
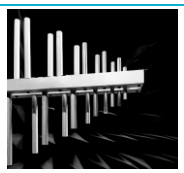
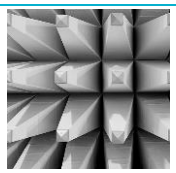

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TEST REPORT

Test report no.: 1-3265/16-01-05-A

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

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.ctcadvanced.com
e-mail: mail@ctcadvanced.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-12076-01-01

Applicant

HARTING IT Software Development GmbH & Co. KG
Marienwerderstr. 2. 4
32339 Espelkamp / GERMANY
Phone: -/-
Fax: -/-
Contact: -/-
e-mail: -/-
Phone: -/-

Manufacturer

HARTING IT Software Development GmbH & Co. KG
Marienwerderstr. 2. 4
32339 Espelkamp / GERMANY

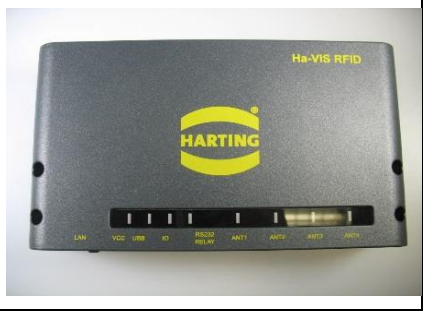
Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

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

Test Item

Kind of test item:	**UHF RFID Reader**
Model name:	**Ha-VIS RF-R400-US**
FCC ID:	**Z4NRF-R400**
IC:	**9941A-RFR400**
Frequency:	ISM band 902 – 928 MHz
Technology tested:	RFID
Antenna:	External antenna
Power supply:	24 V DC by external power supply
Temperature range:	22°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 authorized:

cn=Christoph Schneider, o=CTC advanced GmbH, ou=SND-161128, email=Christoph.Schneider@ctcadvanced.com, c=DE
2017.05.11 08:34:06 +02'00'

Christoph Schneider
Testing Manager
Radio Communications & EMC

Test performed:

cn=Tobias Wittenmeier, o=CTC advanced GmbH, ou=WIT-161128, email=Tobias.Wittenmeier@ctcadvanced.com, c=DE
2017.05.11 07:09:03 +02'00'

Tobias Wittenmeier
Testing Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

This test report replaces the test report with the number 1-3265/16-01-05 and dated 2017-04-03

2.2 Application details

Date of receipt of order:	2016-12-23
Date of receipt of test item:	2017-02-22
Start of test:	2017-02-23
End of test:	2017-04-06
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 15		Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 2	February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	November 2014	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

Guidance	Version	Description
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests No tests under extreme conditions required No tests under extreme conditions required
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	24.0 V DC by external power supply No tests under extreme conditions required No tests under extreme conditions required

5 Test item

5.1 General description

Kind of test item	:	UHF RFID Reader
Type identification	:	Ha-VIS RF-R400-US
HMN	:	-/-
PMN	:	Ha-VIS RF-R400-US
HVIN	:	Ha-VIS RF-R400
FVIN	:	-/-
S/N serial number	:	VM#3
HW hardware status	:	Ha-VIS RF-R400
FW firmware status	:	V00.00.133
Frequency band	:	ISM band 902 – 928 MHz
Type of radio transmission Use of frequency spectrum	: :	FHSS
Type of modulation	:	ASK
Number of channels	:	50
Antenna	:	External antenna
Power supply	:	24.0 V DC by external power supply
Temperature range	:	22 °C

5.2 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: 1-3265/16-01-14_AnnexA
1-3265/16-01-14_AnnexB
1-3265/16-01-14_AnnexD

6 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).

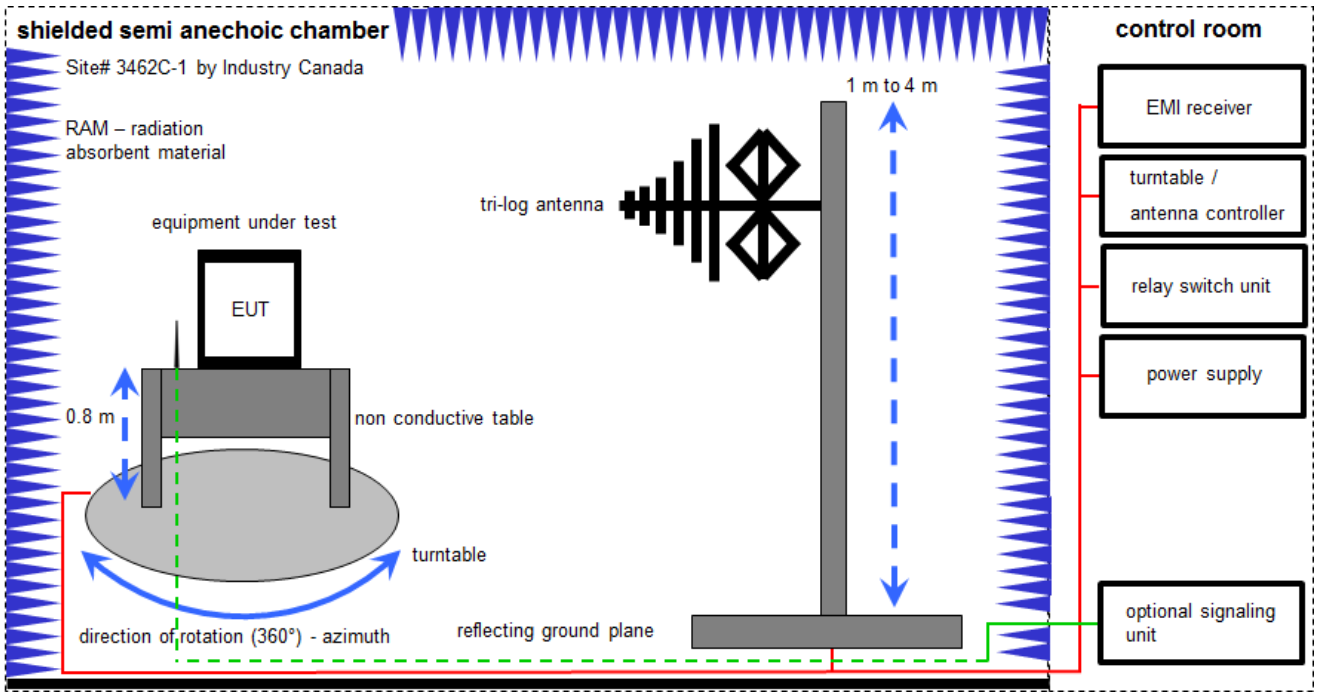
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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

6.1 Shielded semi anechoic chamber

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 conform to 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.



Measurement distance: tri-log antenna 10 meter

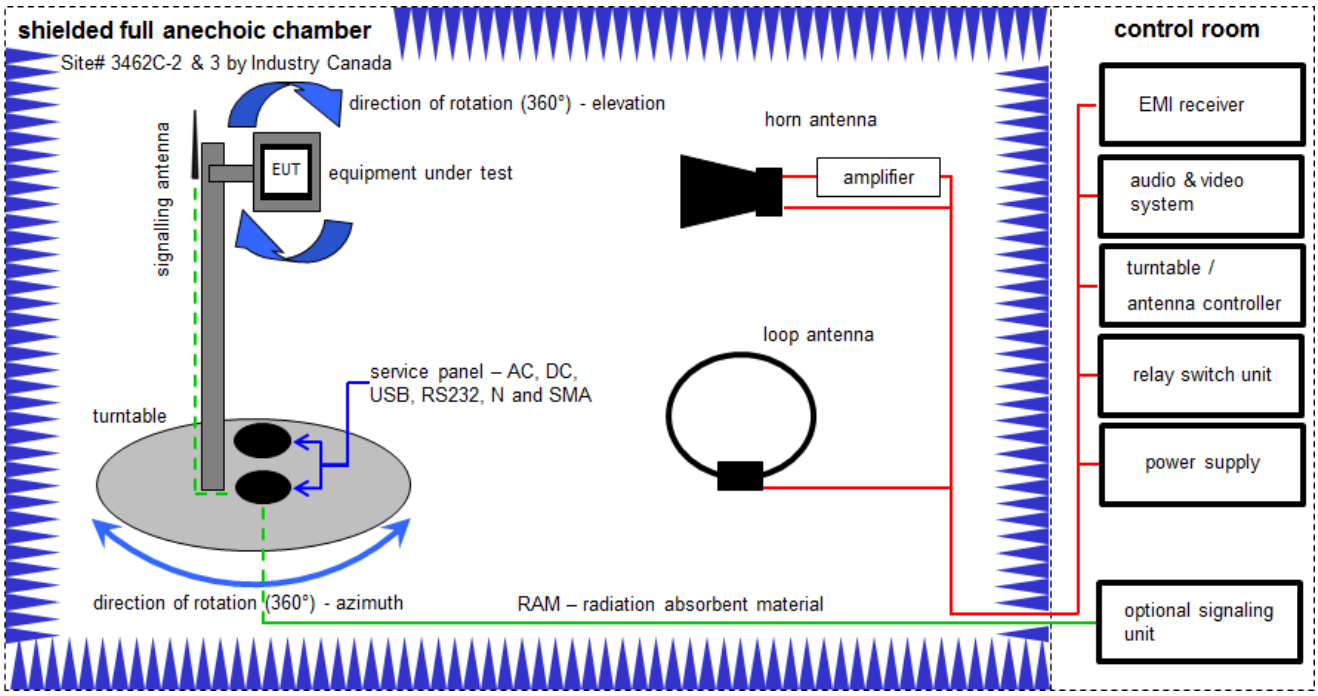
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	01.02.2017	31.01.2018
2	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	02.02.2016	02.02.2018
3	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	0
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	0
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	0
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	25.04.2016	25.04.2018
7	A	Spectrum-Analyzer	FSU26	R&S	200809	300003874	k	31.01.2017	30.01.2018
8	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	0
9	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	0
10	A	Meßkabine 1	HF-Absorberhalle	MWB AG 300023		300000551	ne	-/-	0

6.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter

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

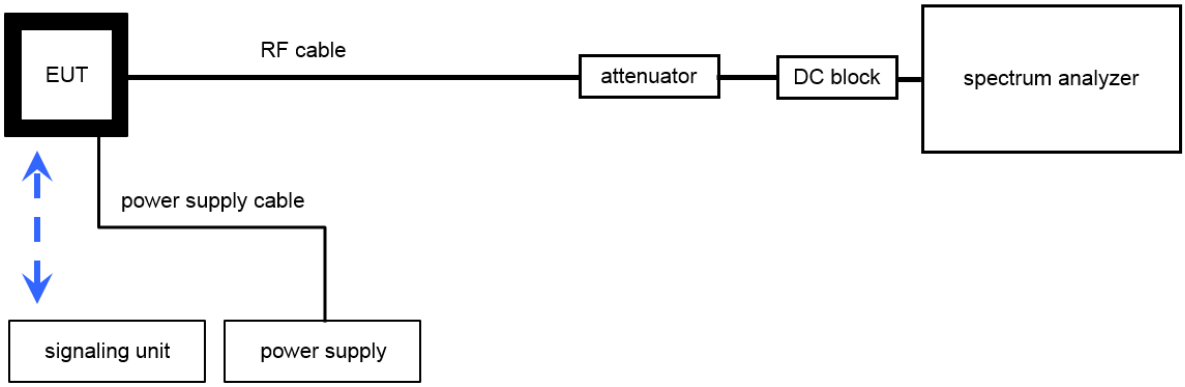
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	0
2	A	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
3	A,B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	31.01.2017	30.01.2018
4	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	0
5	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	0
6	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	0
7	A,B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	0
8	A,B	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO		300004682	ne	-/-	0
9	A,B	PC	ExOne	F+W		300004703	ne	-/-	0
10	A,B	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	Ve	20.01.2015	20.01.2018
11	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	20.05.2015	20.05.2017
12	A,B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	0

6.3 Conducted measurements

Conducted measurements normal conditions



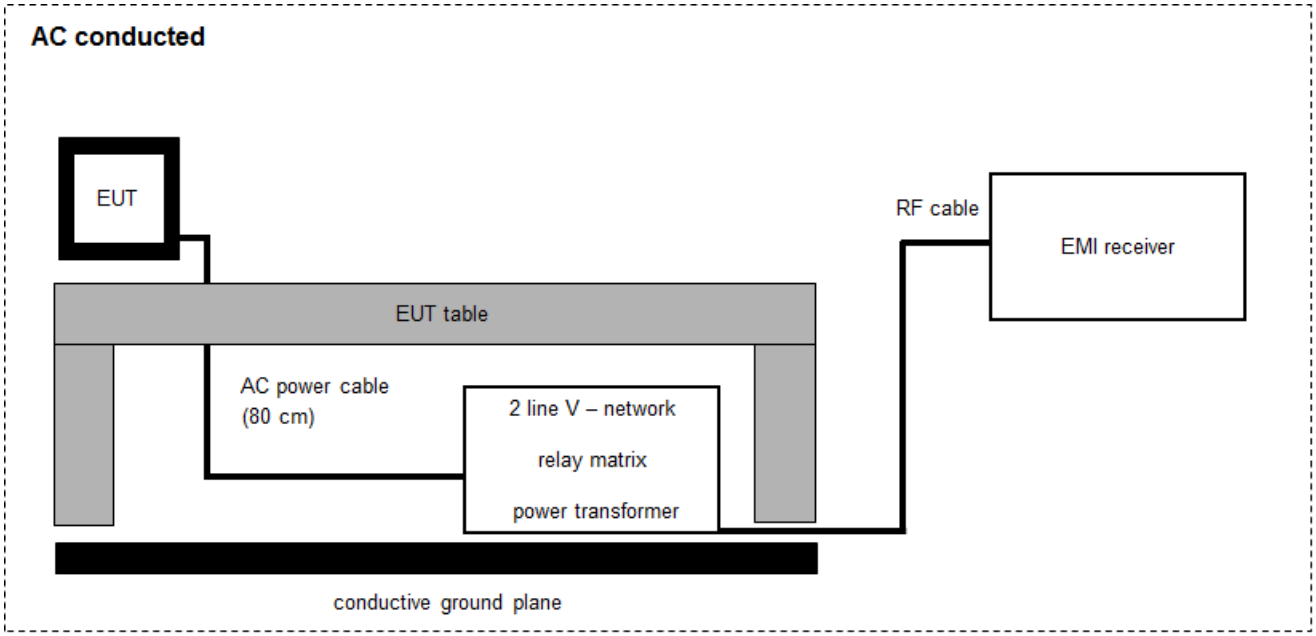
OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal- and Spectrum Analyzer	FSW26	R&S	101455	300004528	k	14.03.2016	14.03.2017
2	A	Coaxial Attenuator	WA23-20-34	Weinschel Ass	B4661	400001130	ev	-/-	0
3	A	HF-Cable 1 m	BPS-1551-394-BPS	Insulated Wire	080492	300001713	g	-/-	0
4	A	Power Supply	2X30V	Zentro	870008	300000830	NK!	-/-	0
5	A	EMI Test Receiver 9 kHz - 3 GHz incl. Preselector	ESPI3	R&S	101713	300004059	k	27.01.2017	26.01.2018

6.4 AC conducted



FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	R&S	893045/004	300000584	k	31.01.2017	30.01.2018
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	k	27.11.2006	-/-
3	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	02.02.2016	02.02.2018
4	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	08.04.2008	-/-
5	A	Power Supply	NGSM 32/10	R&S	3939	400000192	vIKI!	31.01.2017	30.01.2020
6	A	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	16.08.2016	16.08.2017

7 Sequence of testing

7.1 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.

7.2 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.

7.3 Sequence of testing radiated spurious 1 GHz to 12.75 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.

8 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Antenna gain	Declared by manufacturer
Spurious emissions conducted	± 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 Summary of measurement results

☐	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☒	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS - 247, Issue 2	Compliant	2017-05-11	Radiated emissions only

Test specification clause	Test case	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (2)	Antenna gain	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(a)(1) RSS - 247 / 5.1 (2)	Carrier frequency separation	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(a)(1) RSS - 247 / 5.1 (4)	Number of hopping channels	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(a)(1) (iii) RSS - 247 / 5.1 (4)	Time of occupancy (dwell time)	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(a)(1) RSS - 247 / 5.1 (1)	Spectrum bandwidth of a FHSS system bandwidth	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(b)(1) RSS - 247 / 5.4 (2)	Maximum output power	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance radiated	Nominal	Nominal	-/-	☐	☐	☒	☐	No restricted bands nearby
§15.247(d) RSS - 247 / 5.5	Spurious emissions conducted	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-
§15.209(a) RSS - Gen	Spurious emissions radiated below 30 MHz	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 §15.109 RSS - Gen	Spurious emissions radiated 30 MHz to 1 GHz	Nominal	Nominal	TX single channel / RX mode	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 §15.109 RSS - Gen	Spurious emissions radiated above 1 GHz	Nominal	Nominal	TX single channel / RX mode	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Conducted emissions below 30 MHz (AC conducted)	Nominal	Nominal	TX hopping (normal operation)	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

10 RF measurements

10.1 Additional comments

Reference documents: None

Special test descriptions: The EUT has 4 antenna ports. These ports can be used single or in a time division multiplexed mode where only one port is active in a time slot. All ports are equal in the RF performance. All measurements were performed in single port mode on Port1.
The EUT uses the same RF setup as the model ID ISC LRU1002. We only performed the radiated spurious measurements. For the conducted test results see Test Report No. 1-3265_16-01-04

Configuration descriptions: The EUT is designed to be used in combination with different antennas. All conducted measurements were performed with the highest output power supported by the EUT (1 Watt = 30 dBm, conducted output power limit).
For the spurious emission tests radiated we used the following antenna models:

-Harting Ha-VIS RF-ANT LR10 US
-Harting Ha-VIS RF-ANT MR20 US
-Harting Ha-VIS RF-ANT WR30 US
-Harting Ha-VIS RF-ANT WR80 US
-Harting Ha-VIS RF-ANT-WR24 (engineer sample)
-Harting Ha-VIS LOCFIELD

Test mode: ☒ Special software is used.
EUT is transmitting pseudo random data by itself

11 Measurement results

11.1 Antenna gain

Measured:

Antenna gain	
Antenna type	**Gain**
Harting Ha-VIS RF-ANT LR10 US	-30 dBi
Harting Ha-VIS RF-ANT MR20 US	-1.2 dBi
Harting Ha-VIS RF-ANT WR30 US	+5.2 dBi
Harting Ha-VIS RF-ANT WR80 US must be used with at least 5,0 m of cable type Belden H155 (0,3 dB/m) or at least 3,0 m of cable type RG58 (0,5 dB/m).	+5.6 dBi
Harting Ha-VIS RF-ANT-WR24 (engineer sample)	+5.9 dBi
Harting Ha-VIS LOCFIELD	-7 dBi

11.2 Carrier Frequency Separation

Description:

Measurement of the carrier frequency separation of a hopping system. The carrier frequency separation is constant for all modulation-modes. We use ASK-modulation to show compliance. EUT in hopping mode.

Measurement parameters	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	10 kHz
Video bandwidth	30 kHz
Span	See plots
Trace mode	Max hold
Test setup	See sub clause 6.3 A
Measurement uncertainty	See sub clause 8

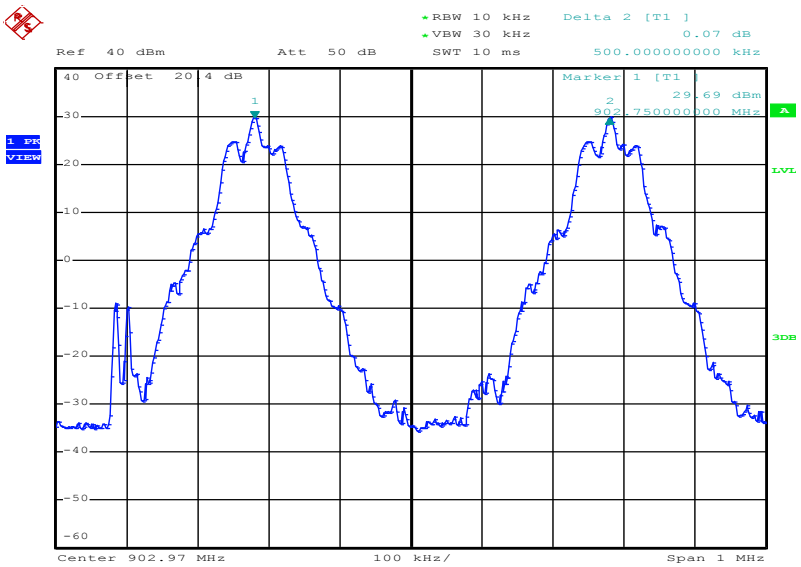
Limits:

FCC	IC
Carrier frequency separation	
Minimum 25 kHz or two-thirds of the 20 dB bandwidth of the hopping system whichever is greater. The two-thirds of the 20 dB bandwidth for IC is only valid for the ISM band 2400 – 2483.5 MHz.	

Result: The channel separation is 500 kHz.

Plots:

Plot 1: Frequency separation



Date: 1.MAR.2017 13:57:47

11.3 Number of Hopping Channels

Description:

Measurement of the total number of used hopping channels. The number of hopping channels is constant for all modulation-modes. We use ASK -modulation to show compliance. EUT in hopping mode.

Measurement parameters	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	See plots
Video bandwidth	See plots
Span	See plots
Trace mode	Max hold
Test setup	See sub clause 6.3 A
Measurement uncertainty	See sub clause 8

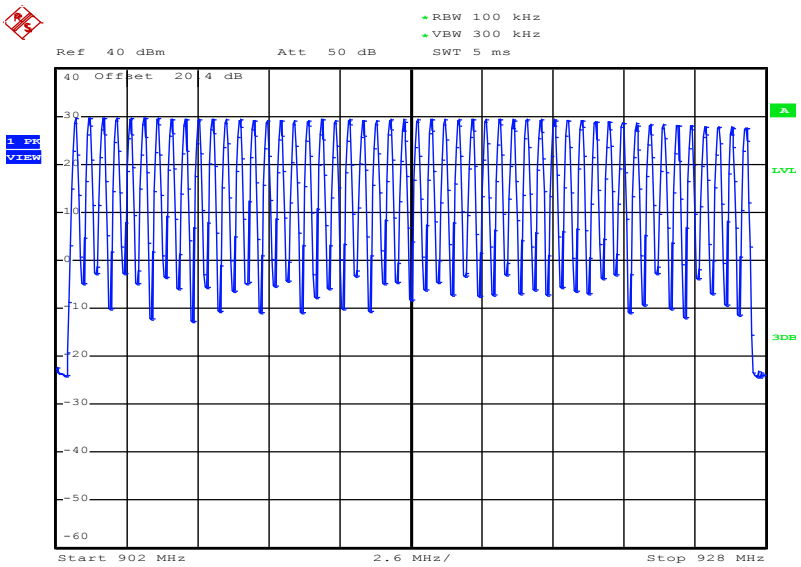
Limits:

FCC	IC
Number of hopping channels	
At least 15 non overlapping hopping channels. If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels.	

Result: The EUT uses 50 channels.

Plots:

Plot 1: Number of channels



Date: 1.MAR.2017 14:07:27

11.4 Average Time of Occupancy (dwell time)

Measurement:

The measurement is performed in zero span mode to show that none of the 50 used channels is allocated more than 0.4 seconds within a 20 seconds interval (50 channels times 0.4s).

Limits:

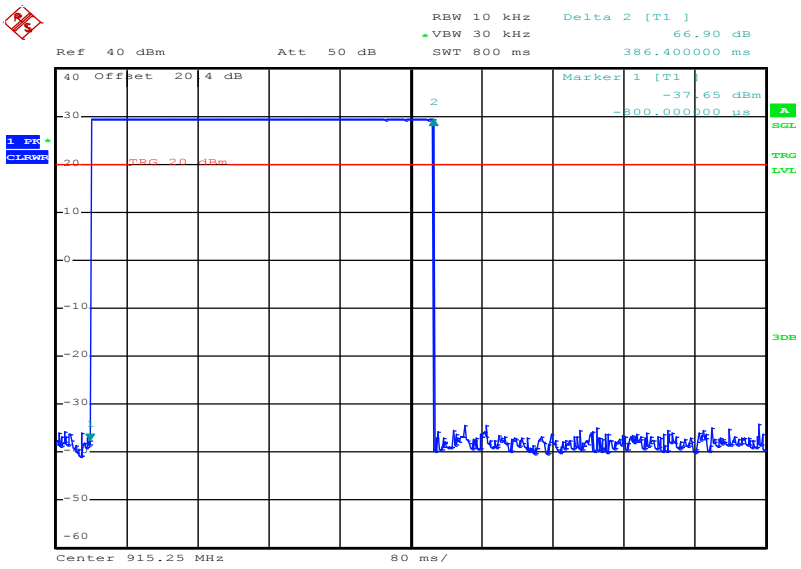
FCC	IC
Average time of occupancy	
For frequency hopping systems operating in the 902-928 MHz band: If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within 10 second period.	

Result: The time slot length is = 386.4 ms
Number of hops / channel @ 20s = 1

Within 20 s period, the average time of occupancy in 20 s: 386.4 ms

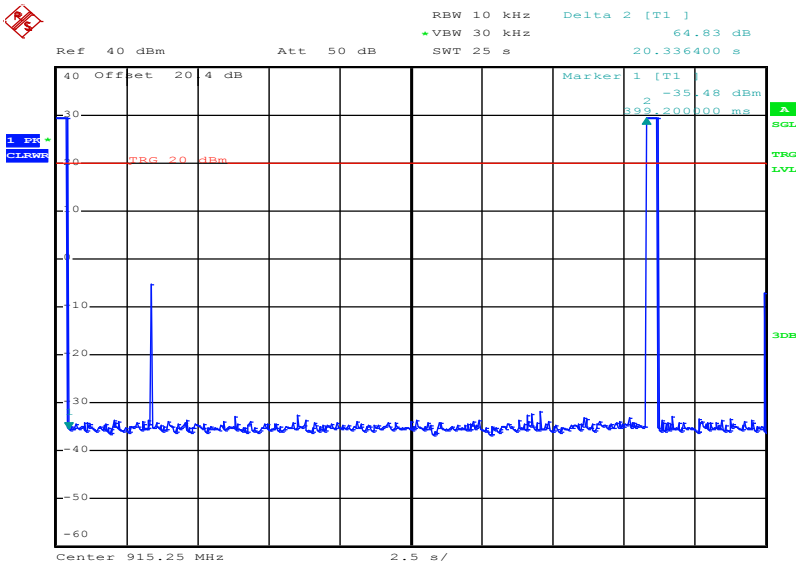
Plots:

Plot 1: Time slot length = 386.4 ms



Date: 1.MAR.2017 14:02:33

Plot 2: hops / channel @ 20s = 1



Date: 1.MAR.2017 14:05:04

11.5 Spectrum bandwidth of a FHSS system

Description:

Measurement of the 20dB bandwidth and 99% bandwidth of the modulated signal. The measurement is performed according to the “Measurement Guidelines” (DA 00-705, March 30, 2000). EUT in single channel mode.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	300 Hz
Video bandwidth	>3*RBW
Span	See plots
Trace mode	Max hold
Test setup	See sub clause 6.3 A
Measurement uncertainty	See sub clause 8

Limits:

FCC	IC
Spectrum bandwidth of a FHSS system	
ASK < 1500 kHz	

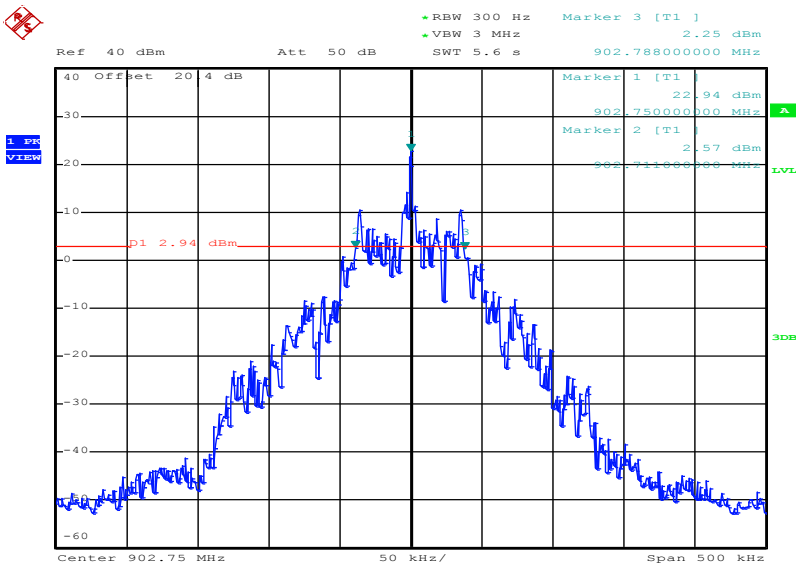
Result:

Test Conditions		20dB BANDWIDTH [kHz]		
		Low channel	Middle channel	High channel
T_{nom}	V_{nom}	77.0	78.0	78.0

Test Conditions		99% BANDWIDTH [kHz]		
		Low channel	Middle channel	High channel
T_{nom}	V_{nom}	97.0	97.0	95.0

Plots:

Plot 1: Low Channel 20 dB-Bandwidth



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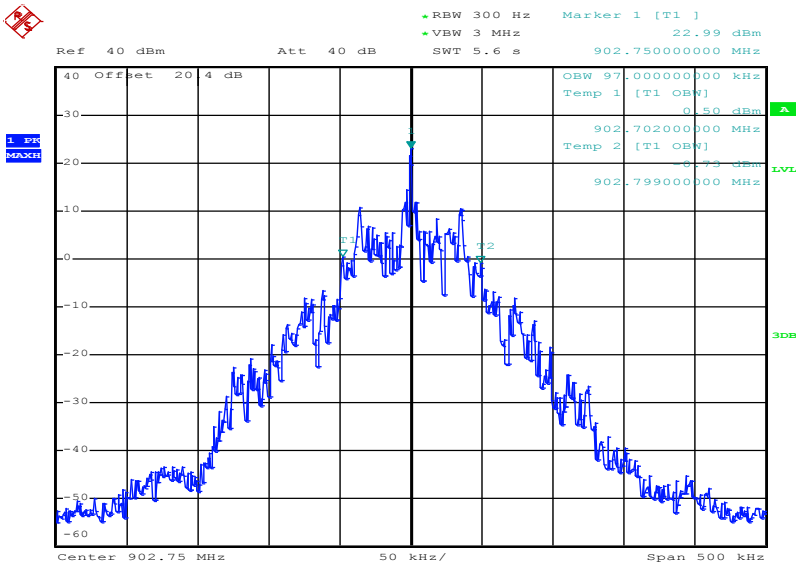
Plot 2: Low Channel OBW 99



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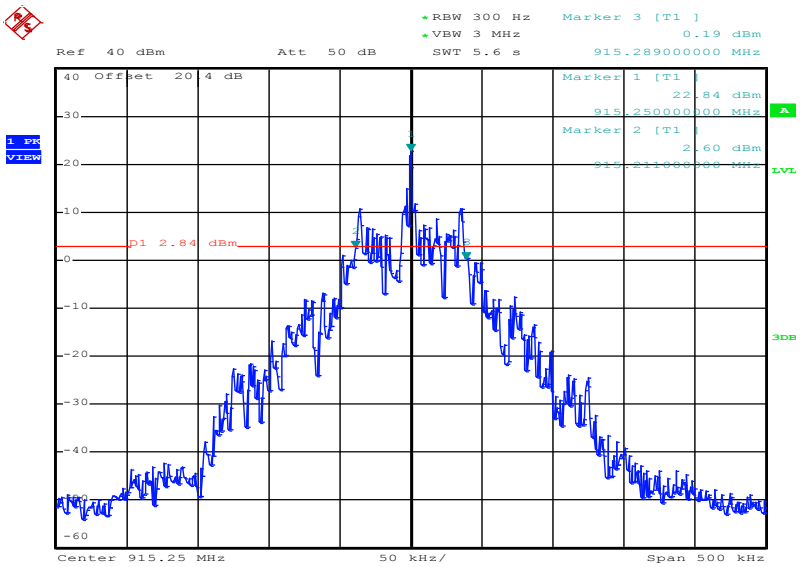
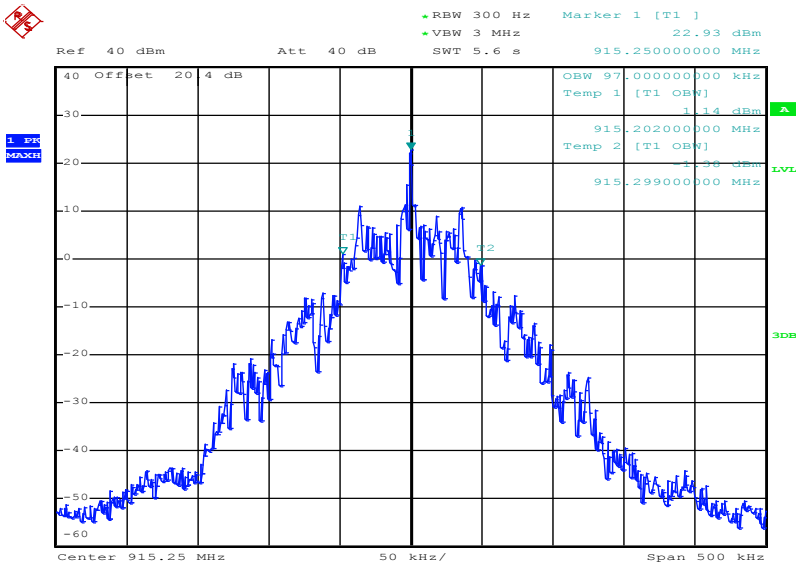
Plot 3: Middle Channel 20 dB-Bandwidth



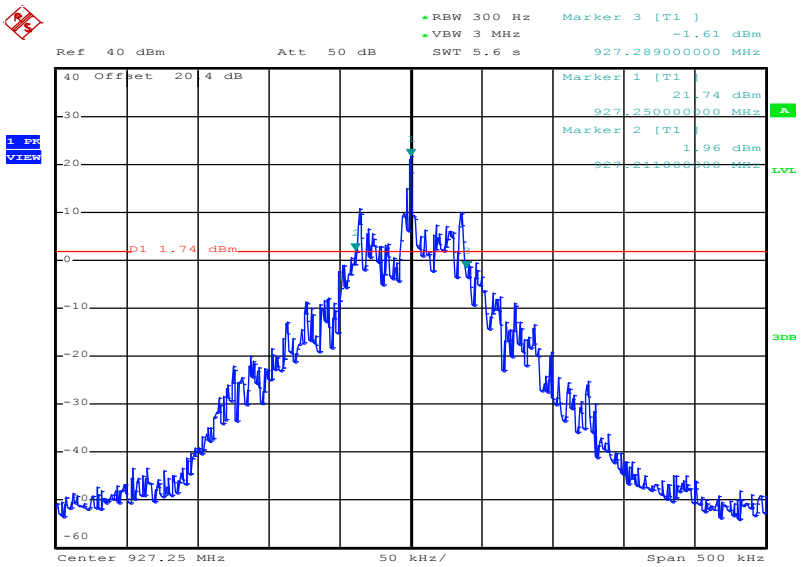
Date: 1.MAR.2017 13:51:08

Plot 4: Middle Channel OBW 99



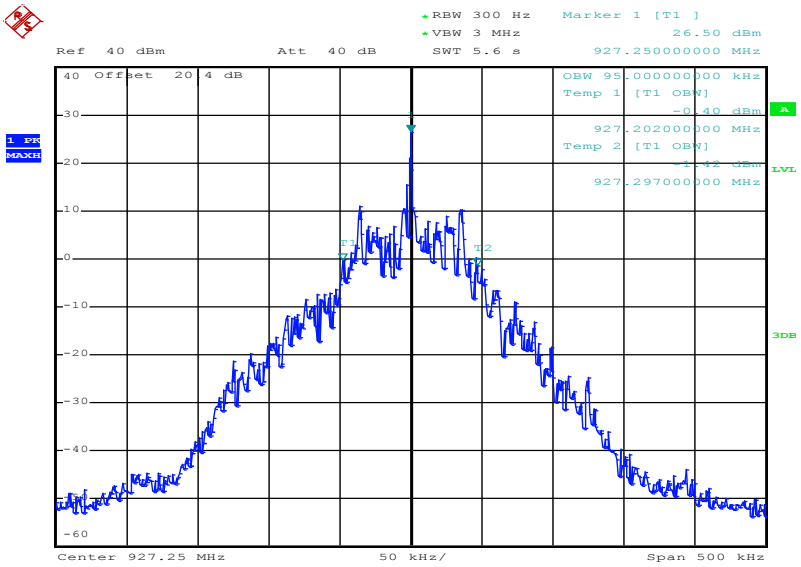
Date: 1.MAR.2017 13:51:59

Plot 5: High Channel 20 dB-Bandwidth



Date: 1.MAR.2017 13:49:27

Plot 6 High Channel OBW 99



Date: 1.MAR.2017 13:47:51

11.6 Maximum Output Power

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	5 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.3 A
Measurement uncertainty:	See chapter 8

Limits:

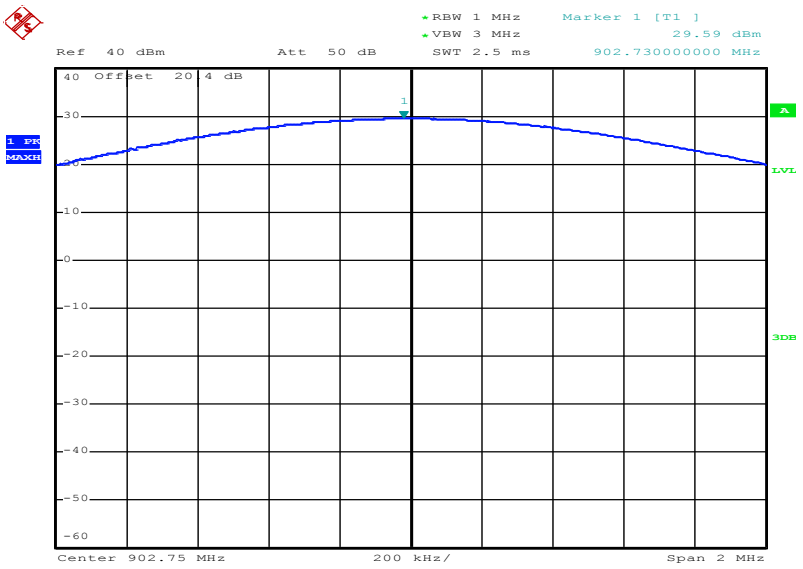
FCC	IC
Maximum Output Power Conducted	
For frequency hopping systems operating in the 902–928 MHz band: 1 watt (30 dBm) for systems employing at least 50 hopping channels; and, 0.25 watts (24 dBm) for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi	

Result:

Test Conditions		Maximum Output Power Conducted [dBm]		
		Low channel	Middle channel	High channel
T_{nom}	V_{nom}	29.6	29.2	28.6
	Max antenna gain	5.9 dbi		
	EIRP	35.5	35.1	34.5

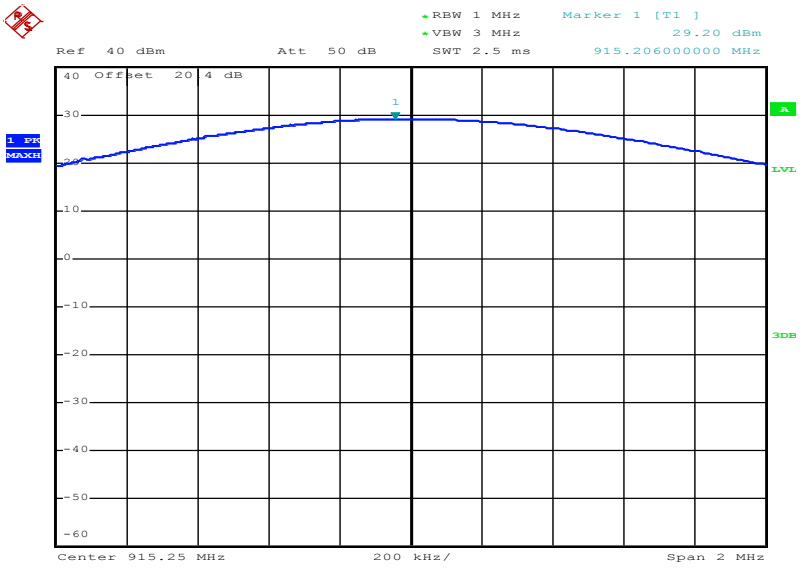
Plots:

Plot 1: Low Channel



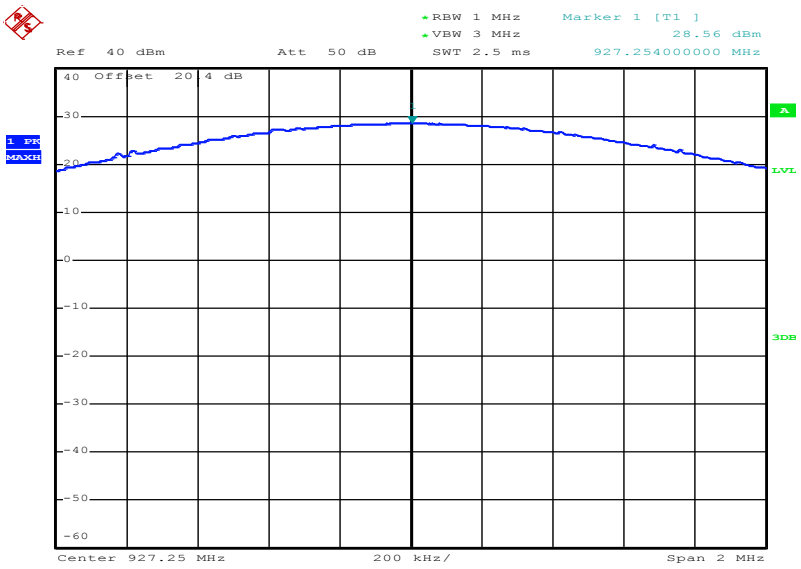
Date: 1.MAR.2017 13:40:56

Plot 2: Middle Channel



Date: 1.MAR.2017 13:41:34

Plot 3: High Channel



Date: 1.MAR.2017 13:42:24

11.7 Detailed spurious emissions @ the band edge – conducted and radiated

Description:

Measurement of the conducted band edge compliance. EUT is measured at the lower and upper band edge in single channel and hopping mode. The measurement is repeated for all modulations.

Measurement parameters	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Span	Lower Band Edge: 902 MHz Upper Band Edge: 928 MHz
Trace mode	Max hold
Test setup	See sub clause 6.3 A
Measurement uncertainty	See sub clause 8

Limits:

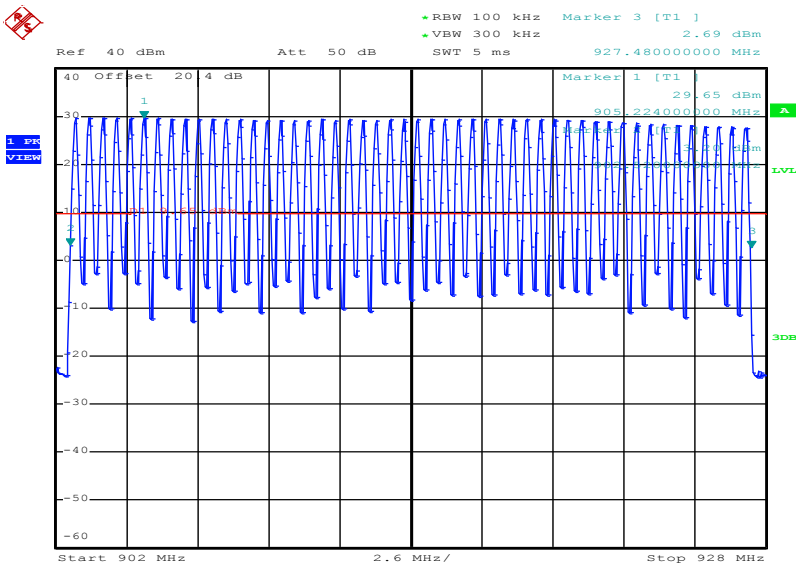
FCC	IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.	

Results conducted:

Scenario	Spurious band edge conducted [dB]		
Modulation	lowest channel	middle channel	highest channel
Lower band edge – hopping on	> 20 dB	> 20 dB	> 20 dB
Upper band edge – hopping on	> 20 dB	> 20 dB	> 20 dB

Plots:

Plot 1: 20 dB – hopping on



Date: 1.MAR.2017 14:08:15

Results radiated:

No restricted band in the range ± 2 channel bandwidths of the Band-edges of the specified emission band! (608 MHz – 614 MHz and 960 MHz – 1240 MHz).

Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

11.8 Spurious Emissions Conducted

Description:

Measurement of the conducted spurious emissions in transmit mode. The EUT is set to single channel mode. The measurement is repeated for low, mid and high channel.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	F < 1 GHz: 1 MHz F > 1 GHz: 1 MHz
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 100 kHz
Span:	9 kHz to 12.75 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.3A
Measurement uncertainty:	See chapter 8

Limits:

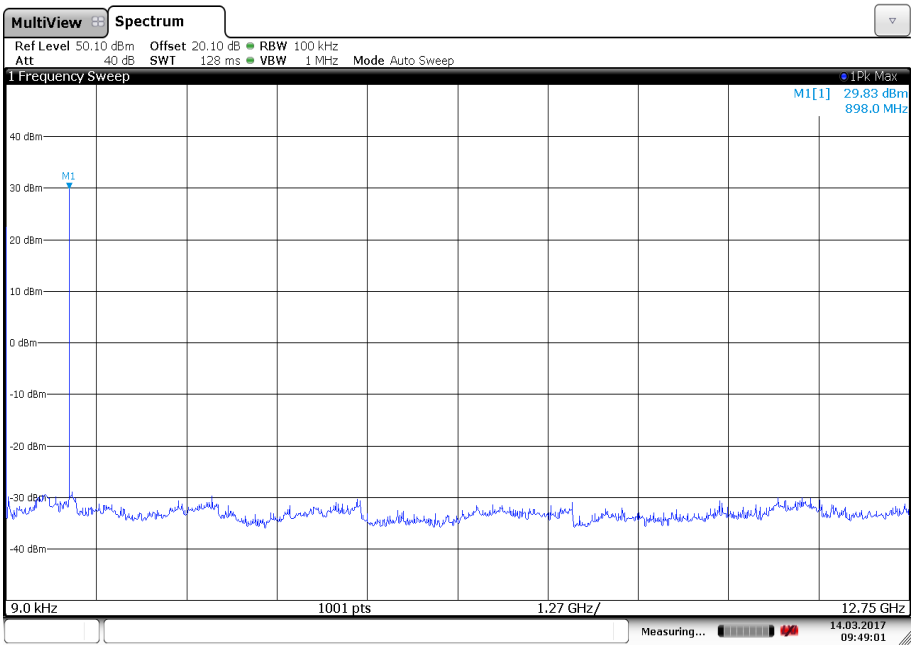
FCC	IC
TX spurious emissions conducted	
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required	

Result:

Emission Limitation					
Frequency [MHz]		Amplitude of emission [dBm]	Limit max. allowed emission power	actual attenuation below frequency of operation [dB]	Results
902.75		29.83	30 dBm		Operating frequency
No emissions detected!			-20 dBc		
915.25		29.91	30 dBm		Operating frequency
No emissions detected!			-20 dBc		
927.25		29.03	30 dBm		Operating frequency
No emissions detected!			-20 dBc		

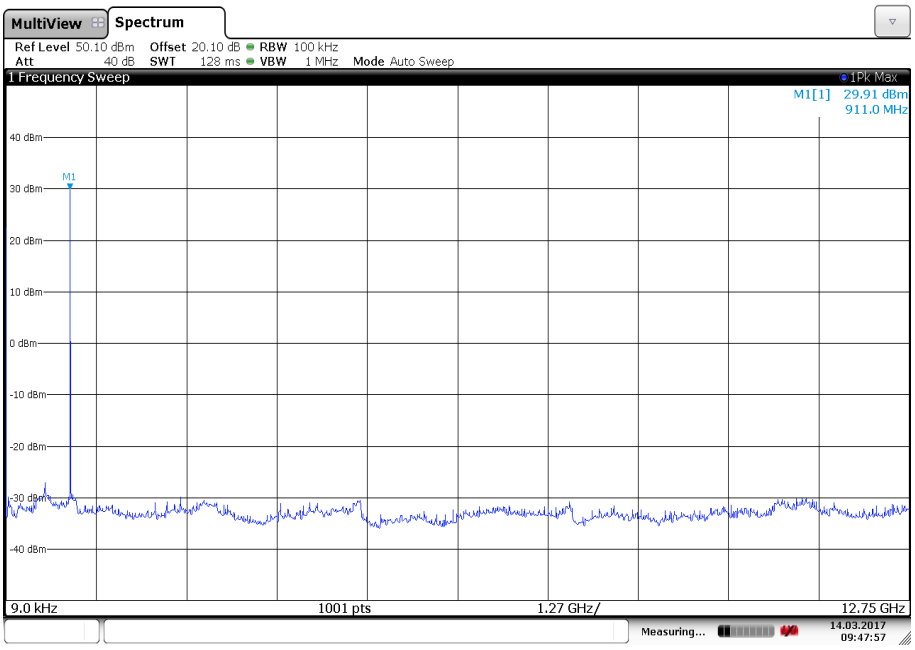
Plots:

Plot 1: Low channel, 9 kHz – 12.75 GHz



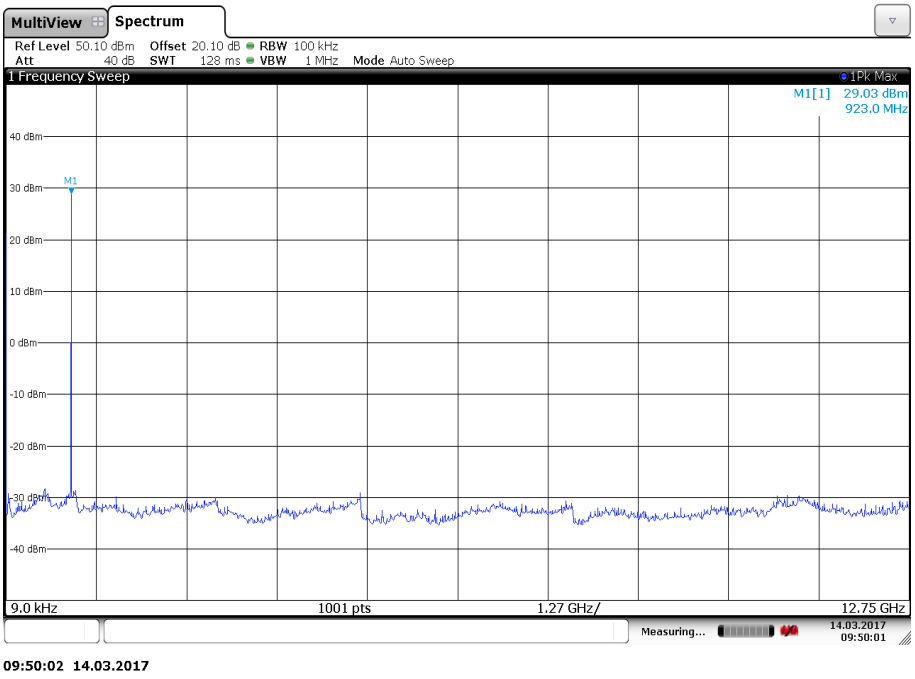
09:49:01 14.03.2017

Plot 2: Middle channel, 9 kHz – 12.75 GHz



09:47:57 14.03.2017

Plot 3: High channel, 9 kHz – 12.75 GHz



11.9 Spurious Emissions Radiated < 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channels are 00; 39 and 78. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m according the ANSI C63.10.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 6.2 A
Measurement uncertainty:	See chapter 8

Limits:

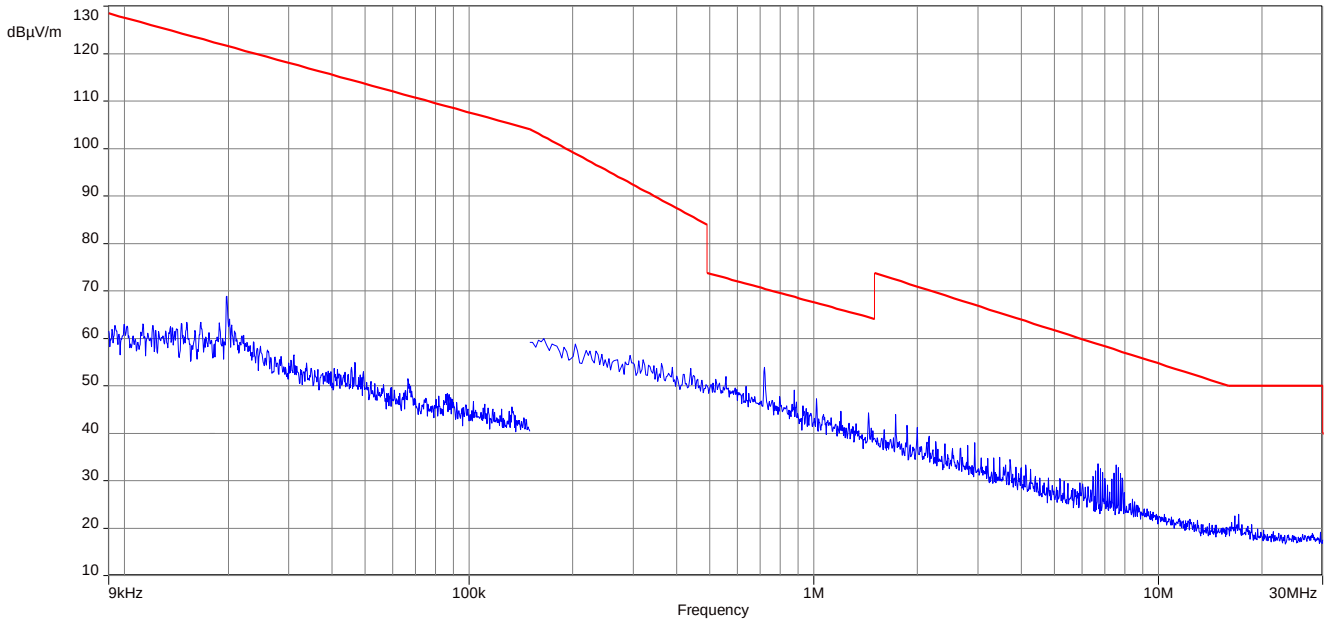
FCC		IC
TX spurious emissions radiated < 30 MHz		
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Result:

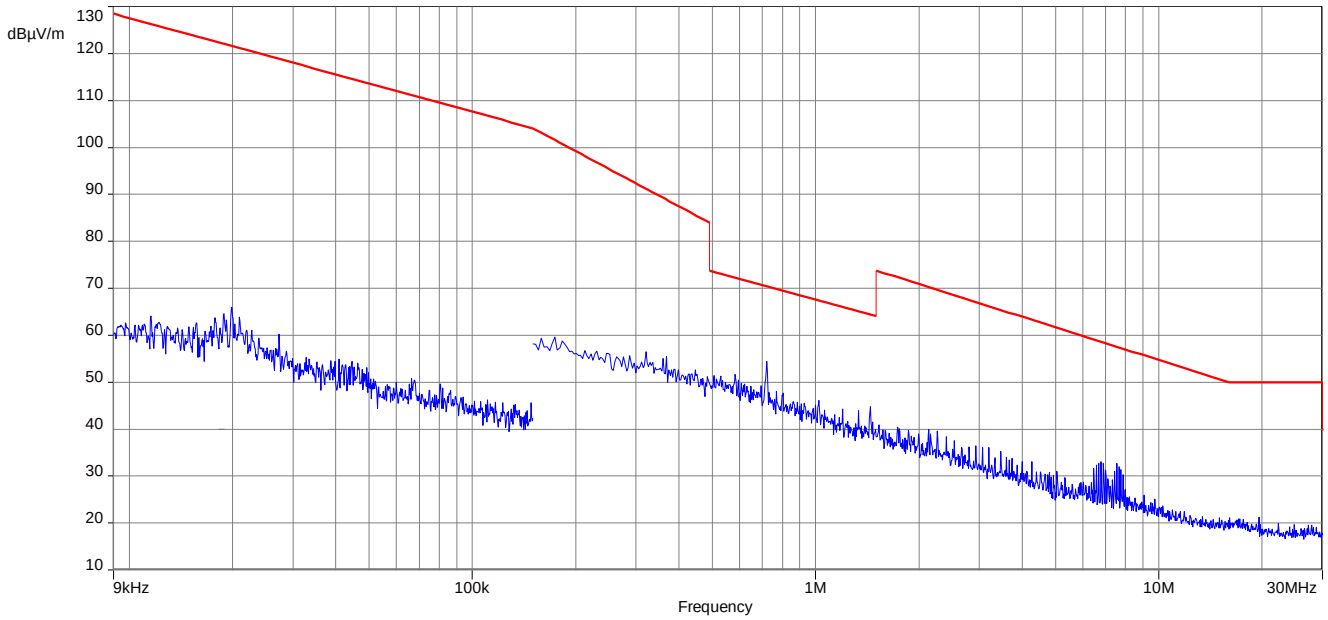
SPURIOUS EMISSIONS LEVEL [dBµV/m]								
Lowest channel			Middle channel			Highest channel		
Frequency [MHz]	Detector	Level [dBµV/m]	Frequency [MHz]	Detector	Level [dBµV/m]	Frequency [MHz]	Detector	Level [dBµV/m]
All emissions were more than 10 dB below the limit.								

Plots antenna LR10:

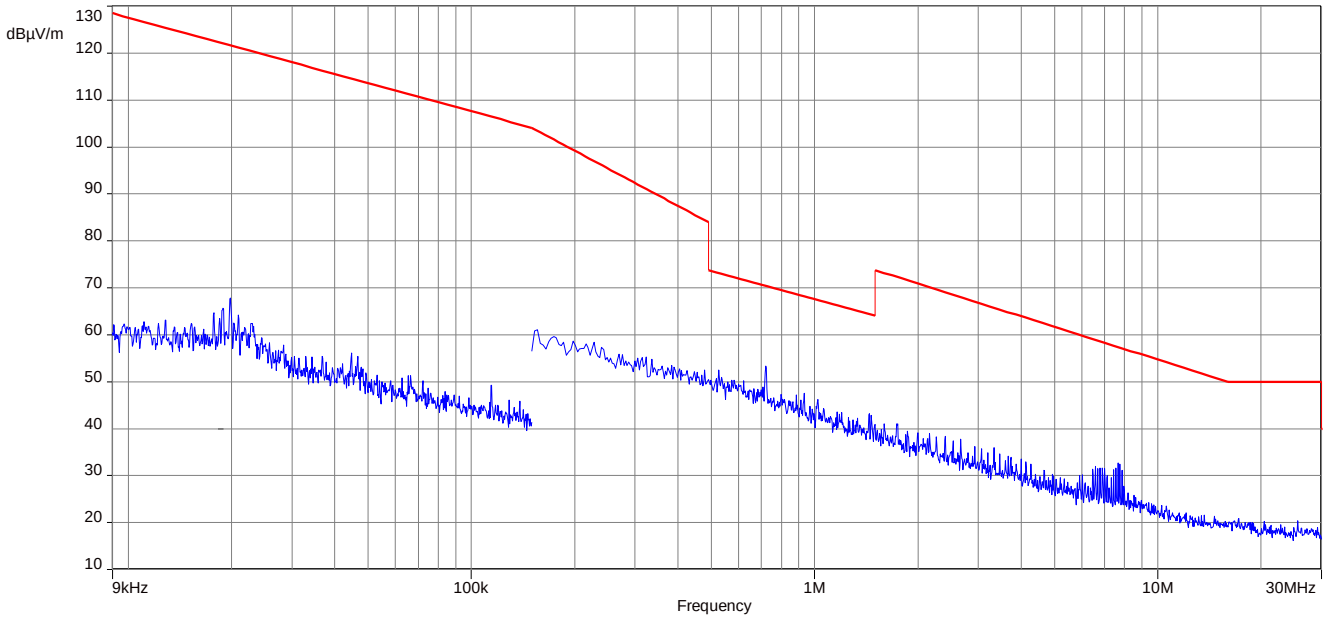
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel

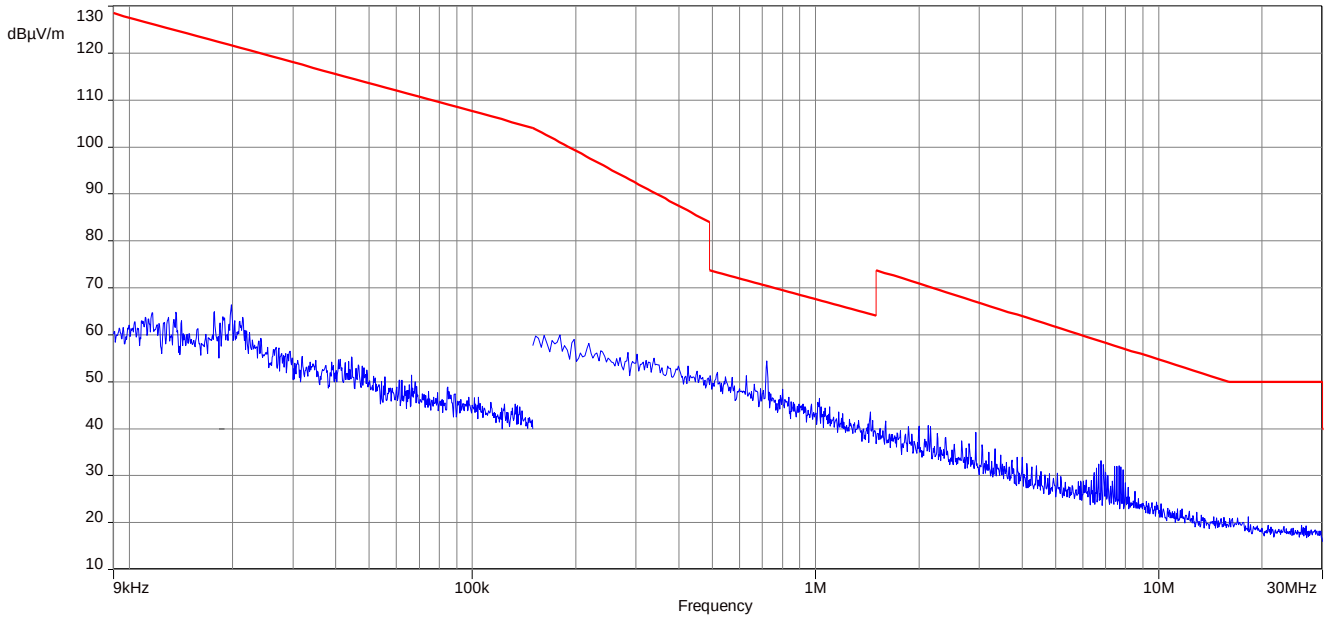


Plot 3: TX-Mode high channel

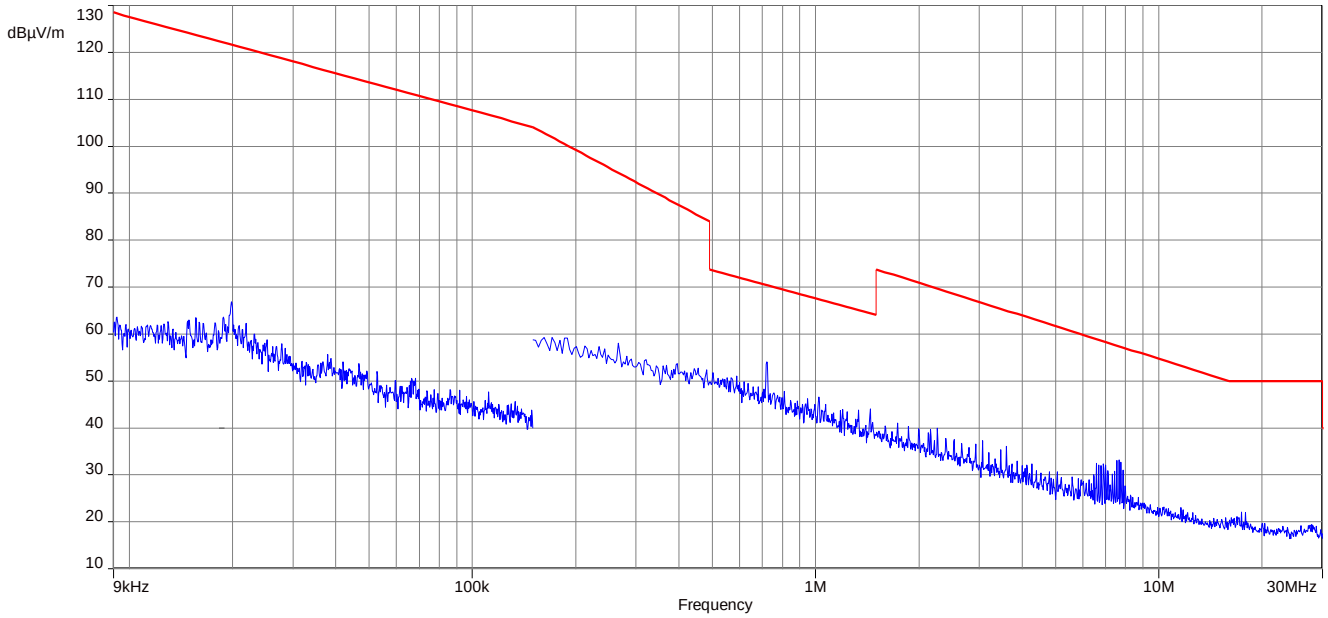


Plots antenna MR20US:

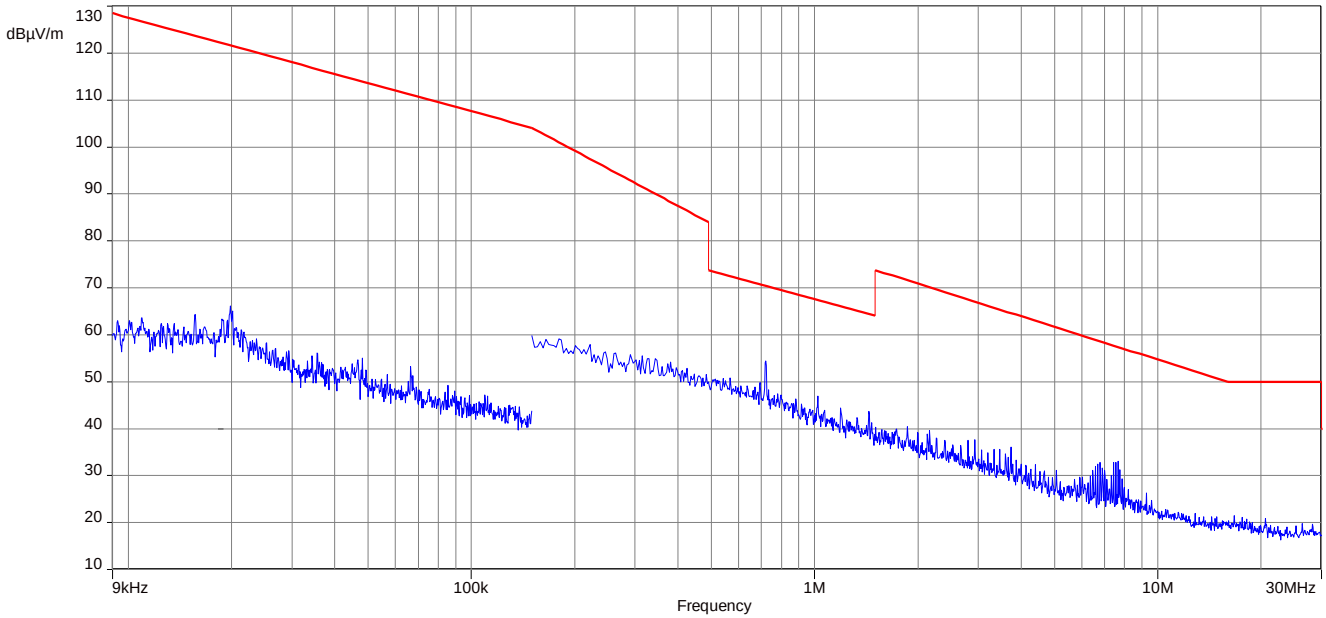
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel

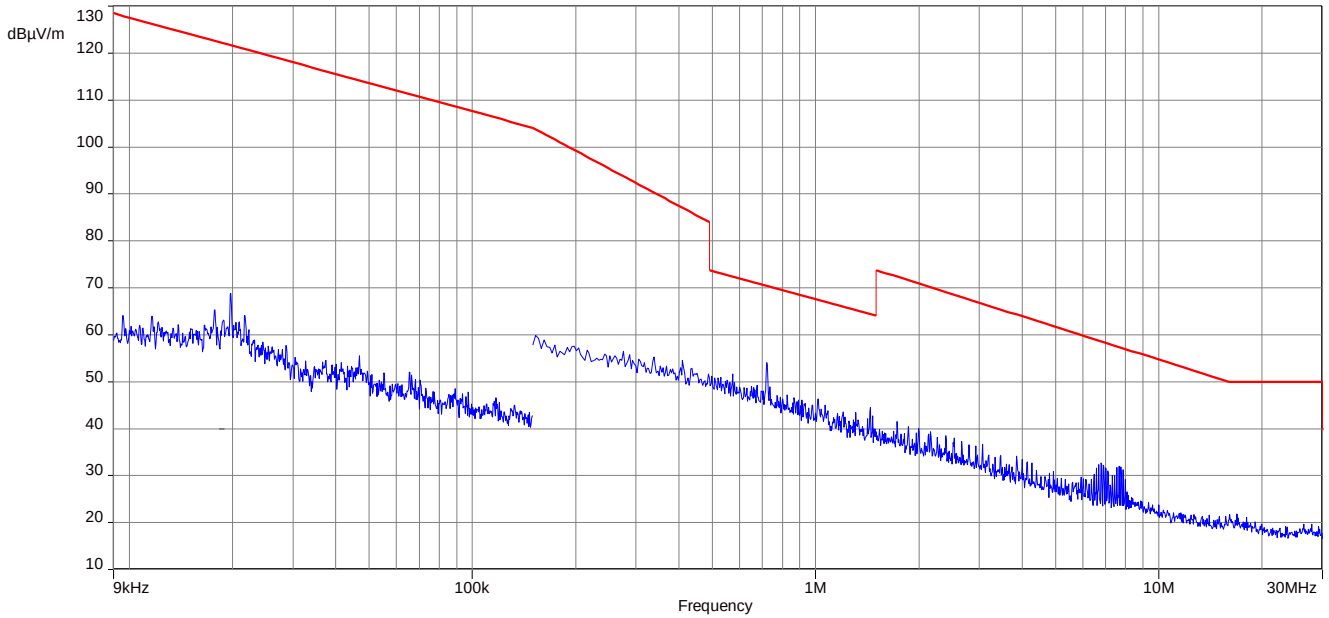


Plot 3: TX-Mode high channel

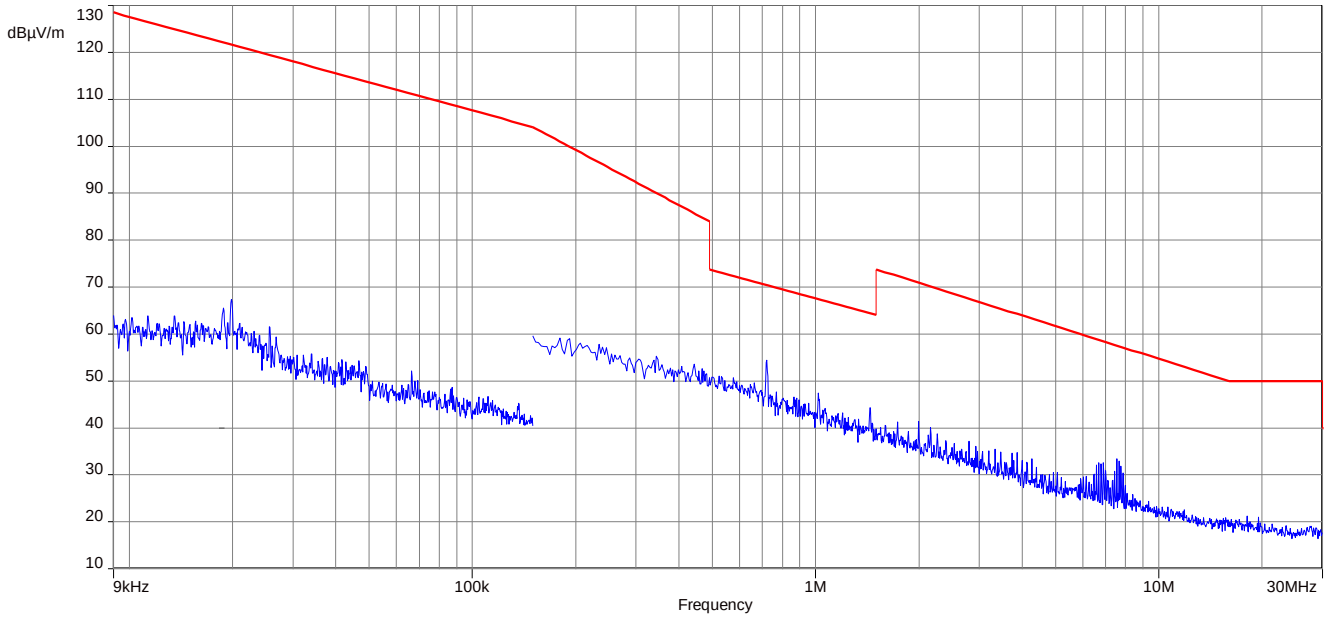


Plots antenna WR24 engineer sample:

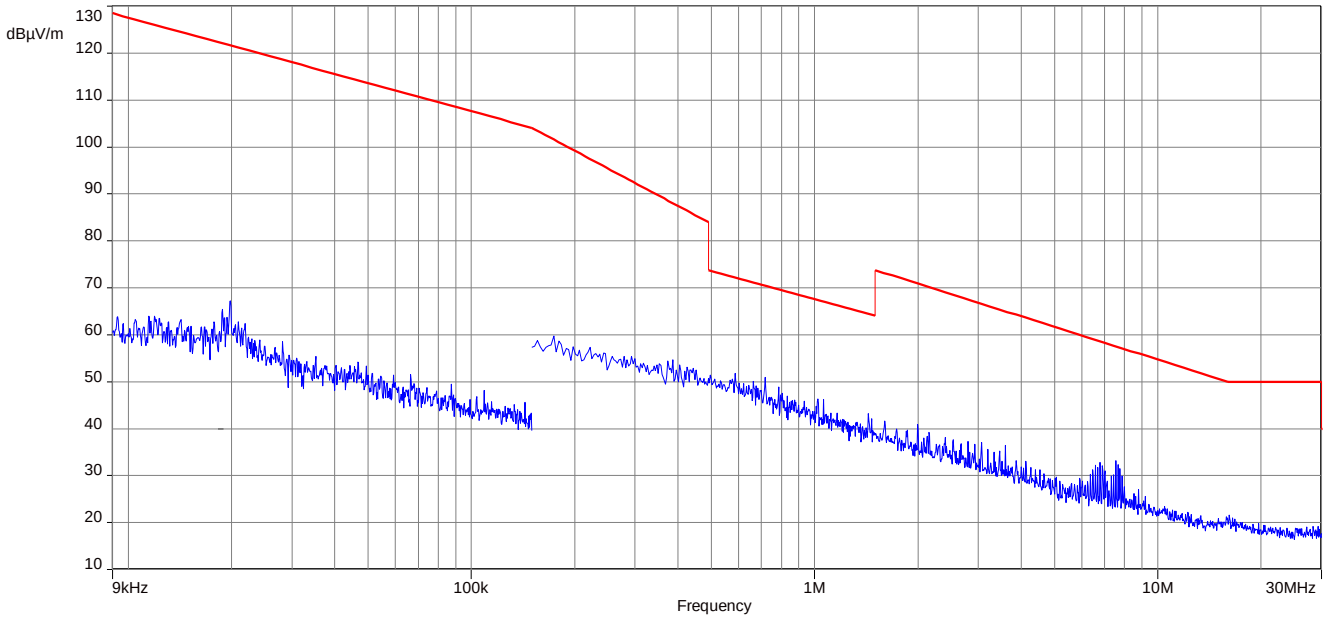
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel

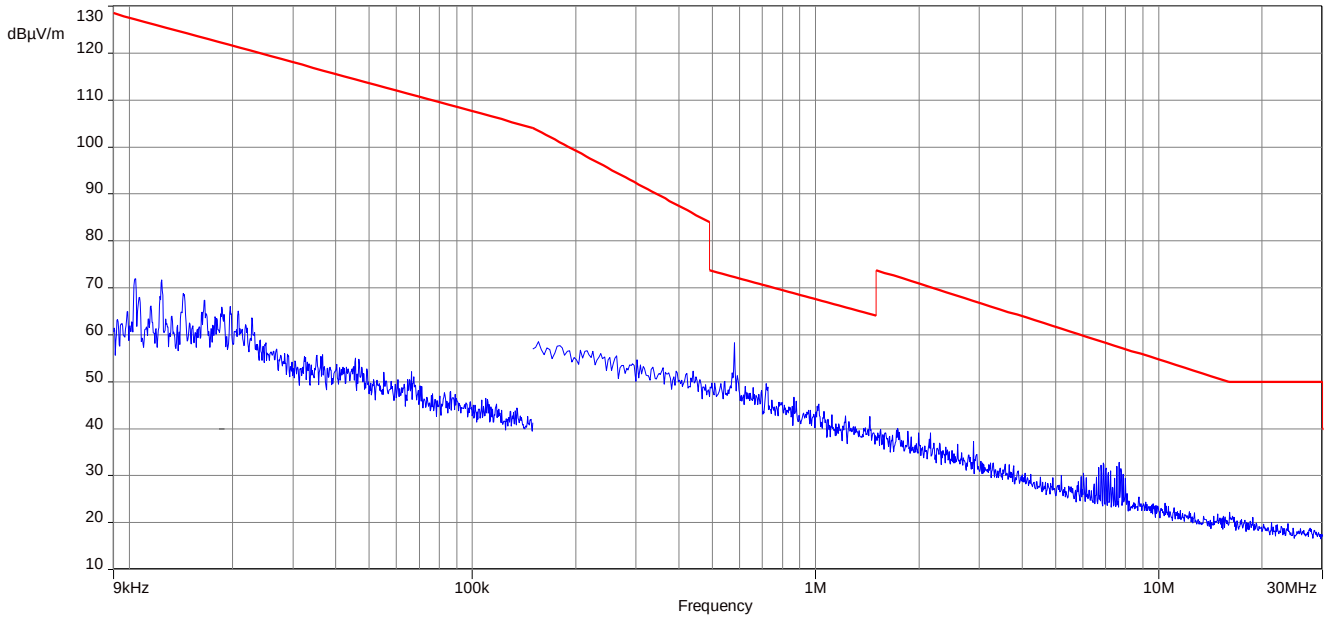


Plot 3: TX-Mode high channel

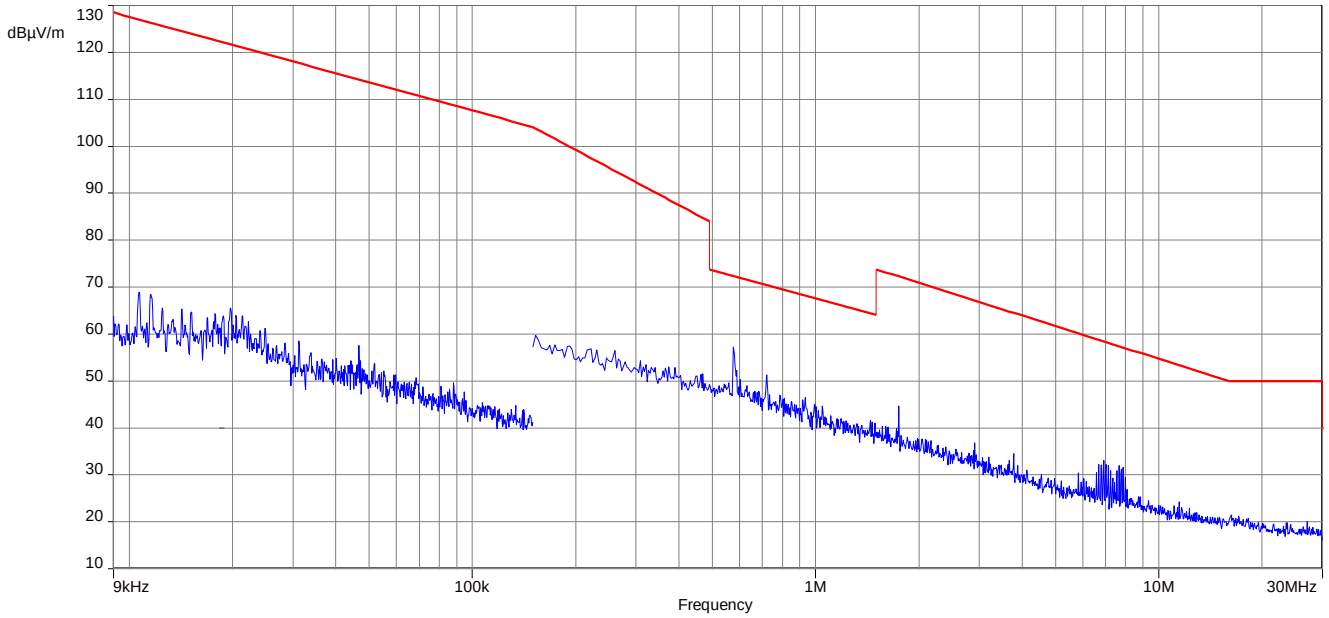


Plots antenna WR30US:

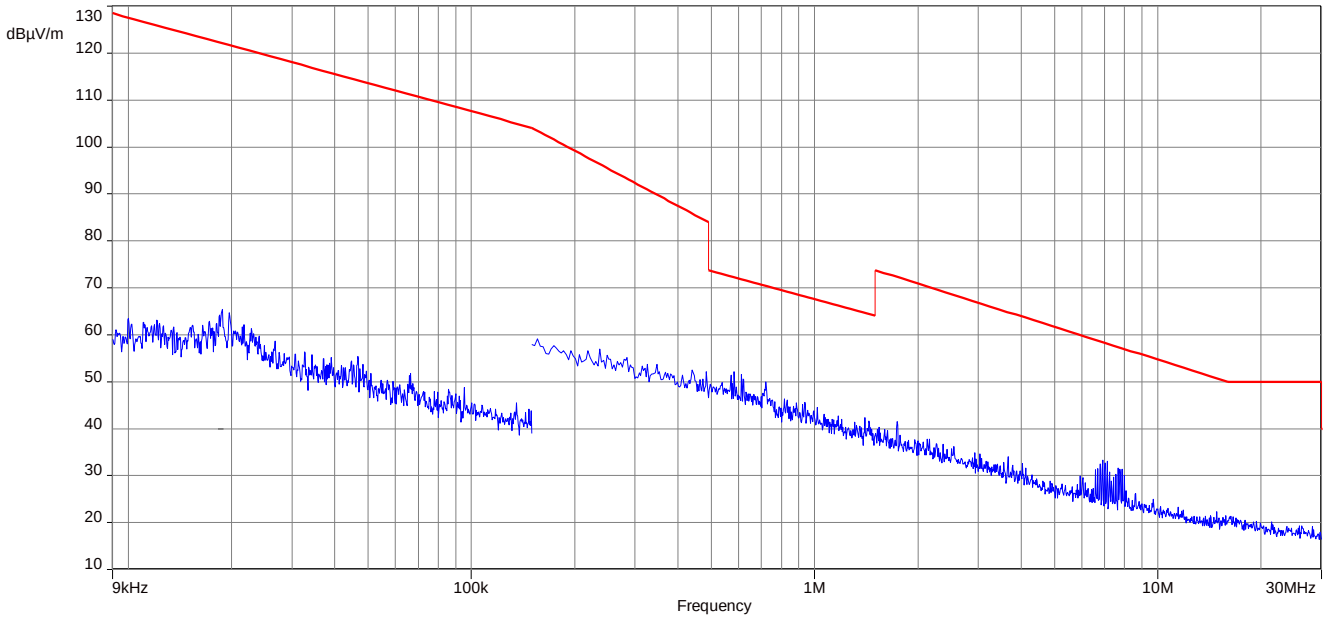
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel

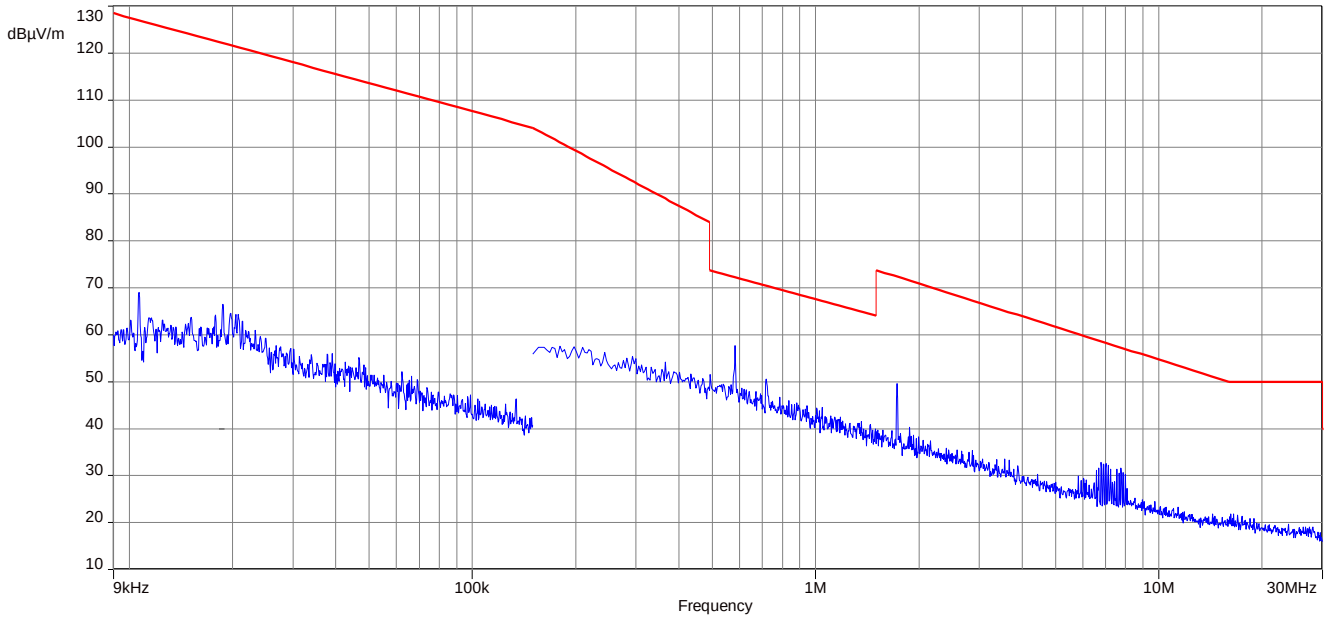


Plot 3: TX-Mode high channel

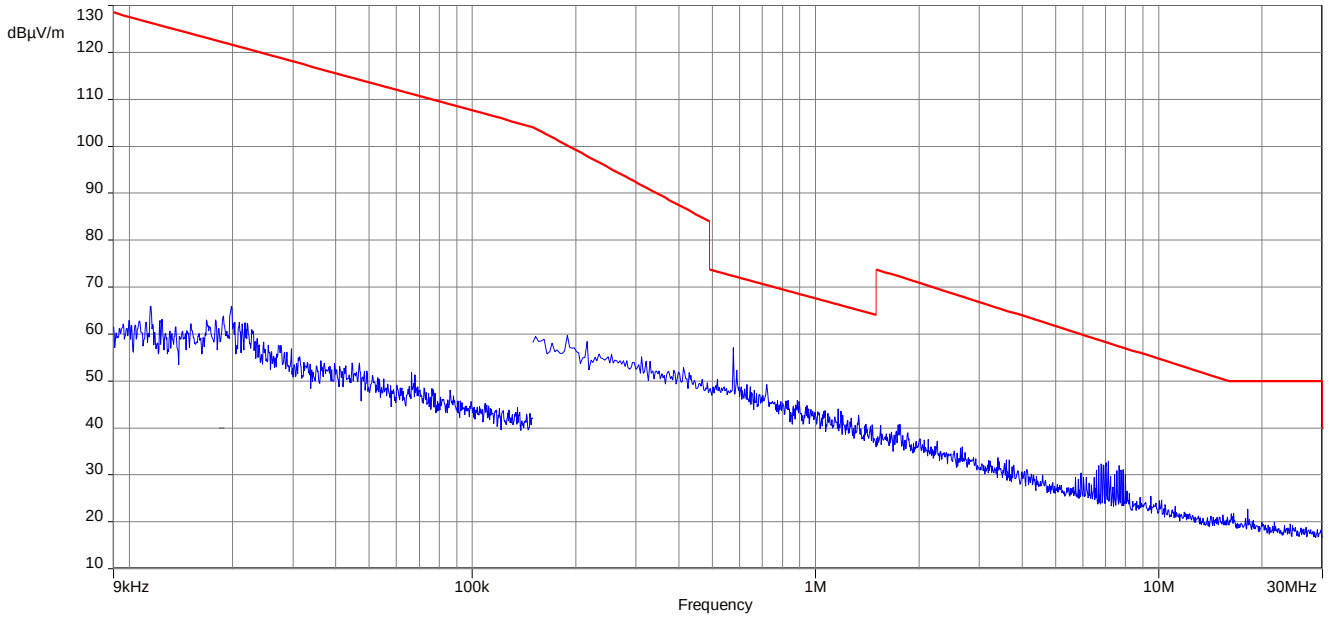


Plots antenna WR80-30-US:

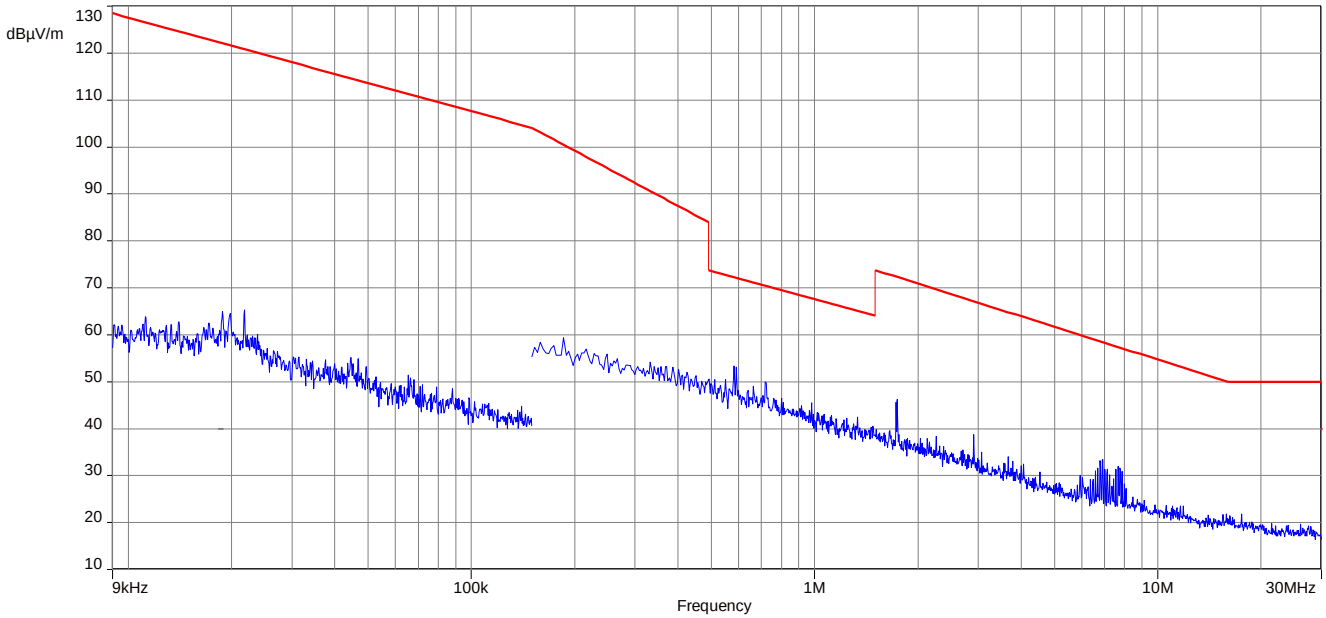
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel

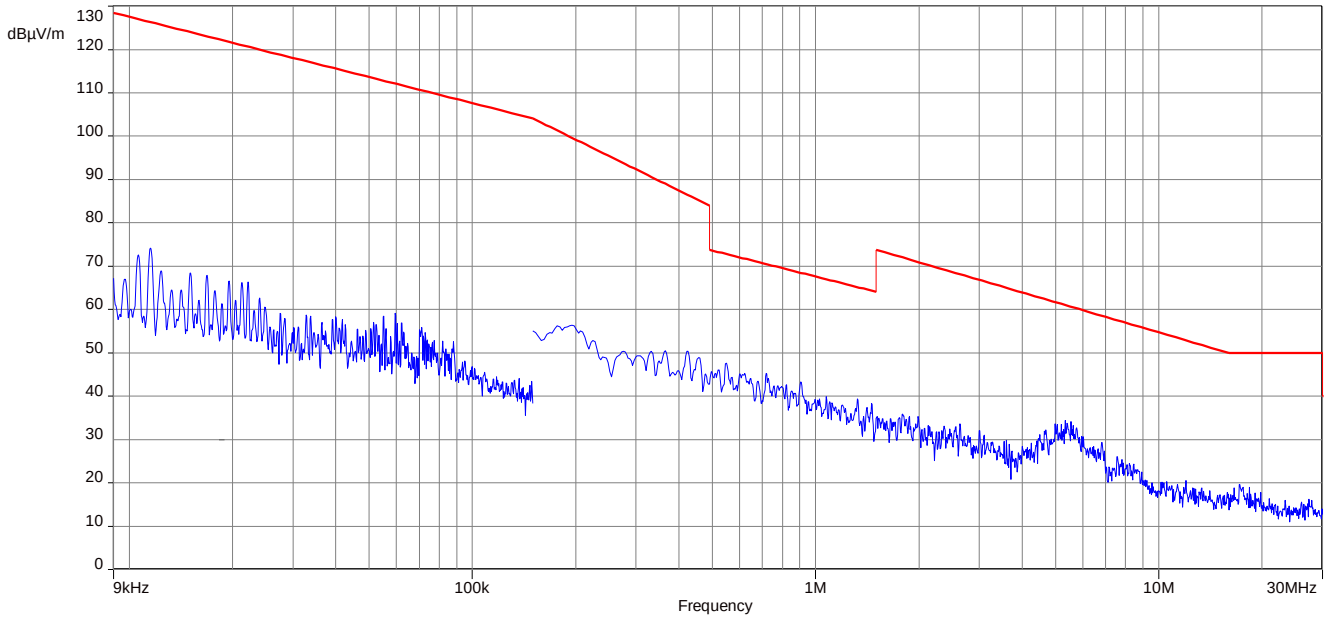


Plot 3: TX-Mode high channel

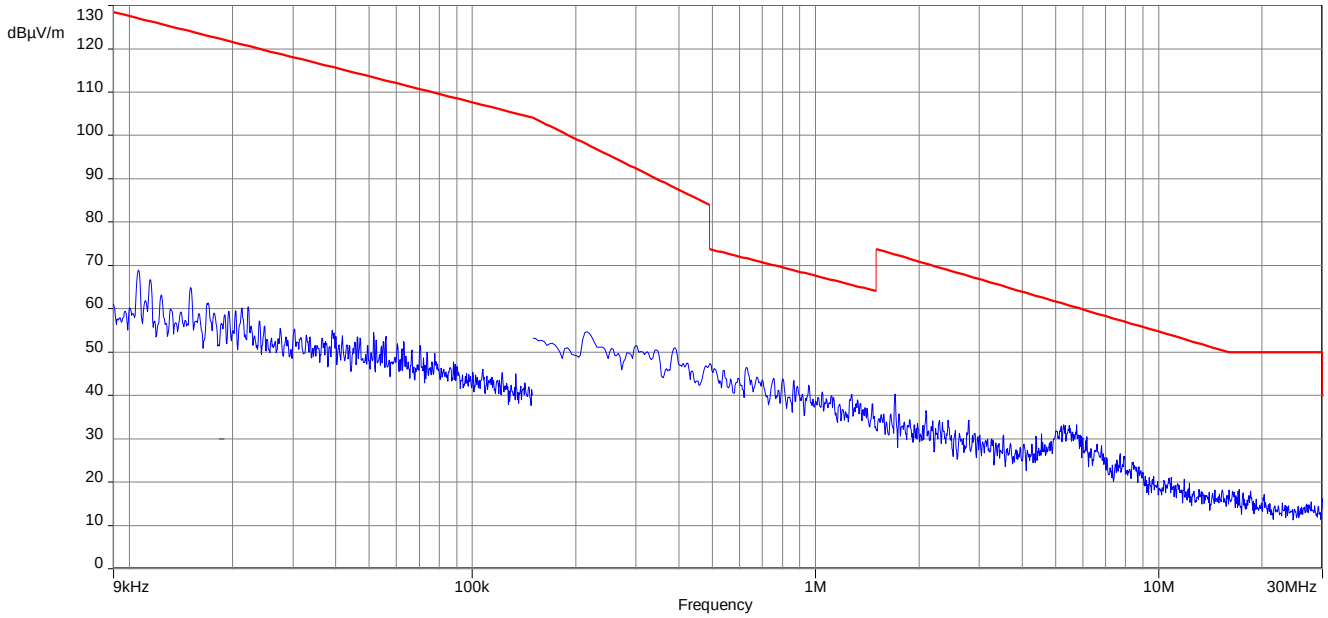


Plots antenna LOCFIELD:

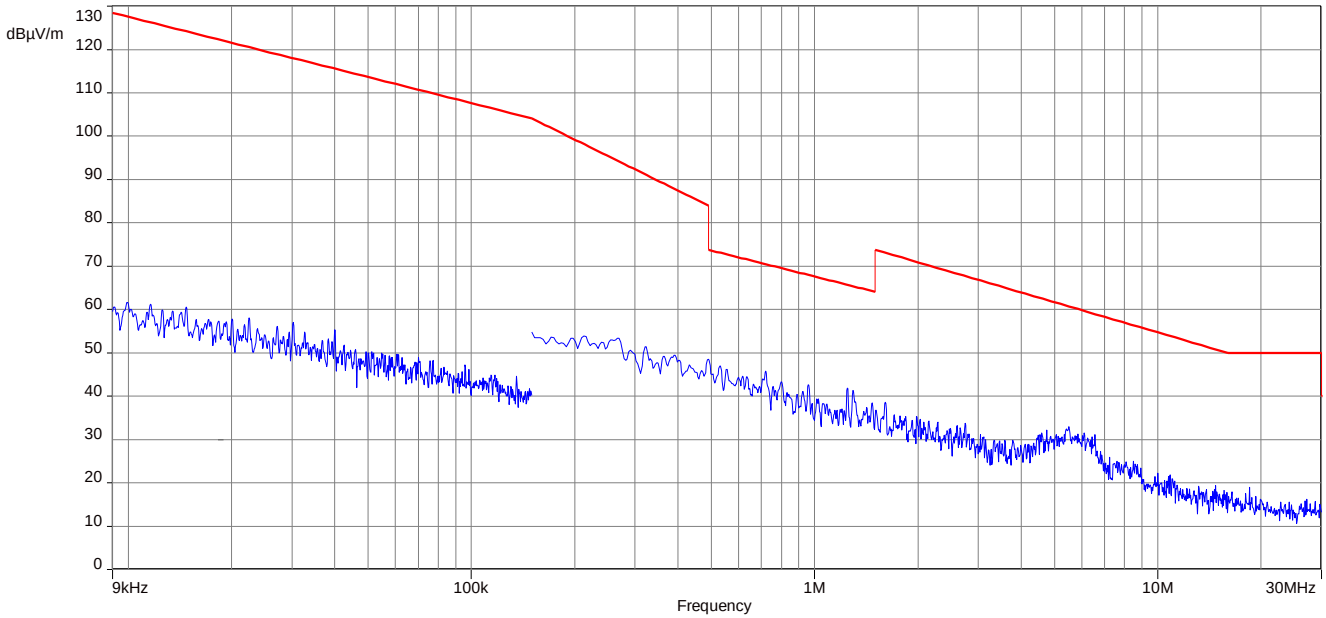
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel



Plot 3: TX-Mode high channel



11.10 Spurious Emissions Radiated > 30 MHz

11.10.1 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed at channel low, mid and high.

Measurement:

Measurement parameters	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	3 x VBW
Video bandwidth	120 kHz
Span	30 MHz to 1 GHz
Trace mode	Max hold
Measured modulation	ASK
Test setup	See sub clause 6.1 A
Measurement uncertainty	See sub clause 8

Limits:

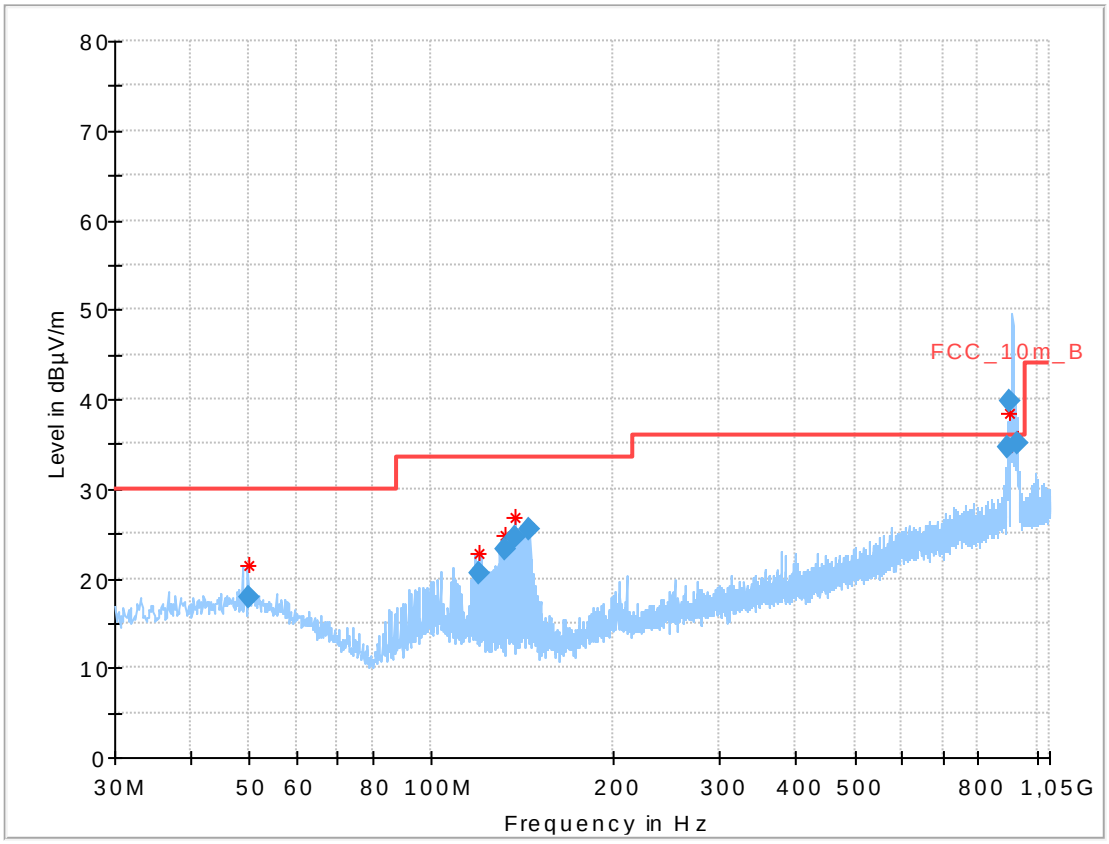
FCC	IC	
Band-edge Compliance of conducted and radiated emissions		
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

Note: The limit was recalculated with 20 dB / decade (Part 15.31) for all radiated spurious emissions 30 MHz to 1 GHz from 3 meter limit to a 10 meter distance. (40dB/decade for emissions < 30MHz)

Result: See result table below the plots.

Plots antenna Ha-Vis RF-ANT-WR30-US:

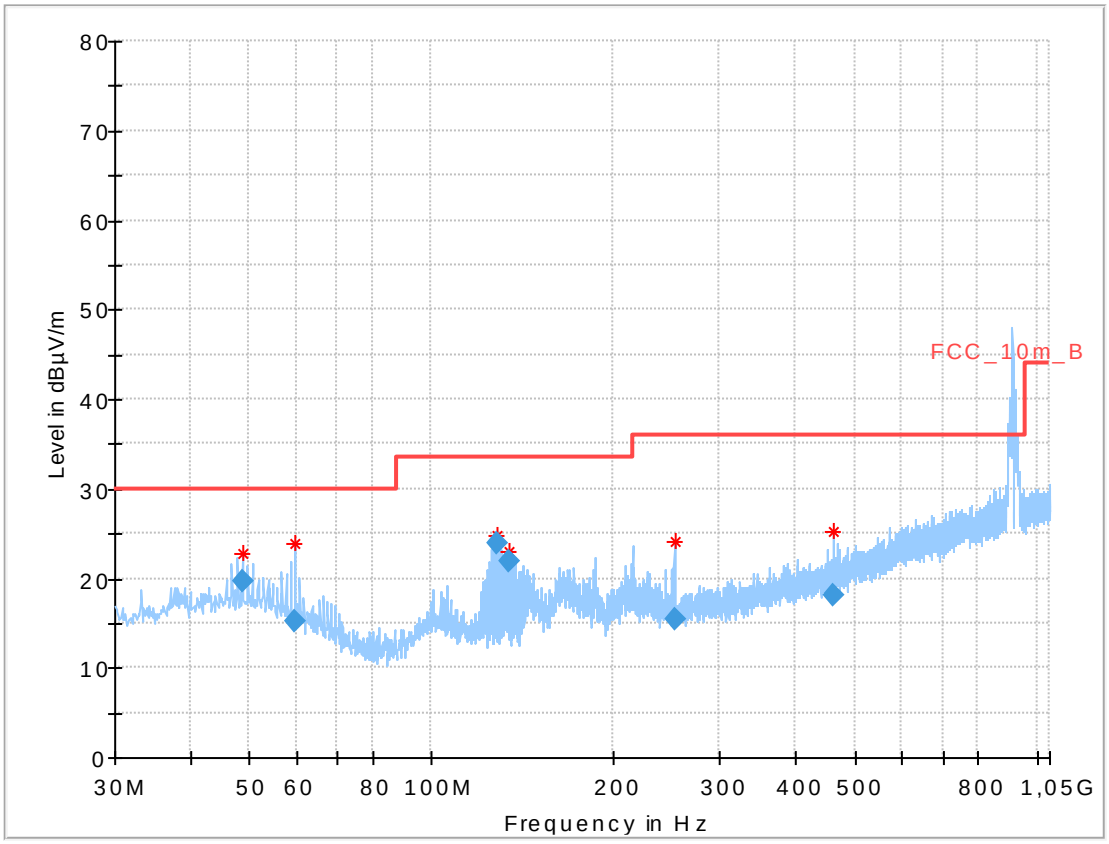
Plot 1: 30 MHz – 1 GHz, horizontal & vertical polarisation (lowest channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.798500	17.91	30.00	12.09	1000.0	120.000	98.0	V	100.0	13.7
120.139500	20.51	33.50	12.99	1000.0	120.000	101.0	V	10.0	10.3
132.847500	23.19	33.50	10.31	1000.0	120.000	98.0	V	280.0	9.3
137.713800	24.69	33.50	8.81	1000.0	120.000	100.0	V	-10.0	9.0
144.547350	25.46	33.50	8.04	1000.0	120.000	98.0	V	10.0	9.1
893.888700	34.63	36.00	1.37	1000.0	120.000	98.0	H	-10.0	24.1

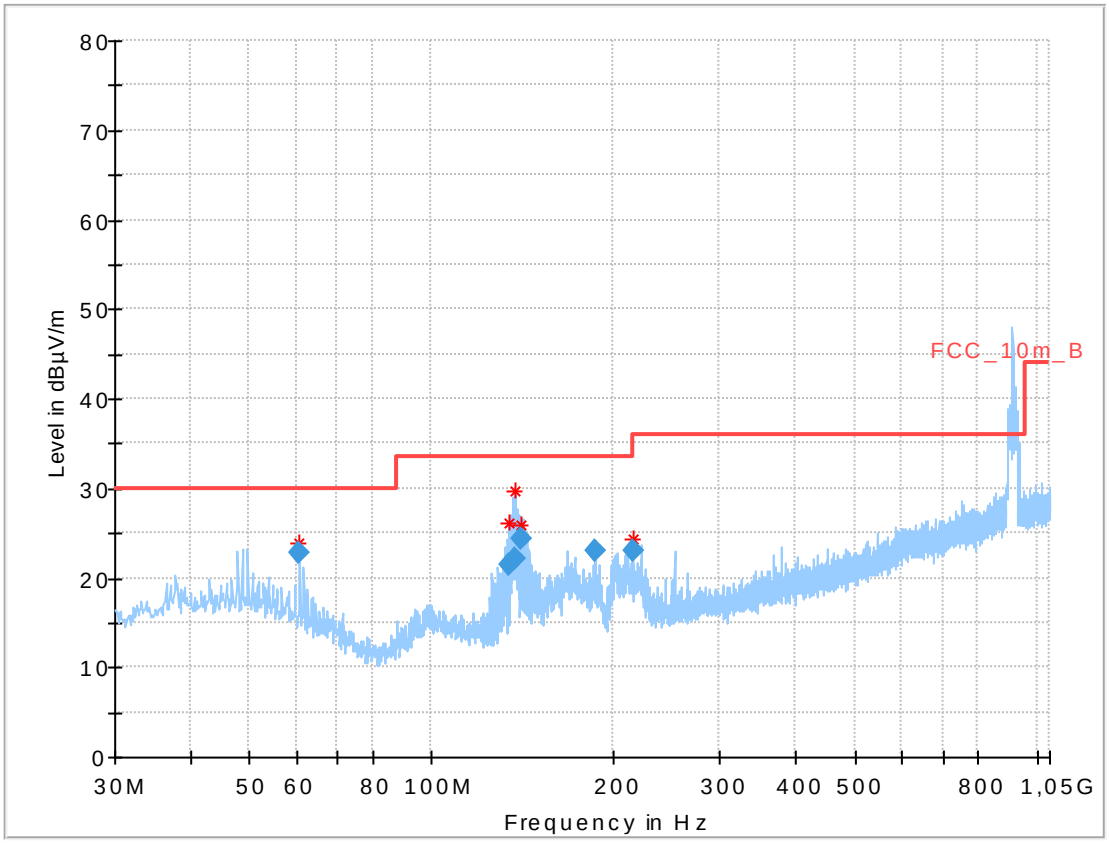
Plot 2: 30 MHz – 1 GHz, horizontal & vertical polarisation (middle channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
48.825150	19.64	30.00	10.36	1000.0	120.000	98.0	V	190.0	13.7
59.570250	15.17	30.00	14.83	1000.0	120.000	170.0	V	82.0	12.0
127.955400	24.01	33.50	9.49	1000.0	120.000	101.0	V	261.0	9.7
134.801250	21.92	33.50	11.58	1000.0	120.000	98.0	V	260.0	9.2
251.991900	15.32	36.00	20.68	1000.0	120.000	170.0	V	-10.0	13.5
461.972550	18.17	36.00	17.83	1000.0	120.000	101.0	V	190.0	17.9

Plot 3: 30 MHz – 1 GHz, horizontal & vertical polarisation (highest channel)

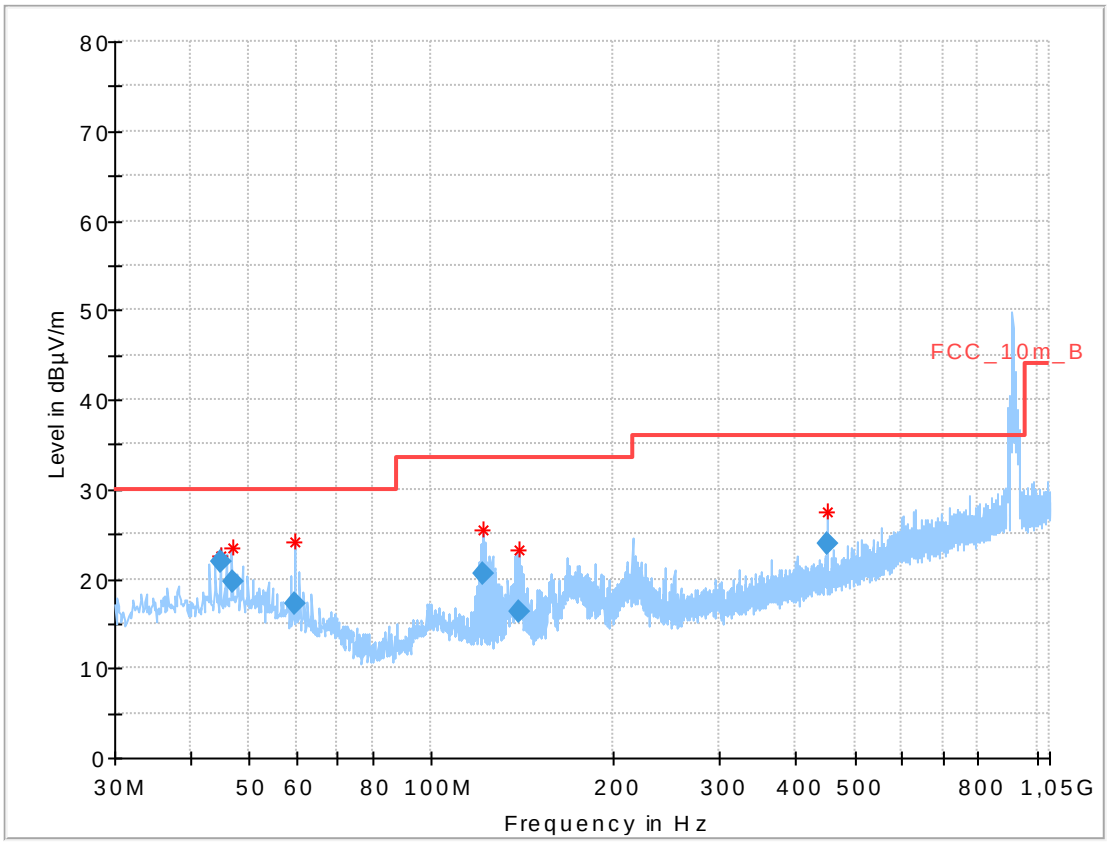


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
60.567450	22.86	30.00	7.14	1000.0	120.000	98.0	V	280.0	11.7
134.831250	21.53	33.50	11.97	1000.0	120.000	101.0	V	-8.0	9.2
137.746500	22.16	33.50	11.34	1000.0	120.000	98.0	V	-10.0	9.0
140.663400	24.30	33.50	9.20	1000.0	120.000	98.0	V	-10.0	8.9
186.134850	22.91	33.50	10.59	1000.0	120.000	98.0	V	10.0	11.2
214.783350	22.91	33.50	10.59	1000.0	120.000	101.0	V	-10.0	12.4

Plots antenna Ha-Vis RF-ANT-WR80-30-US :

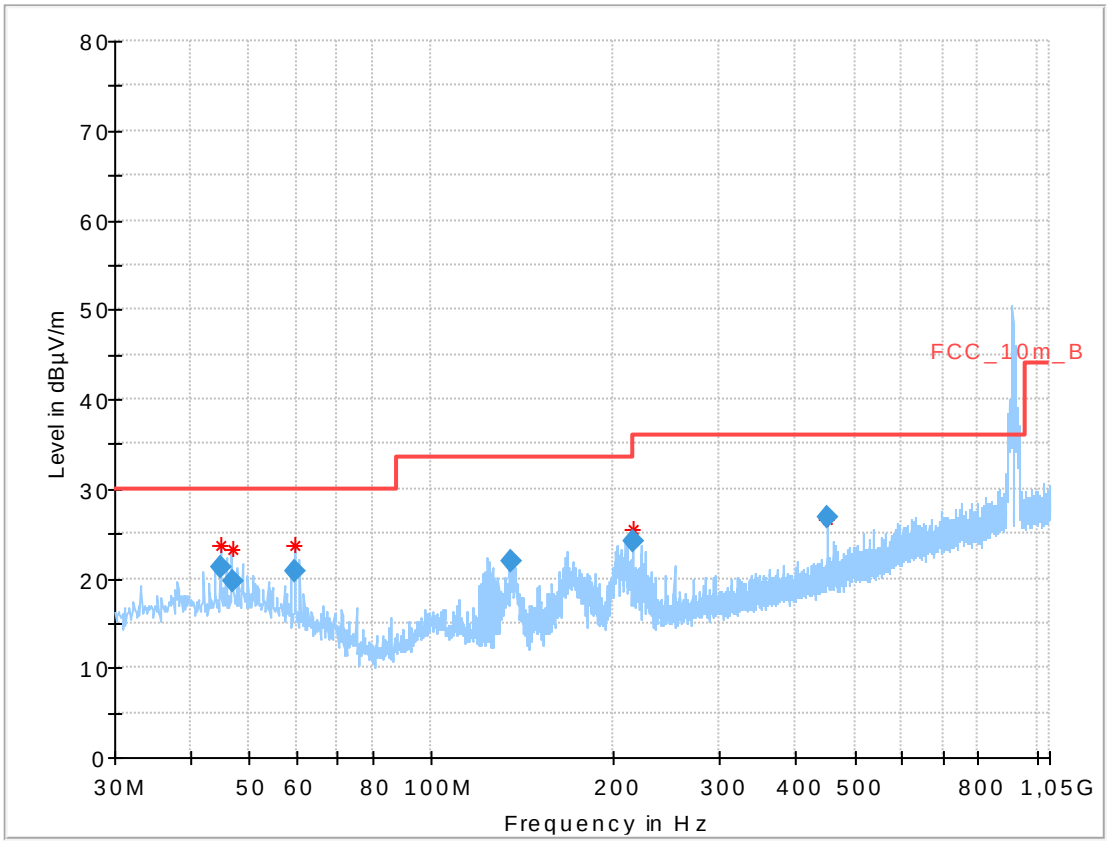
Plot 1: 30 MHz – 1 GHz, horizontal & vertical polarisation (lowest channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
44.923800	21.82	30.00	8.18	1000.0	120.000	102.0	V	280.0	13.6
46.876500	19.62	30.00	10.38	1000.0	120.000	98.0	V	190.0	13.7
59.576400	17.19	30.00	12.81	1000.0	120.000	101.0	V	80.0	12.0
122.098800	20.52	33.50	12.98	1000.0	120.000	98.0	V	-10.0	10.1
139.627050	16.26	33.50	17.24	1000.0	120.000	101.0	V	-10.0	8.9
449.966250	24.00	36.00	12.00	1000.0	120.000	98.0	V	171.0	17.6

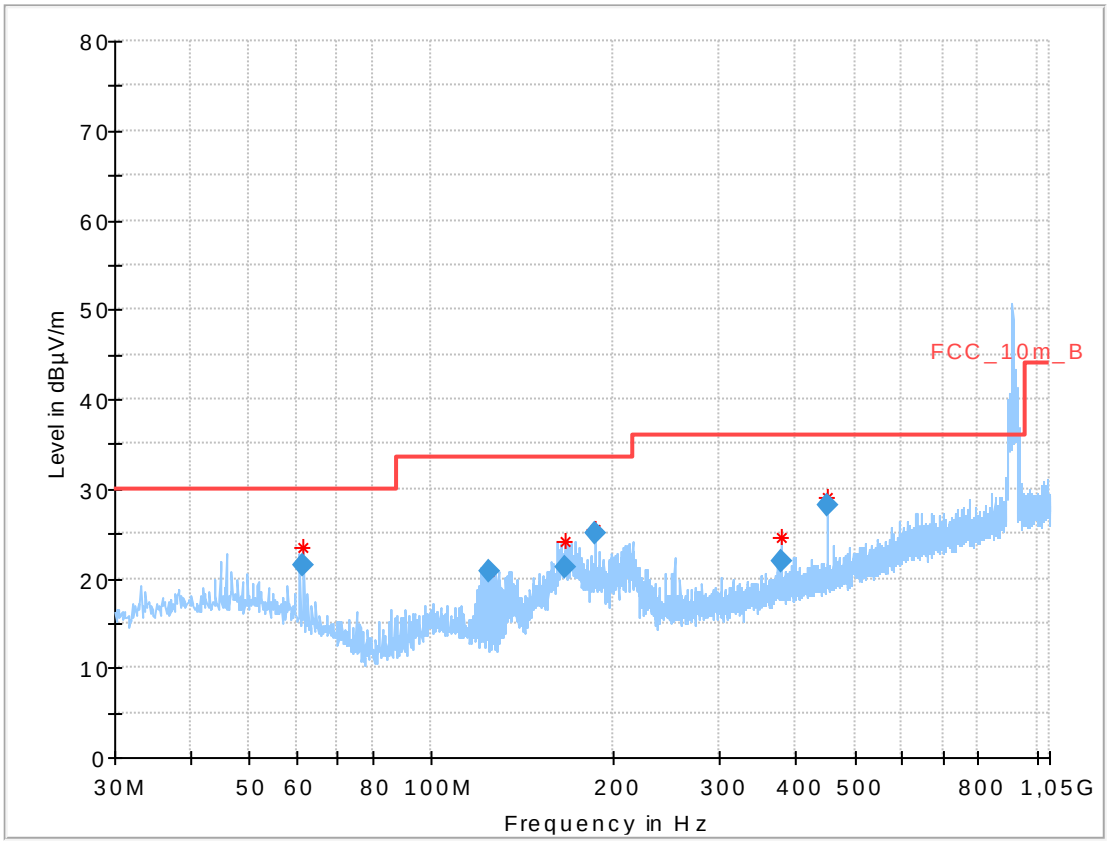
Plot 2: 30 MHz – 1 GHz, horizontal & vertical polarisation (middle channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
44.920500	21.25	30.00	8.75	1000.0	120.000	101.0	V	260.0	13.6
46.893450	19.76	30.00	10.24	1000.0	120.000	101.0	V	261.0	13.7
59.570550	20.88	30.00	9.12	1000.0	120.000	101.0	V	100.0	12.0
135.767100	21.94	33.50	11.56	1000.0	120.000	98.0	V	-8.0	9.1
214.760100	24.07	33.50	9.43	1000.0	120.000	98.0	V	-10.0	12.4
450.001800	26.78	36.00	9.22	1000.0	120.000	98.0	V	171.0	17.6

Plot 3: 30 MHz – 1 GHz, horizontal & vertical polarisation (highest channel)

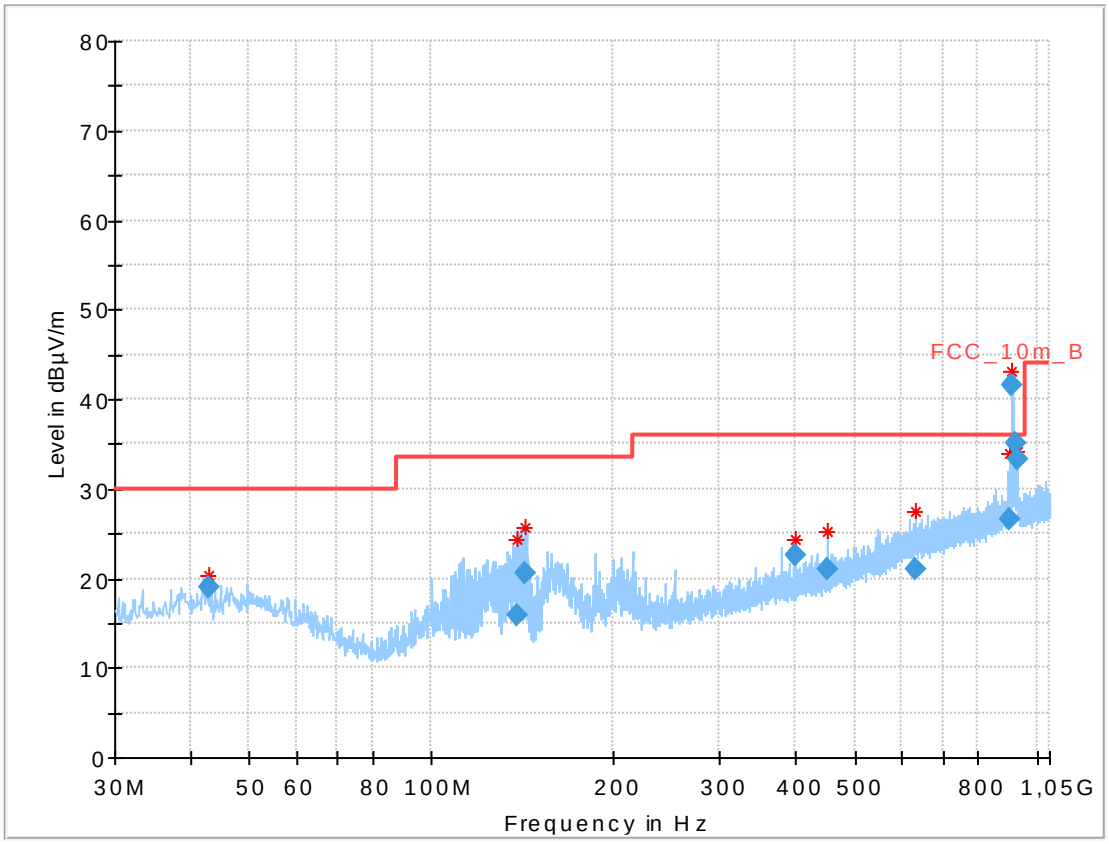


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
61.528050	21.42	30.00	8.58	1000.0	120.000	101.0	V	100.0	11.5
125.021700	20.68	33.50	12.82	1000.0	120.000	98.0	V	81.0	9.9
166.986900	21.21	33.50	12.29	1000.0	120.000	98.0	V	81.0	10.1
186.138150	25.06	33.50	8.44	1000.0	120.000	98.0	V	10.0	11.2
378.015750	21.83	36.00	14.17	1000.0	120.000	98.0	V	261.0	16.5
449.990550	28.23	36.00	7.77	1000.0	120.000	98.0	V	170.0	17.6

Plots antenna LOCFIELD:

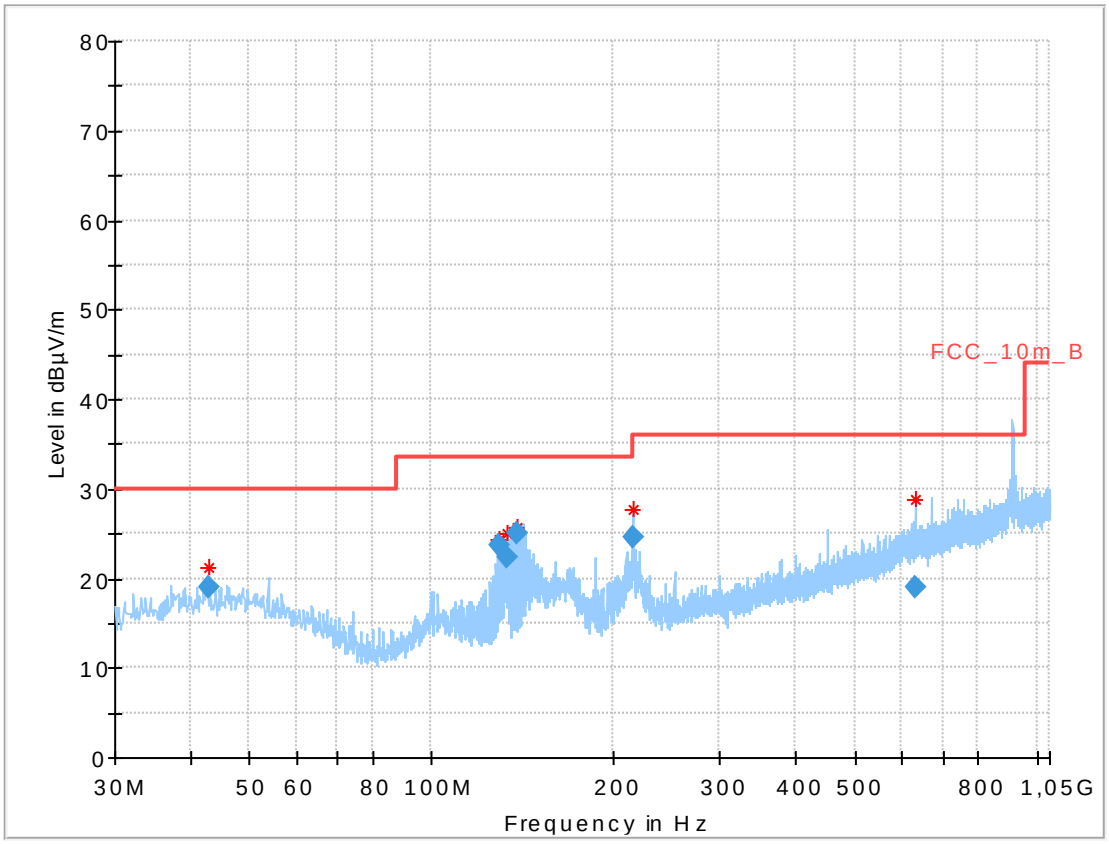
Plot 1: 30 MHz – 1 GHz, horizontal & vertical polarisation (lowest channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.954450	19.07	30.00	10.93	1000.0	120.000	101.0	V	123.0	13.5
138.721500	15.90	33.50	17.60	1000.0	120.000	98.0	V	344.0	8.9
142.605000	20.49	33.50	13.01	1000.0	120.000	98.0	V	3.0	9.0
399.980850	22.47	36.00	13.53	1000.0	120.000	185.0	H	322.0	16.9
449.988900	21.11	36.00	14.89	1000.0	120.000	178.0	H	238.0	17.6
630.046650	21.01	36.00	14.99	1000.0	120.000	101.0	H	176.0	21.0

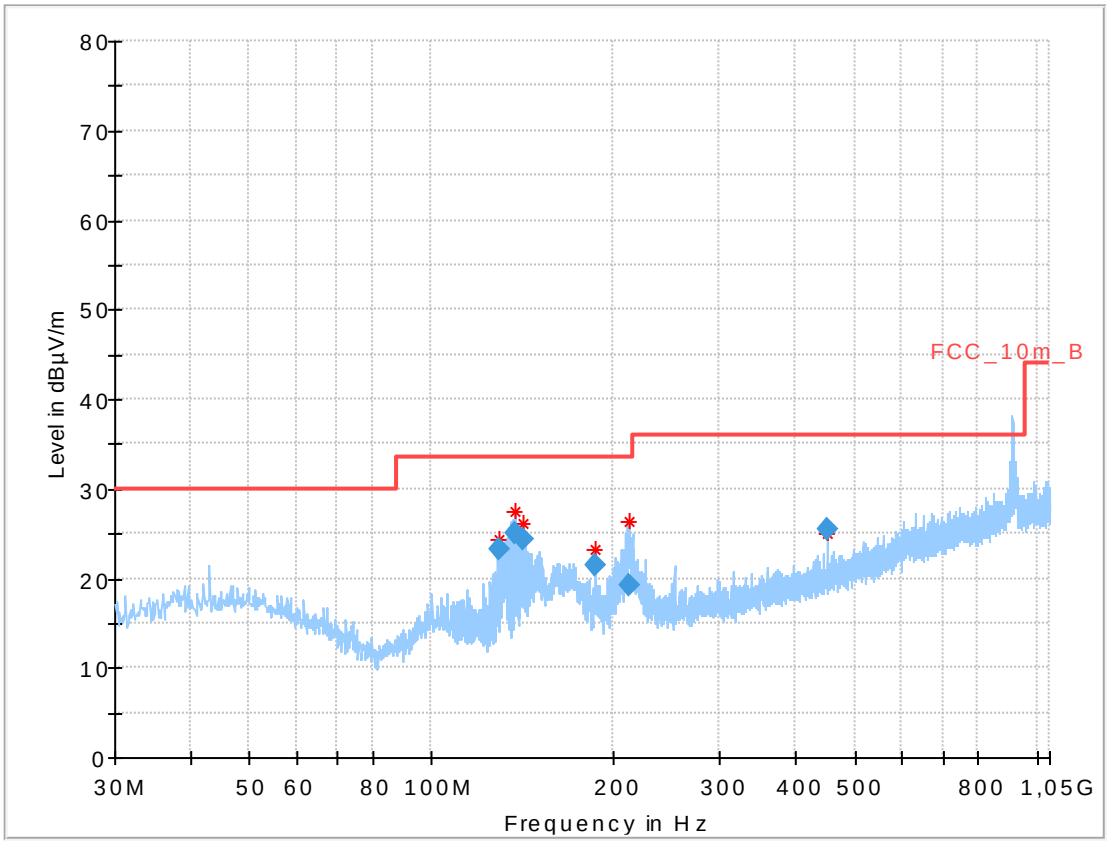
Plot 2: 30 MHz – 1 GHz, horizontal & vertical polarisation (middle channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.939450	18.92	30.00	11.08	1000.0	120.000	101.0	V	82.0	13.5
128.925000	23.78	33.50	9.72	1000.0	120.000	100.0	V	261.0	9.6
133.836750	22.42	33.50	11.08	1000.0	120.000	98.0	V	280.0	9.3
138.699450	25.03	33.50	8.47	1000.0	120.000	98.0	V	261.0	8.9
214.764450	24.57	33.50	8.93	1000.0	120.000	98.0	V	-8.0	12.4
630.353550	19.10	36.00	16.90	1000.0	120.000	100.0	V	100.0	21.0

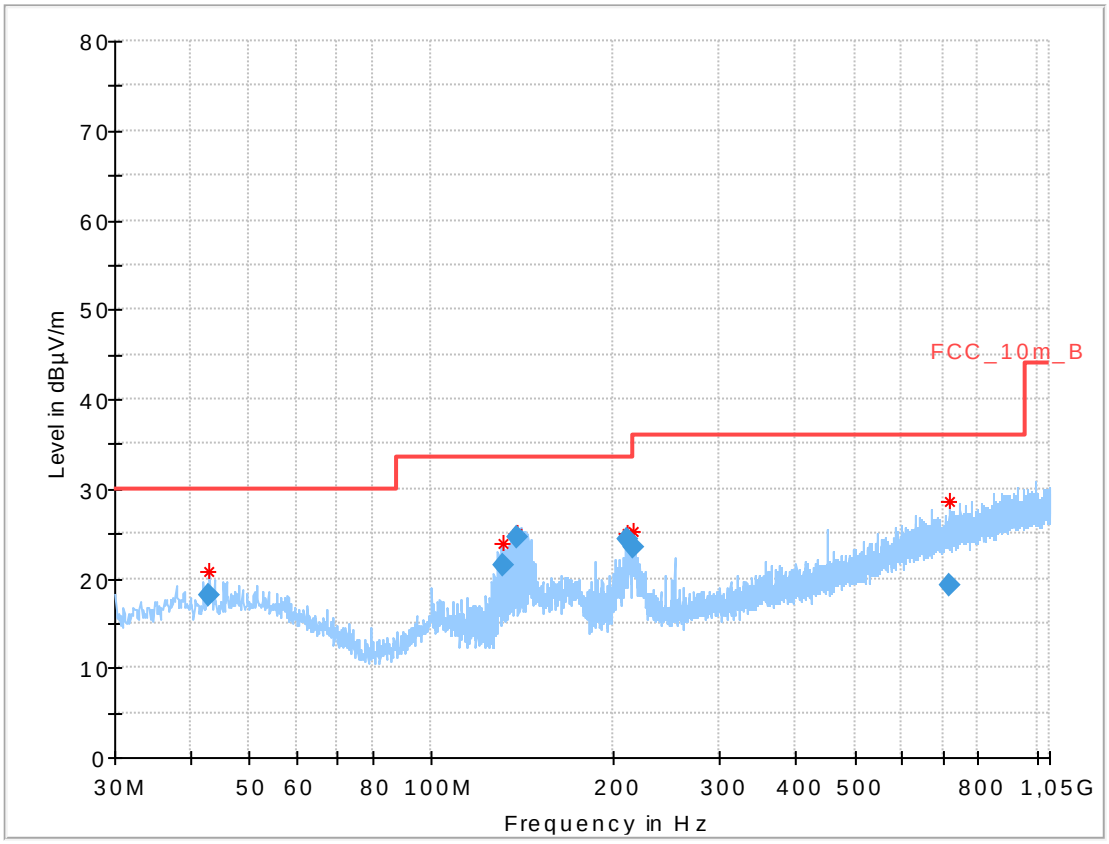
Plot 3: 30 MHz – 1 GHz, horizontal & vertical polarisation (highest channel)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
128.911950	23.13	33.50	10.37	1000.0	120.000	98.0	V	263.0	9.6
137.728800	25.09	33.50	8.41	1000.0	120.000	98.0	V	261.0	9.0
141.640350	24.33	33.50	9.17	1000.0	120.000	98.0	V	261.0	8.9
186.132600	21.50	33.50	12.00	1000.0	120.000	98.0	V	10.0	11.2
212.005950	19.25	33.50	14.25	1000.0	120.000	170.0	V	10.0	12.3
450.003600	25.49	36.00	10.51	1000.0	120.000	98.0	V	170.0	17.6

Plot 4: 30 MHz – 1 GHz, horizontal & vertical polarisation (RX-Mode)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.959850	18.12	30.00	11.88	1000.0	120.000	170.0	V	10.0	13.5
131.850150	21.42	33.50	12.08	1000.0	120.000	101.0	V	280.0	9.4
138.707700	24.54	33.50	8.96	1000.0	120.000	98.0	V	261.0	8.9
210.028200	24.29	33.50	9.21	1000.0	120.000	170.0	V	-8.0	12.2
214.760400	23.41	33.50	10.09	1000.0	120.000	98.0	V	82.0	12.4
717.202050	19.22	36.00	16.78	1000.0	120.000	101.0	V	170.0	22.0

11.10.2 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed in the mode with the highest output power.

Measurement parameters	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 x RBW
Span	1 GHz to 26 GHz
Trace mode	Max hold
Measured modulation	ASK
Test setup	See sub clause 6.2 B (1 GHz – 12.75 GHz)
Measurement uncertainty	See sub clause 8

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

Limits:

ANSI C63.10 – FCC Public Notice DA 00-705
The average emission shall be determined by using Video averaging (VBW = 10 Hz). If the dwell time of the hopping signal is less than 100 ms (per channel), the VBW=10 Hz reading may be adjusted by a factor: F = 20log (dwell time/100 ms)

FCC		IC
TX spurious emissions radiated		
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).		
§15.209		
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance
Above 960	54.0	3

Result:

For radiated spurious emission the limits of 15.209 applies for all frequencies mentioned in 15.205. According to FCC Public Notice DA 00-705 (ANSI C63.10) the average emission shall be determined by using Video averaging (VBW = 10 Hz). If the dwell time of the hopping signal is less than 100 ms (per channel), the VBW=10 Hz reading may be adjusted by a factor:

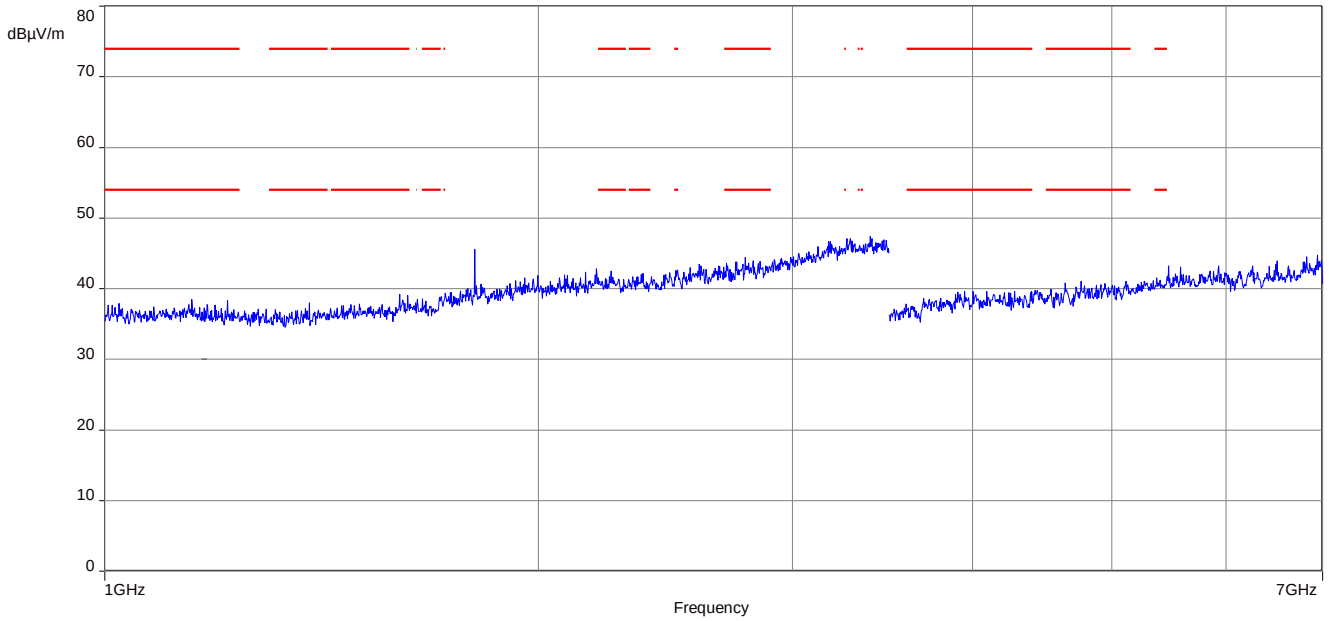
F = 20*log (dwell time/100 ms)

One pulse train is higher than 100 ms so the correction factor is 0 (see plots in chapter 12.4)

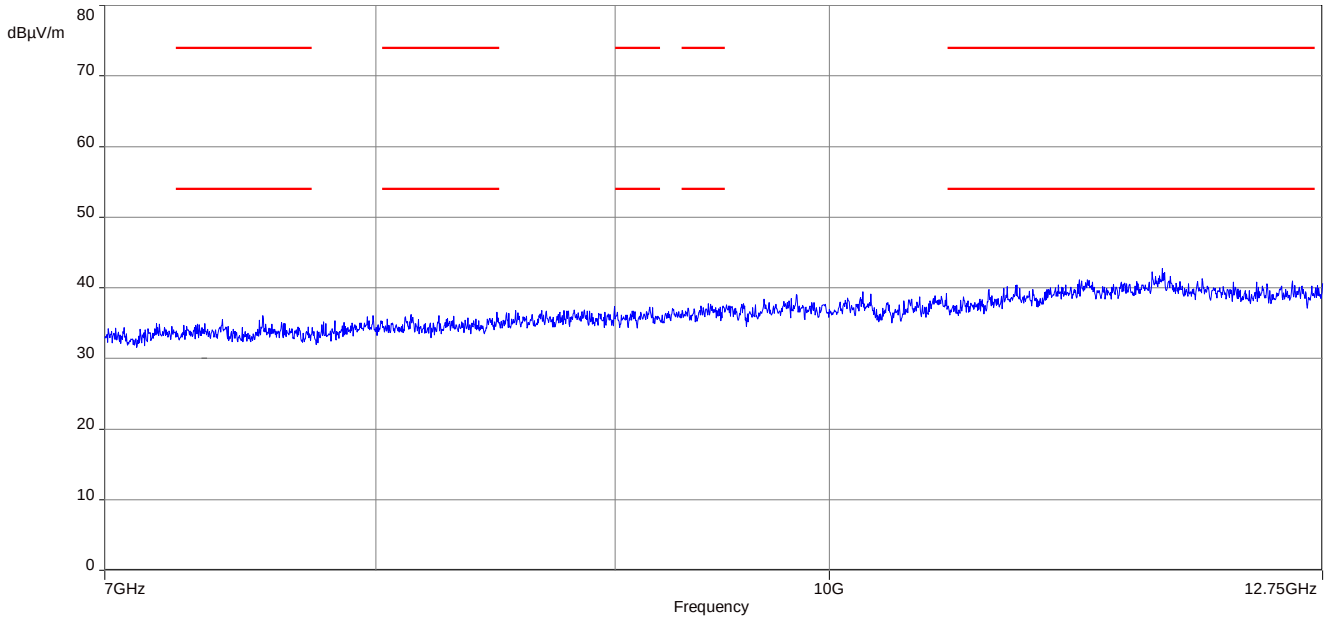
TX spurious emissions radiated [dBµV/m]								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
All emissions were more than 7 dB below the limit.								

Plots antenna LR10:

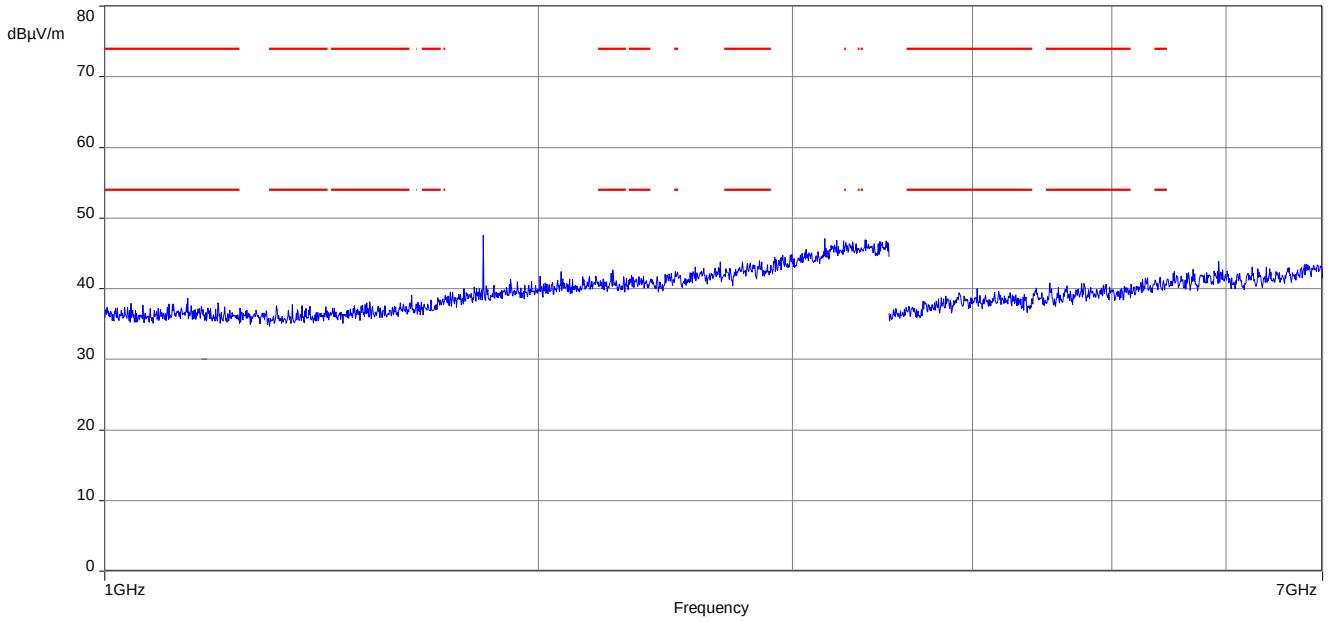
Plot 1: 1 GHz – 7 GHz, horizontal & vertical polarisation (lowest channel)



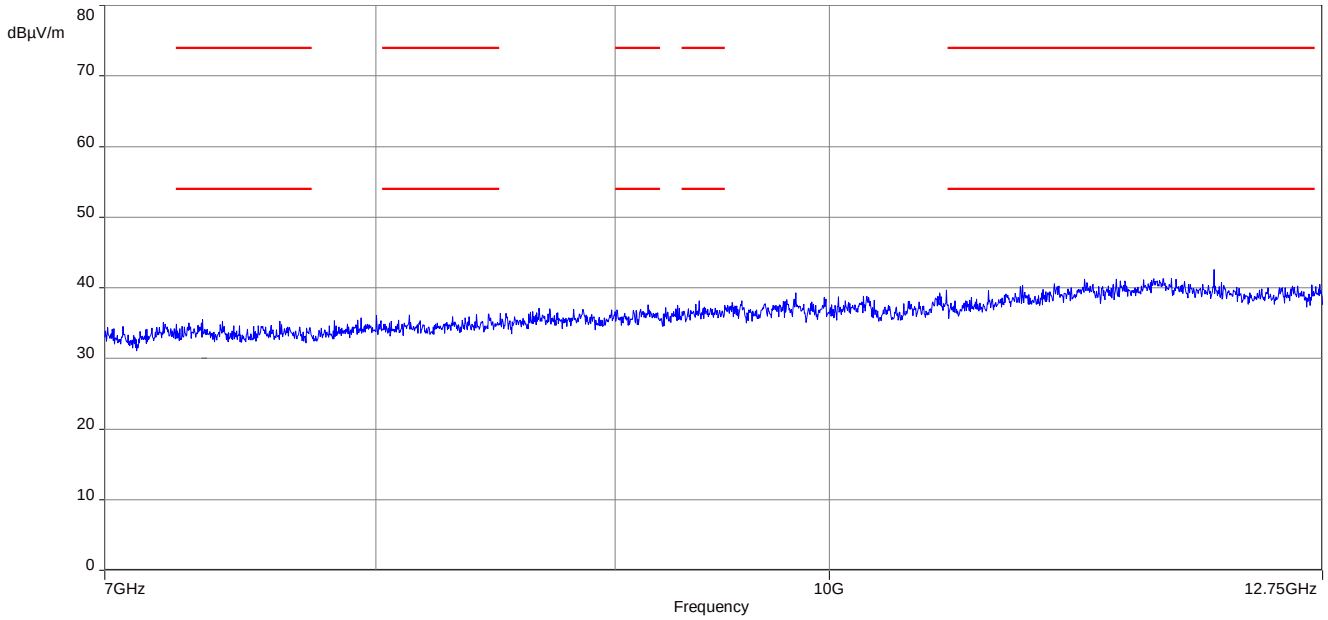
Plot 2: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



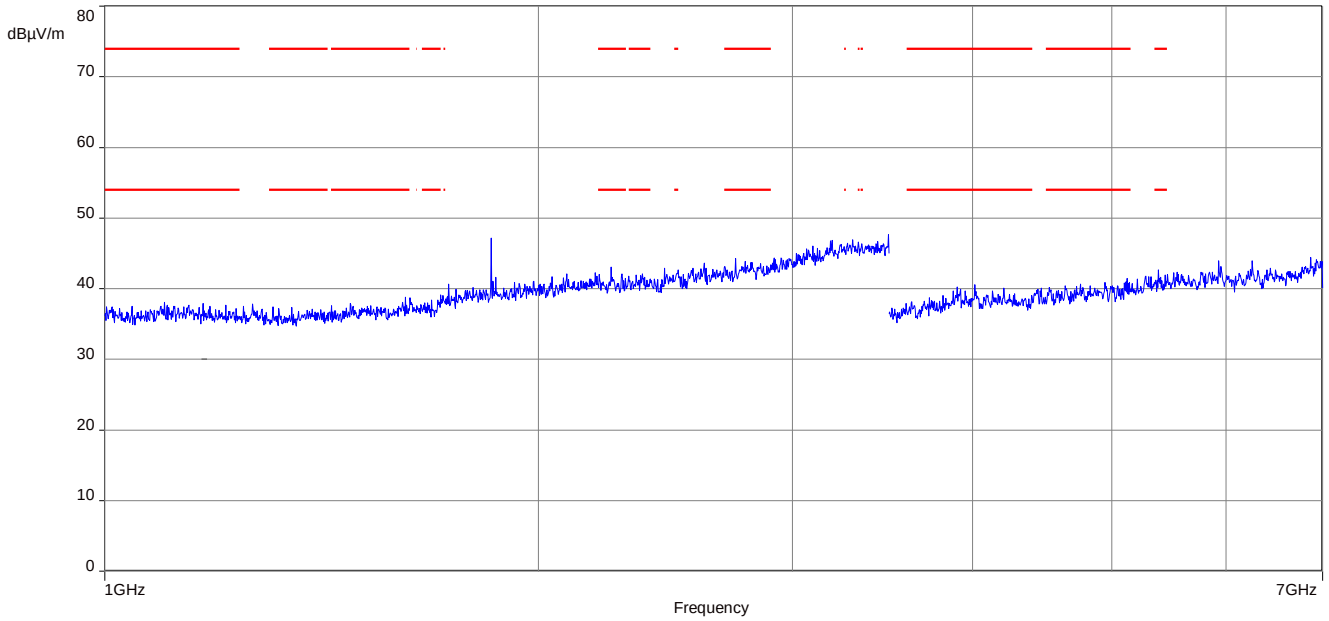
Plot 3: 1 GHz – 7 GHz, horizontal & vertical polarisation (middle channel)



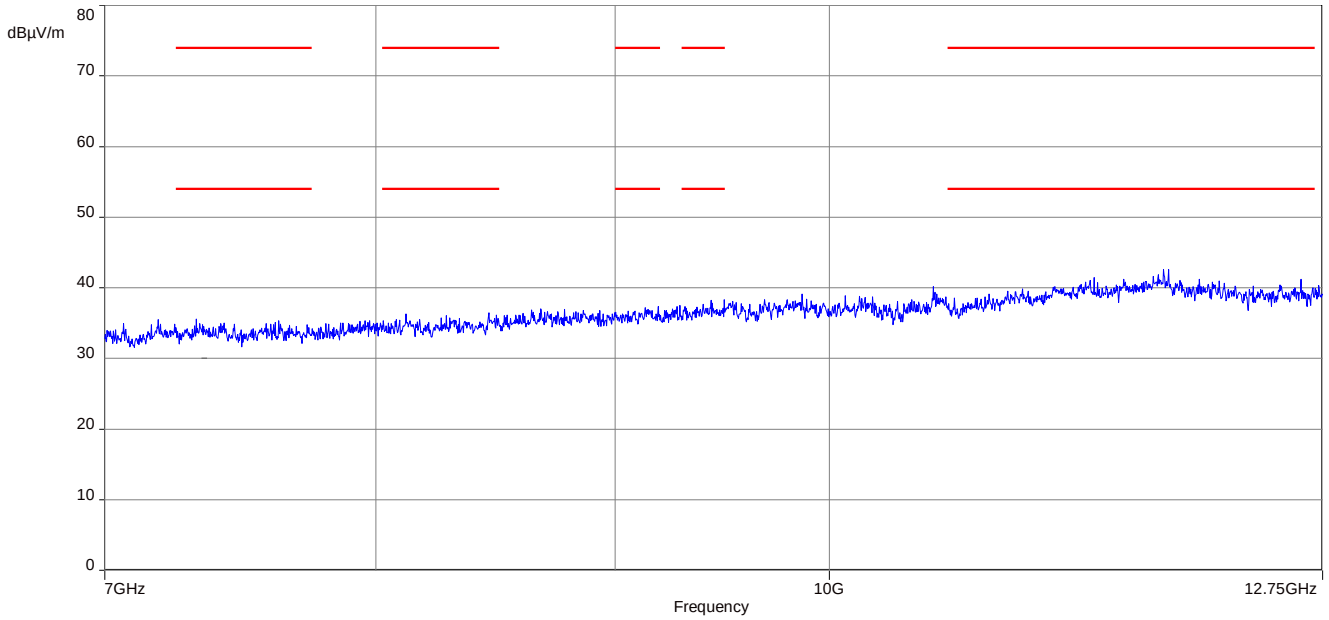
Plot 4: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)



Plot 5: 1 GHz – 7 GHz, horizontal & vertical polarisation (highest channel)

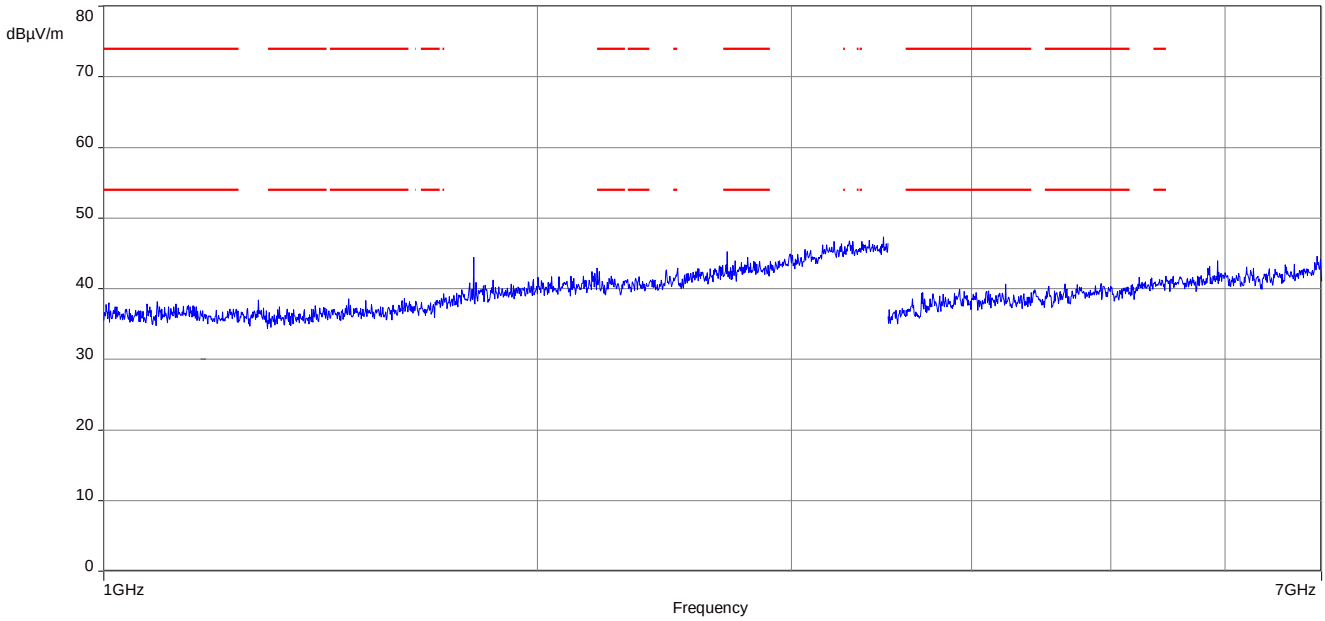


Plot 6: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)

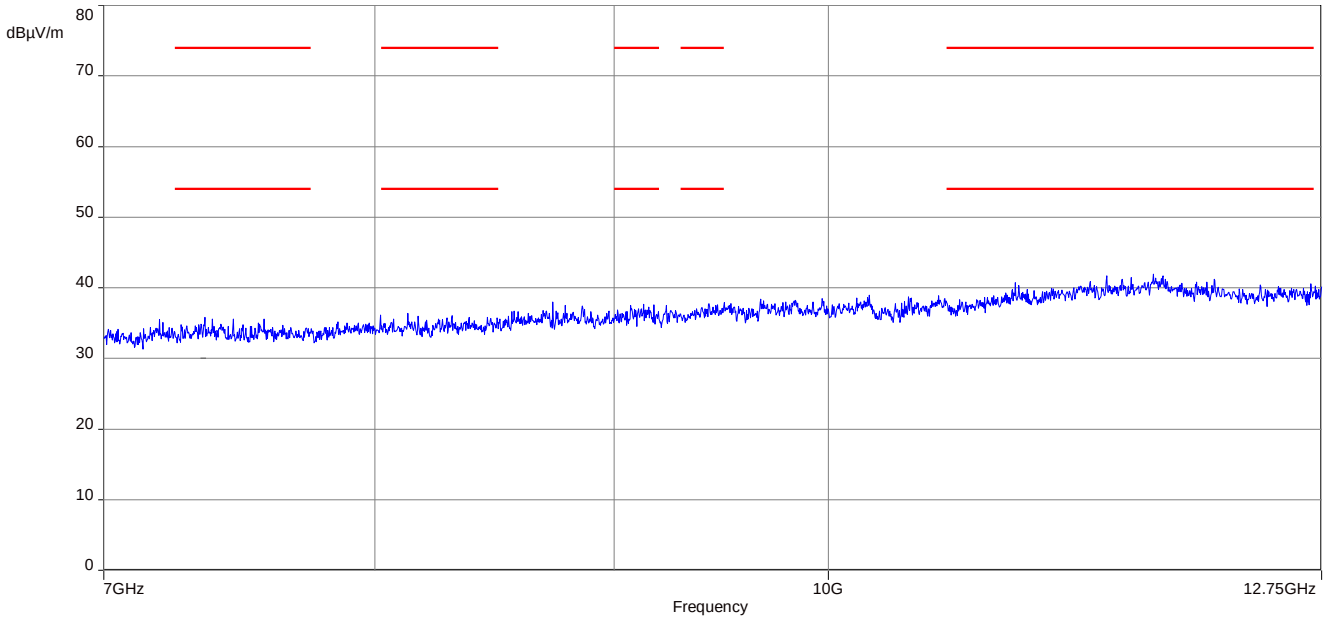


Plots antenna MR20 US:

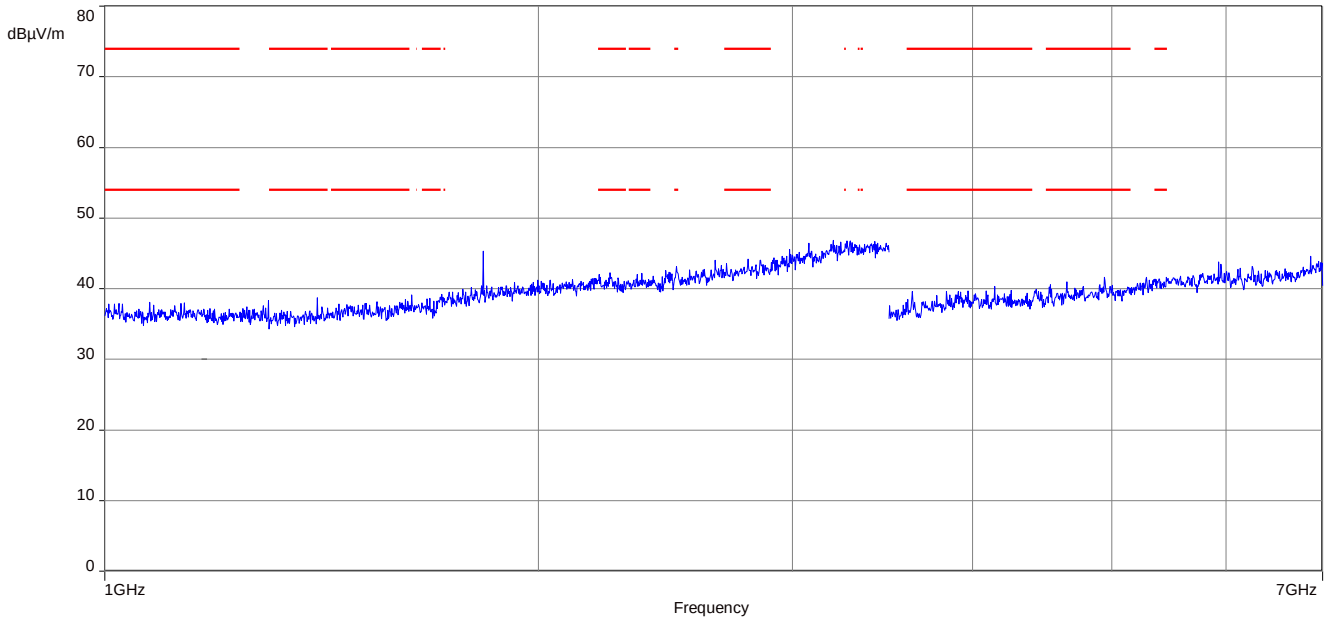
Plot 1: 1 GHz – 7 GHz, horizontal & vertical polarisation (lowest channel)



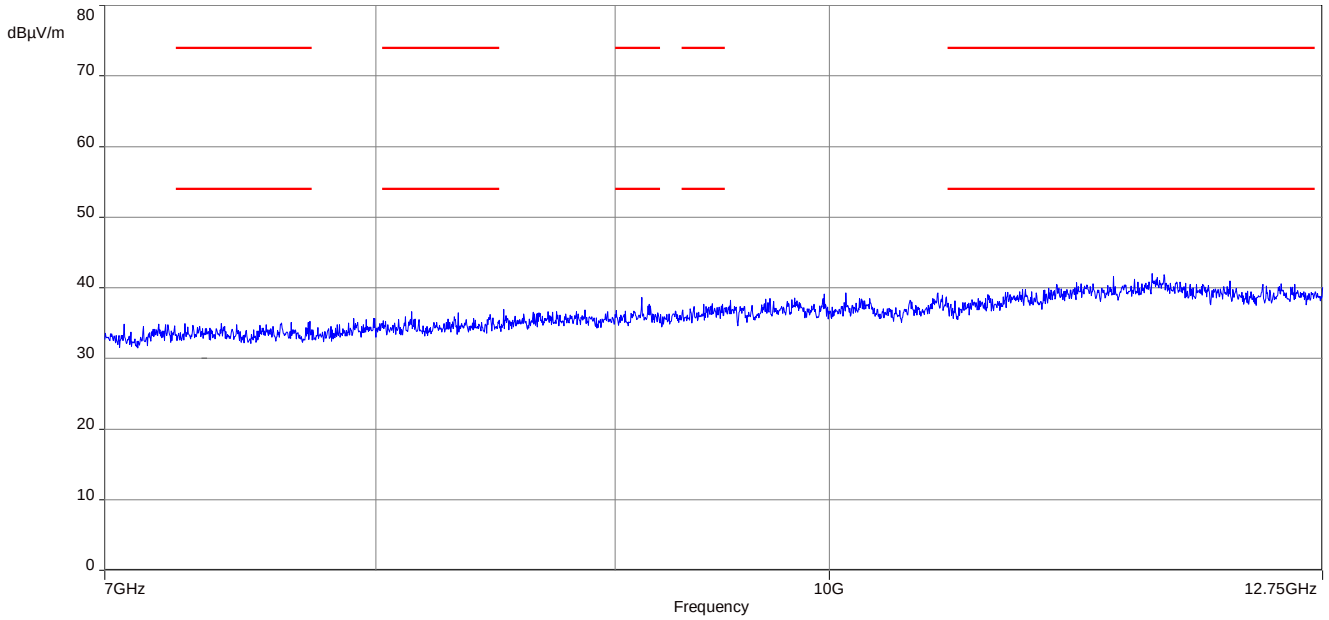
Plot 2: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



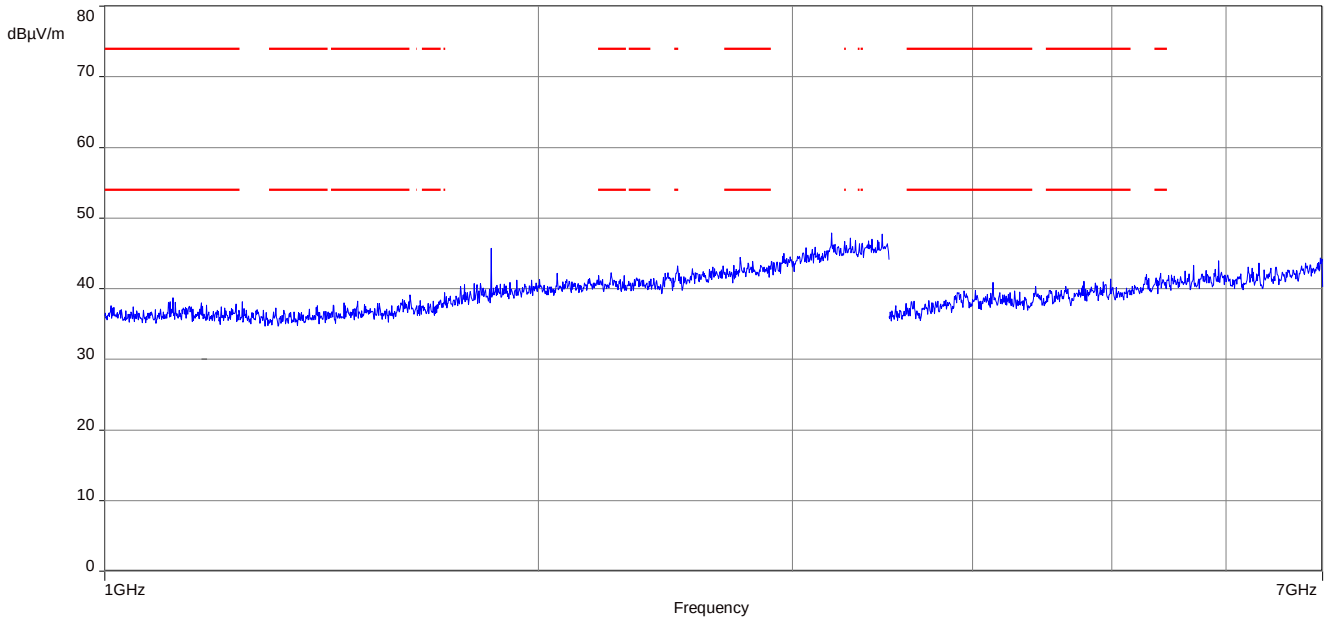
Plot 3: 1 GHz – 7 GHz, horizontal & vertical polarisation (middle channel)



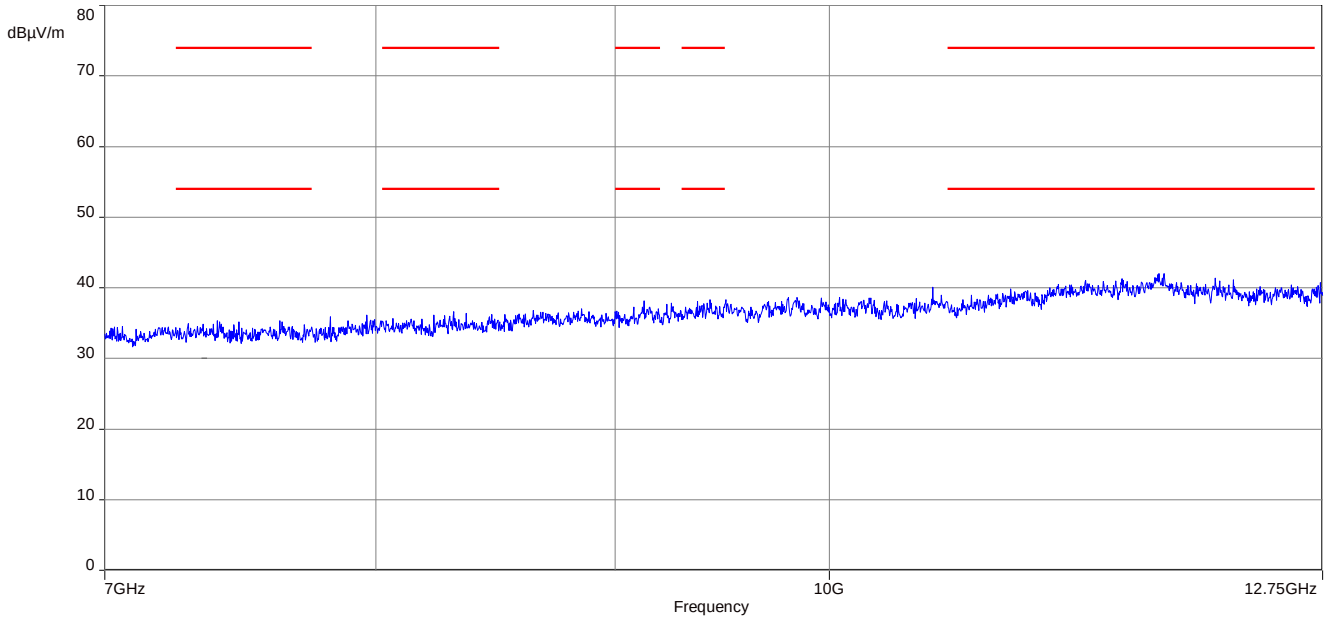
Plot 4: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)



Plot 5: 1 GHz – 7 GHz, horizontal & vertical polarisation (highest channel)

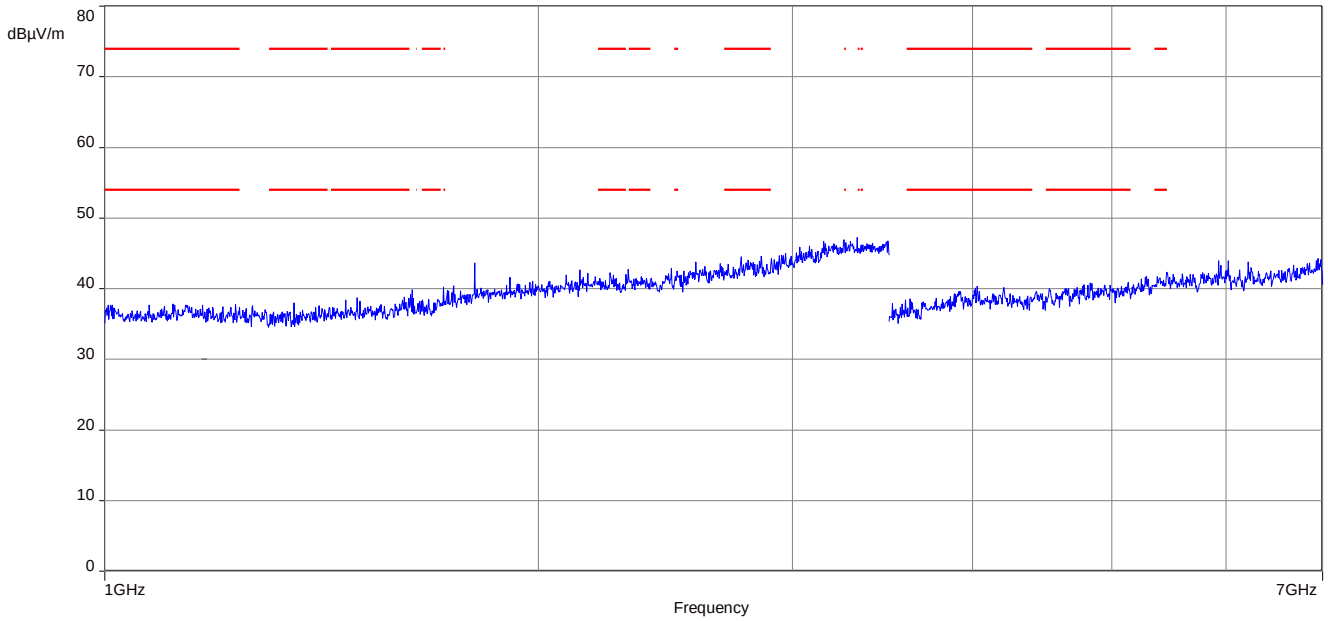


Plot 6: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)

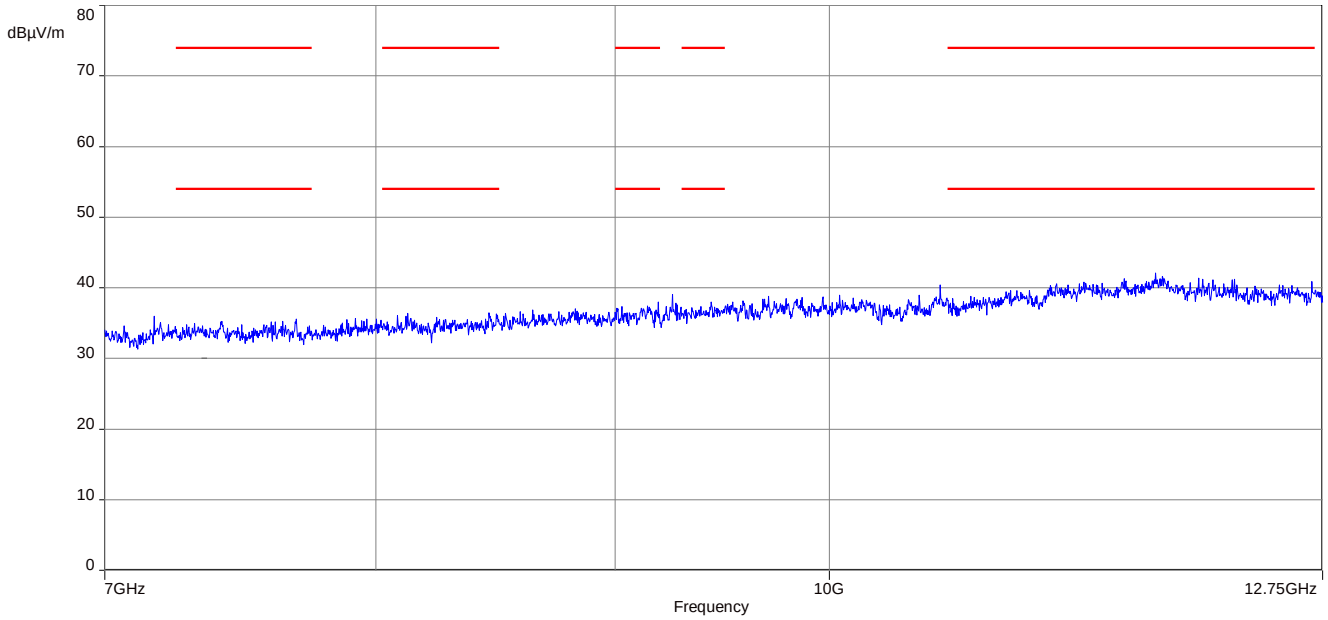


Plots antenna Engineer Patch:

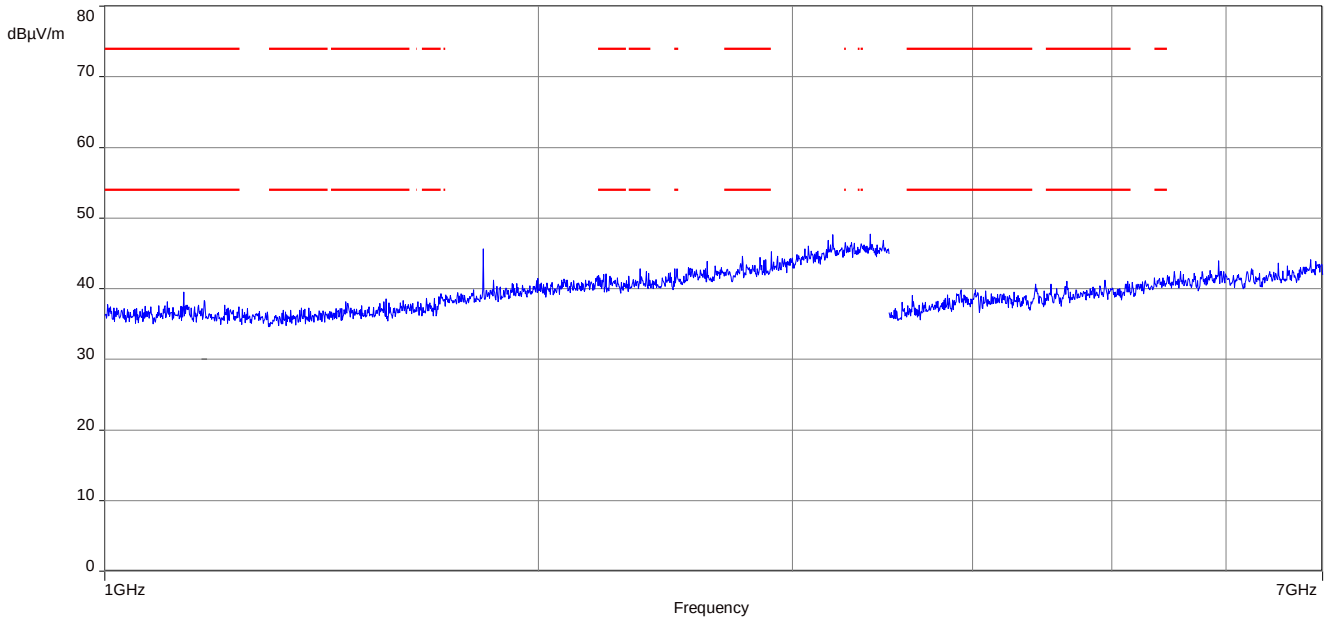
Plot 1: 1 GHz – 7 GHz, horizontal & vertical polarisation (lowest channel)



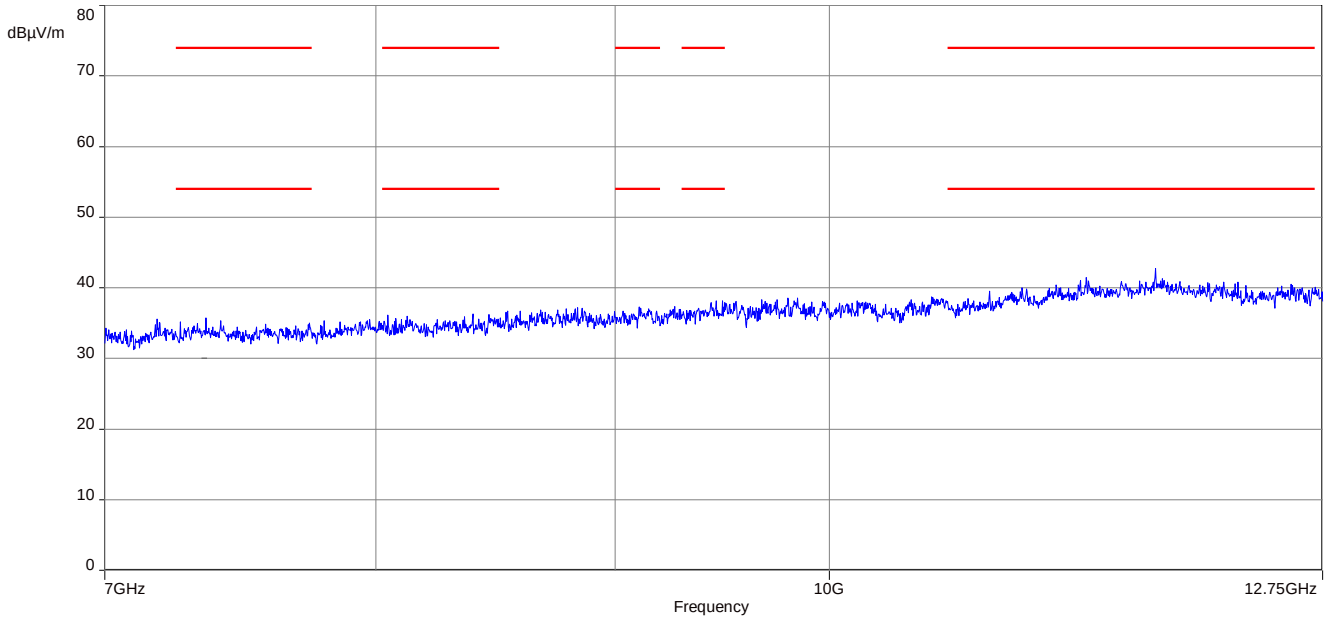
Plot 2: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



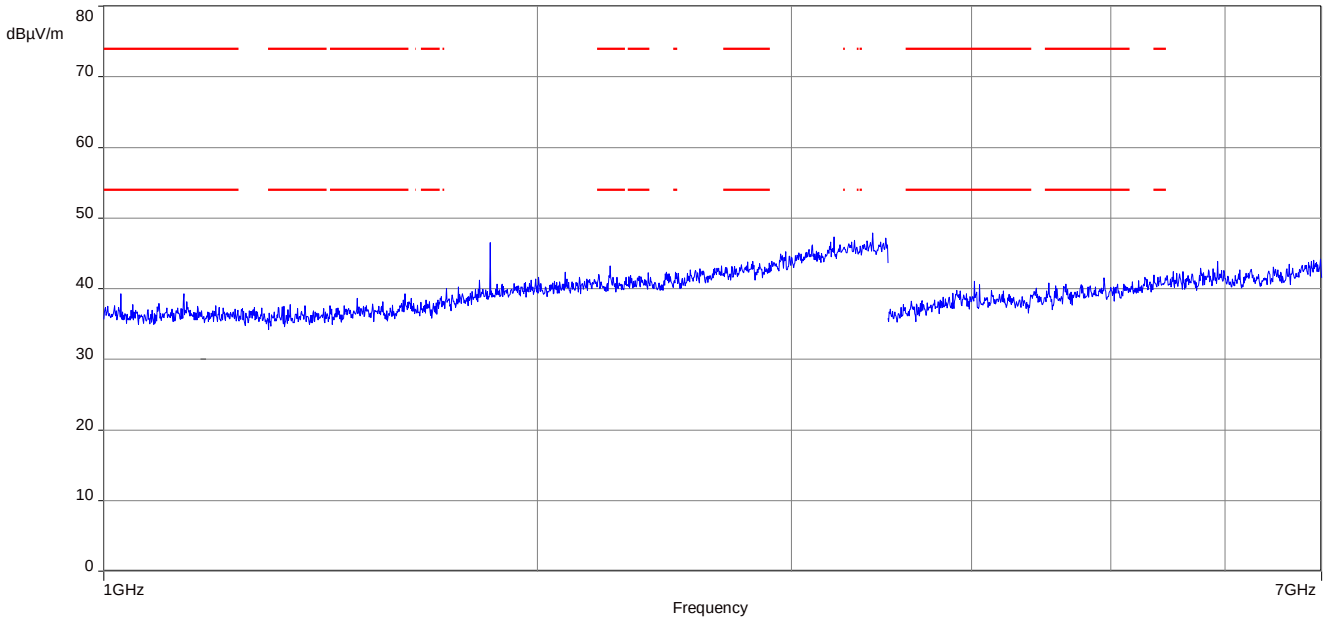
Plot 3: 1 GHz – 7 GHz, horizontal & vertical polarisation (middle channel)



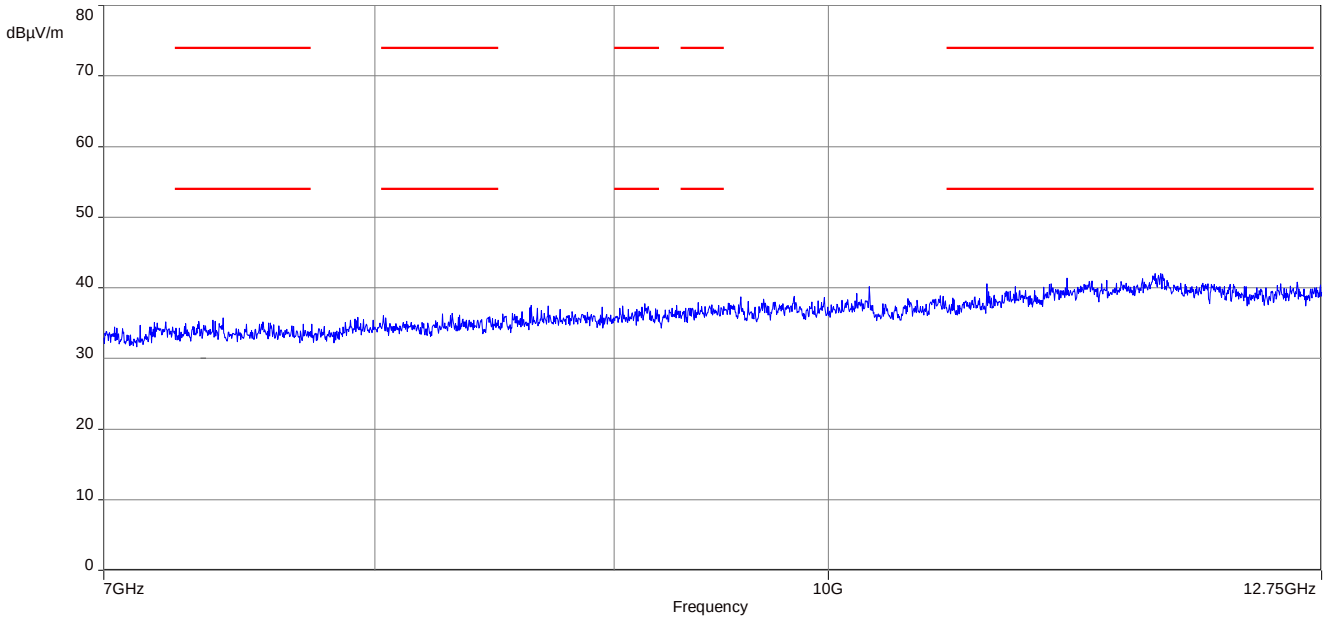
Plot 4: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)



Plot 5: 1 GHz – 7 GHz, horizontal & vertical polarisation (highest channel)

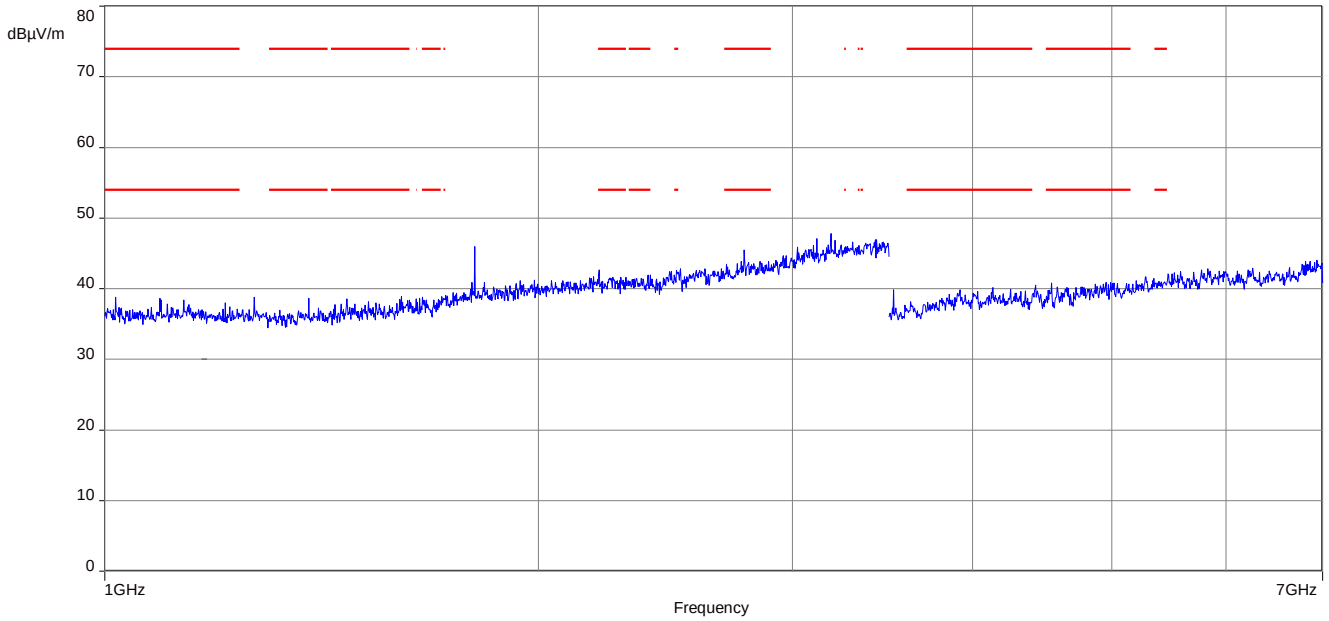


Plot 6: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)

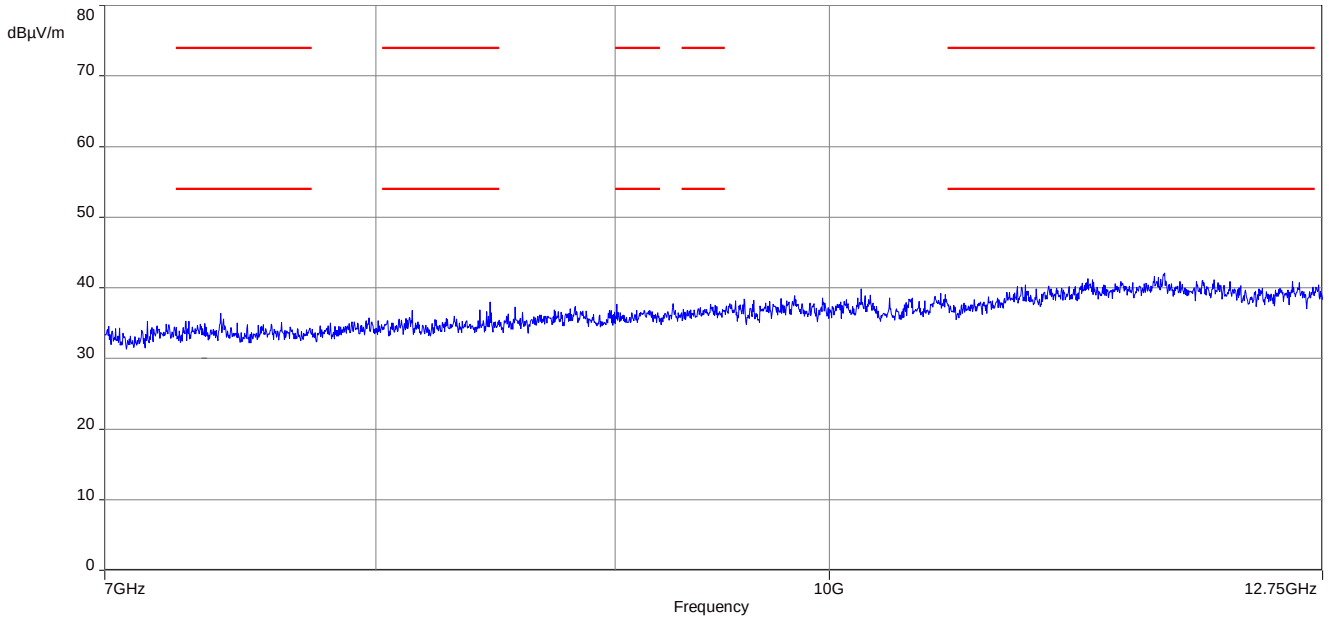


Plots antenna WR30 US:

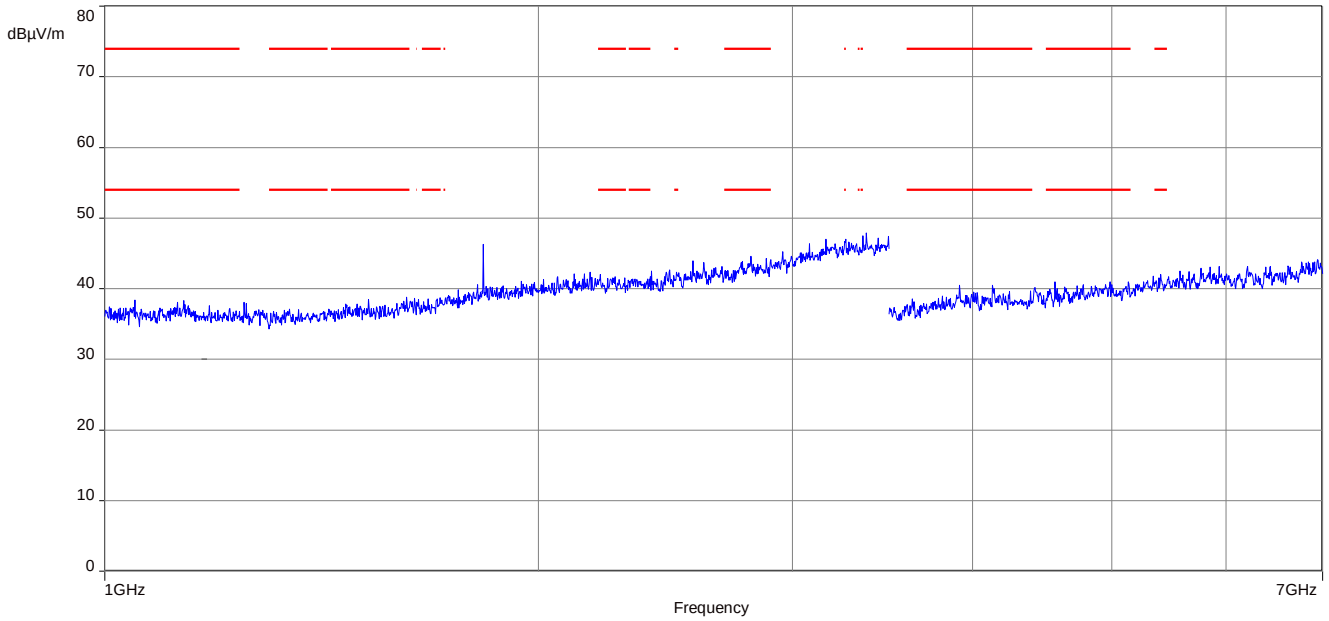
Plot 1: 1 GHz – 7 GHz, horizontal & vertical polarisation (lowest channel)



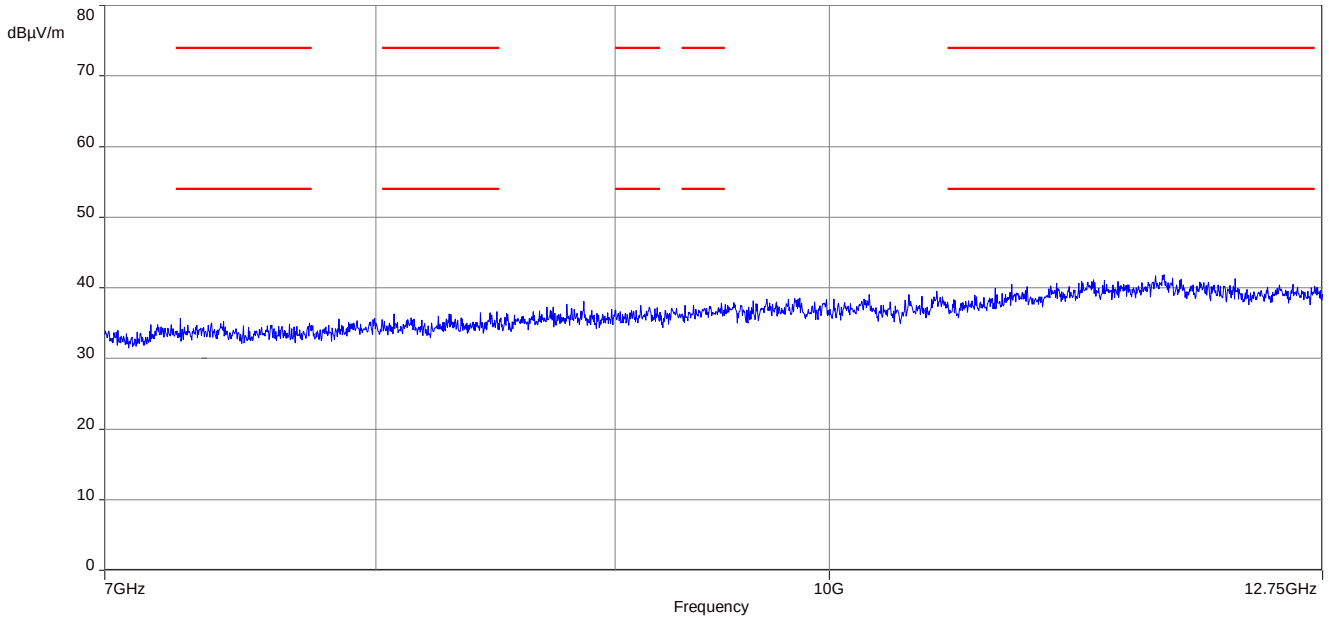
Plot 2: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



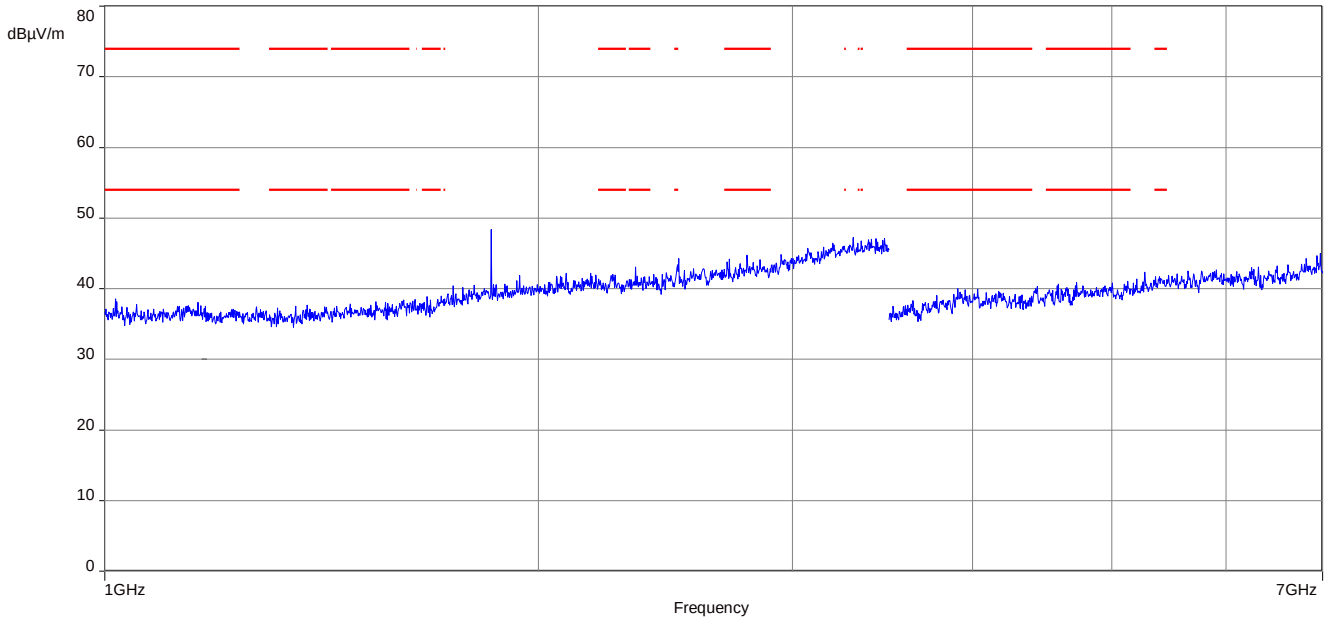
Plot 3: 1 GHz – 7 GHz, horizontal & vertical polarisation (middle channel)



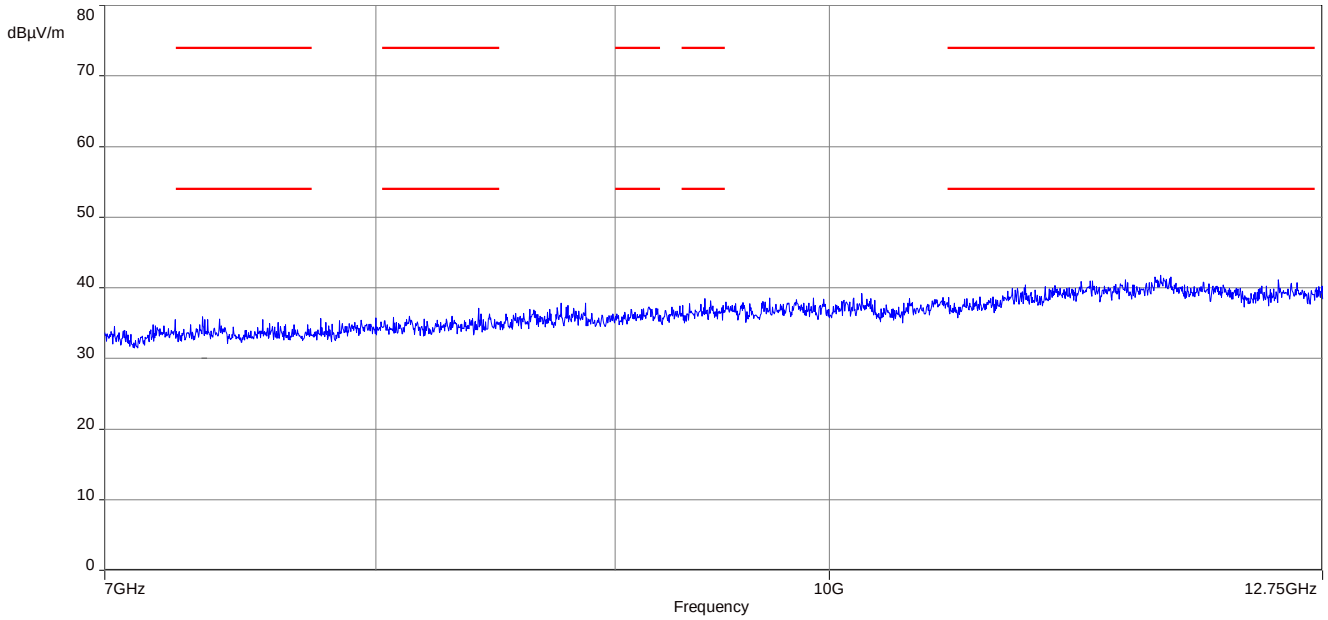
Plot 4: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)



Plot 5: 1 GHz – 7 GHz, horizontal & vertical polarisation (highest channel)

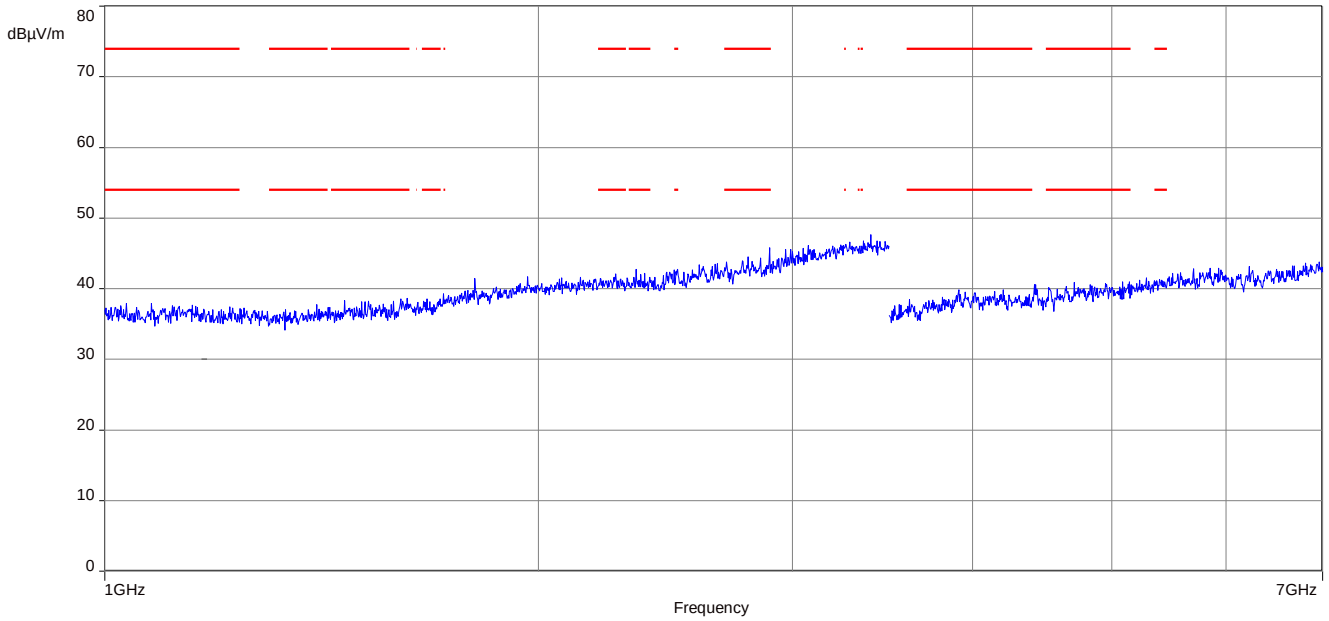


Plot 6: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)

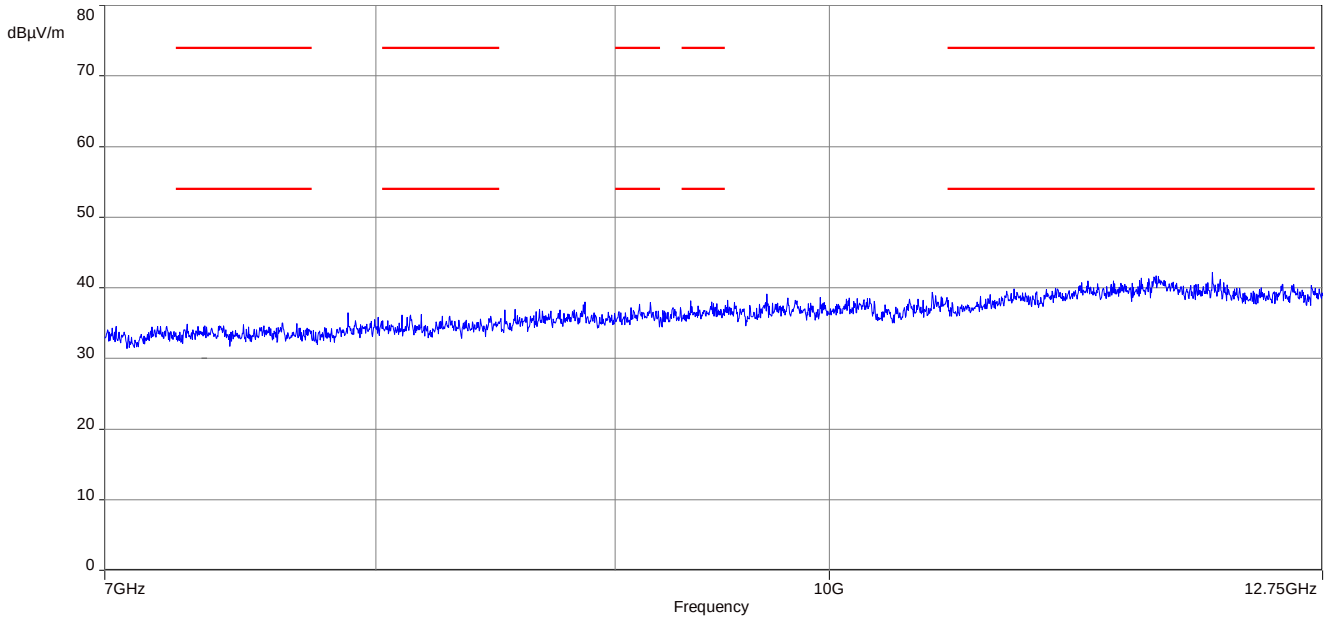


Plots antenna WR80-300-US:

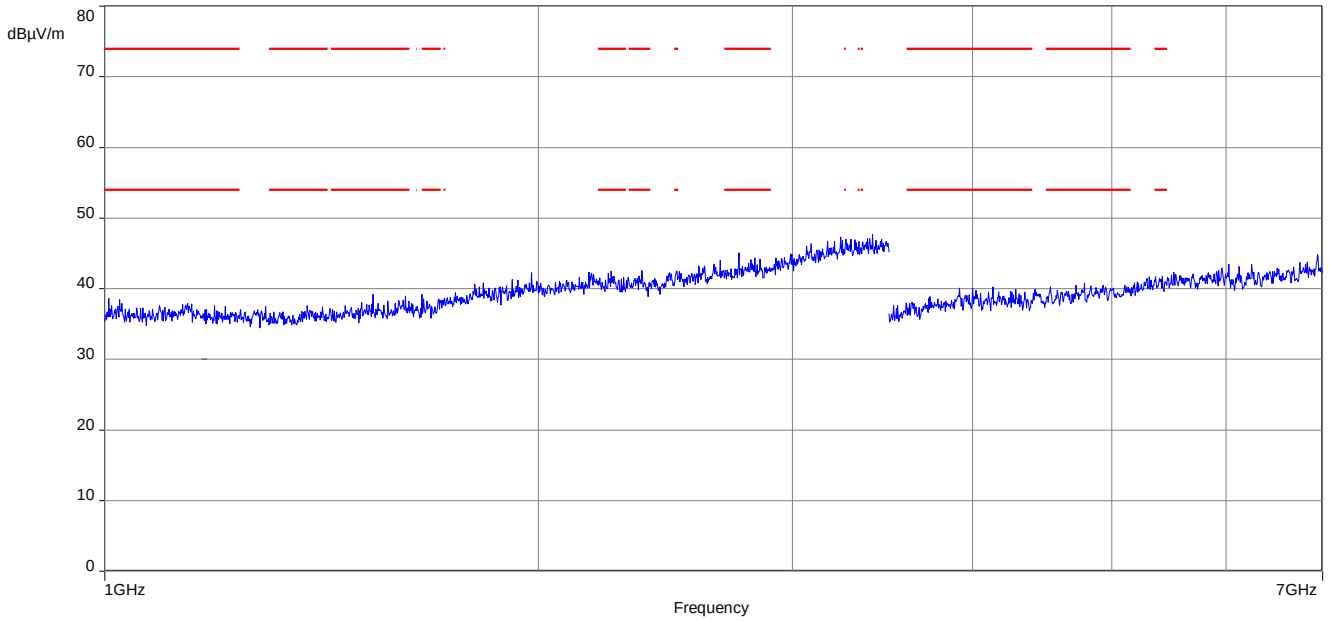
Plot 1: 1 GHz – 7 GHz, horizontal & vertical polarisation (lowest channel)



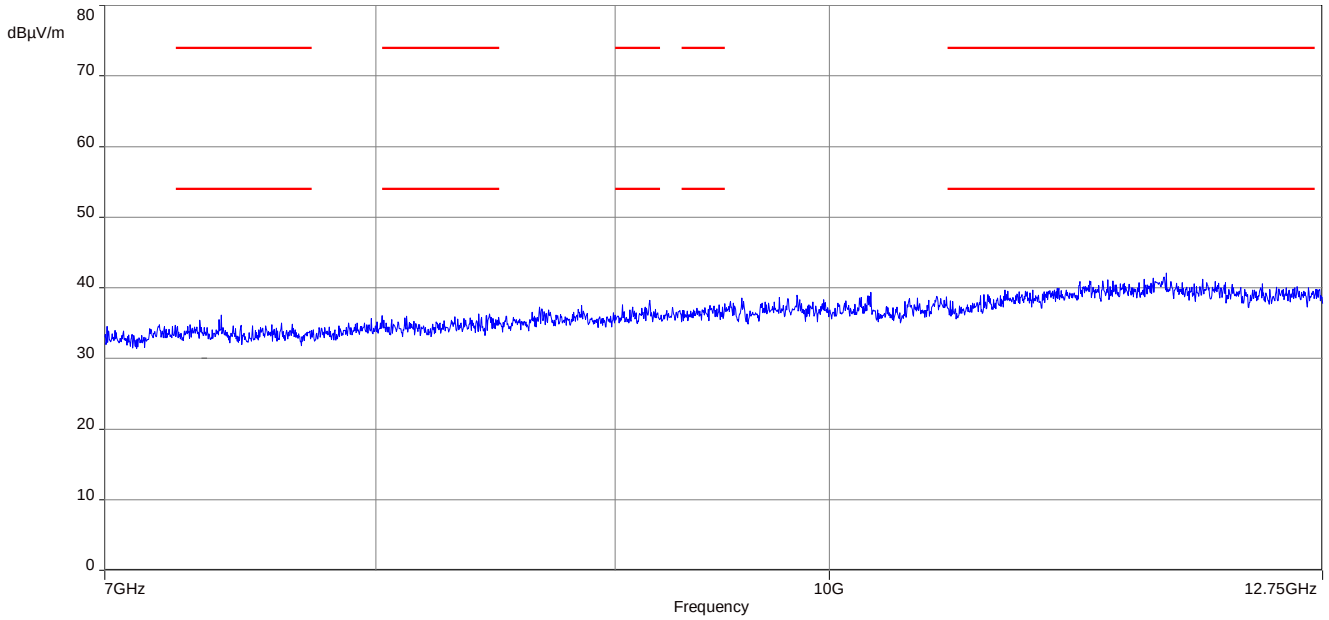
Plot 2: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



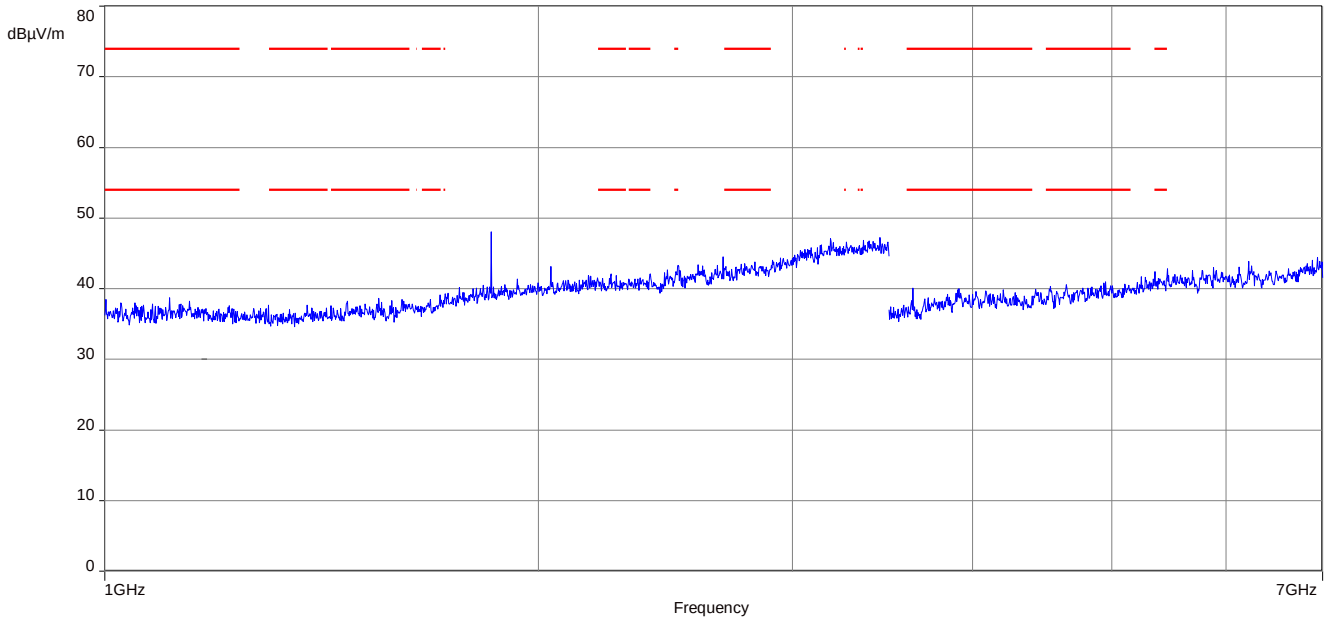
Plot 3: 1 GHz – 7 GHz, horizontal & vertical polarisation (middle channel)



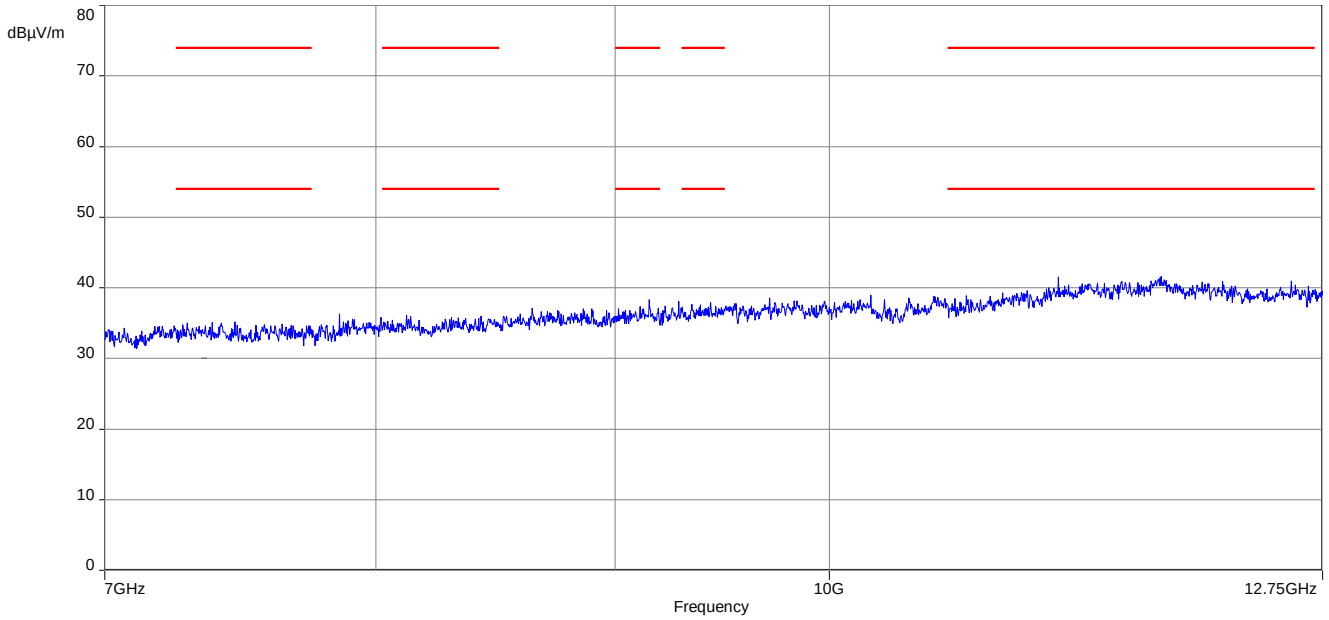
Plot 4: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)



Plot 5: 1 GHz – 7 GHz, horizontal & vertical polarisation (highest channel)

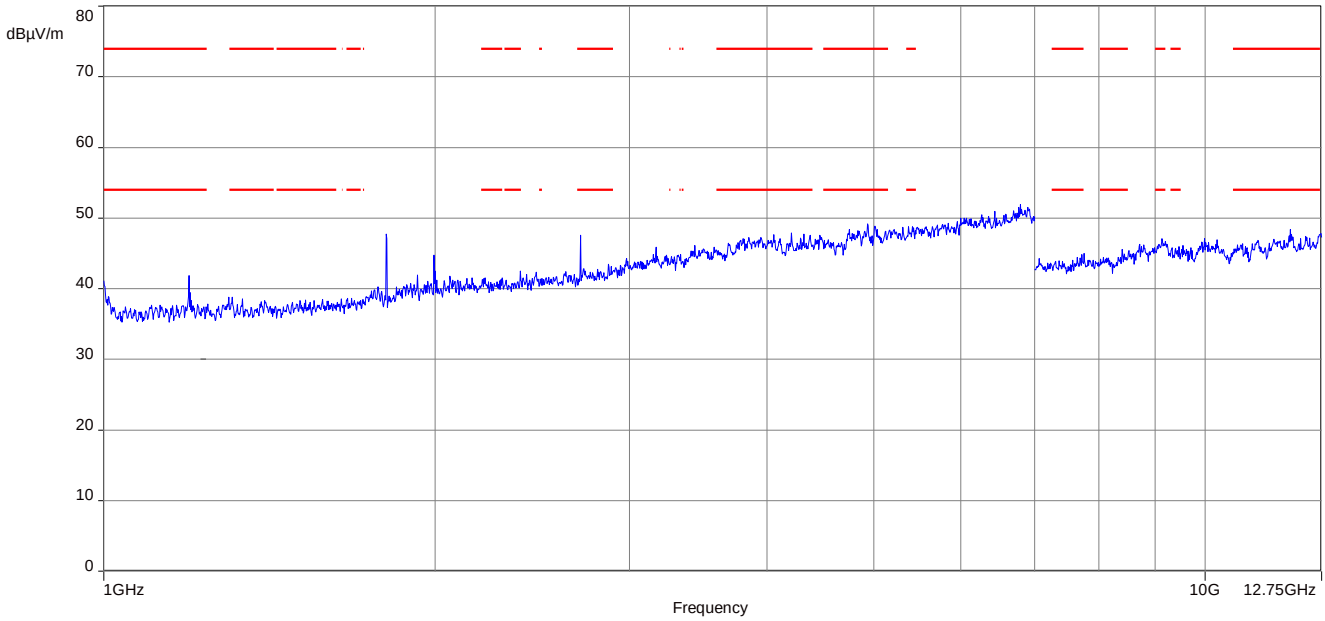


Plot 6: 7 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)

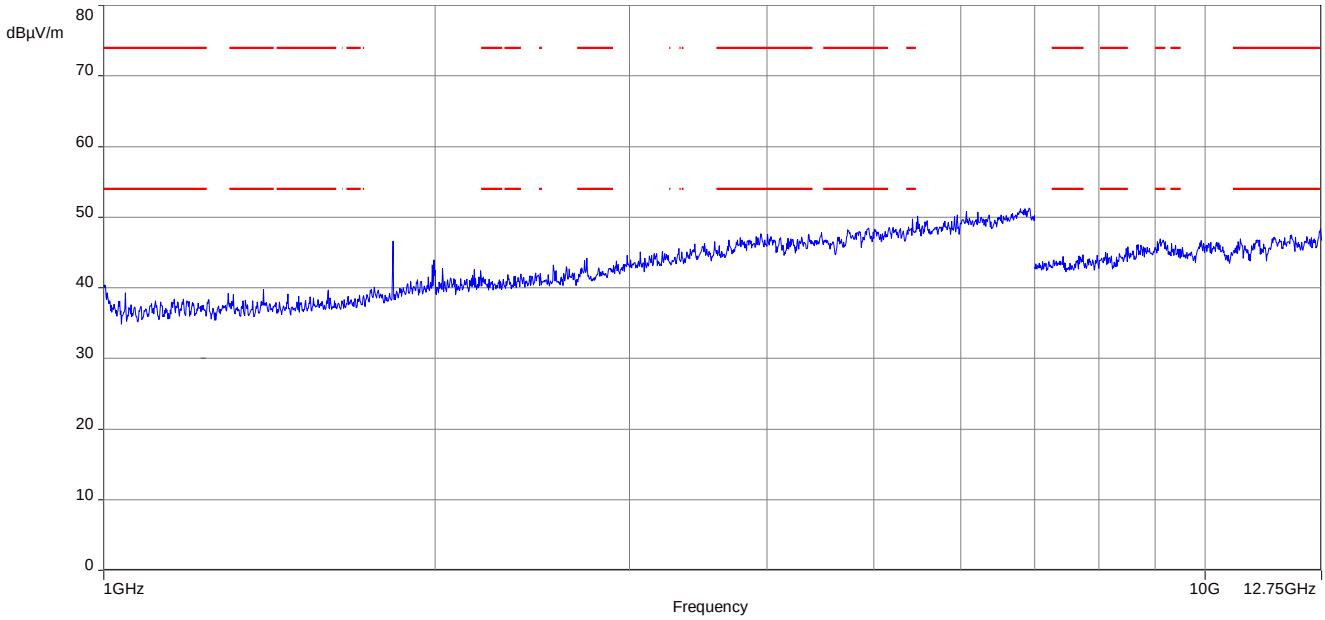


Plots antenna LOCFIELD:

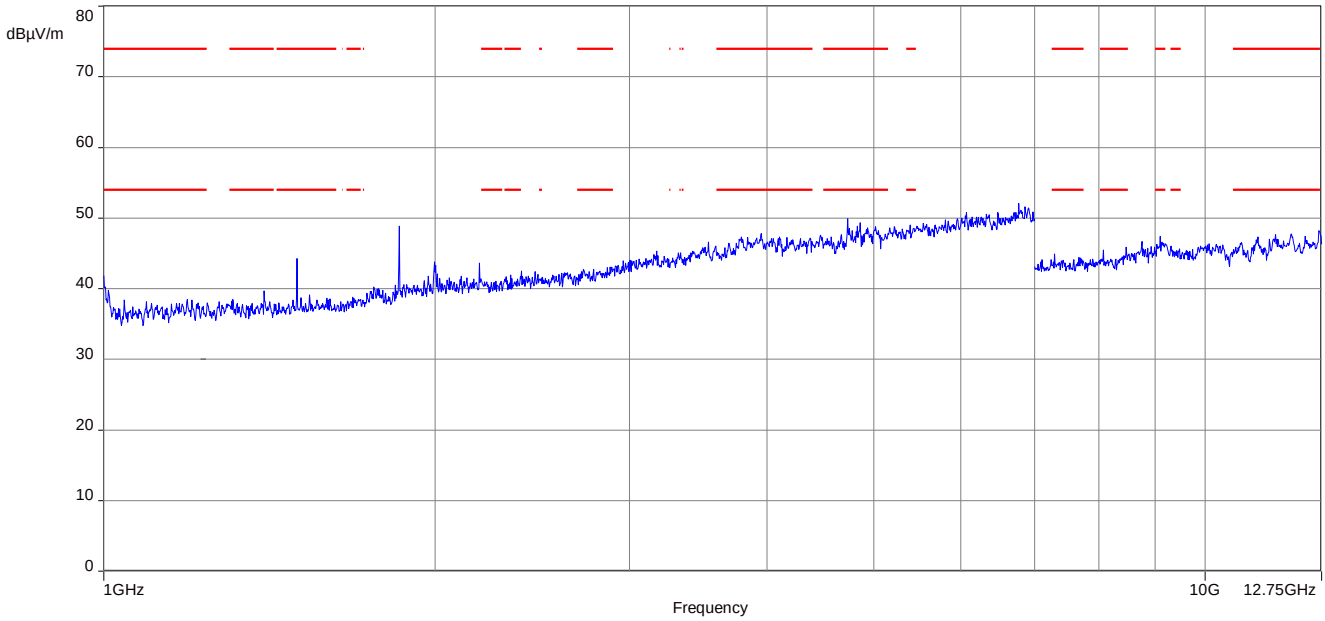
Plot 1: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)



Plot 2: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)

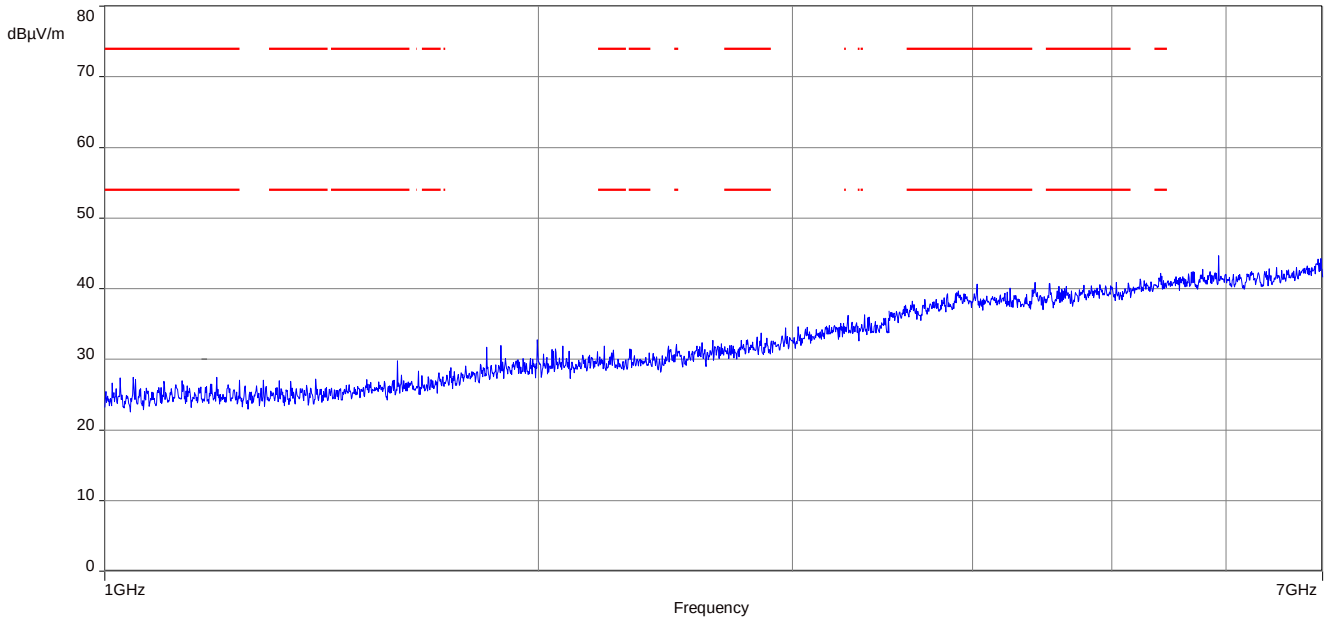


Plot 3: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)

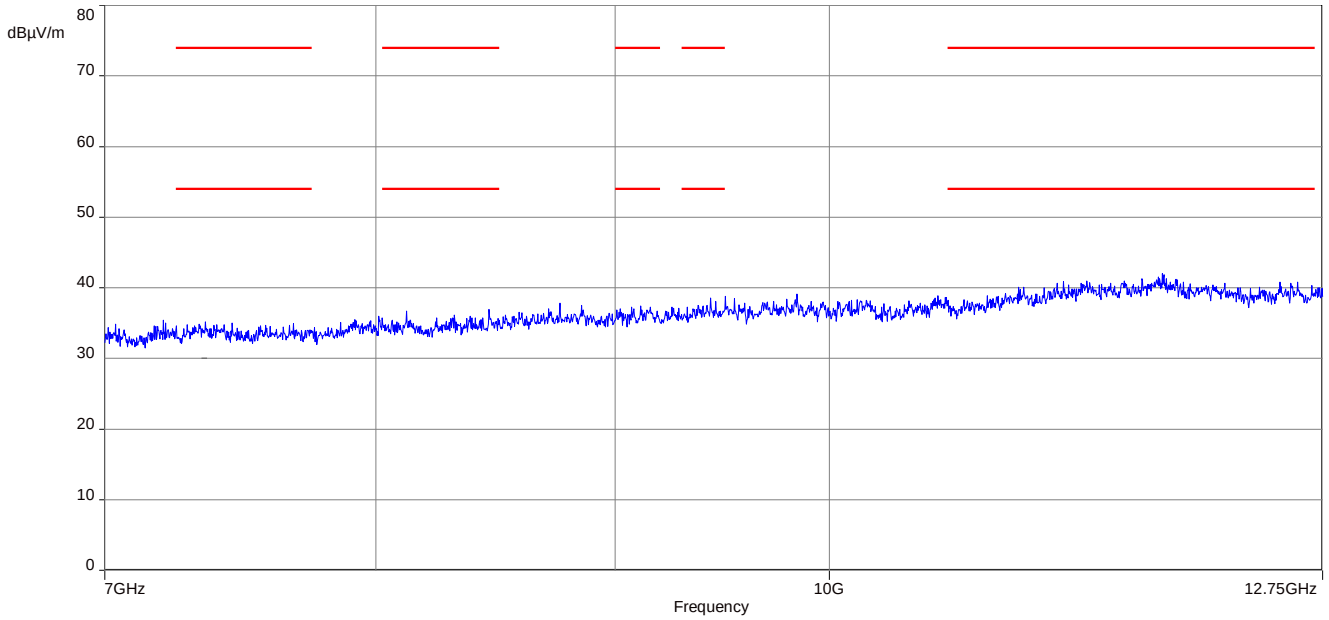


Plots RX:

Plot 1: 1GHz – 7 GHz, RX-Mode, horizontal & vertical polarisation



Plot 2: 7 GHz – 12.75 GHz, RX-Mode, horizontal & vertical polarisation



11.11 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit frequency is 2440 MHz. This measurement is representative for all channels and modes. If critical peaks are found frequency 2402 MHz and 2480 MHz will be measured too. The measurement is performed in the mode with the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

Measurement parameters	
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
Test setup	See sub clause 6.5. A
Measurement uncertainty	See sub clause 8

Limits:

FCC		IC
TX spurious emissions conducted < 30 MHz		
Frequency (MHz)	Quasi-peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

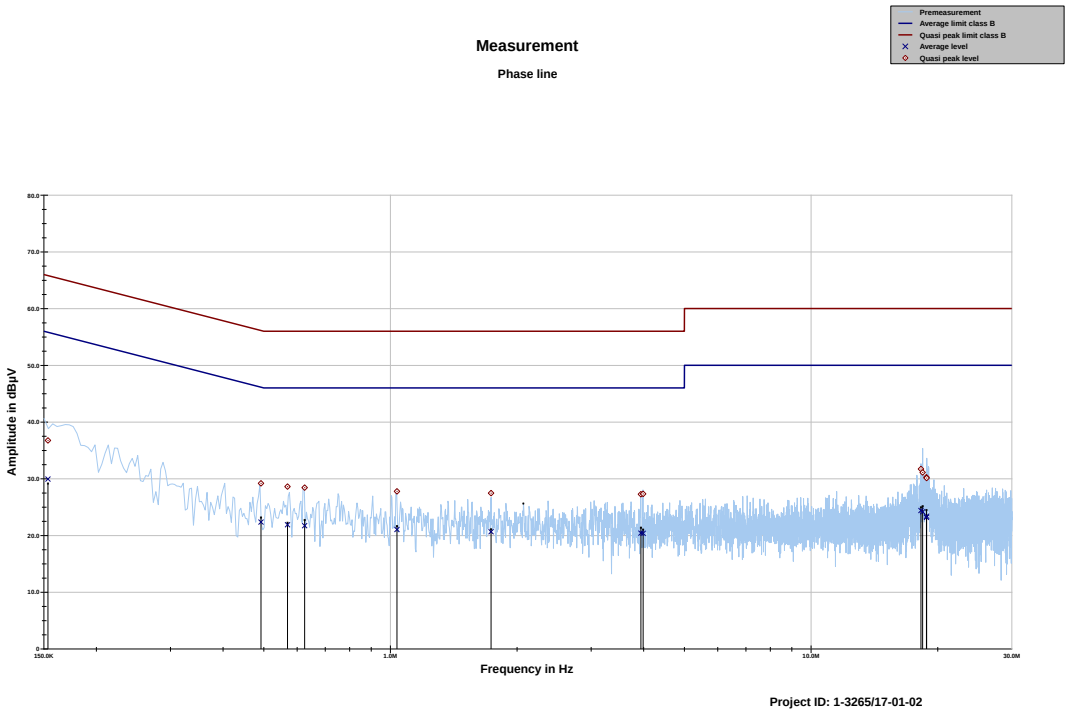
*Decreases with the logarithm of the frequency

Results:

Spurious emissions conducted < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
See result table below the plots.		

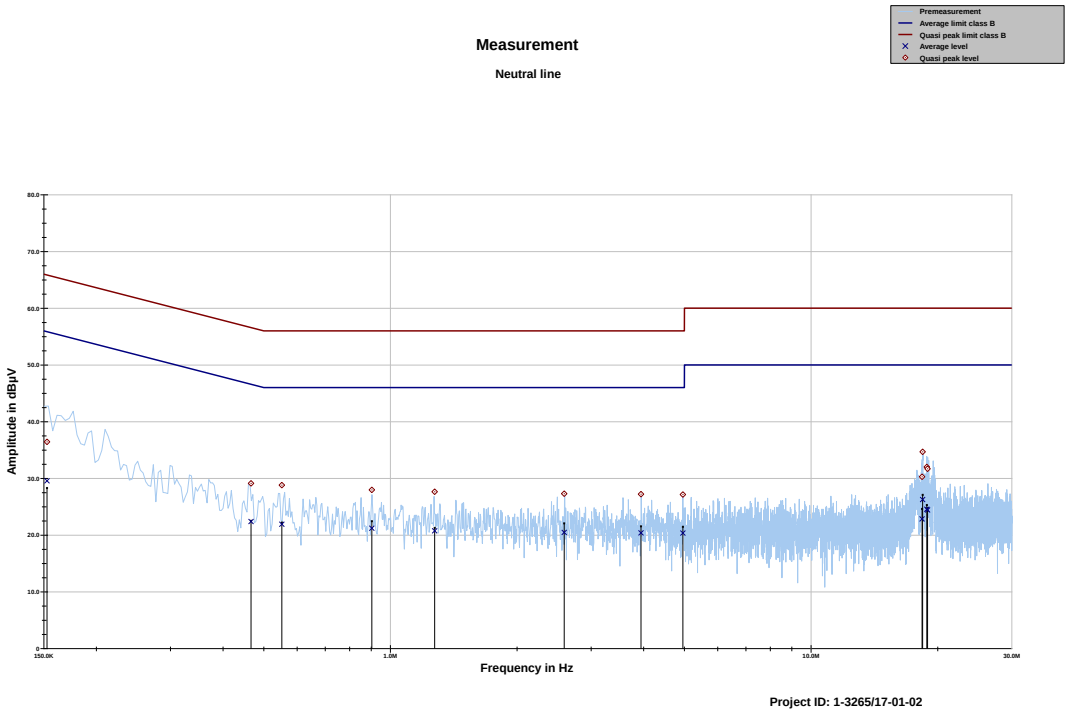
Plots:

Plot 1: 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.153474	36.75	29.06	65.810	29.94	25.96	55.901
0.492530	29.19	26.94	56.125	22.35	23.86	46.213
0.569468	28.61	27.39	56.000	21.88	24.12	46.000
0.625308	28.44	27.56	56.000	21.72	24.28	46.000
1.036495	27.77	28.23	56.000	21.04	24.96	46.000
1.735298	27.47	28.53	56.000	20.66	25.34	46.000
3.941133	27.27	28.73	56.000	20.41	25.59	46.000
3.988875	27.32	28.68	56.000	20.37	25.63	46.000
18.254341	31.70	28.30	60.000	24.40	25.60	50.000
18.422893	31.11	28.89	60.000	24.17	25.83	50.000
18.810520	30.25	29.75	60.000	23.19	26.81	50.000
18.827711	30.12	29.88	60.000	23.39	26.61	50.000

Plot 2: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.152627	36.43	29.42	65.856	29.57	26.36	55.925
0.466274	29.13	27.45	56.580	22.39	24.57	46.964
0.552046	28.81	27.19	56.000	21.91	24.09	46.000
0.903524	27.96	28.04	56.000	21.20	24.80	46.000
1.273907	27.64	28.36	56.000	20.76	25.24	46.000
2.588947	27.30	28.70	56.000	20.47	25.53	46.000
3.943376	27.22	28.78	56.000	20.38	25.62	46.000
4.958272	27.15	28.85	56.000	20.36	25.64	46.000
18.360786	30.28	29.72	60.000	22.85	27.15	50.000
18.421559	34.69	25.31	60.000	26.26	23.74	50.000
18.844411	32.01	27.99	60.000	24.56	25.44	50.000
18.926321	31.70	28.30	60.000	24.43	25.57	50.000

12 Observations

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

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2017-04-03
-A	Update EUT data	2017-05-10

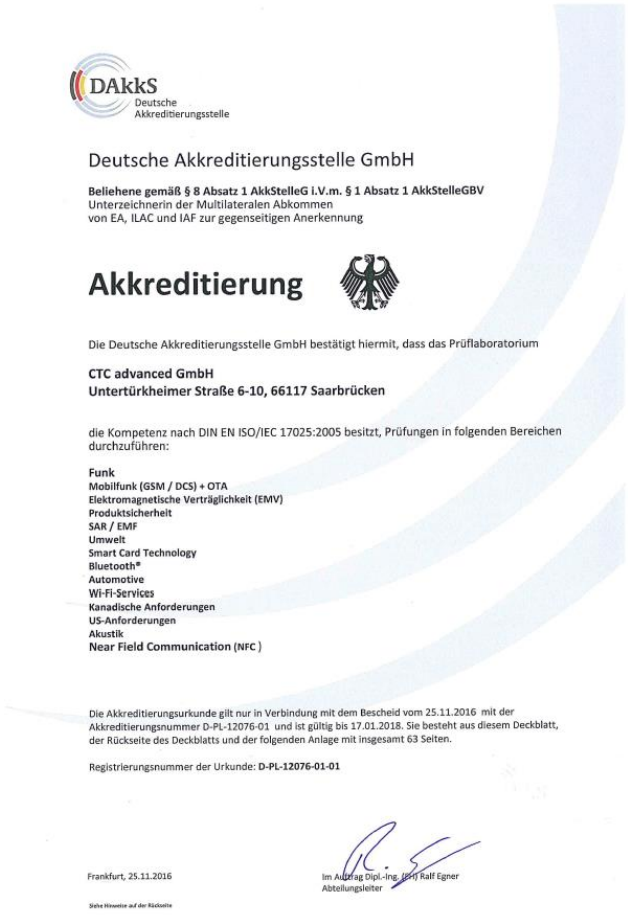
Annex B Further information

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
PMN - Product marketing name
HMN - Host marketing name
HVIN - Hardware version identification number
FVIN - Firmware version identification number
OBW Occupied Bandwidth
OC Operating Channel
OCW Operating Channel Bandwidth
OOB Out Of Band

Annex C Accreditation Certificate

first page



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Frankfurt, 25.11.2016

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

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last page

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