

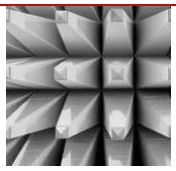

CETECOM™
CETECOM ICT Services
consulting - testing - certification

TEST REPORT

Test report no.: 1-8537/14-01-03-A

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

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
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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

Applicant

ZF TRW
ZAC TECHNOPOLE BREST IROISE Secteur de la pointe du diable - Avenue du Technopole
29280 Plouzane / FRANCE
Phone: +33 02 98 454368
Fax:
Contact: Sylvain Germaine
e-mail: Sylvain.Germaine@TRW.COM
Phone: +33 298 489 828

Manufacturer

ZF TRW
ZAC TECHNOPOLE BREST IROISE Secteur de la pointe du diable - Avenue du Technopole
29280 Plouzane / FRANCE

Test standard/s

FCC 47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I Part 15 - Radio Frequency Devices
RSS-310	Spectrum Management and Telecommunications - Radio Standards Specification Licence-exempt Radio Apparatus (all frequency bands): Category II Equipment

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

Test Item

Kind of test item:	**24 GHz Automotive Radar**
Model name:	**AC100M**
FCC ID:	**S91-AC100M**
IC:	**5860A-AC100M**
Frequency:	**24.05 - 24.25 GHz**
Antenna:	**Patch antenna (1 TX and 1 RX)**
Power Supply:	**12.0 V DC from power supply**
Temperature Range:	**-40 °C to +100 °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:

DN: cn=Karsten Geraldy, o=CETECOM ICT Services GmbH, ou=GER-151201, email=karsten.geraldy@cetecom.com, c=DE
Datum: 2016.06.21 14:49:44 +02'00'

Karsten Geraldy
Lab Manager
Radio Communications & EMC

Test performed:

Digital unterschrieben von Meheza Walla
DN: cn=Meheza Walla, o=CETECOM ICT Services GmbH, ou=WAL-151005, email=Meheza.Walla@cetecom.com, c=DE
Datum: 2016.06.21 14:33:08 +02'00'

Meheza Walla
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

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This test report replaces the test report with the number 1-8537/14-01-03 and dated 2016-05-19!

2.2 Application details

Date of receipt of order:	2015-08-17
Date of receipt of test item:	2015-08-17
Start of test:	2015-08-21
End of test:	2016-05-04
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
FCC 47 CFR Part 15	2015-10	Title 47 of the Code of Federal Regulations; Chapter I Part 15 - Radio Frequency Devices
RSS-310	2010-12	Spectrum Management and Telecommunications - Radio Standards Specification Licence-exempt Radio Apparatus (all frequency bands): Category II Equipment

4 Test environment

Temperature:	T_{nom}	+22 °C during room temperature test
Relative humidity:		45 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	12.0 V DC from power supply

5 Test item

Kind of test item	**:**	**24GHz Automotive Radar**
Type identification	**:**	**AC100M**
HMN	**:**	**NA**
PMN	**:**	**AC100M**
HVIN	**:**	**AC100M**
FVIN	**:**	**NA**
S/N serial number	**:**	**154203728**
Frequency band	**:**	**24.05 - 24.25 GHz** **(24.075 GHz, 24.125 GHz, 24.175 GHz)**
Antenna	**:**	**Patch antenna (1 TX and 1 RX)**
Power supply	**:**	**12.0 V DC from external power supply**
Temperature range	**:**	**-40 °C to +100 °C**

5.1 Additional comments

Test setup- and EUT-photos are included in test report: 1-8537/14-01-01_AnnexA
1-8537/14-01-01_AnnexB
1-8537/14-01-01_AnnexC

6 Test laboratories sub-contracted

None

7 Description of the test setup

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 signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

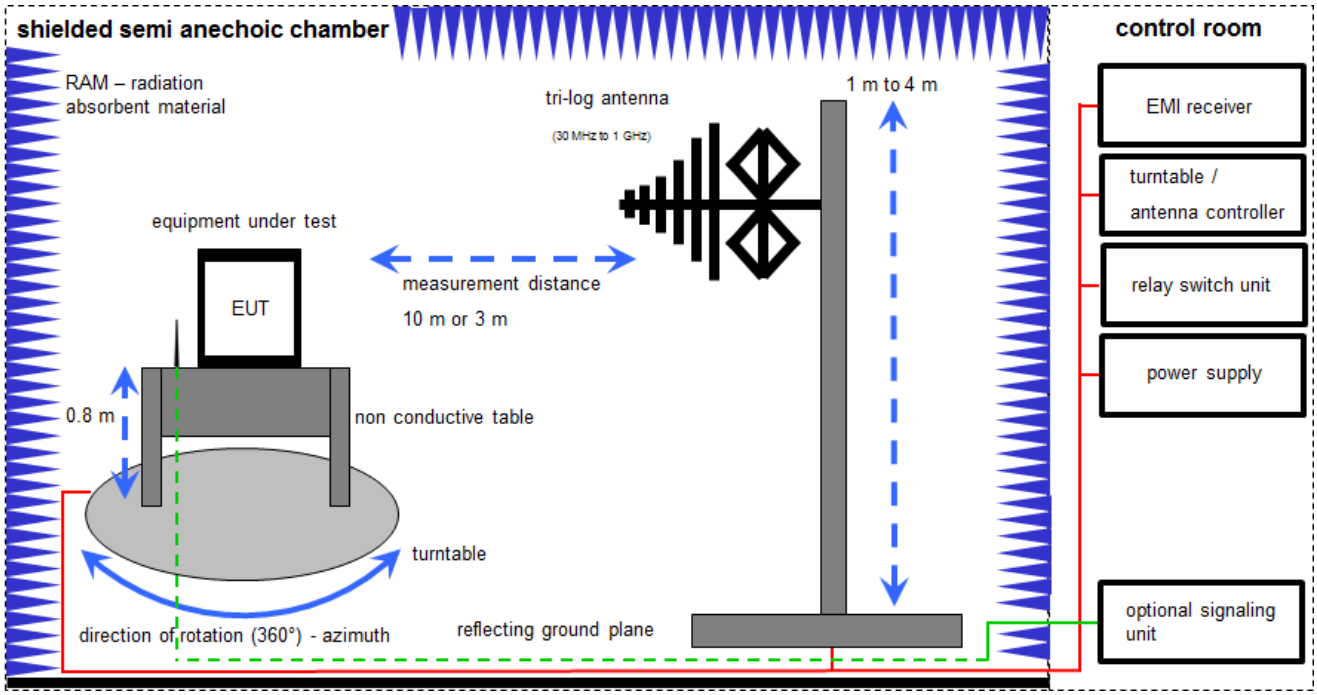
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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

7.1 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 analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



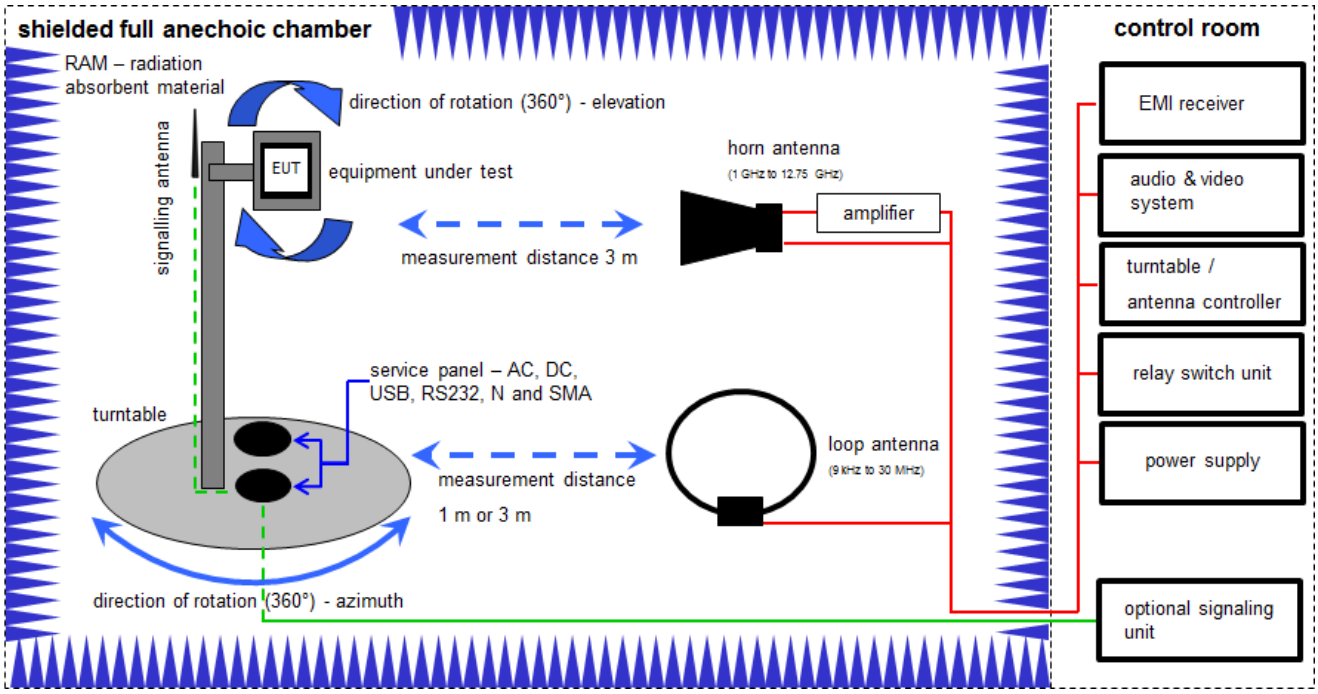
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1		EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	27.01.2016	26.01.2017
2		Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
3		Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
4		Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
5		TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016

