

Test report No:
NIE: 62486RRF.014

Partial Test Report

Reference Standard:
CANADA RSS-197

(*) Identification of item tested	Telematic control unit with wireless technologies, used in automotive industry
(*) Trademark	BMW
(*) Model and /or type reference	WAVE-11-HIGH-R1
Other identification of the product	HW version: D3 SW version: 20512H.001_047_009 FCC ID: T8GWAVE11HIGHHR1 IC: 6434A-WAVE11HIGHHR1
(*) Features	GSM, UMTS, LTE, 5G, GNSS
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16, 76307 KARLSBAD, GERMANY
Test method requested, standard	CANADA RSS-197 Issue 1, Feb. 2010. - Transmitter Unwanted Emissions.
Approved by (name / position & signature)	José Carlos Luque RF Lab. Supervisor 
Date of issue	2021-03-26
Report template No	FDT08_23 (*) "Data provided by the client"

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Competences and guarantees

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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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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

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 model WAVE-11-HIGH-R1 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.

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
62486E/105	Telematic Control Unit	WAVE-11-HIGH-R1	B392120L4900533	2020/09/28
62486E/012	Antenna (DA WAVE HIGH 5G US)	DA05DI20	--	2020/09/22
62486E/036	Antenna Box	AB01-I20-01	--	2020/09/22
62486E/037	Antenna Box	AB01-I20-01	--	2020/09/22
62486E/038	Antenna Box	AB01-I20-01	--	2020/09/22
62486E/039	Antenna Box	AB01-I20-01	--	2020/09/22
62486E/060	Harness	--	--	2020/09/22

Auxiliary elements used with the Sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
62486E/109	Battery Li-ion	11FR1580-2	--	2020/09/28
62486E/042	Antenna ground plane for roof	--	--	2020/09/22
62486E/045	RF Cable for 4-Fakra	--	--	2020/09/22
62486E/056	OABR Cable	--	--	2020/09/22
62486E/064	OABR 1000 BaseT Converter	--	--	2020/09/22
62486E/067	I-Box OABR Adapter	--	--	2020/09/22
62486E/071	Ethernet Cable	--	--	2020/09/22
62486E/090	Speaker	FR7	--	2020/09/28
62486E/101	SOS Pulser (E-Call)	9385	11221	2020/09/28

Sample S/01 has undergone the following test(s): The Radiated tests of the n78A + LTE Band 41 (sub-band 3650-3700 MHz) 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		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 12V car battery / attenuator (4,5 V ≤ UB ≤ 18 V; UB typical: 12 V)					
☐	DC:						
Rated Power	12V DC						
Clock frequencies.....	25MHz;26MHz;32,768kHz;49,58MHz;						
Other parameters	See Technical description						
Software version	D3						
Hardware version	20512H.001_047_009						

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)	2021-02-03
Date (finish)	2021-02-08

Document history

Report number	Date	Description
62486RRF.014	2021-03-26	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 %

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 %

Remarks and comments

The tests have been performed by the technical personnel: Miguel Ángel Torres, Miguel Manuel López, Cristina Calle, Verónica García.

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 - 6GHz ETS LINDGREN 3142E	2020/10	2023/10
5. Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
6. RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2020/10	2021/10
7. RF Preamplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2021/03	2022/03
8. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/09	2021/09
9. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/10	2021/10
10. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
11. UXM 5G RF Test Platform KEYSIGHT TECHNOLOGIES E7515B	2020/01	2022/01
12. Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2021/02	2022/02
13. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
14. Digital Multimeter, FLUKE 175	2020/11	2021/11

Testing verdicts

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

Summary

RSS-197 PARAGRAPH		
Requirement – Test case	Verdict	Remark
RSS-197 5.6.: Transmitter Power and Equivalent Isotropically Radiated Power (e.i.r.p.)	N/M	(1)
RSS-197 5.1.: Modulation Characteristics	N/M	(1)
RSS-197 5.3.: Frequency Stability	N/M	(1)
RSS-197 5.2.: Channel Bandwidth	N/M	(1)
RSS-197 5.7.: Spurious emissions at antenna terminals	N/M	(1)
RSS-197 5.7.: Radiated emissions	P	(2)
<u>Supplementary information and remarks:</u>		
(1) Test not requested. Radiated emissions test only requested. (2) The 62486RRF.001 contains the results of the pre-testing to determine the worst case of the setting of the antennas. · Conf #1: MIMO1 Port -> Int BuA Antenna / MIMO2 Port -> MIMO2 Antenna / Antennenbox for NAD#2. · Conf #2: MIMO1 Port -> Int BuA Antenna / MIMO2 Port -> MIMO2 Antenna / FSA antenna for NAD#2. · Conf #3: MIMO1 Port -> MIMO1 Antenna / MIMO2 Port -> MIMO2 Antenna / Antennenbox for NAD#2. · Conf #4: MIMO1 Port -> MIMO2 Antenna / MIMO2 Port -> MIMO2 Antenna / FSA antenna for NAD#2.		

Appendix A: Test results for RSS-197

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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 for New Radio 5G. 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.

TEST FREQUENCIES:

n78A + LTE Band 41. (antenna configuration 3):

Table 4.3.1.1.1.78-2: Test frequencies for NR operating band n78, SCS 30 kHz and ΔF_{Raster} 30 kHz

CBW [MHz]	carrier Bandwidth [PRBs]	Range		Carrier centre [MHz]	Carrier centre [ARFCN]	point A [MHz]	absolute Frequency Point A [ARFCN]	offsetTo Carrier [Carrier PRBs]	SS block SCS [kHz]	GSCN	absolute Frequency SSB [ARFCN]	k_{SSB}	Offset Carrier CORE SET#0 [RBs] Note 2	CORE SET#0 Index (Offset [RBs]) Note 1	offsetTo PointA (SIB1) [PRBs] Note 1
10	24	Downlink & Uplink	Low	3305.01	620334	3300.69	620046	0	30	7711	620352	18	0	2 (2)	4
			Mid	3549.99	636666	3508.95	633930	102		7881	636672	6	0	2 (2)	208
		High	High	3795	653000	3609.24	640616	504		8051	652992	16	0	1 (1)	1010
15	38	Downlink & Uplink	Low	3307.5	620500	3300.66	620044	0	30	7711	620352	20	0	2 (2)	4
			Mid	3549.99	636666	3506.43	633762	102		7879	636480	6	0	1 (1)	206
		High	High	3792.48	652832	3604.2	640280	504		8048	652704	16	0	3 (3)	1014
20	51	Downlink & Uplink	Low	3310.02	620668	3300.84	620056	0	30	7711	620352	8	0	2 (2)	4
			Mid	3549.99	636666	3504.09	633606	102		7878	636384	18	0	3 (3)	210
		High	High	3789.99	652666	3599.37	639958	504		8044	652320	2	0	1 (1)	1010
25	65	Downlink & Uplink	Low	3312.51	620834	3300.81	620054	0	30	7711	620352	10	0	2 (2)	4
			Mid	3549.99	636666	3501.57	633438	102		7876	636192	18	0	2 (2)	208
		High	High	3787.5	652500	3594.36	639624	504		8041	652032	0	0	3 (3)	1014
30	78	Downlink & Uplink	Low	3315	621000	3300.96	620064	0	30	7711	620352	0	0	2 (2)	4
			Mid	3549.99	636666	3499.23	633282	102		7874	636000	6	0	1 (1)	206
		High	High	3784.98	652332	3589.5	639300	504		8037	651648	12	0	0 (0)	1008
40	106	Downlink & Uplink	Low	3320.01	621334	3300.93	620062	0	30	7711	620352	2	0	2 (2)	4
			Mid	3549.99	636666	3494.19	632946	102		7871	635712	6	0	3 (3)	210
		High	High	3780	652000	3579.48	638632	504		8030	650976	8	0	0 (0)	1008
50	133	Downlink & Uplink	Low	3325.02	621668	3301.08	620072	0	30	7711	620352	16	0	1 (1)	2
			Mid	3549.99	636666	3489.33	632622	102		7867	635328	18	0	0 (0)	204
		High	High	3774.99	651666	3569.61	637974	504		8024	650400	18	0	3 (3)	1014
60	162	Downlink & Uplink	Low	3330	622000	3300.84	620056	0	30	7711	620352	8	0	2 (2)	4
			Mid	3549.99	636666	3484.11	632274	102		7864	635040	6	0	3 (3)	210
		High	High	3769.98	651332	3559.38	637292	504		8016	649632	4	0	0 (0)	1008
80	217	Downlink & Uplink	Low	3340.02	622668	3300.96	620064	0	30	7711	620352	0	0	2 (2)	4
			Mid	3549.99	636666	3474.21	631614	102		7857	634368	18	0	2 (2)	208
		High	High	3759.99	650666	3539.49	635966	504		8003	648384	10	0	3 (3)	1014
90	245	Downlink & Uplink	Low	3345	623000	3300.9	620060	0	30	7711	620352	4	0	2 (2)	4
			Mid	3549.99	636666	3469.17	631278	102		7853	633984	18	0	0 (0)	204
		High	High	3754.98	650332	3529.44	635296	504		7996	647712	8	0	3 (3)	1014
100	273	Downlink & Uplink	Low	3350.01	623334	3300.87	620058	0	30	7711	620352	6	0	2 (2)	4
			Mid	3549.99	636666	3464.13	630942	102		7850	633696	18	0	2 (2)	208
		High	High	3750	650000	3519.42	634628	504		7989	647040	4	0	3 (3)	1014

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 $\Delta F_{\text{OffsetCORESET0-Carrier}}$ in Annex C expressed in number of common RBs.

Sub-band 3650-3700 MHz in 5G:

Module NAD2					Module NAD1			
Test frequencies for n78A: Sub-band 3650-3700 MHz					LTE Band 41			
5G Carrier in Band n78								
Channel	n78A				Channel	BW (MHz)	Freq. (MHz)	EARFCN
	SCS (kHz)	BW (MHz)	Freq. (MHz)	NR-ARFCN				
Low	30	20	3660	644000	Adjacent channel to Low	20	2680	41490
Middle	30	20	3675	645000	Adjacent channel to Middle	20	2680	41490
High	30	20	3690	646000	Adjacent channel to High	20	2680	41490

Note: Tested channels due to the characteristics of the simultaneous transmission of both modules.

RSS-197 5.7.: Transmitter Unwanted Emissions

SPECIFICATION:

1. n78A + LTE Band 41: Sub-band 3650-3700 MHz. RSS-197 Issue 1 Clause 5.7.

RSS-197 Issue 1 Clause 5.7.:

5.7. The unwanted emissions shall be measured at the frequencies of the highest and lowest channel of all bandwidths and types of modulation that the equipment can operate with a resolution bandwidth of 1 MHz or less, but at least 1% of the occupied bandwidth of the transmitter, provided that the measured power is integrated over a 1 MHz bandwidth.

The power of any emissions outside the frequency band 3650-3700 MHz shall be attenuated below the channel transmitter power P (dBW) by $43 + 10 \log(p)$, where p is measured in watts.

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.

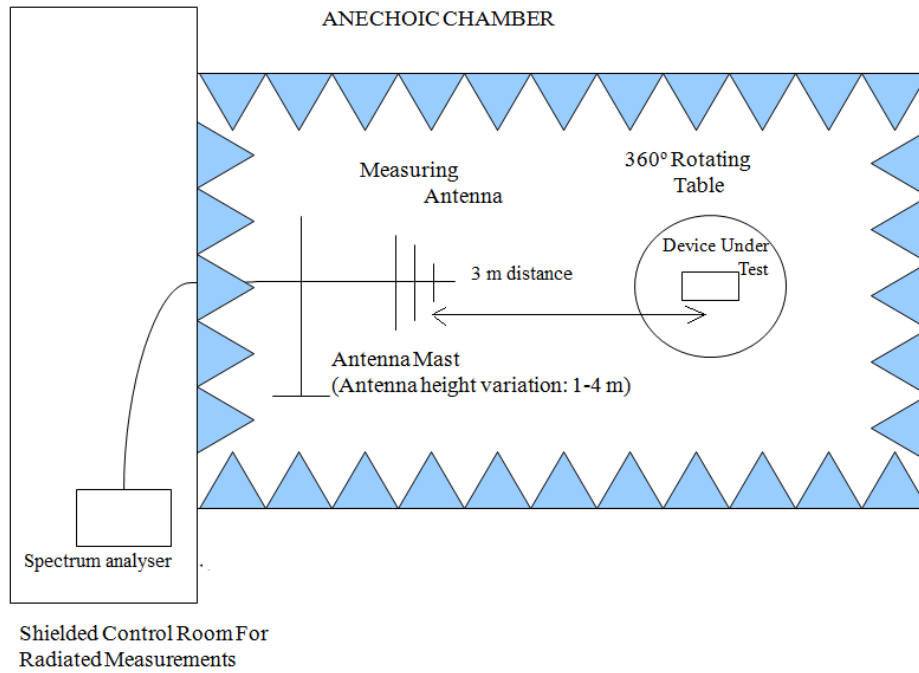
The maximum field strength (dB μ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

