
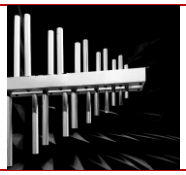
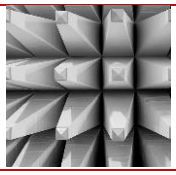

CETECOM™
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consulting - testing - certification

TEST REPORT

Test report no.: 1-7882/14-01-06-C

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-00

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
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e-mail: ict@cetecom.com

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-12076-01-00

Applicant

KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg / GERMANY
Phone: +49 234 588 80-152
Fax: +49 234 588 80-101
Contact: Ouzounis Charalambos
e-mail: c.ouzounis@krohne.com
Phone: +49 234 588 80-152

Manufacturer

KROHNE SAS
2 allee des Ors – BP98
26103 Romans / FRANCE

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 – Radio frequency devices
RSS-211	Level Probing Radar Equipment

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

Test Item

Kind of test item:	**Level Probing Radar**
Model name:	**OPTIWAVE 7400 C**
FCC ID:	**Q6BFMCW24G74L**
IC:	**1991D-FMCW24G74L**
Frequency:	24.05 GHz – 26.05 GHz
Antenna:	external horn or PEEK antenna
Power Supply:	14 – 36 V DC
Temperature Range:	-40 °C to +80 °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:

M. Walla
cn=Meheza Walla, o=CETECOM ICT Services GmbH, ou=WAL-151005, email=Meheza.Walla@cetecom.com, c=DE
2016.01.13 11:03:04 +01'00'

Meheza Walla
Radio Communications & EMC

Test performed:

Geraldy Karsten
cn=Karsten Geraldy, o=CETECOM ICT Services GmbH, ou=GER-151201, email=karsten.geraldy@cetecom.com, c=DE
2016.01.12 11:41:37 +01'00'

Karsten Geraldy
Radio Communications & EMC

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:	2014-04-14
Date of receipt of test item:	2014-05-05
Start of test:	2014-05-06
End of test:	2014-05-14
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15	01.10.2013	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 – Radio frequency devices
RSS-211	01.03.2015	Level Probing Radar Equipment
890966 D01	10.09.2014	Measurement Procedure for Level Probing Radars

4 Test laboratories sub-contracted

None

5 Test environment

Temperature:	T_{nom}	+22 °C during room temperature tests
	T_{max}	+50 °C
	T_{min}	-20 °C
Relative humidity content:		45 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	20.0 V DC
	V_{max}	36.0 V DC
	V_{min}	14.0 V DC

6 Test item

Kind of test item	:	Level Probing Radar
Type identification	:	OPTIWAVE 7400 C
S/N serial number	:	pre-series model
HW hardware status	:	pre-series model
SW software status	:	1.02.02
Frequency band	:	24.05 GHz – 26.05 GHz
Type of modulation	:	FMCW
Number of channels	:	1
Antenna	:	external horn or PEEK antenna
Power supply	:	14 – 36 V DC, < 30 mA
Temperature range	:	-40 °C to +80 °C

6.1 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.
Test setup- and EUT-photos are included in test report: 1-7882/14-01-06_AnnexA
1-7882/14-01-06_AnnexB
1-7882/14-01-06_AnnexC

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-211	PASS	2016-01-12	-/-

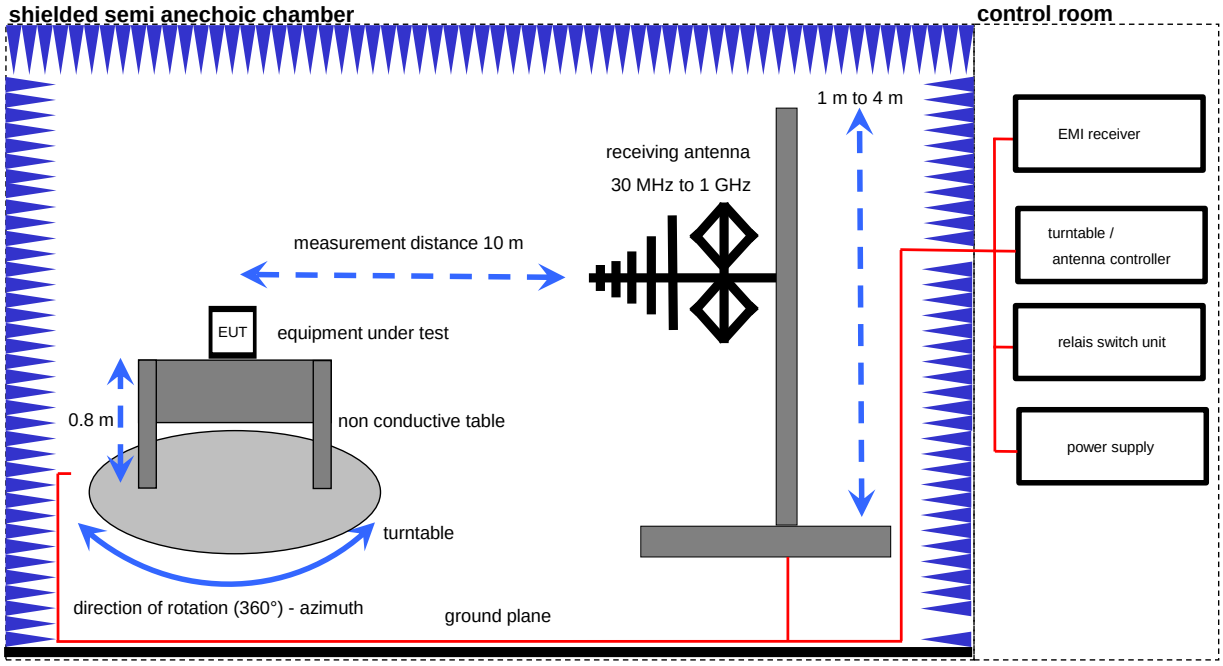
Test Specification Clause	Test Case	Temperature Conditions	Power Source Voltages	Pass	Fail	NA	NP	Results
§15.215(c)	Frequency stability	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	complies
§15.256(f) RSS-211, 2.4	Fundamental bandwidth	Nominal	Nominal	☒	☐	☐	☐	complies
§15.256(g) RSS-211,5.2b	Fundamental emissions limits	Nominal	Nominal	☒	☐	☐	☐	complies
§15.256(h) RSS-211,5.1d	Unwanted emissions limit	Nominal	Nominal	☒	☐	☐	☐	complies
§15.256(i) RSS-211,5.2a	Antenna beamwidth	Nominal	Nominal	☒	☐	☐	☐	complies
§15.256(j) RSS-211,5.2c	Antenna side lobe gain	Nominal	Nominal	☒	☐	☐	☐	complies
§15.256(k) RSS-Gen	Emissions from digital circuitry	Nominal	Nominal	☒	☐	☐	☐	complies
§15.107/207 RSS-Gen	Conducted limits	Nominal	Nominal	☒	☐	☐	☐	complies

Note:
NA = Not applicable; NP = Not performed

8 Description of the test setup

8.1 Radiated measurements chamber F

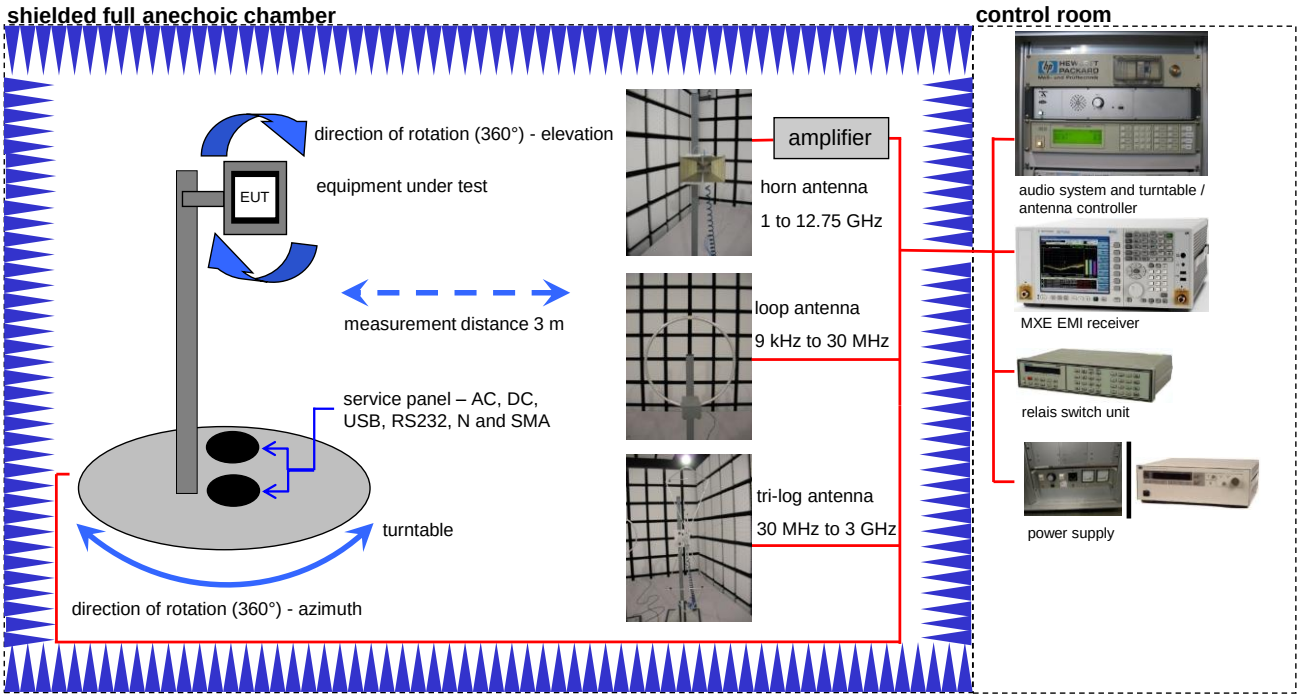
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas 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
Software	EMC32 V.| 9.12.05	R&S	-/-	-/-
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

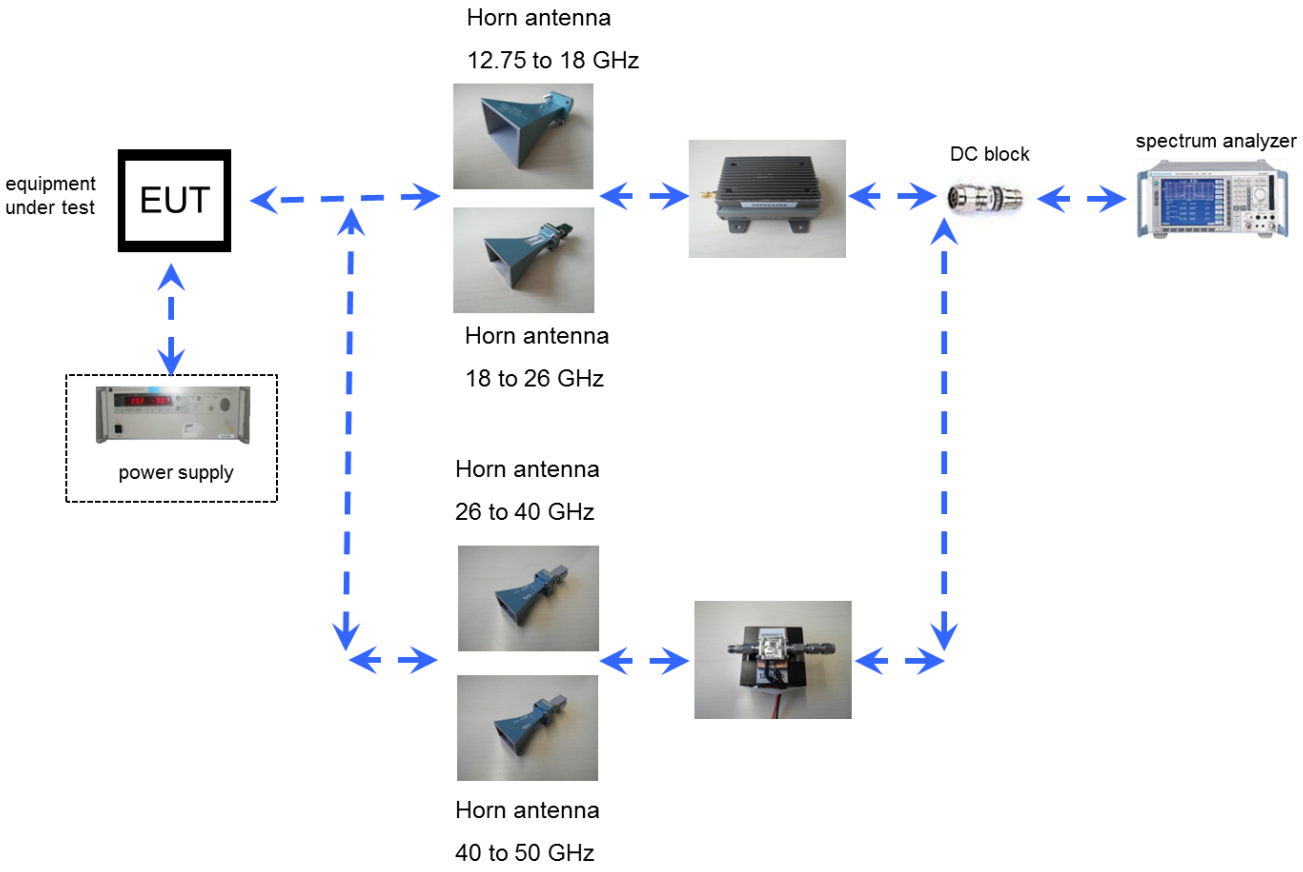
8.2 Radiated measurements chamber C



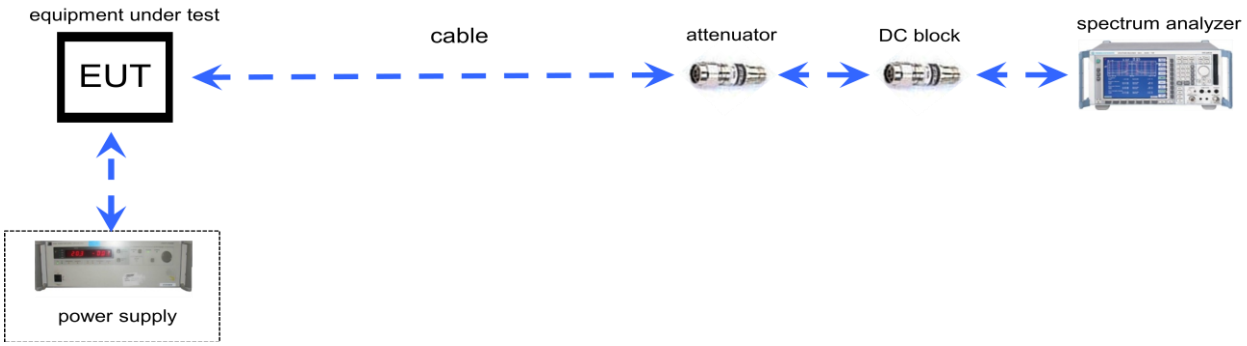
Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405
TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854
Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351
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

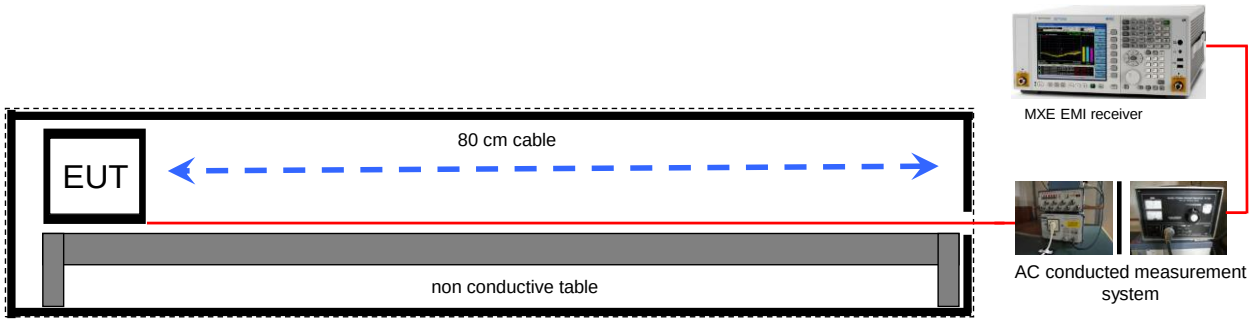
8.3 Radiated measurements 12.75 GHz to 50 GHz



8.4 Conducted measurements



8.5 AC conducted



Equipment table:

Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom
MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405
Isolating Transformer	MPL IEC625 Bus Regeltrenntravo	Erfi	91350	300001155
Switch / Control Unit	3488A	HP Meßtechnik	*	300000199
Switch / Control Unit	3488A	HP Meßtechnik	2719A15013	300001168
Artificial Mains 9 kHz to 30 MHz	ESH3-Z5	R&S	828576/020	300001210

9 Test results

9.1 Frequency stability and fundamental bandwidth

Description:

§15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

§15.256(f) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.

Measurement:

f_C is the point in the radiation where the power is at maximum. The frequency points where the power falls 10 dB below the f_C level and above f_C level are designated as f_L and f_H respectively.
The operating frequency range (i.e. the frequency band of operation) is defined as f_H - f_L.

Measurement parameters:

Resolution bandwidth:	1 MHz
Video bandwidth:	≥1 MHz
Detector:	Pos-Peak
Trace:	Max hold

Limits:

As specified in Section 15.215(c), the bandwidth of the fundamental emission must be contained within the frequency band over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage. Frequency stability is to be measured according to Section 2.1055 at the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth.

§15.256(f)(1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.
§15.256(f)(2) LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz bands under all conditions of operation.

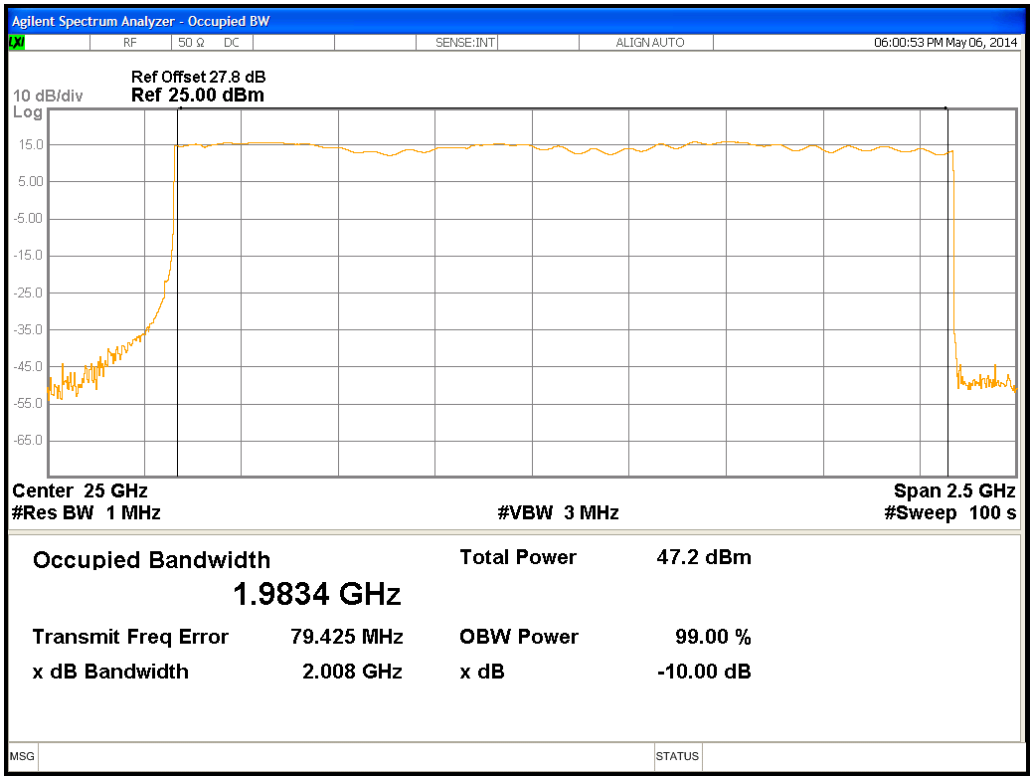
Same requirements for fundamental emission bandwidth are given in RSS-211, 2.4 and 5.1.a)

Results:

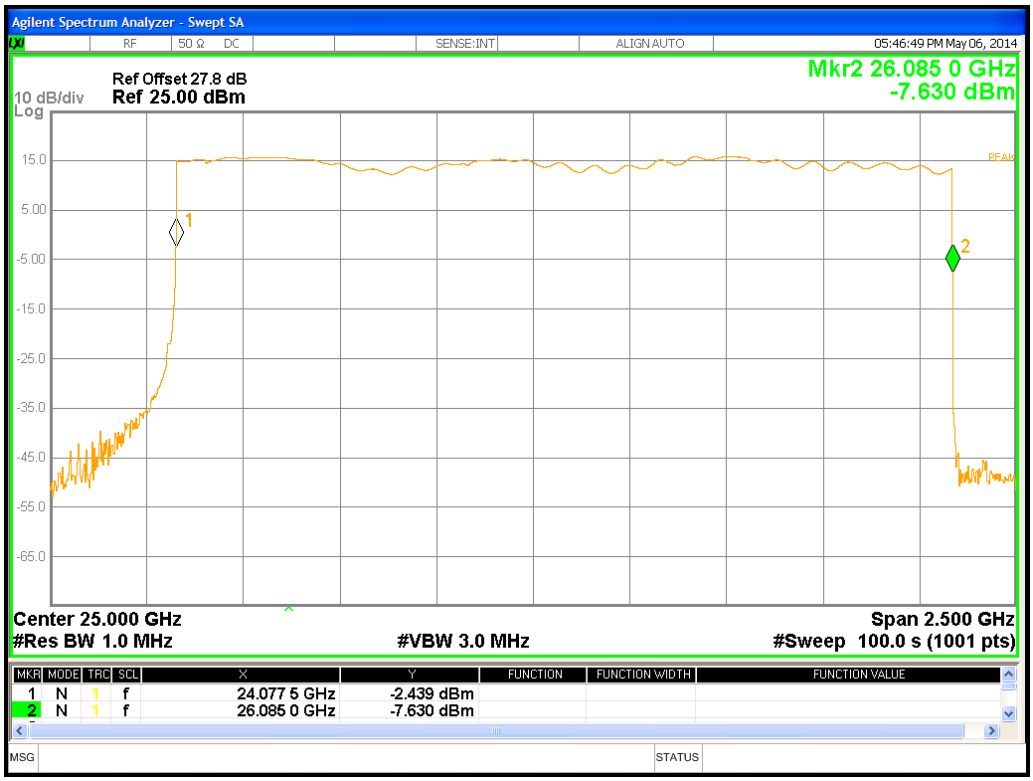
Test Conditions	Transmitter Frequency Range (GHz)		10 dB bandwidth (GHz)
	f_L	f_H	
-20 °C / V_{nom}	24.0775	26.0855	2.0080
-10 °C / V_{nom}	24.0773	26.0854	2.0081
0 °C / V_{nom}	24.0773	26.0853	2.0080
10 °C / V_{nom}	24.0772	26.0852	2.0080
20 °C / V_{min} - V_{max}	24.0771	26.0851	2.0080
30 °C / V_{nom}	24.0769	26.0851	2.0082
40 °C / V_{nom}	24.0767	26.0850	2.0083
50 °C / V_{nom}	24.0765	26.0849	2.0084

Result: **Test passed**

Plot 1: 10 dB bandwidth, Pos-Peak-measurement (conducted measurement with special test adapter)



Plot 2: f_L - f_H, Pos-Peak-measurement (conducted measurement with special test adapter)



9.2 Fundamental emissions

Description:

§15.256(g) Fundamental emissions limits.
(1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).

(2) The EIRP level is to be determined from the maximum measured power within a specified bandwidth.

(i) The EIRP in 1 MHz is computed from the maximum power level measured within any 1-MHz bandwidth using a power averaging detector;

(ii) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50-MHz bandwidth centered on the frequency at which the maximum average power level is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in megahertz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than the RBW. If the RBW is greater than 3 MHz, the application for certification filed shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

(3) The EIRP limits for LPR operations in the bands authorized by this rule section are provided in Table below. The emission limits in Table below are based on boresight measurements (i.e., measurements performed within the main beam of an LPR antenna).

Limits:

Frequency range (GHz)	Average emission limit (EIRP in dBm / 1 MHz)	Peak emission limit (EIRP in dBm / 50 MHz)
5.925 to 7.250	-33	+7 dBm
24.05 to 29.00	-14	+26 dBm
75.00 to 85.00	-3	+34 dBm

Same requirements are given in RSS-211, 5.2.b)

Measurement parameters:

Resolution bandwidth:	1 MHz
Video bandwidth:	≥1 MHz
Span:	depends on DUT
Detector:	Pos-Peak
Trace:	Max hold

Results:

Antenna type	Antenna gain (dBi)	Peak EIRP (dBm)	Average EIRP (dBm)
Wave Horn DN 80 (stainless steel)	24.4	17.0	-37.6
Wave Horn DN 100 (stainless steel)	25.8	18.4	-36.2
Wave Horn DN 80 (metal sheet)	24.5	17.1	-37.5
Wave Horn DN 100 (metal sheet)	25.9	18.5	-36.1
Wave Horn DN 150 (metal sheet)	27.9	20.5	-34.1
Wave Horn DN 200 (metal sheet)	28.4	21.0	-33.6
Drop Antenna DN 80	25.8	18.4	-36.2
Drop Antenna DN 150	30.4	23.0	-31.6
Measurement uncertainty	±2dB		

Note:
See manufacturer's documentation *Radio Approval Optiwave 7400, LPR antenna characteristics* of 2014-05-19.

There are two different aspects which will affect the peak-to-average ratio resp. RMS value at all:
- Duty cycle of the device
- Frequency domain mitigation due to FMCW-modulation

In normal use the EUT uses FMCW with a positive ramp over approx. 2 GHz within 7 ms.
The total DUT cycle is 1000 ms. Therefore the blanking period between the emissions is 993 ms.

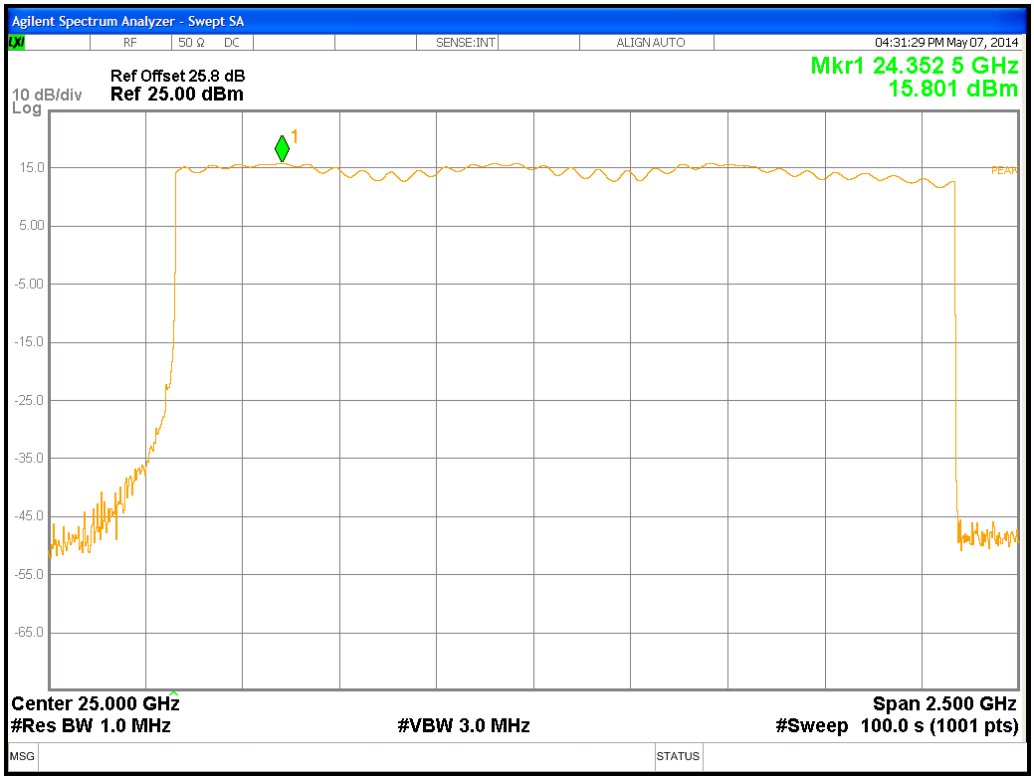
This will lead to:
- dwell time $T_D = T_S / \Delta F = 3.5$ µs/MHz
- averaging factor AF = T_D / cycle time = $3.5*10^{-6} \triangleq -54.6$ dB

Peak output power was measured as conducted output power with settings shown in FCC document *890966 D01, Measurement Procedure for Level Probing Radars*. Measurements were performed using a special test adapter supplied by the manufacturer.
Peak EIRP was calculated based on the peak output power and the antenna gain given in above mentioned antenna test report of the manufacturer.
Plots show measurement results for horn antenna DN 200 and drop antenna DN 150 with highest antenna gain for each antenna type as worst case. Antenna gain is considered in reference level offset.
Average EIRP was calculated according to FCC document *890966 D01, Measurement Procedure for Level Probing Radars*.

Performing the measurements the reference level offset was set 5.2 dB too low. Measurement values of plot no. 3 - 4 have to be corrected by +5.2 dB.

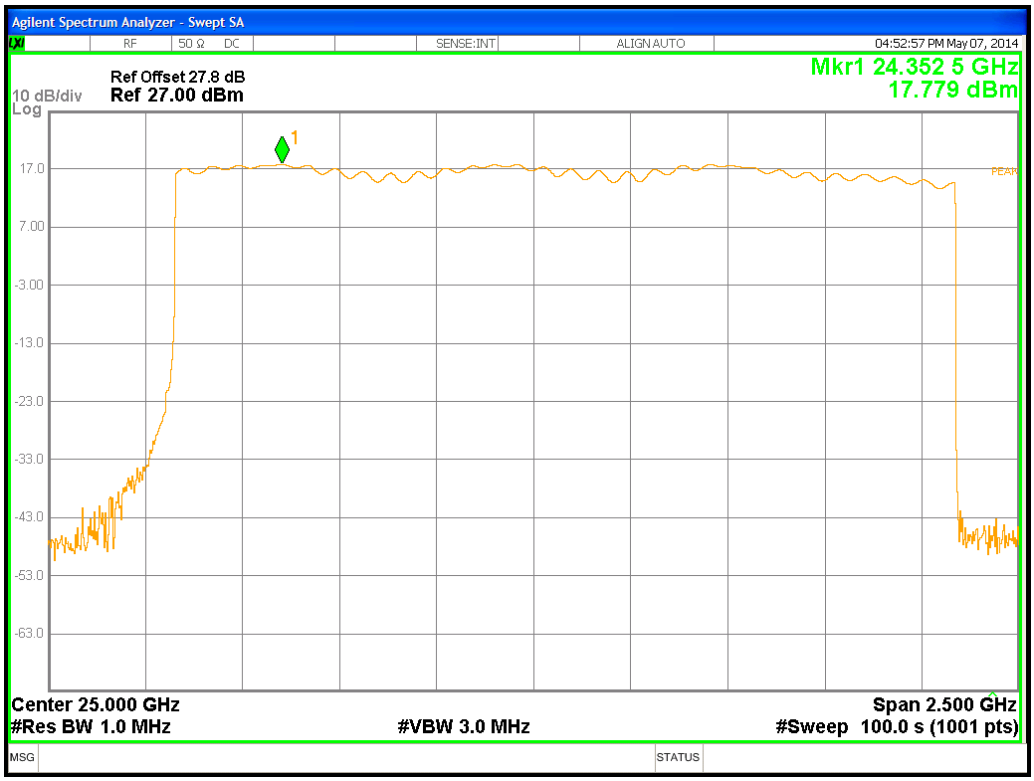
Result: **Test passed**

Plot 3: Pos-Peak-measurement, horn DN 200 (1 MHz RBW)



Note: Measurement values need to be corrected by +5.2 dB.

Plot 4: Pos-Peak-measurement, Drop Antenna DN 150 (1 MHz RBW)



Note: Measurement values need to be corrected by +5.2 dB.

9.3 Unwanted emissions limit

Description:

§15.256(h)
Unwanted emissions from LPR devices shall not exceed the general emission limit in §15.209 of this chapter.

Measurement parameters:

Resolution bandwidth: 100 kHz / 1 MHz
Video bandwidth: ≥ resolution bandwidth
Detector: Quasi Peak / Average (RMS)
Trace: Max hold

Limits:

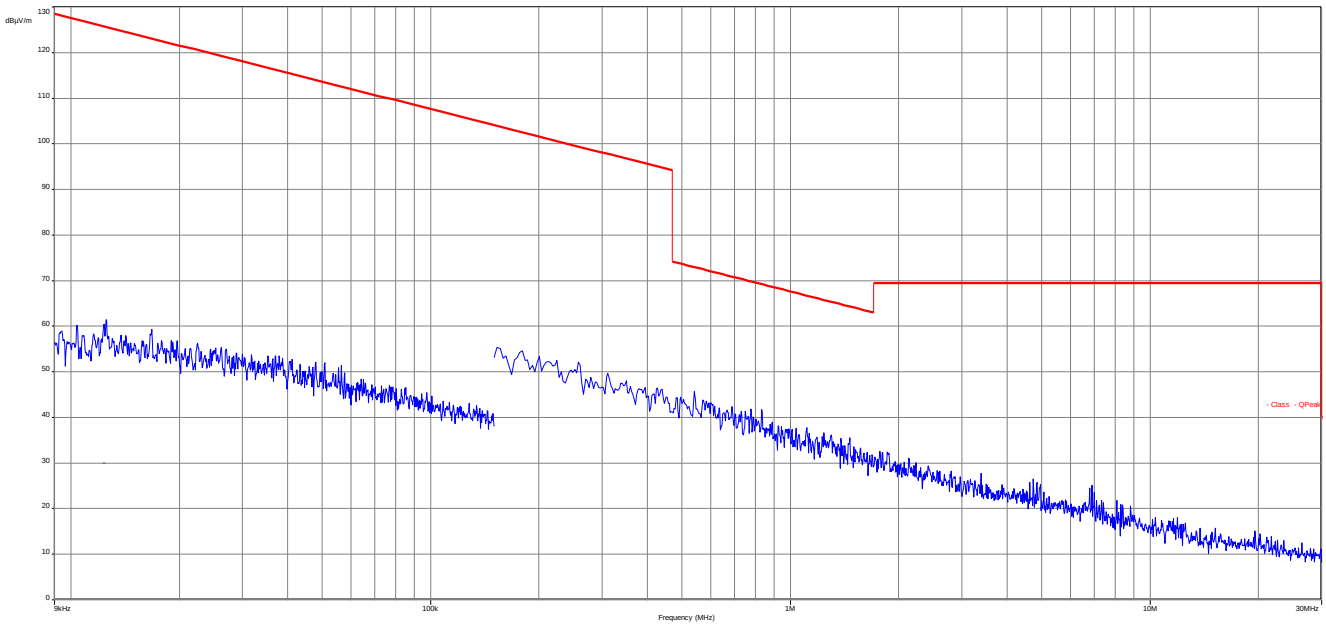
FCC §15.209 / RSS-Gen		
Field strength of the harmonics and spurious.		
Frequency (MHz)	**Field strength (µV/m)**	**Measurement distance (m)**
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30 (29.5 dBµV/m)	30
30 – 88	100 (40 dBµV/m)	3
88 – 216	150 (43.5 dBµV/m)	3
216 – 960	200 (46 dBµV/m)	3
>960	500 (54 dBµV/m)	3

Results:

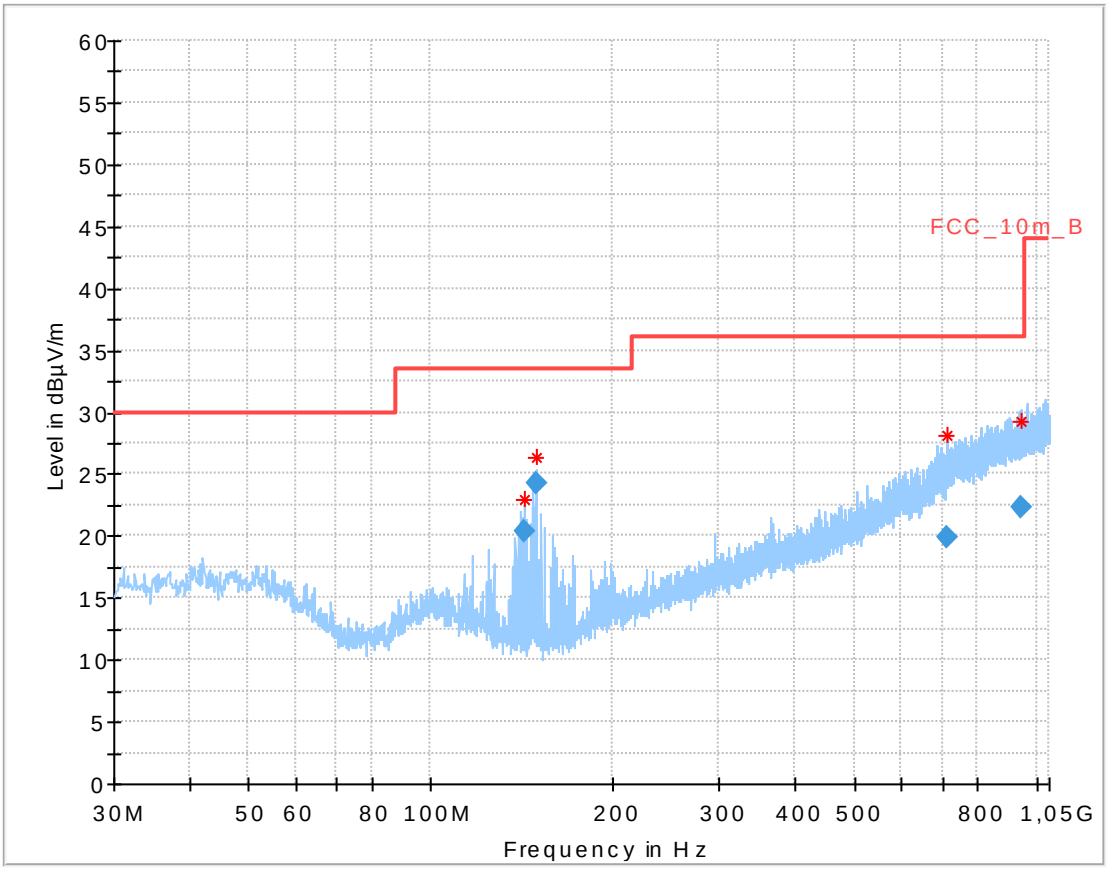
Spurious emission level (dBm)								
-/-			-/-			-/-		
Frequency [GHz]	BW [kHz]	Level [dBm]	Frequency [GHz]	BW [kHz]	Level [dBm]	Frequency [GHz]	BW [kHz]	Level [dBm]
see plots								
Measurement uncertainty			± 3dB					

Result: **Test passed**

Plot 5: 9 kHz – 30 MHz, f_{mid}



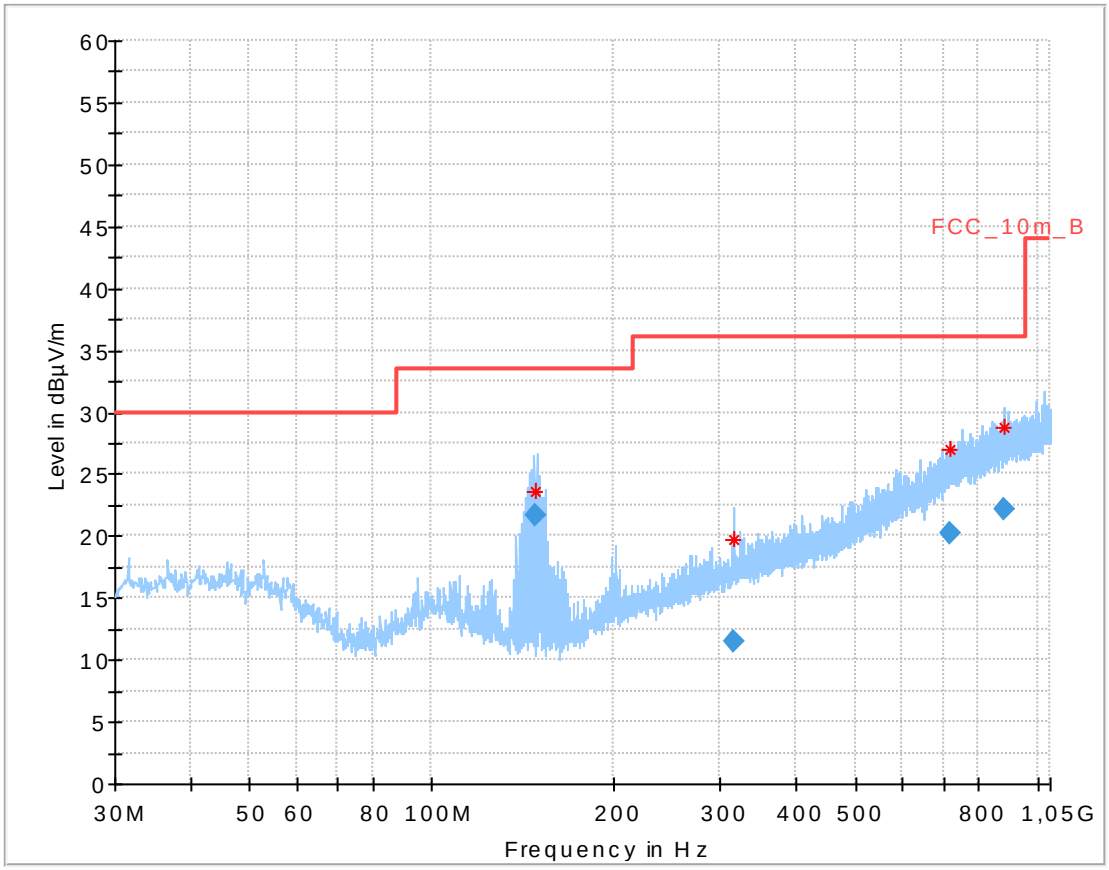
Plot 6: 30 MHz – 1000 MHz, special test mode, frequency sweep stopped at f_{low}



Final Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
142.968000	20.37	33.50	13.13	1000.0	120.000	107.0	V	43.0	8.7
149.104050	24.27	33.50	9.23	1000.0	120.000	103.0	V	62.0	8.9
710.396700	19.95	36.00	16.05	1000.0	120.000	200.0	V	50.0	22.7
940.497000	22.32	36.00	13.68	1000.0	120.000	365.0	V	50.0	25.3

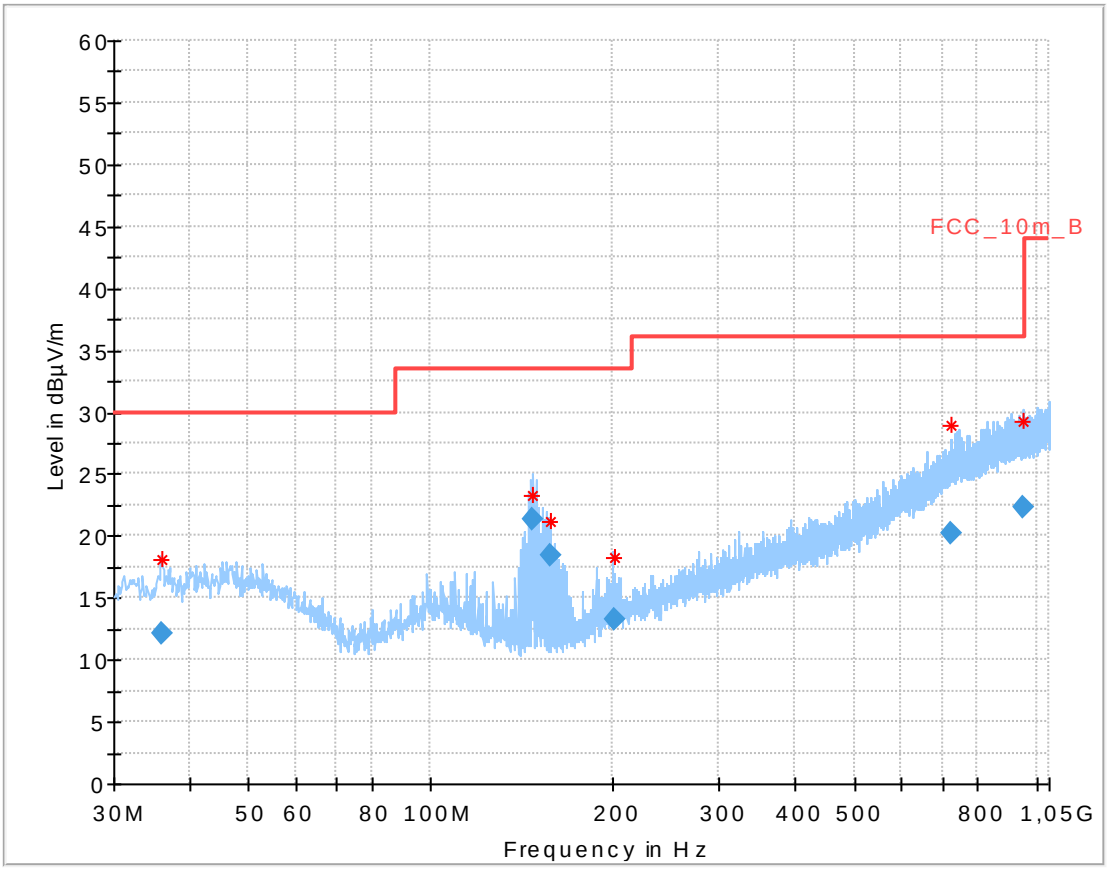
Plot 7: 30 MHz – 1000 MHz, special test mode, frequency sweep stopped at f_{mid}



Final Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
148.699950	21.67	33.50	11.83	1000.0	120.000	115.0	V	27.0	8.9
314.443950	11.44	36.00	24.56	1000.0	120.000	124.0	V	302.0	15.0
718.740000	20.14	36.00	15.86	1000.0	120.000	200.0	V	300.0	22.9
880.333200	22.15	36.00	13.85	1000.0	120.000	124.0	V	199.0	24.9

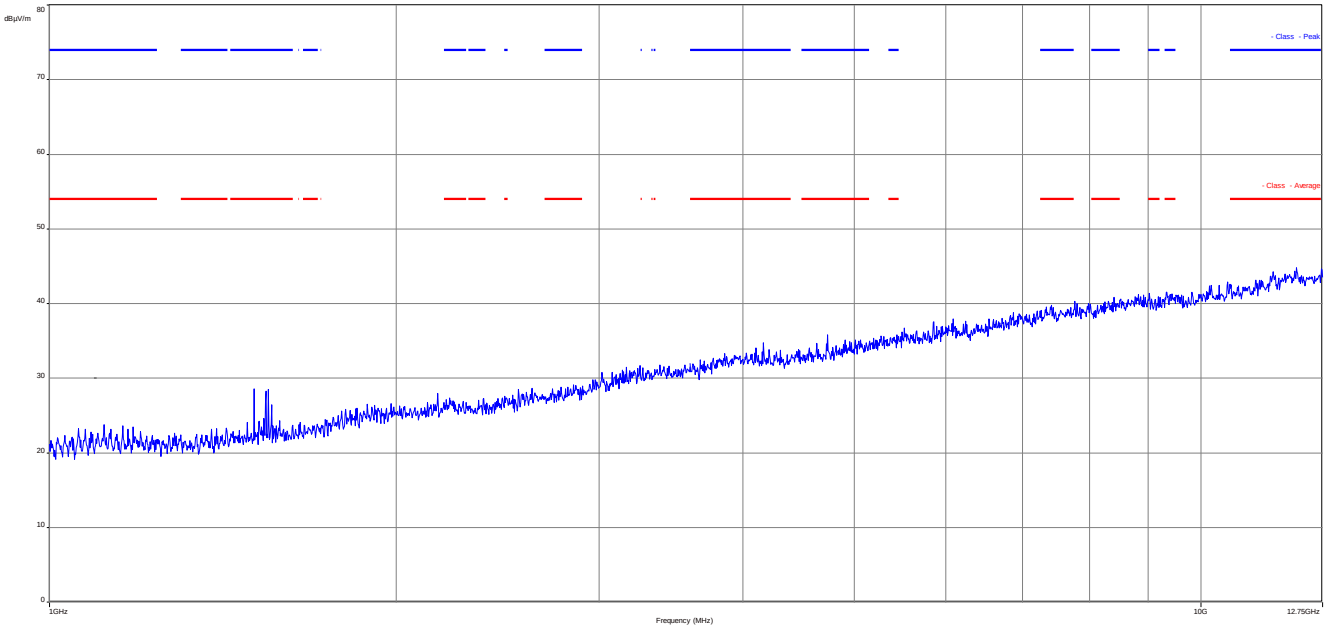
Plot 8: 30 MHz – 1000 MHz, special test mode, frequency sweep stopped at f_{high}



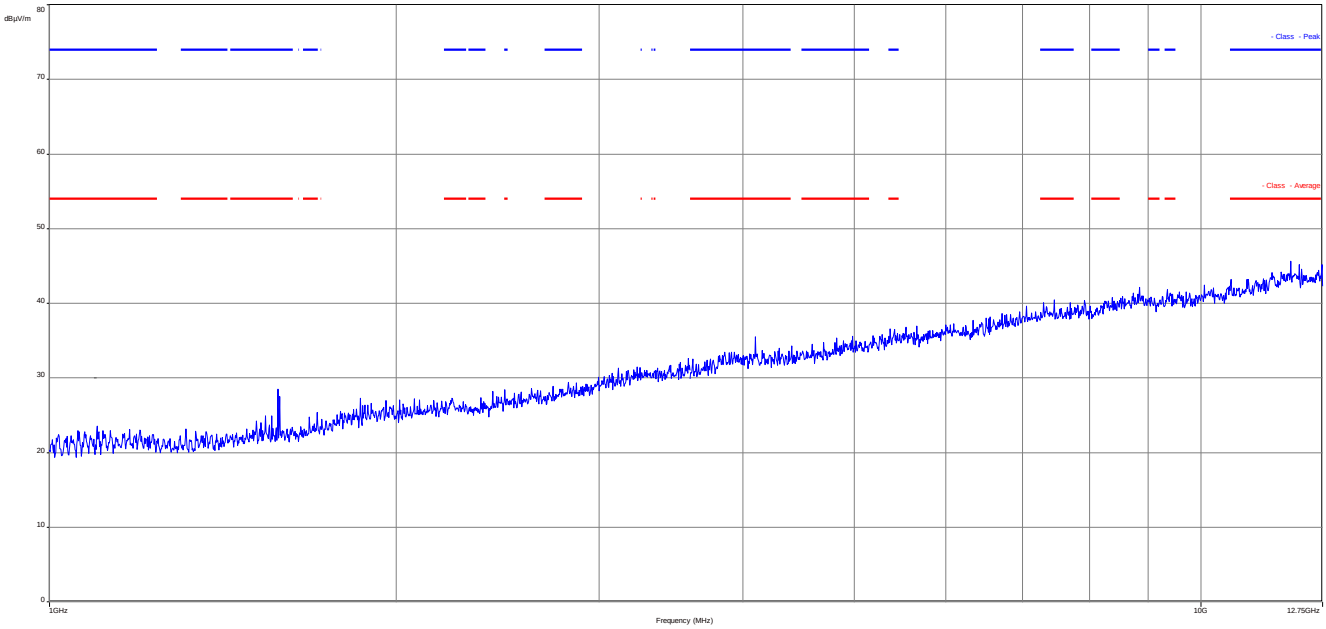
Final Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.977050	12.18	30.00	17.82	1000.0	120.000	308.0	V	284.0	13.1
147.471450	21.33	33.50	12.17	1000.0	120.000	102.0	V	5.0	8.9
157.728900	18.43	33.50	15.07	1000.0	120.000	109.0	V	50.0	9.1
200.684700	13.33	33.50	20.17	1000.0	120.000	104.0	V	352.0	11.7
725.264550	20.21	36.00	15.79	1000.0	120.000	387.0	H	4.0	23.1
947.677500	22.27	36.00	13.73	1000.0	120.000	400.0	H	260.0	25.3

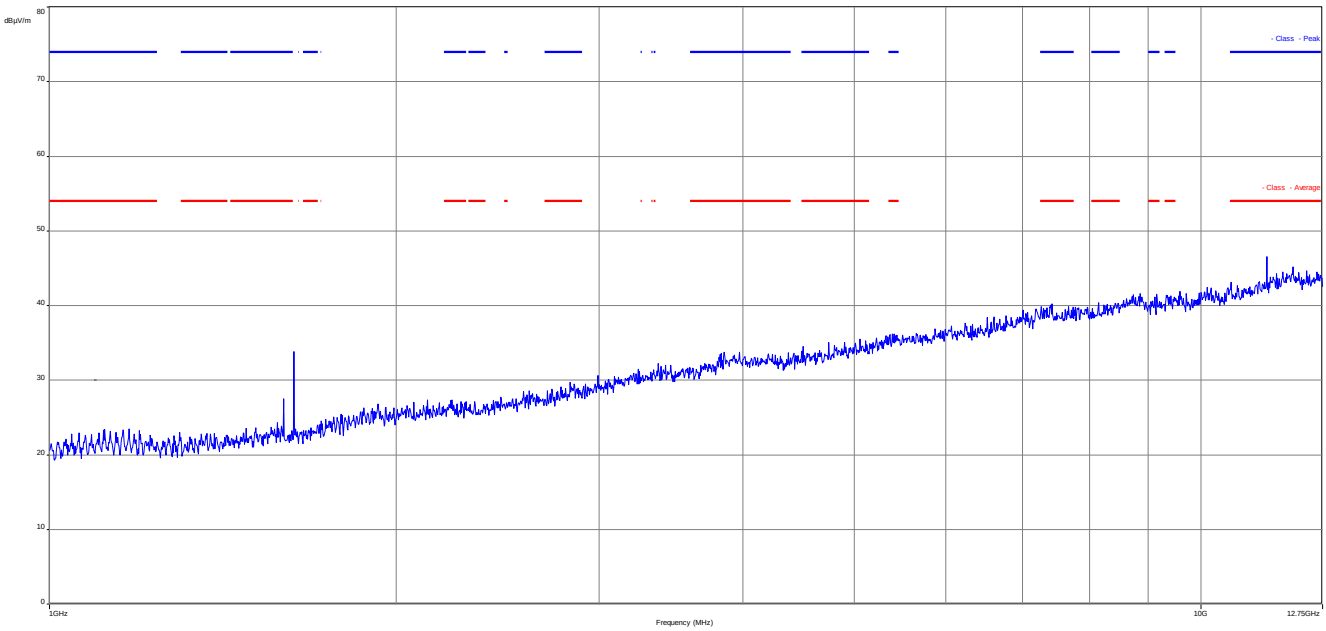
Plot 9: 1 GHz – 12.75 GHz, special test mode, frequency sweep stopped at f_{low}



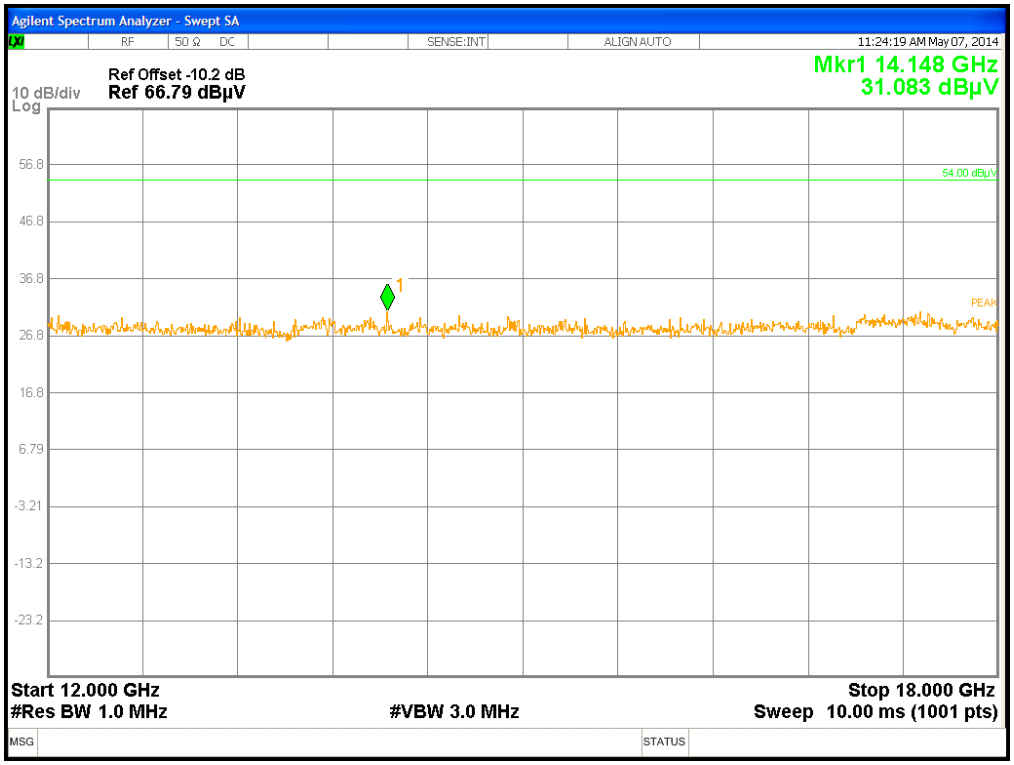
Plot 10: 1 GHz – 12.75 GHz, special test mode, frequency sweep stopped at f_{mid}



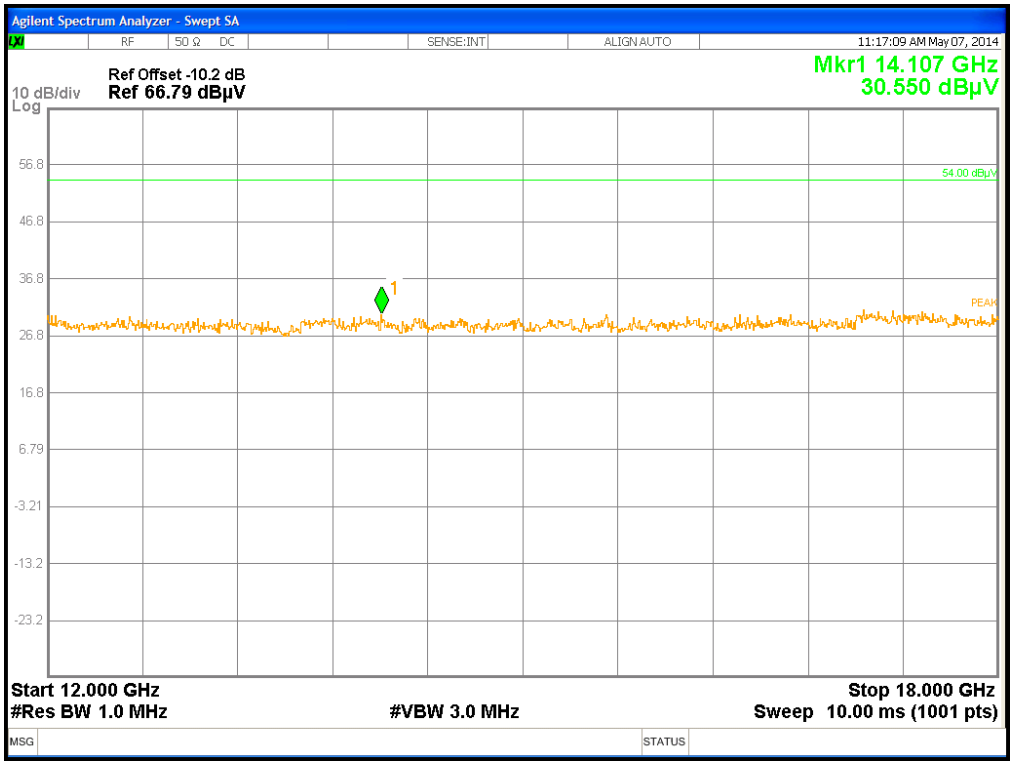
Plot 11: 1 GHz – 12.75 GHz, special test mode, frequency sweep stopped at f_{high}



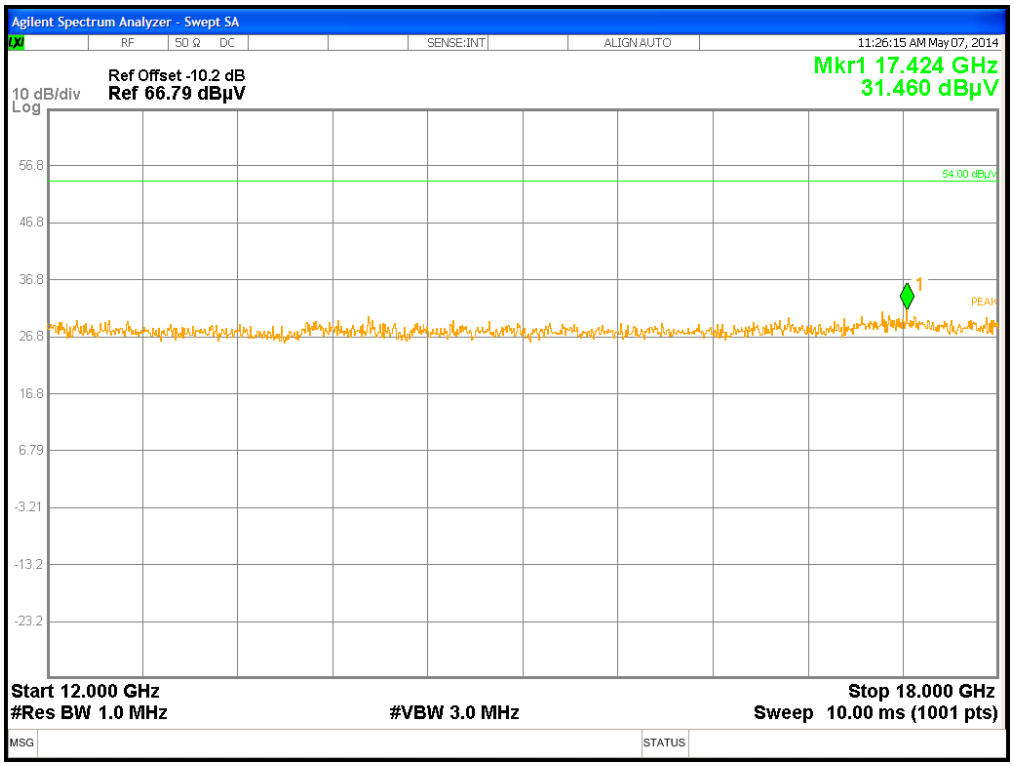
Plot 12: 12 GHz – 18 GHz, special test mode, f_{low}



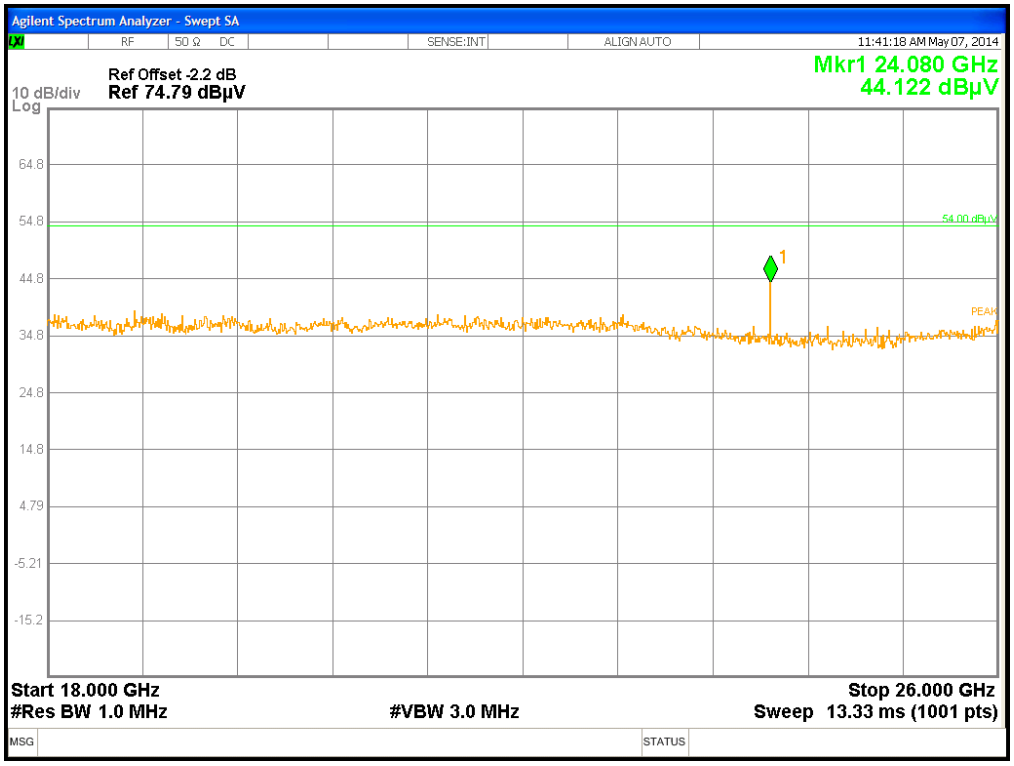
Plot 13: 12 GHz – 18 GHz, special test mode, f_{mid}



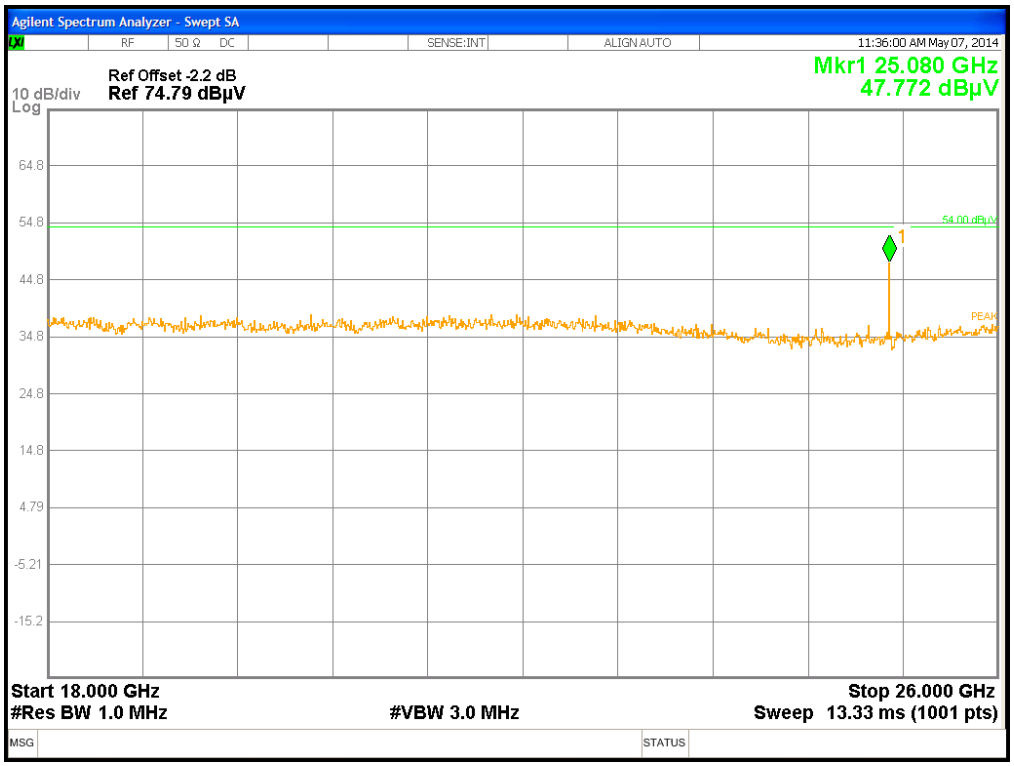
Plot 14: 12 GHz – 18 GHz, special test mode, f_{high}



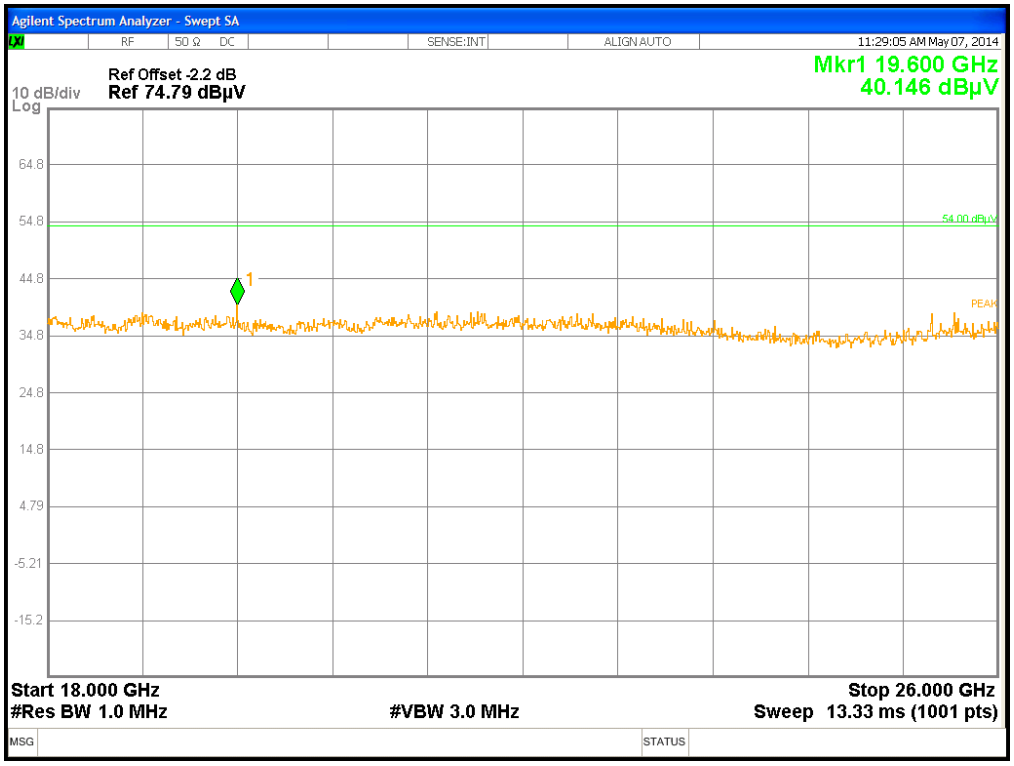
Plot 15: 18 GHz – 26 GHz, special test mode, f_{low}



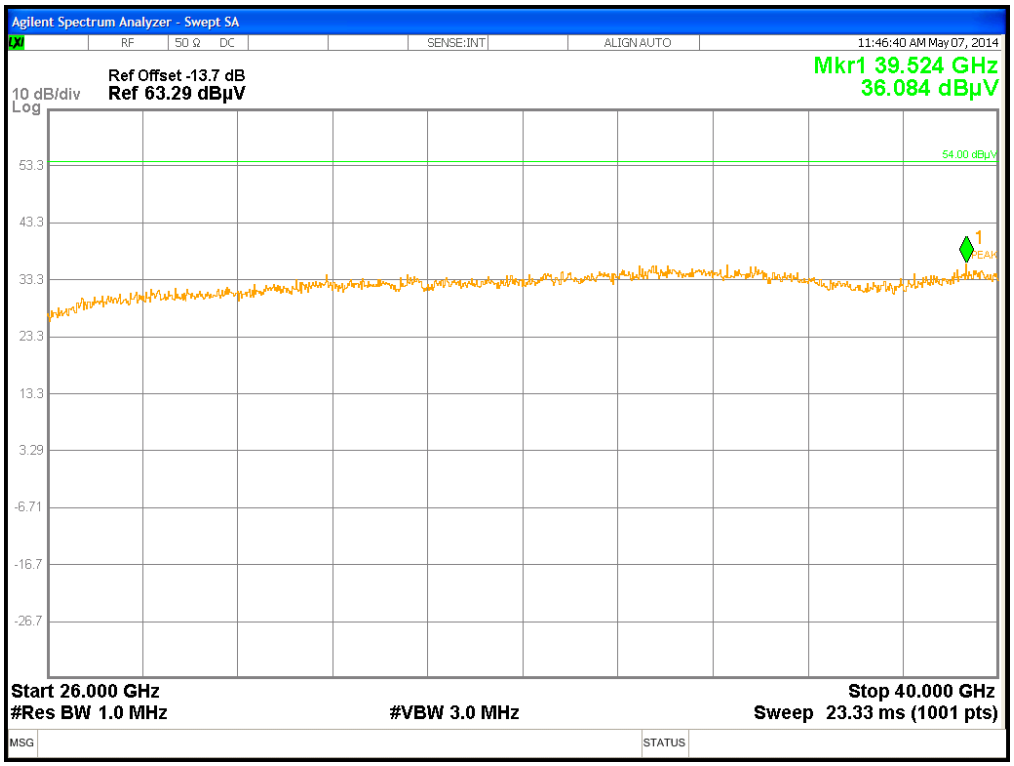
Plot 16: 18 GHz – 26 GHz, special test mode, f_{mid}



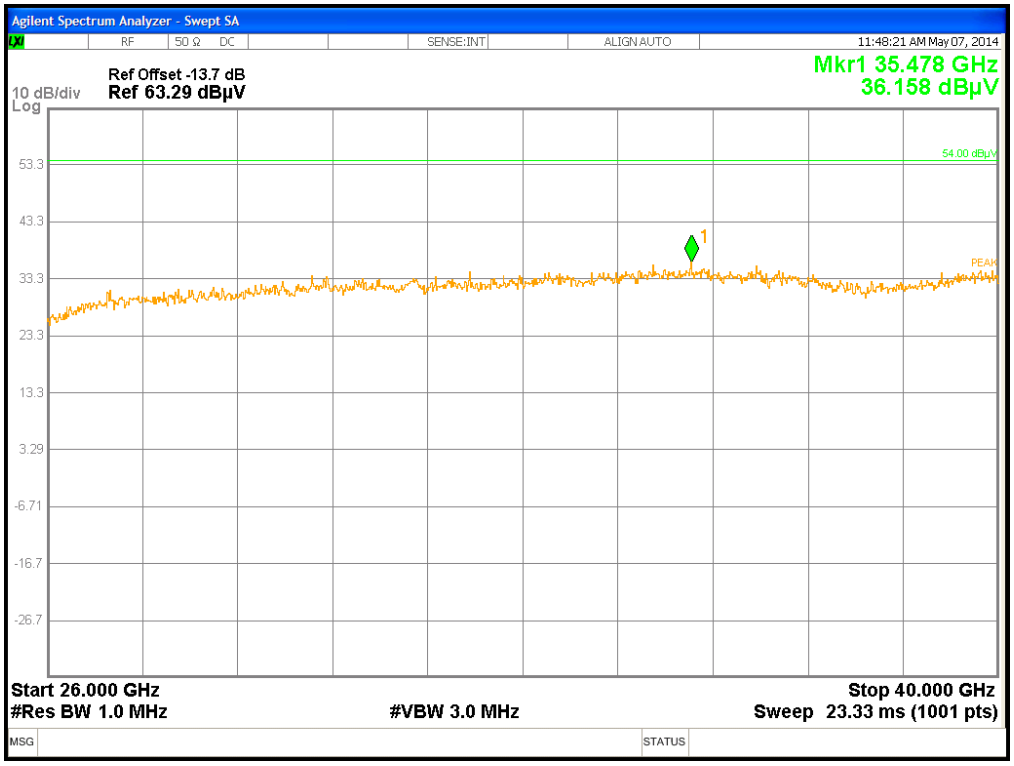
Plot 17: 18 GHz – 26 GHz, special test mode, f_{high}



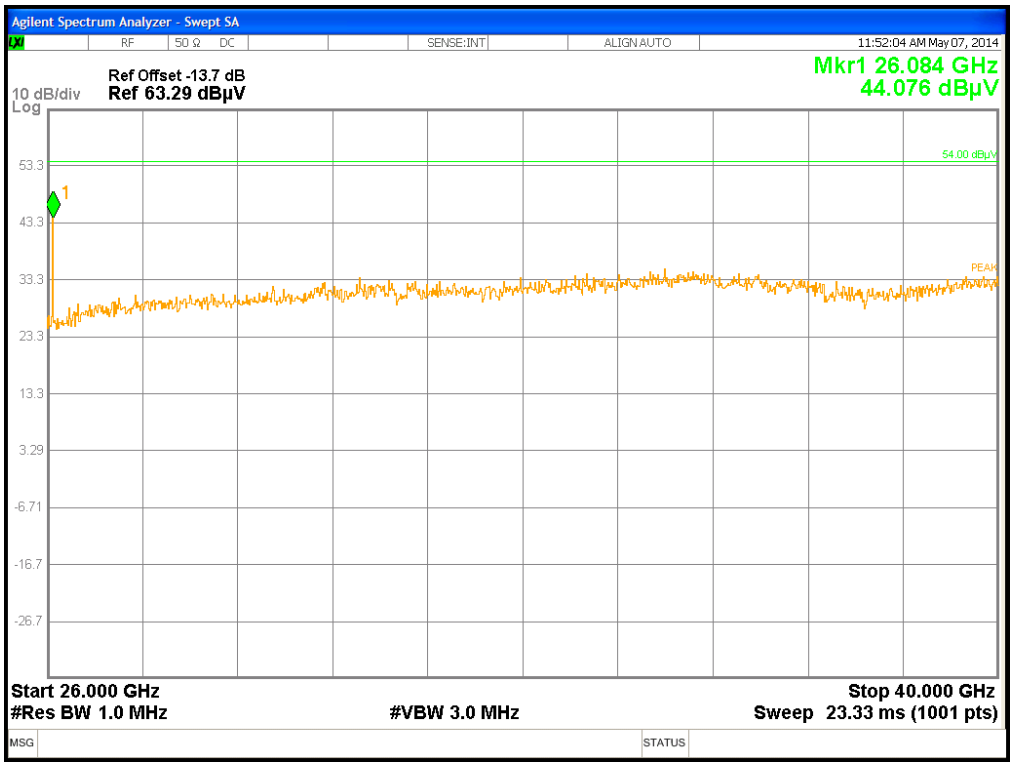
Plot 18: 26 GHz – 40 GHz, special test mode, f_{low}



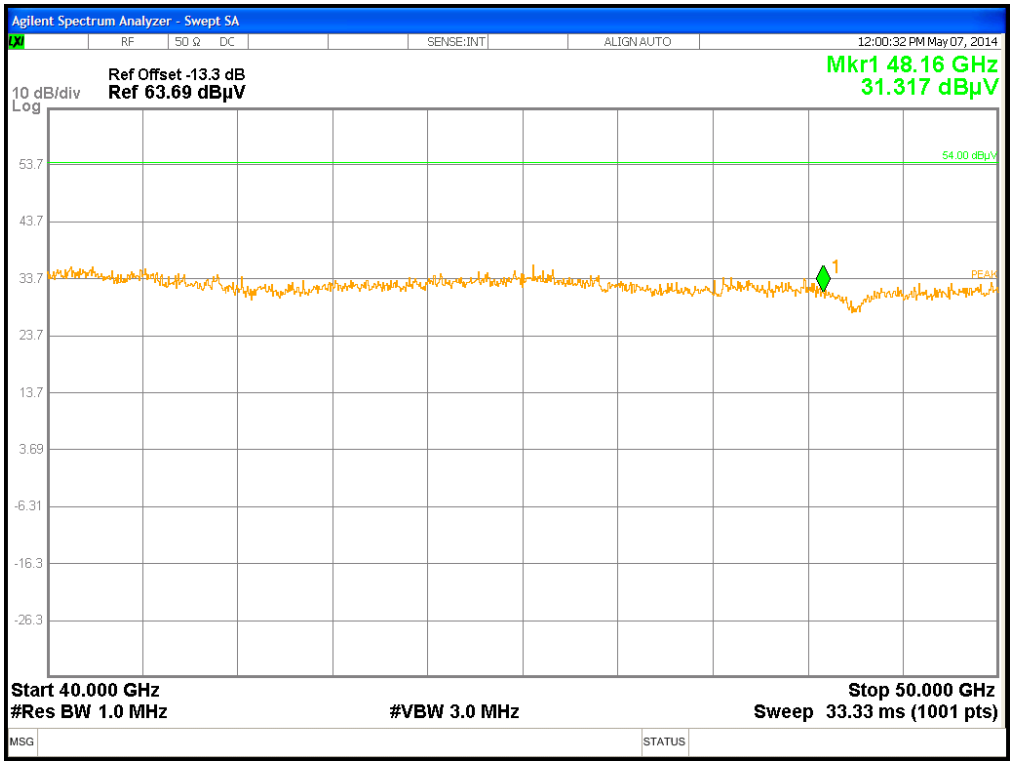
Plot 19: 26 GHz – 40 GHz, special test mode, special test mode, f_{mid}



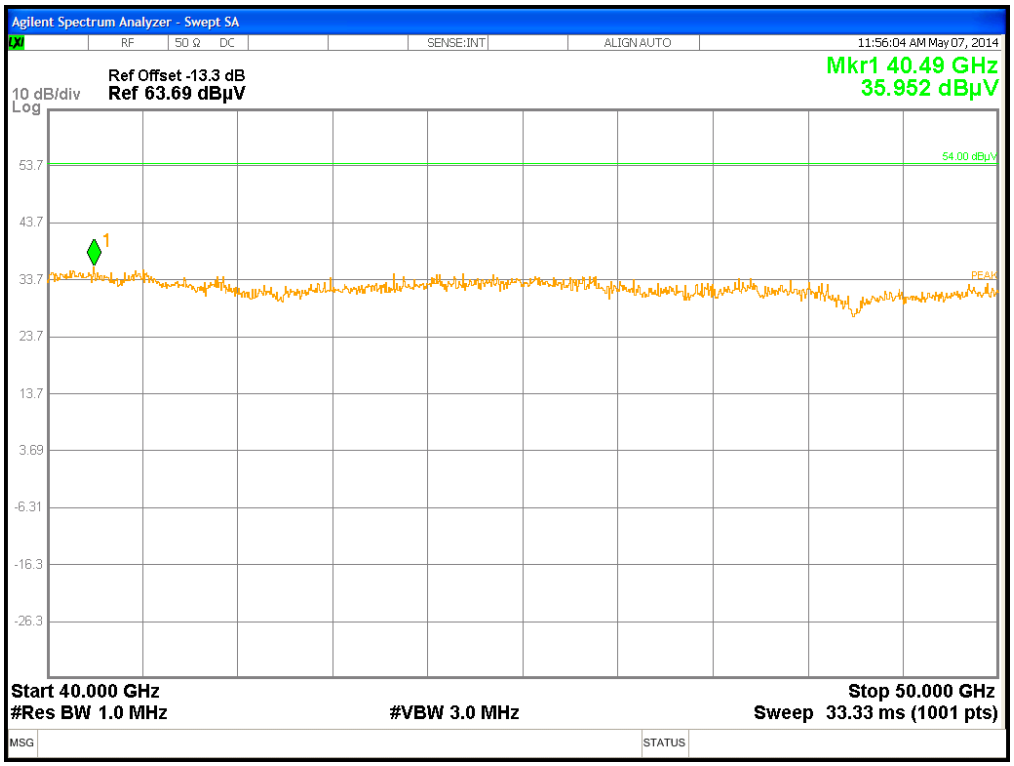
Plot 20: 26 GHz – 40 GHz, special test mode, f_{high}



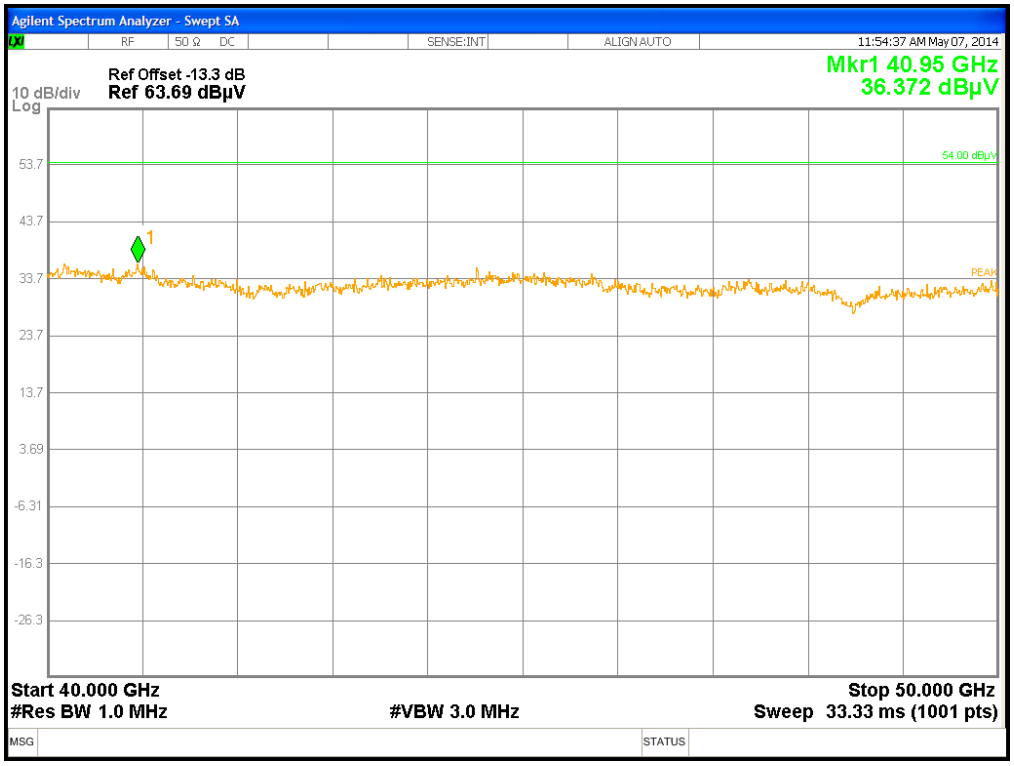
Plot 21: 40 GHz – 50 GHz, special test mode, f_{low}



Plot 22: 40 GHz – 50 GHz, special test mode, f_{mid}

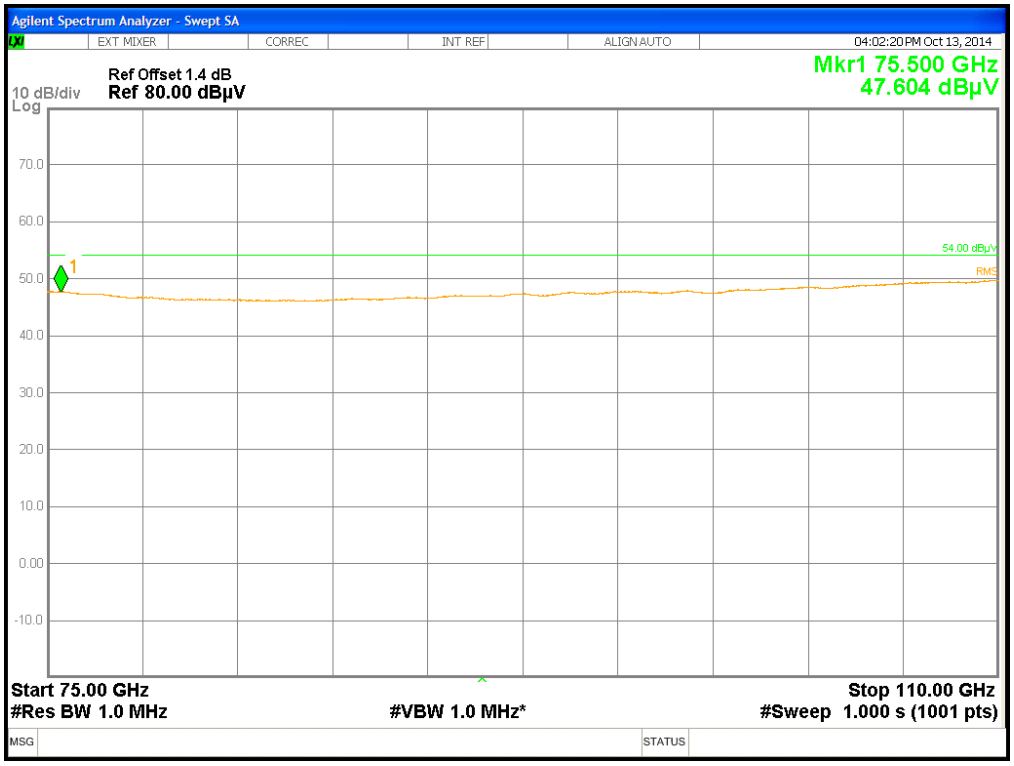


Plot 23: 40 GHz – 50 GHz, special test mode, f_{high}



Plot 24: 50 GHz – 75 GHz, special test mode, $f_{low/mid/high}$

Plot 25: 75 GHz – 110 GHz, special test mode, $f_{low/mid/high}$



9.4 Antenna beamwidth and antenna side lobe gain

Description:

§15.256(i) Antenna beamwidth
(A) LPR devices operating under the provisions of this section within the 5.925-7.250 GHz and 24.05-29.00 GHz bands must use an antenna with a -3 dB beamwidth no greater than 12 degrees.

(B) LPR devices operating under the provisions of this section within the 75-85 GHz band must use an antenna with a -3 dB beamwidth no greater than 8 degrees.

(j) Antenna side lobe gain. LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table below.

Limits:

FCC §15.256 / RSS-211 5.2a) c)		
Frequency range (GHz)	**Antenna beamwidth in degree (°)**	**Antenna side lobe gain limit relative to main beam gain (dB)**
5.925 to 7.250	12	-22
24.05 to 29.00	12	-27
75.00 to 85.00	8	-38

Antenna data:

Antenna type	Antenna gain	3 dB beam width	Side lobe gain
Wave Horn DN 80 (stainless steel)	24.4 dBi	11.4°	<-27 dB
Wave Horn DN 100 (stainless steel)	25.8 dBi	9.6°	<-27 dB
Wave Horn DN 80 (metal sheet)	24.5 dBi	11.7°	<-27 dB
Wave Horn DN 100 (metal sheet)	25.9 dBi	9.6°	<-27 dB
Wave Horn DN 150 (metal sheet)	27.9 dBi	6.6°	<-27 dB
Wave Horn DN 200 (metal sheet)	28.4 dBi	5.6°	<-27 dB
Drop Antenna DN 80	25.8 dBi	7.9°	<-27 dB
Drop Antenna DN 150	30.4 dBi	4.0°	<-27 dB

Note:
See manufacturer's documentation *Radio Approval Optiwave 7400, LPR antenna characteristics* of 2014-05-19.

Result: **Test passed**

9.5 Emissions from digital circuitry

Description:

§15.256(k) Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in §15.209 of this chapter provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k) of this part, e.g., emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in subpart B, part 15 of this chapter. Emissions from these digital circuits shall not be employed in determining the -10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

Measurement:

Measurement parameter	
Detector:	Quasi Peak / Average (RMS)
Sweep time:	Auto
Resolution bandwidth:	100 kHz / 1 MHz
Video bandwidth:	> resbw
Trace-Mode:	Max-Hold

Limits:

FCC §15.209 / RSS-Gen		
Field strength of the harmonics and spurious.		
Frequency (MHz)	**Field strength (µV/m)**	**Measurement distance (m)**
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30 (29.5 dBµV/m)	30
30 – 88	100 (40 dBµV/m)	3
88 – 216	150 (43.5 dBµV/m)	3
216 – 960	200 (46 dBµV/m)	3
>960	500 (54 dBµV/m)	3

Results:

See §15.256(h) Unwanted emissions limit.

Result: **Test passed**

9.6 Conducted limits

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.

Measurement:

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

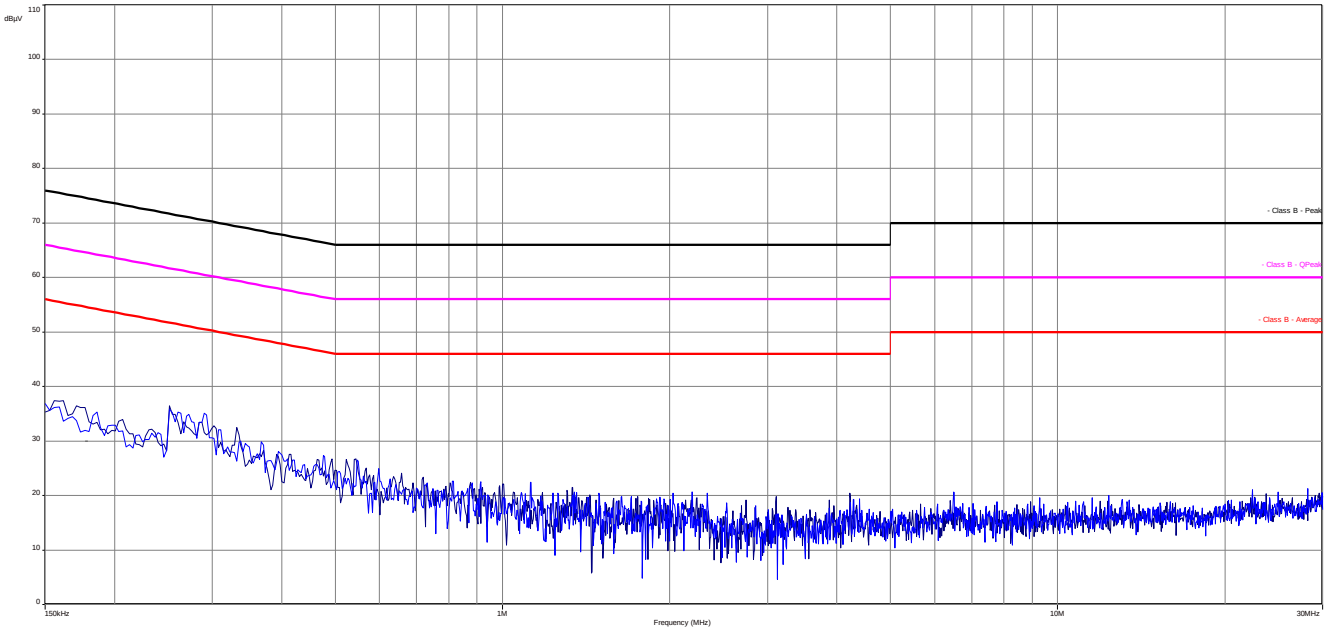
Limits:

FCC §15.107 / §15.207 / RSS-Gen		
Conducted limits		
Frequency of Emission (MHz)	**Conducted Limit (dBµV)**	
	Quasi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 - 30	60	50

*Decreases with the logarithm of the frequency

Result: **Test passed**

Plot 26:


dBµV
110
100
90
80
70
60
50
40
30
20
10
0
150kHz
1M
10M
30MHz
Frequency (MHz)
- Class B - Peak
- Class B - QPeak
- Class B - Average

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 (Lab/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	vIKI!	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	vIKI!	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	A023	Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979	ne		
20	A025	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne		
21	A028	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001991	ne		
22	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
23	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
24	8	DC Power Supply, 60V, 10A	6038A	HP Meßtechnik	3122A11097	300001204	Ve	10.01.2012	10.01.2015
25	n. a.	PXA Spectrum Analyzer 3Hz to 50GHz	N9030A PXA Signal Analyzer	Agilent Technologies	US51350267	300004338	k	09.01.2014	09.01.2015
26	n. a.	Harmonic mixer 50 - 75 GHz		HP Meßtechnik					
27	n. a.	Harmonic mixer 75-110 GHz		HP Meßtechnik					
28	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne		
29	45	Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368	g		

30	50	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2920A04466	300000580	ne		
31	n. a.	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	27.01.2014	27.01.2015
32	n. a.	EMI Test Receiver 20Hz- 26.5GHz	ESU26	R&S	100037	300003555	k	28.02.2014	28.02.2015
33	n. a.	Antenna Tower	Model 2175	ETS-LINDGREN	64762	300003745	izw		
34	n. a.	Positioning Controller	Model 2090	ETS-LINDGREN	64672	300003746	izw		
35	n. a.	Turntable Interface-Box	Model 105637	ETS-LINDGREN	44583	300003747	izw		
36	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 except those reported with the single test cases have been made.

12 Document history

Version	Applied changes	Date of release
DRAFT	Initial release - DRAFT	2014-11-27
final	minor editorial changes	2014-12-11
-A	RSS-211 status changed from *Draft* to *published*	2015-03-27
-B	Plots 30MHz – 1 GHz replaced	2015-04-16
-C	FCC ID and IC changed	2016-01-12

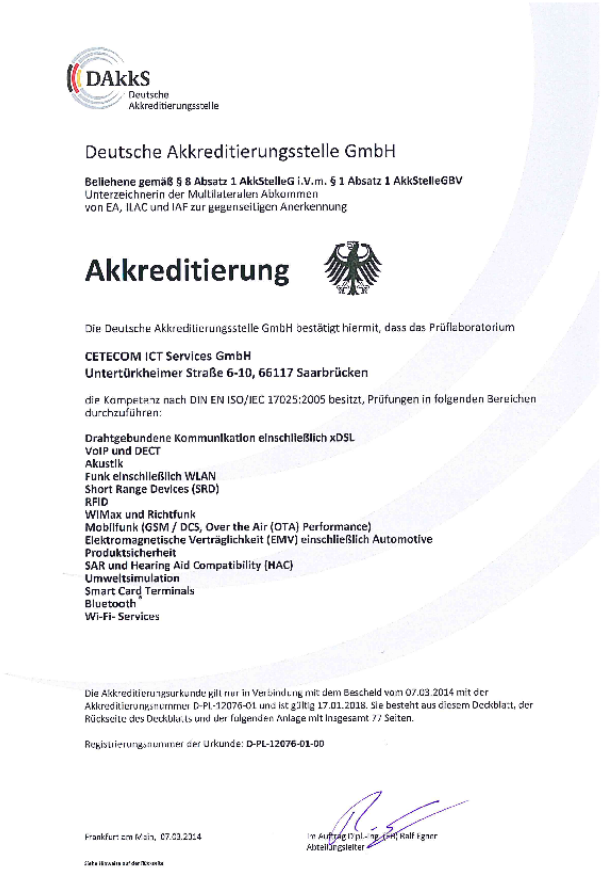
13 Further information

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

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Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

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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:

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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

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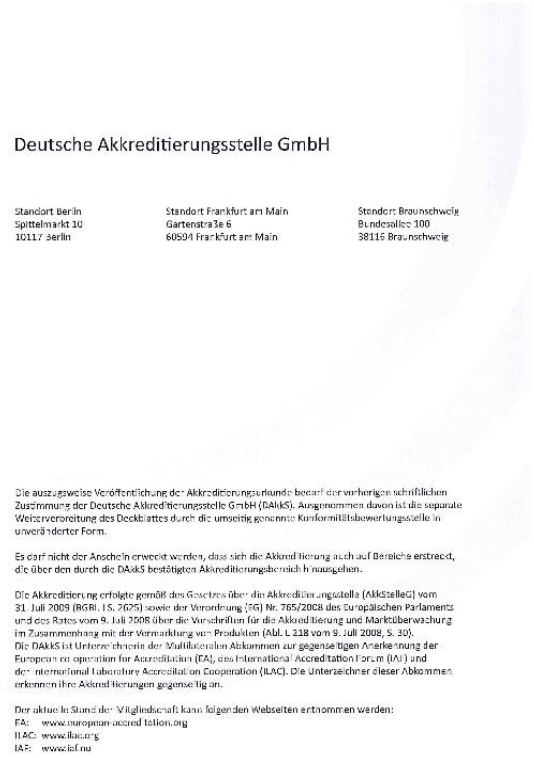
Registrierungsnummer der Urkunde: **D-PL-12076-01-00**

Frankfurt am Main, 07.03.2014

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

Back side of certificate



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60594 Frankfurt am Main

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38116 Braunschweig

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IAF: www.iaf.nu

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The current certificate including annex is published on our website (see link below) or may be received from CETECOM ICT Services on request.

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