7.2 Shielded fully anechoic chamber



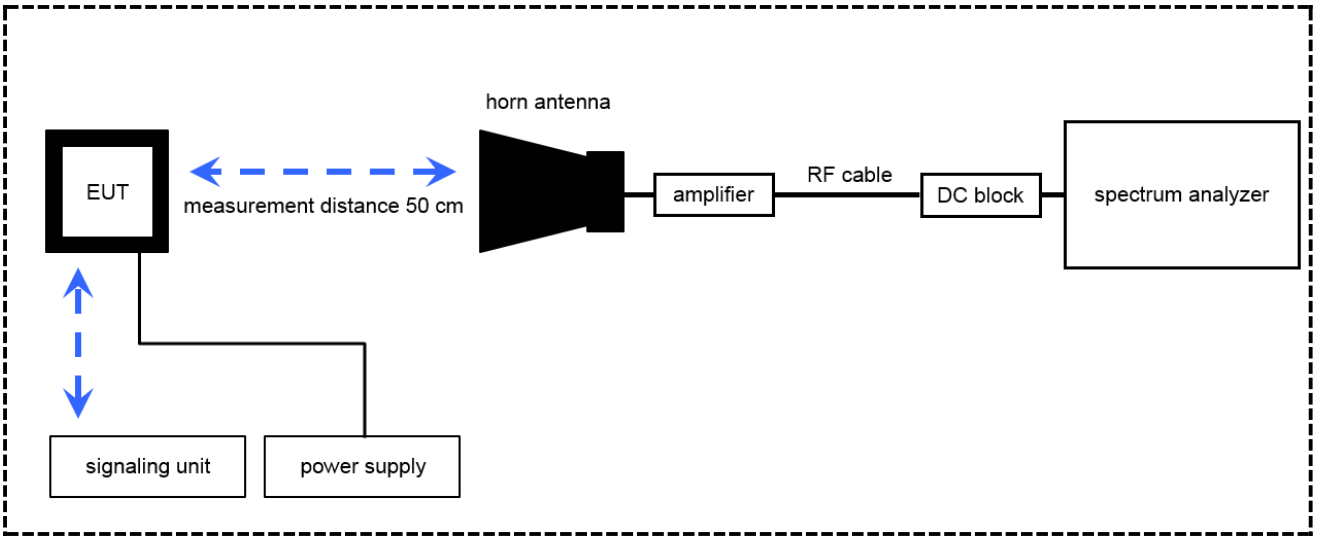
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Power Supply 0-20V	6632A	HP	2851A01814	300000924	ne	09.11.2005	-/-
2	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5290	300000212	k	13.08.2015	13.08.2017
3	n. a.	Software Option für CMU 200	CMU-Kxx	R&S	9709-5290	300003345	ne	-/-	-/-
4	n. a.	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	k	04.09.2015	04.09.2016
5	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	318	300003696	k	22.04.2014	22.04.2017
6	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22050	300004482	ev	-/-	-/-
7	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
8	n. a.	Messrechner und Monitor	Intel Core i3 3220/3,3 GHz, Prozessor	Agilent Technologies	2V2403033A5421	300004591	ne	-/-	-/-
9	n. a.	NEXIO EMV-Software	BAT EMC	EMCO	2V2403033A5421	300004682	ne	-/-	-/-

7.3 Radiated measurements 18 GHz to 50 GHz



OP = AV + D - G
(OP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

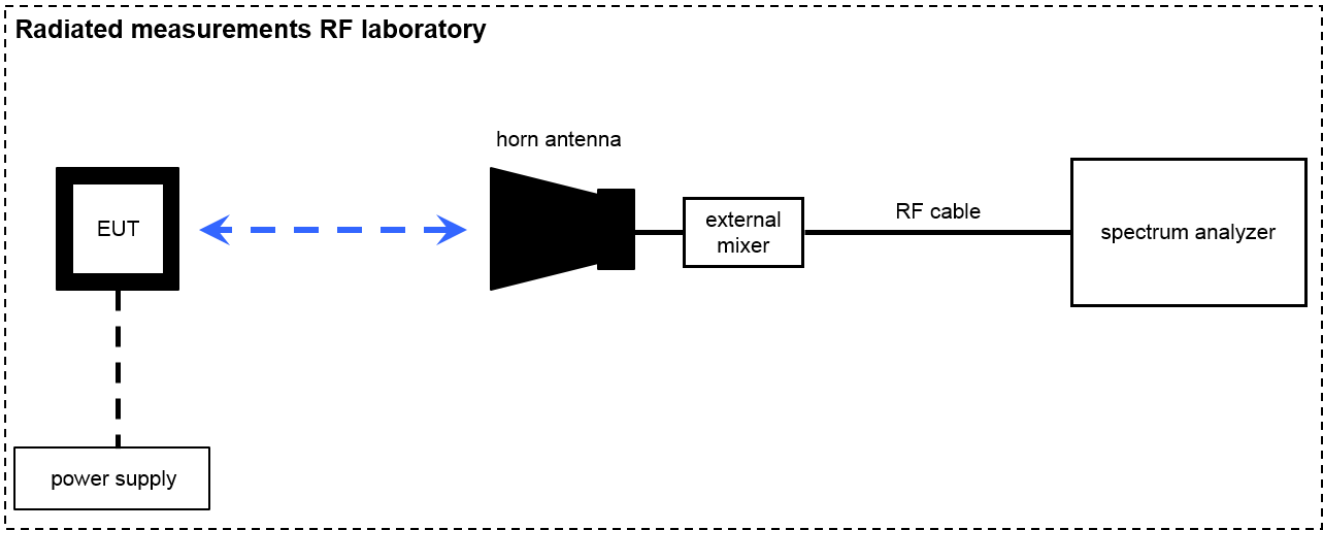
Example calculation:
OP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 µW)

Note: conversion loss of mixer is already included in analyzer value.

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	CR 79	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	7911	300001751	ne	-/-	-/-
2	A023	Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979	ne	-/-	-/-
3	A023	Temperature and Climatic Test Chamber	VUK04/500	Heraeus Voetsch	32678	300000297	ev	03.09.2015	03.09.2017
4	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	14.08.2015	14.08.2017
5	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	NK!	19.07.2013	-/-
6	A029	Power Supply	LA30/5GA	Zentro	2046	300000711	NK!	-/-	-/-
7	A029	Spectrum Analyzer 20 Hz - 50 GHz	FSU50	R&S	200012	300003443	Ve	02.10.2014	02.10.2016
8	A029	Broadband LNA 18-50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	-/-	-/-

7.4 Radiated measurements above 50 GHz



OP = AV + D - G
(OP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

Example calculation:
OP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 µW)

Note: conversion loss of mixer is already included in analyzer value.

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A025	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
2	A028	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001991	ne	-/-	-/-
3	A028	Harmonic Mixer 2-Port, 50-75 GHz	FS-Z75	R&S	100099	300003949	k	06.03.2015	06.03.2016
4	A028	Harmonic Mixer 3-Port, 75-110 GHz	FS-Z110	R&S	101411	300004959	k	04.05.2015	04.05.2016

8 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Spectrum bandwidth	span/1000
Conducted output power	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB

9 Sequence of testing

9.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the premeasurement are maximized by the software by rotating the turntable from 0° to 360°. In case of the 2-axis positioner is used the elevation axis is also rotated from 0° to 360°.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

9.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

9.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

9.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9.5 Sequence of testing radiated spurious above 50.0 GHz with external mixers

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate for far field (e.g. 0.25 m).
- The EUT is set into operation.

Premeasurement

- The test antenna with external mixer is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.
- Caution is taken to reduce the possible overloading of the external mixer.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- As external mixers may generate false images care is taken to ensure that any emission measured by the spectrum analyzer does indeed originate in the EUT. Signal identification feature of spectrum analyzer is used to eliminate false mixer images (i.e., it is not the fundamental emission or a harmonic falling precisely at the measured frequency).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

10 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	FCC 47 CFR Part 15 RSS-310	Passed	2016-06-21	-/-

Test specification clause	Test case	Temperature conditions	Power supply	Pass	Fail	NA	NP	Results (max.)
§15.203 RSS-Gen 7.1.4	Antenna Requirement	Nominal	Nominal	☒	☐	☐	☐	complies
§15.249(a), (c) RSS-310, 3.10	Field strength of emissions (wanted signal)	Nominal	Nominal	☒	☐	☐	☐	PK: 114.3 dBµV/m AVG: 107.8 dBµV/m @ 3m
ANSI C63.4 § 13.1.7 RSS-GEN 4.6.1	Occupied bandwidth (26dB Bandwidth and 99% Bandwidth)	Nominal	Nominal	☒	☐	☐	☐	26dB: 97.87 MHz 99%: 94.83 MHz
§15.249(a), (d) §15.209 RSS-GEN 4.9	Field strength of emissions (spurious & harmonics)	Nominal	Nominal	☒	☐	☐	☐	complies
§1.1310 §2.1091 FCC OET Bulletin 65 §15.319 (i) RSS-GEN 5.5 RSS 102	MPE Calculation	Nominal	Nominal	☒	☐	☐	☐	0.02 mW/cm^2

Note: NA = Not Applicable; NP = Not Performed

11 Measurement results

11.1 Antenna Requirement

See manufacturer's documentation!

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Limits:

FCC / IC
47 CFR Part 15.203 / RSS-GEN 7.1.4

Result: **The measurement is passed.**

11.2 Field strength of emissions (wanted signal)

Description:

Measurement of the maximum radiated field strength of the wanted signal.

Measurement:

Measurement parameter	
Detector:	Pos-Peak / Average
Sweep time:	120 s
Video bandwidth:	3 MHz
Resolution bandwidth:	1 MHz (6 dB Bandwidth)
Span:	200 MHz
Trace-Mode:	Max Hold

Limits:

FCC / IC		
47 CFR Part 15.249(a), (c) / RSS-310, 3.10		
Field strength of emissions		
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:		
Frequency [GHz]	Field Strength [dBµV/m]	Measurement distance
24.00 – 24.25	128 (Peak) 108 (Average)	3

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Measurement results:

Peak-Measurement:

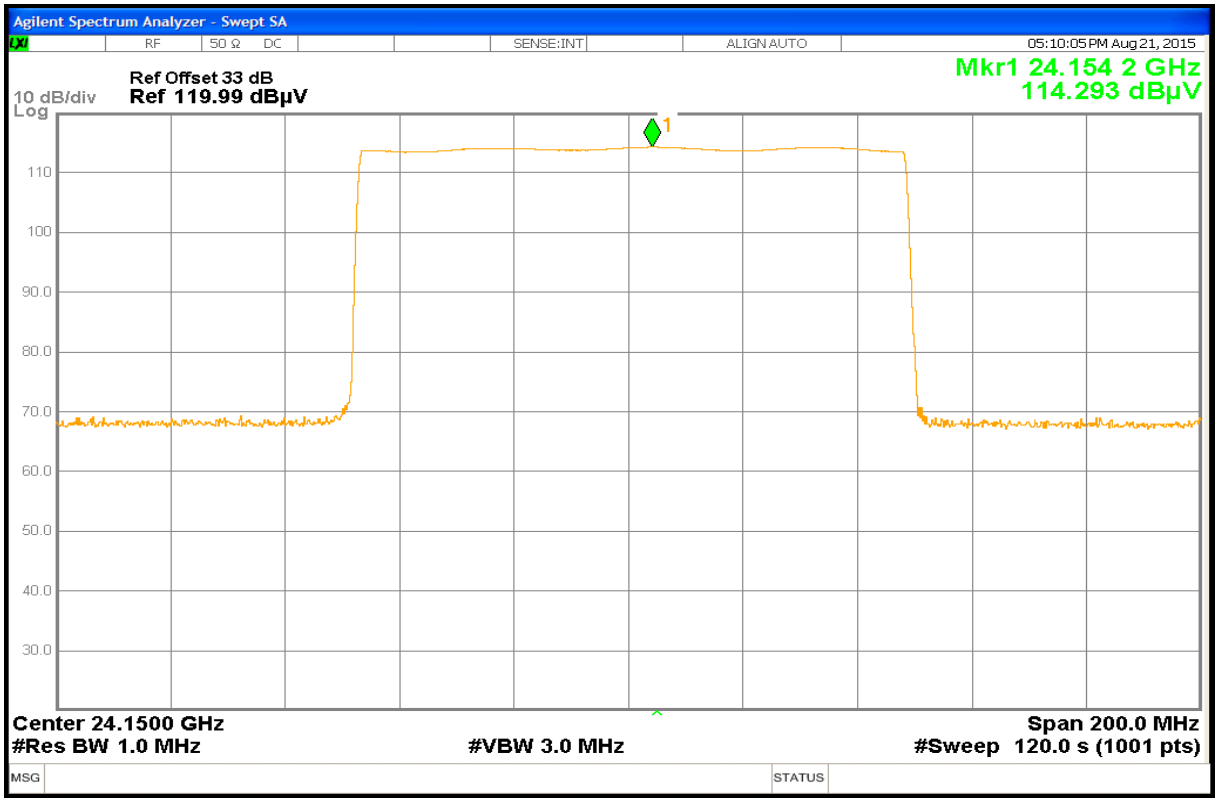
Test condition T_{nom} / V_{nom}	**Frequency** [GHz]	**Maximum field strength (Peak)** measured values [dBµV/m] @ 3 m
normal operation mode	24.154	114.3
Measurement uncertainty	± 3 dB	