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

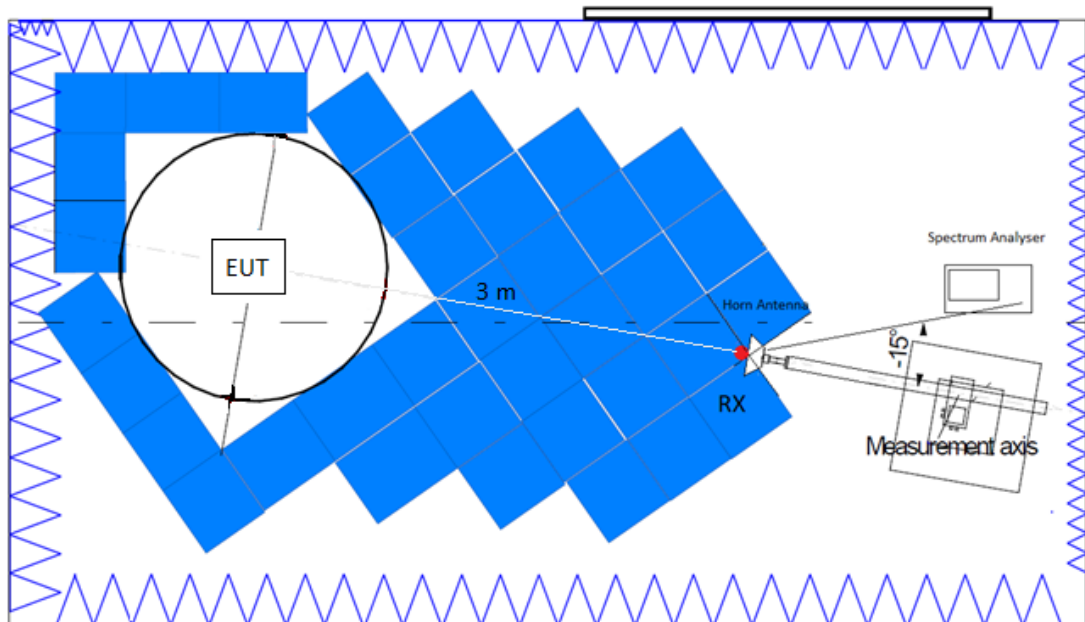
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz or higher were used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

TEST SETUP:

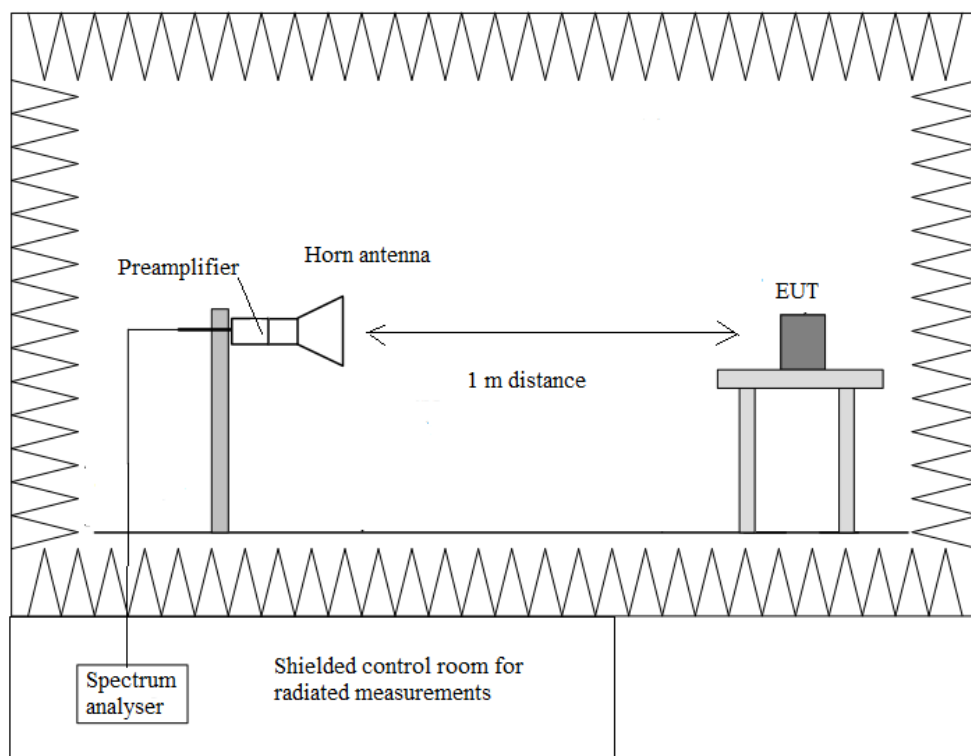
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 18 GHz:



Radiated measurements setup $f > 18$ GHz:



RESULTS:

- **n78A + LTE Band 41: Sub-band 3650-3700 MHz:**

A preliminary scan determined the worst case:

1) n78A (Module NAD2):

n78A: Pi/2 BPSK, BW=20 MHz, SCS=30 kHz, RB=1, Offset=50.

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 CHANNEL:

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 - 7 GHz:

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

Frequency range 7 - 18 GHz:

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

Frequency range 18 - 37 GHz:

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 - 7 GHz:

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

Frequency range 7 - 18 GHz:

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

Frequency range 18 - 37 GHz:

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 - 7 GHz:

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector	Measurement Uncertainty (dB)
5.3424	-25.06	V	Peak	<± 5.13

Frequency range 7 - 18 GHz:

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

Frequency range 18 - 37 GHz:

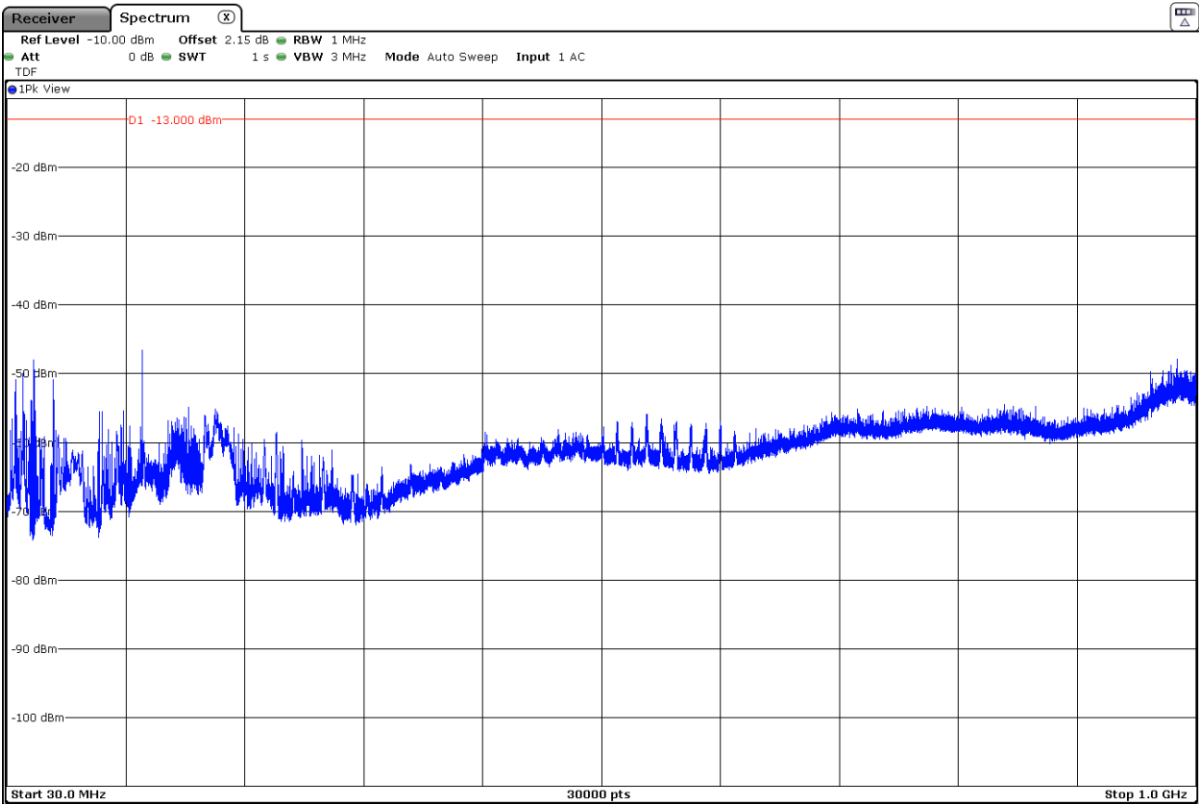
No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB)	<± 5.08 for f < 1 GHz <± 5.13 for f ≥ 1 GHz up to 17 GHz <± 4.82 for f ≥ 17 GHz up to 26.5 GHz <± 5.14 for f ≥ 26.5 GHz up to 37 GHz
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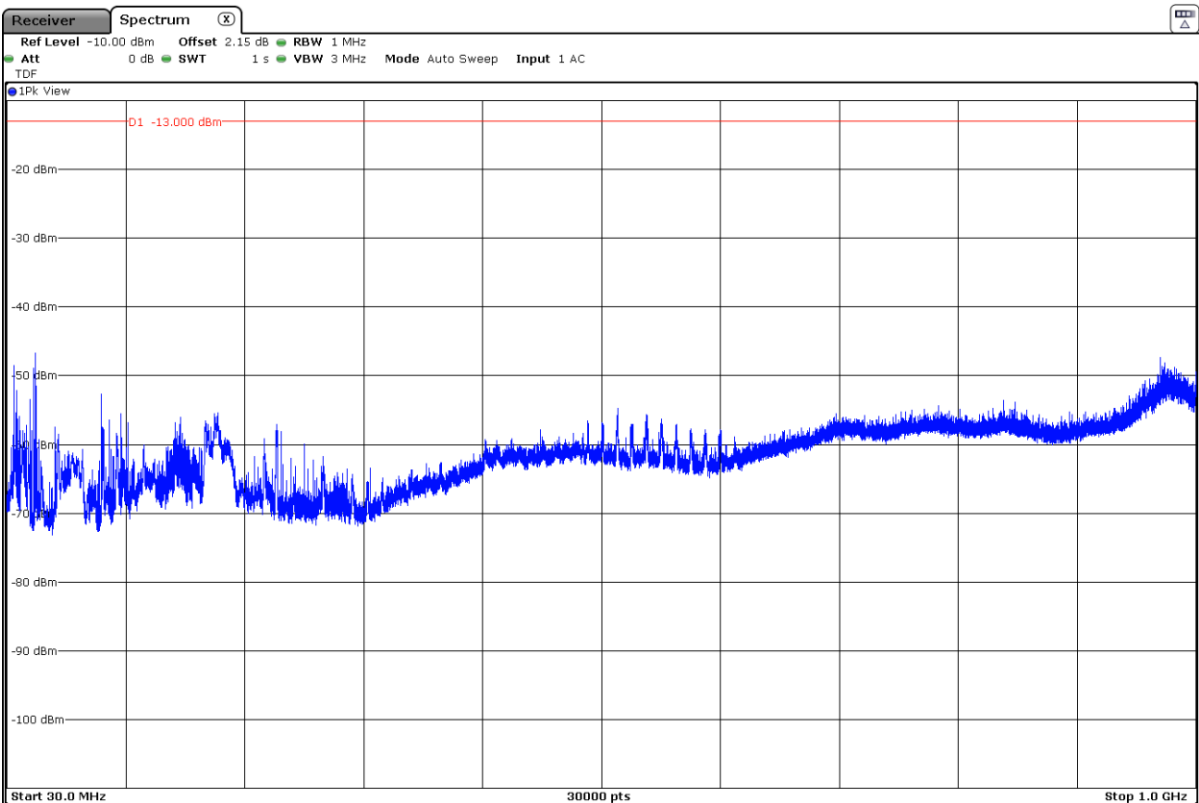
Verdict: PASS

