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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document. **IMPORTANT:** No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification S.A.U.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model WAVE-11-HAF-R2 is a Telematics control unit with wireless technologies, used in automotive, equipped with 2 modems, OEM and customer. The project name WAVE has the meaning "Wireless Access in Vehicular Environment" and thus describes the key features of this device as Communication and Data Interface. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, 5G, and GNSS.

3. Derived model not tested. These models have been declared by the supplier of the sample as being the same as the model under test.

HARMAN AUTOMOTIVE DIVISION
HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GÖRING-STRASSE 16
76307 KARLSBAD, GERMANY



Declaration of similarity

To whom it may concern,

We, **Harman Becker Automotive Systems GmbH,** located in
Becker-Goering-Str. 16; 76307 Karlsbad, Germany

Hereby declare that the following units: **WAVE-11-HIGH-R2** and **WAVE-11-HAF-R2** have integrated the same NAD modules, are using same schematic and same PCB layout.

The only difference between the two models is that **WAVE-11-HIGH-R2** is equipped with chipset U-Blox UBX-F9940, where **WAVE-11-HAF-R2** is equipped with chipset ST-Micro STA9100MGA & STA5635S.

Where only one of the aforementioned variants has been used as DUT, shall remain valid and applicable for these two models described.

This declaration is intended to be included in the test reports where applies

Regards



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DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
68001/009	Telematic control unit with wireless technologies, used in automotive industry (Type B424)	WAVE-11-HAF-R2	B4250S0M4907002	2021/08/10
68000C/083	Antenna (DA WAVE HIGH US 5G ROW)	DA05DI20	--	2021/08/27
62486/024	Antenna Box	AB01-I20-01	--	2020/09/22
62486/027	Antenna Box	AB01-I20-01	--	2020/09/22
68000C/065	Spoiler Antenna (FSA-WAVE-5G Links)	FS01DI20	--	2021/10/28
62486/026	Antenna Box	AB01-I20-01	--	2020/09/22
62486/062	RF Harness	--	--	2020/09/22

Auxiliary elements used with the Sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
68000C/009	Battery	607492	--	2021/07/29
62486/048	RF Cable for 4-Fakra	--	--	2020/09/22
62486/055	OABR Cable	--	--	2020/09/22
62486/047	RF Cable for 4-Fakra	--	--	2020/09/22
62486/162	OABR 1000 BaseT Converter	--	--	2020/09/28
62486/070	I-Box OABR Adapter	--	--	2020/09/22
62486/101	SOS Button (E-Call)	9385	11221	2020/09/28
62486/042	Antenna ground planes for roof	--	--	2020/09/22

Sample S/01 has undergone the following test(s): The Radiated tests indicated in the Appendix A.

Test sample description

Ports.....:	Port name and description	Cable							
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾				
	RF connector –code D violet trunk/roof)	Port not used for SOP2021 (it has V2X interfaces and gateway for SDARS signal towards another ECU)	☐	☒	☐				
	RF connector – code C blue (trunk/roof)	>5m	☒	☒	☐				
	NanoMQS 20pol	>5m	☒	☐	☐				
	NanoMQS 10pol	>8m	☒	☐	☐				
	HDBT MATEnet 2-Pol (Roof/Trunk)	>5m	☒	☐	☐				
	Antenna Connector grey (Roof)	<0.5m	☒	☒	☐				
Supplementary information to the ports.....:	-								
Rated power supply	Voltage and Frequency								
	☒	DC: 12V car battery / attenuator (4,5 V ≤ UB ≤ 18 V; UB typical: 12 V)							
Rated Power.....:	12V DC								
Clock frequencies.....:	25MHz;26MHz;32,768kHz;49,58MHz;								
Other parameters	See Technical description								
Software version.....:	21411A.004_045_017								
Hardware version	D5								
Dimensions in cm (W x H x D) ...:	160x18x112 mm								
Mounting position	☐	Table top equipment							
	☐	Wall/Ceiling mounted equipment							
	☐	Floor standing equipment							
	☐	Hand-held equipment							
	☒	Other: automotive telematics control unit							
Modules/parts.....:	Module/parts of test item		Type	Manufacturer					
	-								
Accessories (not part of the test item)	Description		Type	Manufacturer					
	Cable Harness		-						
	2G/3G4G/5G Antenna		-	Hirschmann/Molex					
	E-CALL button/LED		-						
	SOS Loudspeaker		-						

	Wake-up unit Box	-	
Documents as provided by the applicant	Description	File name	Issue date
	Technical Description		

⁽³⁾ Only for Medical Equipment

Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GOERING-STR. 16, 76307 KARLSBAD, GERMANY

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-10-05
Date (finish)	2021-10-05

Document history

Report number	Date	Description
68001RRF.007	2022-01-11	First release.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the semianechoic chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Miguel Manuel López, Alfonso Gutierrez and Jose Manuel Jimenez.

Used instrumentation:

Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N/A	N/A
2. Shielded Room ETS LINDGREN S101	N/A	N/A
3. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2020/08	2023/08
4. Biconical/Log Antenna 30MHz - 6 GHz ETS LINDGREN 3142E	2020/10	2023/10
5. RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2020/10	2021/10
6. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2021/10	2023/10
7. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
8. Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	N/A	N/A
9. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2020/12	2022/12
10. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N/A	N/A
11. Digital Multimeter FLUKE 175	2020/11	2021/11
12. Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2021/07	2024/07
13. RF Preamplifier G>30dB, 17-40GHz BONN ELEKTRONIK BLMA 1840-4A	2021/09	2022/09

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

FCC PART 27 / RSS-139, RSS-199 PARAGRAPH		
Requirement – Test case	Verdict	Remark
FCC 27.50 / RSS-139 6.5., RSS-199 4.4.: RF output power	N/M	(1)
FCC 2.1047 / RSS-139 6.2., RSS-199 4.1.: Modulation characteristics	N/M	(1)
FCC 27.54 / RSS-139 6.4., RSS-199 4.3.: Frequency stability	N/M	(1)
FCC 2.1049 / RSS-139 6.4., RSS-199 4.3.: Occupied Bandwidth	N/M	(1)
FCC 27.53 / RSS-139 6.6., RSS-199 4.5.: Spurious emissions at antenna terminals	N/M	(1)
FCC 27.53 / RSS-139 6.6., RSS-199 4.5.: Radiated emissions	P	
<u>Supplementary information and remarks:</u>		
(1) Test not requested. Radiated emissions test only requested.		

Appendix A: Test results for FCC Part 27 / RSS-139, RSS-199

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TEST CONDITIONS

POWER SUPPLY (V):

Vnominal: 12 Vdc
Type of Power Supply: External DC (vehicle battery).

The module with the highest antenna gain has been tested using the worst case obtained for conducted output power. And the other module has been tested using an adjacent channel with a setting that would allow communication in the same band to both modules simultaneously.

LTE Band CA_7C + LTE Band 7. QPSK and QAM modulations. CARRIER AGGREGATION & MIMO 2x2:

LTE Band 7:

	Channel (Frequency)			
	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	20775 (2502.5 MHz)	20800 (2505.0 MHz)	20825 (2507.5 MHz)	20850 (2510.0 MHz)
Middle	21100 (2535.0 MHz)	21100 (2535.0 MHz)	21100 (2535.0 MHz)	21100 (2535.0 MHz)
High	21425 (2567.5 MHz)	21400 (2565.0 MHz)	21375 (2562.5 MHz)	21350 (2560.0 MHz)

LTE Band CA_7C:

Range	CC-Combo / N _{RB_agg} [RB]	CC1 Note1					CC2 Note1				
		BW [RB]	N _{UL}	f _{UL} [MHz]	N _{DL}	f _{DL} [MHz]	BW [RB]	N _{UL}	f _{UL} [MHz]	N _{DL}	f _{DL} [MHz]
Low	50+100	50	20805	2505.5	2805	2625.5	100	20949	2519.9	2949	2639.9
		100	20850	2510	2850	2630	50	20994	2524.4	2994	2644.4
	75+50	75	20825	2507.5	2825	2627.5	50	20945	2519.5	2945	2639.5
	75+75	75	20825	2507.5	2825	2627.5	75	20975	2522.5	2975	2642.5
	75+100	75	20828	2507.8	2828	2627.8	100	20999	2524.9	2999	2644.9
		100	20850	2510	2850	2630	75	21021	2527.1	3021	2647.1
Mid	100+100	100	20850	2510	2850	2630	100	21048	2529.8	3048	2649.8
		100	21006	2525.6	3006	2645.6	100	21150	2540	3150	2660
	50+100	50	21051	2530.1	3051	2650.1	50	21195	2544.5	3195	2664.5
		100	21051	2530.1	3051	2650.1	50	21171	2542.1	3171	2662.1
	75+50	75	21051	2530.1	3051	2650.1	50	21171	2542.1	3171	2662.1
	75+75	75	21025	2527.5	3025	2647.5	75	21175	2542.5	3175	2662.5
High	75+100	75	21003	2525.3	3003	2645.3	100	21174	2542.4	3174	2662.4
		100	21026	2527.6	3026	2647.6	75	21197	2544.7	3197	2664.7
	100+100	100	21001	2525.1	3001	2645.1	100	21199	2544.9	3199	2664.9
		100	21206	2545.6	3206	2665.6	100	21350	2560	3350	2680
	50+100	50	21251	2550.1	3251	2670.1	50	21395	2564.5	3395	2684.5
		100	21277	2552.7	3277	2672.7	50	21397	2564.7	3397	2684.7
	75+50	75	21225	2547.5	3225	2667.5	75	21375	2562.5	3375	2682.5
		75	21179	2542.9	3179	2662.9	100	21350	2560	3350	2680
	75+75	75	21201	2545.1	3201	2665.1	75	21372	2562.2	3372	2682.2
		100	21152	2540.2	3152	2660.2	100	21350	2560	3350	2680

Note 1: Carriers in increasing frequency order.

TEST FREQUENCIES:

Module NAD2								Module NAD1		
Carrier Aggregation Intra-band. Test frequencies for CA 7C.								LTE Band 7		
CA 7C: Band 7 with 2 contiguous intra-band CC (PCC+SCC), 1 RB										
Channel	NRB	PCC			SCC1			BW (MHz)	EARFCN	Freq. (MHz)
		BW (MHz)	EARFCN	Freq. (MHz)	BW (MHz)	EARFCN	Freq. (MHz)			
Low	100+100	20	20850	2510	20	21048	2529.8	10	Adjacent channel to SCC1 (21198)	2544.8
Middle	100+100	20	21001	2525.1	20	21199	2544.9	10	Adjacent channel to SCC1 (21349)	2559.9
High	100+100	20	21152	2540.2	20	21350	2560	10	Adjacent channel to PCC (21002)	2525.2

LTE Band CA_41C + LTE Band 41. QPSK and QAM modulations. CARRIER AGGREGATION & MIMO 2x2:

LTE Band 41:

	Channel (Frequency)			
	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	39675 (2498.50 MHz)	39700 (2501.00 MHz)	39725 (2503.50 MHz)	39750 (2506.00 MHz)
Middle	40620 (2593.00 MHz)	40620 (2593.00 MHz)	40620 (2593.00 MHz)	40620 (2593.00 MHz)
High	41565 (2687.50 MHz)	41540 (2685.00 MHz)	41515 (2682.50 MHz)	41490 (2680.00 MHz)

LTE Band CA_41C:

Range	CC-Combo / NRB_agg [RB]	CC1 Note1			CC2 Note1		
		BW [RB]	NUL/DL	f _{UL/DL} [MHz]	BW [RB]	NUL/DL	f _{UL/DL} [MHz]
Low	25+100	25	39683	2499.3	100	39800	2511
		100	39750	2506	25	39867	2517.7
	50+75	50	39703	2501.3	75	39823	2513.3
		75	39725	2503.5	50	39845	2515.5
	50+100	50	39705	2501.5	100	39849	2515.9
		100	39750	2506	50	39894	2520.4
	75+75	75	39725	2503.5	75	39875	2518.5
		75	39728	2503.8	100	39899	2520.9
	75+100	100	39750	2506	75	39921	2523.1
		100	39750	2506	100	39948	2525.8
	100+100	25	40528	2583.8	100	40645	2595.5
		100	40595	2590.5	25	40712	2602.2
Mid	25+100	25	40528	2583.8	100	40645	2595.5
		100	40595	2590.5	25	40712	2602.2
	50+75	50	40549	2585.9	75	40669	2597.9
		75	40571	2588.1	50	40691	2600.1
	50+100	50	40526	2583.6	100	40670	2598.0
		100	40571	2588.1	50	40715	2602.5
	75+75	75	40545	2585.5	75	40695	2600.5
		75	40523	2583.3	100	40694	2600.4
	75+100	100	40546	2585.6	75	40717	2602.7
		100	40521	2583.1	100	40719	2602.9
	100+100	25	40529	2583.9	100	40712	2602.2
		100	40529	2583.9	100	40712	2602.2
High	25+100	25	41373	2668.3	100	41490	2680
		100	41440	2675	25	41557	2686.7
	50+75	50	41395	2670.5	75	41515	2682.5
		75	41417	2672.7	50	41537	2684.7
	50+100	50	41346	2665.6	100	41490	2680
		100	41391	2670.1	50	41535	2684.5
	75+75	75	41365	2667.5	75	41515	2682.5
		75	41319	2662.9	100	41490	2680
	75+100	100	41341	2665.1	75	41512	2682.2
		100	41292	2660.2	100	41490	2680
	100+100	25	41373	2668.3	100	41490	2680
		100	41292	2660.2	100	41490	2680

Note 1: Carriers in increasing frequency order.

Note 2: This test frequency is applicable only for intra-band contiguous CA which requires channel spacing to be less than nominal channel spacing.

TEST FREQUENCIES:

Module NAD2								Module NAD1		
Carrier Aggregation Intra-band. Test frequencies for CA 41C.								LTE Band 41		
CA 41C: Band 41 with 2 contiguous intra-band CC (PCC+SCC), 1 RBlock.										
Channel	NRB	PCC			SCC1			BW (MHz)	EARFCN	Freq. (MHz)
		BW (MHz)	EARFCN	Freq. (MHz)	BW (MHz)	EARFCN	Freq. (MHz)			
Low	100+25	20	39750	2506	5	39867	2517.7	20	Adjacent channel to SCC1 (39992)	2530.2
Middle	100+25	20	40595	2590.5	5	40712	2602.2	20	Adjacent channel to PCC (40837)	2614.7
High	100+25	20	41440	2675	5	41557	2686.7	20	Adjacent channel to PCC (41315)	2662.5

LTE Band CA_66B + LTE Band 66. QPSK and QAM modulations. CARRIER AGGREGATION & MIMO 2x2:

LTE Band 66:

Channel (Frequency)						
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	131979 (1710.7 MHz)	131987 (1711.5 MHz)	131997 (1712.5 MHz)	132022 (1715.0 MHz)	132047 (1717.5 MHz)	132072 (1720.0 MHz)
Middle	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)
High	132665 (1779.3 MHz)	132657 (1778.5 MHz)	132647 (1777.5 MHz)	132622 (1775.0 MHz)	132597 (1772.5 MHz)	132572 (1770.0 MHz)

LTE Band CA_66B:

Range	CC-Combo / NRB_agg [RB]	CC1 Note1					CC2 Note1				
		BW [RB]	N _{UL}	f _{UL} [MHz]	N _{DL}	f _{DL} [MHz]	BW [RB]	N _{UL}	f _{UL} [MHz]	N _{DL}	f _{DL} [MHz]
Low	25+25	25	131997	1712.5	66461	2112.5	25	132045	1717.3	66509	2117.3
	25+50	25	132000	1712.8	66464	2112.8	50	132072	1720	66536	2120
		50	132022	1715	66486	2115	25	132094	1722.2	66558	2122.2
	25+75	25	132002	1713	66466	2113	75	132095	1722.3	66559	2122.3
		75	132047	1717.5	66511	2117.5	25	132140	1726.8	66604	2126.8
	50+50	50	132022	1715	66486	2115	50	132121	1724.9	66585	2124.9
Mid	25+25	25	132398	1752.6	66862	2152.6	25	132446	1757.4	66910	2157.4
	25+50	25	132375	1750.3	66839	2150.3	50	132447	1757.5	66911	2157.5
		50	132397	1752.5	66861	2152.5	25	132469	1759.7	66933	2159.7
	25+75	25	132353	1748.1	66817	2148.1	75	132446	1757.4	66910	2157.4
		75	132398	1752.6	66862	2152.6	25	132491	1761.9	66955	2161.9
	50+50	50	132373	1750.1	66837	2150.1	50	132472	1760	66936	2160
High ²	25+25	25	132647	1777.5	67111	2177.5	25	NA	NA	67159	2182.3
	25+50	25	132647	1777.5	67111	2177.5	50	NA	NA	67183	2184.7
		50	132622	1775	67086	2175	25	NA	NA	67158	2182.2
	25+75	25	132647	1777.5	67111	2177.5	75	NA	NA	67204	2186.8
		75	132597	1772.5	67061	2172.5	25	NA	NA	67154	2181.8
	50+50	50	132622	1775	67086	2175	50	NA	NA	67185	2184.9
High ³	25+25	25	132599	1772.7	67063	2172.7	25	132647	1777.5	67111	2177.5
	25+50	25	132550	1767.8	67014	2167.8	50	132622	1775	67086	2175
		50	132572	1770	67036	2170	25	132644	1777.2	67108	2177.2
	25+75	25	132504	1763.2	66968	2163.2	75	132597	1772.5	67061	2172.5
		75	132549	1767.7	67013	2167.7	25	132642	1777	67106	2177
	50+50	50	132523	1765.1	66987	2165.1	50	132622	1775	67086	2175
Note 1: Carriers in increasing frequency order.											
Note 2: Applicable for intra-band contiguous CA without UL CA.											
Note 3: Applicable for intra-band contiguous CA with UL CA.											

TEST FREQUENCIES:

Module NAD2								Module NAD1		
Carrier Aggregation Intra-band. Test frequencies for CA_66B.								LTE Band 66		
CA_66B: Band 66 with 2 contiguous intra-band CC (PCC+SCC), 1 Block.										
Channel	NRB	PCC			SCC1			BW (MHz)	EARFCN	Freq. (MHz)
		BW (MHz)	EARFCN	Freq. (MHz)	BW (MHz)	EARFCN	Freq. (MHz)			
Low	25+50	5	132000	1712.80	10	132072	1720	3	Adjacent channel to SCC1 (132137)	1726.5
Middle	25+50	5	132375	1750.3	10	132447	1757.5	3	Adjacent channel to PCC (132512)	1764
High	25+50	5	132550	1767.8	10	132622	1775	3	Adjacent channel to PCC (132510)	1763.8

LTE Band CA_66C + LTE Band 66. QPSK and QAM modulations. CARRIER AGGREGATION & MIMO 2x2:

LTE Band 66:

	Channel (Frequency)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	131979 (1710.7 MHz)	131987 (1711.5 MHz)	131997 (1712.5 MHz)	132022 (1715.0 MHz)	132047 (1717.5 MHz)	132072 (1720.0 MHz)
Middle	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)	132322 (1745.0 MHz)
High	132665 (1779.3 MHz)	132657 (1778.5 MHz)	132647 (1777.5 MHz)	132622 (1775.0 MHz)	132597 (1772.5 MHz)	132572 (1770.0 MHz)

LTE Band CA_66C:

Range	CC-Combo / N _{RE_MSC} [RB]	CC1 Note1					CC2 Note1				
		BW [RB]	NUL	f _{UL} [MHz]	N _{DL}	f _{DL} [MHz]	BW [RB]	NUL	f _{UL} [MHz]	N _{DL}	f _{DL} [MHz]
Low	50+75	50	132025	1715.3	66489	2115.3	75	132145	1727.3	66609	2127.3
		75	132047	1717.5	66511	2117.5	50	132167	1729.5	66631	2129.5
	50+100	50	132027	1715.5	66491	2115.5	100	132171	1729.9	66635	2129.9
		100	132072	1720	66536	2120	50	132216	1734.4	66680	2134.4
	75+75	75	132047	1717.5	66511	2117.5	75	132197	1732.5	66661	2132.5
		75	132050	1717.8	66514	2117.8	100	132221	1734.9	66685	2134.9
	75+100	100	132072	1720	66536	2120	75	132243	1737.1	66707	2137.1
		100	132072	1720	66536	2120	25	132189	1731.7	66653	2131.7
	100+25	25	132005	1713.3	66469	2113.3	100	132122	1725.0	66596	2125.0
		100	132072	1720	66536	2120	100	132270	1739.8	66734	2139.8
Mid	50+75	50	132351	1747.9	66815	2147.9	75	132471	1759.9	66935	2159.9
		75	132373	1750.1	66837	2150.1	50	132493	1762.1	66957	2162.1
	50+100	50	132328	1745.6	66792	2145.6	100	132472	1760	66936	2160
		100	132373	1750.1	66837	2150.1	50	132517	1764.5	66981	2164.5
	75+75	75	132347	1747.5	66811	2147.5	75	132497	1762.5	66961	2162.5
		75	132325	1745.3	66789	2145.3	100	132496	1762.4	66960	2162.4
	75+100	100	132348	1747.8	66812	2147.8	75	132519	1764.7	66983	2164.7
		100	132397	1752.5	66861	2152.5	25	132514	1764.2	66978	2164.2
	100+25	25	132330	1745.8	66794	2145.8	100	132447	1757.5	66911	2157.5
		100	132323	1745.1	66787	2145.1	100	132521	1764.9	66985	2164.9
High ²	50+75	50	132622	1775	67086	2175	75	NA	NA	67206	2187
		75	132597	1772.5	67061	2172.5	50	NA	NA	67181	2184.5
	50+100	50	132622	1775	67086	2175	100	NA	NA	67230	2189.4
		100	132572	1770	67036	2170	50	NA	NA	67180	2184.4
	75+75	75	132597	1772.5	67061	2172.5	75	NA	NA	67211	2187.5
		75	132597	1772.5	67061	2172.5	100	NA	NA	67232	2189.6
	100+25	100	132572	1770	67036	2170	75	NA	NA	67207	2187.1
		100	132572	1770	67036	2170	25	NA	NA	67153	2181.7
	100+100	25	132647	1777.5	67111	2177.5	100	NA	NA	67228	2189.2
		100	132572	1770	67036	2170	100	NA	NA	67234	2189.8
High ³	50+75	50	132477	1760.5	66941	2160.5	75	132597	1772.5	67061	2172.5
		75	132499	1762.7	66963	2162.7	50	132619	1774.7	67083	2174.7
	50+100	50	132428	1755.6	66892	2155.6	100	132572	1770	67036	2170
		100	132473	1760.1	66937	2160.1	50	132617	1774.5	67081	2174.5
	75+75	75	132447	1757.5	66911	2157.5	75	132597	1772.5	67061	2172.5
		75	132401	1752.9	66885	2152.9	100	132572	1770	67036	2170
	75+100	100	132423	1755.1	66887	2155.1	75	132594	1772.2	67058	2172.2
		100	132522	1765	66986	2165	25	132639	1776.7	67103	2176.7
	100+25	25	132455	1758.3	66919	2158.3	100	132572	1770.0	67036	2170.0
		100	132374	1750.2	66838	2150.2	100	132572	1770	67036	2170

Note 1: Carriers in increasing frequency order.
Note 2: Applicable for intra-band contiguous CA without UL CA.
Note 3: Applicable for intra-band contiguous CA with UL CA.

TEST FREQUENCIES:

Module NAD2								Module NAD1		
Carrier Aggregation Intra-band. Test frequencies for CA_66C.								LTE Band 66		
CA_66C: Band 66 with 2 contiguous intra-band CC (PCC+SCC), 1 Block.										
Channel	NRB	PCC			SCC1			BW (MHz)	EARFCN	Freq. (MHz)
		BW (MHz)	EARFCN	Freq. (MHz)	BW (MHz)	EARFCN	Freq. (MHz)			
Low	75+50	15	132047	1717.5	10	132167	1729.5	3	Adjacent channel to SCC1 (132237)	1736.5
Middle	75+50	15	132373	1750.1	10	132493	1762.1	3	Adjacent channel to PCC (132558)	1768.6
High	75+50	15	132499	1762.7	10	132619	1774.7	3	Adjacent channel to PCC (132434)	1756.2

LTE Band 38:

Channel (Frequency. MHz)		
Lowest	Middle	Highest
2570	2595	2620

NOTE: Band 38 is completely included in band 41, so the channels of band 41 have been tested to give conformity to the assigned block:

LTE Band 41

Channel (Frequency. MHz)		
Lowest	Middle	Highest
2496	2593	2690

Radiated emissions

SPECIFICATION:

1. LTE Band 7 and LTE Band 41. FCC §2.1053 & §27.53 (m) (4) / RSS-199 Issue 3 Clause 4.5 (b).

FCC §27.53 (m) (4):

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

RSS-199 Issue 3 Clause 4.5 (b):

4.5. In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

(b) for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

- i. $40 + 10 \log_{10} p$ from the channel edges to 5 MHz away
- ii. $43 + 10 \log_{10} p$ between 5 MHz and X MHz from the channel edges, and
- iii. $55 + 10 \log_{10} p$ at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than $43 + 10 \log_{10} p$ on all frequencies between 2490.5 MHz and 2496 MHz, and $55 + 10 \log_{10} p$ at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

LTE Band 7 and LTE Band 41 MEASUREMENT LIMIT:

On all frequencies between the channel edge and 5 megahertz from the channel edge:

At P_o transmitting power, the specified minimum attenuation becomes $40 + 10 \log (P_o)$, and the level in dBm relative P_o becomes:

$$P_o \text{ (dBm)} - [40 + 10 \log (P_o \text{ in mwatts}) - 30] = -10 \text{ dBm}$$

On all frequencies between 5 megahertz and X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section; and between 2490.5 MHz and 2496 MHz:

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log (P_o)$, and the level in dBm relative P_o becomes:

$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

On all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section; and below 2490.5 MHz:

At P_o transmitting power, the specified minimum attenuation becomes $55 + 10 \log (P_o)$, and the level in dBm relative P_o becomes:

$$P_o \text{ (dBm)} - [55 + 10 \log (P_o \text{ in mwatts}) - 30] = -25 \text{ dBm}$$

2. LTE Band 66. FCC §2.1053 & §27.53 (h) / RSS-139 Issue 3 Clause 6.6.

FCC §27.53 (h):

(h) Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 MHz, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10} (P)$ dB.

RSS-139 Issue 3 Clause 6.6:

i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} P$ (watts) dB.

ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} P$ (watts) dB.

LTE Band 66 MEASUREMENT LIMIT:

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log (P_o)$, and the level in dBm relative P_o becomes:

$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

METHOD:

The measurement was performed with the EUT inside an anechoic chamber.

The spectrum was scanned from 30 MHz to at least the 10th harmonic of the High frequency generated within the equipment.

The EUT was placed on a non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz up to 18 GHz.

The EUT was placed on a non-conductive stand at a 1 meter distance from the measuring antenna for measurements below 18 GHz up to 27 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

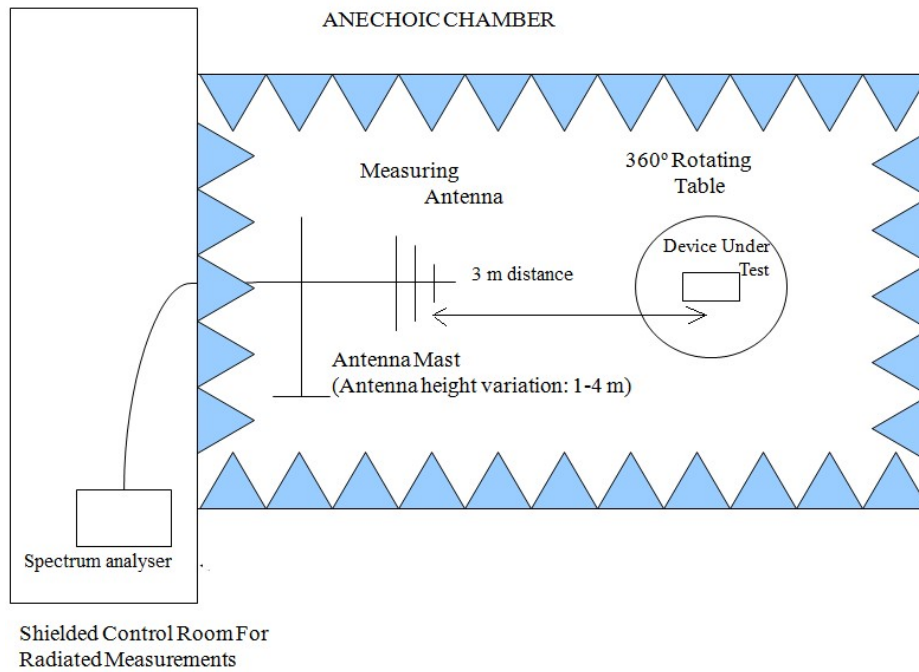
The maximum field strength (dB μ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

$$\text{EIRP (dBm)} = E \text{ (dB}\mu\text{V/m)} + 20 \log(D) - 104.8; \text{ where } D \text{ is the measurement distance (in the far field region) in m.}$$
$$D = 3 \text{ m}$$

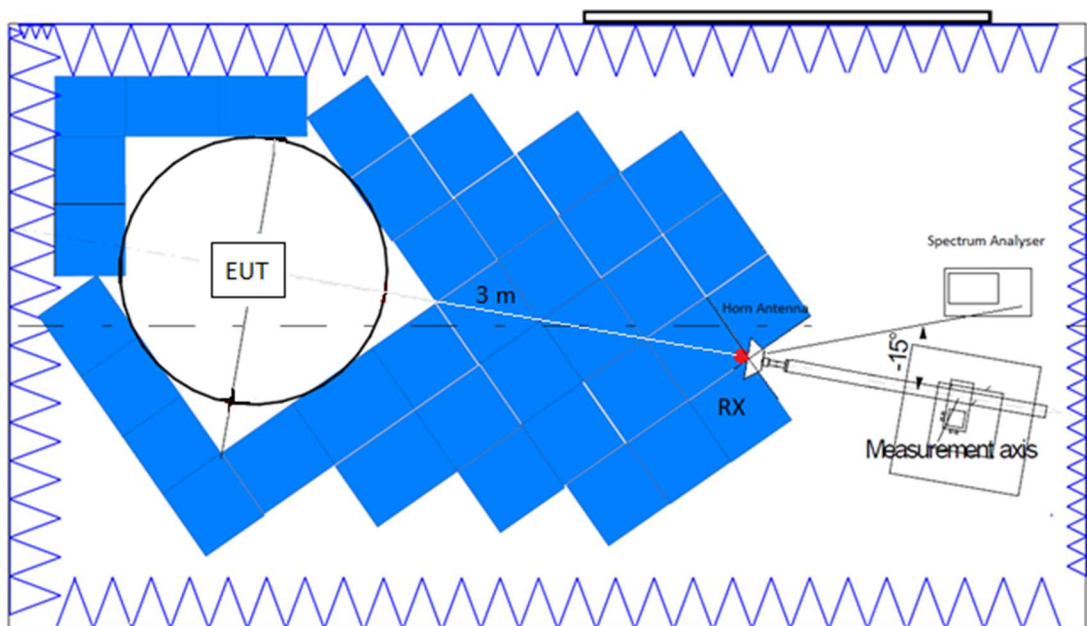
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

TEST SETUP:

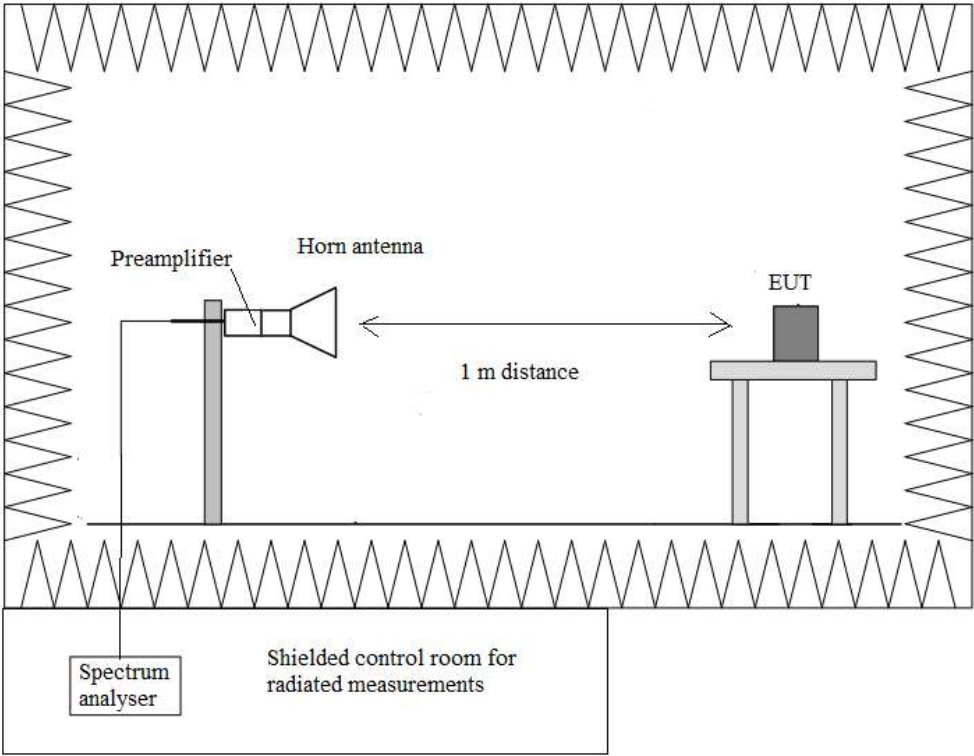
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 18 GHz:



Radiated measurements setup $f > 18\text{ GHz}$:



RESULTS:

LTE Band CA 7C + LTE Band 7:

QPSK and QAM modulations: A preliminary scan determined the worst case:

- 1) LTE CA_7C: For the PCC: QPSK modulation, BW=20 MHz, RB=1, Offset=0.
For the SCC1: QPSK modulation, BW=20 MHz, RB=1, Offset=0.
- 2) LTE Band 7: QPSK modulation, BW=10 MHz, RB=1, Offset=0.

The following results are the ones of the worst case.

- LOW CHANEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 27 GHz:

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector	Measurement Uncertainty (dB)
7.52275	-44.72	V	RMS	<±4.98
17.78275	-38.32	V	RMS	<±4.98

Frequency range 2490.5 - 2496 MHz:

No spurious frequencies at less than 20 dB below the limit.

- MIDDLE CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 27 GHz:

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector	Measurement Uncertainty (dB)
2.4963	-33.91	V	RMS	<±4.98
17.88875	-43.17	V	RMS	<±4.98

Frequency range 2490.5 - 2496 MHz:

No spurious frequencies at less than 20 dB below the limit.

- HIGH CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 27 GHz:

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector	Measurement Uncertainty (dB)
7.59375	-43.27	V	RMS	<±4.98
17.60925	-39.21	V	RMS	<±4.98

Frequency range 2490.5 - 2496 MHz:

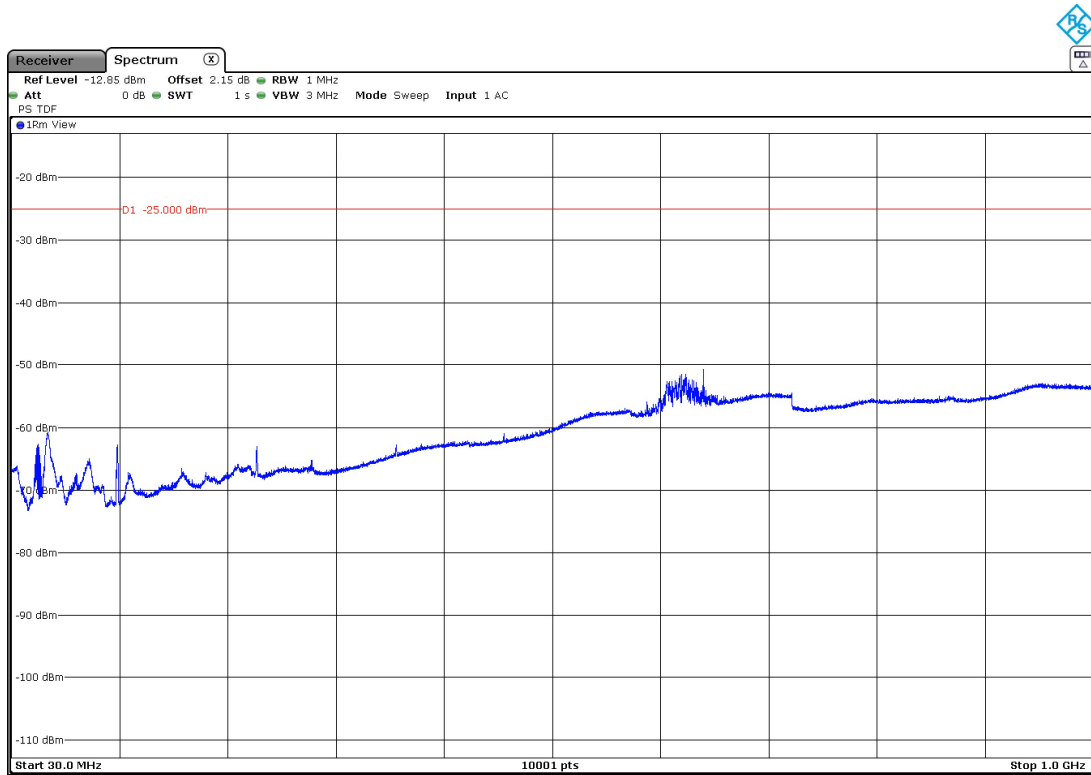
No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB)	<±4.99 for f < 1 GHz <±4.98 for f ≥ 1 GHz up to 17 GHz <±5.08 for f ≥ 17 GHz up to 26 GHz
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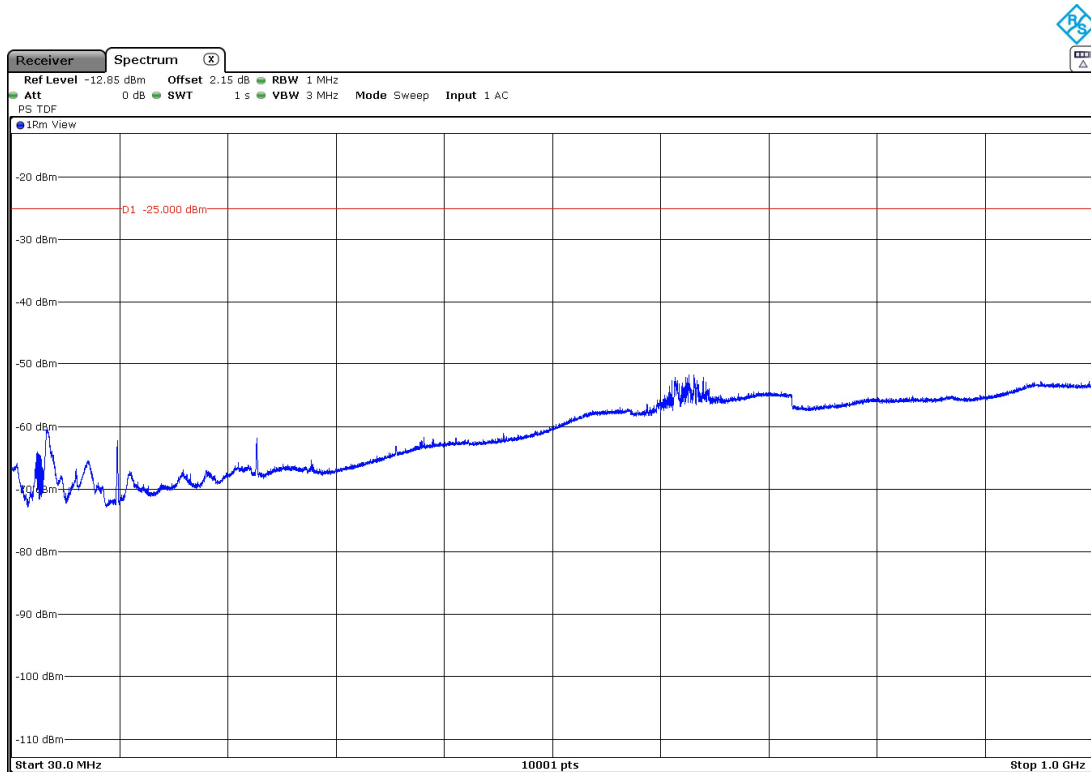
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz (worst case):

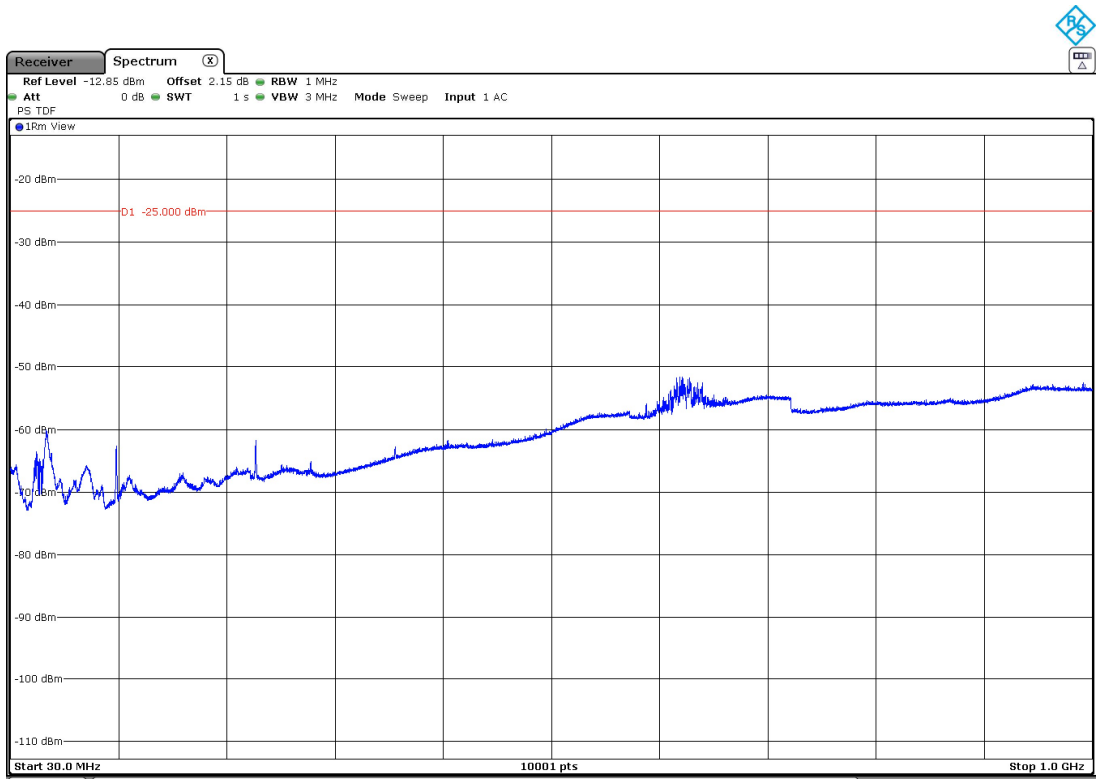
- Low Channel:



- Middle Channel:

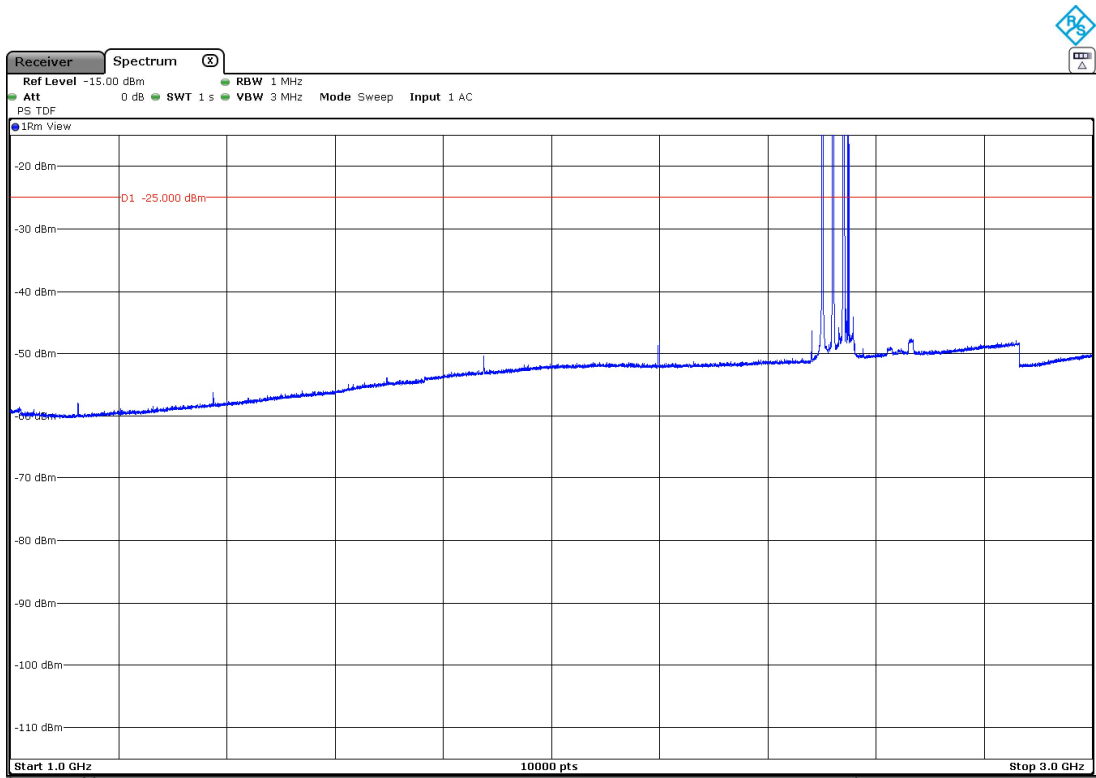


- High Channel:



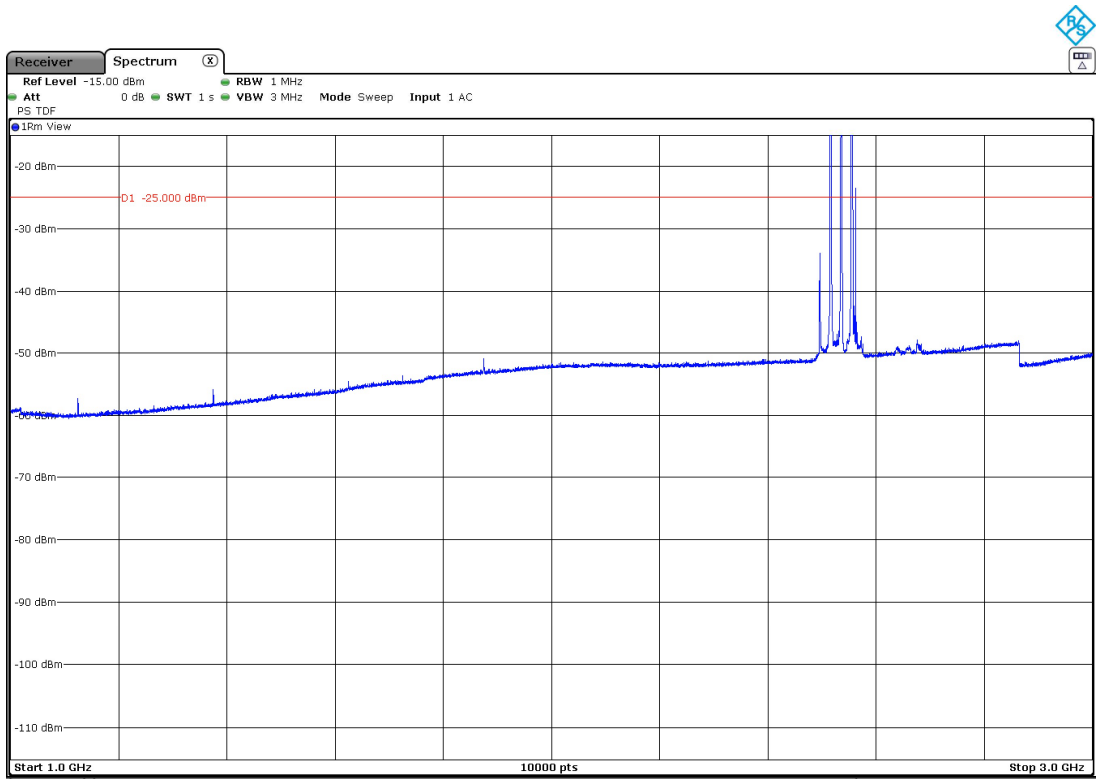
FREQUENCY RANGE 1 - 3 GHz (worst case):

- Low Channel:



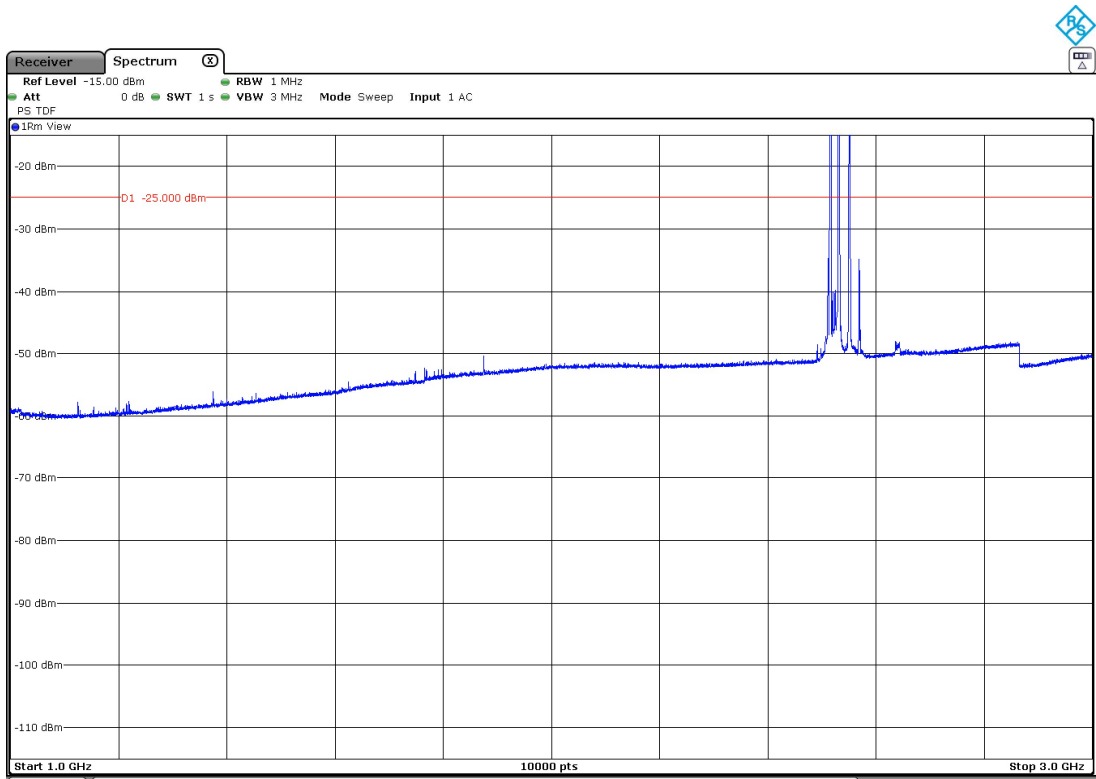
The signals above the limit are the carrier frequencies.

- Middle Channel:



The signals above the limit are the carrier frequencies.

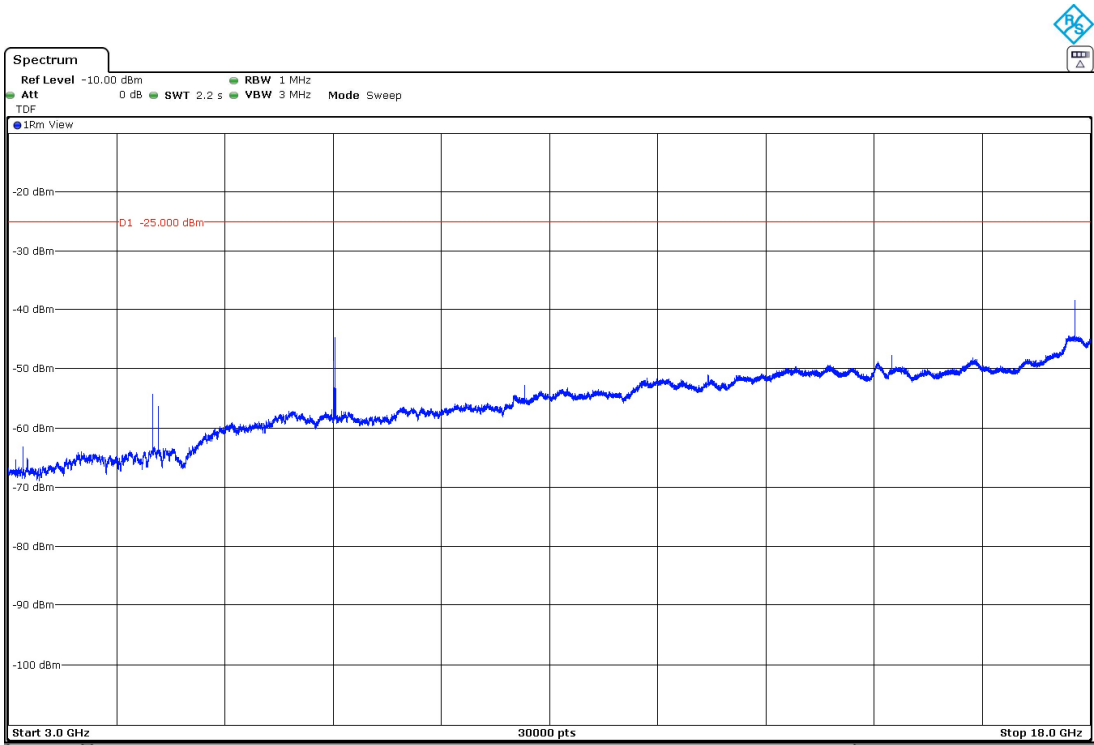
- High Channel:



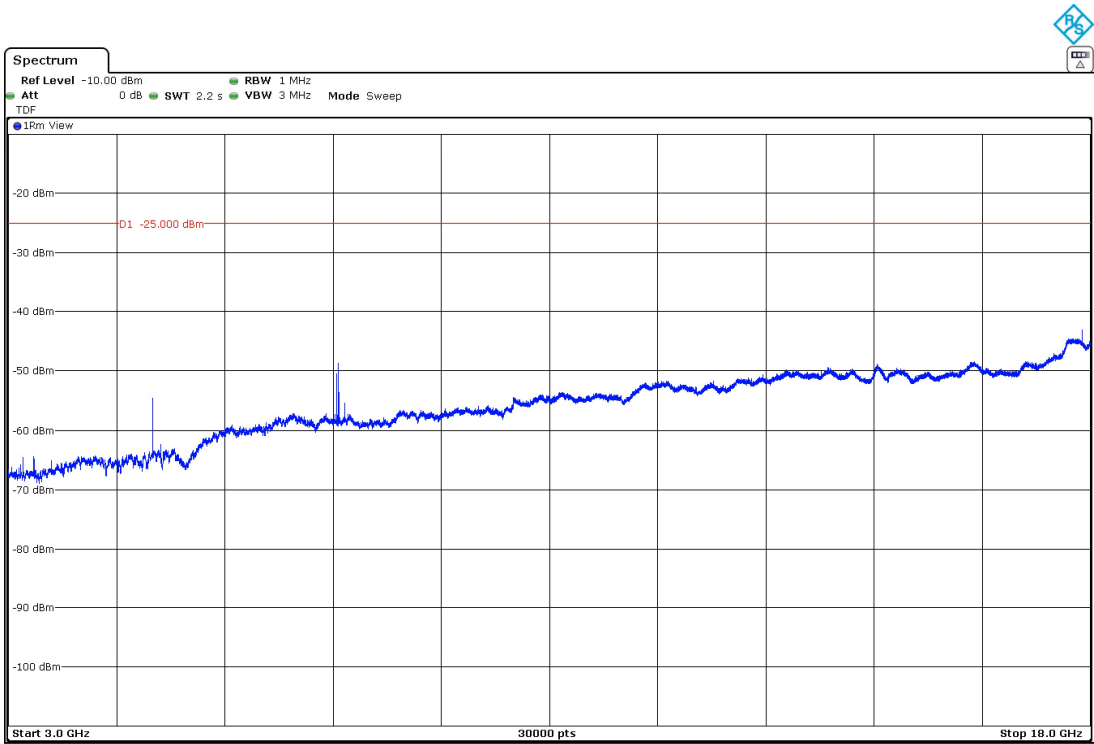
The signals above the limit are the carrier frequencies.

FREQUENCY RANGE 3 - 18 GHz (worst case):

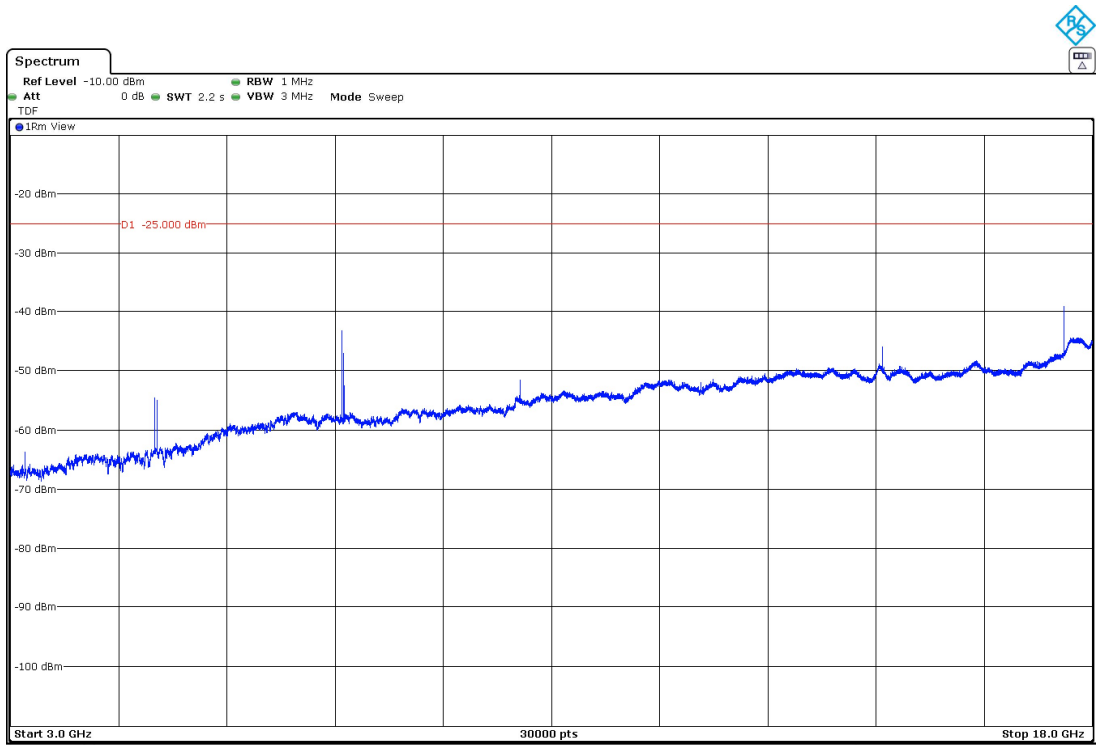
- Low Channel:



- Middle Channel:

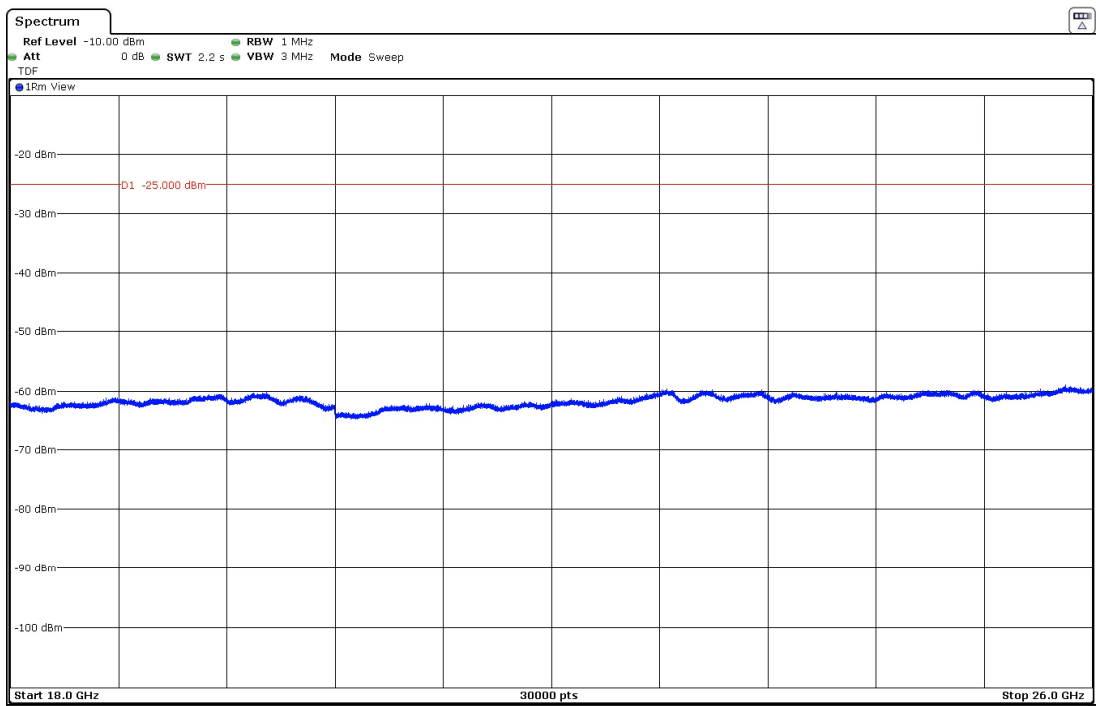


- High Channel:

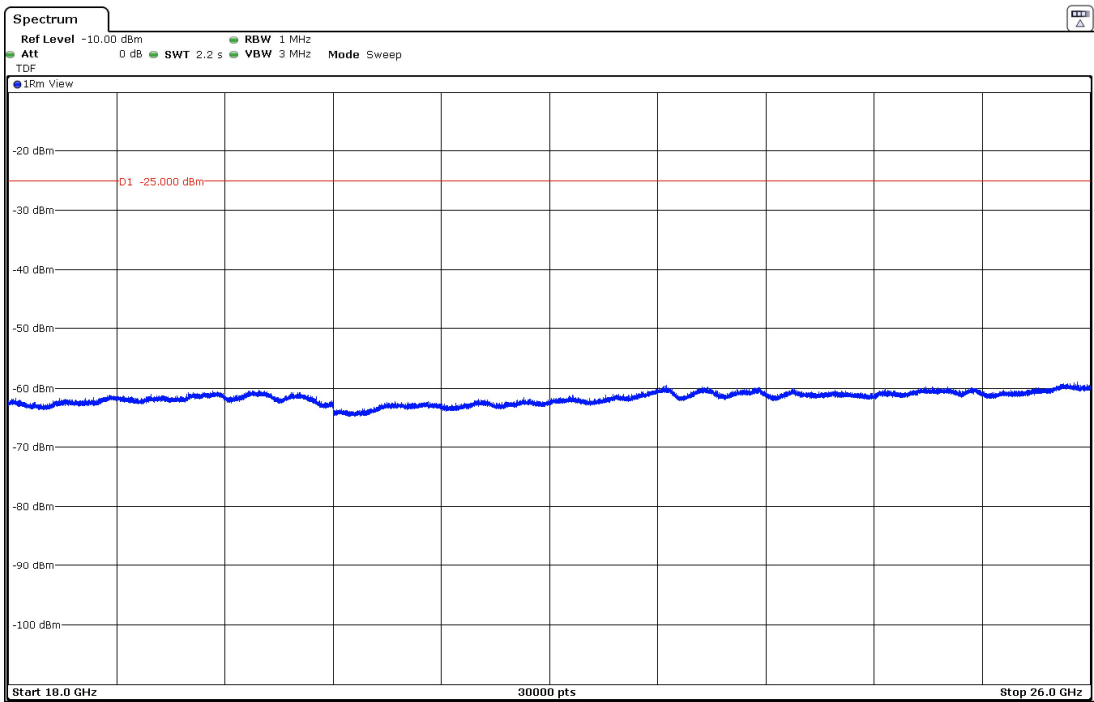


FREQUENCY RANGE 18 - 26 GHz (worst case):

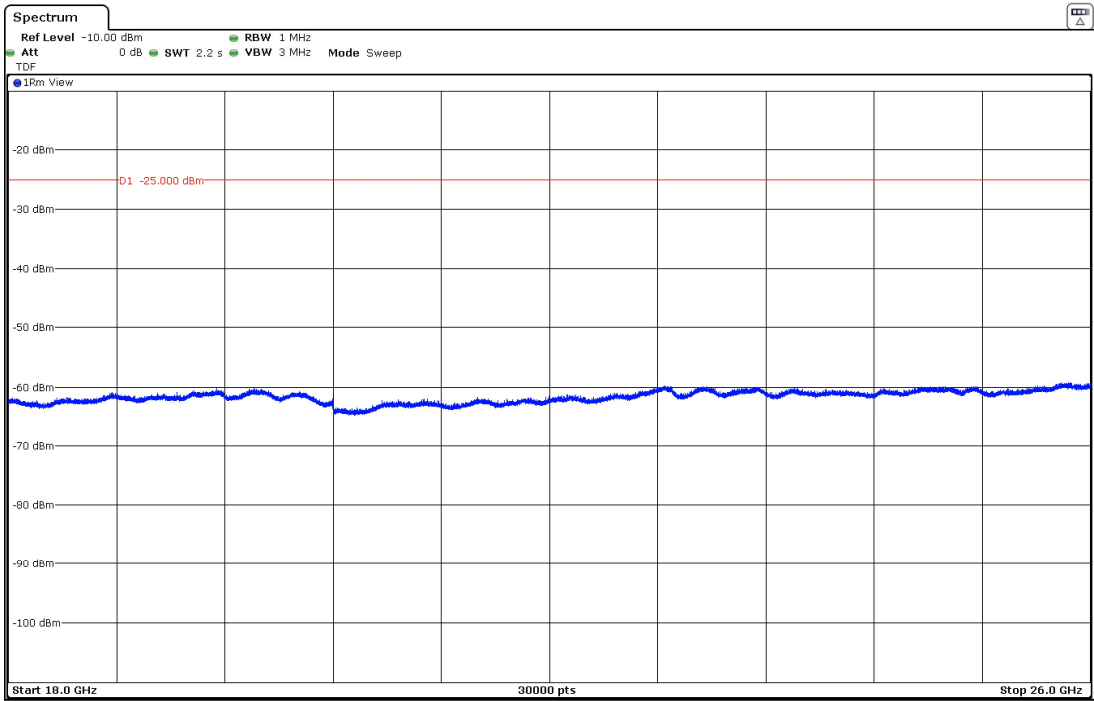
- Low Channel:



- Middle Channel:

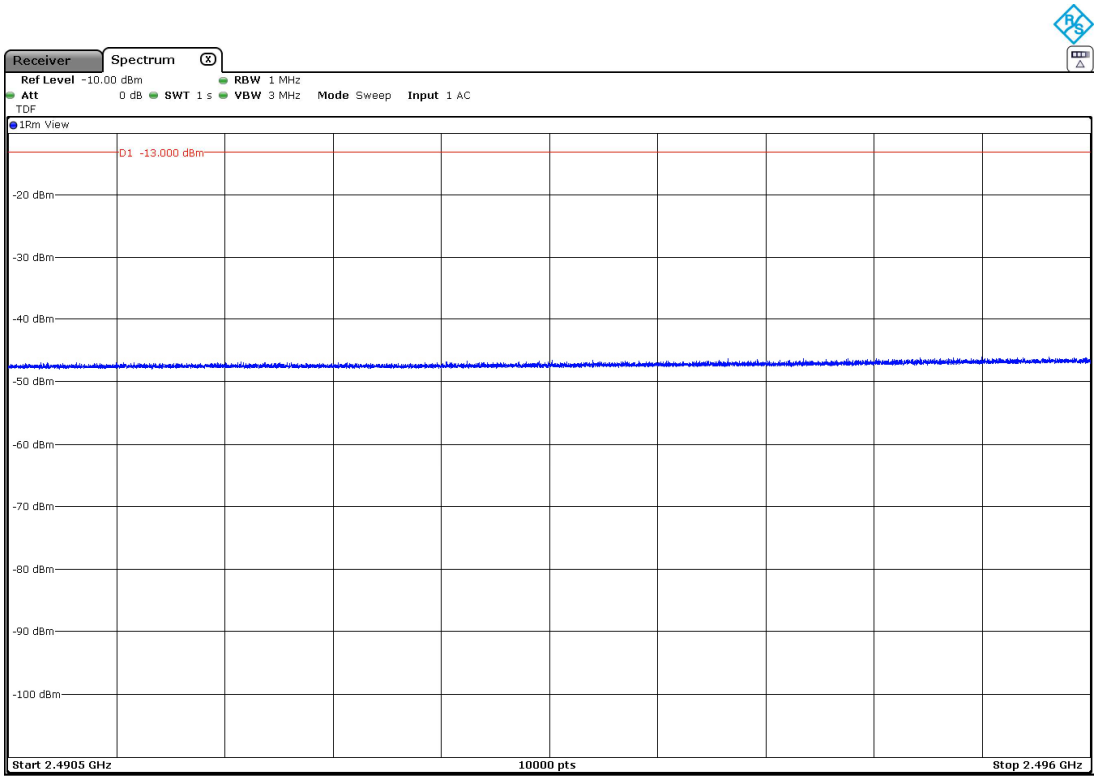


- High Channel:

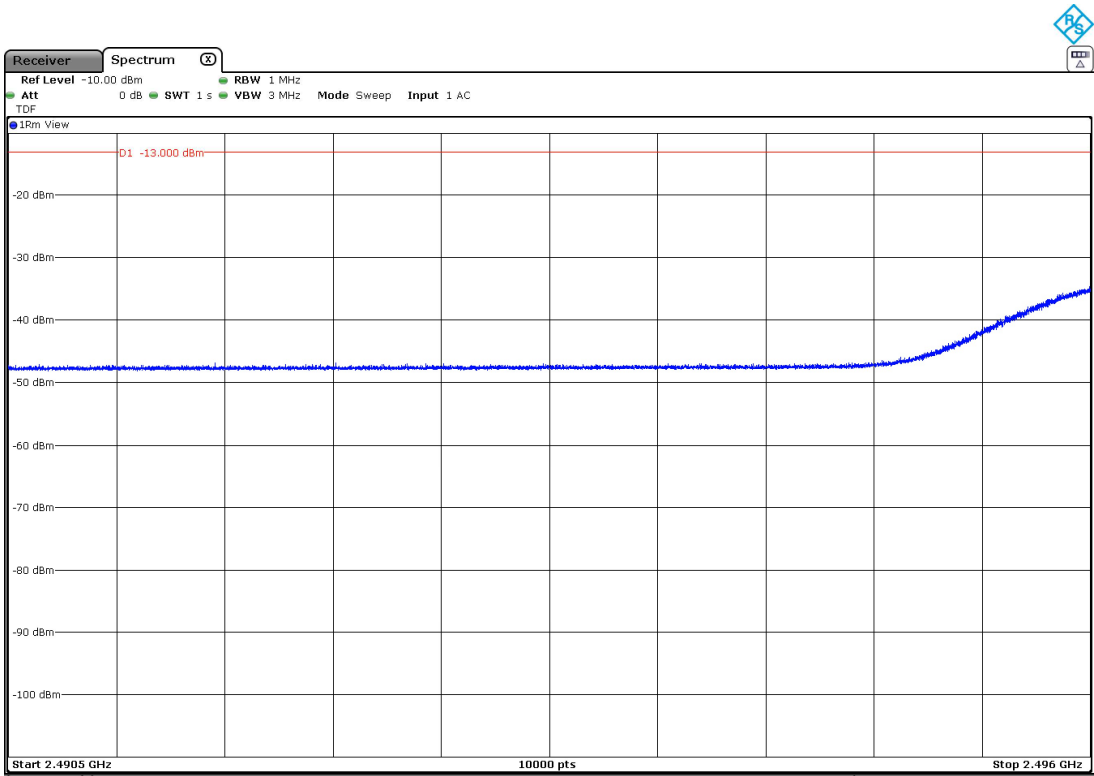


FREQUENCY RANGE 2490.5 - 2496 MHz (worst case):

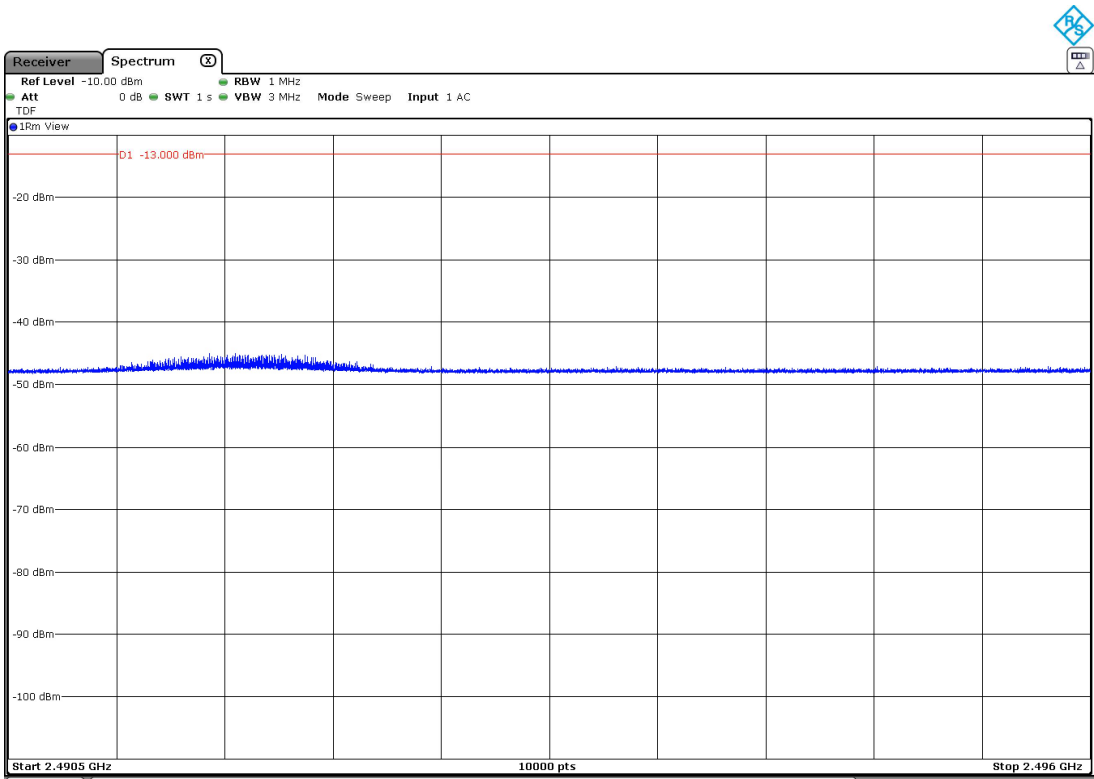
- Low Channel:



- Middle Channel:



- High Channel:



LTE Band CA 41C + LTE Band 41:

QPSK and QAM modulations: A preliminary scan determined the worst case:

- 1) LTE CA_41C: For the PCC: 16QAM modulation, BW=20 MHz, RB=1, Offset=0.
For the SCC1: 16QAM modulation, BW=5 MHz, RB=1, Offset=0.
- 2) LTE Band 41: QPSK modulation, BW=20 MHz, RB=1, Offset=0.

The following results are the ones of the worst case.

- LOW CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 27 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 2490.5 - 2496 MHz:

No spurious frequencies at less than 20 dB below the limit.

- MIDDLE CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 27 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 2490.5 - 2496 MHz:

No spurious frequencies at less than 20 dB below the limit.

- HIGH CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 27 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 2490.5 - 2496 MHz:

No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB)	<±4.99 for $f < 1$ GHz <±4.98 for $f \geq 1$ GHz up to 17 GHz <±5.08 for $f \geq 17$ GHz up to 27 GHz
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Verdict: PASS