Average-Measurement:

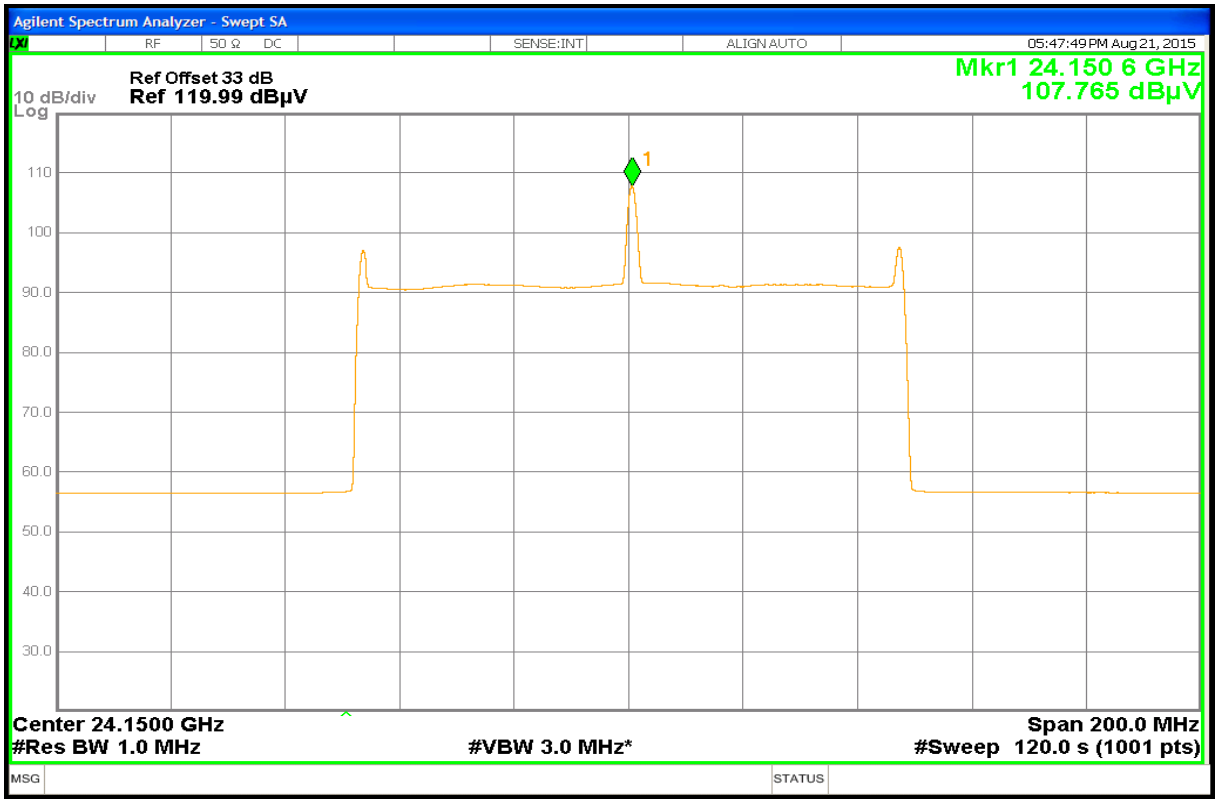
Test condition T_{nom} / V_{nom}	**Frequency** [GHz]	**Maximum field strength (AVG)** measured values [dBµV/m] @ 3 m
normal operation mode	24.151	107.8
Measurement uncertainty	± 3 dB	

Result: **The measurement is passed.**

Plot No. 1: Peak measurement, normal operation mode



Plot No. 2: Average measurement, normal operation mode



11.3 Occupied bandwidth (26 dB bandwidth and 99% bandwidth)

Description:

99% bandwidth:
When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is the 99% emissions bandwidth, as calculated or measured.

26 dB bandwidth:
The occupied bandwidth measurements on an intentional radiator shall be made in accordance with the requirements outlined in ANSI C63.4-2009, Section 13.7. If no bandwidth requirement is specified by the procuring or regulatory agency, measure the bandwidth at –26 dB with respect to the reference level. The resolution bandwidth was set according to Table 5 in section 13.7 of ANSI C63.4-2009.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	120 s
Video bandwidth:	1 MHz
Resolution bandwidth:	3 MHz
Span:	200 MHz
Trace-Mode:	Max Hold

Limits:

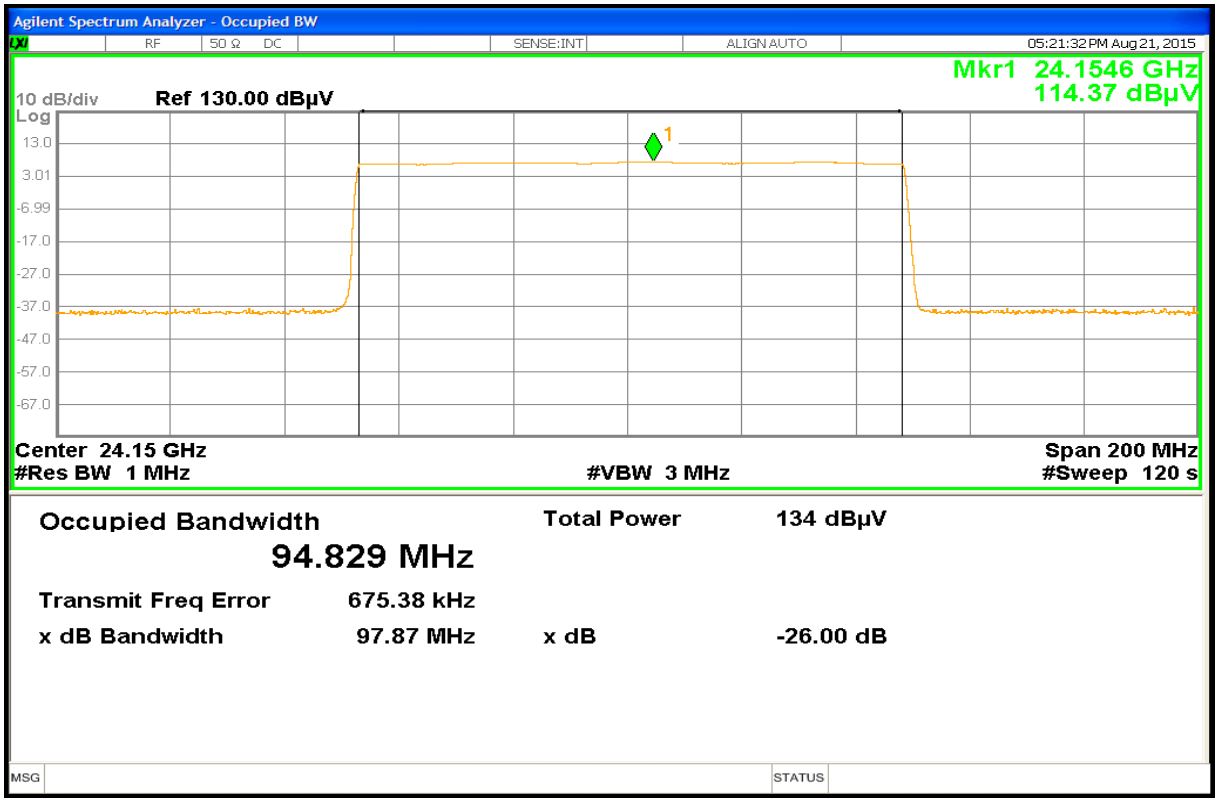
FCC / IC
ANSI C63.4 § 13.1.7 / RSS-GEN 4.6.1

Measurement results:

Test condition T_{nom} / V_{nom}	**26 dB bandwidth** [MHz]	**99% bandwidth** [MHz]
normal operation mode [24.15 GHz]	97.87	94.83
Measurement uncertainty	± span/1000	

Result: **The measurement is passed.**

Plot No. 3: Peak measurement, 99% OBW and -26 dB OBW



11.4 Field strength of emissions (radiated spurious and harmonics)

Description:

Measurement of the radiated spurious emissions in transmit mode.

Measurement:

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

Limits:

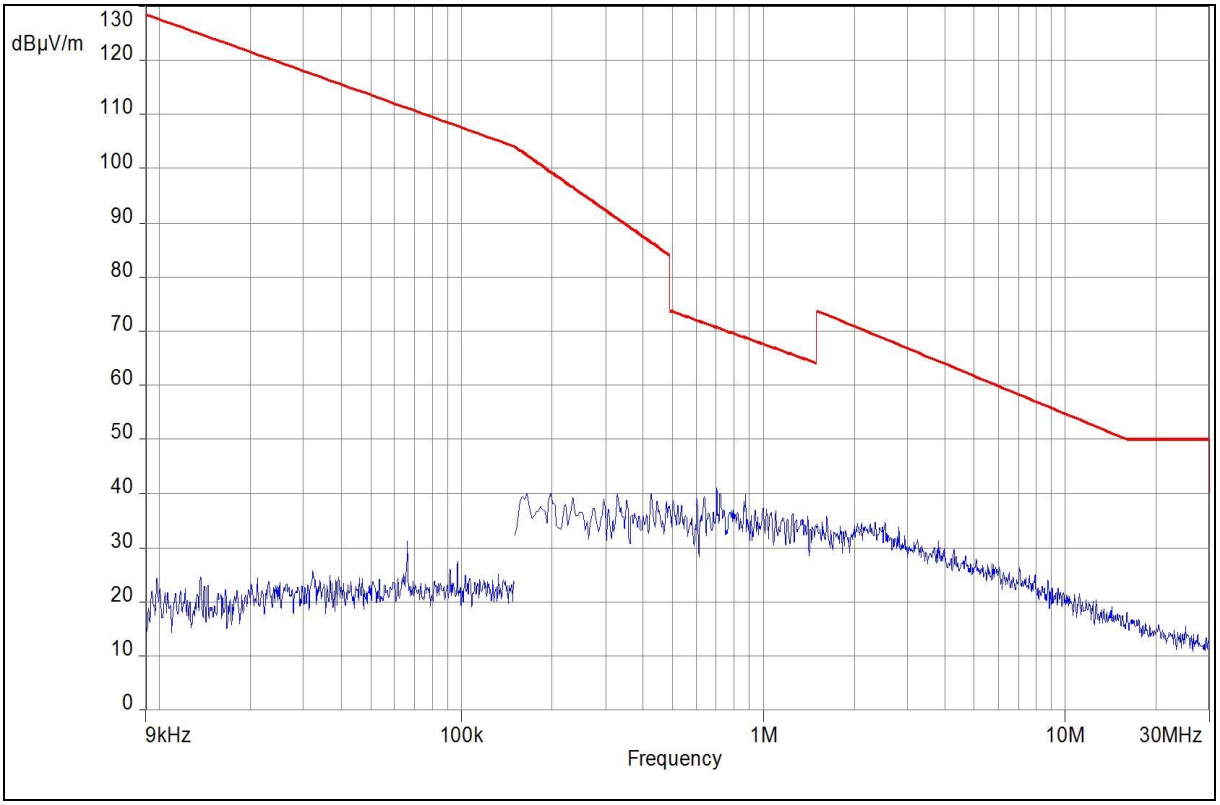
FCC / IC		
CFR Part 15.249 (a), (d); CFR Part 15.209 / RSS-GEN 4.9		
Field Strength of harmonics shall not exceed 68 dBµV/m		
Radiated Spurious Emissions		
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental 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
Above 960	54.0	3

Measurement results:

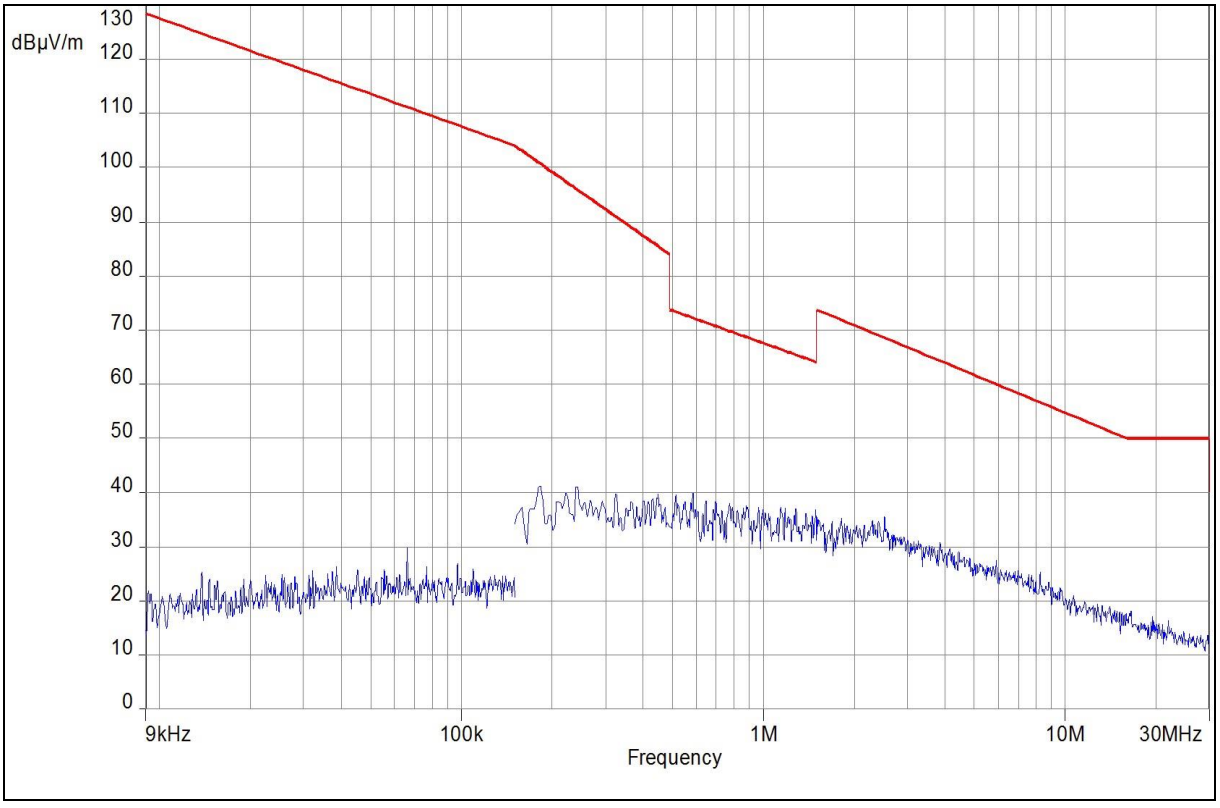
TX Spurious Emissions Radiated [dBµV/m]								
Low Channel			Middle Channel			High Channel		
F [GHz]	Detector	Level [dBµV/m]	F [GHz]	Detector	Level [dBµV/m]	F [GHz]	Detector	Level [dBµV/m]
22.57	AVG	43.54	22.62	AVG	46.30	22.66	AVG	45.81
25.58	AVG	46.47	25.63	AVG	47.29	25.68	AVG	45.71
48.15	AVG	42.52	48.25	AVG	39.65	48.34	AVG	41.40
Measurement uncertainty			± 3 dB					
Note: Peak detector is used for detection of spurious >1GHz, only critical peaks are remeasured with average detector.								

Result: **The measurement is passed.**

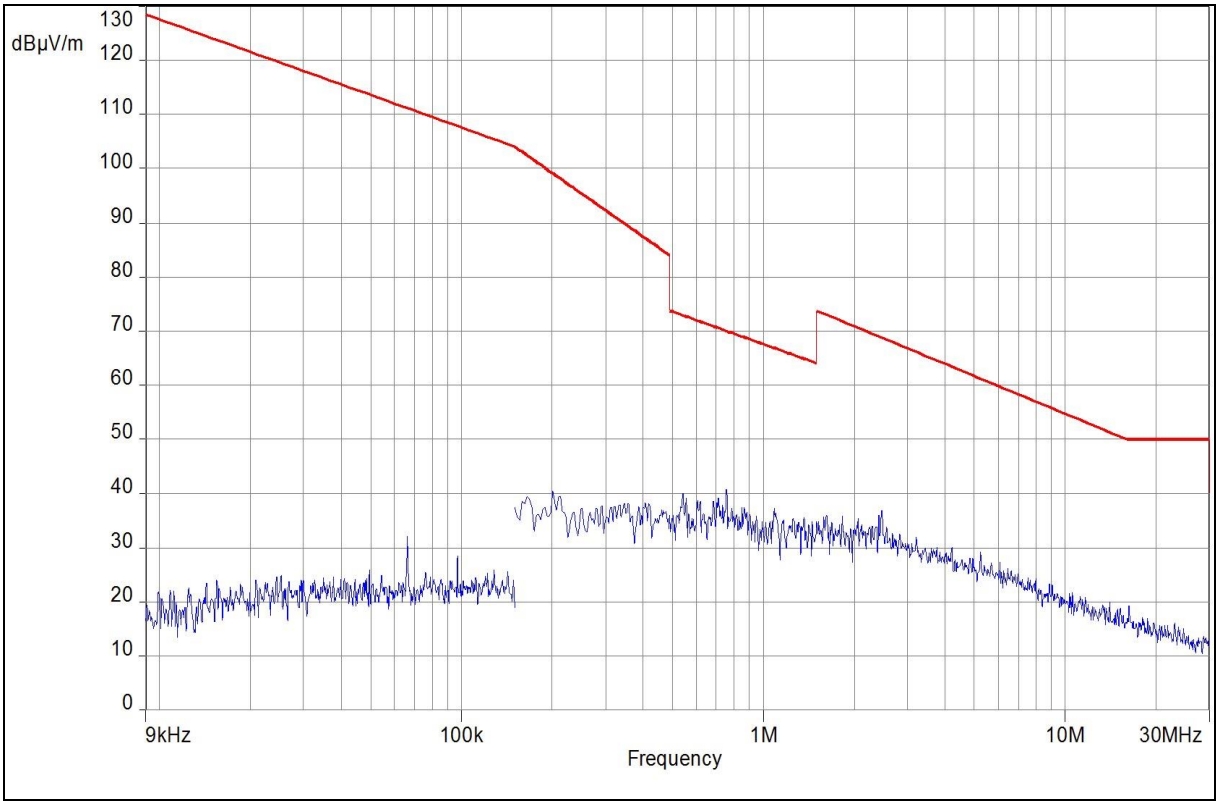
Plot No. 4: 9 kHz – 30 MHz, magnetic loop antenna, low channel



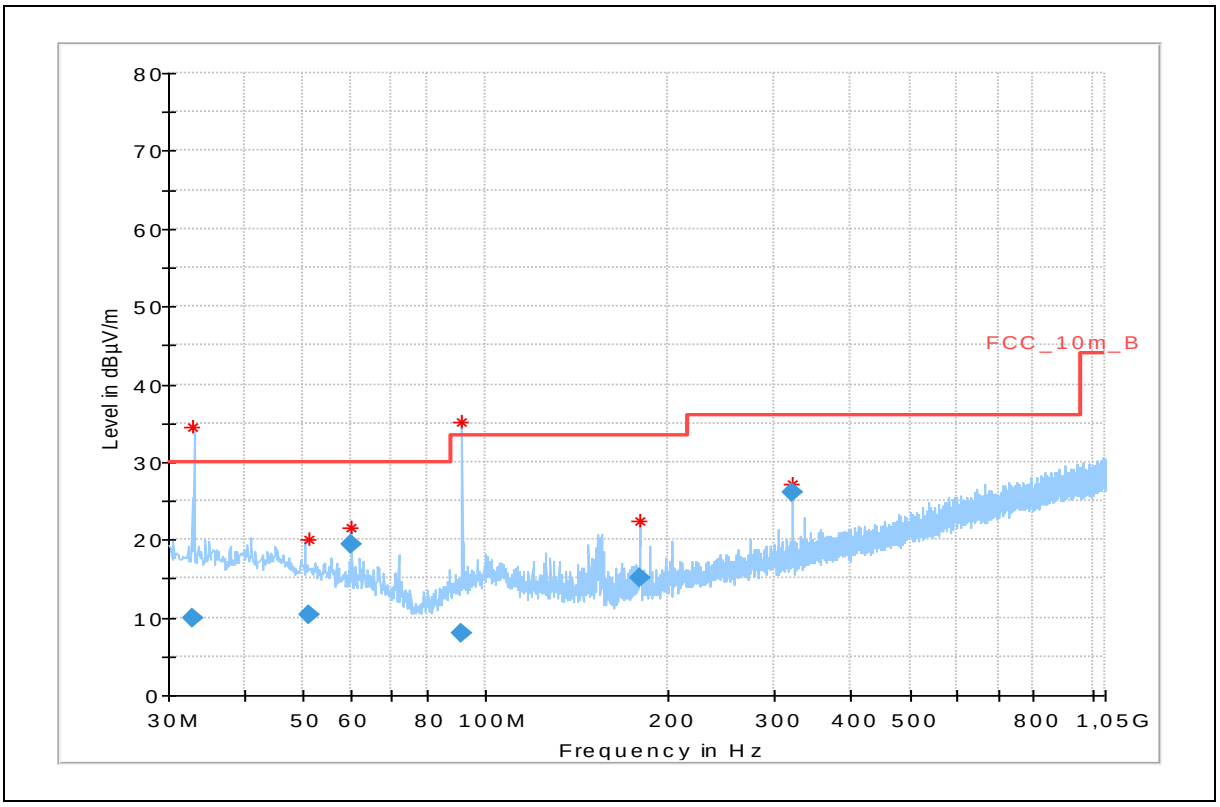
Plot No. 5: 9 kHz – 30 MHz, magnetic loop antenna, middle channel



Plot No. 6: 9 kHz – 30 MHz, magnetic loop antenna, high channel

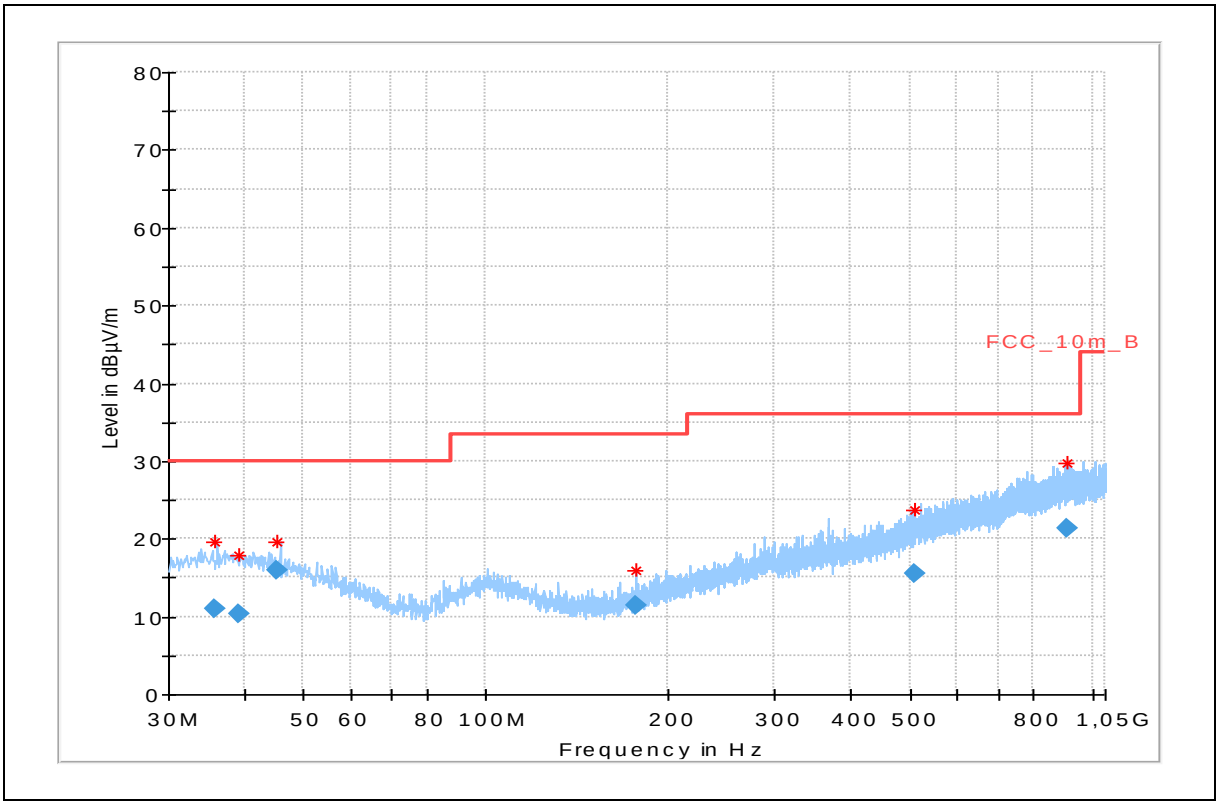


Plot No. 7: 30 MHz to 1 GHz, low channel, horizontal/vertical polarization



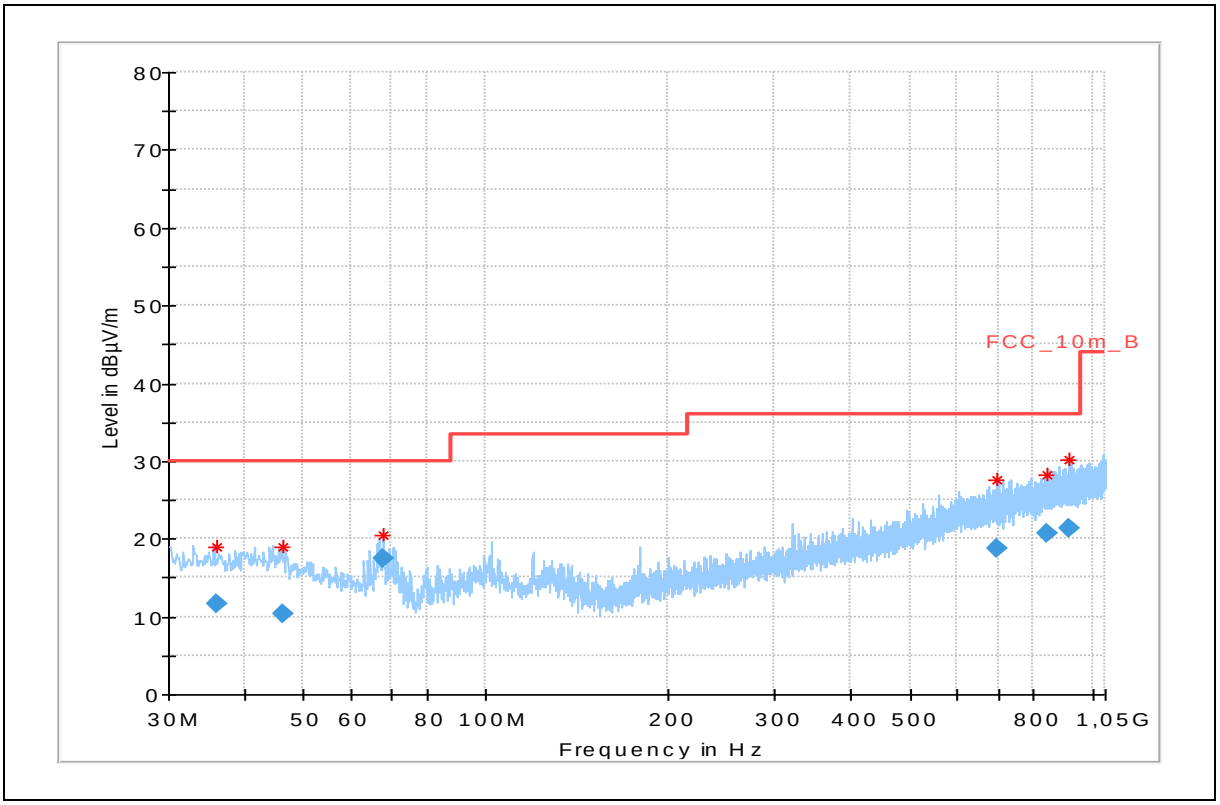
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.756850	10.01	30.00	19.99	1000.0	120.000	101.0	H	261.0	13.6
50.999700	10.28	30.00	19.72	1000.0	120.000	170.0	V	261.0	12.5
60.006300	19.38	30.00	10.62	1000.0	120.000	101.0	V	10.0	10.6
91.146300	7.90	33.50	25.60	1000.0	120.000	98.0	V	261.0	10.6
179.253750	15.20	33.50	18.30	1000.0	120.000	98.0	V	80.0	10.3
319.985850	26.14	36.00	9.86	1000.0	120.000	98.0	V	100.0	15.1

Plot No. 8: 30 MHz to 1 GHz, middle channel, horizontal/vertical polarization



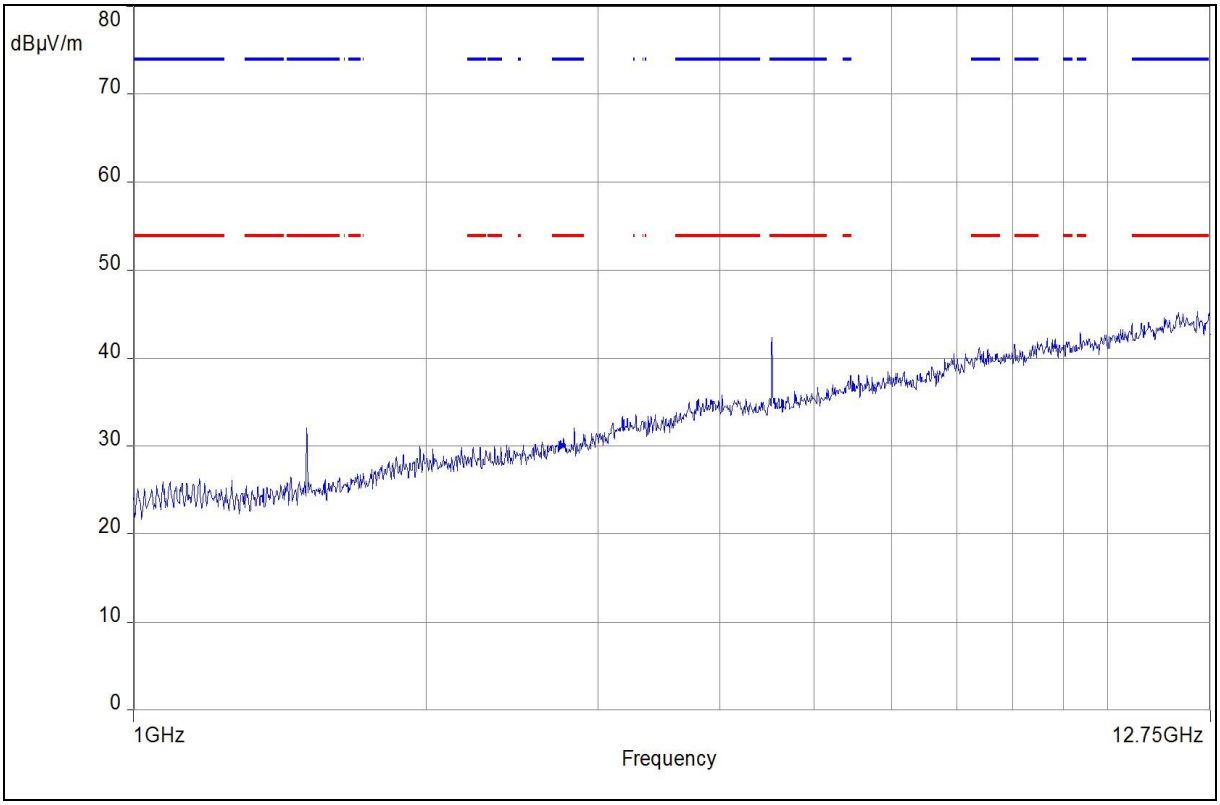
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.776200	11.04	30.00	18.96	1000.0	120.000	101.0	H	170.0	13.8
39.040800	10.42	30.00	19.58	1000.0	120.000	170.0	H	261.0	14.0
45.299700	15.87	30.00	14.13	1000.0	120.000	101.0	V	100.0	13.8
177.273150	11.44	33.50	22.06	1000.0	120.000	98.0	V	260.0	10.2
507.901800	15.54	36.00	20.46	1000.0	120.000	170.0	V	260.0	18.8
909.411000	21.28	36.00	14.72	1000.0	120.000	170.0	V	80.0	24.1

Plot No. 9: 30 MHz to 1 GHz, high channel, horizontal/vertical polarization

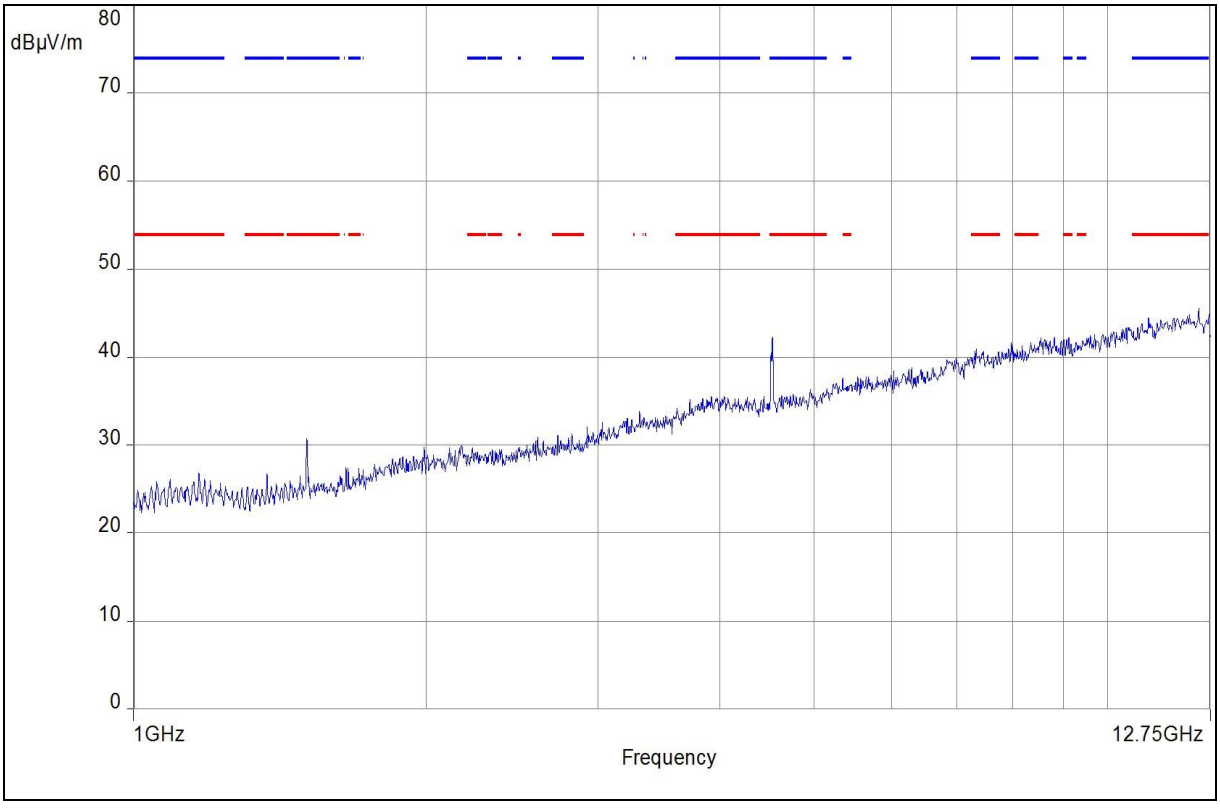


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.924700	11.54	30.00	18.46	1000.0	120.000	101.0	V	280.0	13.8
46.409700	10.26	30.00	19.74	1000.0	120.000	170.0	H	170.0	13.5
67.750500	17.51	30.00	12.49	1000.0	120.000	101.0	V	261.0	8.9
695.722200	18.81	36.00	17.19	1000.0	120.000	170.0	H	100.0	21.5
839.334000	20.67	36.00	15.33	1000.0	120.000	170.0	V	280.0	23.3
914.008650	21.31	36.00	14.69	1000.0	120.000	170.0	V	170.0	24.2

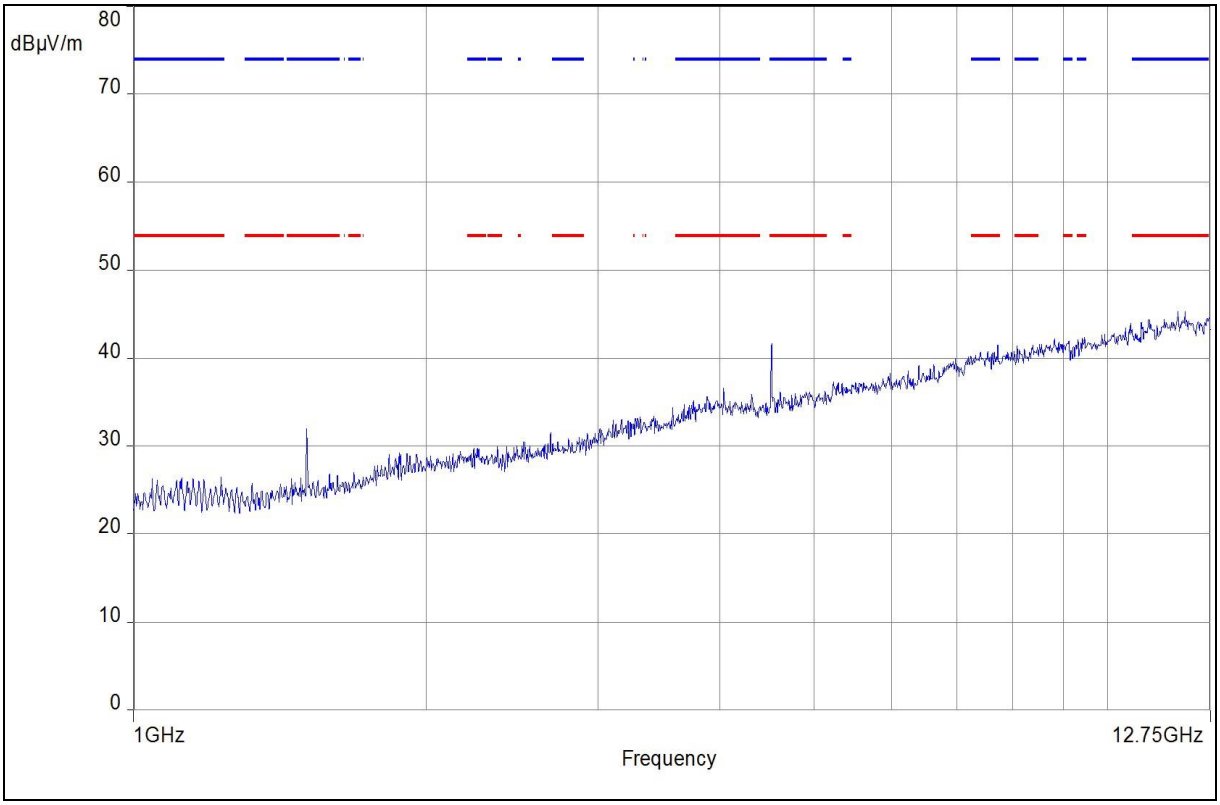
Plot No. 10: 1 GHz to 12.75 GHz, low channel, horizontal/vertical polarization



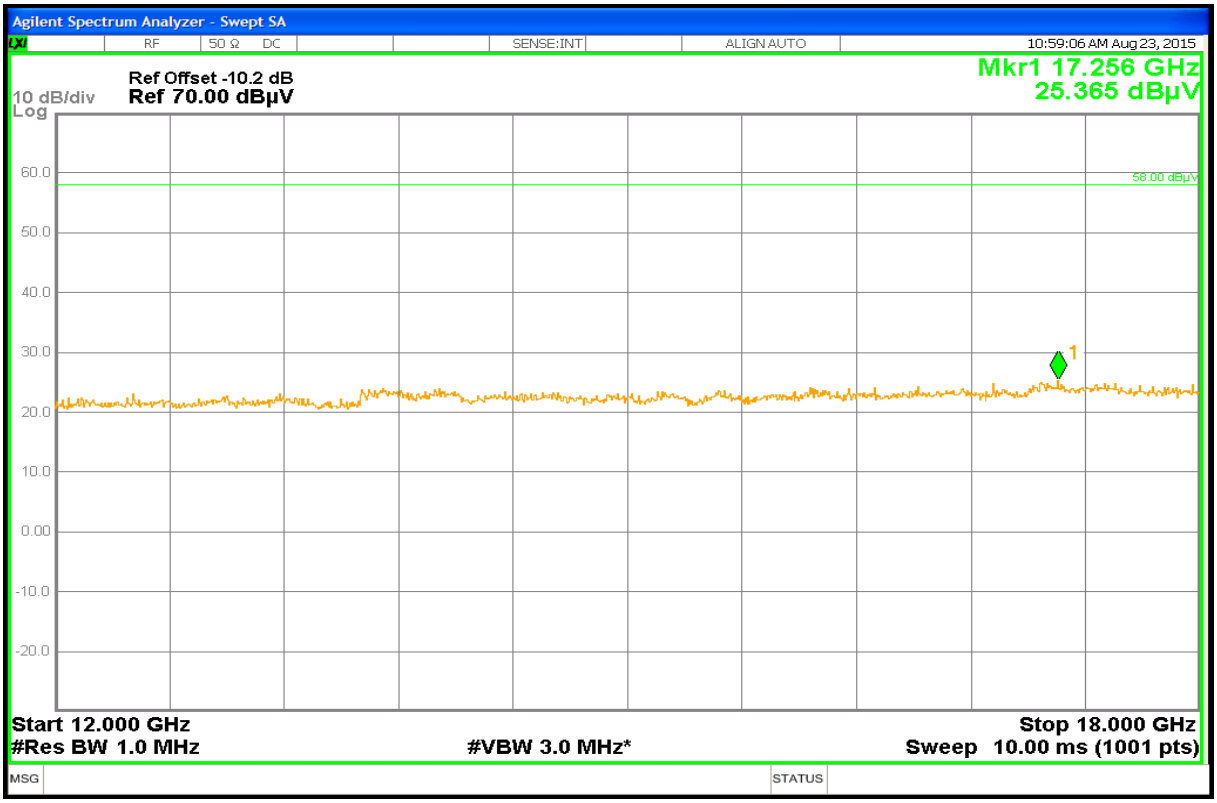
Plot No. 11: 1 GHz to 12.75 GHz, middle channel, horizontal/vertical polarization



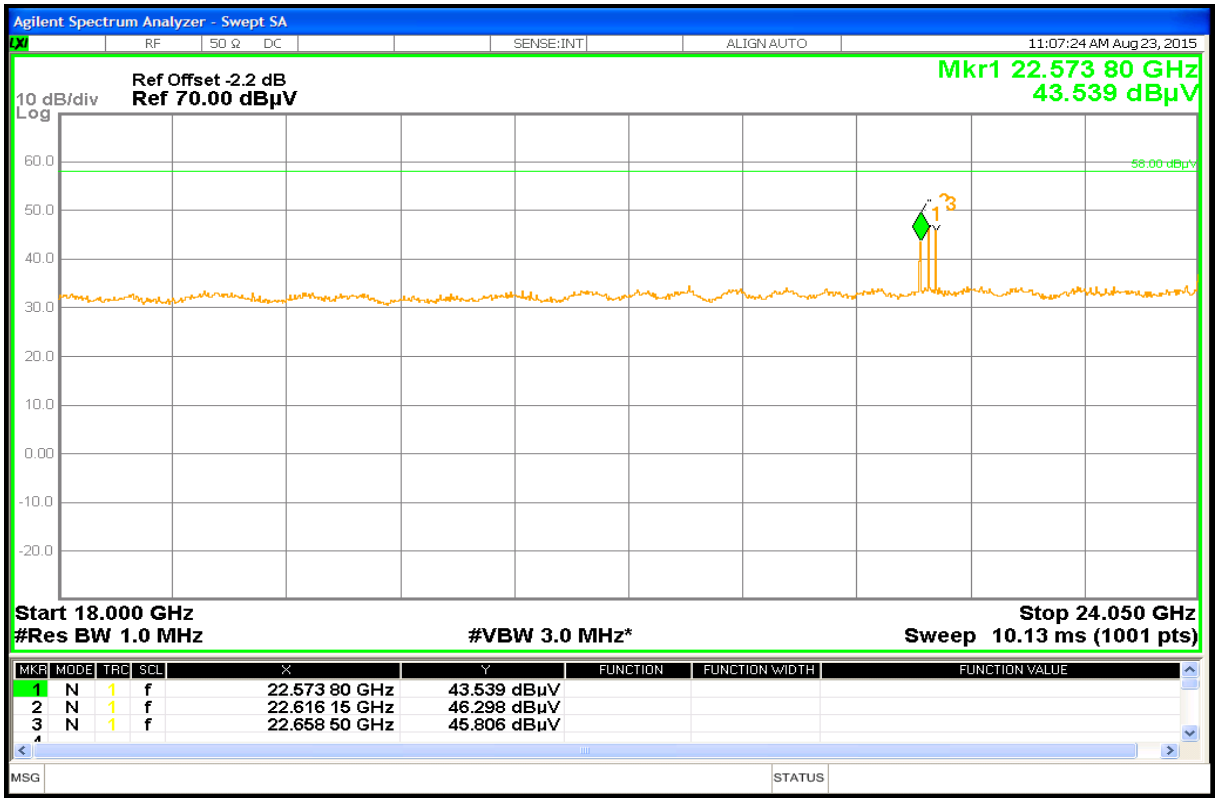
Plot No. 12: 1 GHz to 12.75 GHz, high channel, horizontal/vertical polarization



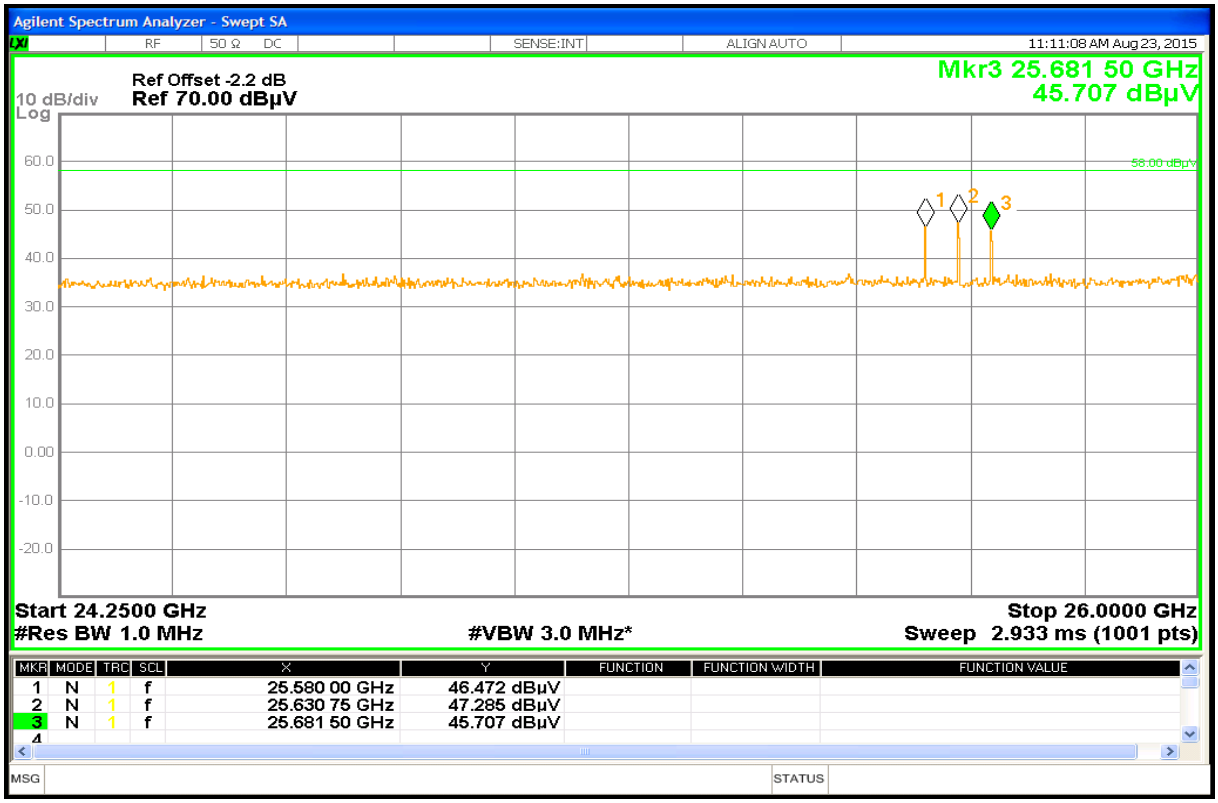
Plot No. 13: 12 GHz to 18 GHz, low/mid/high frequency, horizontal/vertical polarization



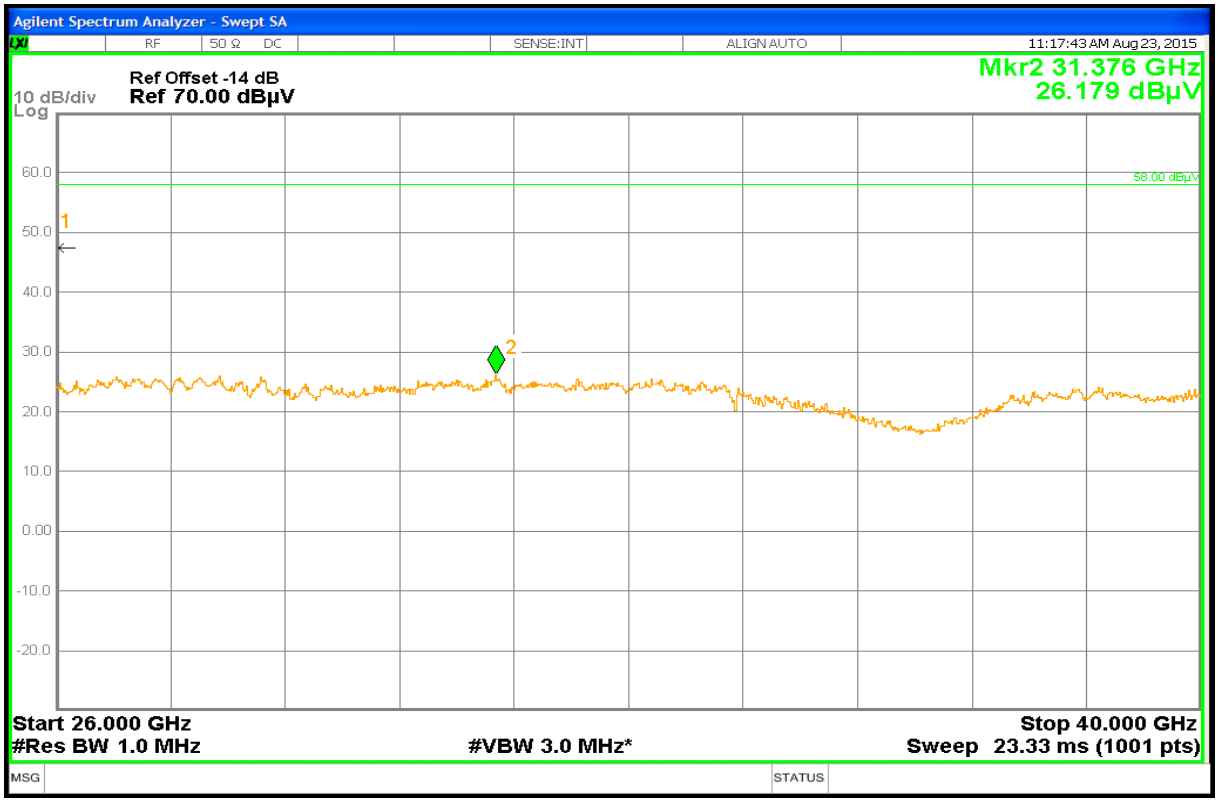
Plot No. 14: 18 GHz to 24.05 GHz, low/mid/high frequency, horizontal/vertical polarization



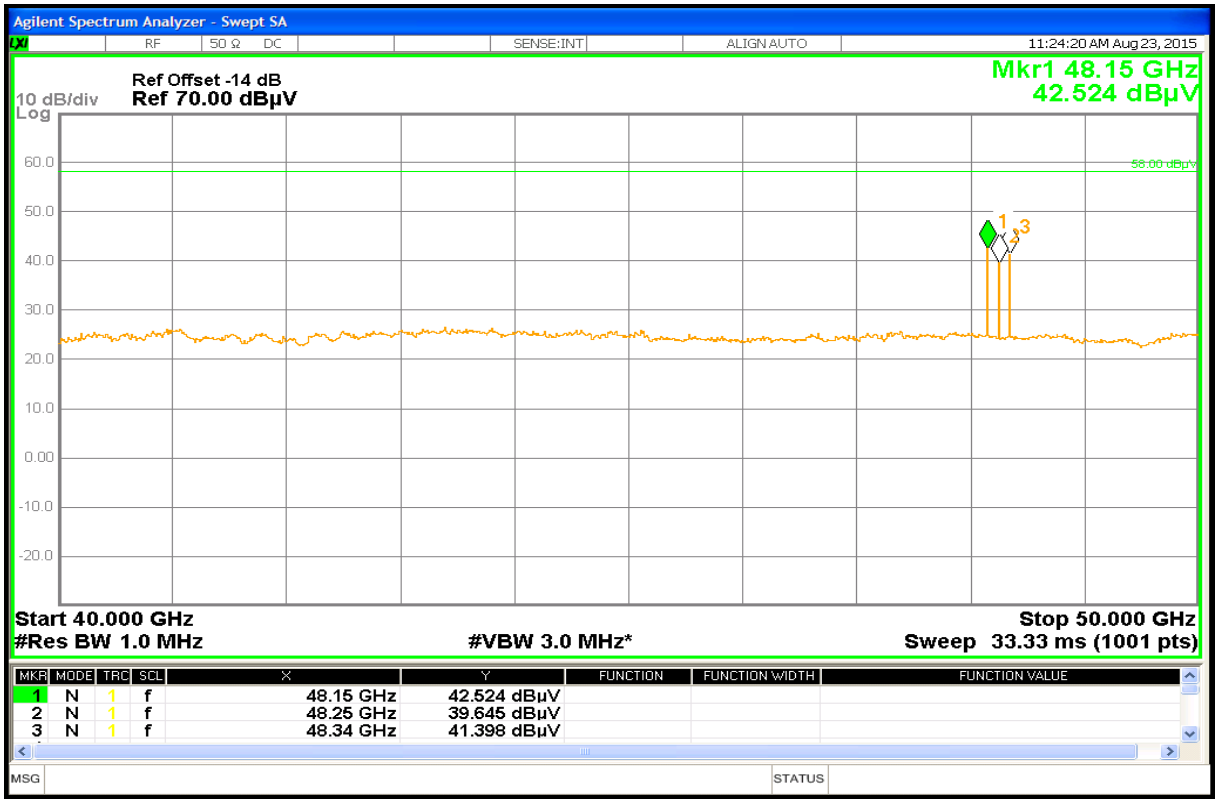
Plot No. 15: 24.25 GHz to 26 GHz, low/mid/high frequency, horizontal/vertical polarization



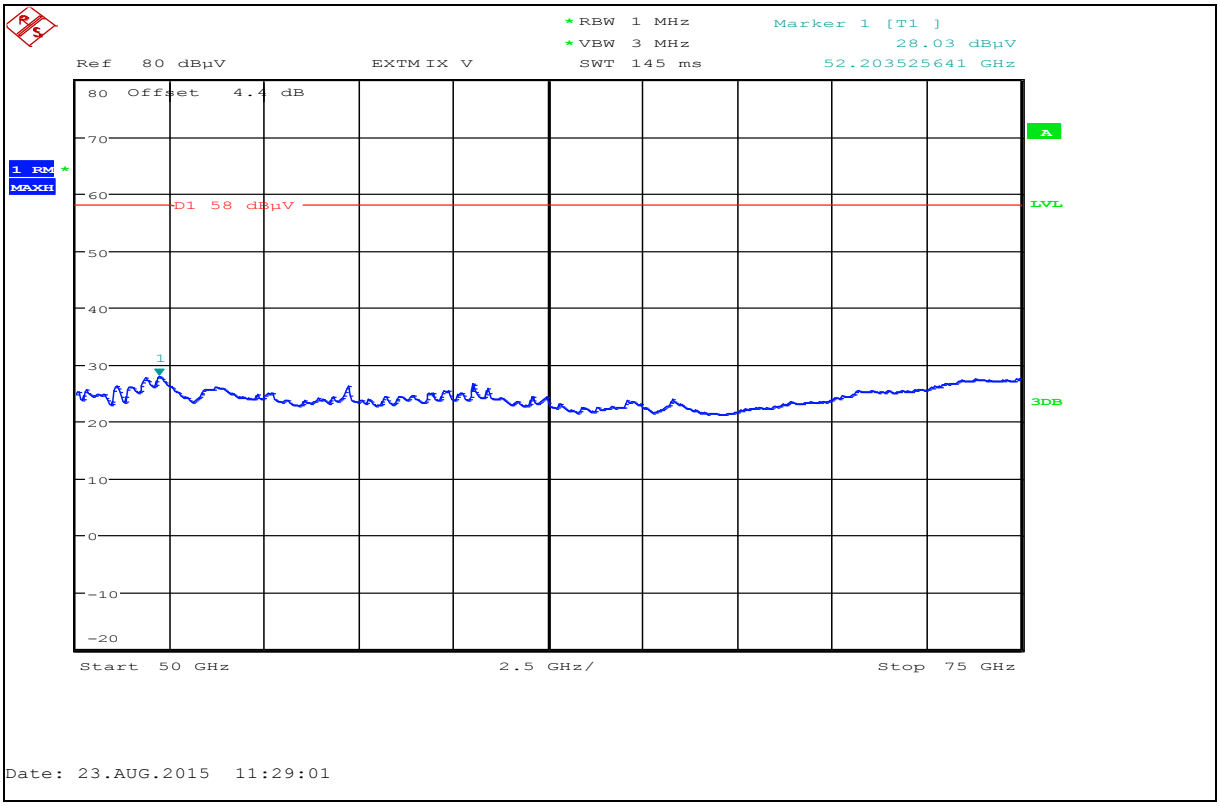
Plot No. 16: 26 GHz to 40 GHz, low/mid/high frequency, horizontal/vertical polarization



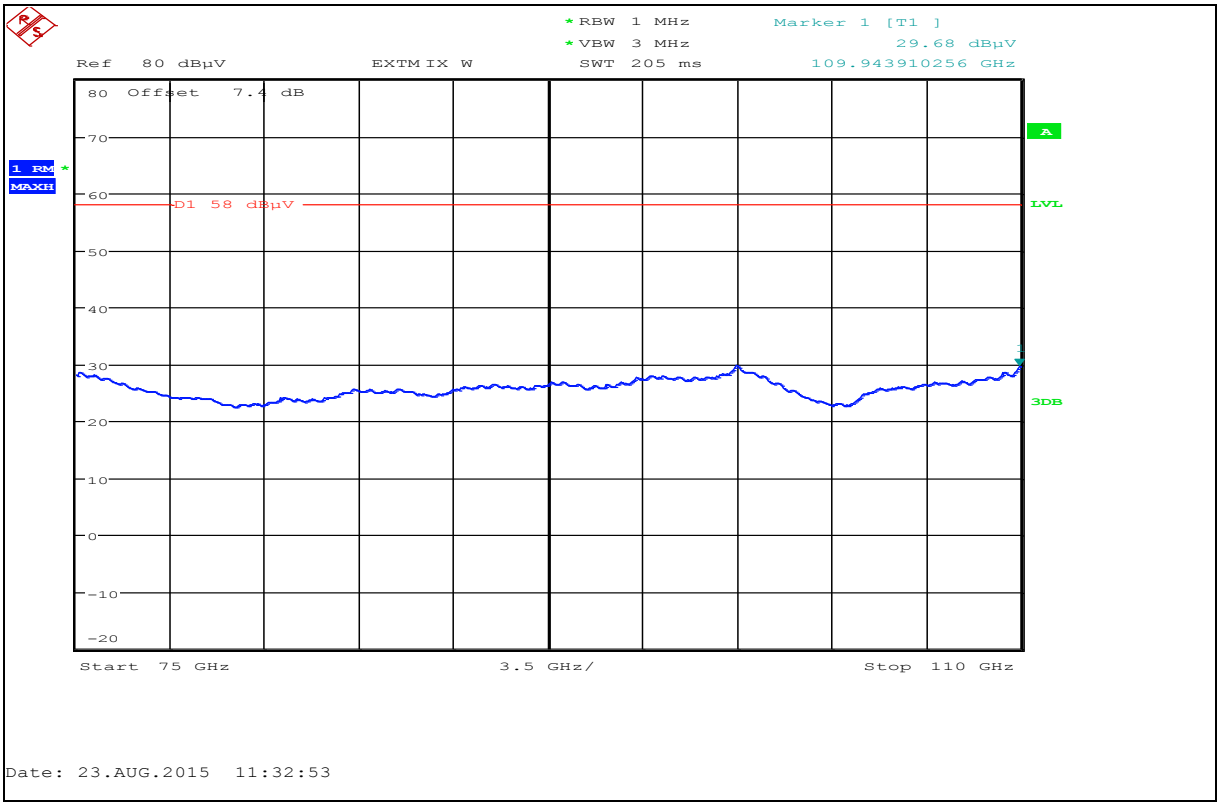
Plot No. 17: 40 GHz to 50 GHz, low/mid/high frequency, horizontal/vertical polarization



Plot No. 18: 50 GHz to 75 GHz, low/mid/high frequency, horizontal/vertical polarization



Plot No. 19: 75 GHz to 110 GHz, low/mid/high frequency, horizontal/vertical polarization



12 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:

The customer declared a maximal E.I.R.P. of 20 dBm ≙ 100 mW

d = 20 cm

➔ PD = 0.02 mW/cm^2

Limits: **FCC §1.1310 (B) / RSS-GEN 5.5; RSS 102**

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

Result: **The measurement is passed.**

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2016-05-19
-A	Registration number changed / MPE Updated	2016-06-21

Annex B 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

Annex C 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:

Funk
Mobilfunk (GSM / DCS) + OTA
Elektromagnetische Verträglichkeit (EMV)
Produktsicherheit
SAR / EMF
Umwelt
Smart Card Technology
Bluetooth®
Automotive
Wi-Fi-Services
Kanadische Anforderungen
US-Anforderungen
Akustik
Near Field Communication (NFC)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 04.05.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

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

Frankfurt, 04.05.2016

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

Siehe Hinweise auf der Rückseite

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

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Europa-Allee 52
60327 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

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Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Note:
The current certificate including annex can be received from CETECOM ICT Services GmbH on request.