

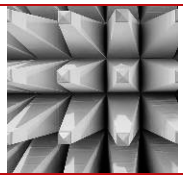

CETECOM™
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consulting - testing - certification

TEST REPORT

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Test report no.: 1-7342/13-01-02

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
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Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01
Area of Testing: Radio Communications & EMC (RCE)

Applicant

CETECOM MOVON Ltd.
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Manufacturer

MANDO corp.
21, Pangyo-ro 255beon-gil, Bundang-gu, Seongnam-si, 463-400, Gyeonggi-do
REPUBLIC OF KOREA
Contact: Suhan Kim
e-mail: Suhan.Kim@halla.com

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I Part 15 - Radio frequency devices
RSS – 210 Issue 8	Low Power Licence-exempt Radiocommunication Devices Annex 13, Section A13.1 Vehicle -Mounted Field Disturbance Sensors in the Band 76.0 - 77.0 GHz

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Automotive Radar**
Model name:	**LRR-10**
FCC ID:	**2ACDX-LRR10**
IC:	**11988A-LRR10**
Frequency:	76.0 - 77.0 GHz
Antenna:	Internal patch antenna (2 TX – 12 RX)
Power supply:	9 – 16 V.DC from power supply
Temperature range:	-40 °C to +85 °C

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorised:

cn=Karsten Geraldy, o=Cetecom ICT Services GmbH, ou=GER-101125, email=karsten.geraldy@cetecom.com, c=DE
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Karsten Geraldy
Professional

Test performed:

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2014.07.11 11:06:50 +02'00'

Meheza Walla
Specialist

1 Table of contents

2 General information

2.1 Notes and disclaimer

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2.2 Application details

Date of receipt of order:	2014-04-21
Date of receipt of test item:	2014-04-28
Start of test:	2014-04-28
End of test:	2014-05-05
Person(s) present during the test:	Mr. Rei Kim / Mr. Kim Suhanmr / Mr. Park Jonggyumr

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15	2013-10	Title 47 of the Code of Federal Regulations; Chapter I Part 15 - Radio frequency devices
RSS – 210 Issue 8	2010-12	Low Power Licence-exempt Radiocommunication Devices Annex 13, Section A13.1 Vehicle -Mounted Field Disturbance Sensors in the Band 76.0 - 77.0 GHz
FCC 12-72	2010-07	Report and Order Amendment of Sections 15.35 and 15.253 of the Commission's Rules Regarding Operation of Radar Systems in the 76-77 GHz Band Amendment of Section 15.253 of the Commission's Rules to Permit Fixed Use of Radar in the 76-77 GHz Band

4 Test environment

Temperature:	T_{nom}	+22 °C during room temperature tests
	T_{max}	+85 °C during high temperature tests
	T_{min}	-40 °C during low temperature tests
Relative humidity content:		55 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	12.00 V DC from power supply
	V_{max}	16.00 V DC
	V_{min}	9.00 V DC

5 Test item

Kind of test item	**:**	**Automotive Radar**
Type identification	**:**	**LRR-10**
S/N serial number	**:**	**LRR-10#170 (Normal Mode)** **LRR-10#171 (Stop Mode, Low Channel)** **LRR-10#172 (Stop Mode, Middle Channel)** **LRR-10#173 (Stop Mode, High Channel)**
HW hardware status	**:**	**PV SMPL**
SW software status	**:**	**-/-**
Frequency band [MHz]	**:**	**76.0 - 77.0 GHz**
Type of modulation	**:**	**FMCW**
Antenna	**:**	**Patch internal antenna (2 TX - 12 RX)**
Power supply	**:**	**9 – 16 V DC from power supply**
Temperature range	**:**	**-40 °C to +85 °C**

5.1 Additional comments

Test setup- and EUT-photos are included in test report: 1-7342/13-01-02_AnnexA
1-7342/13-01-02_AnnexB
1-7342/13-01-02_AnnexD

Special Samples was used to change from normal operation mode to stopped mode (low / mid / high) as required by CFR 47 Part 15.31 (c).

Frequencies: low frequency: 76.125 GHz
mid frequency: 76.500 GHz
high frequency:76.875 GHz

6 Test laboratories sub-contracted

None

7 Summary of measurement results

☒	**No deviations from the technical specifications were ascertained**
☐	There were deviations from the technical specifications ascertained

TC identifier	Description	verdict	date	Remark
RF-Testing	47 CFR Part 15 / RSS- 210 Issue 8, Annex 13	PASS	2014-07-07	-/-

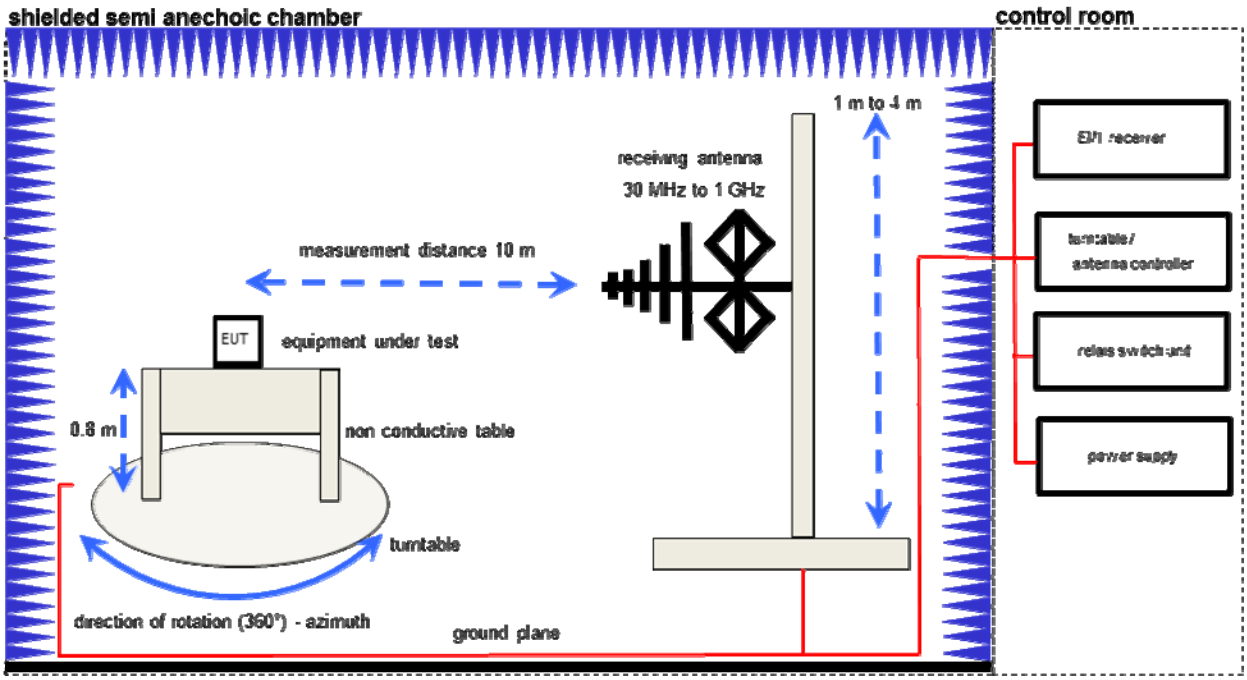
Test specification clause	Test case	Temperature conditions	Power source voltages	Pass	Fail	NA	NP	Results (max.)
§15.253 (d)(1)(2) RSS210 Issue 8 A13.1.3	Power density	Nominal and Extreme	Nominal and Extreme	☒	☐	☐	☐	Peak: 32.13 dBm AVG: 18.14 dBm
RSS210 Issue 8 A13.1.2 (1)(a)	Not in Motion	Nominal and Extreme	Nominal and Extreme	☒	☐	☐	☐	AVG: 18.14 dBm
§1.1310	MPE Calculation	Nominal and Extreme	Nominal and Extreme	☒	☐	☐	☐	0.013 mW/cm²
§2.1049 RSS210 Issue 8 A13.1.1	Occupied bandwidth (99% bandwidth)	Nominal and Extreme	Nominal and Extreme	☒	☐	☐	☐	747 MHz
§15.253 (d) §15.253 (e) §15.209 (a) RSS210 Issue 8 A13.1.2 (2)a/b/c	Field strength of emissions (radiated spurious)	Nominal	Nominal	☒	☐	☐	☐	complies
§§15.253 (f) RSS210 Issue 8 A13.1.5	Frequency stability	Nominal and Extreme	Nominal and Extreme	☒	☐	☐	☐	complies

Note: NA = Not Applicable; NP = Not Performed

8 Description of the test setup

8.1 Radiated measurements chamber F

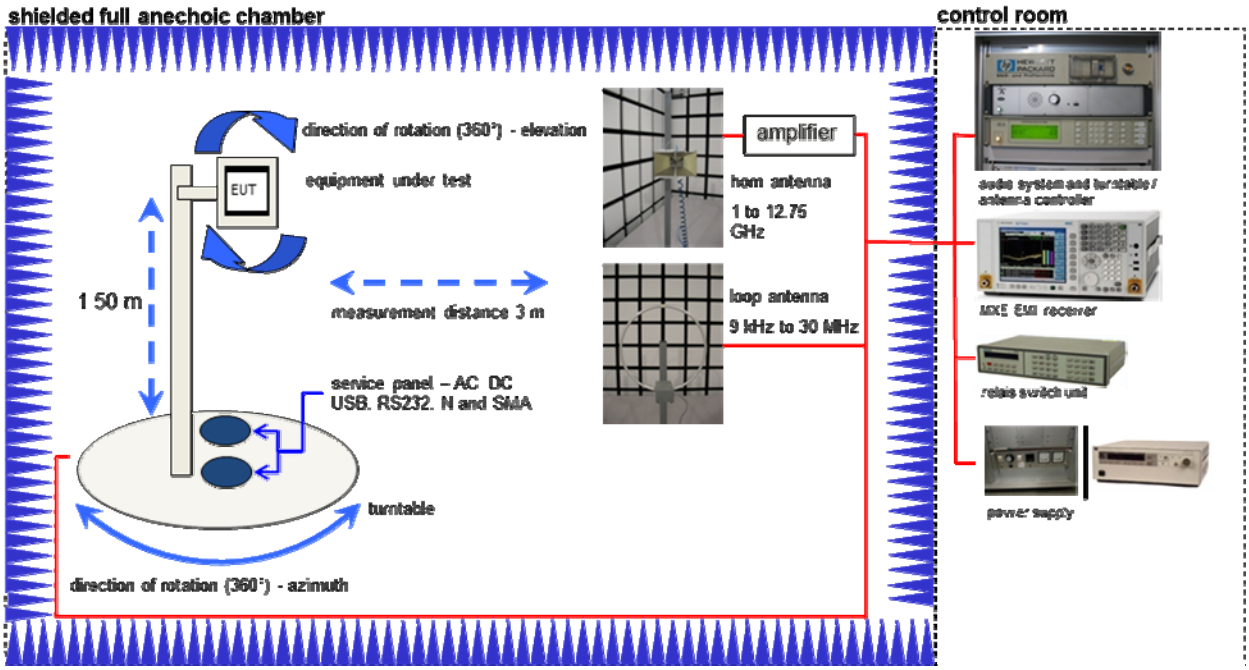
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368
DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2920A04466	300000580
EMI Test Receiver	ESCI 3	R&S	100083	300003312
Amplifier	JS42-00502650-28-5A	MITEQ	1084532	300003379
Antenna Tower	Model 2175	ETS-LINDGREN	64762	300003745
Positioning Controller	Model 2090	ETS-LINDGREN	64672	300003746
Turntable Interface-Box	Model 105637	ETS-LINDGREN	44583	300003747
TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787
Test Receiver	ESH2	R&S	871921/095	300002505
Loop Antenna 9 KHz - 30 MHz	HFH2-Z2	R&S	872096/61	300001824
EMI Test Receiver 9 kHz - 3 GHz incl. Preselector	ESPI3	R&S	101713	300004059

8.2 Radiated measurements chamber C

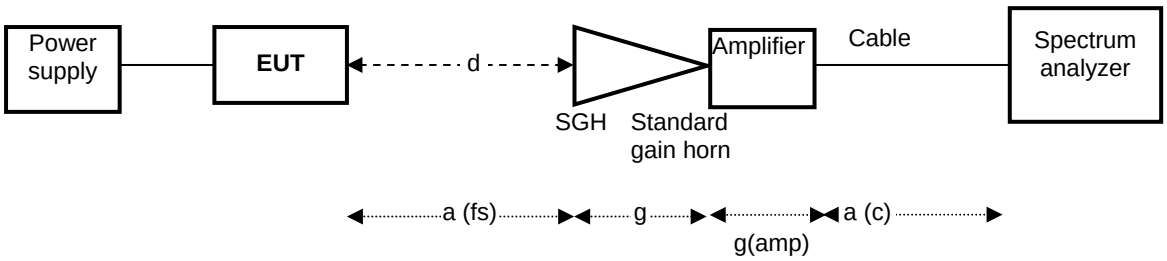


Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405
Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789
Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032
Active Loop Antenna	6502	EMCO	8905-2342	300000256
Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996
Switch / Control Unit	3488A	HP Meßtechnik	*	300000199
Switch / Control Unit	3488A	HP Meßtechnik	2719A15013	300001156
Isolating Transformer	MPL IEC625 Bus Regeltrenntravo	Erfi	91350	300001155
Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997
Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143

8.3 Radiated measurements 12 GHz to 50 GHz

Test set-up for the measurement of spurious radiation in the frequency range 12 GHz to 50 GHz:

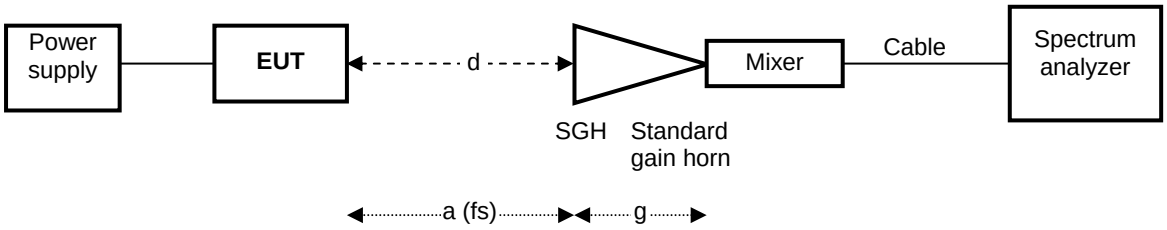


Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787
Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442
Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	7911	300001751
Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979
Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP Meßtechnik	00419	300002268
Broadband Low Noise Amplifier 18-50 GHz	CBL19503070-XX	CERNEX	19338	300004273
Spectrum Analyzer 20 Hz - 50 GHz	FSU50	R&S	200012	300003443

8.4 Radiated measurements above 50 GHz

Test set-up for the measurement of spurious radiation and EIRP in the frequency range 50 GHz to 325 GHz:



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983
Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF	*	300000814
Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001991
Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999
Std. Gain Horn Antenna 145-220 GHz	3024-20	Flann	*	300002000
Std. Gain Horn Antenna above 220 GHz	-/-	Flann	*	300002001
Harmonic mixer 50 - 75 GHz for spectrum analyzers	FS-Z75	R&S	100099	300003949
Harmonic mixer 60 - 90 GHz for spectrum analyzers	FS-Z90	R&S	101555	300004691
Spectrum Analyzer Mixer 2-Port, 75-110 GHz	SAM-110-7	Radiometer Physics GmbH	002	300004155
Spectrum Analyzer Mixer 3-Port, 110-170 GHz	SAM-170	Radiometer Physics GmbH	100014	300004156
Spectrum Analyzer Mixer 3-Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157
Spectrum Analyzer Mixer 3-Port, 220-325 GHz	SAM-325	Radiometer Physics GmbH	100002	300004158
Spectrum Analyzer 20 Hz - 50 GHz	FSU50	R&S	200012	300003443

8.5 Conducted measurements

Not applicable!

9 Measurement results

9.1 Power density

Measurement results:

TEST CONDITIONS	TRANSMITTER Power Density	
	Peak EIRP [dBm]	AVG EIRP [dBm]
T_{nom} / V_{nom}	31.63	17.59
T_{min} / V_{min}-V_{max}	32.13	18.14
T_{max} / V_{min}-V_{max}	28.73	15.58

Limits: **FCC §15.253 (d) (1) (2)**

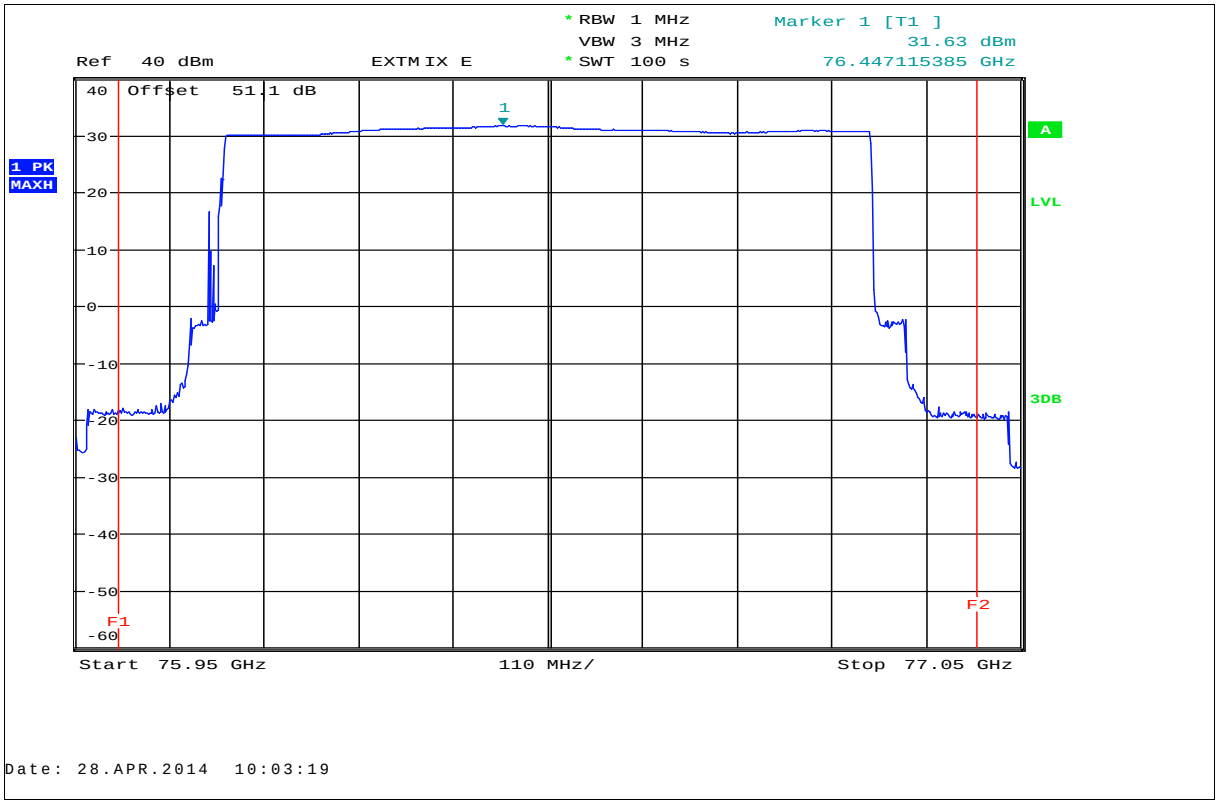
Frequency	Measurement distance	Power Density → EIRP
76.0 - 77.0 GHz	3.0 m	88 µW/cm^2 → 50 dBm (Average) 279 µW/cm^2 → 55 dBm (PEAK)

Limits: **RSS 210 Issue 8, Annex 13.1.3**

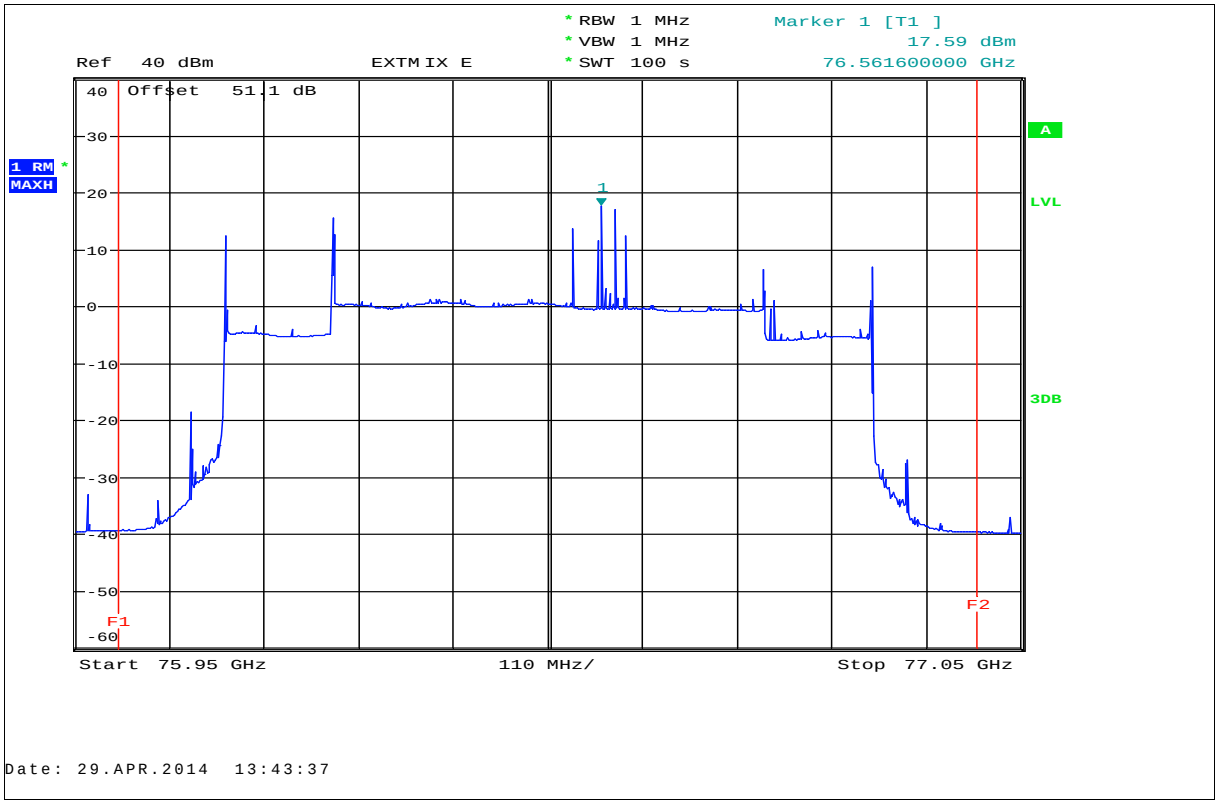
There is no limit on peak transmitter output power

Result: **The measurement is passed.**

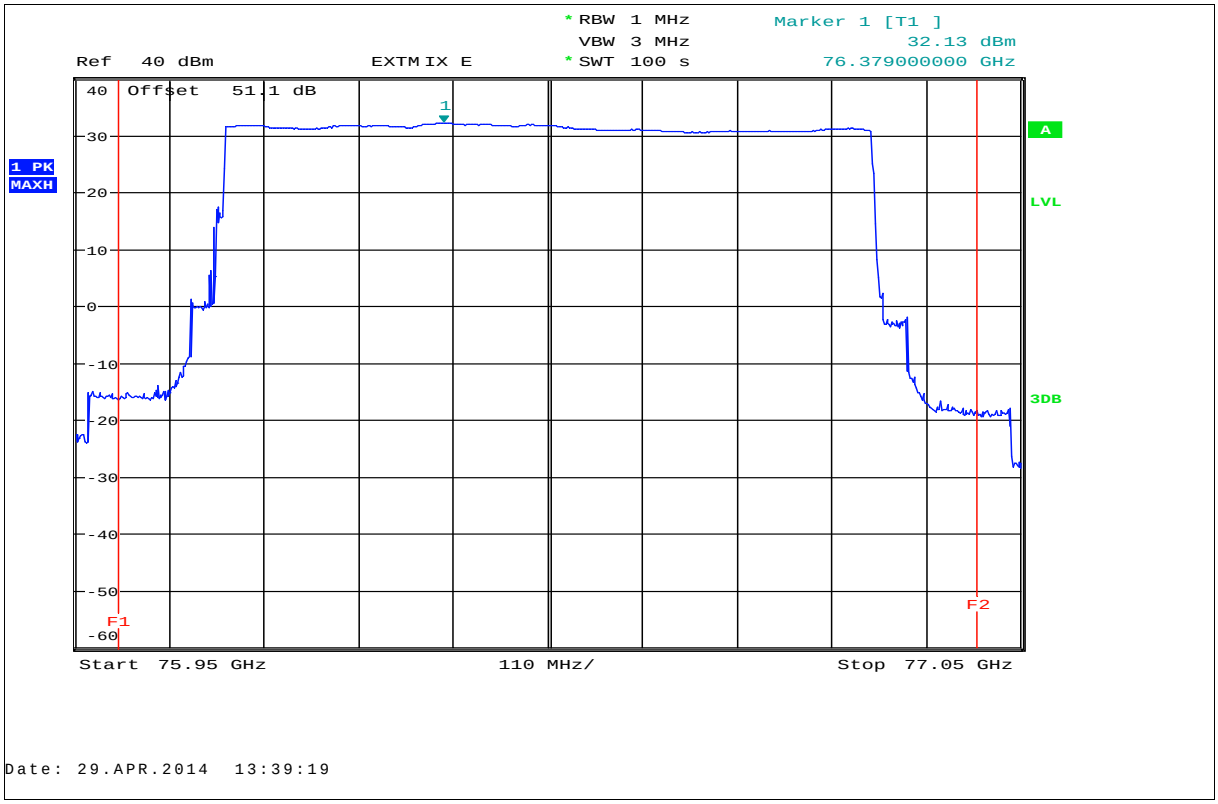
Plot 1: EIRP (Peak detector), T_{nom} / V_{nom}



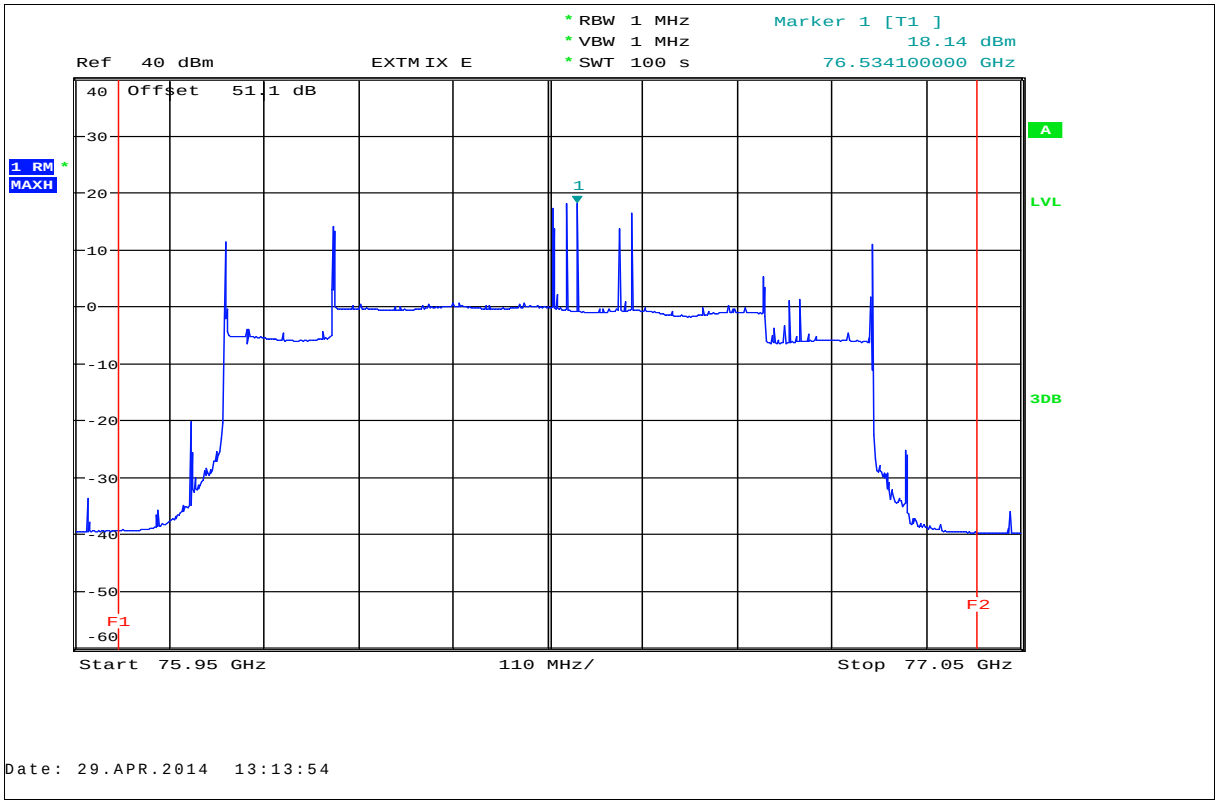
Plot 2: EIRP (RMS detector), T_{nom} / V_{nom}



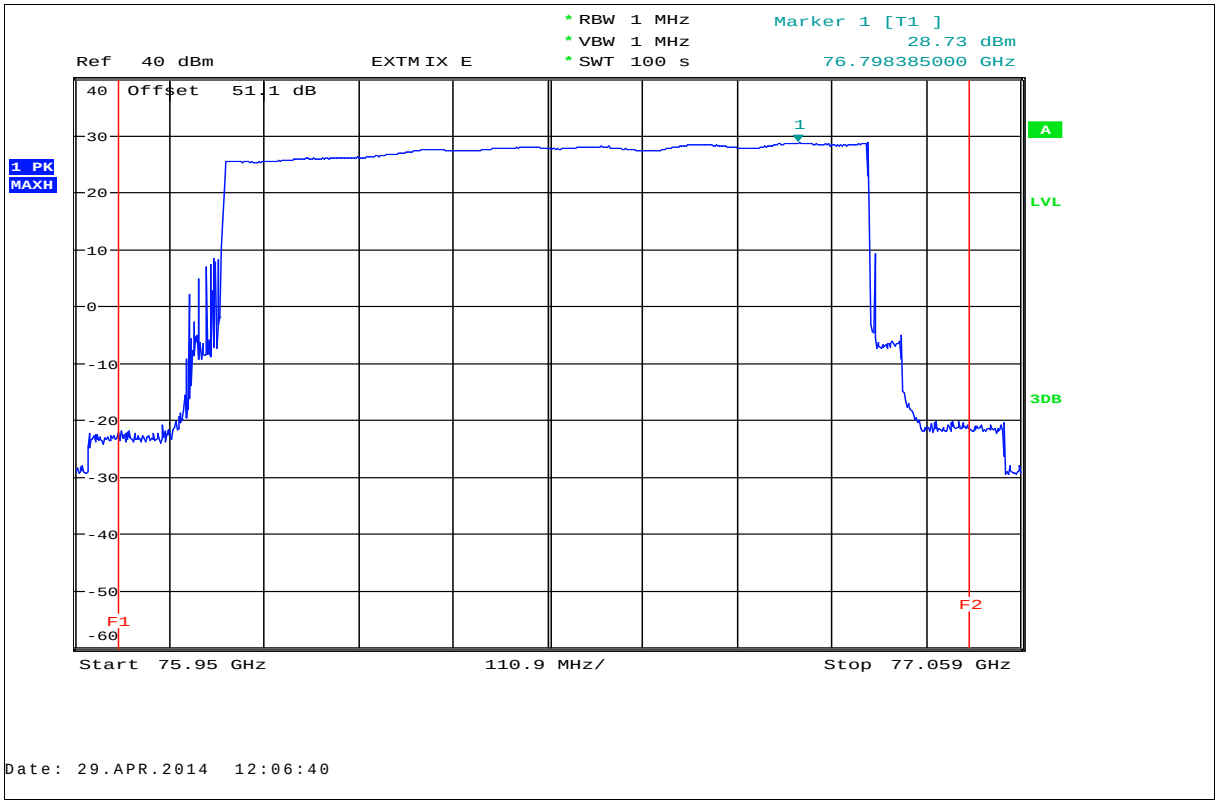
Plot 3: EIRP (Peak detector), T_{min} / V_{min} - V_{max},



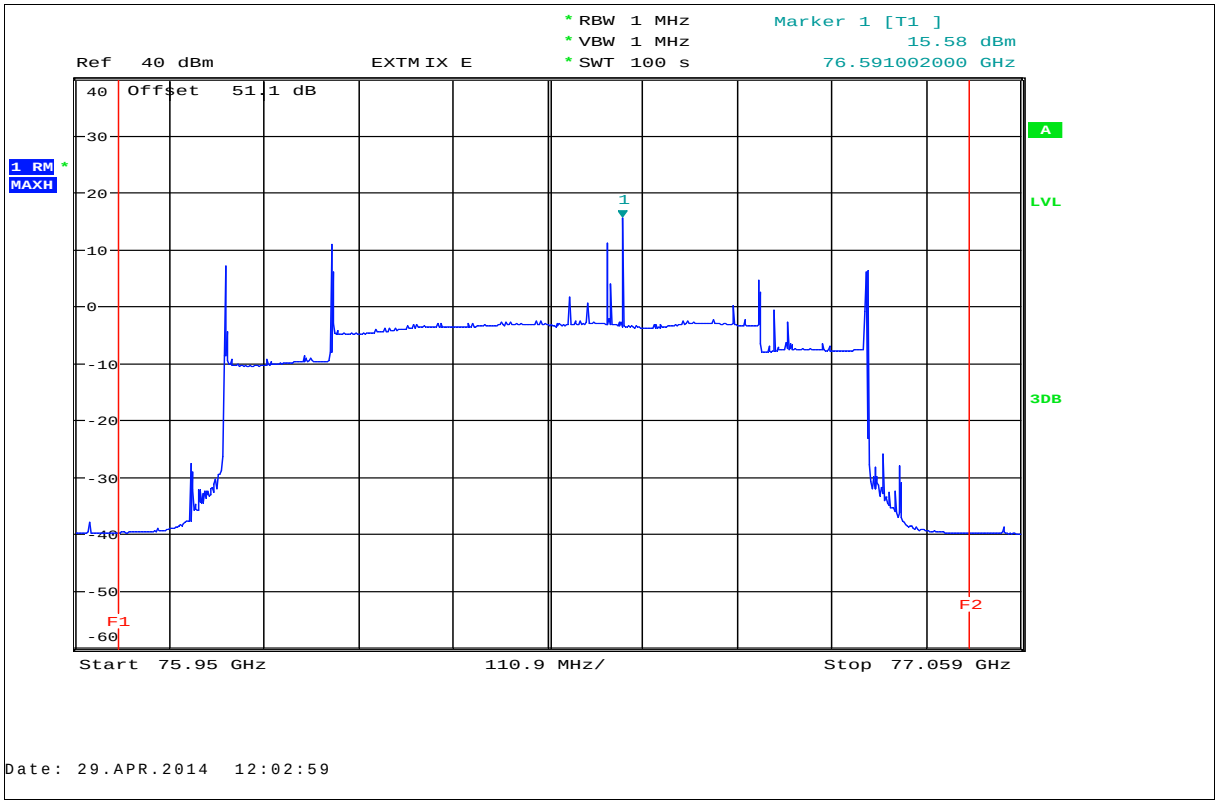
Plot 4: EIRP (RMS detector), T_{min} / V_{min} - V_{max},



Plot 5: EIRP (Peak detector), T_{max} / V_{min} - V_{max},



Plot 6: EIRP (RMS detector), T_{max} / V_{min} - V_{max},



9.2 Not in Motion

Refer to 9.1, the maximum average radiated power is 18.14 dBm = 65.16 mW (at T_{min} / V_{min}-V_{max})

Limits: **RSS 210 Issue 8, Annex 13.1.2 (1)(a)**

200 nW/cm^2 (approximately 23.5 dBm) if the vehicle is moving slower than 1 km/hour

Result: **The measurement is passed.**

9.3 Maximum Permissible Exposure (MPE)

MPE Calculation:

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

PD = Power Density (mW/cm2)
OP = DUT Output Power (dBm)
AG = DUT Antenna Gain (dBi)
d = MPE Distance (cm)

Note: OP [mW], AG as lin.factor

§ 1.1310 Radiofrequency radiation exposure limits.

The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, ''Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation.''

NOTE TO INTRODUCTORY PARAGRAPH: These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP) in ''Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,'' NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3.
Copyright NCRP, 1986, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, exposure limits for field strength and power density are also generally based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ''IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,'' ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

[61 FR 41016, Aug. 7, 1996]

Results:

Refer to 9.1, the maximum average radiated power is 18.14 dBm = 65.16 mW (at T_{min} / V_{min}-V_{max})

d = 20 cm

➔ PD = 0.013 mW/cm^2

Limits: **FCC §1.1310 (B)**

Frequency [GHz]	Power Density [mW / cm^2]
1.500 GHz – 100.000 GHz	1 mW / cm^2

Result: **The measurement is passed.**

9.4 Occupied bandwidth

Definition:

The width of the frequency band which is just sufficient such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the total mean power of a given emission.

Measurement results:

Test conditions	99 % Occupied bandwidth [MHz]
T_{nom} / V_{nom}	747
T_{min} / V_{min} - V_{max}	747
T_{max} / V_{min} - V_{max}	745

Limits: **FCC §2.1049**

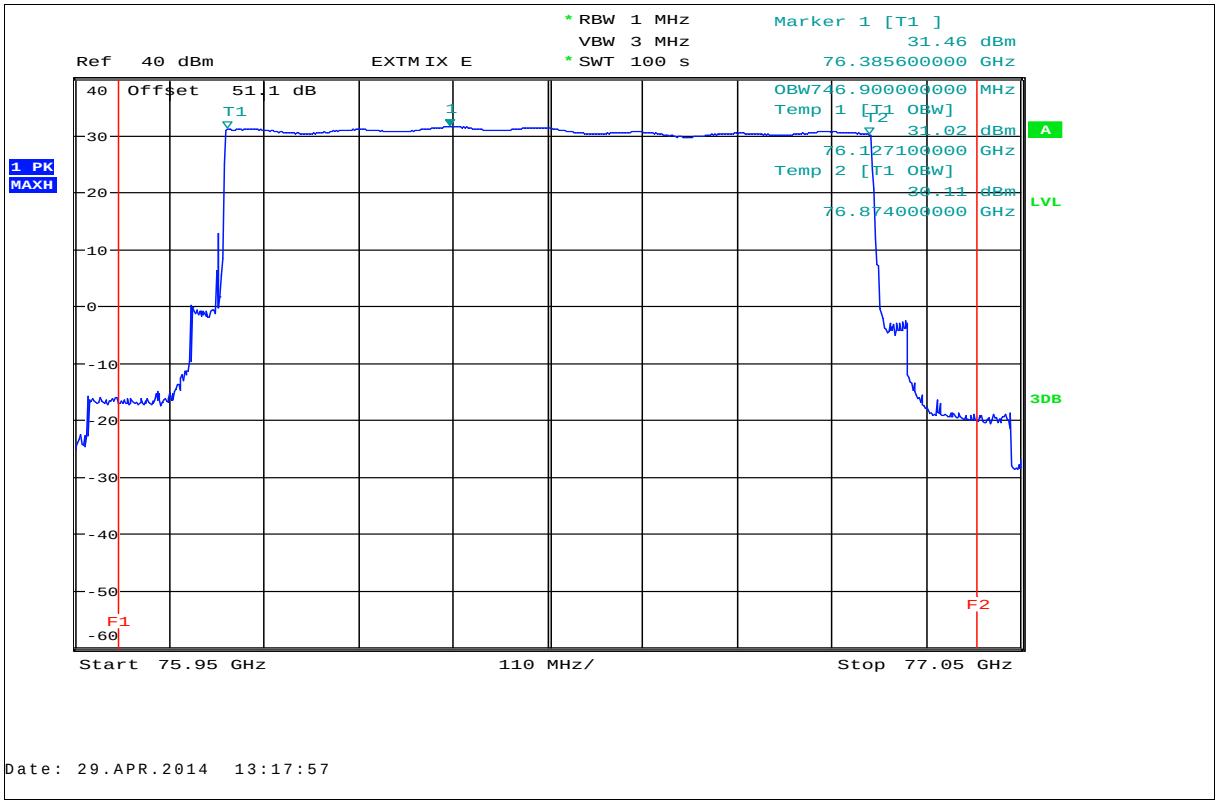
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 77.0 GHz

Limits: **RSS 210 Issue 8, Annex 13.1.1**

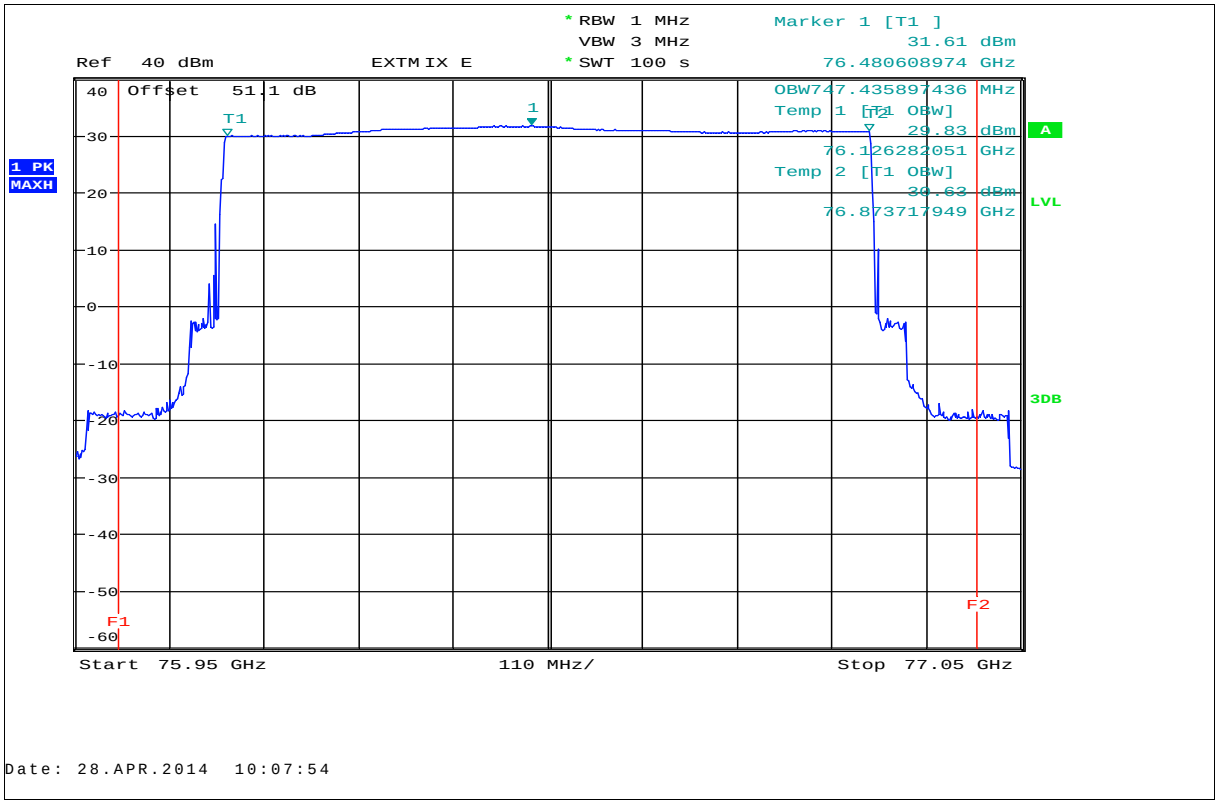
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 77.0 GHz

Result: **The measurement is passed.**

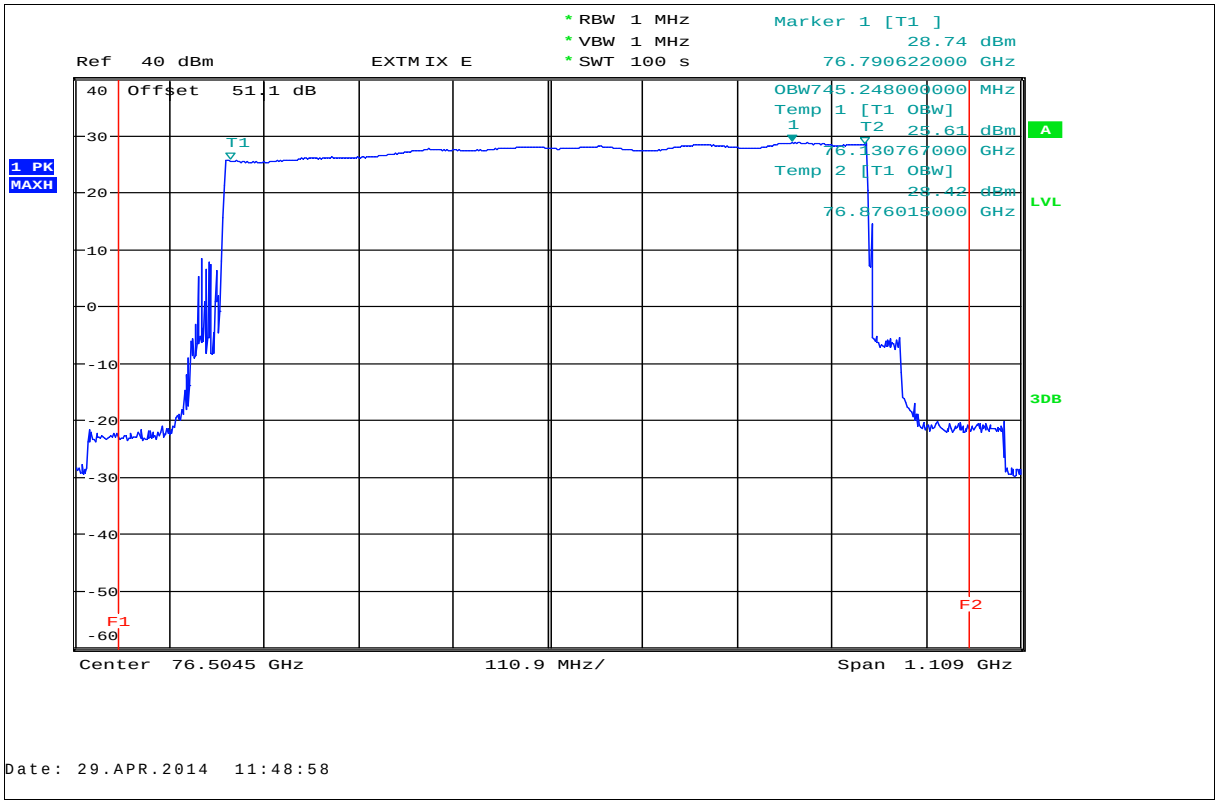
Plot 7: Occupied bandwidth (99%), T_{nom} / V_{nom}



Plot 8: Occupied bandwidth (99%), T_{min} / V_{min} - V_{max}



Plot 9: Occupied bandwidth (99%), T_{max} / V_{min} - V_{max}



9.5 Field strength of emissions (radiated spurious)

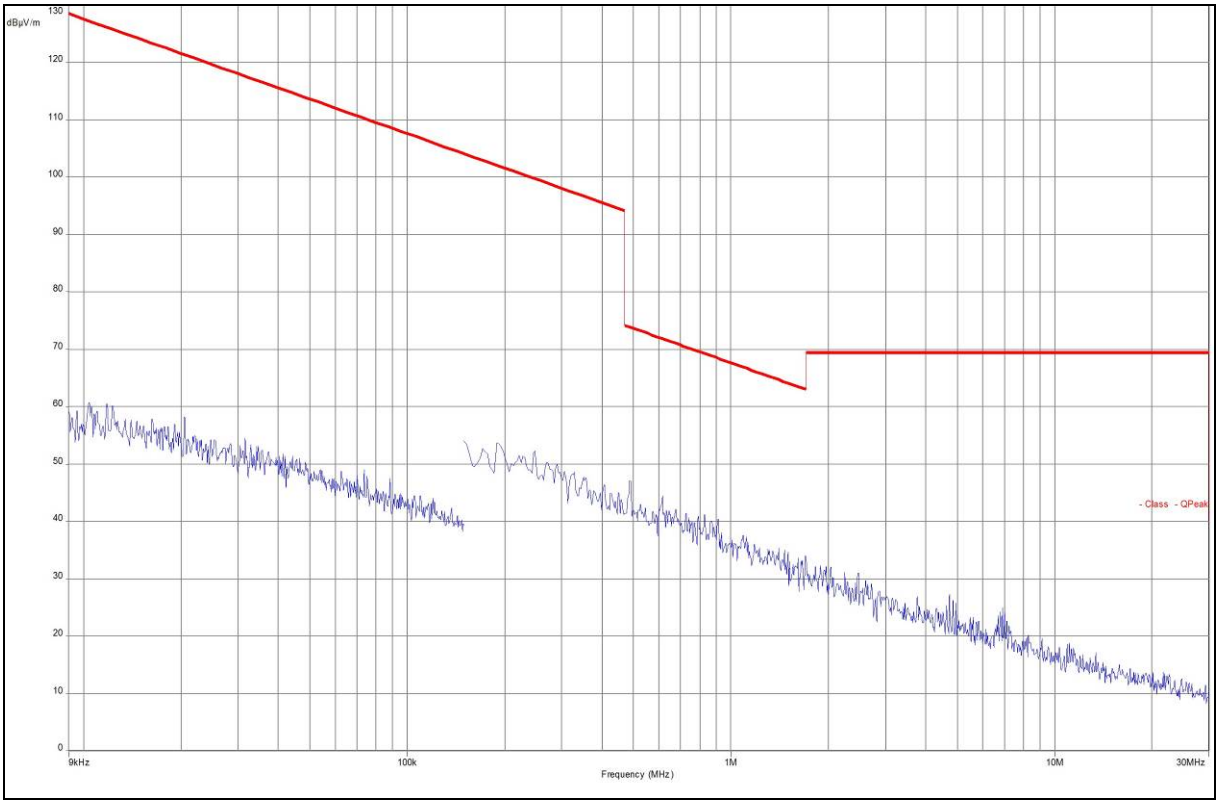
Description:

Measurement of the radiated spurious emissions in transmit mode.

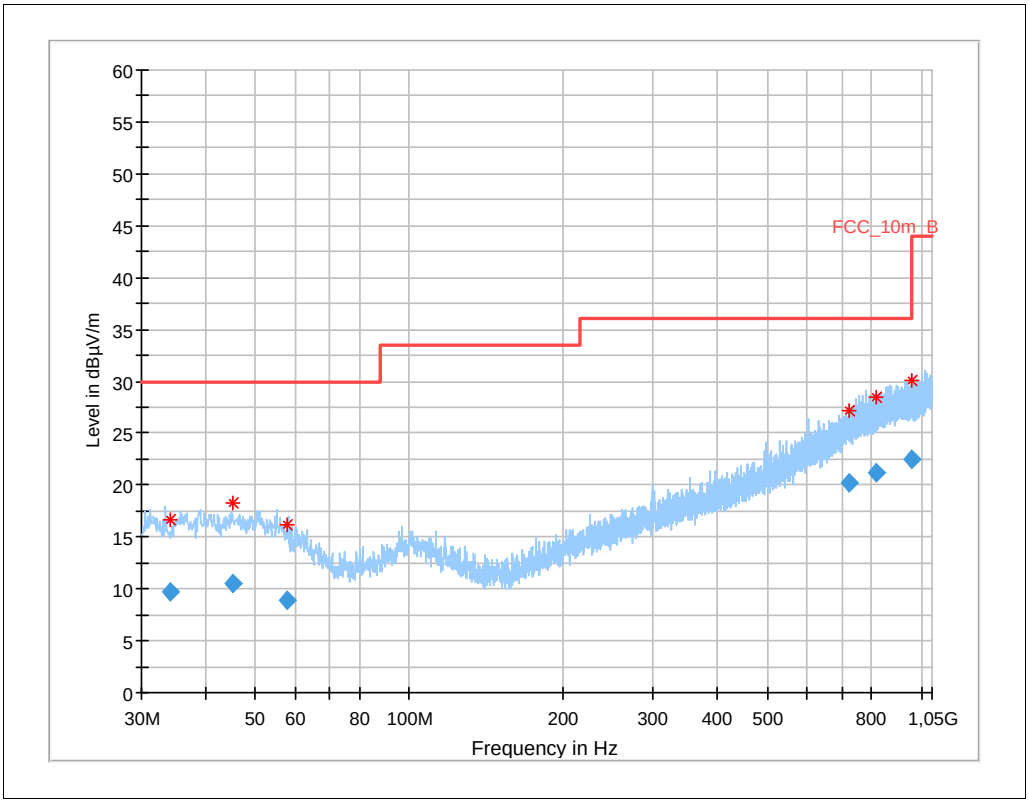
Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	Auto
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Frequency range:	30 MHz to 235 GHz
Trace-Mode:	Max Hold

Plot 10: 9 kHz – 30 MHz, magnetic loop antenna, valid for all frequencies

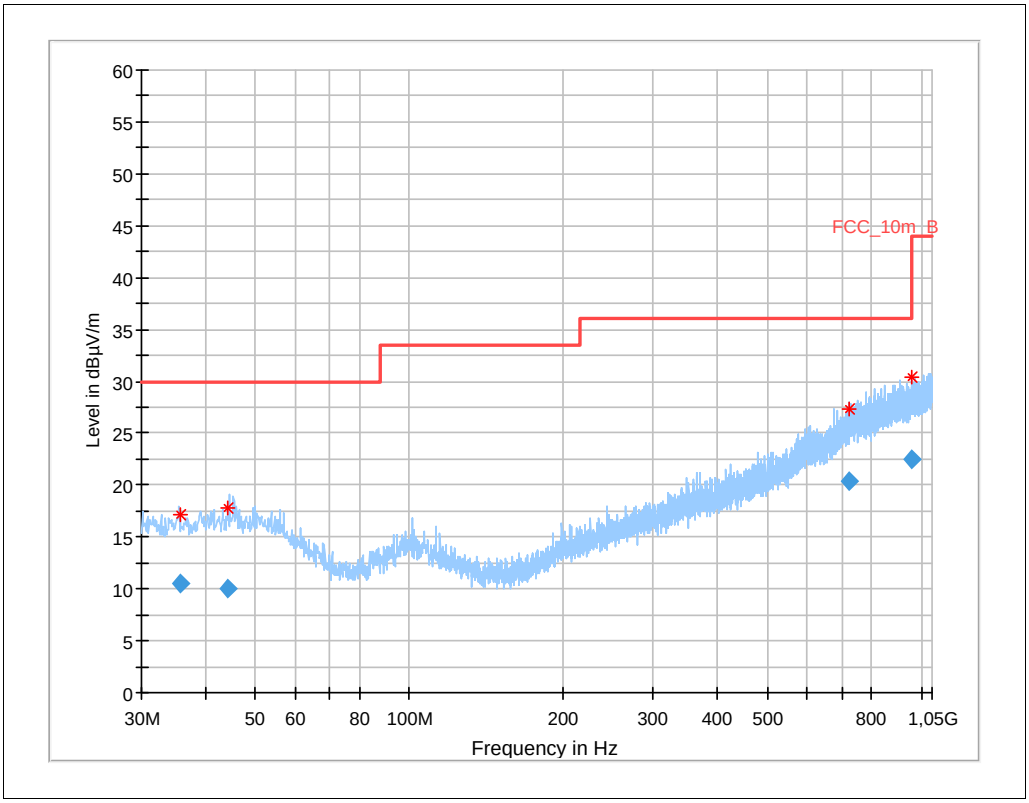


Plot 11: 30 MHz – 1 GHz, antenna horizontal and vertical, low frequency



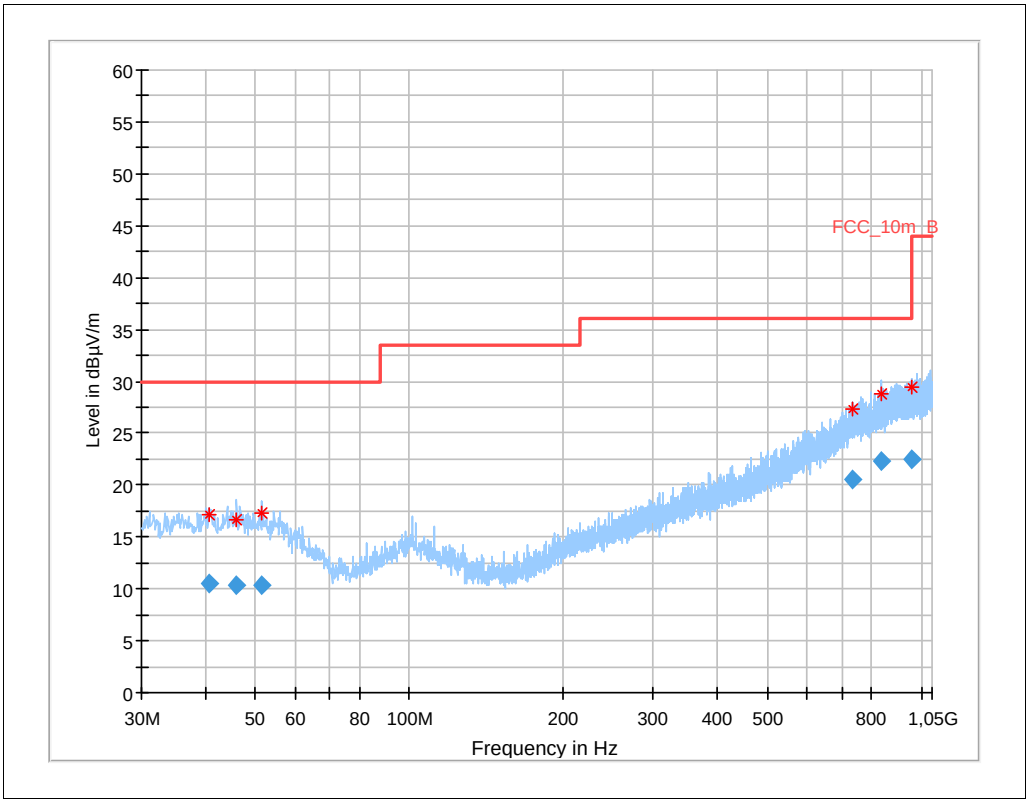
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.02405	9.64	30.00	20.36	1000.0	120.000	200.0	V	5.0	12.9
45.36555	10.55	30.00	19.45	1000.0	120.000	200.0	V	-9.0	13.3
57.67020	8.90	30.00	21.10	1000.0	120.000	148.0	V	152.0	12.2
722.65800	20.18	36.00	15.82	1000.0	120.000	191.0	V	93.0	23.0
816.36120	21.20	36.00	14.80	1000.0	120.000	103.0	H	-4.0	24.1
955.17300	22.49	36.00	13.51	1000.0	120.000	263.0	H	237.0	25.4

Plot 12: 30 MHz – 1 GHz, antenna horizontal and vertical, mid frequency



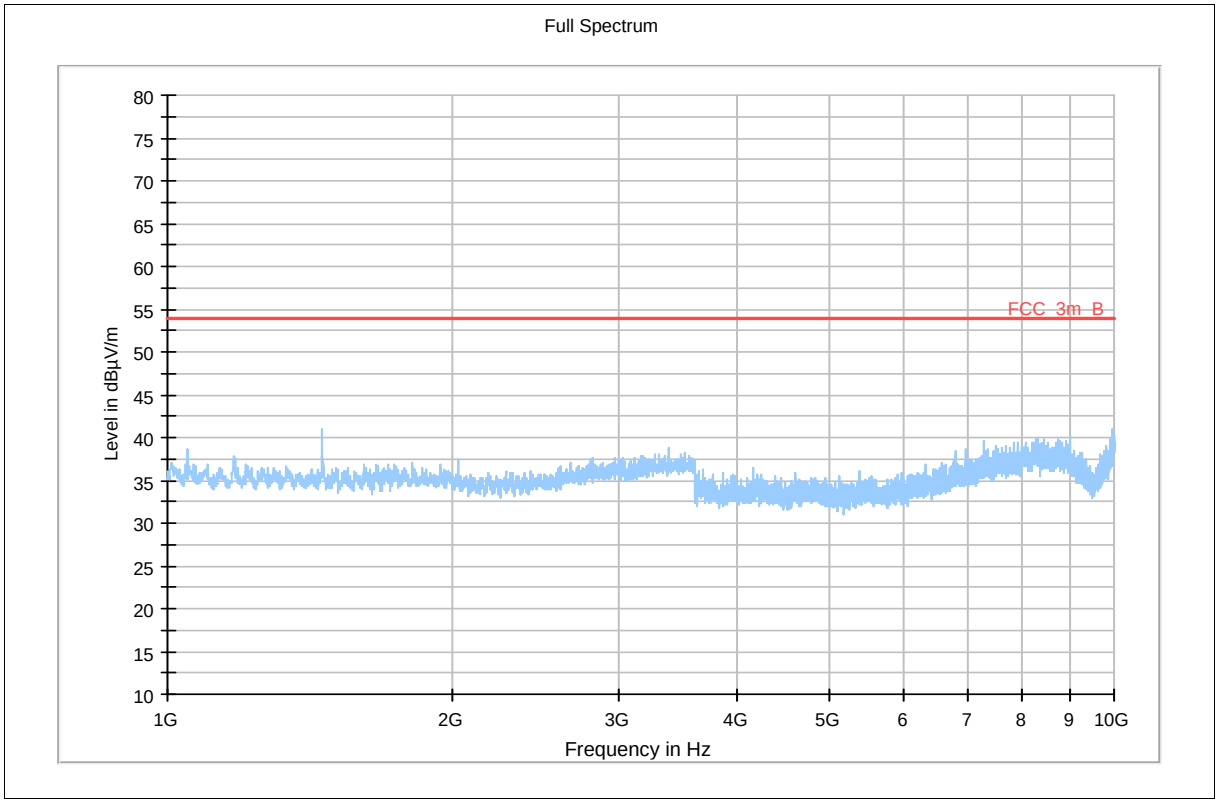
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.79420	10.50	30.00	19.50	1000.0	120.000	200.0	V	173.0	13.1
44.40075	10.04	30.00	19.96	1000.0	120.000	200.0	V	101.0	13.3
722.15940	20.32	36.00	15.68	1000.0	120.000	196.0	V	2.0	23.0
958.46535	22.49	36.00	13.51	1000.0	120.000	103.0	V	230.0	25.4

Plot 13: 30 MHz – 1 GHz, antenna horizontal and vertical, high frequency

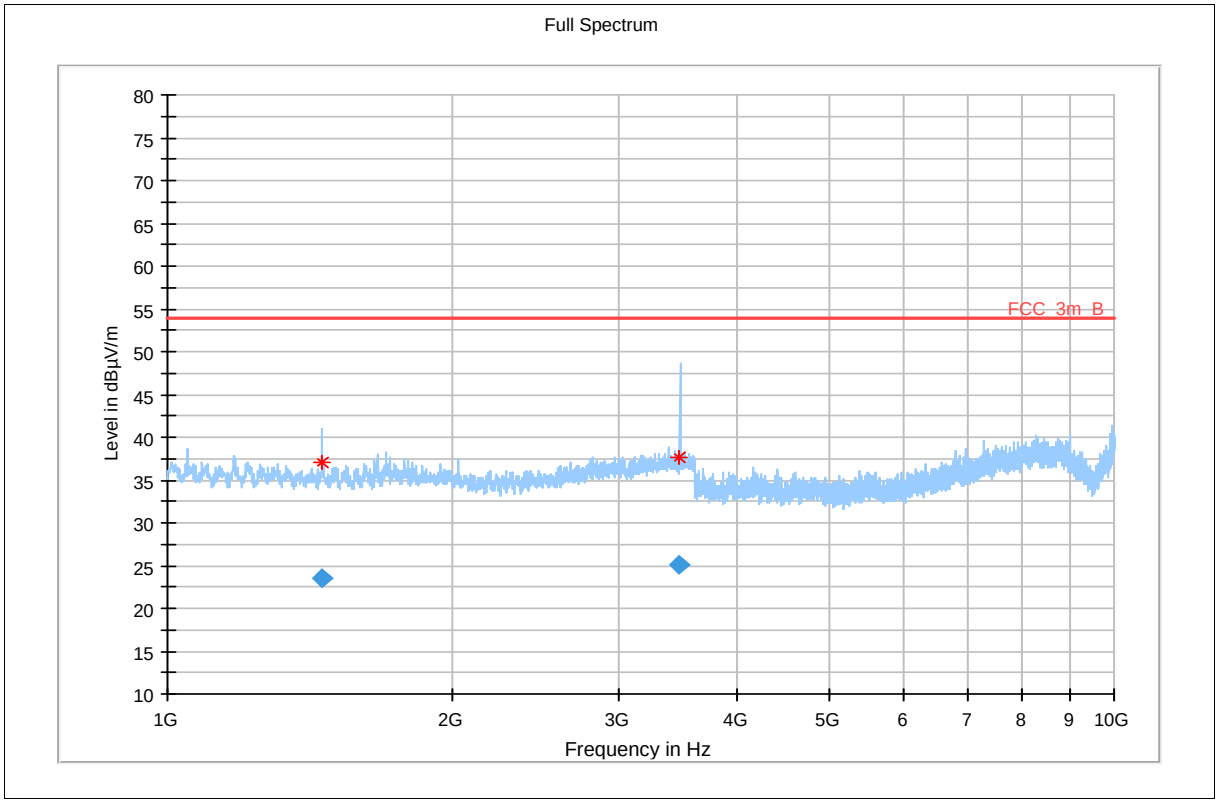


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.70520	10.45	30.00	19.55	1000.0	120.000	236.0	H	5.0	13.4
46.03215	10.28	30.00	19.72	1000.0	120.000	274.0	H	155.0	13.3
51.36855	10.30	30.00	19.70	1000.0	120.000	173.0	V	100.0	13.2
733.95120	20.52	36.00	15.48	1000.0	120.000	380.0	V	161.0	23.3
833.84055	22.33	36.00	13.67	1000.0	120.000	347.0	H	256.0	24.3
956.41980	22.45	36.00	13.55	1000.0	120.000	329.0	H	112.0	25.4

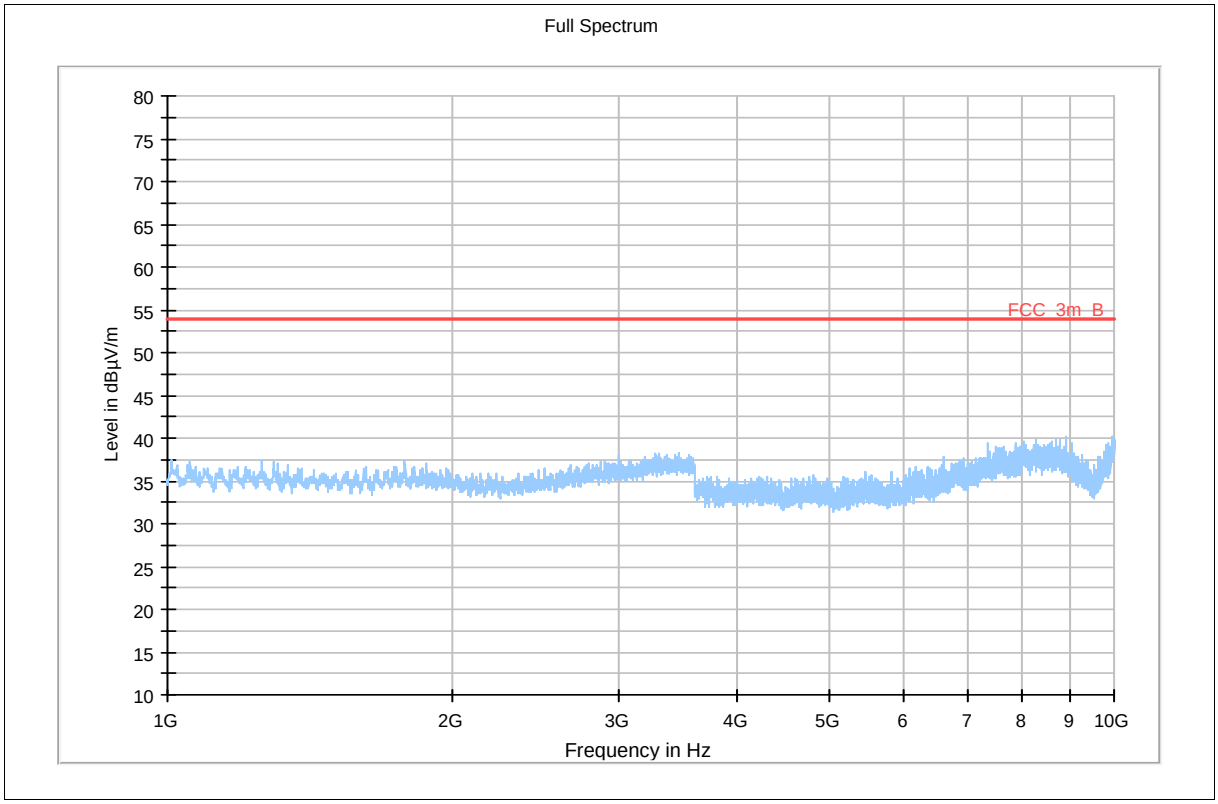
Plot 14: 1 GHz – 10 GHz, antenna horizontal and vertical, low frequency



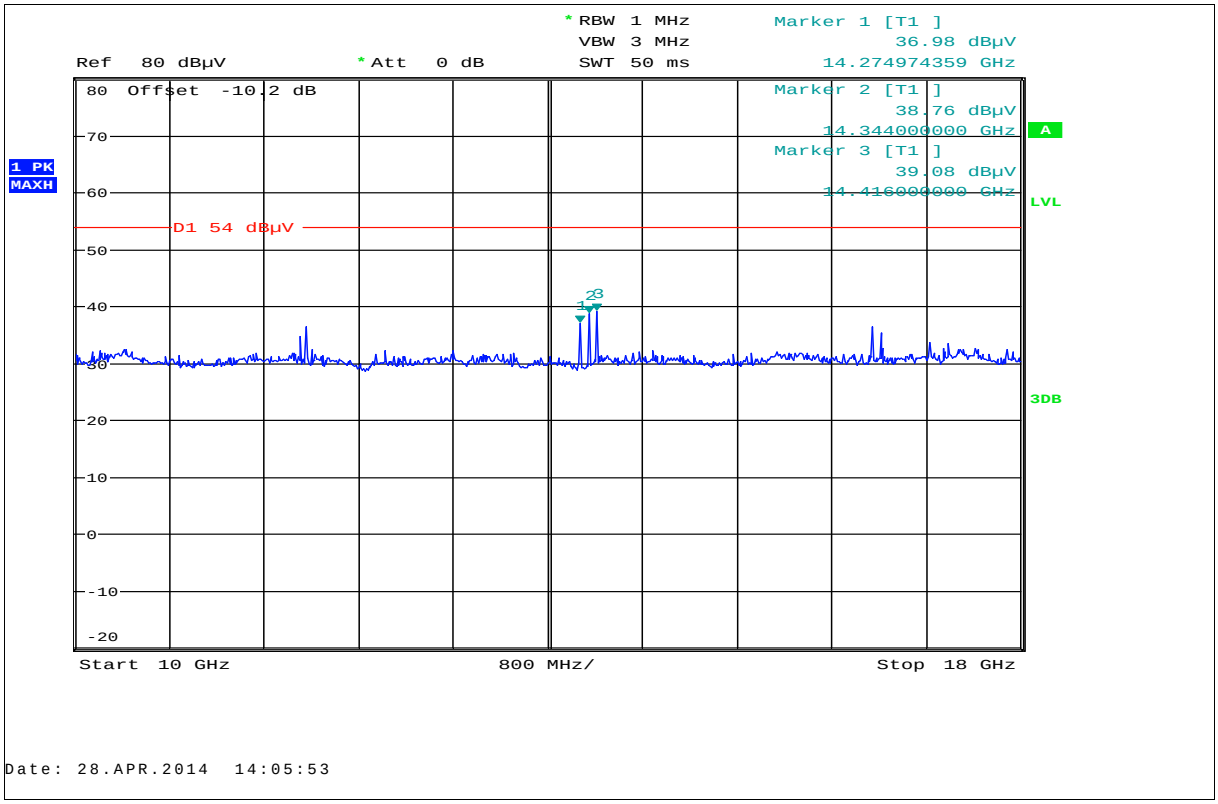
Plot 15: 1 GHz – 10 GHz, antenna horizontal and vertical, middle frequency



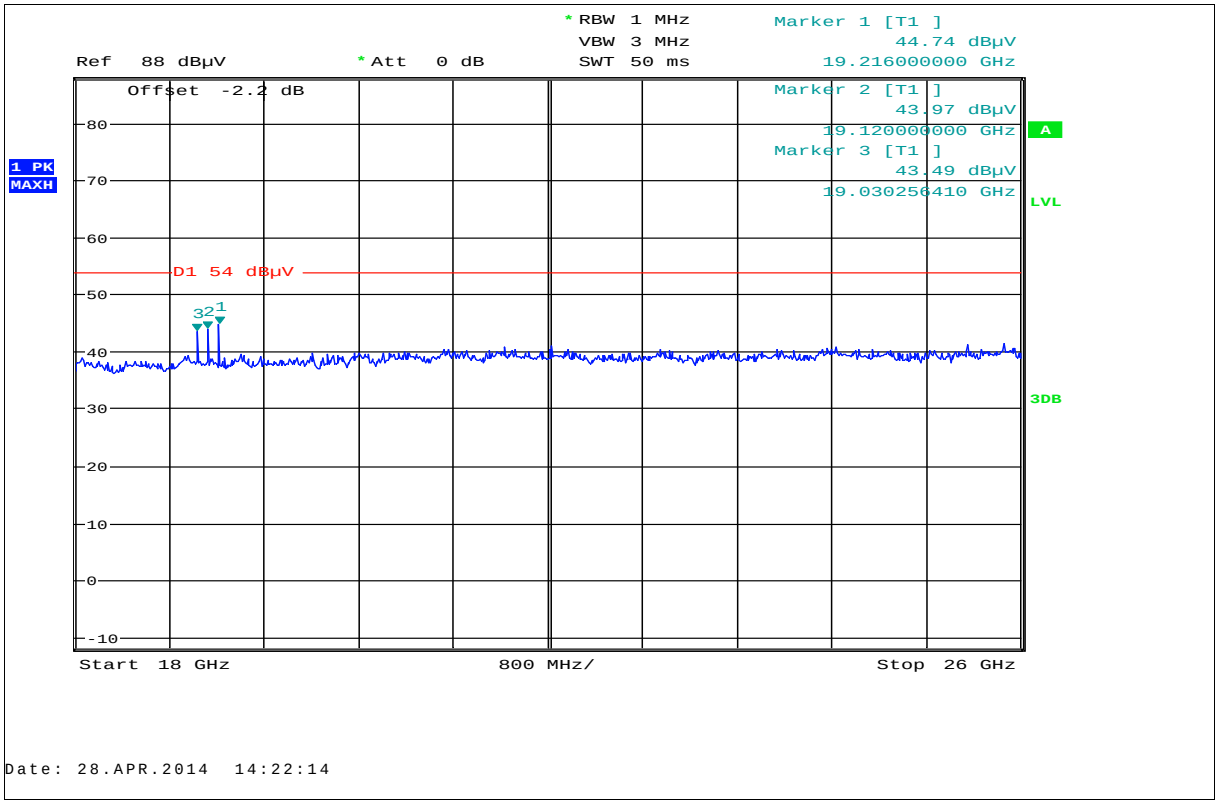
Plot 16: 1 GHz – 10 GHz, antenna horizontal and vertical, high frequency



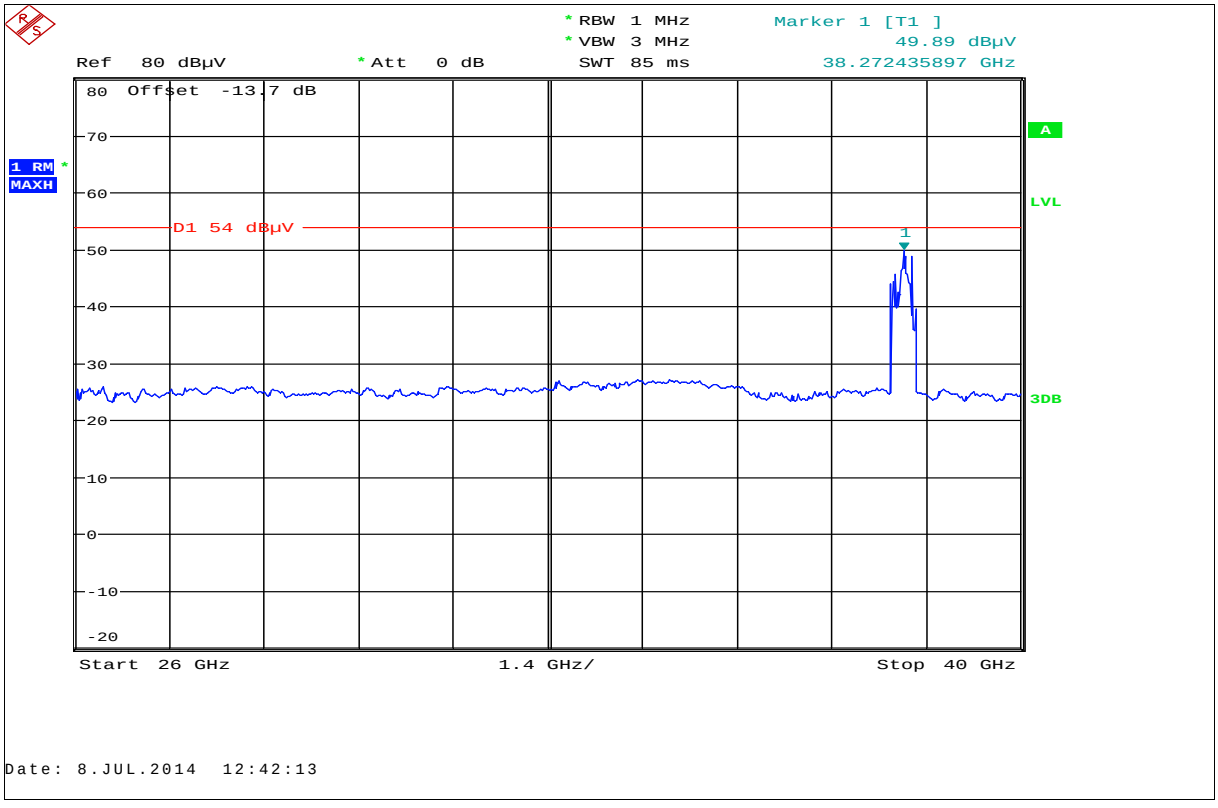
Plot 17: 10 GHz – 18 GHz, antenna horizontal and vertical, TX-Mode, low / mid / high frequency



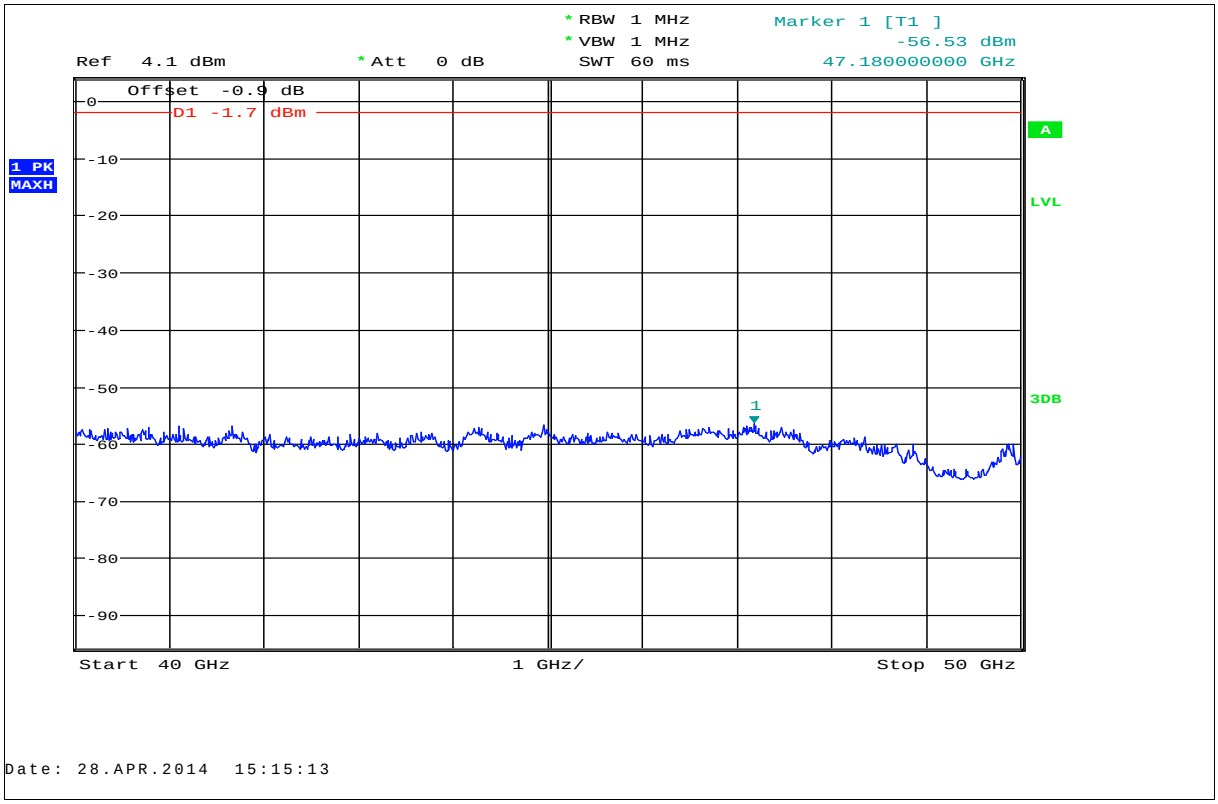
Plot 18: 18 GHz – 26 GHz, antenna horizontal and vertical, low / mid / high frequency



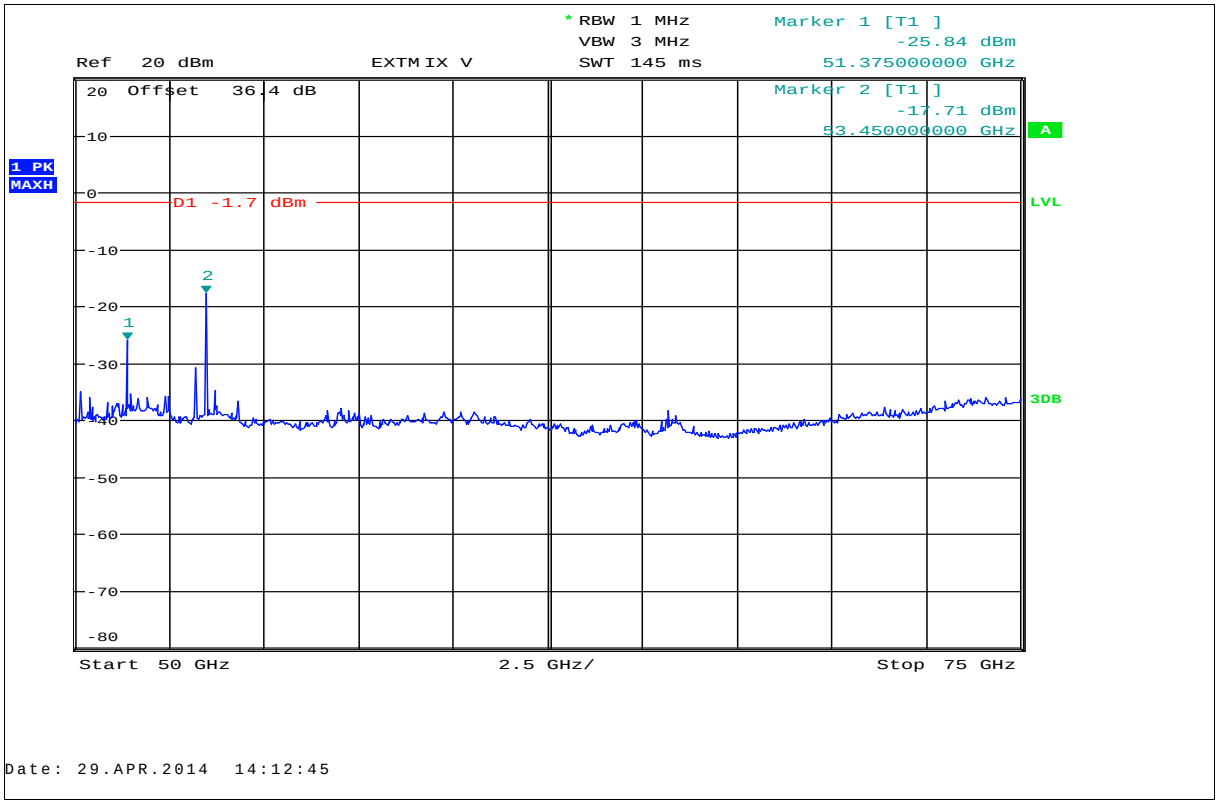
Plot 19: 26 GHz – 40 GHz, antenna horizontal and vertical, low / mid / high frequency



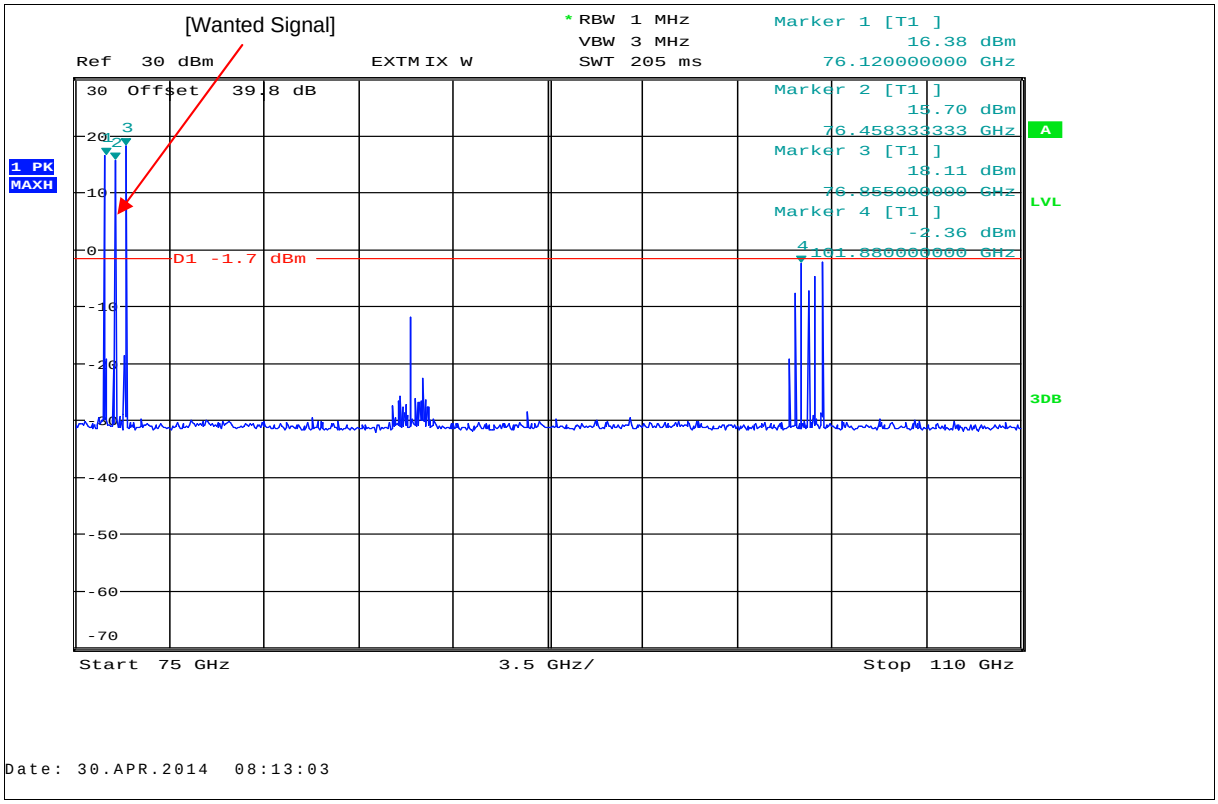
Plot 20: 40 GHz – 50 GHz, antenna horizontal and vertical, low / mid / high frequency



Plot 21: 50 GHz – 75 GHz, antenna horizontal and vertical, low / mid / high frequency

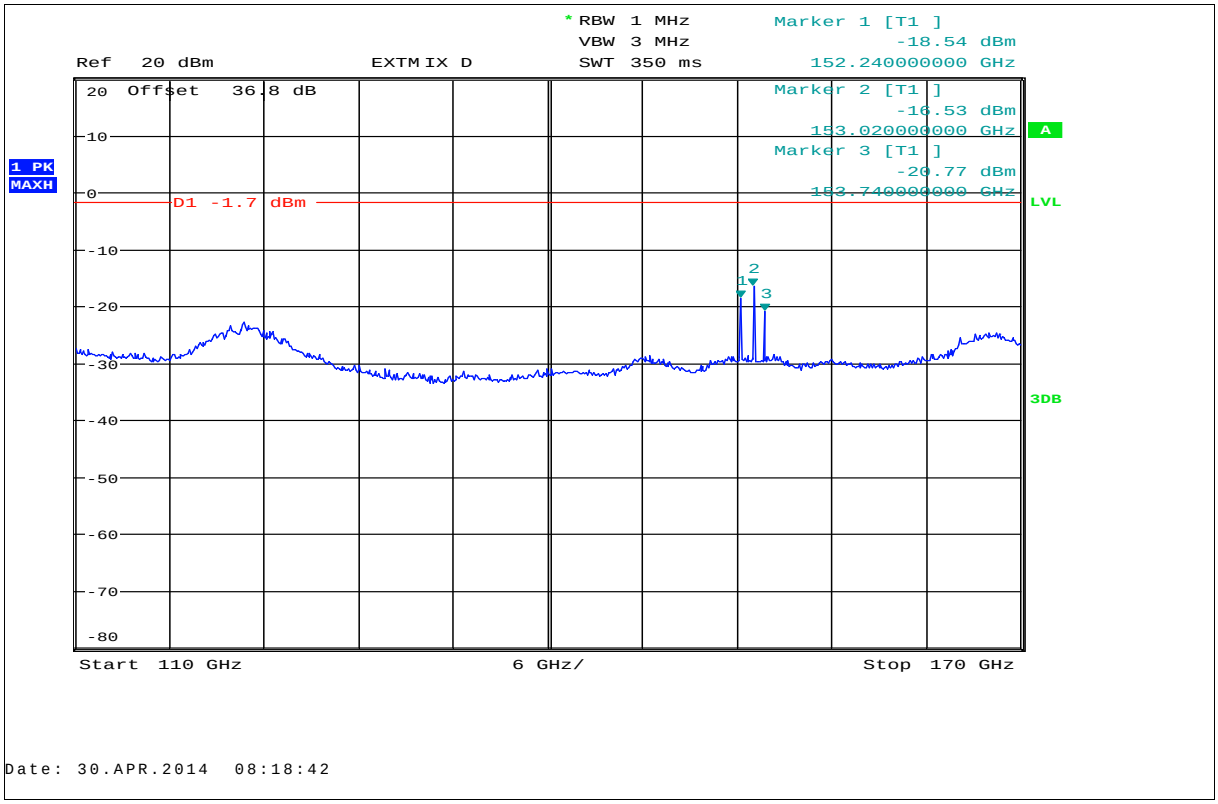


Plot 22: 75 GHz – 110 GHz, antenna horizontal and vertical, low / mid / high frequency

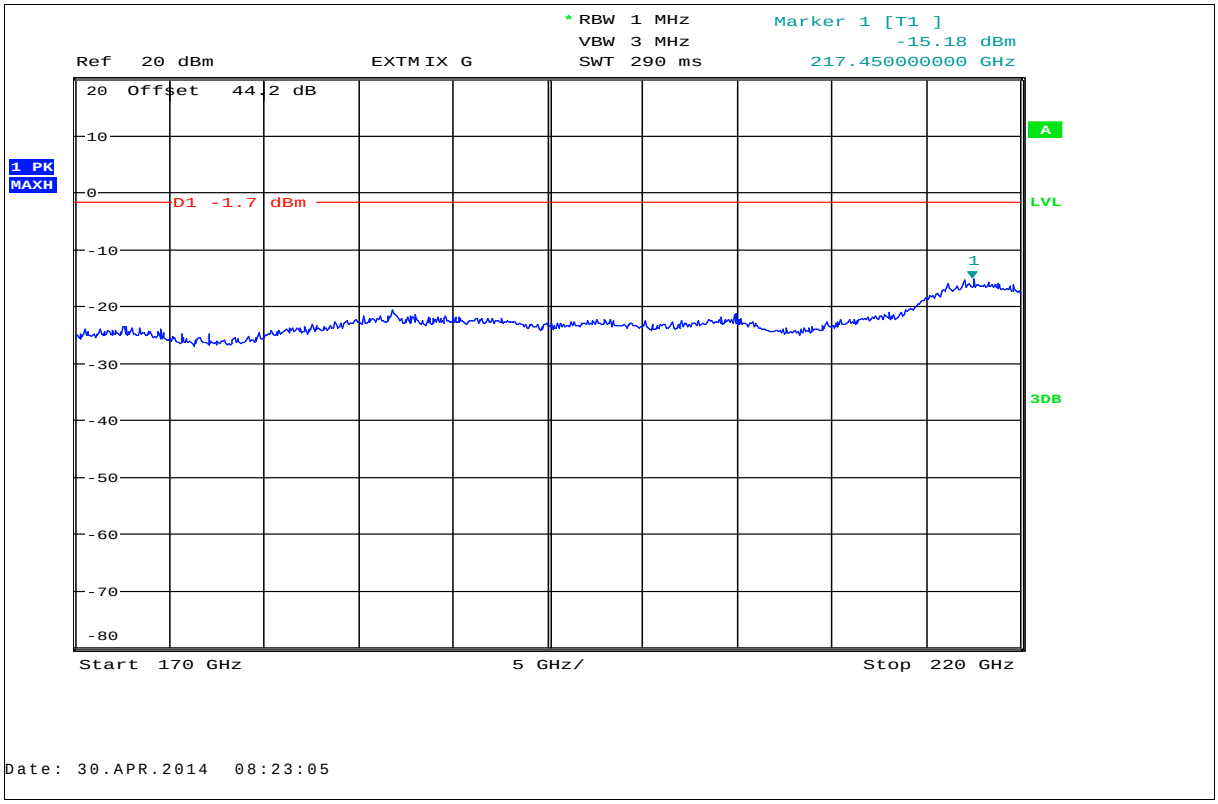


Note: Marker 1, 2, 3 show the wanted signal, other peaks are produced by the harmonic mixer!

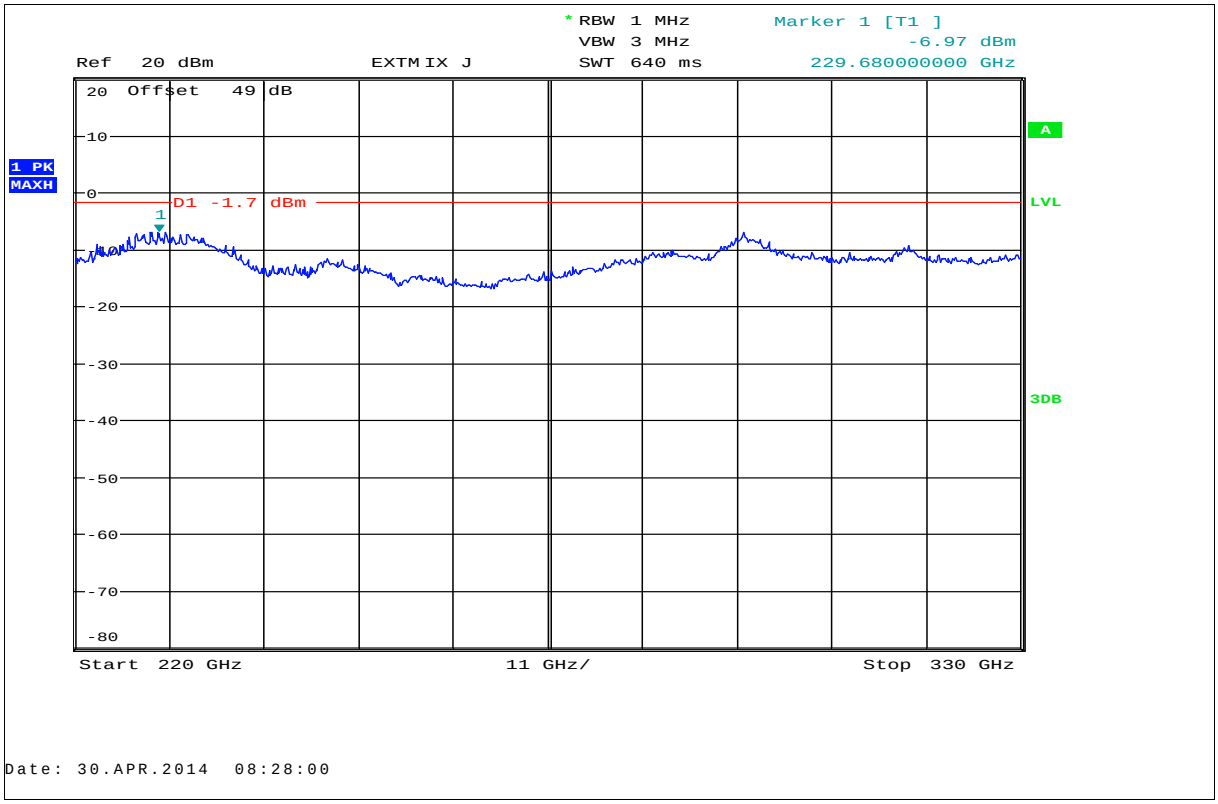
Plot 23: 110 GHz – 170 GHz, antenna horizontal and vertical, low / mid / high frequency



Plot 24: 170 GHz – 220 GHz, antenna horizontal and vertical, low / mid / high frequency



Plot 25: 220 GHz – 330 GHz, antenna horizontal and vertical, low / mid / high frequency



Results:

TX Spurious Emissions Radiated [dBµV/m]								
Low frequency			Mid frequency			High frequency		
F [GHz]	Detector	Level [dBµV/m]	F [GHz]	Detector	Level [dBµV/m]	F [GHz]	Detector	Level [dBµV/m]
No critical peaks found!			No critical peaks found!			No critical peaks found!		
Measurement uncertainty			± 3 dB					

Limits: **FCC §15.253 / 15.209 / 15.205**

FCC		
CFR Part 15.253 (d) (e) / CFR Part 15.209 (a) / CFR Part 15.205		
Radiated Spurious Emissions		
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.		
Frequency [MHz]	Field Strength [dBµV/m]	Measurement distance
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30	30
30 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
960 – 40 000	54.0	3

Limits: **FCC §15.253 (e) (2) (ii) + (3)**

Frequency Range [GHz]	Measurement distance	Power Density
40 – 200	3.0 m	600 pW/cm^2 → -1.7 dBm
200 – 231	3.0 m	1000 pW/cm^2 → +0.5 dBm

Limits: **RSS 210 Issue 8, Annex 13.1.2 (2) (a) / (b) / (c)**

Frequency Range [GHz]	Measurement distance	Power Density
40 – 200	3.0 m	600 pW/cm^2 → -1.7 dBm
200 – 231	3.0 m	1000 pW/cm^2 → +0.5 dBm

Result: **The measurement is passed.**

9.6 Frequency stability

TEST CONDITIONS	Carrier Frequency
(T_{nom} / V_{nom})	Refer to plot 26
(T_{min} / $V_{min-max}$)	Refer to plot 27
(T_{max} / $V_{min-max}$)	Refer to plot 28

Limits: **FCC §15.253 (f)**

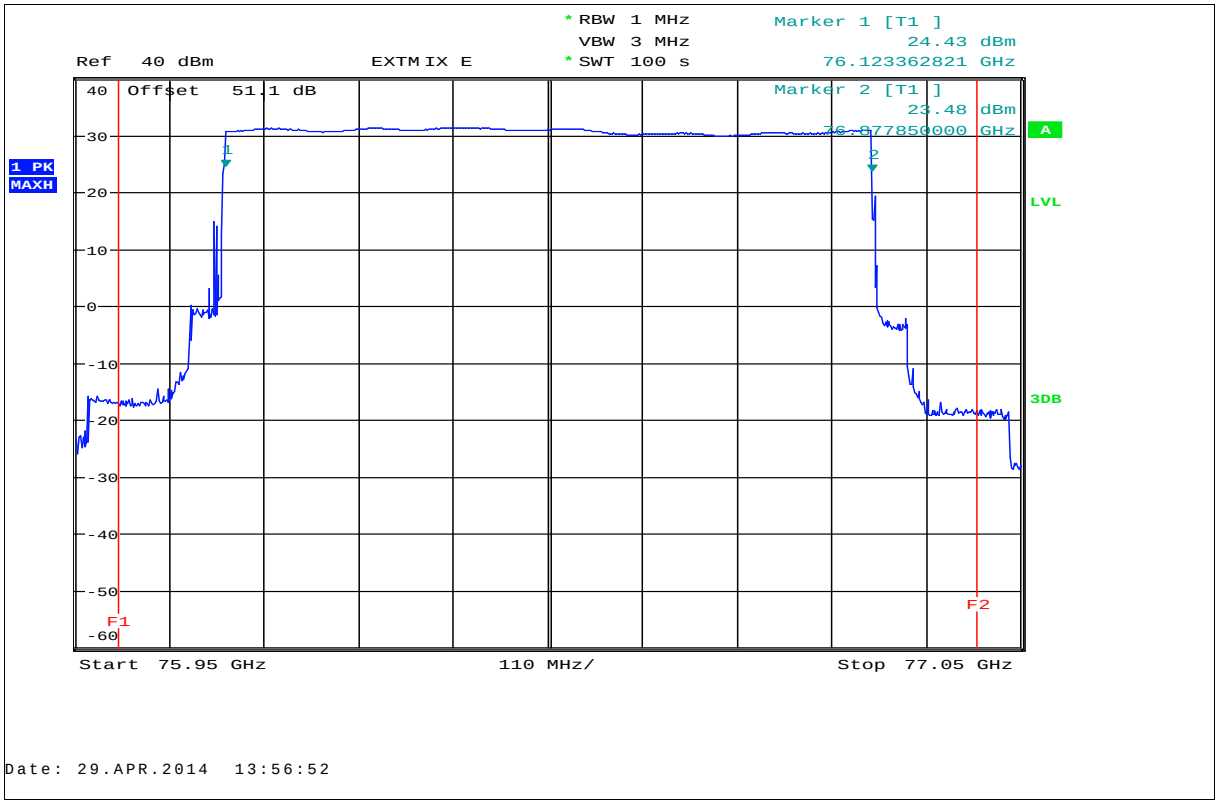
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 77.0 GHz

Limits: **RSS 210 Issue 8, Annex 13.1.5**

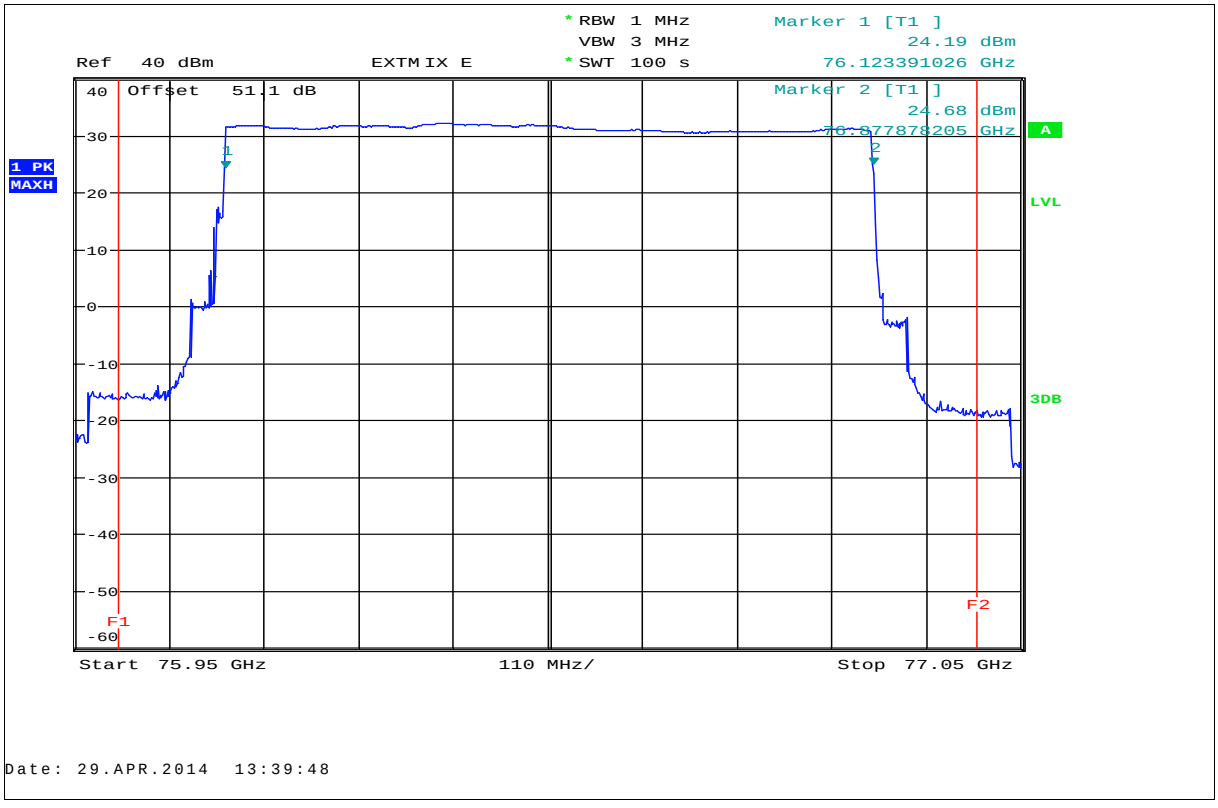
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 77.0 GHz

Result: **The measurement is passed.**

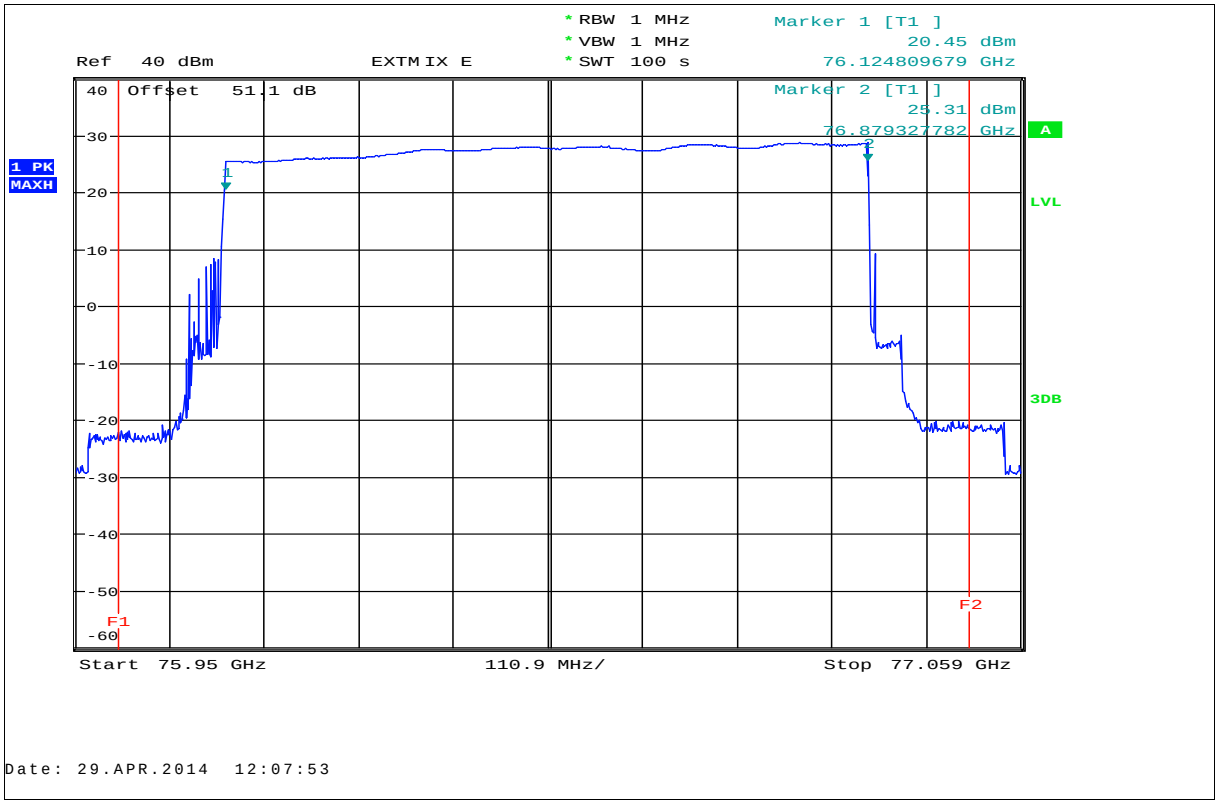
Plot 26: Frequency Stability, T_{nom} / V_{nom}



Plot 27: Frequency Stability, T_{min} / $V_{min-max}$



Plot 28: Frequency Stability, T_{max} / $V_{min-max}$



10 Test equipment and ancillaries used for tests

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, rf-generating and signalling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Labor/Item).

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2818A03450	300001040	Ve	12.01.2012	12.01.2015
2	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vlKl!	08.05.2013	08.05.2015
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
4	n. a.	Switch / Control Unit	3488A	HP Meßtechnik	*	300000199	ne		
5	9	Artificial Mains 9 kHz to 30 MHz	ESH3-Z5	R&S	828576/020	300001210	Ve	30.01.2014	30.01.2016
6	n. a.	Switch / Control Unit	3488A	HP Meßtechnik	2719A15013	300001156	ne		
7	9	Isolating Transformer	MPL IEC625 Bus Regeltrenntravo	Erfi	91350	300001155	ne		
8	n. a.	Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997	ne		
9	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	13.06.2013	13.06.2015
10	n. a.	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
11	n. a.	Band Reject filter	WRCG1855/1910-1835/1925-40/8SS	Wainwright	7	300003350	ev		
12	n. a.	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev		
13	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne		
14	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vlKl!	14.10.2011	14.10.2014
15	n. a.	MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	13.03.2014	13.03.2015
16	CR 79	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	7911	300001751	ne		
17	11b	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP Meßtechnik	00419	300002268	ev		
18	n. a.	Broadband Low Noise Amplifier 18-50 GHz	CBL19503070-XX	CERNEX	19338	300004273	ne		
19	A022	Std. Gain Horn Antenna 26.4-40.1 GHz	2224-20	Flann	235	300001976	ne		
20	A023	Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979	ne		
21	A025	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne		
22	A028	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001991	ne		
23	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
24	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
25	8	DC Power Supply, 60V, 10A	6038A	HP Meßtechnik	3122A11097	300001204	Ve	10.01.2012	10.01.2015

26	n. a.	Spectrum Analyzer 20 Hz - 50 GHz	FSU50	R&S	200012	300003443	Ve	09.10.2012	09.10.2014
27	n. a.	Harmonic mixer 50 - 75 GHz for spectrum analyzers	FS-Z75	R&S	100099	300003949	k	13.03.2014	13.03.2015
28	n. a.	Harmonic mixer 60 - 90 GHz for spectrum analyzers	FS-Z90	R&S	101555	300004691	k	21.10.2013	21.10.2014
29	n. a.	Spectrum Analyzer Mixer 2-Port, 75-110 GHz	SAM-110-7	Radiometer Physics GmbH	002	300004155	k	31.01.2014	31.01.2016
29	n. a.	Spectrum Analyzer Mixer 3-Port, 110-170 GHz	SAM-170	Radiometer Physics GmbH	100014	300004156	k	12.02.2014	12.02.2016
29	n. a.	Spectrum Analyzer Mixer 3-Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157	k	12.02.2014	12.02.2016
30	n. a.	Spectrum Analyzer Mixer 3-Port, 220-325 GHz	SAM-325	Radiometer Physics GmbH	100002	300004158	k	12.02.2014	12.02.2016
31	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne		
32	45	Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368	g		
33	50	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2920A04466	300000580	ne		
34	n. a.	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	27.01.2014	27.01.2015
35	n. a.	Funkstörmessempfänger 20Hz- 26.5GHz	ESU26	R&S	100037	300003555	k	28.02.2014	28.02.2015
36	n. a.	Antenna Tower	Model 2175	ETS-LINDGREN	64762	300003745	izw		
37	n. a.	Positioning Controller	Model 2090	ETS-LINDGREN	64672	300003746	izw		
38	n. a.	Turntable Interface-Box	Model 105637	ETS-LINDGREN	44583	300003747	izw		
39	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016

Agenda: Kind of Calibration

k	calibration / calibrated		EK	limited calibration
ne	not required (k, ev, izw, zw not required)		zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification		izw	internal cyclical maintenance
Ve	long-term stability recognized		g	blocked for accredited testing
vlkl!	Attention: extended calibration interval			
NK!	Attention: not calibrated		*)	next calibration ordered / currently in progress

11 Observations

No observations exceeding those reported with the single test cases have been made.

12 Document history

Version	Applied changes	Date of release
1.0	Initial release	2014-07-07

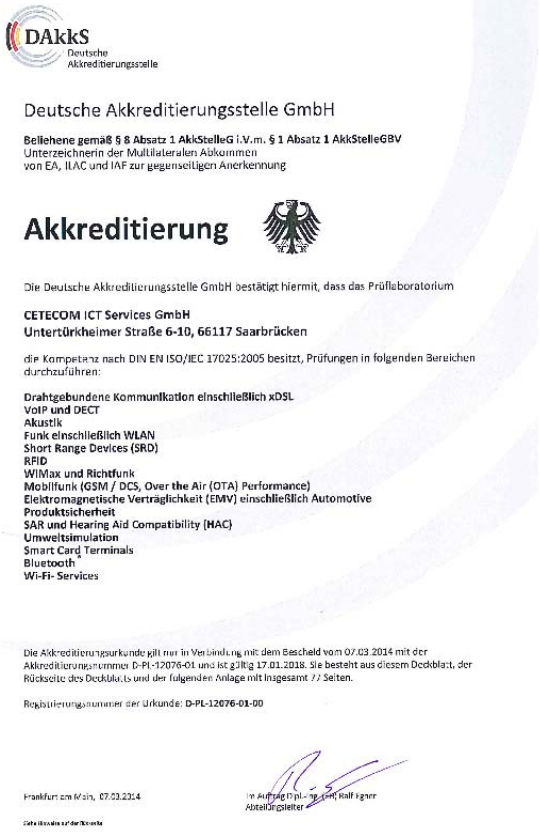
13 Further information

Glossary

AVG - Average
DUT - Device under test
EMC - Electromagnetic Compatibility
EN - European Standard
EUT - Equipment under test
ETSI - European Telecommunications Standard Institute
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
N/A - Not applicable
PP - Positive peak
QP - Quasi peak
S/N - Serial number
SW - Software

14 Accreditation Certificate

Front side of certificate



DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Drahtgebundene Kommunikation einschließlich xDSL
VoIP und DECT
Akustik
Funk einschließlich WLAN
Short Range Devices (SRD)
RFID
WIMax und Richtfunk
Mobilfunk (GSM / DCS, Over the Air (OTA) Performance)
Elektromagnetische Verträglichkeit (EMV) einschließlich Automotive
Produktsicherheit
SAR und Hearing Aid Compatibility (HAC)
Umweltsimulation
Smart Card Terminals
Bluetooth
Wi-Fi- Services

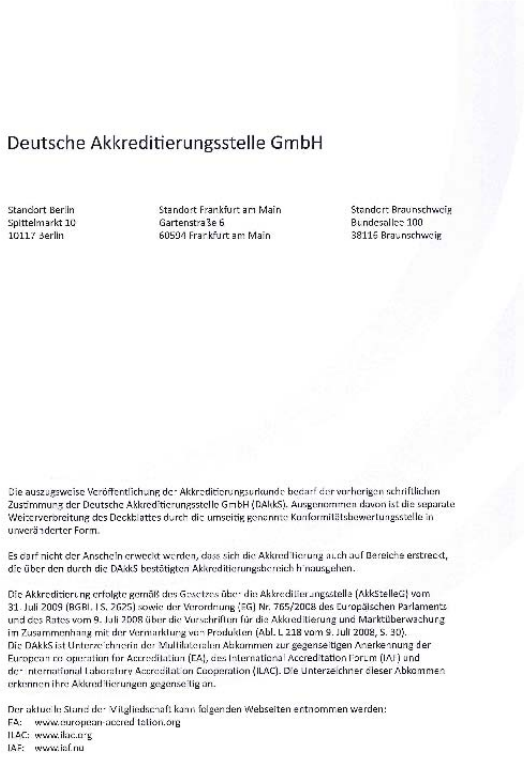
Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 07.03.2014 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 77 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-00**

Frankfurt am Main, 07.03.2014

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Back side of certificate



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Note:

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