



TEST REPORT

Test report no.: 1-0397/20-02-11-A

BNNetzA-CAB-02/21-102

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: <https://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 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkKS). The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

Digi International Inc.
9350 Excelsior Blvd, Suite 700
Hopkins, 55343 / UNITED STATES
Phone: -/-
Contact: Dan Kobylarz
e-mail: daniel.kobylarz@digi.com
Phone: +1 (952) 912-3029

Manufacturer

Digi International Inc.
9350 Excelsior Blvd, Suite 700
Hopkins, 55343 / UNITED STATES

Test standard/s

FCC - Title 47 CFR Part 15 FCC - 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

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

Test Item

Kind of test item: Embedded ARM System on Module
Model name: ConnectCore 8M Nano SoM
FCC ID: MCQ-CCIMX8MN
IC: 1846A-CCIMX8MN
Frequency: 2400 MHz to 2483.5 MHz DTS band
Technology tested: WLAN
Antenna: one U.FL antenna port for one of the listed antennas
Power supply: 4.5 V to 5.5 V DC via external power supply
Temperature range: -40°C to +85°C

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.

Test report authorized:

Andreas Luckenbill
Head of Department
Radio Communications

Test performed:

David Lang
Lab Manager
Radio Communications

1 Table of contents

1	Table of contents	2
2	General information	4
2.1	Notes and disclaimer	4
2.2	Application details	4
2.3	Test laboratories sub-contracted	4
3	Test standard/s, references and accreditations	5
4	Reporting statements of conformity – decision rule	6
5	Test environment	7
6	Test item.....	7
6.1	General description	7
6.2	Additional information	8
7	Description of the test setup.....	8
7.1	Shielded semi anechoic chamber	9
7.2	Shielded fully anechoic chamber.....	10
7.3	Conducted measurements with peak power meter & spectrum analyzer	11
7.4	Radiated measurements > 18 GHz.....	12
7.5	AC conducted	13
8	Sequence of testing	14
8.1	Sequence of testing radiated spurious 9 kHz to 30 MHz	14
8.2	Sequence of testing radiated spurious 30 MHz to 1 GHz	15
8.3	Sequence of testing radiated spurious 1 GHz to 18 GHz	16
8.4	Sequence of testing radiated spurious above 18 GHz	17
9	Measurement uncertainty	18
10	Summary of measurement results.....	19
11	Additional information and comments	20
12	Additional EUT parameter	22
13	Measurement results.....	23
13.1	Antenna gain.....	23
13.2	Identify worst case data rate.....	23
13.3	Maximum output power.....	24
13.4	Duty cycle	25
13.5	Peak power spectral density	26
13.6	6 dB DTS bandwidth	27
13.7	Occupied bandwidth – 99% emission bandwidth	28
13.8	Occupied bandwidth – 20 dB bandwidth	29
13.9	Band edge compliance radiated	30
13.10	Band edge compliance conducted	37
13.11	Spurious emissions conducted	39
13.12	Spurious emissions radiated below 30 MHz.....	42
13.13	Spurious emissions radiated 30 MHz to 1 GHz	55

13.14	Spurious emissions radiated above 1 GHz	74
13.15	Spurious emissions conducted below 30 MHz (AC conducted).....	95
14	Observations	97
15	Glossary	98
16	Document history	99
17	Accreditation Certificate – D-PL-12076-01-04	99
18	Accreditation Certificate – D-PL-12076-01-05	100

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.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.

The testing service provided by CTC advanced GmbH has been rendered under the current "General Terms and Conditions for CTC advanced GmbH".

CTC advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

Under no circumstances does the CTC advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.

Under no circumstances does the CTC advanced GmbH test report include or imply any product or service warranties from CTC advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CTC advanced GmbH.

All rights and remedies regarding vendor's products and services for which CTC advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by CTC advanced GmbH. In no case this test report can be considered as a Letter of Approval.

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 1-0397/20-02-11 and dated 2021-03-02.

2.2 Application details

Date of receipt of order:	2020-08-03
Date of receipt of test item:	2020-10-06
Start of test:	2020-10-09
End of test:	2020-10-22
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - 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 5 incl. Amendment 1	March 2019	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

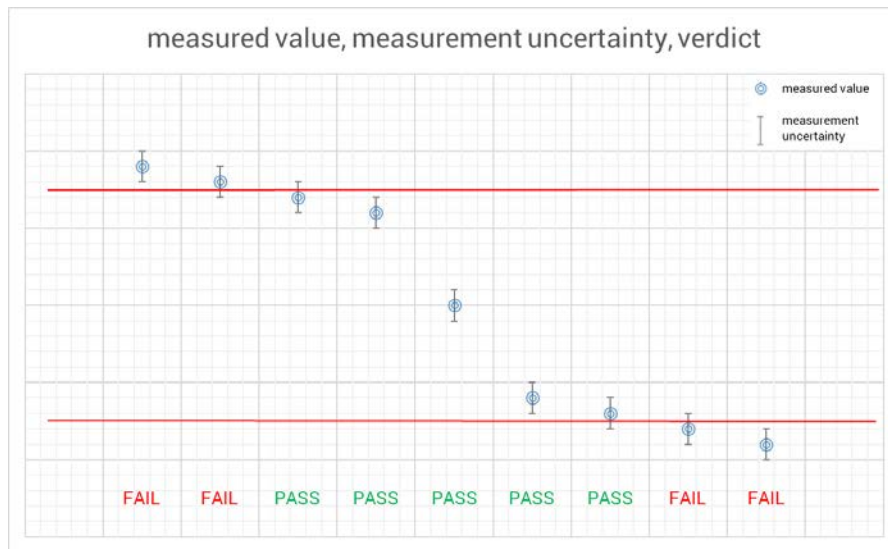
Guidance	Version	Description
KDB 558074 D01	v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement 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

Accreditation	Description	
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf	  <small>Deutsche Akkreditierungsstelle D-PL-12076-01-04</small>
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf	  <small>Deutsche Akkreditierungsstelle D-PL-12076-01-05</small>

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.

The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} +22 °C during room temperature tests T_{max} +85 °C during high temperature tests T_{min} -40 °C during low temperature tests
Relative humidity content	:	55 %
Barometric pressure	:	1021 hpa
Power supply	:	V_{nom} 5.0 V DC via external power supply V_{max} 5.5 V V_{min} 4.5 V

6 Test item

6.1 General description

Kind of test item	:	Embedded ARM System on Module
Model name	:	ConnectCore 8M Nano SoM
HMN	:	-/-
PMN	:	ConnectCore 8M Nano
HVIN	:	CC8MN
FVIN	:	-/-
S/N serial number	:	Rad. 8M DVK 054 (55002060-01 AS47102.0009) RSE > 1GHz, Unknown (labeled CTC #1) (RSE 30MHz to 1 GHz) Cond. 8M DVK 054 (55002060-01 AS47102.0009)
Hardware status	:	55002070-xx
Software status	:	82004426
Firmware status	:	82004431
Frequency band	:	2400 MHz to 2483.5 MHz DTS band
Type of radio transmission	:	DSSS, OFDM
Use of frequency spectrum	:	
Type of modulation	:	CCK, (D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM,
Number of channels	:	13
Antenna	:	one U.FL antenna port for one of the listed antennas; TAOGLAS GW.48.A151: 3.42 dBi* , TAOGLAS FXP830.07.0100C: 3.32 dBi* , TAOGLAS FXP831.07.0100C: 3.0 dBi* , YAGEO ANTX100P001B24553: 4.6 dBi* , Ethertronics 1001932: 2.5 dBi* , Linx Technologies Inc. ANT-DB1-RAF-RPS: 2.5 dBi* *peak antenna gain as per data sheet (see section 11)
Power supply	:	4.5 V to 5.5 V DC via external power supply
Temperature range	:	-40°C to +85°C

6.2 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:

- 1-0397/20-02-01_AnnexA
- 1-0397/20-02-01_AnnexB
- 1-0397/20-02-01_AnnexD

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).

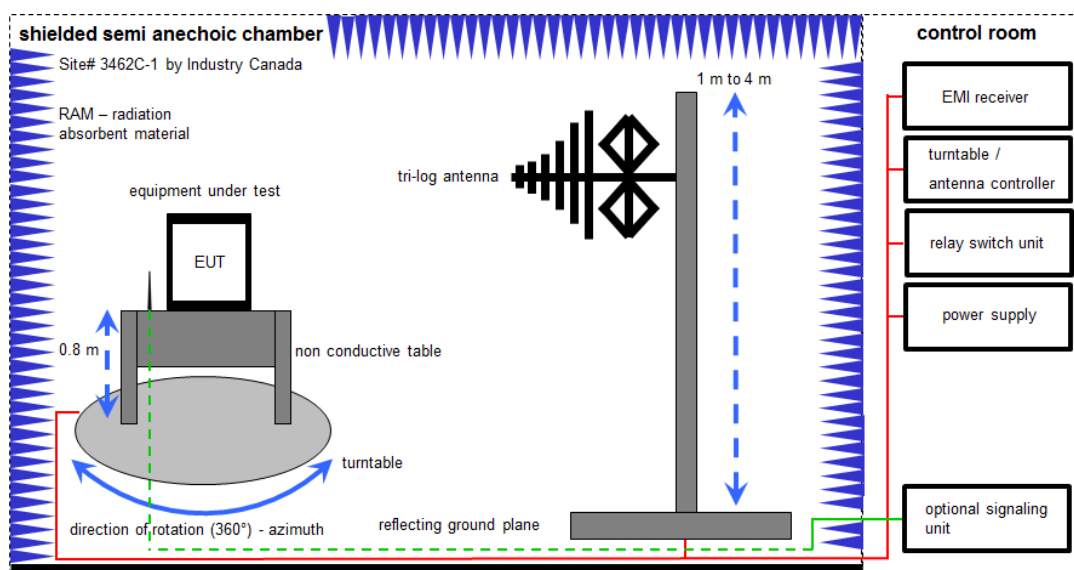
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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
vlk!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz 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
EMC32 software version: 10.59.00

FS = UR + CL + AF

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

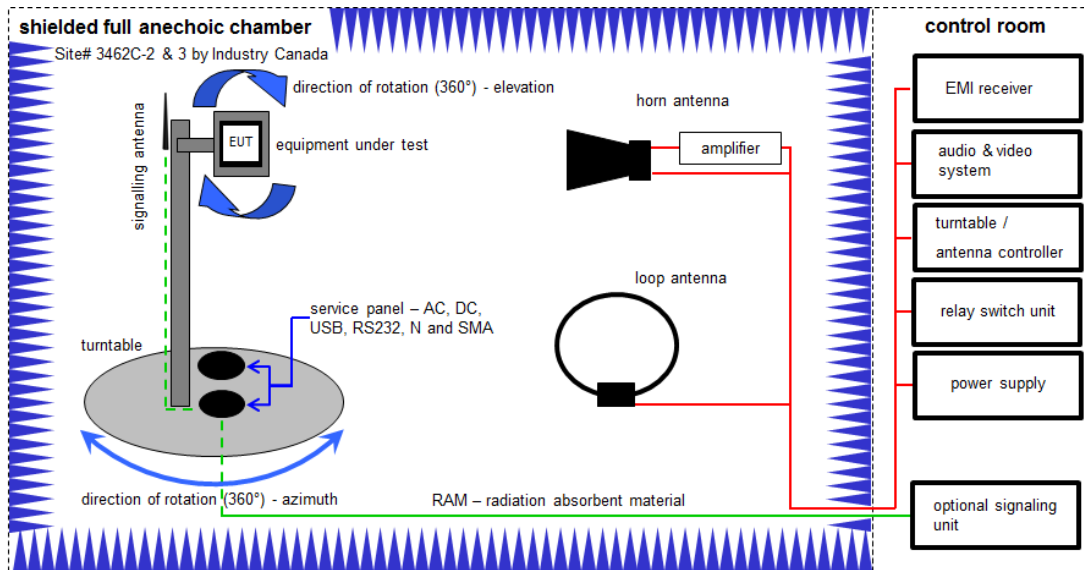
Example calculation:

FS [dB μ V/m] = 12.35 [dB μ V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB μ V/m] (35.69 μ V/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	A	Meßkabine 1	HF-Absorberhalle	MWB AG 300023	Batch no. 699714	300000551	ne	-/-	-/-
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vKII	19.02.2019	18.02.2021
8	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	21.05.2019	20.11.2020

7.2 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)

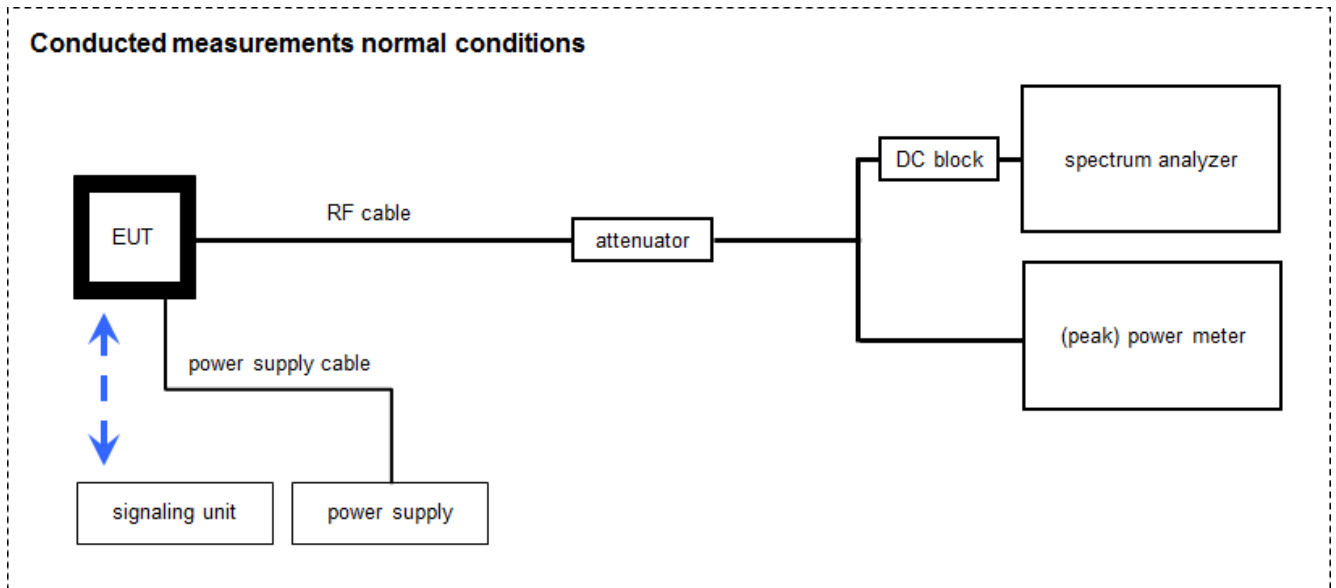
Example calculation:

FS [dB μ V/m] = 40.0 [dB μ V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB μ V/m] (71.61 μ V/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vKI!	12.12.2017	11.12.2020
2	B	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vKI!	13.06.2019	12.06.2021
3	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vKI!	27.02.2019	26.02.2021
5	A, B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
6	A	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
7	A	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492	ev	-/-	-/-
8	A, B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2019	10.12.2020
9	A	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
10	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
11	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
12	A, B	NEXIO EMV-Software	BAT EMC V3.20.06	EMCO		300004682	ne	-/-	-/-

7.3 Conducted measurements with peak power meter & spectrum analyzer



WLAN tester version: 1.1.13; LabView2015

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

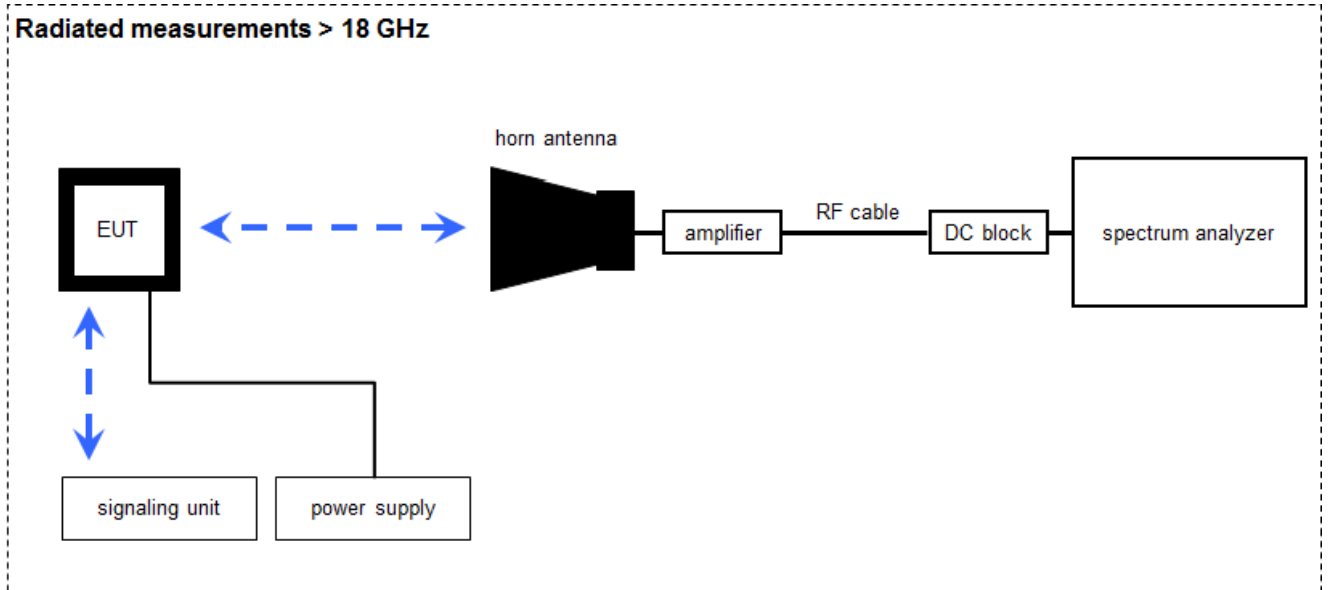
Example calculation:

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	PC Tester R005	Intel Core i3 3220/3,3 GHz, Prozessor		2V2403033A4523	300004589	ne	-/-	-/-
2	A	RF-Cable	ST18/SMAM/SMAM /72	Huber & Suhner	Batch no. 699714	400001184	ev	-/-	-/-
3	A	DC-Blocker 0.1-40 GHz	8141A	Inmet		400001185	ev	-/-	-/-
4	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits		400001186	ev	-/-	-/-
5	A	DC Power Supply	HMP2020	Rohde & Schwarz	102850	300005517	vKI!	12.12.2019	11.12.2021
6	A	Tester Software RadioStar (C.BER2 for BT Conformance)	Version 1.0.0.X	CTC advanced GmbH	0001	400001380	ne	-/-	-/-
7	A	USB Wideband Power Sensor (50MHz - 18GHz)	U2021XA	Keysight	MY591900010	300005802	k	11.12.2019	10.12.2020
8	A	DC-Blocker 0.1-40 GHz	8141A	Inmet		400001185	ev	-/-	-/-
9	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits		400001186	ev	-/-	-/-

7.4 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

FS = UR + CA + AF

(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

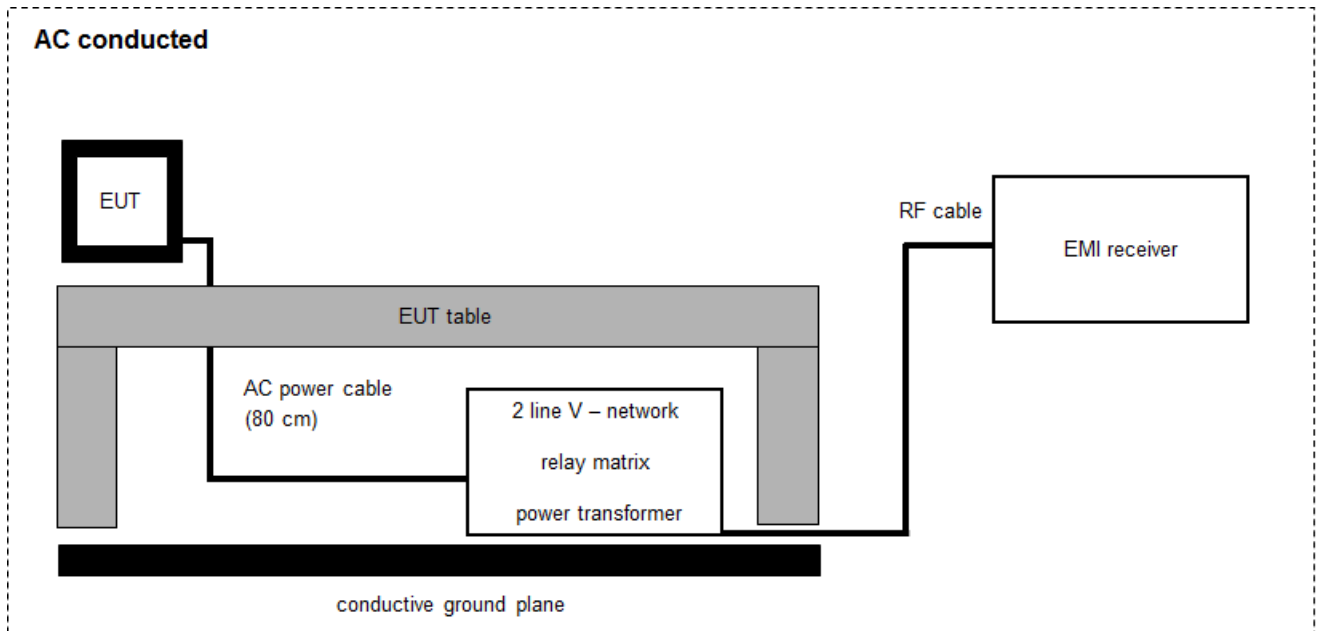
Example calculation:

FS [dB μ V/m] = 40.0 [dB μ V/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dB μ V/m] (6.79 μ V/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vIK!	21.01.2020	20.01.2022
3	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	17.12.2019	16.12.2020
4	A	RF-Cable	ST18/SMAm/SMAm /48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm /48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-

7.5 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:

$$FS [dB\mu V/m] = 37.62 [dB\mu V/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dB\mu V/m] (244.06 \mu V/m)$$

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	892475/017	300002209	vIK!	11.12.2019	10.12.2021
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	10.12.2019	09.12.2020
4	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-

8 Sequence of testing

8.1 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, it is placed on a table with 0.8 m height.
- 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 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 pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- 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.

*Note: The sequence will be repeated three times with different EUT orientations.

8.2 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 $\pm 45^\circ$ 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.

8.3 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.

8.4 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 Measurement uncertainty

Measurement uncertainty		
Test case	Uncertainty	
Antenna gain	± 3 dB	
Power spectral density	± 1.15 dB	
DTS bandwidth	± 100 kHz (depends on the used RBW)	
Occupied bandwidth	± 100 kHz (depends on the used RBW)	
Maximum output power conducted	± 1.15 dB	
Detailed spurious emissions @ the band edge - conducted	± 1.15 dB	
Band edge compliance radiated	± 3 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.15 dB
	> 7 GHz	± 1.15 dB
	> 18 GHz	± 1.89 dB
	≥ 40 GHz	± 3.12 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	
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB	

10 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	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	See table!	2021-03-16	-/-

Test specification clause	Test case	Guideline	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (f)(ii)	Antenna gain	-/-	Nominal	Nominal	DSSS	-/-				-/-
§15.35	Duty cycle	-/-	Nominal	Nominal	DSSS OFDM	-/-				-/-
§15.247(e) RSS - 247 / 5.2 (b)	Power spectral density	KDB 558074 DTS clause: 8.4	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(a)(2) RSS - 247 / 5.2 (a)	DTS bandwidth	KDB 558074 DTS clause: 8.2	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(b)(3) RSS - 247 / 5.4 (d)	Maximum output power	KDB 558074 DTS clause: 8.3.1.3	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge – cond.	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance cond. & rad.	KDB 558074 DTS clause: 8.7.3	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	TX spurious emissions cond.	KDB 558074 DTS clause: 8.5	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.209(a) RSS-Gen	TX spurious emissions rad. below 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions rad. 30 MHz to 1 GHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions rad. above 1 GHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.109 RSS-Gen	RX spurious emissions rad. 30 MHz to 1 GHz	-/-	Nominal	Nominal	RX / idle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.109 RSS-Gen	RX spurious emissions rad. above 1 GHz	-/-	Nominal	Nominal	RX / idle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-

Notes:

C	Compliant	NC	Not compliant	NA	Not applicable	NP	Not performed
----------	-----------	-----------	---------------	-----------	----------------	-----------	---------------

11 Additional information and comments

Reference documents: Antenna specifications: ant-db1-raf-ccc.pdf,
 AVX-E_1001932PT.pdf
 FXP830.07.0100C.pdf,
 FXP831.07.0100C.pdf,
 GW.48.A151.pdf,
 An_PCB_2400-5000_ANTX100P001B24553_v0.pdf
 Customer Questionnaire,
 CC8X_RF_Certification_Testing_Guide.pdf (2020-07-22)

Co-applicable documents: 1-0397/20-02-01_log1_conducted.pdf

Special test descriptions: For conducted measurements with limit expressed in e.i.r.p. the maximum antenna gain of 4.6dBi in the 2.4GHz band was considered (YAGEO ANT-X100P001B24553)

Radiated measurements: For each type of antenna (PCB & Dipole) the antenna with the highest gain was tested.

Dipole antenna: TAOGLAS (GW48.151) 3.42dBi

PCB antenna: YAGEO (ANT-X100P001B24553) 4.6dBi

Configuration descriptions: Test modes were enabled using test software qdart_conn_qrct.win version 4.0.00138.0 from Qualcomm. Power settings and worst case modulations used for testing were defined by the manufacturer.

Power Settings vs. Data Rate:

Data rate:	Power setting:
b-mode	12
g-mode	12
nHT20-mode	12
nHT40-mode	11

- EUT selection:
- Only one device available
 - Devices selected by the customer
 - Devices selected by the laboratory (Randomly)

Provided channels:

Channels with 20 MHz channel bandwidth:

channel number & center frequency													
channel	1	2	3	4	5	6	7	8	9	10	11	12	13
f_c / MHz	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462	2467	2472

Channels with 40 MHz channel bandwidth:

channel number & center frequency													
channel	-/-	-/-	3	4	5	6	7	8	9	10	11	-/-	-/-
f_c / MHz	-/-	-/-	2422	2427	2432	2437	2442	2447	2452	2457	2462	-/-	-/-

Note: The channels used for the tests are marked in bold in the list.

12 Additional EUT parameter

- Test mode:
- No test mode available
Iperf was used to ping another device with the largest support packet size
 - Test mode available
Special software is used.
EUT is transmitting pseudo random data by itself
- Modulation types:
- Wide Band Modulation (None Hopping – e.g. DSSS, OFDM)
 - Frequency Hopping Spread Spectrum (FHSS)
- Antennas and transmit operating modes:
- Operating mode 1 (single antenna)
 - *Equipment with 1 antenna,*
 - *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
 - *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*
 - Operating mode 2 (multiple antennas, no beamforming)
 - *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*
 - Operating mode 3 (multiple antennas, with beamforming)
 - *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.
In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.*

13 Measurement results

13.1 Antenna gain

The maximum antenna gain is declared by the manufacturer (see section 6 & 11).

13.2 Identify worst case data rate

Results:

Modulation scheme / bandwidth	
DSSS / b – mode	1 Mbit/s
OFDM / g – mode	6 Mbit/s
OFDM / n HT20 – mode	MCS0
OFDM / n HT40 – mode	MCS0

Note: Worst case data rate or modulation scheme declared by the manufacturer

13.3 Maximum output power

Description:

Measurement of the maximum conducted peak output power. The measurements are performed using the data rate identified in the previous chapter.

Measurement:

Measurement parameter	
According to DTS clause: 8.3.1.3	
Peak power meter	
External result file(s)	1-0397/20-02-11 _log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

Limits:

FCC	IC
Conducted 1.0 W / 30 dBm with an antenna gain of max. 6 dBi	
Conducted limit with an gain of 4.6 dBi = 30 dBm	

Results:

	maximum output power / dBm		
	lowest channel	middle channel	highest channel
Output power conducted DSSS / b – mode	17.5	15.3	16.6
Output power conducted OFDM / g – mode	20.6	19.3	20.3
Output power conducted OFDM / n HT20 – mode	20.7	19.3	20.2
Output power conducted OFDM / n HT40 – mode	17.6	18.7	19.1

13.4 Duty cycle

Description:

Measurement of the timing behavior.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Depends on the signal see plot
Resolution bandwidth	10 MHz
Video bandwidth	10 MHz
Trace mode	Max hold
External result file(s)	1-0397/20-02-11_log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

Limits:

FCC	IC
No limitation!	

Results:

T_{nom}	V_{nom}	lowest channel	middle channel	highest channel
DSSS / b – mode		99 % / 0.04 dB	99 % / 0.06 dB	99 % / 0.04 dB
OFDM / g – mode		95 % / 0.39 dB	95 % / 0.39 dB	94 % / 0.40 dB
OFDM / n HT20 – mode		94 % / 0.41 dB	94 % / 0.41 dB	94 % / 0.54 dB
OFDM / n HT40 – mode		89 % / 0.81 dB	89 % / 0.81 dB	89 % / 0.80 dB

13.5 Peak power spectral density

Description:

Measurement of the peak power spectral density of a digital modulated system. The PSD shows the strength of the variations as a function of the frequency. The measurement is repeated for both modulations at the lowest, middle and highest channel.

Measurement:

Measurement parameter	
According to DTS clause: 8.4	
Detector	Positive Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Span	30 MHz
Trace mode	Max. hold (allow trace to fully stabilize)
External result file(s)	1-0397/20-02-11 _log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

Limits:

FCC	IC
8 dBm / 3 kHz (conducted)	

Results:

Formula for PKPSD calculation: $PKPSD_{calculated} = PKPSD_{measured} + 10 \cdot \log(3kHz/RBW_{measured}[kHz])$

calculated	peak power spectral density / dBm @ 3 kHz		
	Lowest channel	Middle channel	Highest channel
DSSS / b – mode	-6.65	-9.66	-7.87
OFDM / g – mode	-10.39	-11.64	-9.81
OFDM / n HT20 – mode	-11.69	-13.22	-11.97
OFDM / n HT40 – mode	-16.53	-16.55	-14.88

13.6 6 dB DTS bandwidth

Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
According to DTS clause: 8.2	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	500 kHz
Span	30 MHz / 50 MHz
Trace mode	Single count with 200 counts
External result file(s)	1-0397/20-02-11 _log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

Limits:

FCC	IC
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

	6 dB DTS bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	7548	8036	7548
OFDM / g – mode	15456	15720	15408
OFDM / n HT20 – mode	15692	16312	15432
OFDM / n HT40 – mode	35440	35464	35032

13.7 Occupied bandwidth – 99% emission bandwidth

Description:

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	300 kHz
Video bandwidth	1 MHz
Span	30 MHz / 50 MHz
Measurement procedure	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace mode	Single count with 200 counts
External result file(s)	1-0397/20-02-11 _log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

Usage:

-/-	IC
OBW is necessary for Emission Designator	

Results:

	99% emission bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	12871	13023	12563
OFDM / g – mode	16722	16850	16594
OFDM / n HT20 – mode	17786	17910	17658
OFDM / n HT40 – mode	36308	36812	36580

13.8 Occupied bandwidth – 20 dB bandwidth

Description:

Measurement of the 20 dB bandwidth of the modulated carrier.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	500 kHz
Span	30 MHz / 50 MHz
Trace mode	Single count with min. 200 counts
External result file(s)	1-0397/20-02-11 _log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

Usage:

-/-	IC
Within the used band!	

Results:

	20 dB bandwidth / kHz		
	lowest channel	middle channel	highest channel
DSSS / b – mode	14856	14924	14664
OFDM / g – mode	18724	19024	18648
OFDM / n HT20 – mode	19900	19952	19528
OFDM / n HT40 – mode	40120	40536	39776

13.9 Band edge compliance radiated

Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to the lowest channel for the lower restricted band and to the highest channel for the upper restricted band. The measurement is repeated for all modulations. Measurement distance is 3 meter.

Measurement:

	Measurement parameter for peak measurements	Measurement parameter for average measurements
		According to DTS clause: 8.7.3
Detector	Peak	RMS
Sweep time	Auto	Auto
Resolution bandwidth	1 MHz	100 kHz
Video bandwidth	1 MHz	300 kHz
Span	See plot	2 MHz
Trace mode	Max. hold	RMS Average over 101 sweeps
Analyzer function	-/-	Band power function (Compute the power by integrating the spectrum over 1 MHz)
Test setup	See chapter 7.2 A	
Measurement uncertainty	See chapter 9	

Limits:

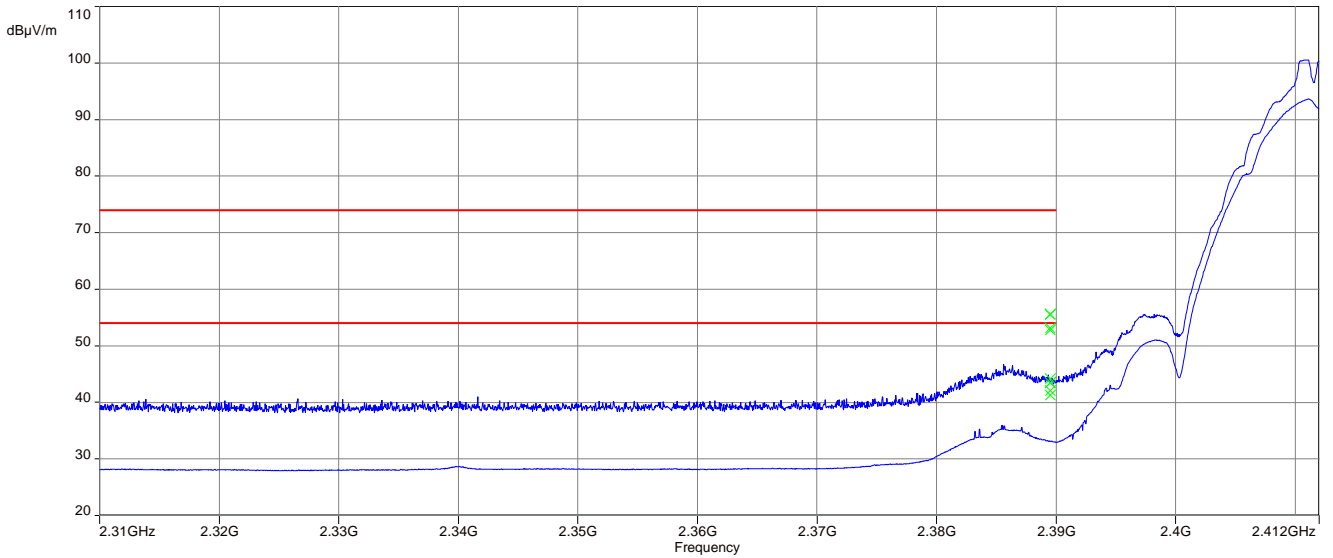
FCC	IC
74 dBµV/m @ 3 m (Peak) 54 dBµV/m @ 3 m (AVG)	

Results:

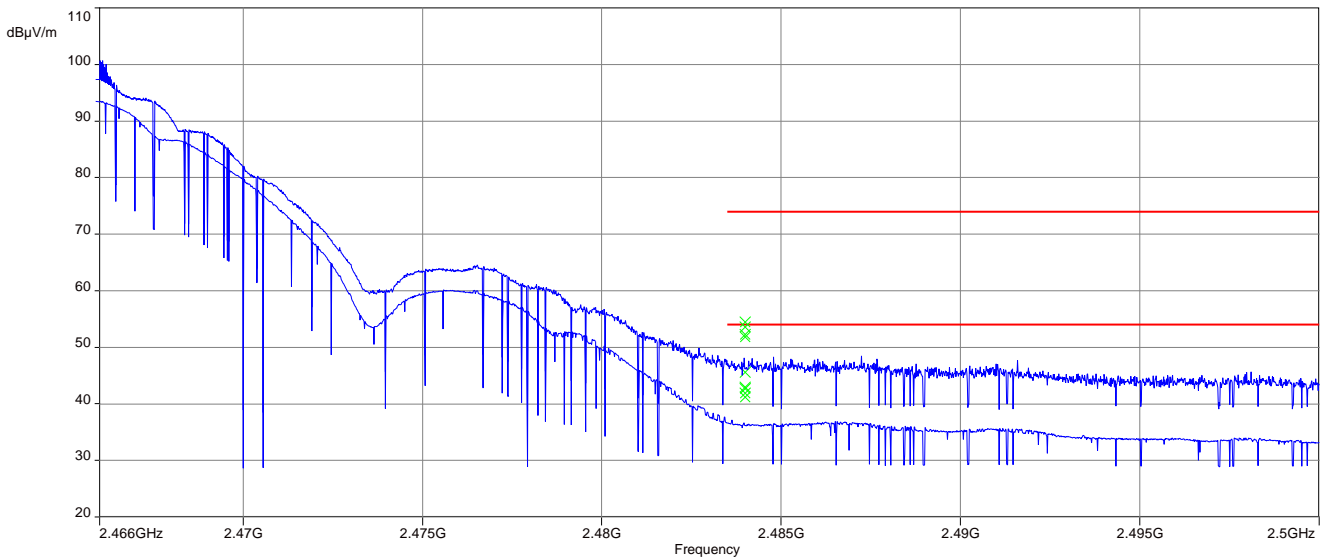
band edge compliance radiated / (dBµV / m) @ 3 m			
	DSSS	OFDM (20 MHz nominal channel bandwidth)	OFDM (40 MHz nominal channel bandwidth)
Lower band edge	>20 dB below limit (Peak) >20 dB below limit (AVG)	>20 dB below limit (Peak) >20 dB below limit (AVG)	>20 dB below limit (Peak) >20 dB below limit (AVG)
Upper band edge	>20 dB below limit (Peak) >20 dB below limit (AVG)	>20 dB below limit (Peak) >20 dB below limit (AVG)	>20 dB below limit (Peak) >20 dB below limit (AVG)

Plots: DSSS - peak / average (YAGEO ANTX100P001B24553)

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

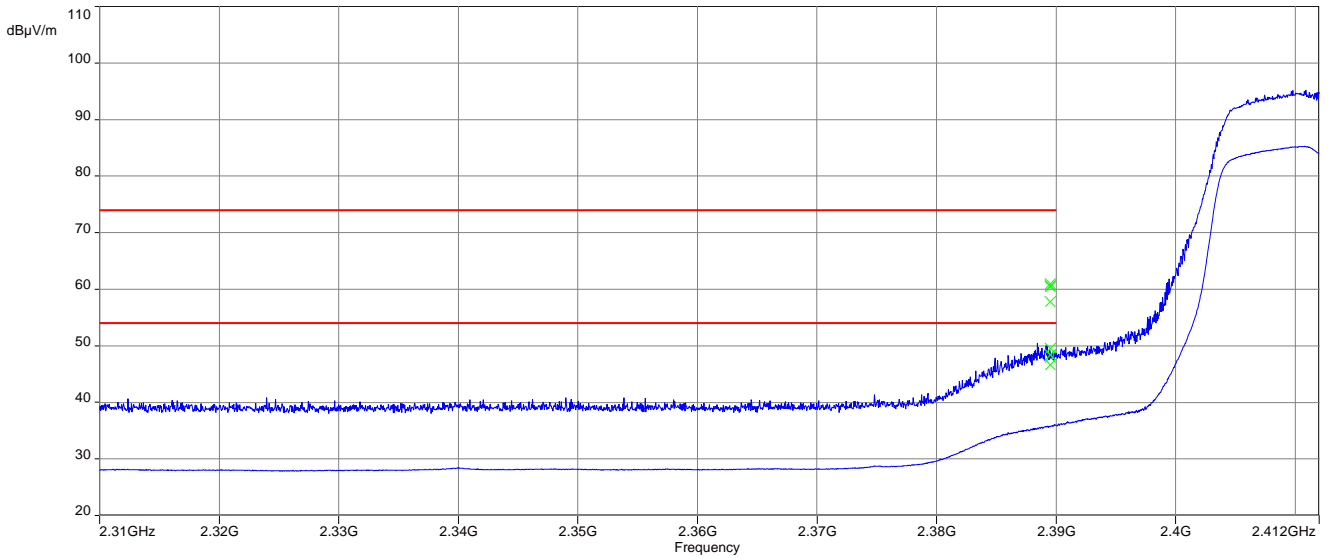


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

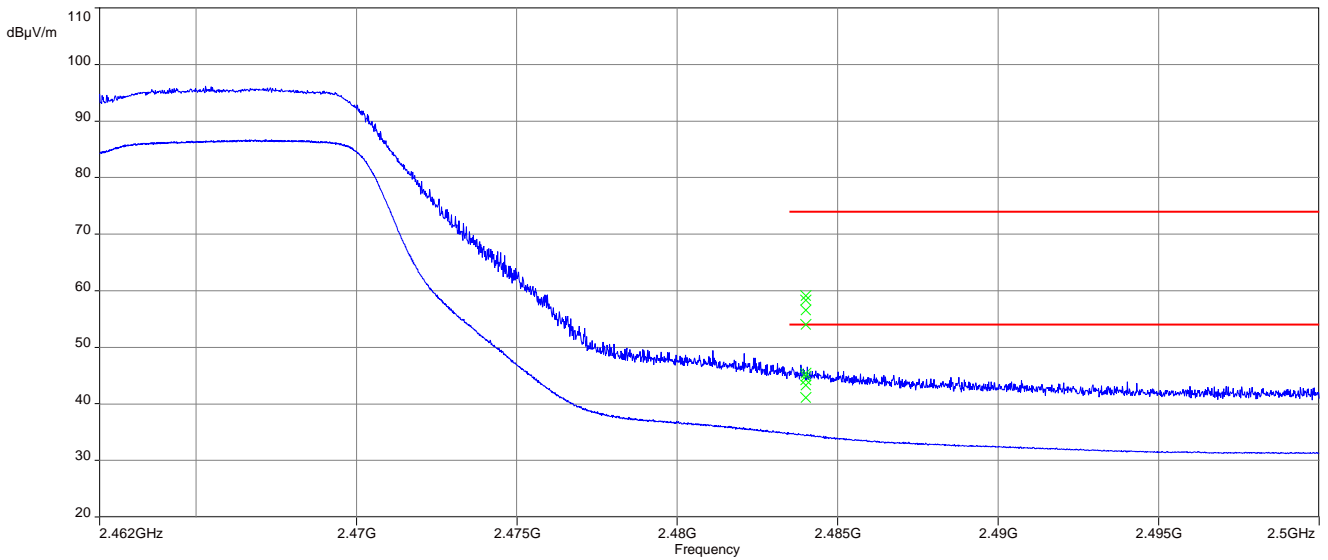


Plots: OFDM (20 MHz bandwidth) - peak / average (YAGEO ANTX100P001B24553)

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

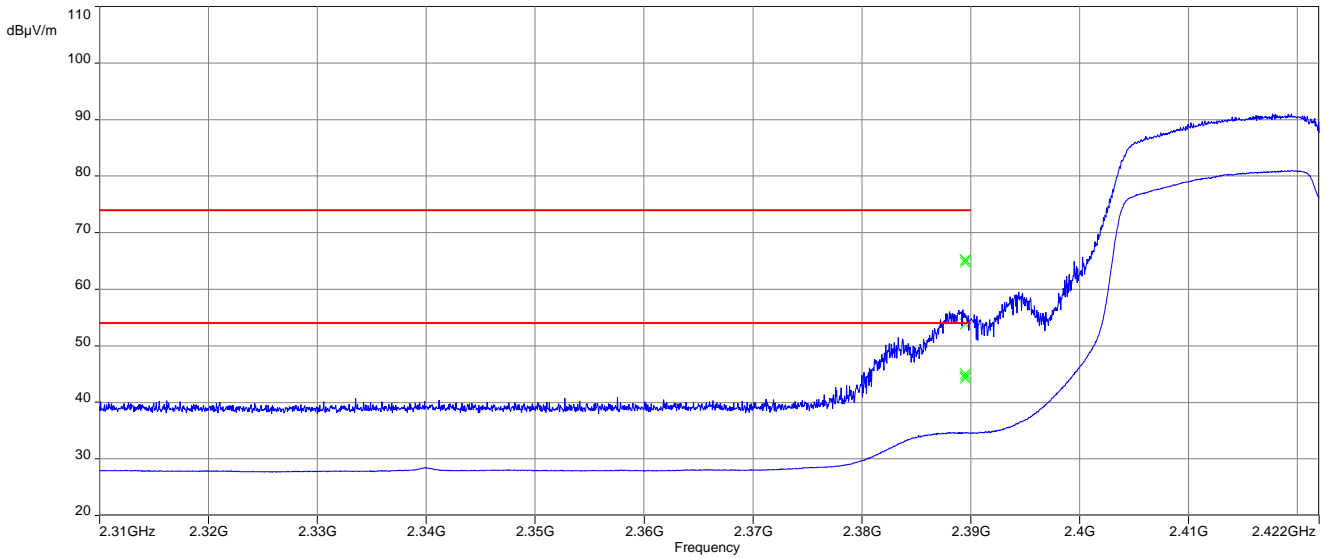


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

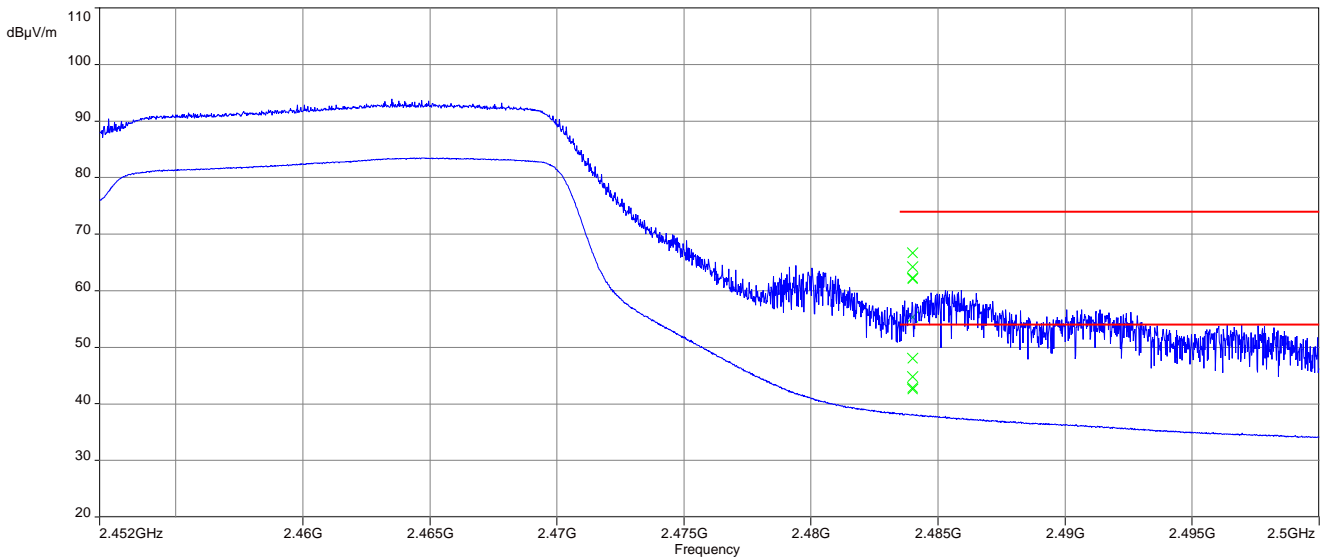


Plots: OFDM (40 MHz bandwidth) - mode peak / average (YAGEO ANTX100P001B24553)

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

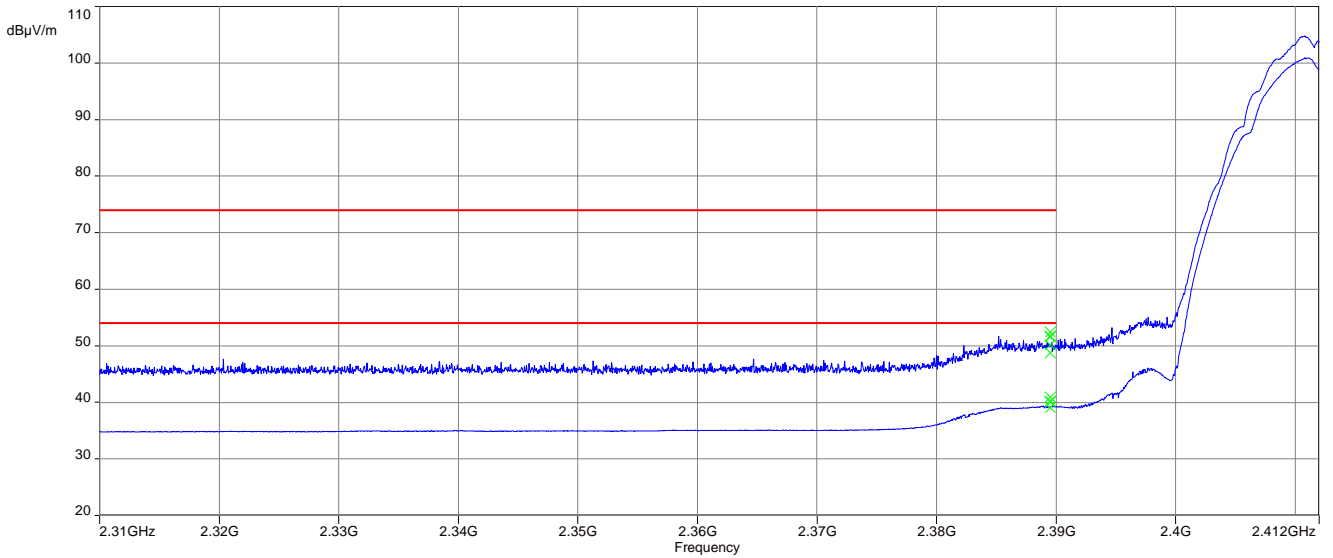


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

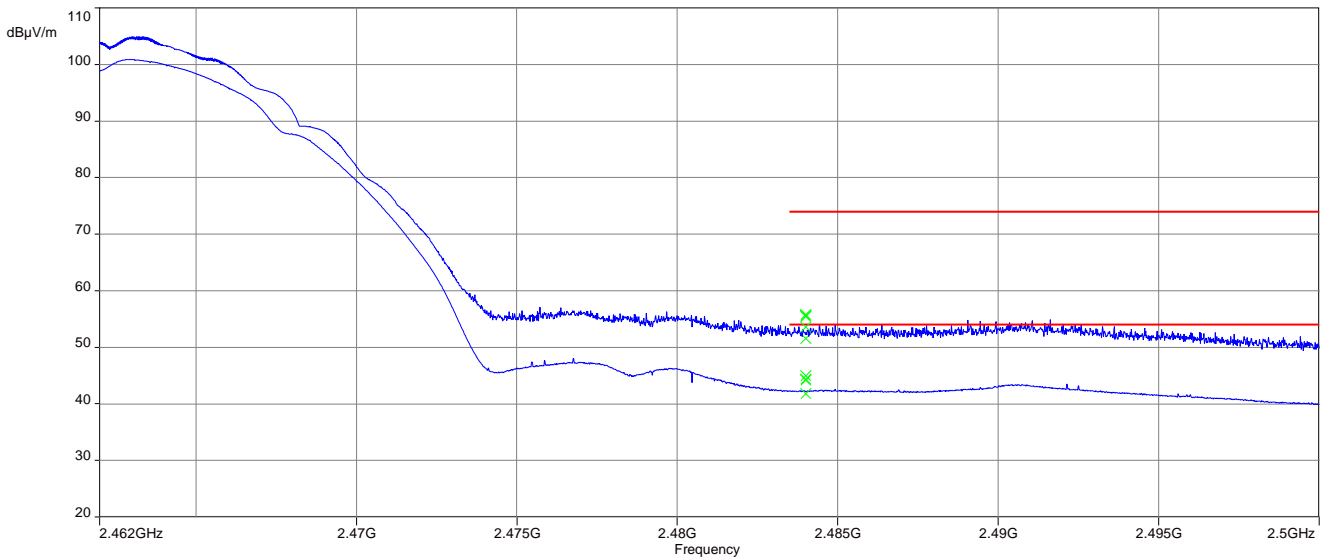


Plots: DSSS - peak / average (TAOGLAS (GW48.151))

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

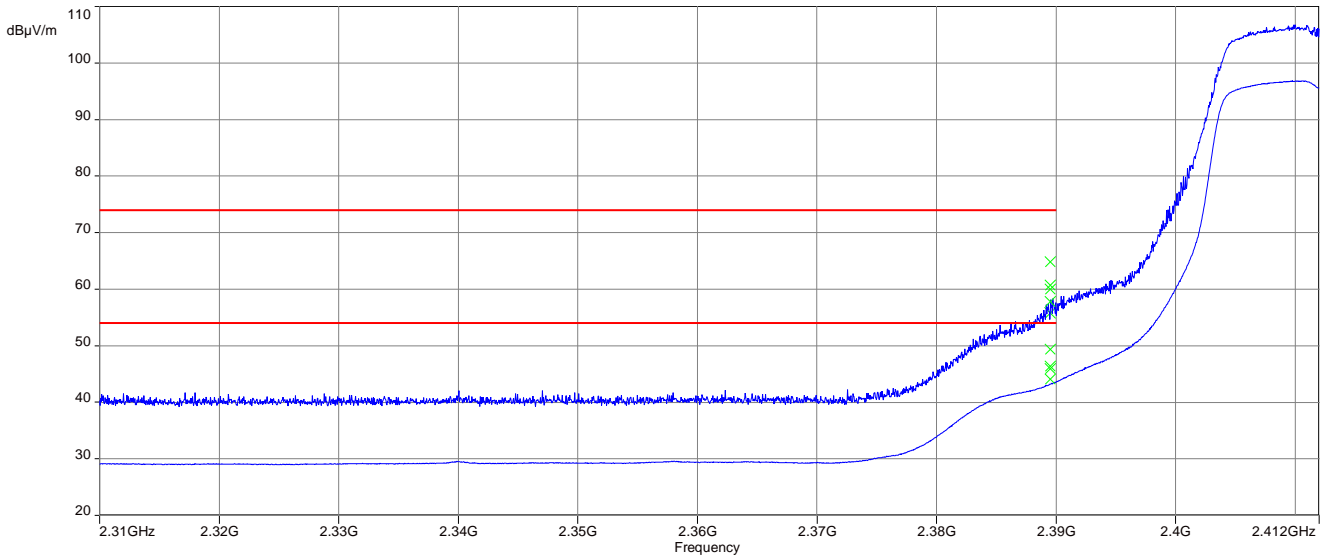


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

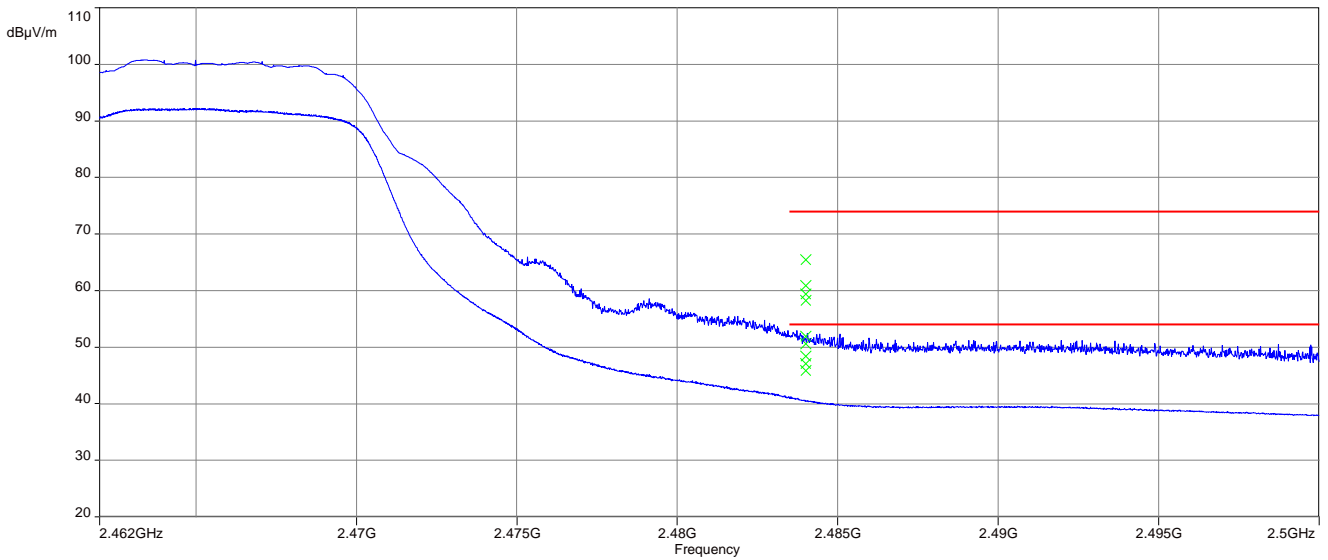


Plots: OFDM (20 MHz bandwidth) - peak / average (TAOGLAS (GW48.151))

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

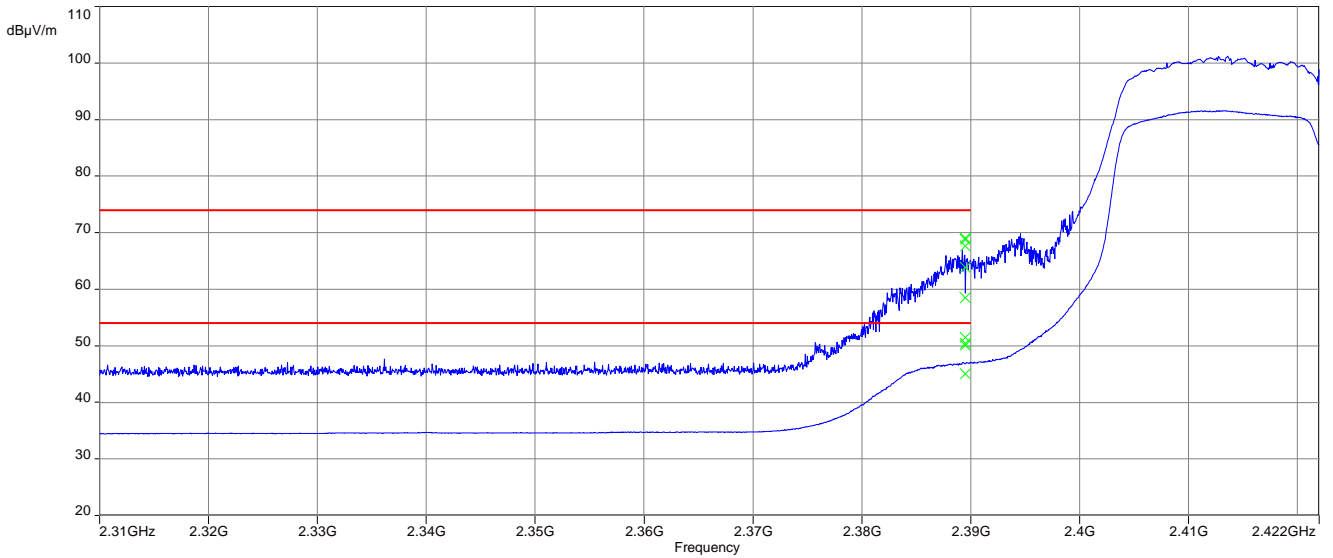


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

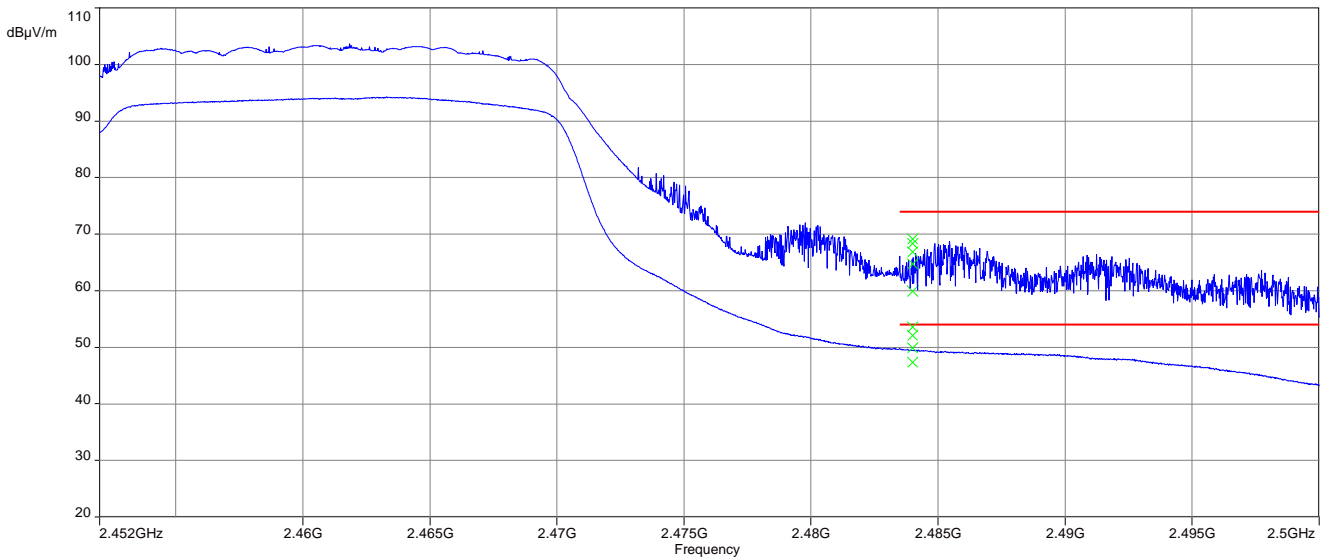


Plots: OFDM (40 MHz bandwidth) - mode peak / average (TAOGLAS (GW48.151))

Plot 1: TX mode, lower band edge, vertical & horizontal polarization



Plot 2: TX mode, upper band edge, vertical & horizontal polarization



13.10 Band edge compliance conducted

Description:

Measurement of the radiated band edge compliance with a conducted test setup.

Measurement:

Measurement parameter for measurements				
According to DTS clause: 8.7.3 and clause 12.2.2				
Detector	RMS			
Sweep time	Auto			
Resolution bandwidth	100 kHz			
Video bandwidth	300 kHz			
Span	2 MHz			
	lower band edge	2388 MHz	to	2390 MHz
	upper band edge	2483.5 MHz	to	2485.5 MHz
Trace mode	Trace average with 200 counts			
External result file(s)	1-0397/20-02-11_log1_conducted.pdf			
Test setup	See chapter 7.3			
Measurement uncertainty	See chapter 9			

Limits:

FCC	IC
-41.26 dBm	

Results:

Modulation:	band edge compliance / dBm (gain calculation)			
	DSSS / b – mode	OFDM / g – mode	OFDM / n HT20 – mode	OFDM / n HT40 – mode
Max. lower band edge power conducted	-49.64	-48.75	-48.54	-49.93
Antenna gain / dBi	4.6			
Max. lower band edge power radiated	-45.04	-44.15	-43.94	-45.33
Max. upper band edge power conducted	-50.13	-47.88	-47.35	-46.34
Antenna gain / dBi	4.6			
Max. upper band edge power radiated	-45.53	-43.28	-42.75	-41.74

13.11 Spurious emissions conducted

Description:

Measurement of the conducted spurious emissions in transmit mode. The measurement is performed at the lowest; the middle and the highest channel. The measurement is repeated for all modulations.

Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	100 kHz
Video bandwidth	500 kHz
Span	9 kHz to 25 GHz
Trace mode	Max Hold
External result file(s)	1-0397/20-02-11 _log1_conducted.pdf
Test setup	See chapter 7.3
Measurement uncertainty	See chapter 9

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 30 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: DSSS / b – mode

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		5.71	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		3.96	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		5.37	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / g – mode

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		2.86	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		1.06	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		3.11	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / n HT20 – mode

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		3.50	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		1.04	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		2.74	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / n HT40 – mode

TX spurious emissions conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
Lowest channel		-2.87	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Middle channel		-1.64	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Highest channel		-0.79	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

13.12 Spurious emissions radiated below 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

Measurement:

Measurement parameter	
Detector	Peak / Quasi Peak
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
Measured modulation	<input checked="" type="checkbox"/> DSSS b – mode <input checked="" type="checkbox"/> OFDM g – mode <input type="checkbox"/> OFDM n HT20 – mode <input checked="" type="checkbox"/> OFDM n HT40 – mode
Test setup	See chapter 7.2 B
Measurement uncertainty	See chapter 9

Limits:

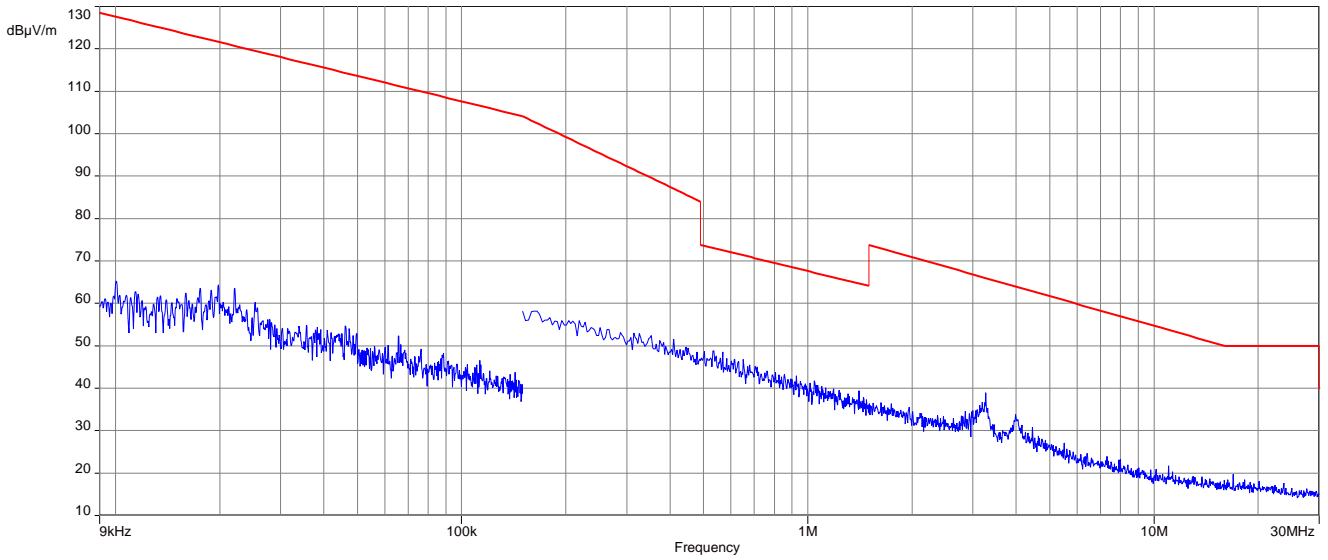
FCC		IC	
Frequency / MHz	Field Strength / (dBµV / m)	Measurement distance / m	
0.009 – 0.490	2400/F(kHz)	300	
0.490 – 1.705	24000/F(kHz)	30	
1.705 – 30.0	30	30	

Results:

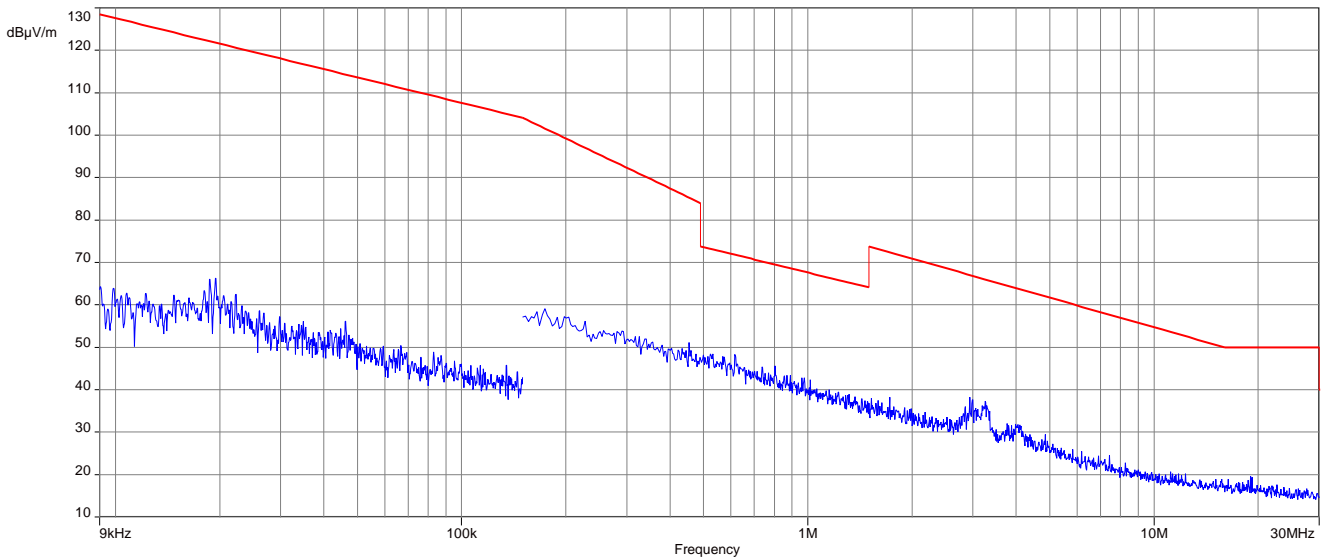
TX spurious emissions radiated < 30 MHz / (dBµV / m) @ 3 m		
Frequency / MHz	Detector	Level / (dBµV / m)
All detected peaks are more than 20 dB below the limit.		

Plots: DSSS (YAGEO ANTX100P001B24553)

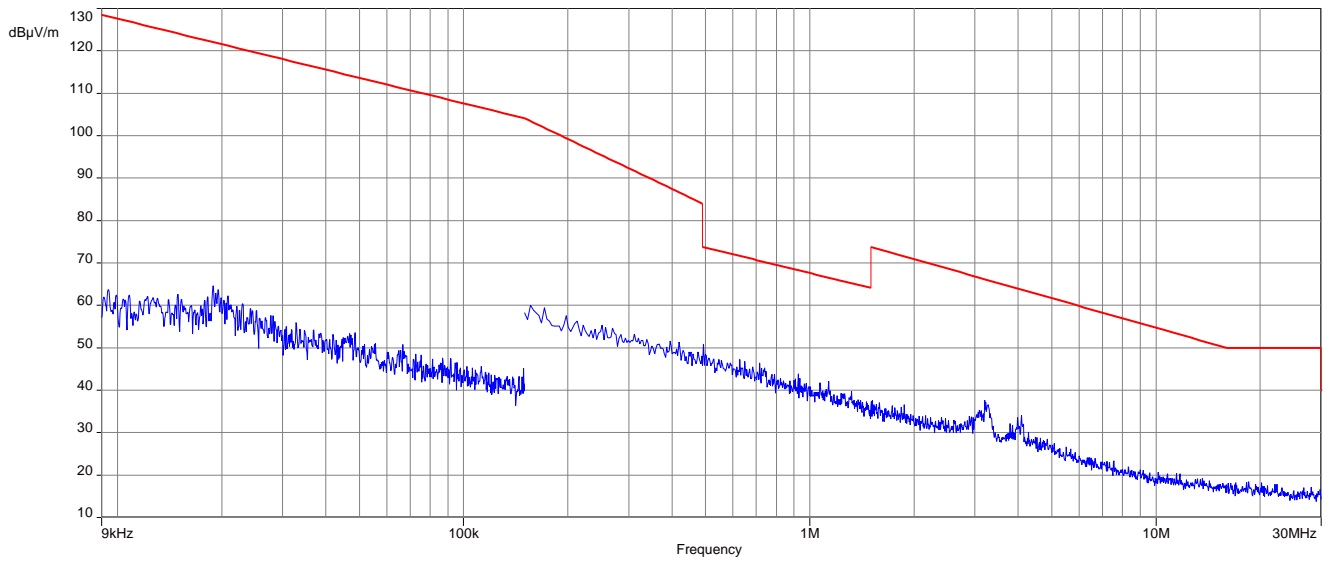
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel

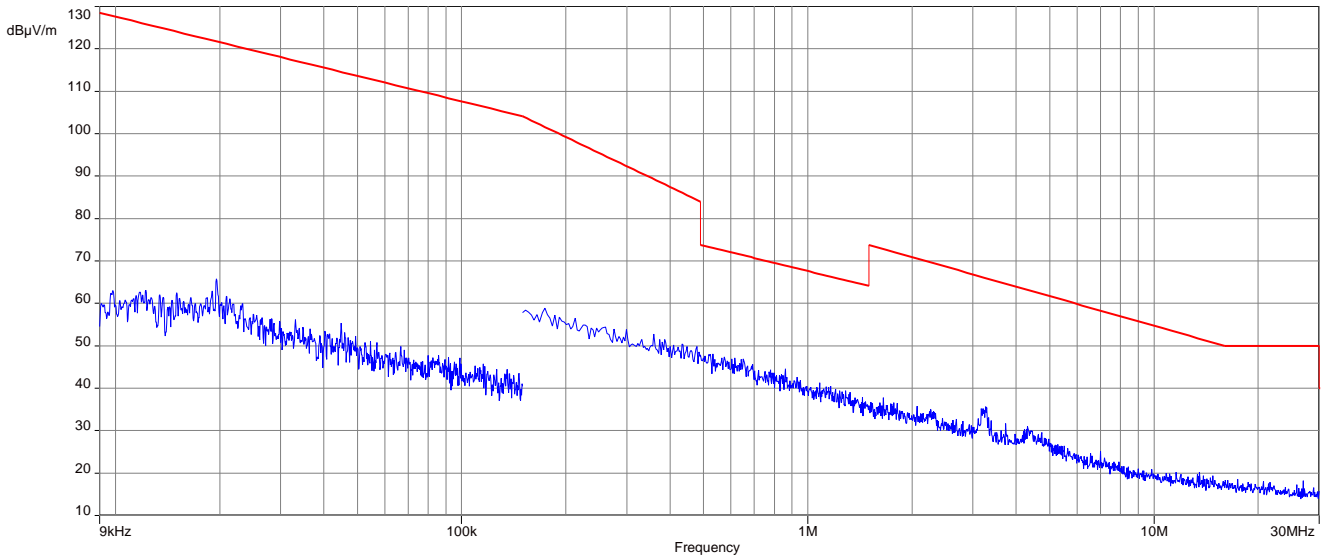


Plot 3: 9 kHz to 30 MHz, highest channel

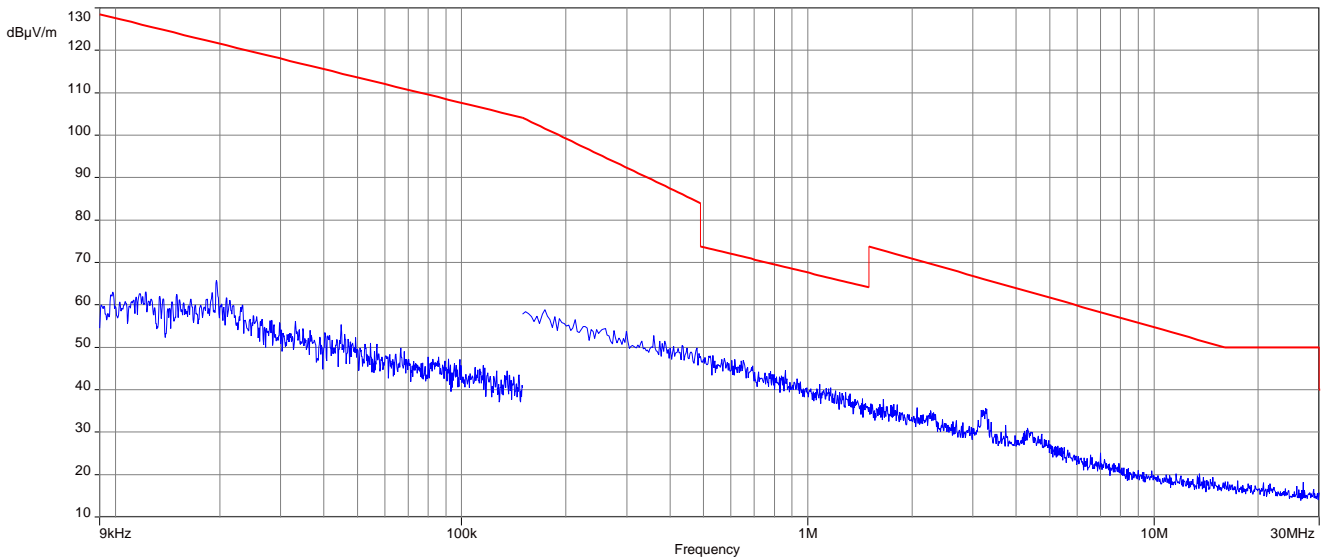


Plots: OFDM (20 MHz nominal channel bandwidth) (YAGEO ANTX100P001B24553)