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

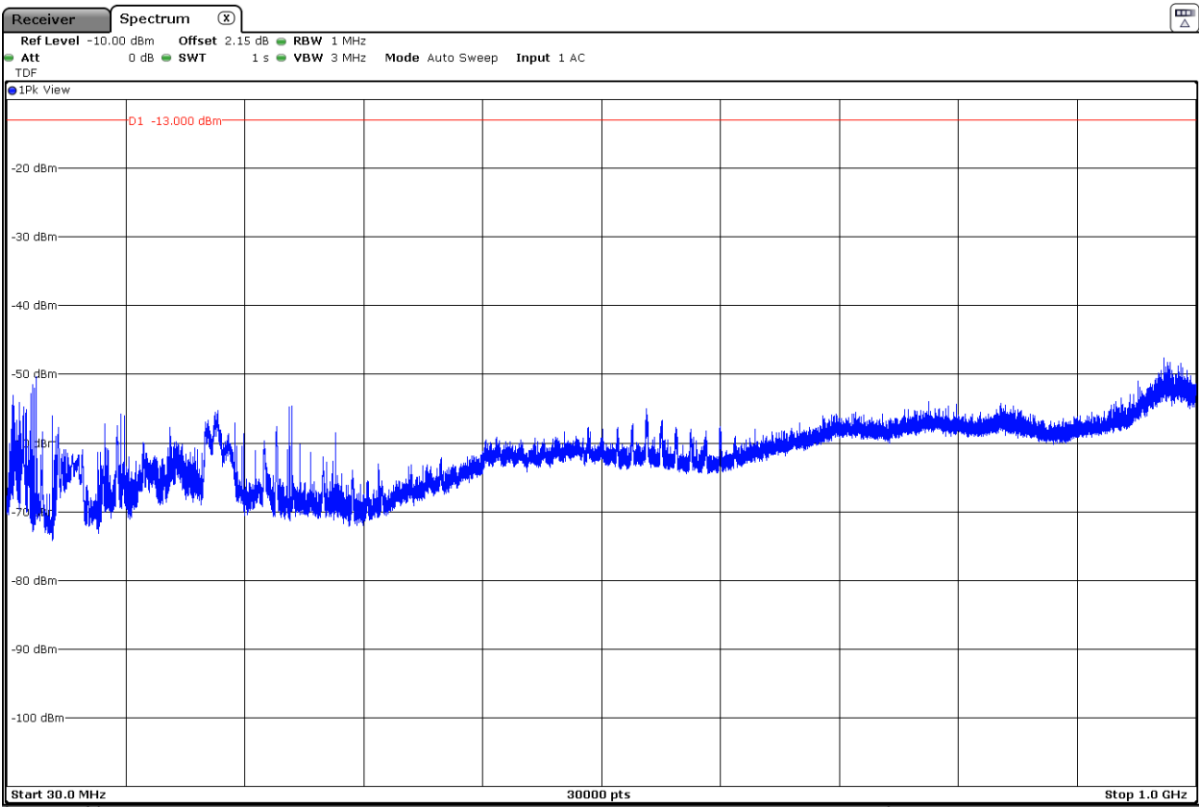
- Low Channel:



- Middle Channel:

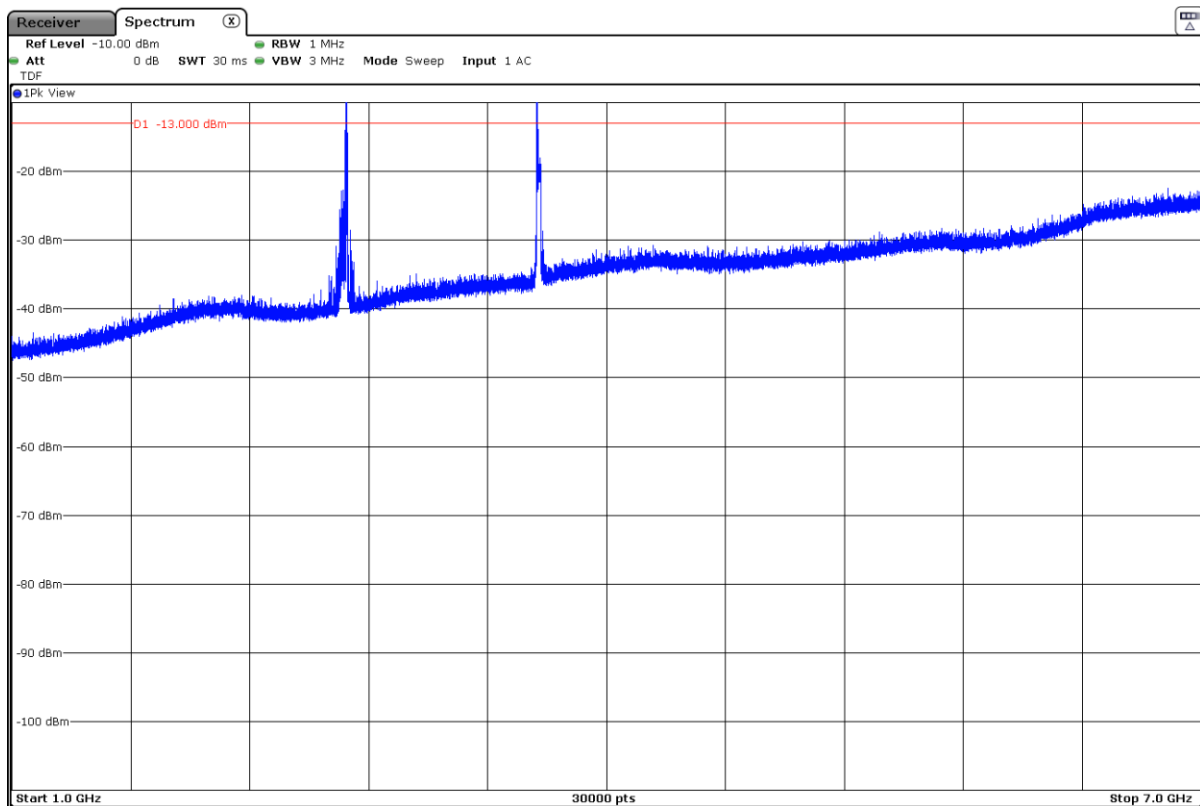


- High Channel:



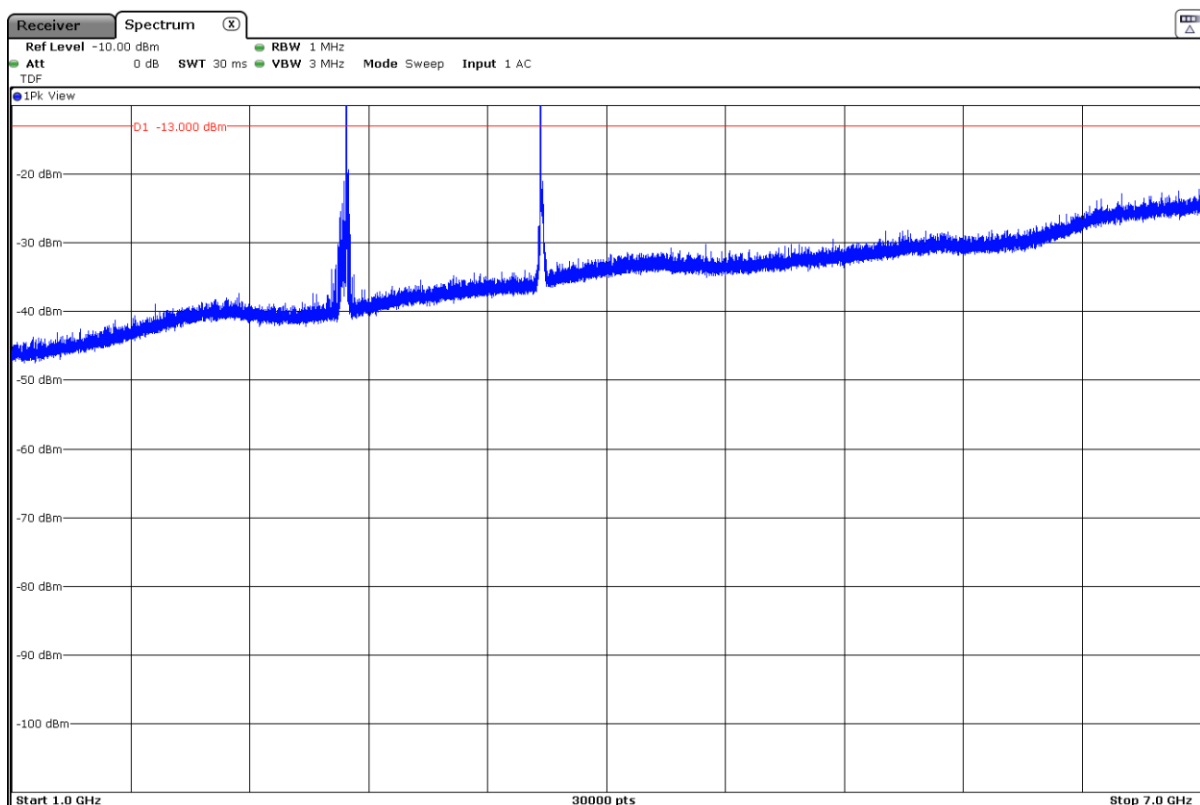
FREQUENCY RANGE 1 - 7 GHz (worst case):

- Low Channel:



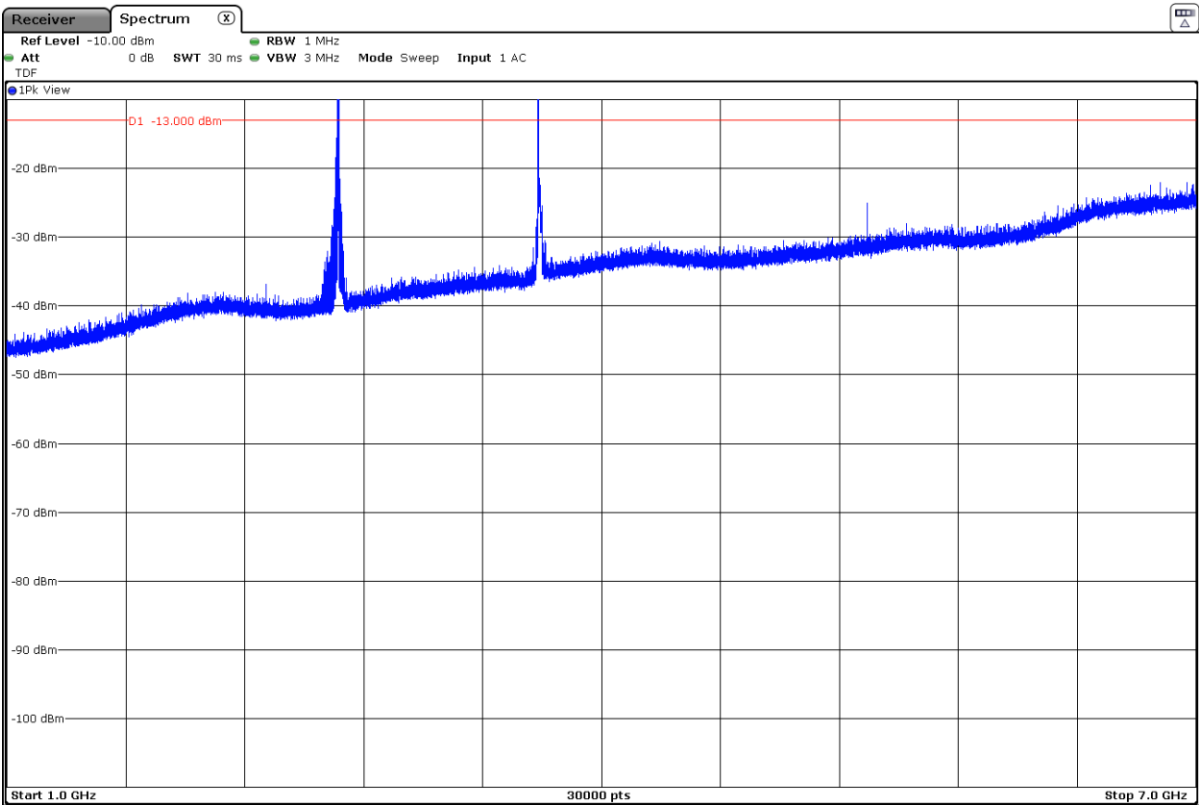
The peak above the limit are the carrier frequencies.

- Middle Channel:



The peak above the limit are the carrier frequencies.

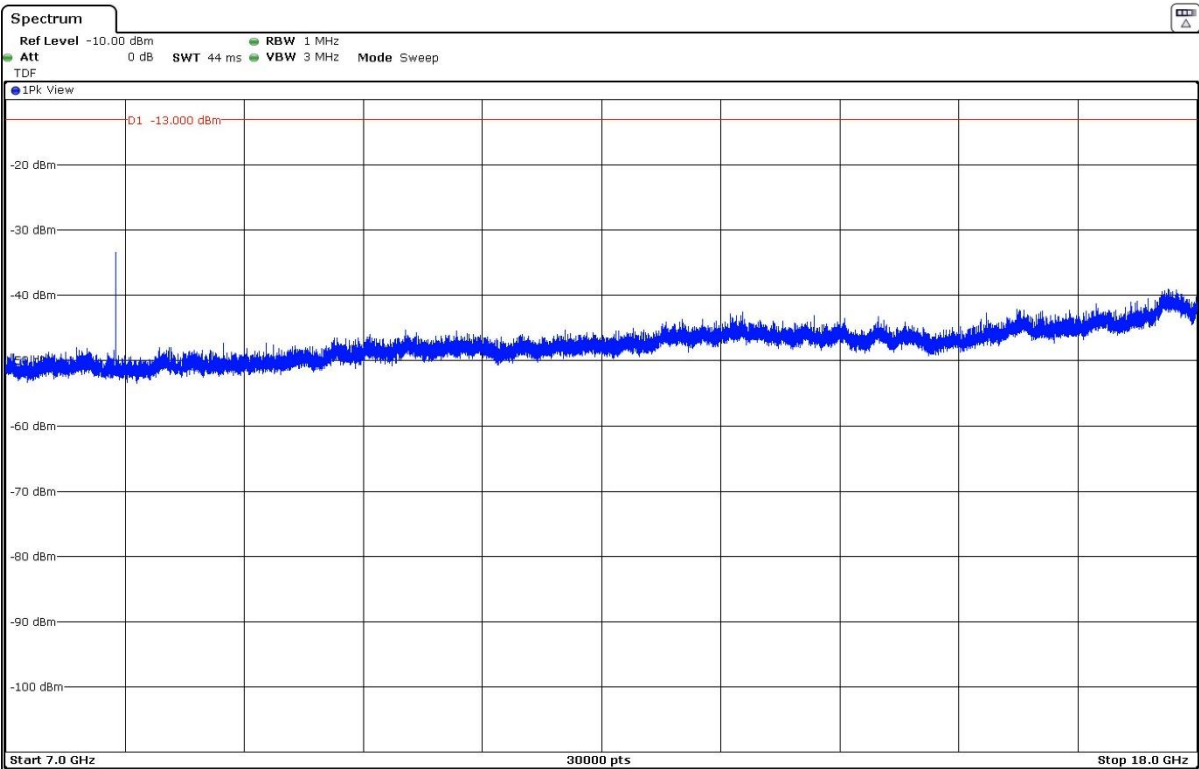
- High Channel:



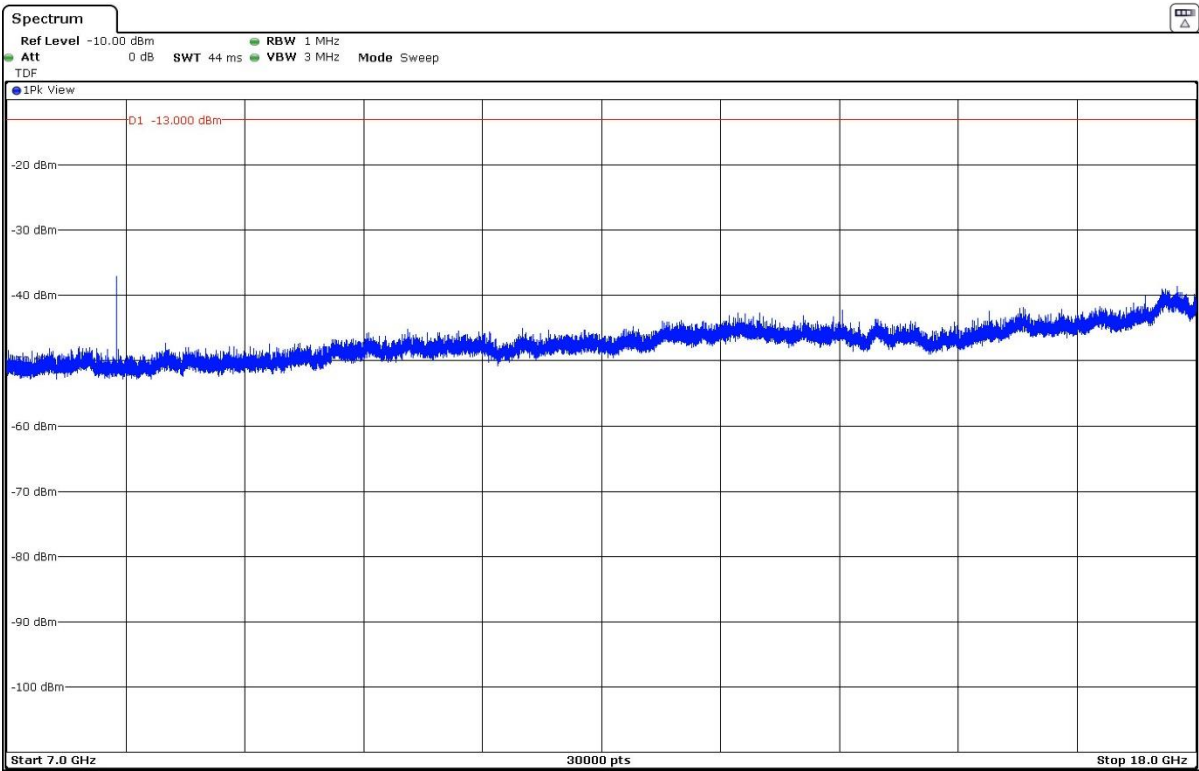
The peak above the limit are the carrier frequencies.

FREQUENCY RANGE 7 - 18 GHz (worst case):

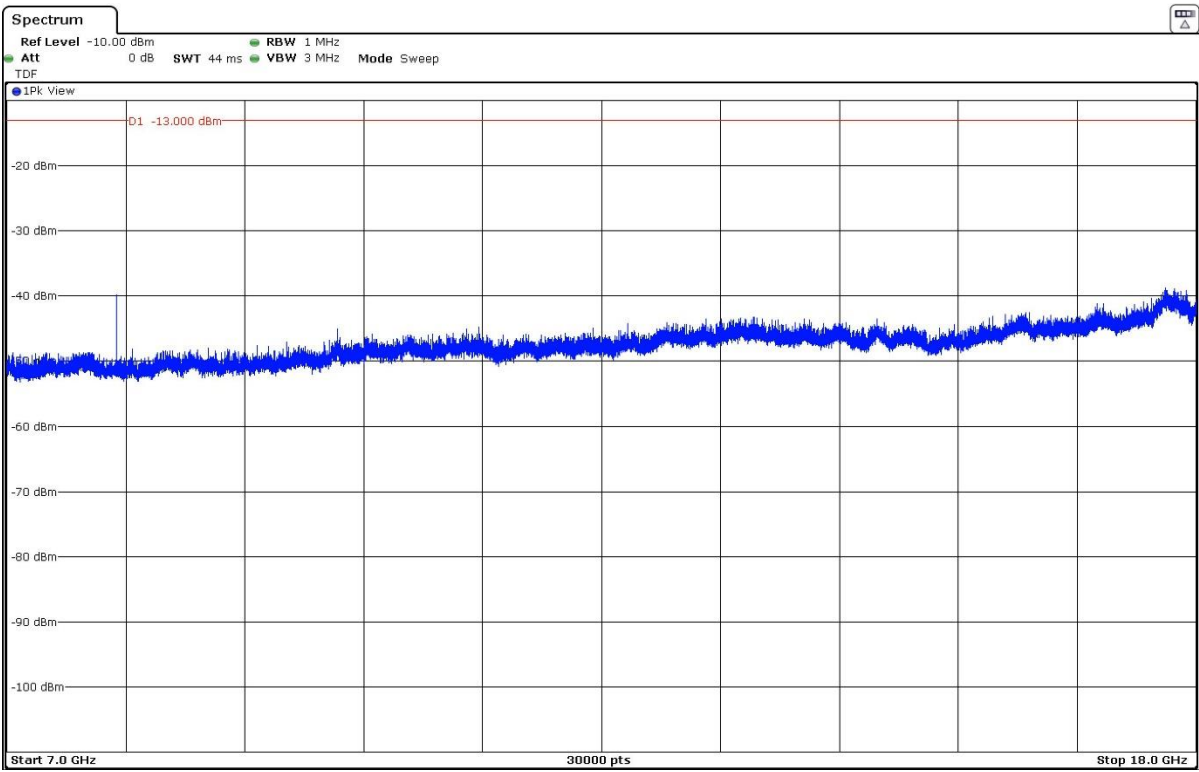
- Low Channel:



- Middle Channel:

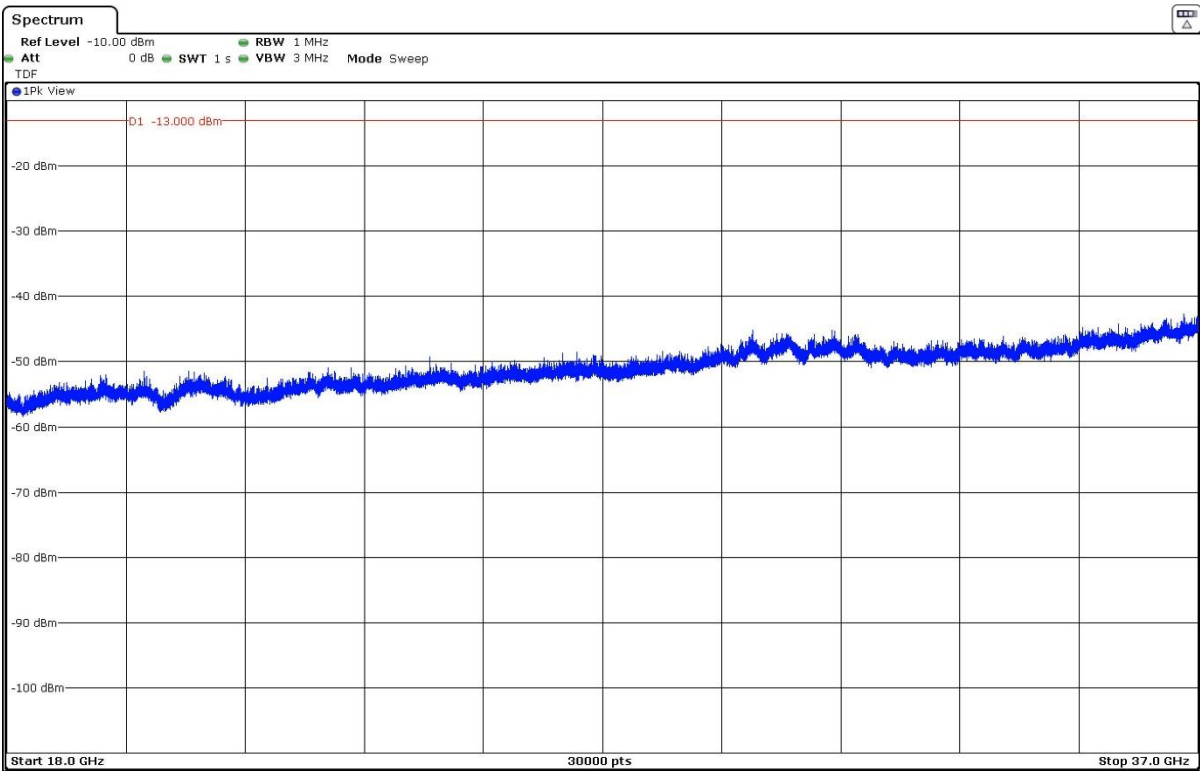


- High Channel:

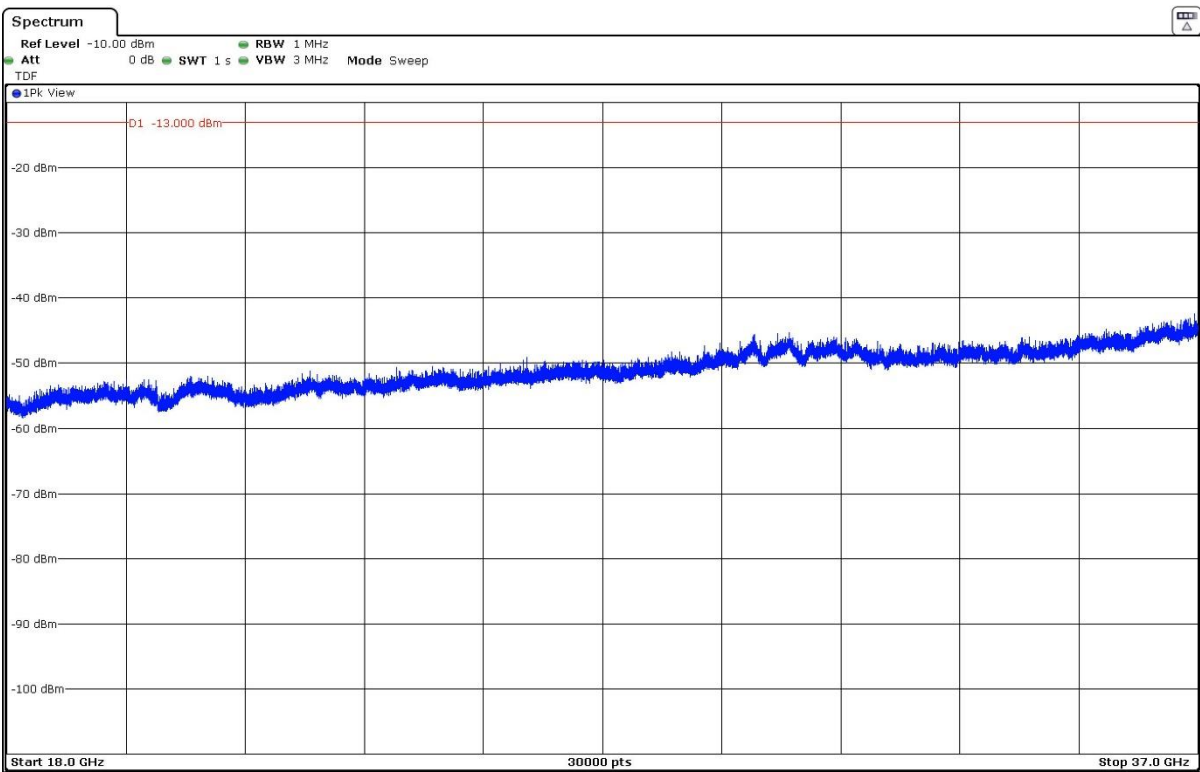


FREQUENCY RANGE 18 - 37 GHz (worst case):

- Low Channel:



- Middle Channel:



- High Channel:

