DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29507456

ISED CABid: ES1909

Test Report No:
NIE: 68001RRF.009

Partial Test Report

Reference Standard:
USA FCC Part 27
CANADA RSS-130, RSS-139, RSS-199

(*) Identification of item tested	Telematic control unit with wireless technologies, used in automotive industry
(*) Trademark	BMW
(*) Model and /or type reference	WAVE-11-HAF-R2
(*) Derived model not tested	WAVE-11-HIGH-R2
Other identification of the product	Type: B424 HW version: D5 SW version: 21411A.004_045_017 IMEI TAC: 35011736 (OEM modem), 35894272 (CUS modem) Contains FCC ID: T8GSAN9000 Contains FCC ID: T8GSAN9001 Contains IC: 6434A-SAN9000 Contains IC: 6434A-SAN9001
(*) Features	GSM, UMTS, LTE, 5G, GNSS
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD, GERMANY
Test method requested, standard	USA FCC Part 27 (10-1-20 Edition). CANADA RSS-130 Issue 2, Feb. 2019. CANADA RSS-139 Issue 3, July 2015. CANADA RSS-199 Issue 3, December 2016. - Radiated Emissions. ANSI C63.26-2015. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Approved by (name / position & signature)	Rafael López Martín EMC Consumer & RF Lab. Manager  2022.01.11 16:43:57 +01'00'
Date of issue	2022-01-11
Report template No	FDT08_23 (*) "Data provided by the client"

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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.

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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-GOERING-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

i. V. Alexandru Neacsu

By: Alexandru Costin Neacsu
Title: Regulatory Product Compliance Expert
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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 Nº	Description	Model	Serial Nº	Date of reception
68001/012	Telematic control unit with wireless technologies, used in automotive industry (Type B424)	WAVE-11-HAF-R2	B425G40M4907018	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/067	Spoiler Antenna ZB G05/G07	--	0014	2021/07/29
62486/025	Antenna Box	AB01-I20-01	--	2020/09/22
62486/062	RF Harness	--	--	2020/09/22

Auxiliary elements used with the Sample S/01:

Control Nº	Description	Model	Serial Nº	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
62486/156	OABR Cable Adapter	--	--	2020/09/28
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)	2021-11-09
Date (finish)	2021-11-11

Document history

Report number	Date	Description
68001RRF.009	2022-01-11	First release.

Environmental conditions

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Alfonso Gutiérrez, Miguel Ángel Torres and Javier Miguel Nadales.

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	2020/12	2022/12
6.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2020/03	2022/03
7.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	N/A	N/A
8.	UXM 5G RF Test Platform KEYSIGHT TECHNOLOGIES E7515B	N/A	N/A
9.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2021/11	2023/11
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-130 4.6., RSS-139 6.5., RSS-199 4.4.: RF output power	N/M	(1)
FCC 2.1047 / RSS-130 4.2., RSS-139 6.2., RSS-199 4.1.: Modulation characteristics	N/M	(1)
FCC 27.54 / RSS-130 4.3., RSS-139 6.4., RSS-199 4.3.: Frequency stability	N/M	(1)
FCC 2.1049 / RSS-Gen 6.7., RSS-139 6.4., RSS-199 4.3.: Occupied Bandwidth	N/M	(1)
FCC 27.53 / RSS-130 4.7., RSS-139 6.6., RSS-199 4.5.: Spurious emissions at antenna terminals	N/M	(1)
FCC 27.53 / RSS-130 4.7., RSS-139 6.6., RSS-199 4.5.: Radiated emissions	P	
Supplementary information and remarks: (1) Test not requested.		

Appendix A: Test results for FCC Part 27 / RSS-130, RSS-139, RSS-199

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TEST CONDITIONS

The module with the highest antenna gain has been tested using the worst-case obtained for conducted output power for EN-Dual Connectivity. And the other module has been tested using an adjacent channel to the 5G with LTE band with a setting that would allow communication in the same band to both modules simultaneously.

This report cover the worst-case between DC_5A_n66A and DC_12A_n66A.
This report cover the worst-case between DC_2A_n71A and DC_66A_n71A.

(*): Data provided by the Applicant.

POWER SUPPLY (*):

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

TEST FREQUENCIES (*):

E-UTRA New Radio Dual Connectivity & MIMO 2x2:

EN-DC configuration DC_26A_n41A + LTE Band 41:

Table 4.3.1.1.1.41-2: Test frequencies for NR operating band n41, SCS 30 kHz and ΔF_{Raster} 30 kHz

CBW [MHz]	*carrier Bandwidth* [PRBs]	Range		Carrier centre [MHz]	Carrier centre [ARFCN]	point A [MHz]	*absolute FrequencyPoint A* [ARFCN]	*offsetToCarrier* [Carrier PRBs]	SS block SCS [kHz]	GSCN	*absolute FrequencySSB* [ARFCN]	k_{SSB}	Offset Carrier CORESET#0 [RBs] Note 2	CORESET#0 Index (Offset [RBs]) Note 1	offsetToPointA (SIB1) [PRBs] Note 1
10	24	Downlink & Uplink	Low	2501.01	500202	2496.69	499338	0	30	6252	500190	20	0	1 (1)	2
			Mid	2592.99	518598	2551.95	510390	102		6483	518670	0	0	3 (3)	210
			High	2685	537000	2499.24	499848	504		6711	536910	18	0	0 (0)	1008
15	38	Downlink & Uplink	Low	2503.5	500700	2496.66	499332	0	30	6252	500190	22	0	1 (1)	2
			Mid	2592.99	518598	2549.43	509886	102		6474	517950	0	0	0 (0)	204
			High	2682.48	536496	2494.2	498840	504		6699	535950	10	0	1 (1)	1010
20	51	Downlink & Uplink	Low	2506.02	501204	2496.84	499368	0	30	6252	500190	10	0	1 (1)	2
			Mid	2592.99	518598	2547.09	509418	102		6471	517710	4	0	3 (3)	210
			High	2679.99	535998	2489.37	497874	504		6687	534990	12	0	1 (1)	1010
30	78	Downlink & Uplink	Low	2511	502200	2496.96	499392	0	30	6252	500190	2	0	1 (1)	2
			Mid	2592.99	518598	2542.23	508446	102		6456	516510	0	0	0 (0)	204
			High	2674.98	534996	2479.5	495900	504		6663	533070	6	0	2 (2)	1012
40	106	Downlink & Uplink	Low	2516.01	503202	2496.93	499386	0	30	6252	500190	4	0	1 (1)	2
			Mid	2592.99	518598	2537.19	507438	102		6444	515550	16	0	0 (0)	204
			High	2670	534000	2469.48	493896	504		6636	530910	2	0	0 (0)	1008
50	133	Downlink & Uplink	Low	2521.02	504204	2497.08	499416	0	30	6252	500190	18	0	0 (0)	0
			Mid	2592.99	518598	2532.33	506466	102		6432	514590	20	0	0 (0)	204
			High	2664.99	532998	2459.61	491922	504		6612	528990	20	0	0 (0)	1008
60	162	Downlink & Uplink	Low	2526	505200	2496.84	499368	0	30	6252	500190	10	0	1 (1)	2
			Mid	2592.99	518598	2527.11	505422	102		6420	513630	0	0	2 (2)	208
			High	2659.98	531996	2449.38	489876	504		6588	527070	14	0	2 (2)	1012
80	217	Downlink & Uplink	Low	2536.02	507204	2496.96	499392	0	30	6252	500190	2	0	1 (1)	2
			Mid	2592.99	518598	2517.21	503442	102		6396	511710	20	0	2 (2)	208
			High	2649.99	529998	2429.49	485898	504		6537	522990	4	0	1 (1)	1010
90	245	Downlink & Uplink	Low	2541	508200	2496.9	499380	0	30	6252	500190	6	0	1 (1)	2
			Mid	2592.99	518598	2512.17	502434	102		6381	510510	4	0	0 (0)	204
			High	2644.98	528996	2419.44	483888	504		6513	521070	10	0	2 (2)	1012
100	273	Downlink & Uplink	Low	2546.01	509202	2496.87	499374	0	30	6252	500190	8	0	1 (1)	2
			Mid	2592.99	518598	2507.13	501426	102		6369	509550	20	0	0 (0)	204
			High	2640	528000	2409.42	481884	504		6486	518910	6	0	0 (0)	1008

Note 1: The CORESET#0 Index and the associated CORESET#0 Offset refers to Table 13-4 in TS 38.213 [22]. The value of CORESET#0 Index is signalled in controlResourceSetZero (pdcch-ConfigSIB1) in the MIB. The offsetToPointA IE is expressed in units of resource blocks assuming 15 kHz subcarrier spacing for FR1 and 60 kHz subcarrier spacing for FR2.

Note 2: The parameter Offset Carrier CORESET#0 specifies the offset from the lowest subcarrier of the carrier and the lowest subcarrier of CORESET#0. It corresponds to the parameter $\Delta F_{OffsetCORESET\text{-}0\text{-}Carrier}$ in Annex C expressed in number of common RBs.

Module NAD2								Module NAD1			
DC_26A_n41A								LTE Band 41			
Inter-band. Test frequencies for DC_26A_n41A.											
Inter-band DC with a LTE Carrier in Band 26 and a 5G Carrier in Band n41.											
Channel	26A			n41A							
	BW (MHz)	Freq. (MHz)	EARFCN	SCS (kHz)	BW (MHz)	Freq. (MHz)	EARFCN	Channel	BW (MHz)	Freq. (MHz)	EARFCN
Low	15	831.5	26865	30	100	2546.01	509202	Adjacent channel to Low	20	2606	40750
Middle	15	836.5	26915	30	100	2592.99	518598	Adjacent channel to Middle	20	2653	41220
High	15	841.5	26965	30	100	2640	528000	Adjacent channel to High	20	2580	40490

EN-DC configuration DC_5A_n66A + LTE Band 66:

Table 4.3.1.1.1.66-1: Test frequencies for NR operating band n66, uplink and downlink channel bandwidth combinations and SCS 15 kHz

UL/DL Band width combination	CBW [MHz]	*carrier Bandwidth* [PRBs]	Range		Carrier centre [MHz]	Carrier centre [ARFCN]	point A [MHz]	*absolute FrequencyPoint A* [ARFCN]	*offsetToCarrier* [Carrier PRBs]	SS block SCS [kHz]	GSCN	*absolute FrequencySSB* [ARFCN]	k_{SSB}	Offset Carrier CORESET#0 [RBs] Note 2	CORESET#0 Index (Offset [RBs]) Note 1	offsetToPointA (SIB1) [PRBs] Note 1
5/5	5	25	Downlink	Low	2112.5	422500	2110.25	422050	0	15	5279	422410	0	0	0 (0)	0
				Mid	2145	429000	2124.39	424878	102		5361	428910	0	0	0 (0)	102
				High	2177.5	435500	2084.53	416906	504		5443	435410	0	0	0 (0)	504
	5	25	Uplink	Low	1712.5	342500	1710.25	342050	0	-	-	-	-	-	-	-
				Mid	1745	349000	1652.03	330406	504		-	-	-	-	-	-
				High	1777.5	355500	1774.17	354834	6		-	-	-	-	-	-
5/20	20	106	Downlink	Low	2120	424000	2110.46	422092	0	15	5282	422650	6	1	2 (4)	5
				Mid	2152.5	430500	2124.6	424920	102		5364	429150	6	1	2 (4)	107
				High	2185	437000	2084.74	416948	504		5446	435650	6	1	2 (4)	509
	5	25	Uplink	Low	1712.5	342500	1710.25	342050	0	-	-	-	-	-	-	-
				Mid	1745	349000	1652.03	330406	504		-	-	-	-	-	-
				High	1777.5	355500	1774.17	354834	6		-	-	-	-	-	-
5/40	40	216	Downlink	Low	2130	426000	2110.56	422112	0	15	5283	422670	6	1	2 (4)	5
				Mid	2155	431000	2117.2	423440	102		5344	427490	6	0	0 (0)	102
				High	2180	436000	2069.84	413968	504		5405	432490	6	0	0 (0)	504
	5	25	Uplink	Low	1712.5	342500	1710.25	342050	0	-	-	-	-	-	-	-
				Mid	1737.5	347500	1644.53	328906	504		-	-	-	-	-	-
				High	1762.5	352500	1759.17	351834	6		-	-	-	-	-	-
10/10	10	52	Downlink	Low	2115	423000	2110.32	422064	0	15	5280	422430	2	0	0 (0)	0
				Mid	2145	429000	2121.96	424392	102		5355	428430	2	0	0 (0)	102
				High	2175	435000	2079.6	415920	504		5430	434430	2	0	0 (0)	504
	10	52	Uplink	Low	1715	343000	1710.32	342064	0	-	-	-	-	-	-	-
				Mid	1745	349000	1649.6	329920	504		-	-	-	-	-	-
				High	1775	355000	1769.24	353848	6		-	-	-	-	-	-
10/20	20	106	Downlink	Low	2120	424000	2110.46	422092	0	15	5282	422650	6	1	2 (4)	5
				Mid	2150	430000	2122.1	424420	102		5357	428650	6	1	2 (4)	107
				High	2180	436000	2079.74	415948	504		5432	434650	6	1	2 (4)	509
	10	52	Uplink	Low	1715	343000	1710.32	342064	0	-	-	-	-	-	-	-
				Mid	1745	349000	1649.6	329920	504		-	-	-	-	-	-
				High	1775	355000	1769.24	353848	6		-	-	-	-	-	-
10/40	40	216	Downlink	Low	2130	426000	2110.56	422112	0	15	5283	422670	6	1	2 (4)	5
				Mid	2155	431000	2117.2	423440	102		5344	427490	6	0	0 (0)	102
				High	2180	436000	2069.84	413968	504		5405	432490	6	0	0 (0)	504
	10	52	Uplink	Low	1715	343000	1710.32	342064	0	-	-	-	-	-	-	-
				Mid	1740	348000	1644.6	328920	504		-	-	-	-	-	-
				High	1765	353000	1759.24	351848	6		-	-	-	-	-	-
15/15	15	79	Downlink	Low	2117.5	423500	2110.39	422078	0	15	5281	422450	4	0	0 (0)	0
				Mid	2145	429000	2119.53	423906	102		5349	427950	4	0	0 (0)	102
				High	2172.5	434500	2074.67	414934	504		5417	433450	4	0	0 (0)	504
	15	79	Uplink	Low	1717.5	343500	1710.39	342078	0	-	-	-	-	-	-	-
				Mid	1745	349000	1647.17	329434	504		-	-	-	-	-	-
				High	1772.5	354500	1764.31	352862	6		-	-	-	-	-	-
20/20	20	106	Downlink	Low	2120	424000	2110.46	422092	0	15	5282	422650	6	1	2 (4)	5
				Mid	2145	429000	2117.1	423420	102		5343	427470	6	0	0 (0)	102
				High	2170	434000	2069.74	413948	504		5407	432530	2	0	1 (2)	506
	20	106	Uplink	Low	1720	344000	1710.46	342092	0	-	-	-	-	-	-	-
				Mid	1745	349000	1644.74	328948	504		-	-	-	-	-	-
				High	1770	354000	1759.38	351876	6		-	-	-	-	-	-
20/40	40	216	Downlink	Low	2130	426000	2110.56	422112	0	15	5283	422670	6	6	2 (4)	5
				Mid	2155	431000	2117.2	423440	102		5344	427490	6	0	0 (0)	102
				High	2180	436000	2069.84	413968	504		5405	432490	6	0	0 (0)	504
	20	106	Uplink	Low	1720	344000	1710.46	342092	0	-	-	-	-	-	-	-
				Mid	1745	349000	1644.74	328948	504		-	-	-	-	-	-
				High	1770	354000	1759.38	351876	6		-	-	-	-	-	-
25/25	25	133	Downlink	Low	2122.5	424500	2110.53	422106	0	15	5283	422670	8	1	2 (4)	5
				Mid	2145	429000	2114.67	422934	102		5337	426990	8	0	0 (0)	102
				High	2167.5	433500	2064.81	412962	504		5394	431550	4	0	1 (2)	506
	25	133	Uplink	Low	1722.5	344500	1710.53	342106	0	-	-	-	-	-	-	-
				Mid	1745	349000	1642.31	328462	504		-	-	-	-	-	-
				High	1767.5	353500	1754.45	350890	6		-	-	-	-	-	-
30/30	30	160	Downlink	Low	2125	425000	2110.6	422120	0	15	5284	422690	10	1	2 (4)	5
				Mid	2145	429000	2112.24	422448	102		5331	426510	10	0	0 (0)	102
				High	2165	433000	2059.88	411976	504		5381	430570	6	0	1 (2)	506
	30	160	Uplink	Low	1725	345000	1710.6	342120	0	-	-	-	-	-	-	-
				Mid	1745	349000	1639.88	327976	504		-	-	-	-	-	-
				High	1765	353000	1749.52	349904	6		-	-	-	-	-	-
40/40	40	216	Downlink	Low	2130	426000	2110.56	422112	0	15	5283	422670	6	1	2 (4)	5
				Mid	2145	429000	2107.2	421440	102		5319	425550	2	0	1 (2)	104
				High	2160	432000	2049.84	409968	504		5358	428670	6	1	2 (4)	509
	40	216	Uplink	Low	1730	346000	1710.56	342112	0	-	-	-	-	-	-	-
				Mid	1745	349000	1634.84	326968	504		-	-	-	-	-	-
				High	1760	352000	1739.48	347896	6		-	-	-	-	-	-

Note 1: The CORESET#0 Index and the associated CORESET#0 Offset refers to Table 13-1 in TS 38.213 [22]. The value of CORESET#0 Index is signalled in controlResourceSetZero (pdcch-ConfigSIB1) in the MIB. The offsetToPointA IE is expressed in units of resource blocks assuming 15 kHz subcarrier spacing for FR1 and 60 kHz subcarrier spacing for FR2.

Note 2: The parameter Offset Carrier CORESET#0 specifies the offset from the lowest subcarrier of the carrier and the lowest subcarrier of CORESET#0. It corresponds to the parameter $\Delta F_{\text{OffsetCORESET-0-Carrier}}$ in Annex C expressed in number of common RBs.

Module NAD2								Module NAD1			
DC_5A_n66A								LTE Band 66			
Inter-band. Test frequencies for DC_5A_n66A.											
Inter-band DC with a LTE Carrier in Band 5 and a 5G Carrier in Band n66.											
Channel	5A			n66A				Channel	BW (MHz)	Freq. (MHz)	EARFCN
	BW (MHz)	Freq. (MHz)	EARFCN	SCS (kHz)	BW (MHz)	Freq. (MHz)	EARFCN				
Low	10	829	20450	15	5	1712.5	342500	Adjacent channel to Low	3	1716.5	132037
Middle	10	836.5	20525	15	5	1745	349000	Adjacent channel to Middle	3	1749	132362
High	10	844	20600	15	5	1777.5	355500	Adjacent channel to High	3	1773.5	132607

EN-DC configuration DC_2A_n71A + LTE Band 71:

Table 4.3.1.1.1.71-1: Test frequencies for NR operating band n71 and SCS 15 kHz

CBW [MHz]	*carrier Bandwidth* [PRBs]	Range		Carrier centre [MHz]	Carrier centre [ARFCN]	point A [MHz]	*absoluteFrequencyPointA* [ARFCN]	*offsetToCarrier* [Carrier PRBs]	SS block SCS [kHz]	GSCN	*absoluteFrequencySSB* [ARFCN]	A_{SSB}	Offset Carrier CORESET#0 [RBs] Note 2	CORESET#0 Index (Offset [RBs]) Note 1	offsetToPointA (SIB1) [PRBs] Note 1
5	25	Downlink	Low	619.5	123900	617.25	123450	0	15	1548	123870	8	1	0 (0)	1
			Mid	634.5	126900	613.89	122778	102		1587	126990	0	1	2 (4)	107
			High	649.5	129900	556.53	111306	504		1623	129870	8	1	0 (0)	505
		Uplink	Low	665.5	133100	663.25	132650	0	-	-	-	-	-	-	-
			Mid	680.5	136100	587.53	117506	504		-	-	-	-	-	-
			High	695.5	139100	692.17	138434	6		-	-	-	-	-	-
10	52	Downlink	Low	622	124400	617.32	123464	0	15	1549	123890	10	1	0 (0)	1
			Mid	634.5	126900	611.46	122292	102		1581	126510	2	1	2 (4)	107
			High	647	129400	551.6	110320	504		1610	128890	10	1	0 (0)	505
		Uplink	Low	668	133600	663.32	132664	0	-	-	-	-	-	-	-
			Mid	680.5	136100	585.1	117020	504		-	-	-	-	-	-
			High	693	138600	687.24	137448	6		-	-	-	-	-	-
15	79	Downlink	Low	624.5	124900	617.39	123478	0	15	1547	123850	4	0	0 (0)	0
			Mid	634.5	126900	609.03	121806	102		1575	126030	4	1	2 (4)	107
			High	644.5	128900	546.67	109334	504		1600	127970	8	1	1 (2)	507
		Uplink	Low	670.5	134100	663.39	132678	0	-	-	-	-	-	-	-
			Mid	680.5	136100	582.67	116534	504		-	-	-	-	-	-
			High	690.5	138100	682.31	136462	6		-	-	-	-	-	-
20	106	Downlink	Low	627	125400	617.46	123492	0	15	1548	123870	6	0	0 (0)	0
			Mid	634.5	126900	606.6	121320	102		1569	125550	6	1	2 (4)	107
			High	642	128400	541.74	108348	504		1587	126990	10	1	1 (2)	507
		Uplink	Low	673	134600	663.46	132692	0	-	-	-	-	-	-	-
			Mid	680.5	136100	580.24	116048	504		-	-	-	-	-	-
			High	688	137600	677.38	135476	6		-	-	-	-	-	-

Note 1: The CORESET#0 Index and the associated CORESET#0 Offset refers to Table 13-1 in TS 38.213 [22]. The value of CORESET#0 Index is signalled in controlResourceSetZero (pdcch-ConfigSIB1) in the MIB. The offsetToPointA IE is expressed in units of resource blocks assuming 15 kHz subcarrier spacing for FR1 and 60 kHz subcarrier spacing for FR2.

Note 2: The parameter Offset Carrier CORESET#0 specifies the offset from the lowest subcarrier of the carrier and the lowest subcarrier of CORESET#0. It corresponds to the parameter $\Delta F_{OffsetCORESET\text{-}0\text{-}Carrier}$ in Annex C expressed in number of common RBs.

Module NAD2								Module NAD1			
DC_2A_n71A								LTE Band 71			
Inter-band. Test frequencies for DC_2A_n71A.											
Inter-band DC with a LTE Carrier in Band 2 and a 5G Carrier in Band n71.											
Channel	2A			n71A				Channel	BW (MHz)	Freq. (MHz)	EARFCN
	BW (MHz)	Freq. (MHz)	EARFCN	SCS (kHz)	BW (MHz)	Freq. (MHz)	EARFCN				
Low	20	1860	18700	15	15	670.5	134100	Adjacent channel to Low	20	688	133372
Middle	20	1880	18900	15	15	680.5	136100	Adjacent channel to Middle	10	693	133422
High	20	1900	19100	15	15	690.5	138100	Adjacent channel to High	20	673	133222

Radiated Emissions

SPECIFICATION:

1. 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 that 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 log10 p from the channel edges to 5 MHz away

ii. 43 + 10 log10 p between 5 MHz and X MHz from the channel edges, and

iii. 55 + 10 log10 p at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than 43 + 10 log10 p on all frequencies between 2490.5 MHz and 2496 MHz, and 55 + 10 log10 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 41 MEASUREMENT LIMIT:

On all frequencies between the channel edge and 5 megahertz from the channel edge:
At Po transmitting power, the specified minimum attenuation becomes 40+10 log (Po), and the level in dBm relative Po becomes:

Po (dBm) – [40 + 10 log (Po in mwatts) - 30] = -10 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 Po transmitting power, the specified minimum attenuation becomes 43+10 log (Po), and the level in dBm relative Po becomes:

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = -13 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 Po transmitting power, the specified minimum attenuation becomes 55+10 log (Po), and the level in dBm relative Po becomes:

Po (dBm) – [55 + 10 log (Po in mwatts) - 30] = -25 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 bands, 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 log10 (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 log10 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 log10 P (watts) dB.

LTE Band 66 MEASUREMENT LIMIT:

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

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = -13 dBm

3. LTE Band 71. FCC §2.1053 & §27.53 (g) / RSS-130 Issue 2 Clause 4.7.

FCC §27.53 (g):

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

RSS-130 Issue 2 Clause 4.7:

4.7.1. The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

LTE Band 71 MEASUREMENT LIMIT:

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

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = -13 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 18 GHz and at 1 m distance for measurements above 18 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.

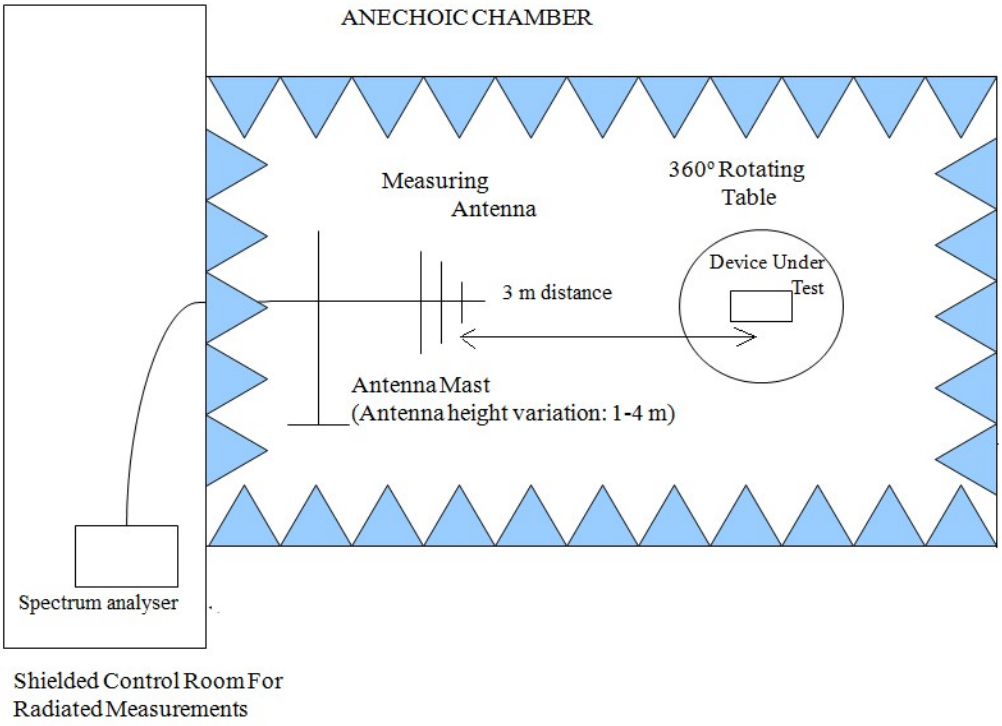
The maximum field strength (dBµV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

EIRP (dBm) = E (dBµV/m) + 20 log(D) - 104.8; where D is the measurement distance (in the far field region) in m.
D = 3 m

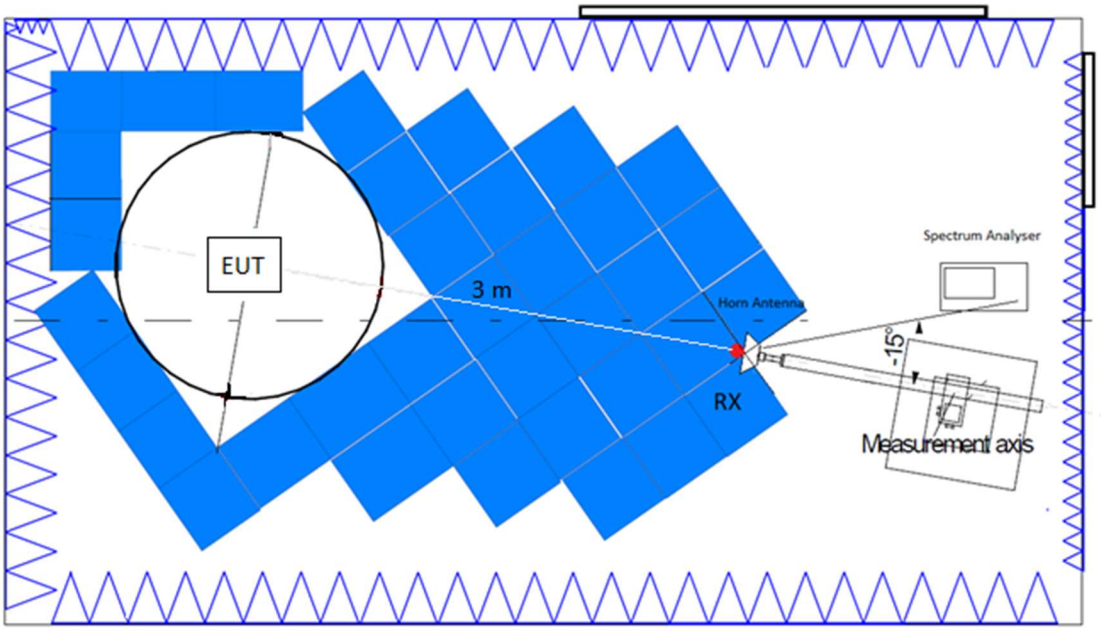
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

TEST SETUP:

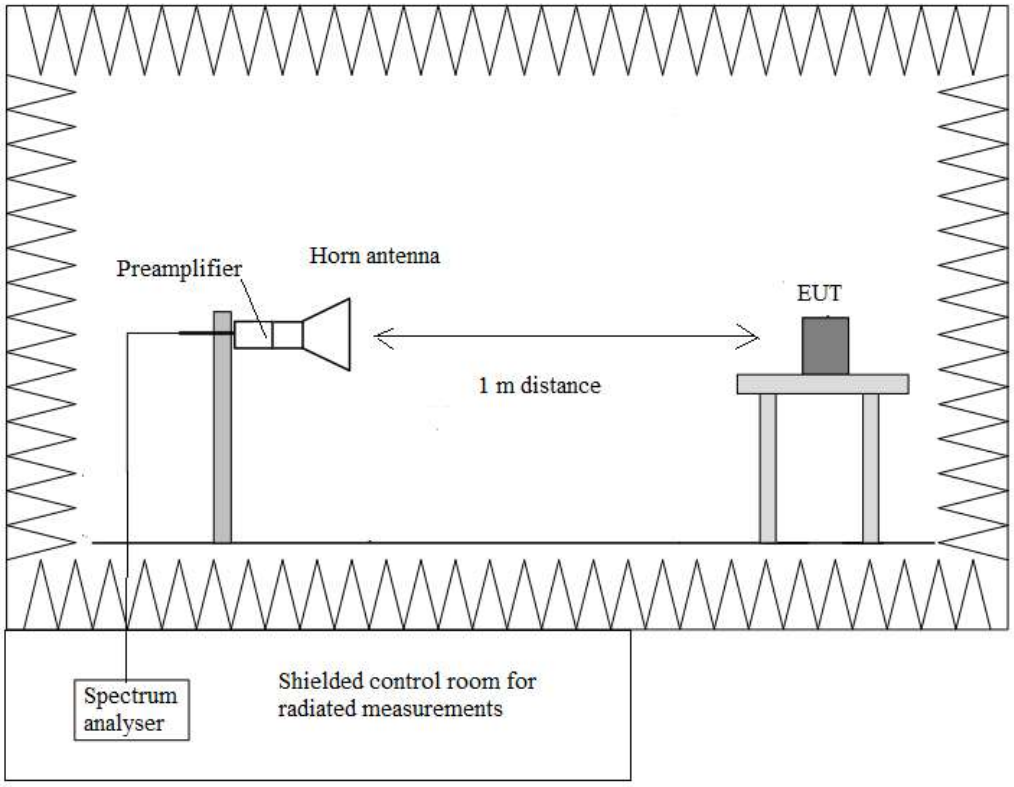
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 18 GHz:



Radiated measurements setup f > 18 GHz:



RESULTS:

- **DC_26A_n41A + LTE Band 41:**

A preliminary scan determined the worst-case:

1) DC_26A_n41A (Module NAD2):
   26A: QPSK, BW=15 MHz, RB=1, Offset=0.
   n41A: Pi/2 BPSK, BW=100 MHz, SCS=30 kHz, RB=136, Offset=68.

2) LTE Band 41 (Module NAD1):
   41: QPSK, BW=20 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:

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

Frequency range 2490.5 - 2496 MHz:

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector
2.495855	-15.7	H	RMS
2.495857	-15.23	H	RMS
2.495863	-18.7	H	RMS
2.49597	-15.66	H	RMS

- 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:

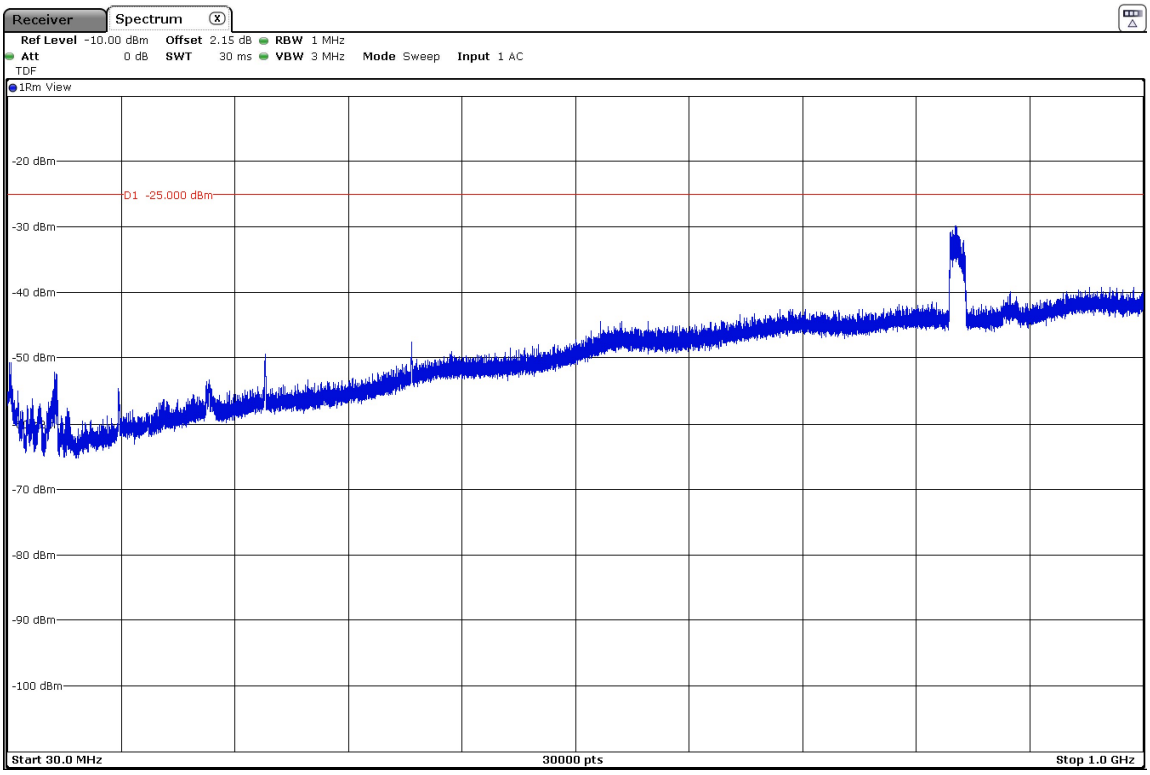
No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB)	<±4.99 for f < 1 GHz <±4.98 for f ≥ 1 GHz up to 17 GHz <±5.08 for f ≥ 17 GHz up to 26.5 GHz <±5.33 for f ≥ 26.5 GHz up to 27 GHz

Verdict: PASS

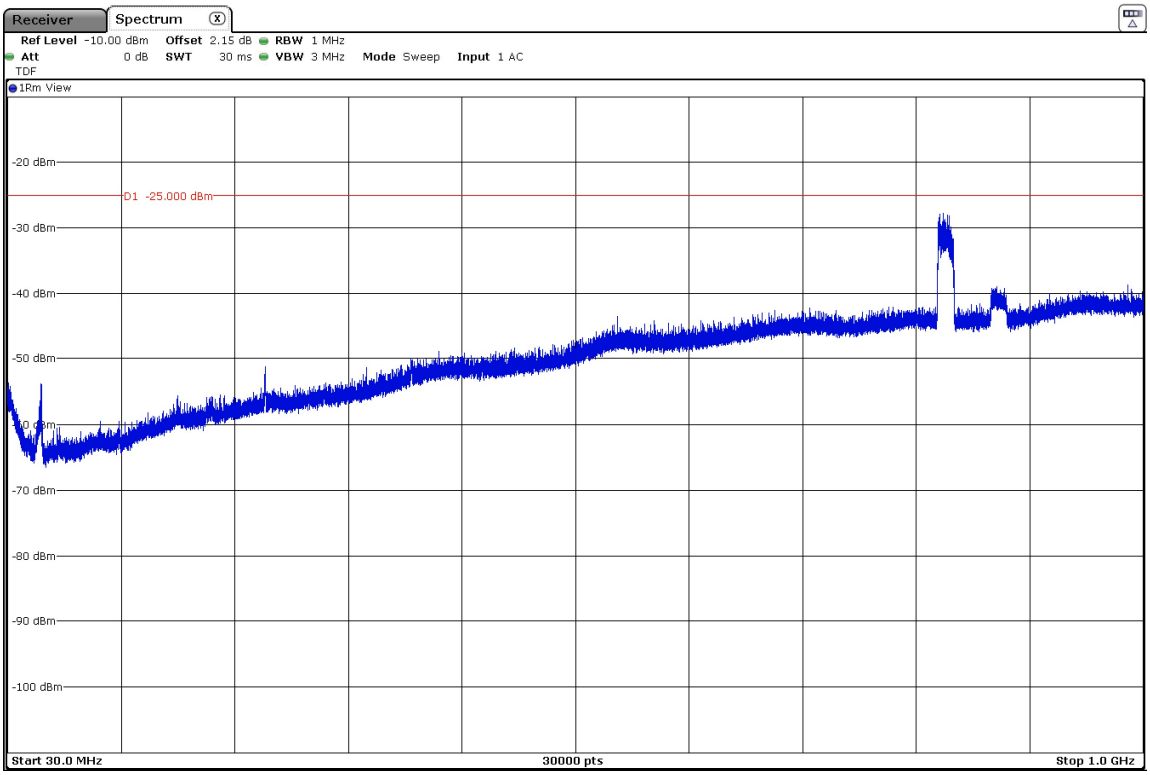
FREQUENCY RANGE 30 MHz - 1 GHz (worst-case):

- Low Channel:



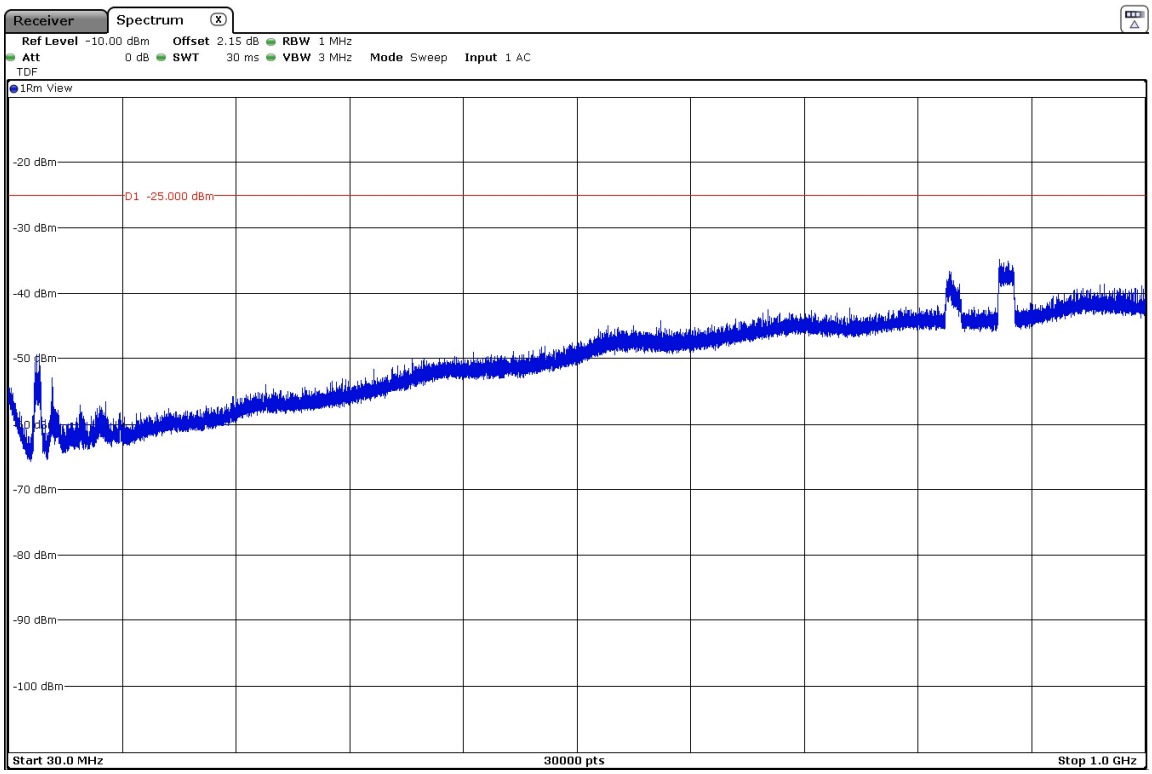
The peaks at 831.5 and 876.5 MHz are the LTE UL and DL of DC_26A_n41A.

- Middle Channel:



The peaks at 836.5 and 881.5 MHz are the LTE UL and DL of DC_26A_n41A.

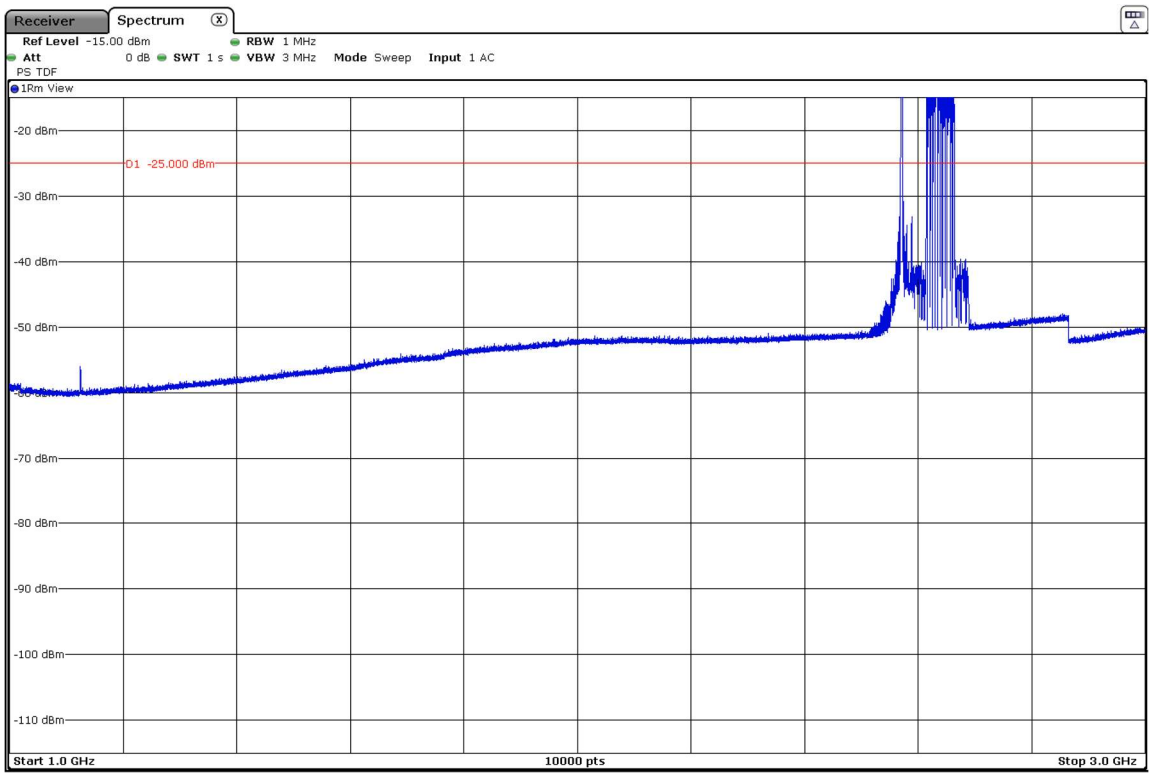
- High Channel:



The peaks at 841.5 and 886.5 MHz are the LTE UL and DL of DC_26A_n41A.

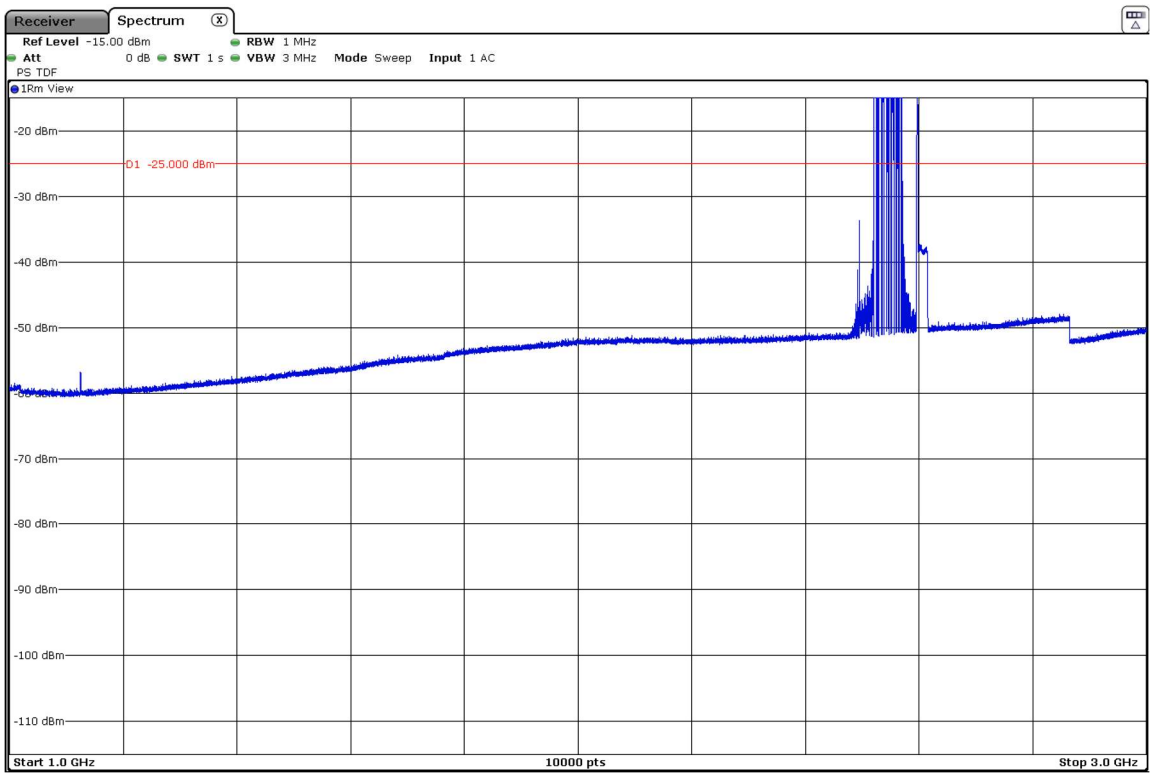
FREQUENCY RANGE 1 - 3 GHz (worst-case):

- Low Channel:



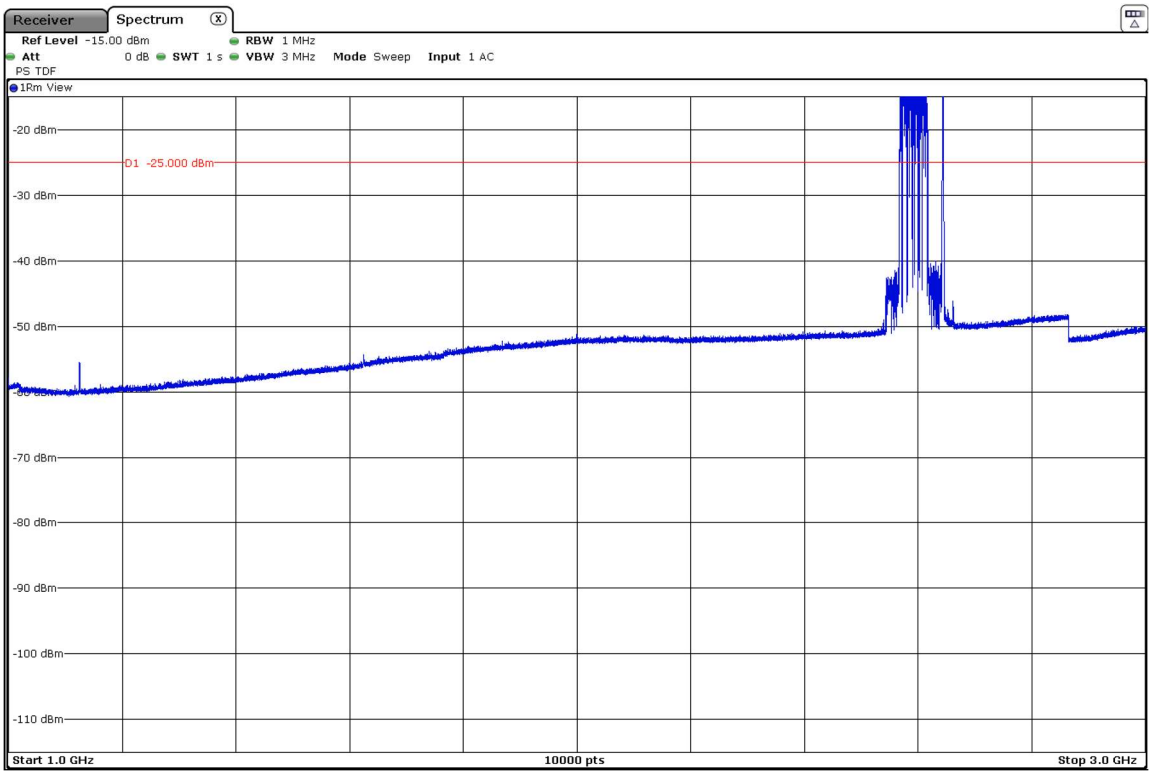
The peaks at 2546.01 MHz (41A) and 2606 MHz (LTE 41) above the limit are the carriers.

- Middle Channel:



The peaks at 2592.99 MHz (n41A) and 2653 MHz (LTE 41) above the limit are the carriers.

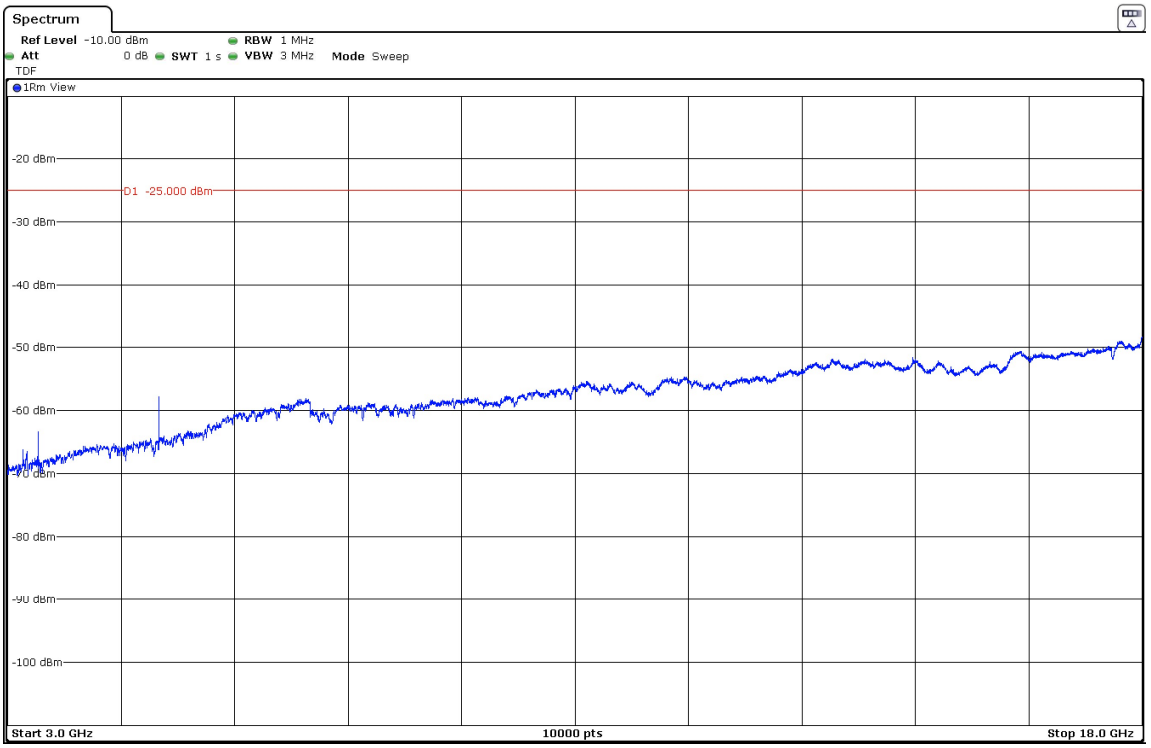
- High Channel:



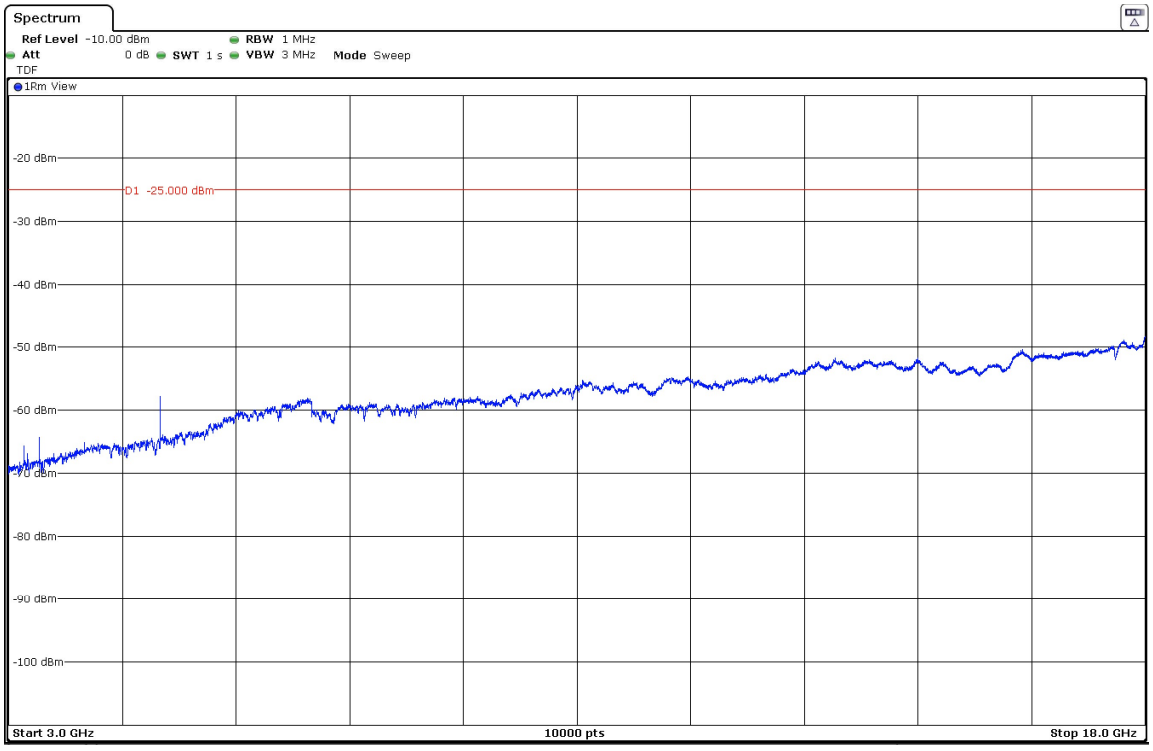
The peaks at 2640 MHz (n41A) and 2580 MHz (LTE 41) above the limit are the carriers.

FREQUENCY RANGE 3 - 18 GHz (worst-case):

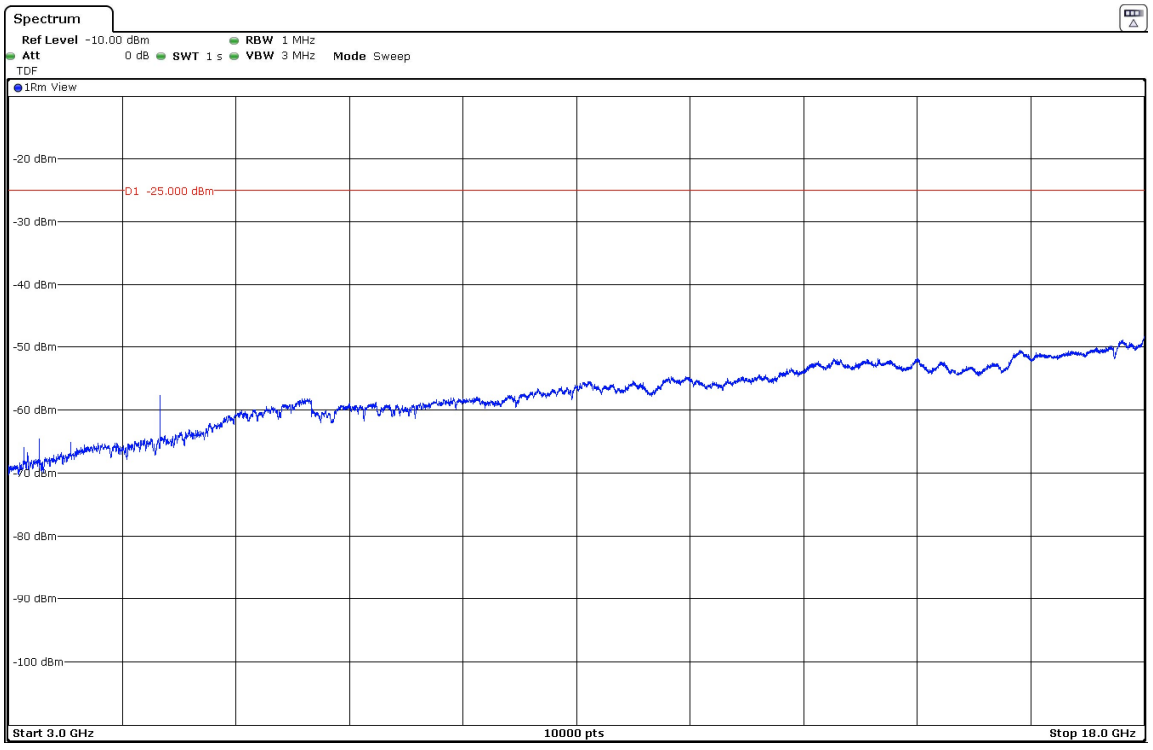
- Low Channel:



- Middle Channel:

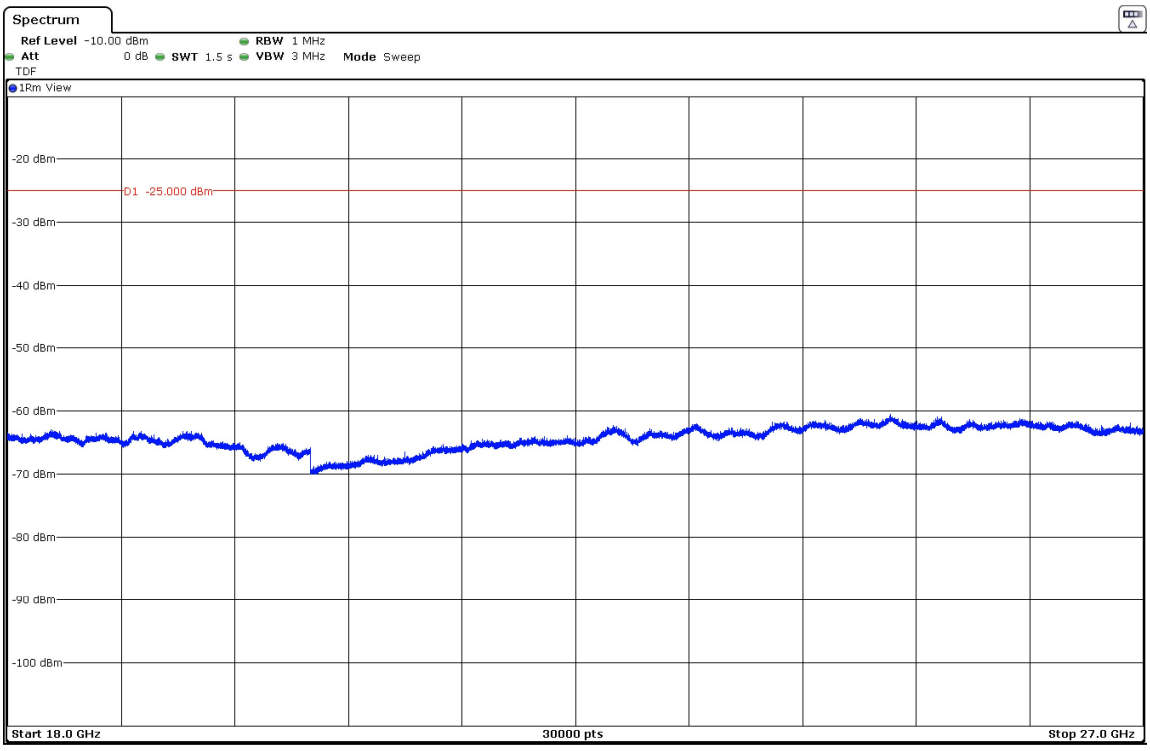


- High Channel:

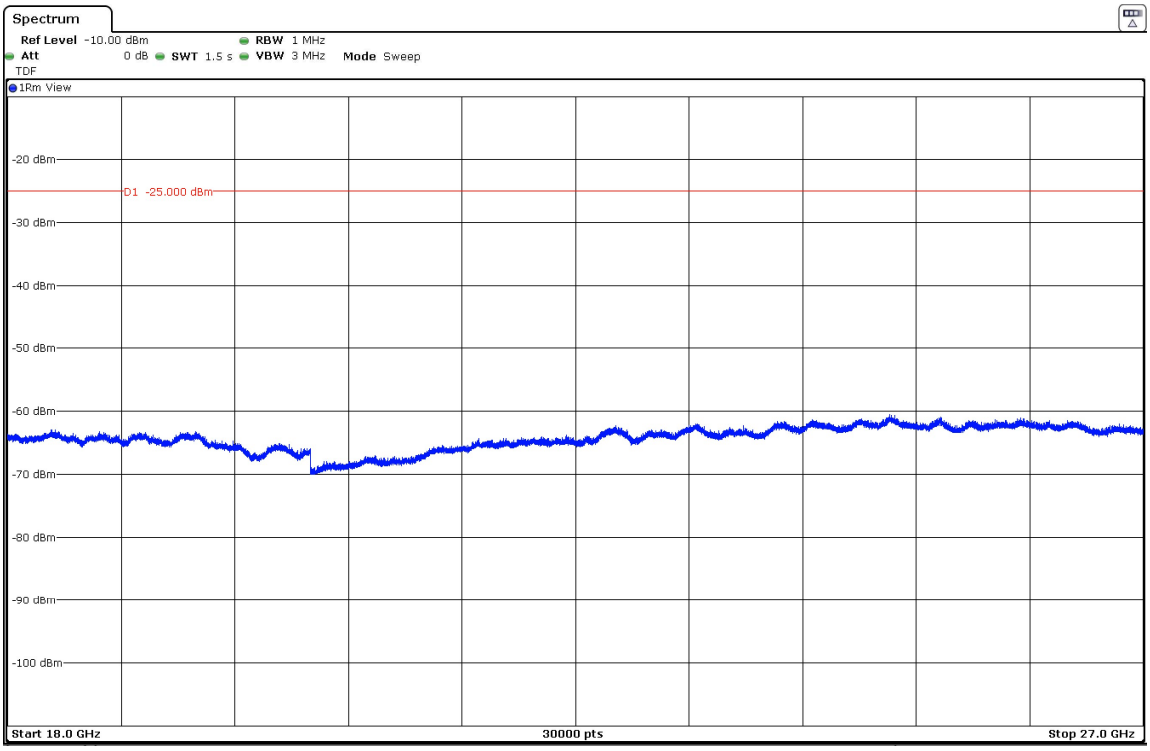


FREQUENCY RANGE 18 - 27 GHz (worst-case):

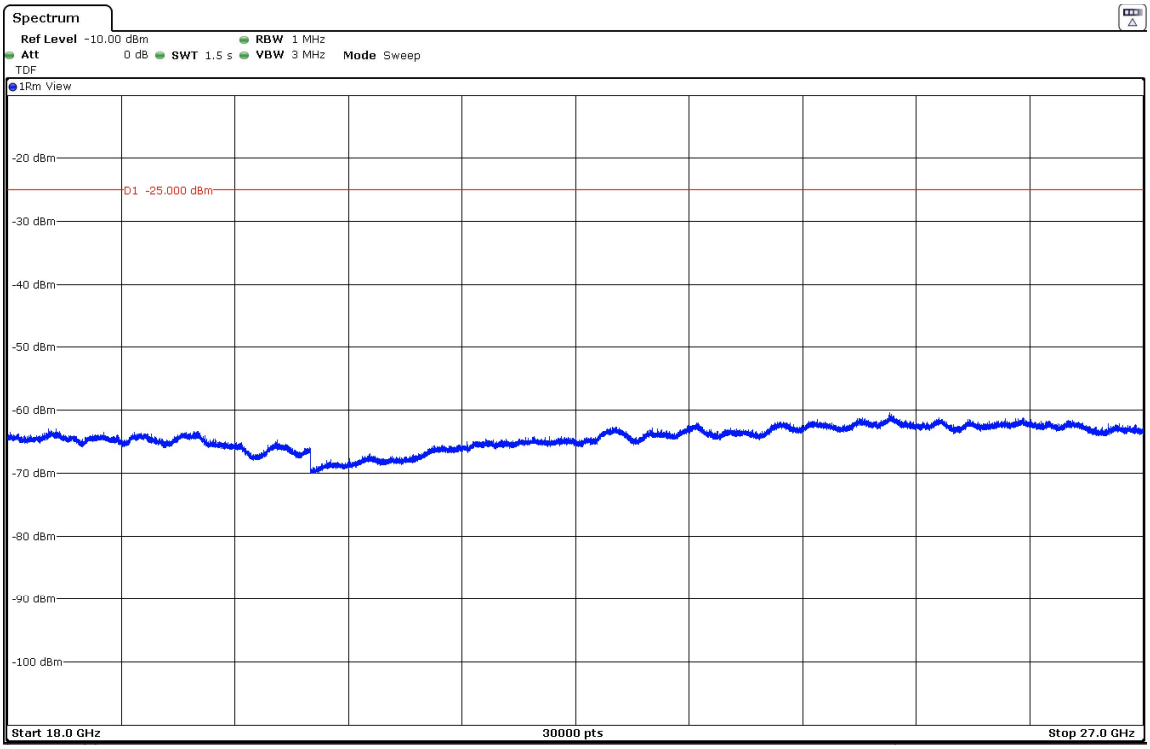
- Low Channel:



- Middle Channel:



- High Channel:



FREQUENCY RANGE 2490.5 - 2496 MHz (worst-case):

- Low Channel: