rheinland	UA 50314109-0002	TÜVRheinland
TUV SÜD	CARAT 094465 0004 Rev.00	
Korean Agency for Technology and Standards	KT733	ACTING IN ACCREDITION ACCREDITION
KOREAN REGISTER OF SHIPPING	PCT40841-TL001	ROREAN REGISTER

Remark. This report is not related to KOLAS accreditation and relevant regulation.

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Report Form_01 (Rev.2)



2. EUT (Equipment Under Test) INFORMATION

2.1 General Description

The COMMAX Co., Ltd., Model CRM-24B (referred to as the EUT in this report) is a BLE Module. The EUT is a device for transferring Bluetooth low energy signal to a Bluetooth low energy Device through wireless communication. The product specification described herein was obtained from product data sheet or user's manual.

Operating Frequency	2 402 MHz ~ 2 480 MHz	
Kind of Class	DTS – Digital Transmission System	
Max. RF Output Power	0.76 dBm	
Modulation Types	GFSK	
Number of Channels	40 CH	
Channel Bandwidth	2 MHz	
Generated or used Freq. in EUT	32.768 kHz, 16 MHz	
Type of Antenna	■ Integrated Type □ Dedicated Type	
Antenna Gain	3.90 dBi	
Operating Temperature	- 40 °C ~ + 85 °C	
Normal Test Voltage	DC 3.3 V	
Electrical Rating	DC 3.3 V	
Test SW Version	Tera Term Version 4.91	
RF power setting in TEST SW	04	
Software Version	191114	
Hardware Version	2.01	

2.2 Additional Model

None

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Page 7 of 52 Report Form_01 (Rev.2)



	3 Available channel number and frequency					
	Operating Mode: Bluetooth LE, 2 MHz Channel Spacing					
Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)	
0	2 402	14	2 430	28	2 458	
1	2 404	15	2 432	29	2 460	
2	2 406	16	2 434	30	2 462	
3	2 408	17	2 436	31	2 464	
4	2 410	18	2 438	32	2 466	
5	2 412	19	2 440	33	2 468	
6	2 414	20	2 442	34	2 470	
7	2 416	21	2 444	35	2 472	
8	2 418	22	2 446	36	2 474	
9	2 420	23	2 448	37	2 476	
10	2 422	24	2 450	38	2 478	
11	2 424	25	2 452	39	2 480	
12	2 426	26	2 454			
13	2 428	27	2 456			

2.3 Available channel number and frequency

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Page 8 of 52

Report Form_01 (Rev.2) http://www.the-eng.co.kr



3. TEST CONDITION

3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
BLE Module (EUT)	CRM-24B	N/A	COMMAX Co., Ltd.
Notebook PC	E5470	ZU10190-15008	DELL
Adapter for Notebook PC	LA65NM130	N/A	DELL

3.2 Mode of operation during the test

Software used to control the EUT for staying in continuous transmitting mode is programmed.

The used modulation type for the testing is GFSK.

3.3 Preliminary Testing for Worst case configuration

For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission tests were performed with the EUT set to transmit and receive at the channel with the highest output power as worst case scenario. All spurious emission tests were performed in X, Y and Z axis direction. And the worst Z-axis (9 kHz ~ 30 MHz), Y-axis (30 MHz ~ 1 GHz, Above 1 GHz) test condition was recorded in this test report.

Based on preliminary testing following operating modes were selected for the final test as listed below.

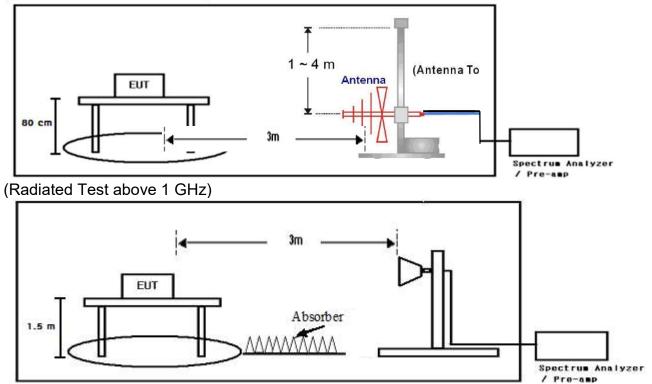
3.3.1 Test Channel and Frequency

Operating Mode	Test Channel	Frequency
	Low Channel	2 402 MHz
Bluetooth Low Energy	Middle Channel	2 440 MHz
	High Channel	2 480 MHz

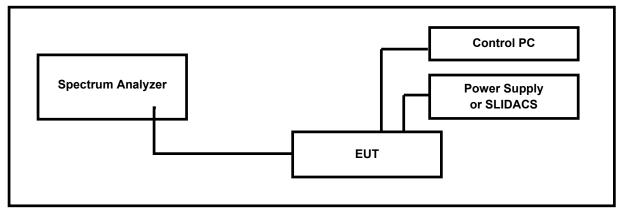


3.4 Test Setup Drawing

(Radiated Test below 1 GHz)



(Conducted Test)



3.5 EUT Modifications

- No EMC Relevant Modifications were performed by this test laboratory.

Report No.: TR-W1912-002 Page 10 of 52 ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942 TEL: +82-31-727-8300 FAX: +82-31-746-0800

Report Form_01 (Rev.2)



4. ANTENNA REQUIREMENT

According to FCC CFR 47 Part 15 section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provision of this section.

4.1 Antenna Description

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
2.4	PCB Pattern Antenna	3.90	-

4.2 Conclusion

The antenna connector type of the EUT is PCB Pattern Antenna, so the EUT met the requirement.

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

FAX: +82-31-746-0800

Page 11 of 52 Report Form_01 (Rev.2)



5. TEST RESULT

5.1 6 dB Bandwidth

5.1.1 Limit

The minimum 6 dB bandwidth shall be at least 500 kHz acc to Section 15.247 (a) (2), and RSS-247 5.2 (a).

5.1.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.2

The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW \geq 3 X RBW, peak detector and max hold.

5.1.3 Test Data

	0040 44 00	Temperature	(22.5 ± 0.5) °C
Date of Test	2019-11-29	Relative humidity	(41.1 ± 3.1) % R.H.
Test Result	PASS	Tested by	Do-heon Kim
	Operating Mod	e: Bluetooth LE	
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 402	0.74	
Middle	2 440	0.73	0.5
High	2 480	0.74	

FAX: +82-31-746-0800

Page 12 of 52 Report Form_01 (Rev.2)



5.1.4 Test Plots

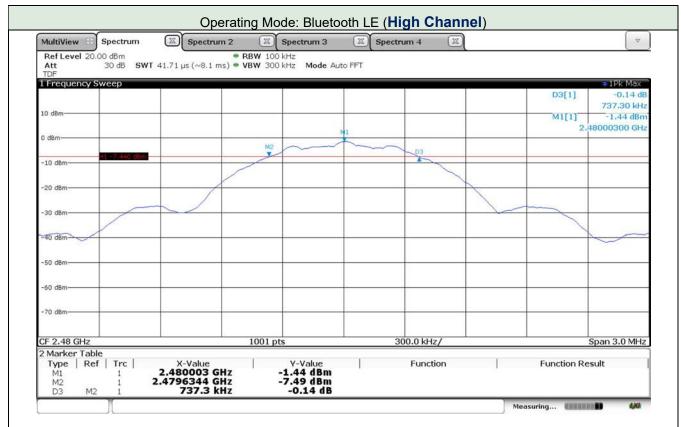


Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Page 13 of 52





ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Page 14 of 52 Report Form_01 (Rev.2)



5.2 99 % Bandwidth

5.2.1 Limit

Not applicable.

5.2.2 Method of Measurement

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1 % to 5 % of the OBW. The span is set to capture all products of the modulation process, including the emission skirts. The VBW is set to 3 times the RBW. The sweep time is coupled and peak detection and max hold mode is used. The spectrum analyzer internal 99% bandwidth function is utilized.

5.2.3 Test Data

	2010-11-20		Temperature		(22.5 ± 0.5) °C	
Date of Test	2019-11-29		Relative humidity		(41.1 ± 3.1) % F	R.H.
Test Result	PASS		Tested by		Do-heon Kim	JA
		Operational Mod	de: Bluetooth LE			
Channel		Frequen	cy (MHz)	99	99 % Bandwidth (MHz	
Low		2 4	102		1.09	
Middle		2 4	40		1.09	
High		2 4	180		1.11	

Report Form_01 (Rev.2)

TEL: +82-31-727-8300

FAX: +82-31-746-0800



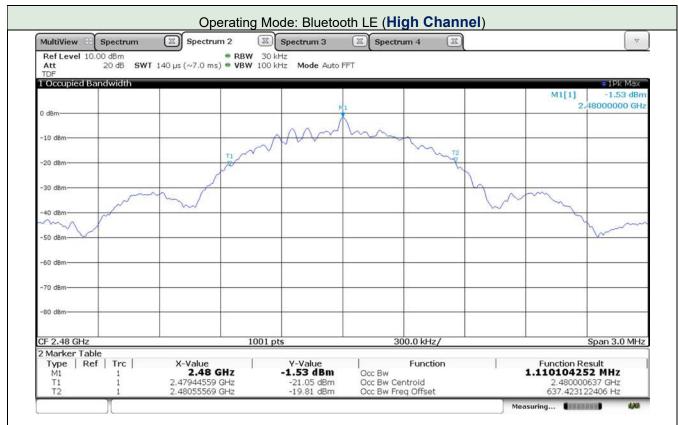
5.2.4 Test Plots



Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942





ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Page 17 of 52 Report Form_01 (Rev.2)



5.3 Maximum Peak Output Power

5.3.1 Limit

Acc. To section 15.247 and RSS-247 5.4 d), For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.3.1.1 RBW ≥ DTS bandwidth

The cable assembly insertion loss was entered as an offset in the spectrum analyzer to allow for direct reading of power.

5.3.3 Test Data for Output Power

			Temperature		(22.5 :	± 0.5) °C
Date of Test	2019-11-29	2019-11-29		dity	(41.1 :	± 3.1) % R.H.
Test Result	PASS		Tested by		Do-he	on Kim
	Ор	erating Mod	e: Bluetooth LE			-
Channel	Frequency (MHz)	Measured	d Value (dBm) Limit (dE		8m)	Margin (dB)
Low	2 402		0.76			29.24
Middle	2 440		0.22 30			29.78
High	2 480	-	1.25			31.25

Remark. Margin = Limit – Measured Value

Report No.: TR-W1912-002

Page 18 of 52

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800



5.3.4 Test Plots

MultiView	Spectrum	Spectrur	n 2 🕱	Spectrum 3	Spectru	m 4 🕱		~
Ref Level 1		= RBW						
Att TDF	20 dB SWT	1.01 ms 🖷 VBW	10 MHz Mode	e Auto Sweep				
1 Frequency	/ Sweep							1Pk Max
							M1[1]	0.76 dBr
0.40m				M1			2	40175000 GH
0 dBm	- 3							-
-10 dBm					· · · · · · · · · · · · · · · · · · ·			
								-
-20 dBm								- mail
and the second s								
-30 dBm	-		<u>.</u>				-	
-40 dBm							 	_
-50 dBm								
-60 d8m								
-70 dBm								
70 00m								
-80 dBm			2					
CF 2,402 GH	12		1001 pt	te		0 MHz/	1	Span 10.0 MH
		Oper					 asuring C	
			rating Mod	le: Bluetoot	th LE (Mid	dle Char	 asuring 🖬 🌆	
MultiView 8)[Spectrur	rating Mod			dle Char	 asuring E M	
MultiView B Ref Level 1 Att	Spectrum 0.00 dBm	Spectrur	rating Mod	le: Bluetoot Spectrum 3	th LE (Mid	dle Char	 asuring (
MultiView B Ref Level 1 Att TDF	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetoot Spectrum 3	th LE (Mid	dle Char	 asuring (
MultiView B Ref Level 1 Att	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetoot Spectrum 3	th LE (Mid	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView P Ref Level 1 Att TDF 1 Frequency	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetoot Spectrum 3	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView B Ref Level 1 Att TDF	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView B Ref Level 11 Att TDF I Frequency 0 dBm-	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView P Ref Level 1 Att TDF 1 Frequency	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView B Ref Level 11 Att TDF I Frequency 0 dBm-	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView B Ref Level 11 Att TDF I Frequency 0 dBm-	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView 8 Ref Level 10 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0,22 dBr
MultiView 8 Ref Level 10 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView 8 Ref Level 10 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView 8 Ref Level 10 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView E Ref Level 11 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView P Ref Level 11 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView E Ref Level 11 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView Product Ref Level 11 Att TDF I Frequency 0 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView P Ref Level 11 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView Product Ref Level 11 Att TDF IFrequency 0 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView Product Ref Level 11 Att TDF I Frequency 0 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView B Ref Level 11 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView Product Ref Level 11 Att TDF IFrequency 0 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView B Ref Level 11 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT	Spectrur RBW	rating Mod	le: Bluetool Spectrum 3 e Auto Sweep	th LE (Mid Spectru	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 0.22 dBr 0.43995000 GH 0.439950000 GH 0.43995000 GH 0.43995000 GH 0.43995000 GH
MultiView B Ref Level 11 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SWT /Sweep	Spectrur RBW	rating Mod	le: Bluetoot Spectrum 3 e Auto Sweep	th LE (Mid	dle Char	 M1[1]	• 1Pk Max 0.22 dBr 2,43995000 GH

Report No.: TR-W1912-002

TEL: +82-31-727-8300

FAX:

Report Form_01 (Rev.2)



MultiView	Spectrum	Spectrum 2	Spectrum 3	Spectrum 4	X		▽
Ref Level 1 Att TDF		● RBW 3 MH 1.01 ms ● VBW 10 MH					
1 Frequency	Sweep					• 1	Pk Max
						M1[1] -1 2.47978	.25 dBi
0 dBm			M1			2,47970	500 GH
-10 dBm							
20 000							
-20 dBm							
20 doni							n.
-30 dBm							×
50 Ubii							
-40 dBm							
40 000							
~50 dBm			-				
-50 0611-							
-60 dBm							
00 0011							
-70 dBm							
- 70 dbm			· · · · · · · · · · · · · · · · · · ·				
~80 dBm							
-00 06/1-							

Page 20 of 52

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

FAX: +82-31-746-0800

Report Form_01 (Rev.2)



5.4 Peak Power Spectral Density

5.4.1 Limit

Acc. To section 15.247 and RSS-247 5.2 b), the power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.4.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.4 Method PKPSD (peak PSD).

The transmitter output is connected to a spectrum analyzer with the RBW set from 3 kHz to 100 kHz, VBW \geq 3 X RBW, peak detector and max hold.

5.4.3 Test Data

			Temperature		(22.5 :	± 0.5) °C
Date of Test	2019-11-29	2019-11-29		Relative humidity		± 3.1) % R.H.
Test Result	PASS		Tested by		Do-he	on Kim
		Operating Mod	le: Bluetooth LE			
Channel	Frequency (MHz) Measure	d Value (dBm)	Limit (dB	m)	Margin (dB)
Low	2 402		-9.77			17.77
Middle	2 440		-10.76			18.76
High	2 480	-	12.44			20.44

Remark. Margin = Limit – Measured Value

Report Form_01 (Rev.2)

TEL: +82-31-727-8300

FAX: +82-31-746-0800



5.4.4 Test Plots

MultiView	Spectrum	Spectru	m 2 🖾	Spectrum 3	Spectru	um 4 🛛 🖾)		▼
Ref Level 1			• RBW 3 kH						
Att TDF	20 dB SW1	1.4 ms (~9.6 ms) • VBW 10 kH	z Mode Auto F	FT				
1 Frequency	Sweep								1Pk Max
								M1[1]	-9.77 dBn 2.40199453 GH
0 dBm									
				м					
-10 d8m									
					hand				
-20 d8m	A	harmon	mmm	www. how	Manny	Marine	Wannas	Man	
	many	Marine					1	when	nomme
-80 dBm									www
-40 dBm								_	
-50 dBm			-	-					
-60 dBm	-							_	
-70 dBm								-	
-80 dBm	-	~						_	
05.0 105 5					-				1.1000
CF 2.402 GH	Z		1001 pt	5	1.	10.6 kHz/			an 1.10595 MH
		Оре	rating Mod	e: Bluetoo	th LE (Mic	Idle Chai		leasuring 💷	
MultiView 8	Spectrum	Ope (Spectrue		e: Bluetoo Spectrum 3	th LE (Mic			leasuring	
Ref Level 1	0.00 dBm	Spectru	m 2 🖾	Spectrum 3	Spectru			leasuring	
Ref Level 10 Att TDF	0.00 dBm 20 dB SW 1		m 2 🖾	Spectrum 3	Spectru			leasuring	Ū. Ţ
Ref Level 1 Att	0.00 dBm 20 dB SW 1	Spectru	m 2 🖾	Spectrum 3	Spectru				• iPk Max
Ref Level 10 Att TDF	0.00 dBm 20 dB SW 1	Spectru	m 2 🖾	Spectrum 3	Spectru			M1[1]	• iPk Max
Ref Level 10 Att TDF	0.00 dBm 20 dB SW 1	Spectru	m 2 🖾	Spectrum 3	Spectru				● 1Pk Max -10.76 dBr
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾			● 1Pk Max -10.76 dBr
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾			● 1Pk Max -10.76 dBr
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectru	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	● 1Pk Max -10.76 dBr
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 11 Att TDF 1 Frequency 0 dBm-	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 0 dBm -10 dBm -20 dBm -20 dBm -30 dBm -40 dBm -50 dBm	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -70 dBm -40 dBm	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 0 dBm -10 dBm -20 dBm -20 dBm -30 dBm -40 dBm -50 dBm	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 0 dBm -10 dBm -20 dBm -20 dBm -30 dBm -40 dBm -50 dBm	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 0 d8m -10 d8m -20 d8m -20 d8m -20 -30 d8m -40 -50 d8m	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 0 d8m -10 d8m -20 d8m -20 d8m -20 -30 d8m -40 -50 d8m	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF 1 Frequency 0 d8m -10 d8m -20 d8m -20 d8m -30 d8m -40 d8m -50 d8m -60 d8m -70 d8m	20 dB SW1	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 z Mode Auto F	Spectru	um 4 🛛 🖾		M1[1]	
Ref Level 10 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm	Sweep	Spectrue (~9.6 ms	■ 2 図 ■ RBW 3 kH = VBW 10 kH	Spectrum 3 Z Mode Auto F M M M M M M M M M M M M M M M M M M M	Spectra FT	um 4 🛛 🖾			 ■ 1Pk Max -10.76 dBr 2.43999458 GH

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

FAX: +82-31-746-0800

Page 22 of 52 Report Form_01 (Rev.2)



MultiView	Spectrum	Spectrum	12 🕱	Spectrum 3	Spectru	im 4 🕱			~
Ref Level 10. Att TDF		1.4 ms (~9.6 ms)	 RBW 3 k VBW 10 k 		FFT				
1 Frequency S	Sweep							M1[1]	 1Pk Max -12.44 dBn 48000222 GH
0 dBm									
-10 d8m				-	N1				
-20 dBm	a	Montan	AMAY	MANNAN	howard	WWW WWW	MAMM	mwww	
-30 dep My	MANA .				`			WWW	mont
-40 dBm									
-50 dBm									
1.00 M									
-60 dBm									
-70 dBm									
-80 dBm									
CF 2.48 GHz			1001 r			0.6 kHz/			1.10595 MHz

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800



5.5 Out of Band Emission

5.5.1 Limit

Acc. To section 15.247(d) and RSS-247 5.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

5.5.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.5 Emissions in non-restricted frequency bands. The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW \geq 3 X RBW, peak detector and max hold. Measurements utilizing these settings are made of the in-band reference level, band-edge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

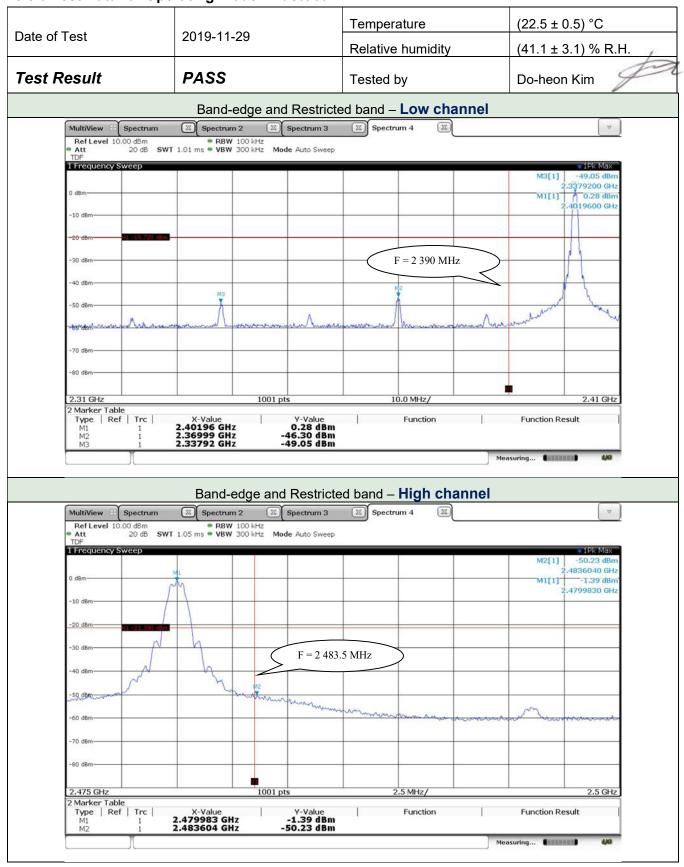
Page 24 of 52 Report Form_01 (Rev.2)

TEL: +82-31-727-8300

FAX: +82-31-746-0800



5.5.3 Test Data for Operating mode: Bluetooth LE



Report No.: TR-W1912-002

Page 25 of 52

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report Form_01 (Rev.2) http://www.the-eng.co.kr



MultiView	Spectrum	Spect	trum 2	Spectrum 3	Spectru	um 4 🖾			V
Ref Level 1	0.00 dBm	• R	BW 100 kHz	_(·)			
Att TDF	20 dB SW	T 24.7 ms 🖷 V	' BW 300 kHz	Mode Auto Sweep					
1 Frequency	Sweep							MELTI	1Pk Max 50.00 dPa
								M5[1]	-50.89 dBr
0 dBm								M1[1]	0.28 dBr
-10 dBm									2.40250 GH
-20 dBm-									
-30 dBm									
-40 dBm									
40 0011									M2 M5 ^{M3} M4
-50 dBm									TILL
-69. 9800	and sugar add to got the	annon	and monteners	andread	dendumperen.			muchel	phillip Mr
A Charles and a second s				an she want	all and a comparison of	president and and a second	ale marine and the		
-70 dBm									
-80 dBm	-								
30.0 MHz		1	10	01 pts	24	7.0 MHz/			2.5 GH
2 Marker Ta Type R		X-Value		Y-Value	1	Function	1	Function Re	sult
M1	1	2.4025 G 2.3705 G	iHz	0.28 dBm -46.79 dBm	•		31		
M2 M3	1	2.3384 G	Hz	-49.33 dBm					
M4 M5	1	2.4346 G 2.3063 G		-50.04 dBm -50.89 dBm					
							211		
][Non-re	estricted band	– Low Ch	annel (2)	,	asuring Man	4,40
		<u> </u>		estricted band			,	osuring 🖬 🌆	
MultiView	Spectrum		trum 2	estricted band	- Low Ch		,	asuring 🕊 🗰	
Ref Level 1 Att	.0.00 dBm	• RI	trum 2 BW 100 kHz				,	osuring Man	
Ref Level 1	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	osuring U	
Ref Level 1 Att TDF	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	 1Pk Max -38.96 dBr
Ref Level 1 Att TDF	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GH
Ref Level 1 Att TDF 1 Frequency 0 dBm-	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,		● 1Pk Max -38.96 dBr 7.2090 GF -24.83 dBr
Ref Level 1 Att TDF 1 Frequency	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GF -24.83 dBr
Ref Level 1 Att TDF 1 Frequency 0 dBm-	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GF -24.83 dBr
Ref Level 1 Att TDF I Frequency 0 dBm	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr
Ref Level 1 Att TDF JFrequency 0 dBm	0.00 dBm 20 dB SW	■ Ri T 225 ms ■ VE	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr
Ref Level 1 Att TDF I Frequency 0 dBm	0.00 dBm 20 dB SW	■ Ri T 225 ms ■ VE	trum 2 BW 100 kHz BW 300 kHz	Spectrum 3			,	M2[1]	● 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm	0.00 dBm 20 dB SW	■ Ri T 225 ms ■ VE	trum 2 BW 100 kHz	Spectrum 3			,	M2[1]	▼ ■ 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	Sweep	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz M3	Spectrum 3 Mode Auto Sweep			,	M2[1] M1[1]	● 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	0.00 dBm 20 dB SW	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz	Spectrum 3 Mode Auto Sweep		Jm 4 🖾		M2[1] M1[1]	▼ ■ 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	Sweep	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz M3	Spectrum 3 Mode Auto Sweep		Jm 4 🖾		M2[1] M1[1]	▼ ■ 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm -50 dBm -70 dBm	Sweep	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz M3	Spectrum 3 Mode Auto Sweep		Jm 4 🖾		M2[1] M1[1]	▼ ■ 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF I Frequency 0 d8m -10 d8m -20 d8m -30 d8m -40 d8m -50 d8m -50 d8m	Sweep	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz M3	Spectrum 3 Mode Auto Sweep		Jm 4 🖾		M2[1] M1[1]	 ■ 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -50 dBm -50 dBm -70 dBm -70 dBm -70 dBm -80 dBm	Sweep	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz M3	Spectrum 3 Mode Auto Sweep	Spectra	um 4 🗵		M2[1] M1[1]	▼ • 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm -50 dBm -70 dBm	Sweep	• Ri • Ri • Ri • Ri • Vi	trum 2 BW 100 kHz BW 300 kHz M3	Spectrum 3 Mode Auto Sweep	Spectra	Jm 4 🖾		M2[1] M1[1]	▼ ■ 1Pk Max -38.96 dBr 7.2090 GH -24.83 dBr 4.8040 GH
Ref Level 1 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm -50 dBm -50 dBm -50 dBm -50 dBm -70 dBm -80 dBm -30 dBm -70 dBm -70 dBm -70 dBm -80 dBm 2.5 GHz 2 Marker Tai Type R	Sweep	M2 M2 X-Value	trum 2 BW 100 kHz BW 300 kHz M3 M3 M3 M3 10	Spectrum 3 Mode Auto Sweep	Spectra	um 4 🗵		M2[1] M1[1]	
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm -50 dBm -70 dBm -70 dBm -80 dBm -30 dBm	Sweep	M2 M2	trum 2 (BW 100 kHz BW 300 kHz M3 M3 M3 M3 M3 M3 M3 M3 M3 M3 M3 M3 M3	Spectrum 3 Mode Auto Sweep	Spectra	JIM 4		M2[1] M1[1]	

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Page 26 of 52



MultiView	Spectrum	Spect	trum 2	Spectru	ım 3 🖾 S	pectrum 4	(II)			▼
Ref Level 1	0.00 dBm	• R	BW 100 kH							
Att TDF	20 dB SW	ſ24.7 ms 🖷 V	'BW 300 kH	iz Mode Auto	Sweep					
1 Frequency	Sweep								MELTI	1Pk Max 51.20 dB
										-51.39 dBi
0 dBm									M1[1]	-0.42 dBr
-10 dBm									2	.43950 GH
-20 d8m-	H1 - 19,580 dBm	_								
-30 dBm										
-40 dBm	-	-								M2 (
-50 dBm										M4M3
	14 00000	-	2	50000					. 1.	1. Lake
-60 dere	mater remained	War manufactured	Bruch Market	mounterman	and a second market	manna	monorena	month man water and	annealer	ULLLAMP W
-70 dBm										
00 dbe:										
-80 dBm										
30.0 MHz				1001 pts		247.0 MHz/	/			2.5 GH
2 Marker Tal		v vala			hun I	F				1.
Type Re M1	er 1rc 1	X-Value 2.4395 G	iHz	-0.42	dBm	Functio	n	Fun	ction Resu	It
M2 M3	1	2.4075 G 2.3754 G	iHz	-47.36 -50.68	dBm					
M4 M5	1	2.3433 G 2.4716 G		-51.17 -51.39						
	Y							1		
			Non-re	estricted ba	and – Middl	e Chann	el (2)	Measuring	CERTIFIC	. 490
MultiView	Spectrum	Spect				0.0000000000000000000000000000000000000		Measuring		
MultiView	Spectrum 0.00 dBm	-	trum 2	Spectru		e Chann pectrum 4	el (2)	Measuring		, 400
Ref Level 1 Att	0.00 dBm	• RI	trum 2 BW 100 kH:	Spectru	ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring		
Ref Level 1	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring		v • 1Pk Max
Ref Level 1 Att TDF	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	M3[1]	● 1Pk Max -52.79 dBr
Ref Level 1 Att TDF	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF 1 Frequency	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	■ 1Pk Max -52.79 dBr 9.7490 GH
Ref Level 1 Att TDF IFrequency 0 dBm	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF IFrequency 0 dBm	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm	0.00 dBm 20 dB SW	• RI	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 dBm	0.00 dBm 20 dB SW	● Ri f 225 ms ● VE	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm	0.00 dBm 20 dB SW	● Ri f 225 ms ● VE	trum 2 BW 100 kH:		ım 3 🖾 S	0.0000000000000000000000000000000000000		Measuring	мз[1] м1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	0.00 dBm 20 dB SW	• RI F 225 ms • VE	trum 2 BW 100 kH; BW 300 kH;	Z Mode Auto S	ım 3 🖾 S	A. A.		Measuring	M3[1] M1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	0.00 dBm 20 dB SW	• RI F 225 ms • VE	trum 2 BW 100 kH; BW 300 kH;	Z Mode Auto S	ım 3 🖾 S	A			M3[1] M1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF 1 Frequency 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm	Sweep	• RI • 225 ms • VE	trum 2 BW 100 kH; BW 300 kH;	Z Mode Auto S	ım 3 🖾 S	A. A.			M3[1] M1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -50 dBm -50 dBm -70 dBm	Sweep	• RI • 225 ms • VE	trum 2 BW 100 kH; BW 300 kH;	Z Mode Auto S	ım 3 🖾 S	A. A.			M3[1] M1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 d8m -10 d8m -30 d8m -30 d8m -40 d8m -50 d8m	Sweep	• RI • 225 ms • VE	trum 2 BW 100 kH; BW 300 kH;	Z Mode Auto S	ım 3 🖾 S	A. A.			M3[1] M1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 d8m -10 d8m -20 d8m -30 d8m -40 d8m -50 d8m -50 d8m -70 d8m -70 d8m -80 d8m	Sweep	• RI • 225 ms • VE	M3	Spectru Z Mode Auto	ım 3 🖾 S	pectrum 4			M3[1] M1[1]	
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -50 dBm -50 dBm -70 dBm	Sweep	• RI • 225 ms • VE	M3	Z Mode Auto S	ım 3 🖾 S	A. A.			M3[1] M1[1]	 ■ 1Pk Max -52.79 dBr 9.7490 GH -28.86 dBr
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -50 dBm -50 dBm -70 dBm -80 dBm -80 dBm 2.5 GHz 2 Marker Tal Type R	Sweep	RI R	trum 2 BW 100 kH; BW 300 kH;	Spectru Z Mode Auto S O	Im 3 I S	pectrum 4			M3[1] M1[1]	1Pk Max -52.79 dBi 9.7490 GH -28.86 dBi 4.8710 GH 4.8710 GH 25.0 GH 25.0 GH
Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm -40 dBm -50 dBm -70 dBm -80 dBm -80 dBm -30 dBm	Sweep	• RI • 225 ms • VE	Hz	Spectru Z Mode Auto	Im 3 I S Sweep	2.25 GHz/			M3[1] M1[1]	1Pk Max -52.79 dBi 9.7490 GH -28.86 dBi 4.8710 GH 4.8710 GH 25.0 GH 25.0 GH



MultiView	Spectrum	X	Spectru	m 2	X	Spectrum 3	Spectru	um 4 🕱)		▼
Ref Level 1	0.00 dBm		· RBW	/ 100 kH	iz Iz				L		
Att TDF	024300-00100 - 540404 0204	T 24.7 1	ms 🖷 VBW	/ 300 kH	z Moo	le Auto Sweep					
1 Frequency	Sweep									MELT	1Pk Max
13-12-07										M5[1]	-52.14 dBr 2.38280 GH
0 dBm										M1[1]	-1.91 dBr
-10 dBm				-							2,47900 GH
-20 dBm											
-20 dbm-	H1 21.390 dBm										
-30 dBm		-		-		-					
-40 dBm											
											M2 M4M5M3 ¥
-50 dBm											III
-60 dBm	with man with a service and	mehre	reger Wondyng	manghing	markey	A Maria La como		1		rennersebotheton	الالعامالياليالي
and						alle to day and when the	and a second second second	en an	-		
-70 dBm											
-80 dBm	-	-					· · · · · · · · ·				
30.0 MHz		10 A		1	1001 pt	s	24	7.0 MHz/		- 10 	2.5 GH
2 Marker Tal Type Re		х	-Value		1	Y-Value	1	Function	1	Function Re	sult
M1 M2	1		479 GH			-1.91 dBm 48.91 dBm	20		24		
M3	1	2.4:	149 GH:	z	-	51.79 dBm					
M4 M5	1		532 GH			52.05 dBm 52.14 dBm					
MD		2.34	328 GH				High Ck	annal (2	,	easuring E	4,86
				Non-r	estric	cted band -	- High Ch		,	easuring 🖣 🖬	
MultiView	Spectrum	2.3	Spectru	Non-r	restric		- High Cl		,	easuring	**
MultiView Ref Level 1 Att	Spectrum 0.00 dBm	X	Spectrue RBW	Non-r m 2		cted band -			,	easuring	
MultiView Ref Level 1	Spectrum 0.00 dBm 20 dB SW	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	easuring	
MultiView Ref Level 1 Att TDF	Spectrum 0.00 dBm 20 dB SW	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	 ▼ 1Pk Max -53.38 dBr
MultiView Ref Level 1 Att TDF	Spectrum 0.00 dBm 20 dB SW	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,		⊽ ● 1Pk Max
MultiView Ref Level 1 Att TDF 1 Frequency	Spectrum 0.00 dBm 20 dB SW	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	 ■ 1Pk Max -53.38 dBr 2.5000 GH
MultiView B Ref Level 1 Att TDF 1 Frequency 0 d8m	Spectrum 0.00 dBm 20 dB SW	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	● 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr
MultiView Ref Level 1 Att TDF I Frequency 0 dBm-	Spectrum 0.00 dBm 20 dB SW	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	● 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr
MultiView B Ref Level 1 Att TDF 1 Frequency 0 d8m	Spectrum 0.00 dBm 20 dB SW Sweep	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	● 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr
MultiView Ref Level 1 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SW	3 T 225 n	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	● 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr
MultiView B Ref Level 1 Att TDF 1 Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SW Sweep	X	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	● 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr
MultiView Ref Level 1 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SW Sweep	3 T 225 n	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	 • 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView Bef Level 1 Att TDF 1 Frequency 0 d8m -10 d8m	Spectrum 0.00 dBm 20 dB SW Sweep	T 225 n	Spectrue RBW	Non-r m 2		cted band - Spectrum 3			,	M4[1]	● 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr
MultiView Ref Level 1 Att TDF I Frequency 0 d8m -10 d8m -20 d8m -30 d8m -40 d8m	Spectrum 0.00 dBm 20 dB SW Sweep	T 225 n	Spectrum RBW S VBW	Non-r m 2 100 kHz 300 kHz		cted band - Spectrum 3		um 4 🐹	,	M4[1] M1[1]	 • 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView Bef Level 1 Att TDF 1 Frequency 0 d8m -10 d8m	Spectrum 0.00 dBm 20 dB SW Sweep	T 225 n	Spectrum RBW S VBW	Non-r m 2 100 kHz 300 kHz		cted band - Spectrum 3		um 4 🐹	,	M4[1] M1[1]	 • 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView President Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -10 dBm -20 dBm -20 dBm -30 dBm -30 dBm -40 dBm -40 dBm -50 dBm -70 dBm -70 dBm	Spectrum 0.00 dBm 20 dB SW Sweep	T 225 n	Spectrum RBW S VBW	Non-r m 2 100 kHz 300 kHz		cted band - Spectrum 3		um 4 🐹	,	M4[1] M1[1]	 • 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView Control Cont	Spectrum 0.00 dBm 20 dB SW Sweep	T 225 n	Spectrum RBW S VBW	Non-r m 2 100 kHz 300 kHz		cted band - Spectrum 3		um 4 🐹	,	M4[1] M1[1]	 • 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView Prefixed 1 Att TDF I Frequency 0 0 dBm - -10 dBm - -20 dBm - -30 dBm - -40 dBm - -50 dBm - -70 dBm - -80 dBm -	Spectrum 0.00 dBm 20 dB SW Sweep	T 225 n	Spectrum RBW S VBW	Non-r m 2 300 kHz	Z Mod	cted band - Spectrum 3 e Auto Sweep	Spectru	um 4 🐹	,	M4[1] M1[1]	• 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView President Ref Level 1 Att TDF I Frequency 0 dBm -10 dBm -10 dBm -20 dBm -20 dBm -30 dBm -30 dBm -40 dBm -40 dBm -50 dBm -70 dBm -70 dBm	Spectrum 0.00 dBm 20 dB SW SWeep	T 225 n	Spectrum RBW S VBW	Non-r m 2 300 kHz		cted band - Spectrum 3 e Auto Sweep	Spectru	um 4 🐹	,	M4[1] M1[1]	 • 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH
MultiView Bit Ref Level 1 Att TDF I Frequency 0 dBm	Spectrum 0.00 dBm 20 dB SW SWeep	X	Spectrum RBW S VBW	Non-r m 2 100 kHz 300 kHz	Z Mod	Cted band - Spectrum 3 e Auto Sweep	Spectru	um 4 🐹	,	M4[1] M1[1]	 ■ 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr -36.59 dBr -4.9610 GH -4.9610 GH -25.0 GH
MultiView B Ref Level 1 Att TDF IFrequency 0 d8m	Spectrum 0.00 dBm 20 dB SW Sweep	X X X X X X X X X X X X X X	Spectrum RBW S VBW	Non-r m 2 100 kHz 300 kHz	estric Z Mod	s	Spectru	um 4 🗵	,	M4[1] M1[1]	 ■ 1Pk Max -53.38 dBr 2.5000 GH -36.59 dBr 4.9610 GH -4.9610 GH -25.0 GH

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report Form_01 (Rev.2)

Page 28 of 52



5.6 Radiated Emission

5.6.1 Limit

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	24

Acc. To section 15.205, 15.209, RSS-GEN 8.9, following table shall be applied.

5.6.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.6 Radiated emission measurements. The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm for below 1 GHz and 1.5 m for above 1 GHz above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 25 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to 2 I/T, where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.



5.6.3 Test Site Requirement for KDB 414788 D01

Acc. to KDB 414788 D01 Radiated Test Site v01, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we *declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 414788 D01 Radiated Test Site v01*.

5.6.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	$\pm 2.6~\mathrm{dB}$	30 MHz ~ 1 GHz	$\pm4.5~\mathrm{dB}$
1 GHz ~ 18 GHz	\pm 5.0 dB	18 GHz ~25 GHz	\pm 5.2 dB

5.6.5 Sample Calculated Example

At 80 MHz

Limit = 40.0 dBuV/m

Result (dBuV/m)

= Receiver Reading (dBuV) + Antenna Factor (dB/m) - Pre-amplifier Gain (dB) + Cable Loss (dB) = 30

Margin = Limit – Result = 40 - 30 = 10

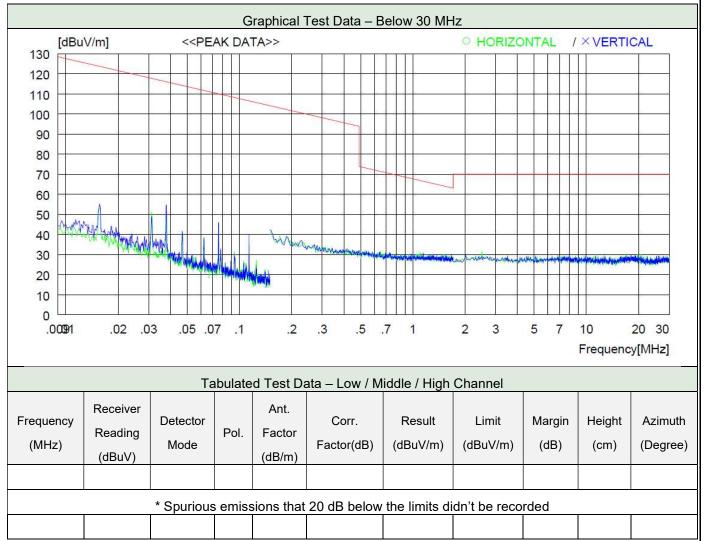
so the EUT has 10.0 dB margin at 80 MHz



5.6.6 Test Data

Date of Test	2019-12-02	2019-12-02		Temperature		(22.1 ± 2.7) °C	
				Relative humidity		(40.9 ± 5.9) % R.H.	
Measurement Frequ	uency Range		9 kHz ~ 2	5 GHz			525
Test Result	PASS		Tested By	1		Do-heon Kim	JA
Frequency range	Detector Mode	Reso	olution BW	Video BW	Vi	deo Filtering	Measurement distance
Below 30 MHz	Peak or Q.P.		9 kHz	100 kHz		-	3 m
30 MHz ~ 1 000 MHz	Peak or Q.P.	1	00 kHz	300 kHz		-	3 m
	Peak	1 MHz		3 MHz			3 m
Above 1 GHz	Average		1 MHz	3 MHz			3 m

5.6.6.1 Test Data below 30 MHz



Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Page 31 of 52

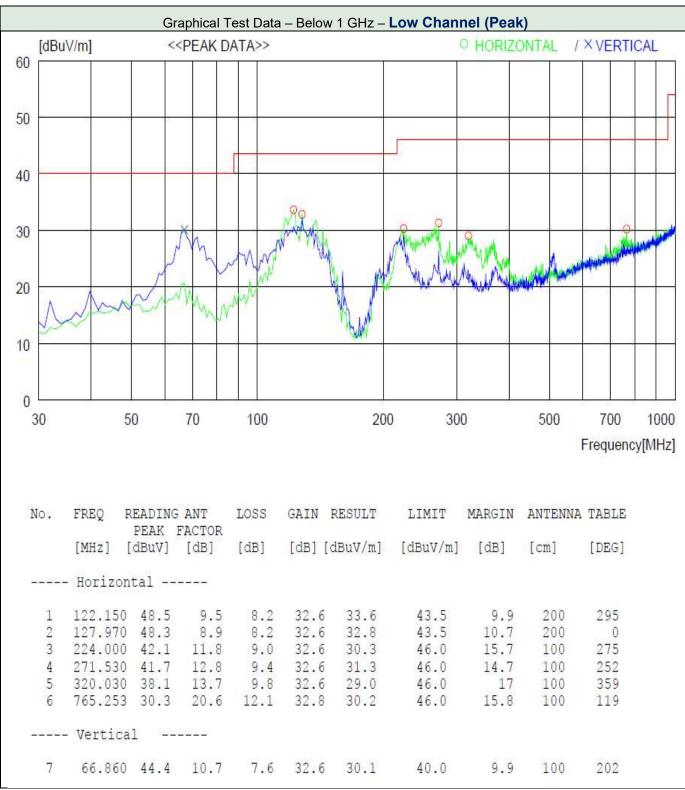
http://www.the-eng.co.kr

TEL: +82-31-727-8300

FAX: +82-31-746-0800

Report Form_01 (Rev.2)





5.6.6.2 Test Data from 30 MHz to 1 GHz

Report No.: TR-W1912-002

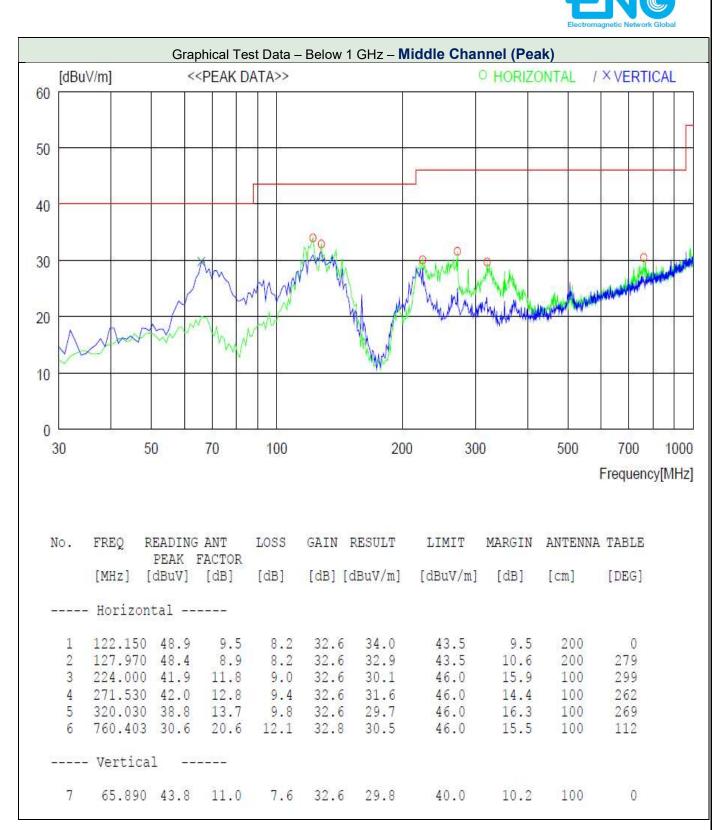
Page 32 of 52

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report Form_01 (Rev.2)

TEL: +82-31-727-8300

FAX: +82-31-746-0800



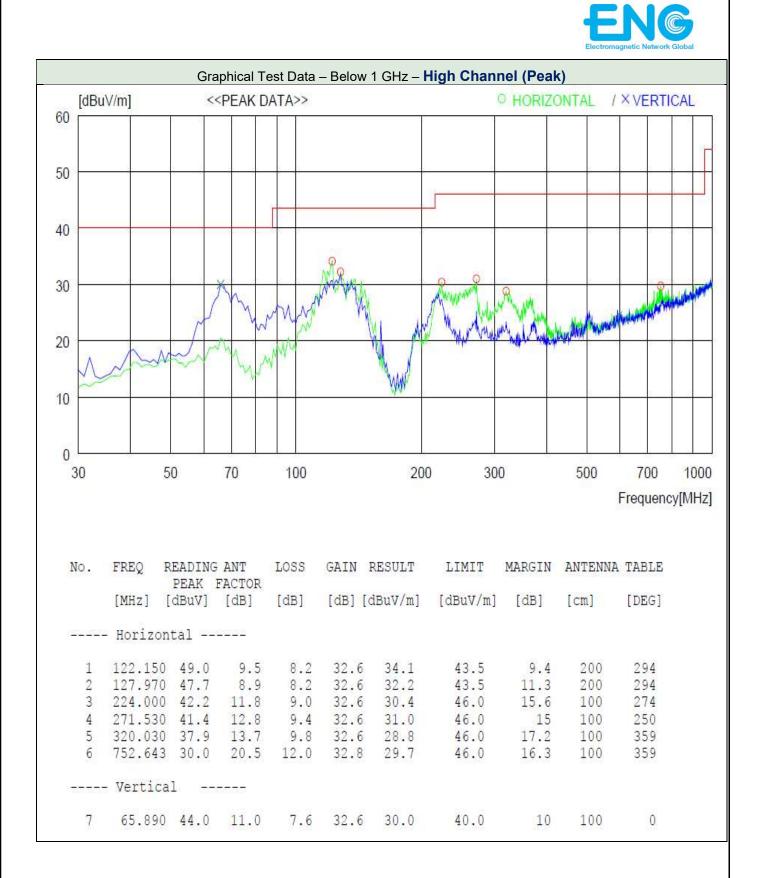
Note: "H" means Horizontal polarity, "V" means Vertical polarity.

Report No.: TR-W1912-002 ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942 Page 33 of 52

Report Form_01 (Rev.2)

TEL: +82-31-727-8300

FAX: +82-31-746-0800



Page 34 of 52

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

FAX: +82-31-746-0800

Report Form_01 (Rev.2)



5.6.6.3 Test Data above 1 GHz

5.6.6.3.1 Duty Cycle

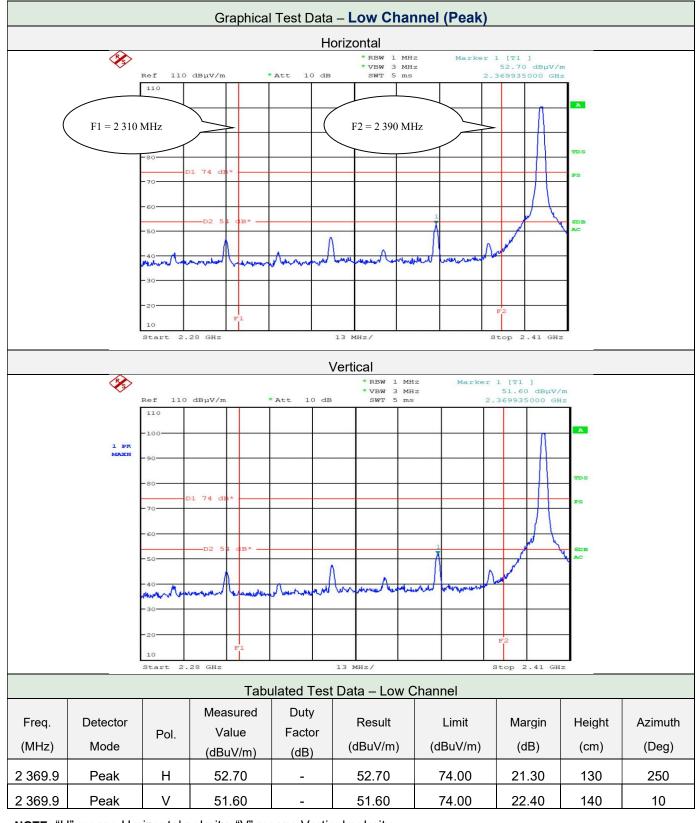
Date of Test		2019-12-02		Temperatur	е	(22.1 ± 2.	7) °C	
				Relative humidity ((40.9 ± 5.	(40.9 ± 5.9) % R.H.	
Measurement Dis	Distance 3 m			Tested By		Do-heon Kim		
Detector Mode		Resolution BW		Video BW			Sweep Time	
PEAK		1 MHz		3 MHz			Auto	
AVERAGE		1 MHz		3	MHz		Auto	
			Graphical	Test Data				
MultiView 🕀 Spectrum		Spectrum 2	Spectrum 3	Spectrum 4				
TRG:VID TDF	SWT 1 ms	RBW 10 MHz VBW 10 MHz					SGL	
1 Zero Span							1Pk Clrw M1[1] 0.50 dBm	
10 dBm				-			12.000 μs D1[1] -0.09 dB	
0 dBm	MI					P 1	609.500 μs	
-10-d0m TRG -10.00	0 dBm							
-20 dBm								
-30 dBm-	W					WHHH	human	
-40 dBm-								
-50 dBm-								
-60 dBm								
-70 dBm								
CF 2.44 GHz	TRG		100	1 pts			100.0 μs/	
2 Marker Table Type Ref Trc M1 1 D1 M1 1 D2 M1 1	×- 12 609 732	Value 2.0 µs 9.5 µs 2.5 µs	Y-Value 0.50 dBm -0.09 dB -0.11 dB	Fu	Inction	Func	tion Result	
						Ready	444	
			Tabulated	Test Data				
Operating Mode	On Time On +			Dff Time Duty C ns) (%)				
Bluetooth LE		609.5 732		2.5 83.21			0.80	

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Report Form_01 (Rev.2)





5.6.6.3.2 Test Data for Band edge (Restricted band)

NOTE: "H" means Horizontal polarity, "V" means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Page 36 of 52

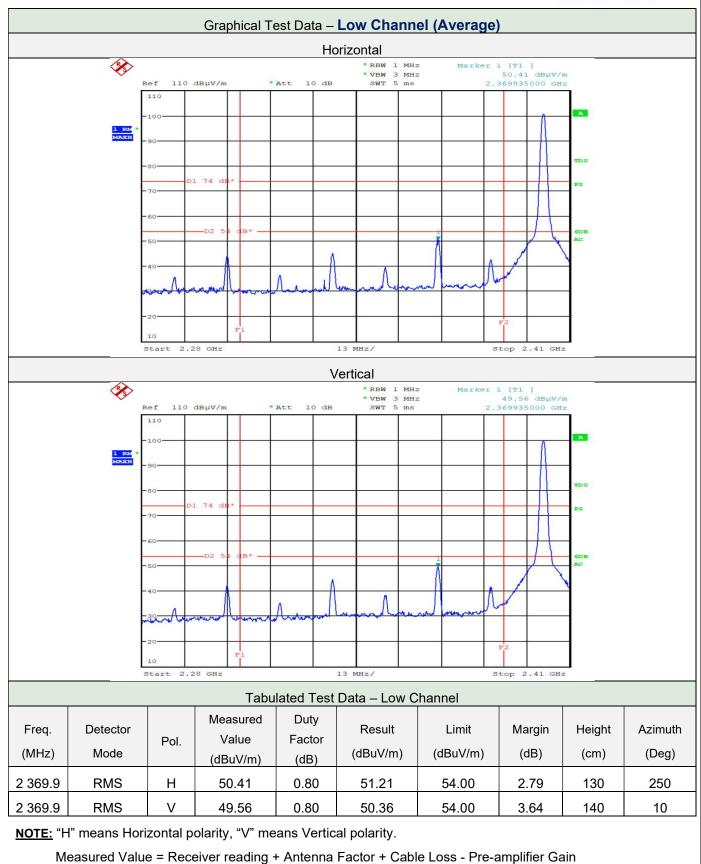
Report Form_01 (Rev.2)

http://www.the-eng.co.kr

TEL: +82-31-727-8300

FAX: +82-31-746-0800





Result = Measured Value + Duty Factor

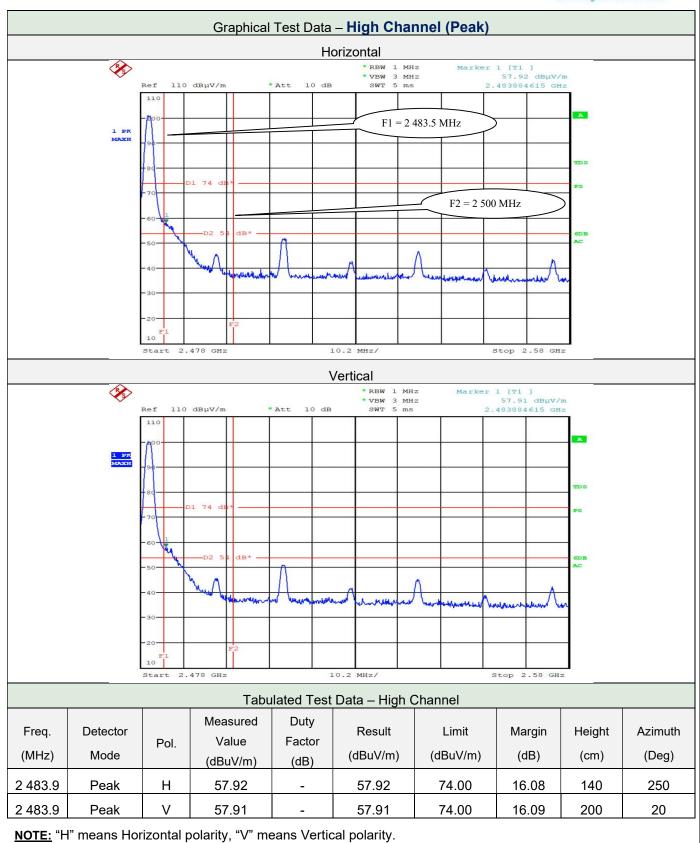
Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Page 37 of 52

Report Form_01 (Rev.2) http://www.the-eng.co.kr





Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

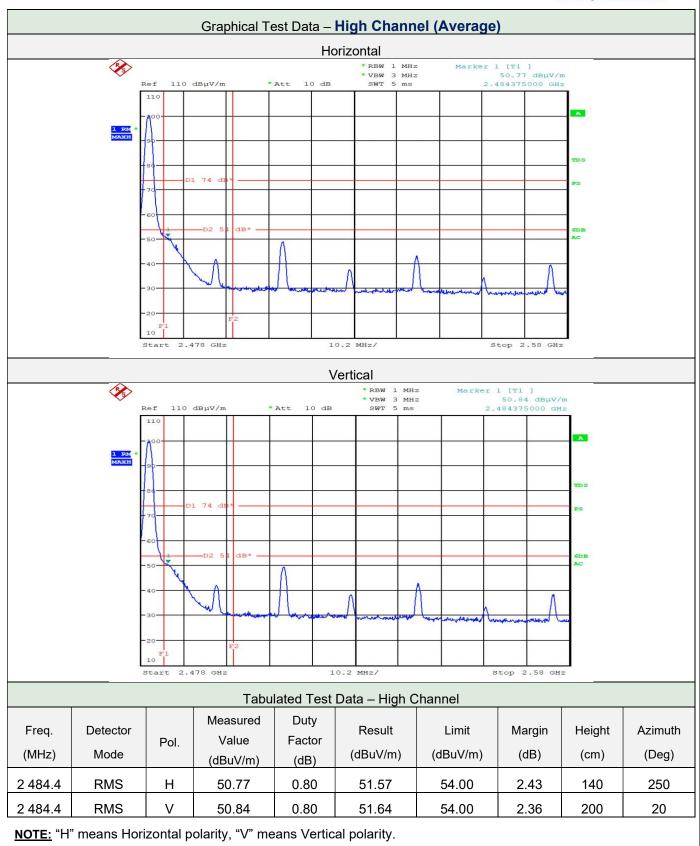
TEL: +82-31-727-8300

FAX: +82-31-746-0800

Page 38 of 52

Report Form_01 (Rev.2) http://www.the-eng.co.kr





Result = Measured Value + Duty Factor

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

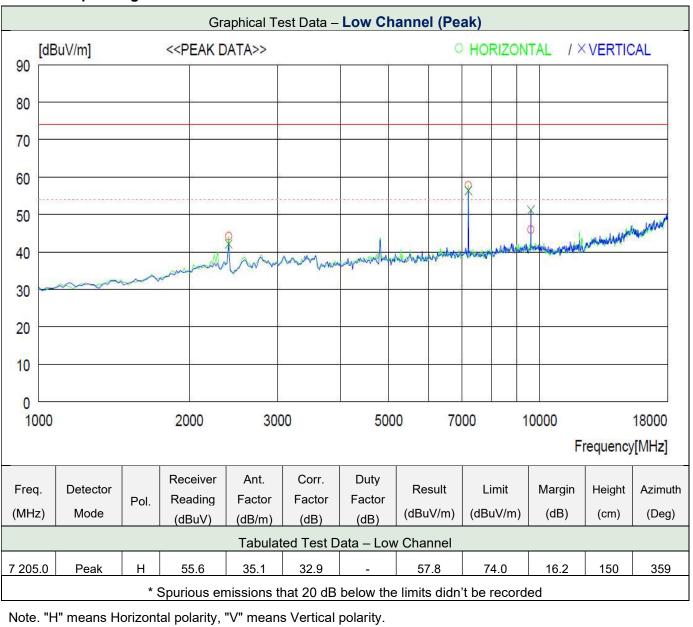
FAX: +82-31-746-0800

Page 39 of 52

Report Form_01 (Rev.2)



5.6.6.4 Test Data for Harmonic & Spurious emission (1 GHz to 18 GHz)



5.6.6.4.1 Operating mode: Bluetooth LE

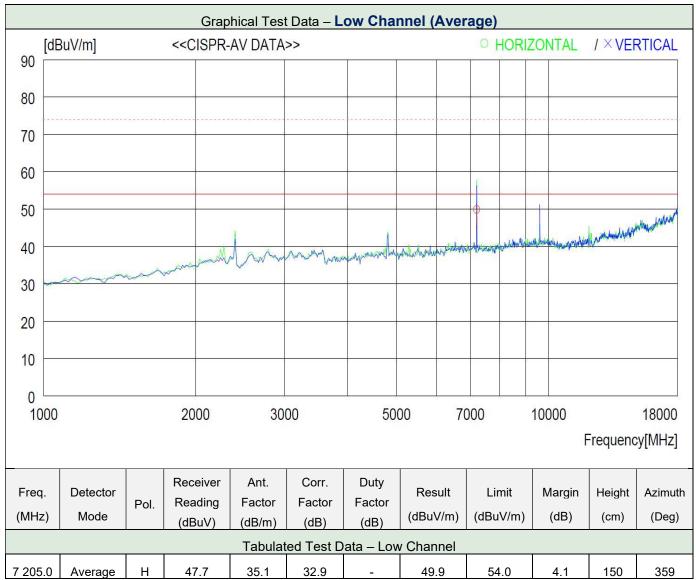
Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit - Result

Report Form_01 (Rev.2)





Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Non-restricted band emission is not added duty factor.

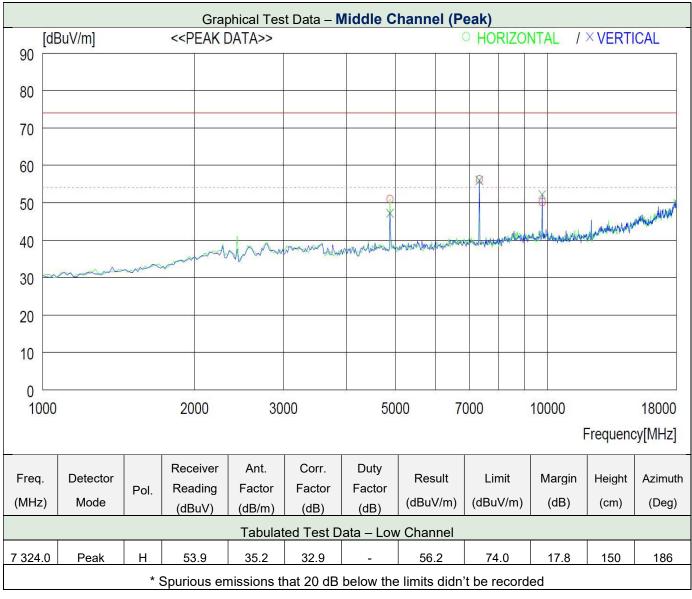
http://www.the-eng.co.kr

Report Form_01 (Rev.2)

TEL: +82-31-727-8300

FAX: +82-31-746-0800





Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

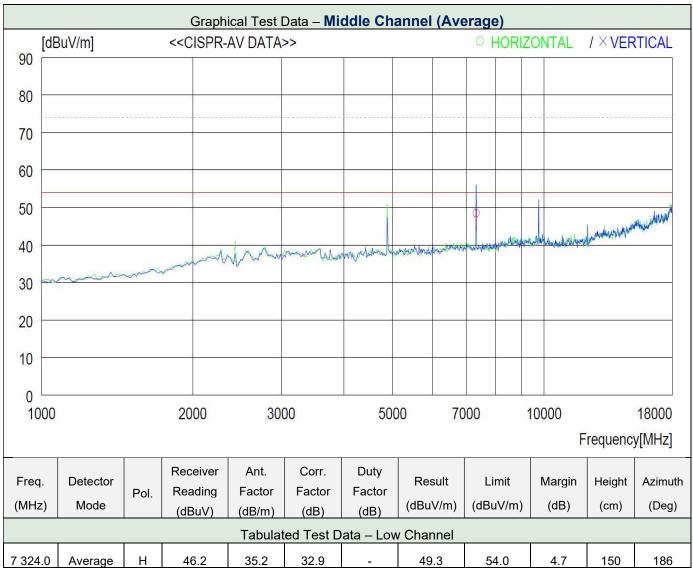
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report Form_01 (Rev.2)





Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit - Result

Non-restricted band emission is not added duty factor.

Report No.: TR-W1912-002





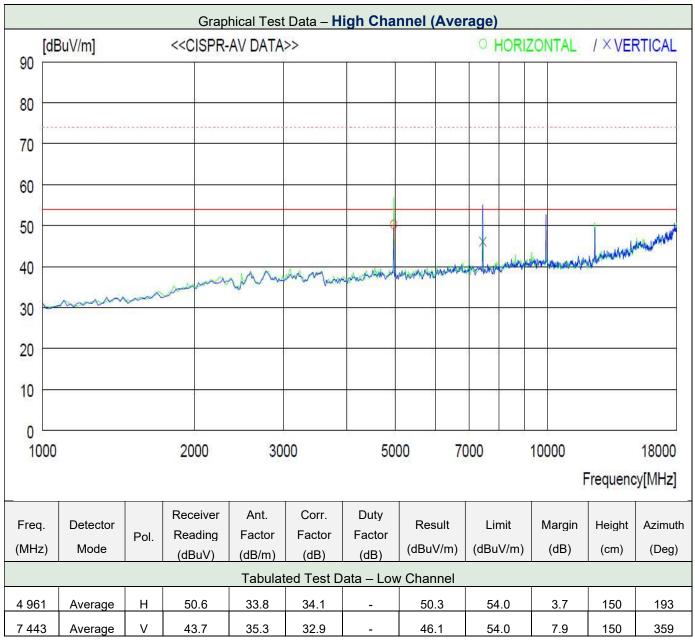
Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Report Form_01 (Rev.2)





Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

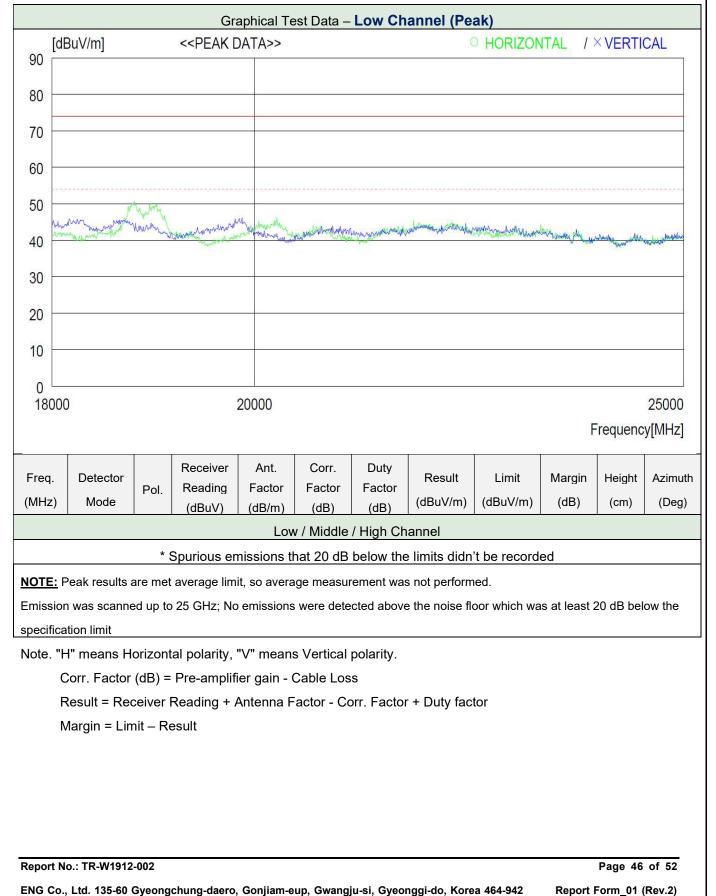
Non-restricted band emission is not added duty factor.

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report Form_01 (Rev.2)





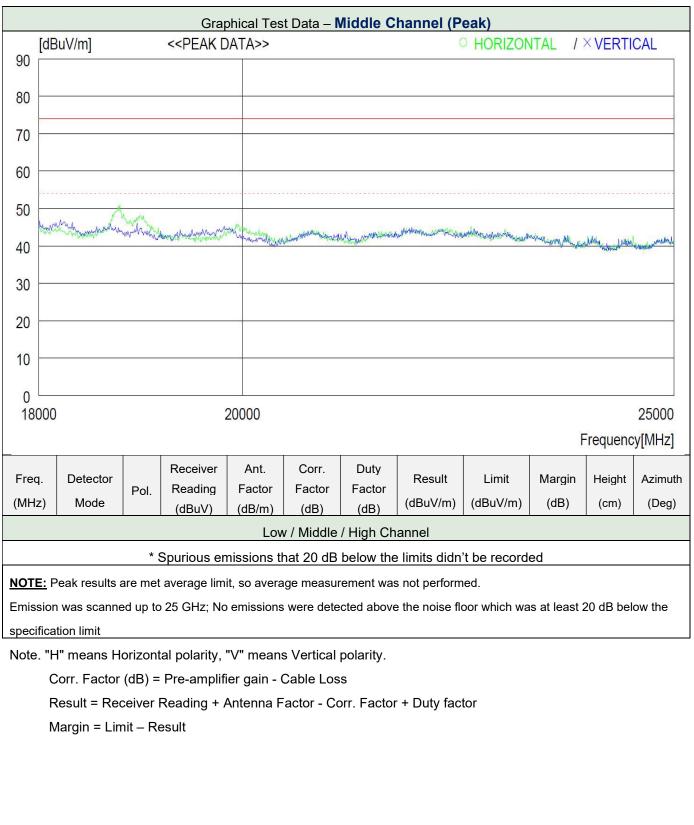
5.6.6.5 Test Data for Harmonic & Spurious emission (18 GHz to 25 GHz)

TEL: +82-31-727-8300

FAX: +82-31-746-0800

······





Page 47 of 52

Report Form_01 (Rev.2)



			Gra	aphical Te	st Data –	High Ch	annel (Pe	ak)			
[dE 90 □	Bu <mark>V/m]</mark>		< <peak [<="" td=""><td></td><td></td><td></td><td></td><td>· HORIZOI</td><td>NTAL /</td><td>× VERT</td><td>ICAL</td></peak>					· HORIZOI	NTAL /	× VERT	ICAL
80											
70 —											
60 -											
50											
40	manut	manning	Abab boom and well	Munitica	101 Mir Mary Mary	mal was president and	international and him	out of the second of the second	within manage provide	harry more	and the second of the second o
										number.	
30 —											
20											
10 -											
0											
18000)			20000							25000
_	I					1	I	I		Frequen	cy[MHz]
Freq.	Detector	.	Receiver Reading	Ant. Factor	Corr. Factor	Duty Factor	Result	Limit	Margin	Height	Azimuth
(MHz)	Mode	Pol.	(dBuV)	(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(Deg)
				Low	v / Middle	/ High Ch	annel				
		* (Spurious en	nissions tł	nat 20 dB	below the	e limits didn	't be record	ed		
			average limi								
specifica		a up to	25 GHz; No	emissions	were dete		e the hoise th	oor which wa	Is at least 4	20 ab bei	ow the
		orizont	al polarity, '	V" means	s Vertical	polarity.					
			Pre-amplifi								
R	Result = Red	eiver l	Reading + A	∖ntenna F	actor - Co	orr. Factor	+ Duty fac	tor			
Margin = Limit – Result											

Page 48 of 52

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report No.: TR-W1912-002



5.7 AC Power Line Conducted Emission

5.7.1 Limit

Frequency Range (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 -30	60	50

Acc. to section 15.207 (a), RSS-GEN 8.8 following table shall be applied.

5.7.2 Method of Measurement

The EUT was placed on a wooden table, 0.8 m height above the horizontal ground plane and 40 cm from the vertical ground plane. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasipeak or average.

The test was performed for both Neutral and Hot lines.

5.7.3 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 150 kHz	± 2.00 dB	150 kHz ~ 30 MHz	± 2.00 dB

5.7.4 Sample Calculated Example

At 5.31 MHzQP Limit = 60.0 dBuVCorrection Factor (C. Factor) of LISN, Pulse Limiter and cable loss at 5.31 MHz = 9.7 dBQ.P Reading from the Test receiver = 20.8 dBuV

(Calculated value for system losses by software EMC32 manufactured by Rohde & Schwarz)

Therefore Q.P Margin = 60 - 20.8 = 39.2

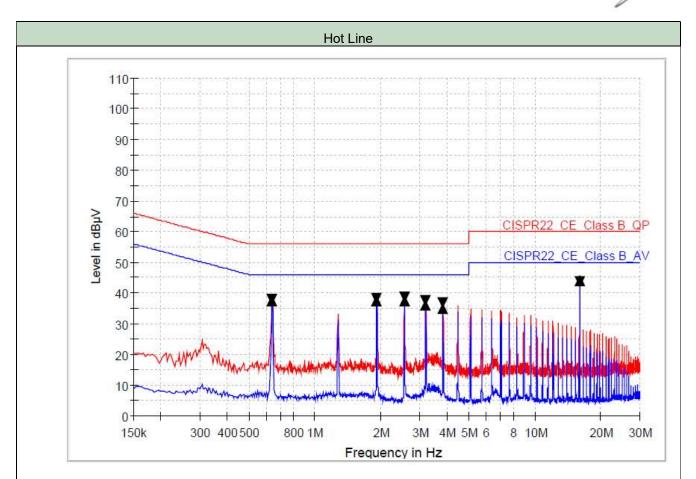
so the EUT has 39.2 dB margin at 5.31 MHz

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942



5.7.5 Worst Case Test Data

Data of Toot	2019-11-29	Temperature	22.8 °C	
Date of Test	2019-11-29	Relative humidity	40.9 % R.H.	
Measurement Frequ	iency Range	9 kHz ~ 30MHz		1
Test Result	PASS	Tested By	Do-heon Kim	A



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.638000	37.9	37.4	9.000	L1	9.7	18.1	56.0	8.6	46.0
1.914000	38.1	37.4	9.000	L1	9.8	17.9	56.0	8.6	46.0
2.554000	38.5	37.4	9.000	L1	9.9	17.5	56.0	8.6	46.0
3.190000	37.6	36.2	9.000	L1	10.0	18.4	56.0	9.8	46.0
3.826000	36.7	34.9	9.000	L1	10.0	19.3	56.0	11.1	46.0
16.002000	43.7	44.0	9.000	L1	10.3	16.3	60.0	6.0	50.0

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

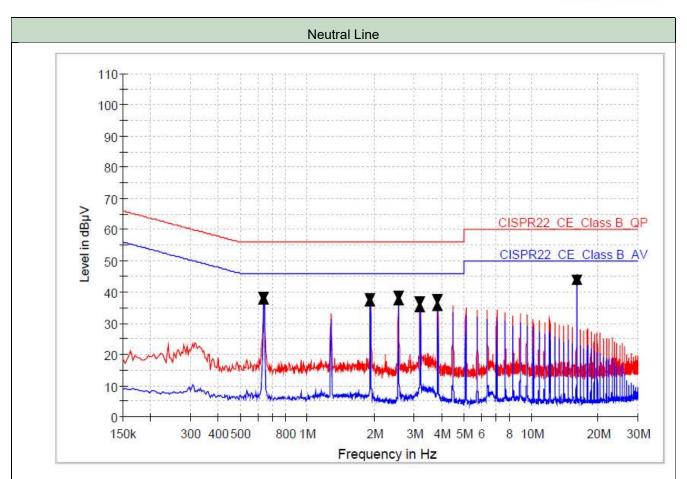
FAX: +82-31-746-0800

Page 50 of 52

http://www.the-eng.co.kr

Report Form_01 (Rev.2)





Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.638000	38.2	37.8	9.000	N	9.7	17.8	56.0	8.2	46.0
1.914000	37.8	37.1	9.000	N	9.8	18.2	56.0	8.9	46.0
2.554000	38.6	37.6	9.000	N	9.9	17.4	56.0	8.4	46.0
3.194000	36.9	35.2	9.000	N	10.0	19.1	56.0	10.8	46.0
3.830000	37.4	35.5	9.000	N	10.0	18.6	56.0	10.5	46.0
16.002000	43.7	44.0	9.000	N	10.3	16.3	60.0	6.0	50.0

Report No.: TR-W1912-002

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

FAX: +82-31-746-0800

Page 51 of 52

Report Form_01 (Rev.2) http://www.the-eng.co.kr



Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal. Date	Cal. Interval
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2020-04-24	1 Y
Attenuator	56-10	58769	WEINSCHEL	2020-01-22	1 Y
Test Receiver	ESU 26	100303	Rohde & Schwarz	2020-01-18	1 Y
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2021-04-22	2 Y
DC Power Supply	6032A	SG41000637	Agilent	2020-03-29	1 Y
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2021-11-12	2 Y
Horn Antenna	HF 907	102426	Rohde & Schwarz	2021-01-11	2 Y
Horn Antenna	BBHA 9170	BBHA 9170 #783	Schwarzbeck	2020-11-26	2 Y
Notch Filter	BRM50702	G318	MICRO-TRONICS	2020-11-07	1 Y
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2020-01-18	1 Y
Pre-Amplifier	310N	344015	Sonoma Instrument	2020-01-18	1 Y
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2020-04-19	1 Y
Pre-Amplifier	CBL18265035	28706	CERNEX	2020-04-01	1 Y
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	N/A	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	N/A	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	N/A	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	N/A	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/ 34130814/L	INNCO SYSTEM	N/A	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/ 34130814/L	INNCO SYSTEM	N/A	N/A
EMI Test Receiver	ESCI 7	100722	Rohde & Schwarz	2020-01-18	1 Y
LISN	ENV216	100110	Rohde & Schwarz	2020-01-14	1 Y

The measuring equipment utilized to perform the tests documented in this test report has been calibrated in accordance with manufacturer's recommendations, and is traceable to recognized national standards.

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

TEL: +82-31-727-8300

FAX: +82-31-746-0800