



FCC 5G NR ENDC RADIATION SPURIOUS EMISSION TEST REPORT

FCC ID : GKRRMLN1
Equipment : 5G LGA Module
Brand Name : COMPAL
Model Name : RML-N1
Marketing Name : 5G LGA Module
Applicant : Compal Electronics, Inc.
No.581 & 581-1, Ruiguang Rd., Neihu District,
Taipei, (114) Taiwan
Manufacturer : Compal Electronics, Inc.
No.581 & 581-1, Ruiguang Rd., Neihu District,
Taipei, (114) Taiwan
Standard : FCC 47 CFR Part 2, 22(H), 24(E), 27

The product was received on Nov. 01, 2021 and testing was started from Nov. 16, 2021 and completed on Nov. 18, 2021. We, Sporton International Inc. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)



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History of this test report

Report No.	Version	Description	Issued Date
FG133040-04D	01	Initial issue of report	Nov. 30, 2021
FG133040-04D	02	1. Add all functions supported by the device. 2. Revise test mode 3. Revise note in summary	Dec. 14, 2021



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1053 §22.917 (a) §24.238 (a) §27.53 (g) §27.53 (h) §27.53(l)(2)	Radiated Spurious Emission (n2) (n5) (n12) (n25) (n66) (n71) (n77) (n78)	Pass	Under limit 31.08 dB at 11226.000 MHz
	§2.1051 §27.53 (m)(4)	Radiated Spurious Emission (n41)		
	§2.1053 §27.53 (a)(4)	Conducted Spurious Emission (n30)		

Note: This is a variant report by turning on WWAN Band (LTE Band 13, 17 / 5G NR n78) via software. All the test cases were performed on original report which can be referred to Sporton Report Number FG133040-02H.

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Keven Cheng
Report Producer: Celery Wei



1 General Description

1.1 Product Feature of Equipment Under Test

LTE/5G NR, and GNSS.

Product Specification subjective to this standard	
Test Antenna Type	Monopole Antenna
Test Antenna Gain	<p><Ant. 0> 5G NR n2: 3.9 dBi 5G NR n5: 0.9 dBi 5G NR n12: 0 dBi 5G NR n25: 3.9 dBi 5G NR n30: -1.1 dBi 5G NR n41: 5.0 dBi 5G NR n66: 2.7 dBi 5G NR n71: 0 dBi</p> <p><Ant. 2> 5G NR n41: 3.5 dBi</p> <p><Ant. 4> 5G NR n2: 3.7 dBi 5G NR n66: 3.9 dBi</p> <p><Ant. 5> 5G NR n77: -2.1 dBi 5G NR n78: -2.1 dBi</p>

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications are made to the EUT during all test items.

1.3 Testing Location

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. 03CH07-HY
Test Engineer	Jesse Wang, Stan Hsieh and Ken Wu
Temperature	19~27°C
Relative Humidity	48~63%

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: TW1190



1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ ANSI C63.26-2015
- ♦ ANSI / TIA-603-E
- ♦ FCC 47 CFR Part 2, 22(H), 24(E), 27
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.
3. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

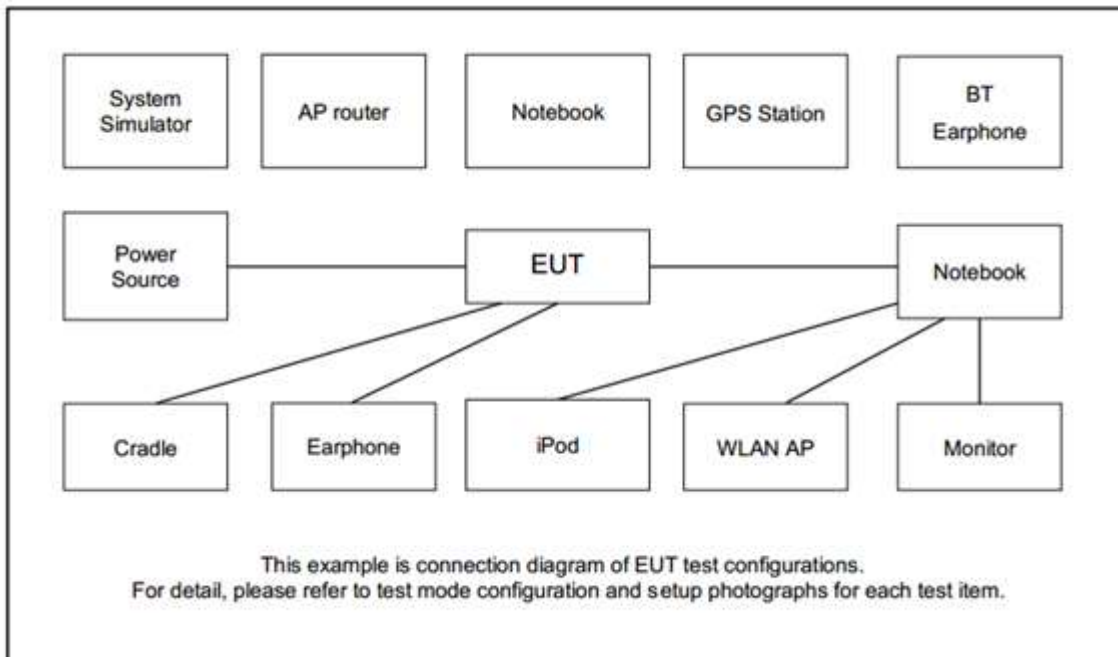
2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find Z plane as worst plane.

Test Items	Antenna combination	Band	Bandwidth (MHz)			RB #	Test Channel			Worst Plan
			10+20	10+100	PI/2 BPSK		1	L	M	
Radiated Spurious Emission	Ant. 0+0	EN-DC 13A + n2A	v	-	v	v	-	v	-	Z
	Ant. 3+0	EN-DC 13A +n5A	v	-	v	v	-	v	-	Z
	Ant. 0+0	EN-DC 13A + n66A	v	-	v	v	-	v	-	Z
	Ant. 0+5	EN-DC 13A + n77A	-	v	v	v	-	v	-	Z
Remark	<ol style="list-style-type: none"> The mark "v " means that this configuration is chosen for testing The mark "- " means that this bandwidth is not supported. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported. For radiated measurement, pre-scanned in two modes, DFT-s OFDM and CP OFDM. The worst cases (DFT-s OFDM) were recorded in this report, and the worst modes of FR1 and LTE for simultaneous transmission were verified and compliant. Test combination is EN-DC 13A + n2A / EN-DC 13A +n5A / EN-DC 13A + n66A / EN-DC 13A + n77A. 									

2.2 Connection Diagram of Test System





2.3 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	DC Power Supply	GW Instek	GPE-2323	N/A	N/A	Unshielded, 1.8 m
2.	System Simulator	Anritsu	MT8821C	N/A	N/A	Unshielded, 1.8 m
3.	5G Wireless Test Platform	Anritsu	MT8000A	N/A	N/A	Unshielded, 1.8 m
4.	fixture	Compal	ZM52	N/A	N/A	N/A

2.4 Frequency List of Low/Middle/High Channels

5G NR Band n2 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	372000	376000	380000
	Frequency	1860	1880	1900
15	Channel	371500	376000	380500
	Frequency	1857.5	1880	1902.5
10	Channel	371000	376000	381000
	Frequency	1855	1880	1905
5	Channel	370500	376000	381500
	Frequency	1852.5	1880	1907.5

5G NR Band n5 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	166800	167300	167800
	Frequency	834	836.5	839
15	Channel	166300	167300	168300
	Frequency	831.5	836.5	841.5
10	Channel	165800	167300	168800
	Frequency	829	836.5	844
5	Channel	165300	167300	169300
	Frequency	826.5	836.5	846.5



5G NR Band n66 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
40	Channel	346000	349000	352000
	Frequency	1730	1745	1760
20	Channel	344000	349000	354000
	Frequency	1720	1745	1770
15	Channel	343500	349000	354500
	Frequency	1717.5	1745	1772.5
10	Channel	343000	349000	355000
	Frequency	1715	1745	1775
5	Channel	342500	349000	355500
	Frequency	1712.5	1745	1777.5

5G NR Band n77 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
100	Channel	650000	656000	662000
	Frequency	3750	3840	3930
90	Channel	649668	656000	662332
	Frequency	3745.02	3840	3934.98
80	Channel	649334	656000	662666
	Frequency	3740.01	3840	3939.99
60	Channel	648668	656000	663332
	Frequency	3730.02	3840	3949.98
50	Channel	648334	656000	663666
	Frequency	3725.01	3840	3954.99
40	Channel	648000	656000	664000
	Frequency	3720	3840	3960
20	Channel	647334	656000	664666
	Frequency	3710.01	3840	3969.99
15	Channel	647168	656000	664832
	Frequency	3707.52	3840	3972.48
10	Channel	647000	656000	665000
	Frequency	3705	3840	3975

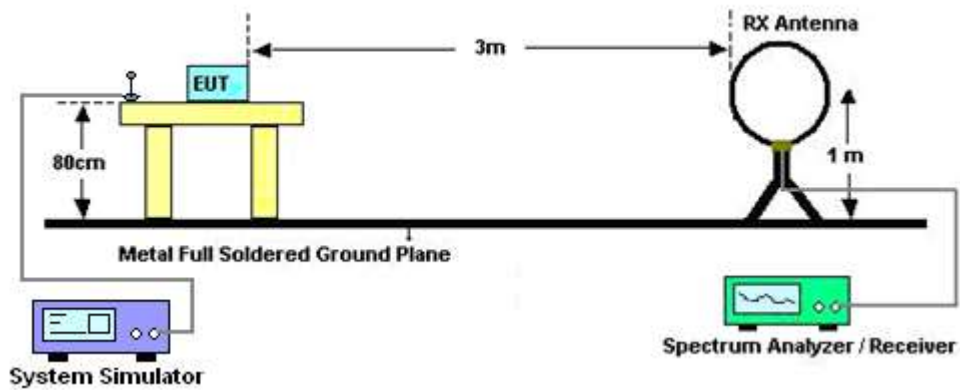
3 Radiated Test Items

3.1 Measuring Instruments

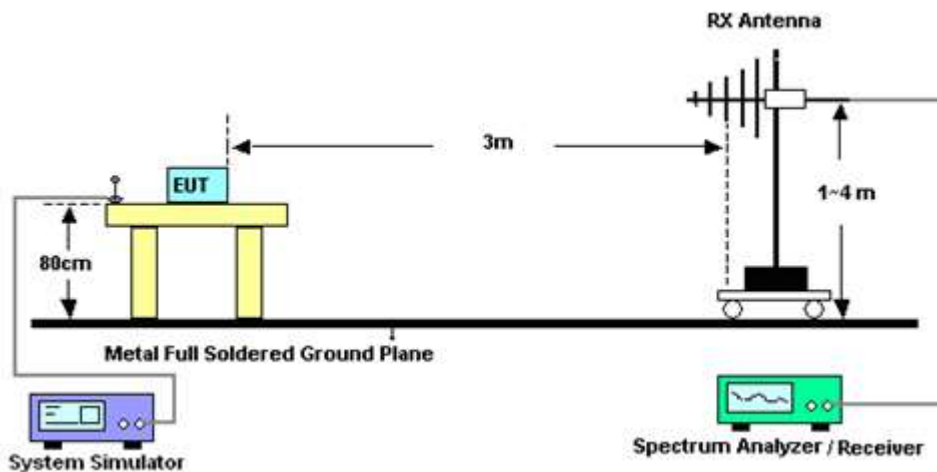
See list of measuring instruments of this test report.

3.1.1 Test Setup

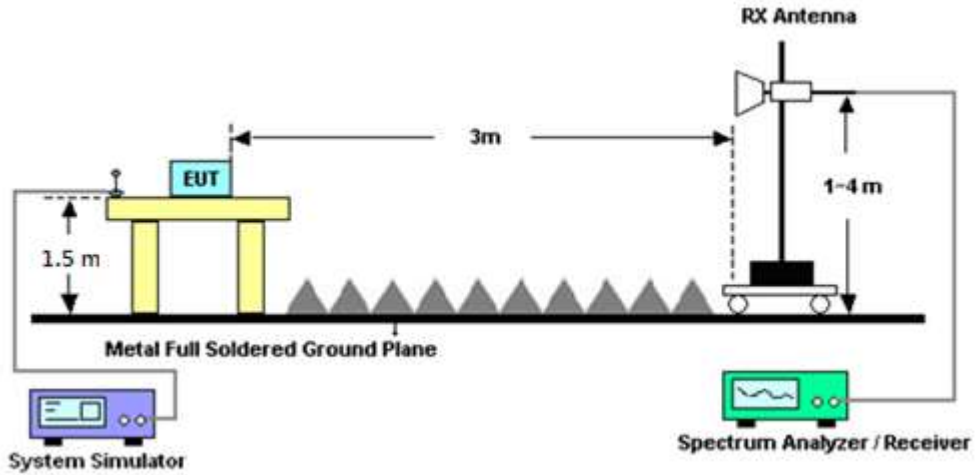
For radiated test below 30MHz



For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



3.1.2 Test Result of Radiated Test

Please refer to Appendix A.

Note:

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.



3.2 Radiated Spurious Emission Measurement

3.2.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB.

3.2.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 7 and ANSI / TIA-603-E Section 2.2.12.

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
8. Taking the record of output power at antenna port.
9. Repeat step 7 to step 8 for another polarization.
10. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)



4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	35419 & 03	30MHz~1GHz	Apr. 28, 2021	Nov. 16, 2021~Nov. 18, 2021	Apr. 27, 2022	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Dec. 01, 2020	Nov. 16, 2021~Nov. 18, 2021	Nov. 30, 2021	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz~18GHz	Apr. 22, 2021	Nov. 16, 2021~Nov. 18, 2021	Apr. 21, 2022	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	May 18, 2021	Nov. 16, 2021~Nov. 18, 2021	May 17, 2022	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~26.5GHz	Oct. 04, 2021	Nov. 16, 2021~Nov. 18, 2021	Oct. 03, 2022	Radiation (03CH07-HY)
Preamplifier	EMEC	EM18G40G	0600789	18-40GHz	Jul. 23, 2021	Nov. 16, 2021~Nov. 18, 2021	Jul. 22, 2022	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9030A	MY52350276	3Hz~44GHz	Jul. 22, 2021	Nov. 16, 2021~Nov. 18, 2021	Jul. 21, 2022	Radiation (03CH07-HY)
3m Semi Anechoic Chamber (NSA)	TDK	SAC-3M	03CH07-HY	30MHz~1GHz	Jan. 01, 2021	Nov. 16, 2021~Nov. 18, 2021	Dec. 31, 2021	Radiation (03CH07-HY)
3m Semi Anechoic Chamber (Site VSWR)	TDK	SAC-3M	03CH07-HY	1GHz~18GHz	Dec. 23, 2020	Nov. 16, 2021~Nov. 18, 2021	Dec. 22, 2021	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY15682-4	30MHz to 18GHz	Feb. 24, 2021	Nov. 16, 2021~Nov. 18, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971-4	9kHz to 18GHz	Feb. 24, 2021	Nov. 16, 2021~Nov. 18, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655-4	9kHz to 18GHz	Feb. 24, 2021	Nov. 16, 2021~Nov. 18, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2,80 1606/2	18GHz~40GHz	Feb. 24, 2021	Nov. 16, 2021~Nov. 18, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126	532078/126E	30MHz~18GHz	Sep. 17, 2021	Nov. 16, 2021~Nov. 18, 2021	Sep. 16, 2022	Radiation (03CH07-HY)
Controller	EMEC	EM1000	N/A	Control Ant Mast	Apr. 28, 2021	Nov. 16, 2021~Nov. 18, 2021	Apr. 27, 2022	Radiation (03CH07-HY)
Controller	MF	MF-7802	N/A	Control Turn table	N/A	Nov. 16, 2021~Nov. 18, 2021	N/A	Radiation (03CH07-HY)
Antenna Mast	EMEC	AM-BS-4500E	N/A	Boresight mast 1M~4M	Apr. 28, 2021	Nov. 16, 2021~Nov. 18, 2021	Apr. 27, 2022	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Nov. 16, 2021~Nov. 18, 2021	N/A	Radiation (03CH07-HY)
Software	Audix	E3 6.2009-8-24	N/A	N/A	N/A	Nov. 16, 2021~Nov. 18, 2021	N/A	Radiation (03CH07-HY)
USB Data Logger	TECPEL	TR-32	HE17XB2495	N/A	Mar. 09, 2021	Nov. 16, 2021~Nov. 18, 2021	Mar. 08, 2022	Radiation (03CH07-HY)
Horn Antenna	EMCO	3117	00143261	1GHz~18GHz	Jan. 26, 2021	Nov. 16, 2021~Nov. 18, 2021	Jan. 25, 2022	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA917025 1	18GHz~40GHz	Dec. 02, 2020	Nov. 16, 2021~Nov. 18, 2021	Dec. 01, 2021	Radiation (03CH07-HY)
Signal Generator	Rohde & Schwarz	SMF100A	101107	100kHz~40GHz	Dec. 04, 2020	Nov. 16, 2021~Nov. 18, 2021	Dec. 03, 2021	Radiation (03CH07-HY)



5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.16 dB
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.71 dB
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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.16 dB
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Appendix A. Test Results of Radiated Test

<Ant. 0+0>

EN-DC 13A-n2A

EN-DC 13A-n2A / 20MHz / PI/2 BPSK										
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)	
Middle	3744	-45.99	-13	-32.99	-66.68	-52.6	1.68	8.29	H	
	5610	-46.54	-13	-33.54	-71.82	-53.6	2.69	9.74	H	
	7482	-47.27	-13	-34.27	-73.86	-56.6	2.44	11.76	H	
	11226	-44.08	-13	-31.08	-78.31	-53.8	2.69	12.41	H	
										H
										H
										H
	3744	-55.89	-13	-42.89	-76.55	-62.5	1.68	8.29	V	
	5610	-47.14	-13	-34.14	-72.19	-54.2	2.69	9.74	V	
	7482	-53.87	-13	-40.87	-80.85	-63.2	2.44	11.76	V	
	11226	-48.18	-13	-35.18	-82.32	-57.9	2.69	12.41	V	
										V
										V
										V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



EN-DC 13A-n66A

EN-DC 13A-n66A / 20MHz / PI/2 BPSK									
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Middle	3450	-49.01	-13	-36.01	-69.28	-55.2	1.59	7.78	H
	5178	-53.04	-13	-40.04	-76.95	-60.3	2.44	9.70	H
	6906	-53.43	-13	-40.43	-75.4	-61.5	2.62	10.69	H
	12076	-45.88	-13	-32.88	-79.43	-55.5	2.70	12.32	H
									H
									H
									H
	3450	-56.91	-13	-43.91	-77.31	-63.1	1.59	7.78	V
	5178	-55.84	-13	-42.84	-79.48	-63.1	2.44	9.70	V
	6906	-52.43	-13	-39.43	-79.12	-60.5	2.62	10.69	V
	12076	-48.88	-13	-35.88	-81.57	-58.5	2.70	12.32	V
									V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



<Ant. 3+0>

EN-DC 13A-n5A

EN-DC 13A-n5A / 20MHz / PI/2 BPSK									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Middle	1656	-63.77	-13	-50.77	-75.69	-65.50	0.98	4.86	H
	2480	-60.29	-13	-47.29	-77.39	-62.2	1.28	5.34	H
	3308	-59.24	-13	-46.24	-78.2	-62.7	1.54	7.16	H
									H
									H
									H
									H
	1656	-63.87	-13	-50.87	-75.69	-65.6	0.98	4.86	V
	2480	-60.39	-13	-47.39	-77.39	-62.3	1.28	5.34	V
	3308	-59.04	-13	-46.04	-78.2	-62.5	1.54	7.16	V
									V
									V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



<Ant. 0+5>

EN-DC 13A-n77A

EN-DC 13A-n77A / 100MHz / PI/2 BPSK									
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Middle	7585	-44.65	-13	-31.65	-49.63	-54.10	2.40	11.85	H
	11370	-53.53	-13	-40.53	-65.77	-63.20	2.68	12.35	H
	15160	-44.34	-13	-31.34	-58.15	-54.50	3.66	13.82	H
									H
									H
									H
									H
	7585	-51.75	-13	-38.75	-56.63	-61.20	2.40	11.85	V
	11370	-55.13	-13	-42.13	-67.55	-64.80	2.68	12.35	V
	15160	-50.94	-13	-37.94	-38.67	-61.10	3.66	13.82	V
									V
									V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.