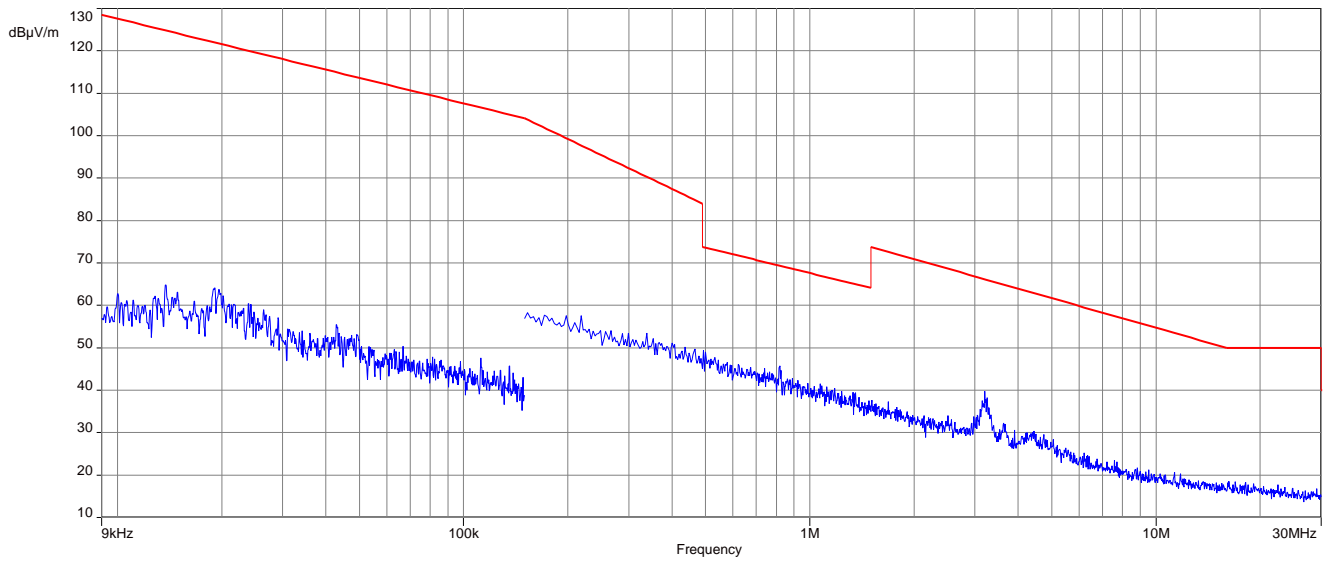
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel

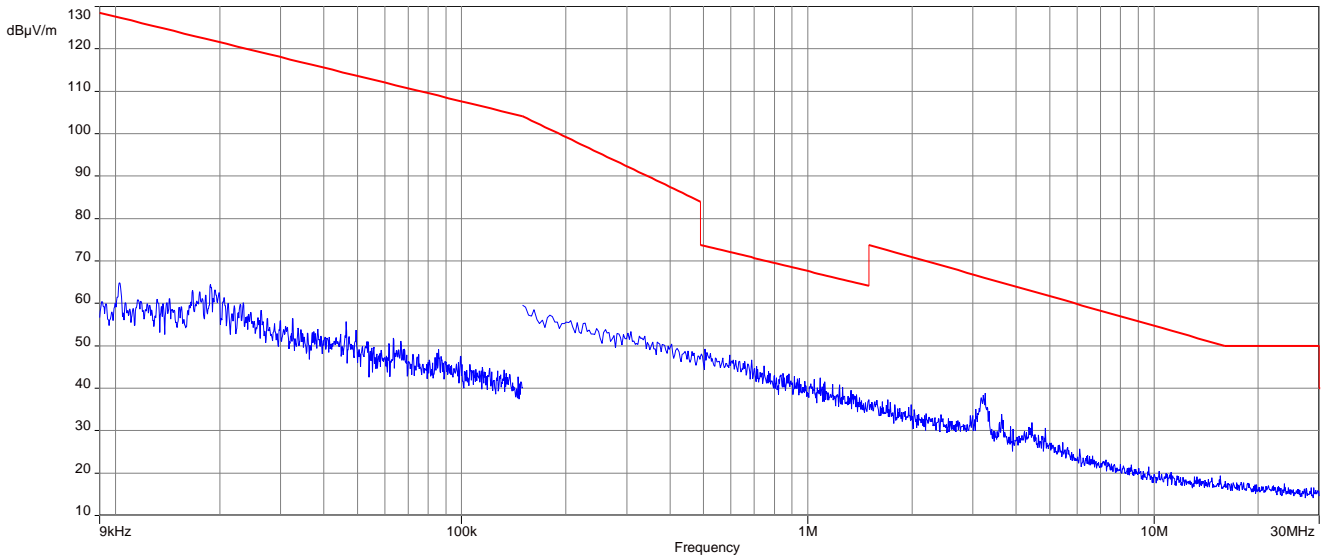


Plot 3: 9 kHz to 30 MHz, highest channel

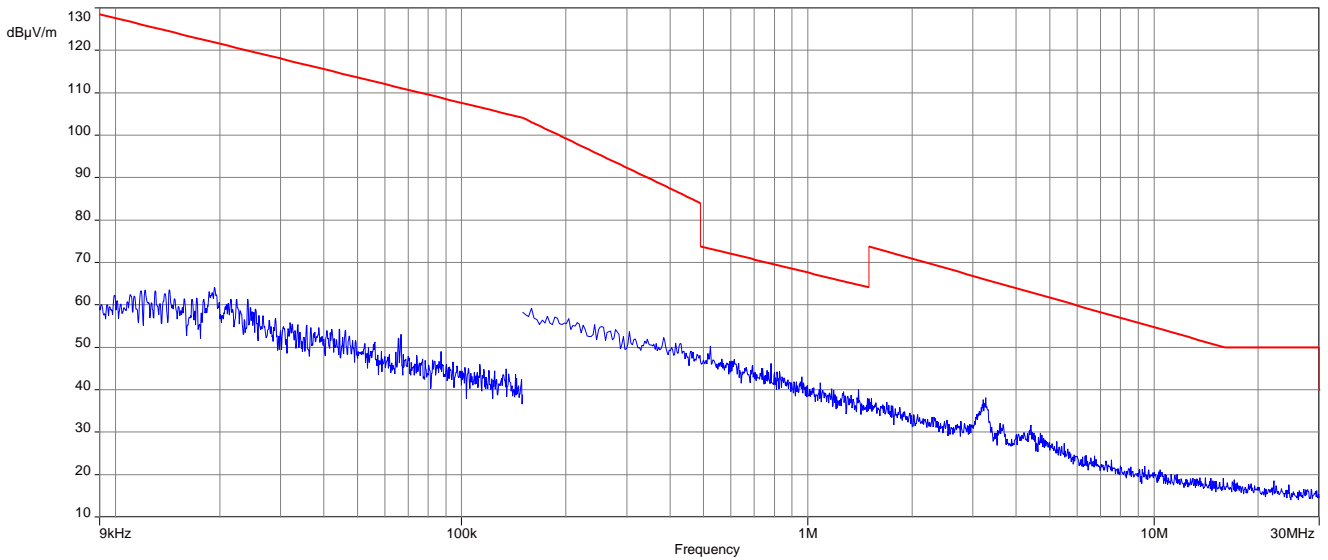


Plots: OFDM (40 MHz nominal channel bandwidth) (YAGEO ANTX100P001B24553)

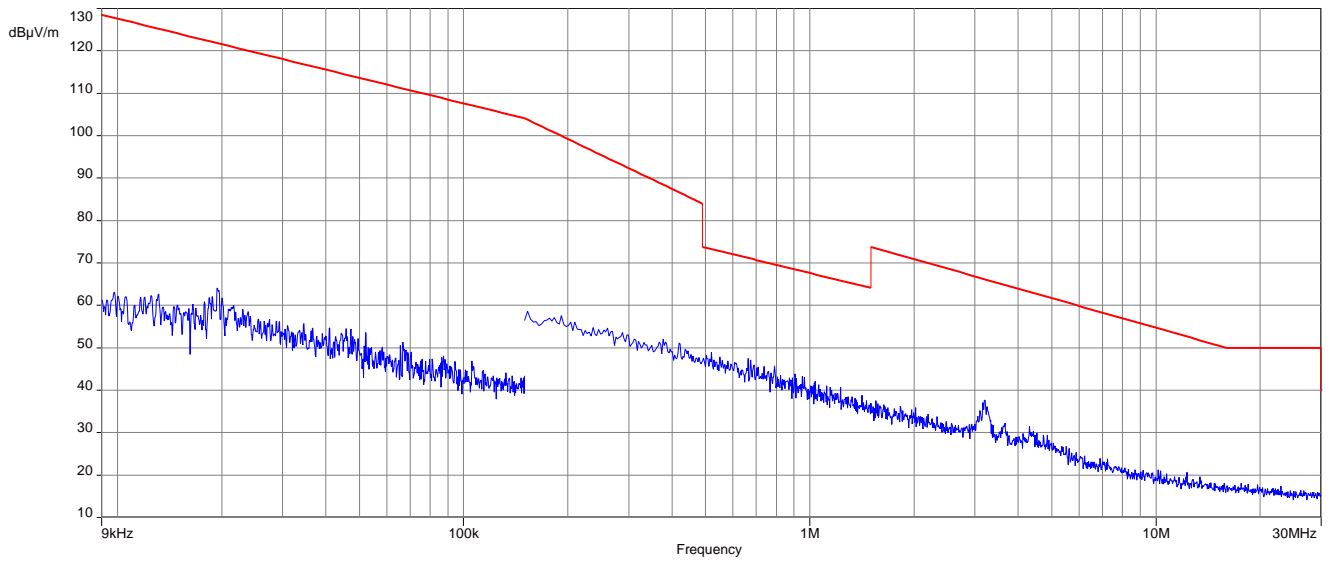
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel

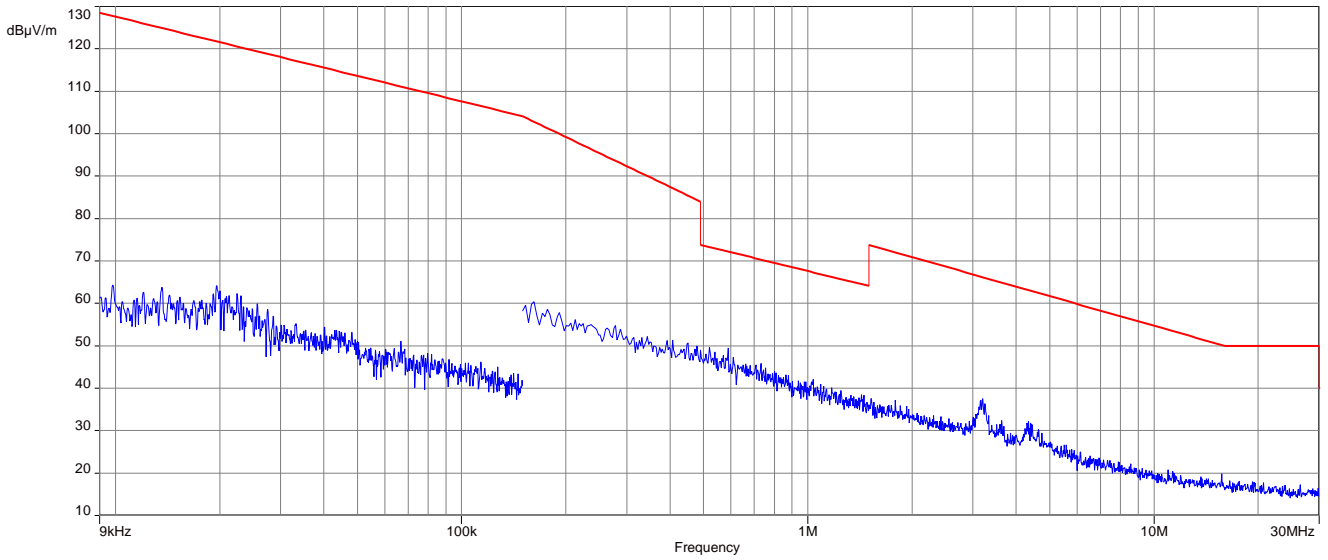


Plot 3: 9 kHz to 30 MHz, highest channel

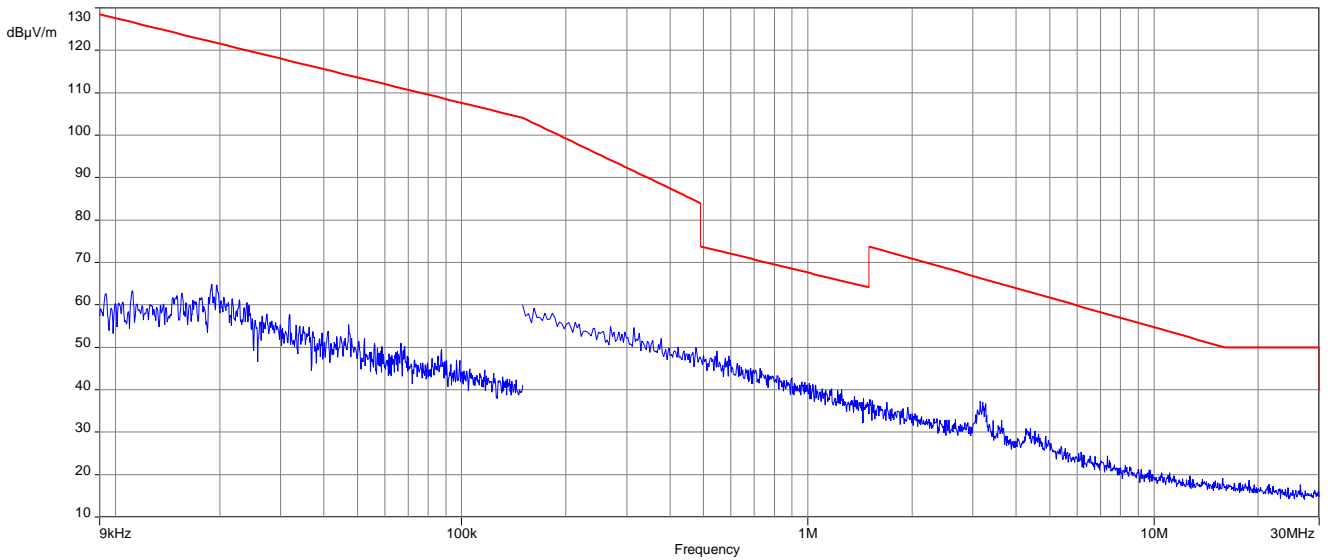


Plots: DSSS (TAOGLAS (GW48.151))

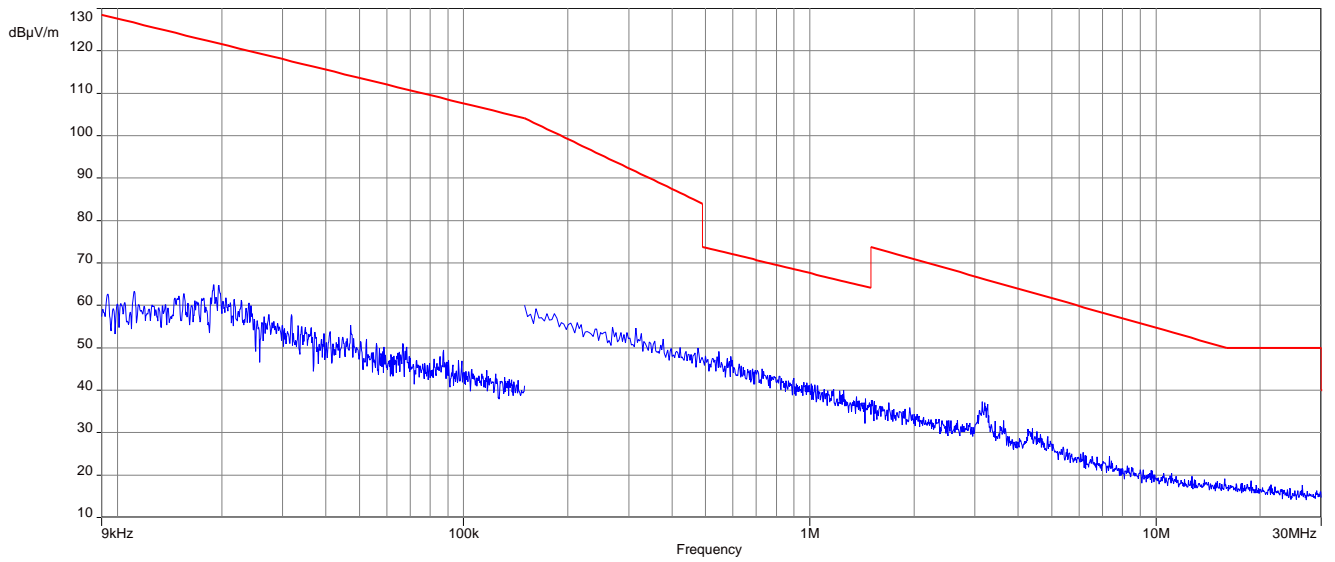
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel

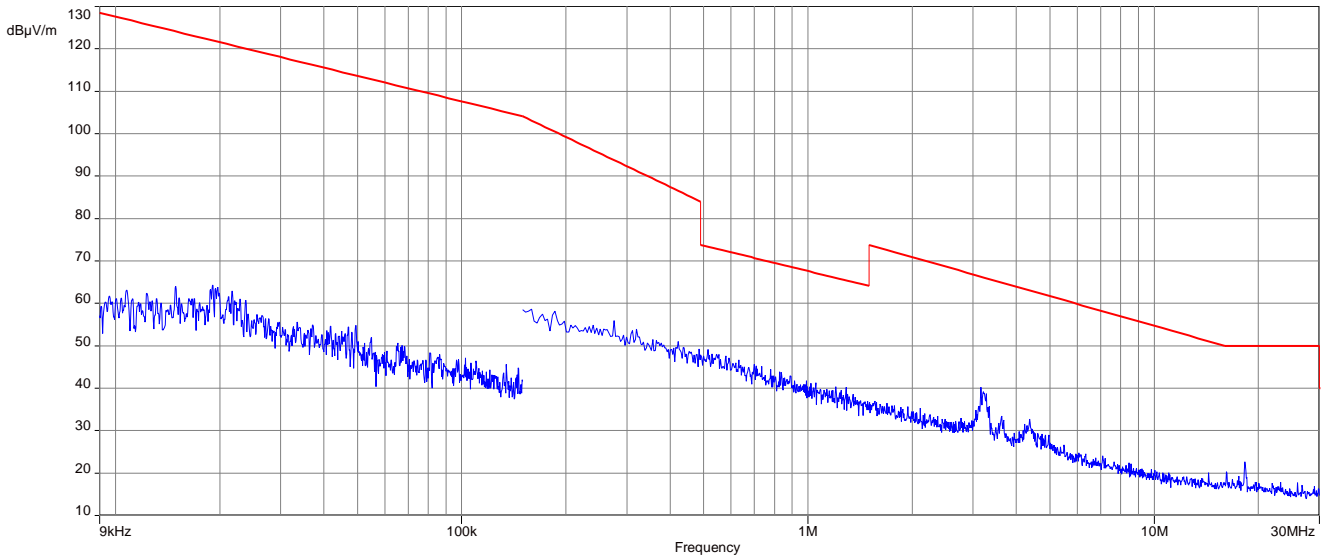


Plot 3: 9 kHz to 30 MHz, highest channel

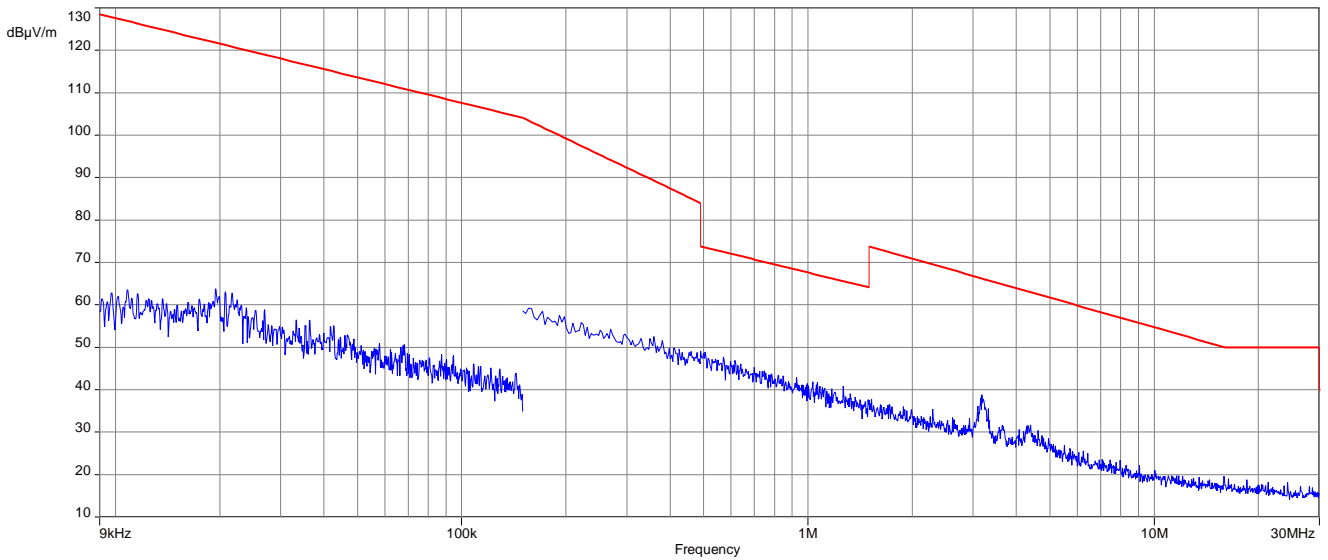


Plots: OFDM (20 MHz nominal channel bandwidth) (TAOGLAS (GW48.151))

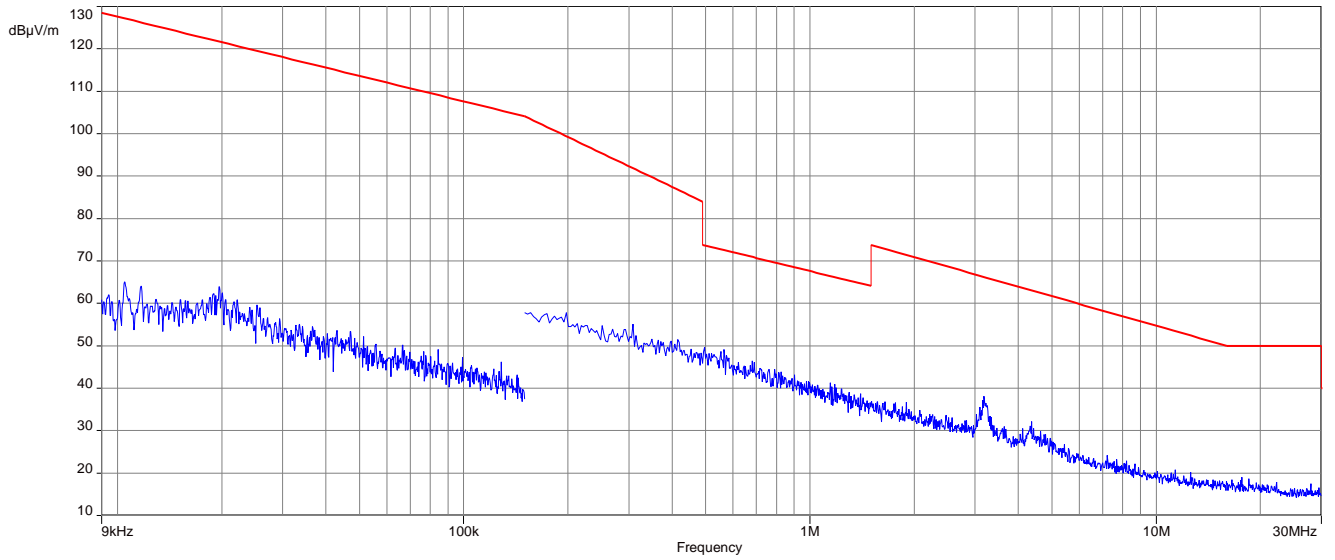
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel

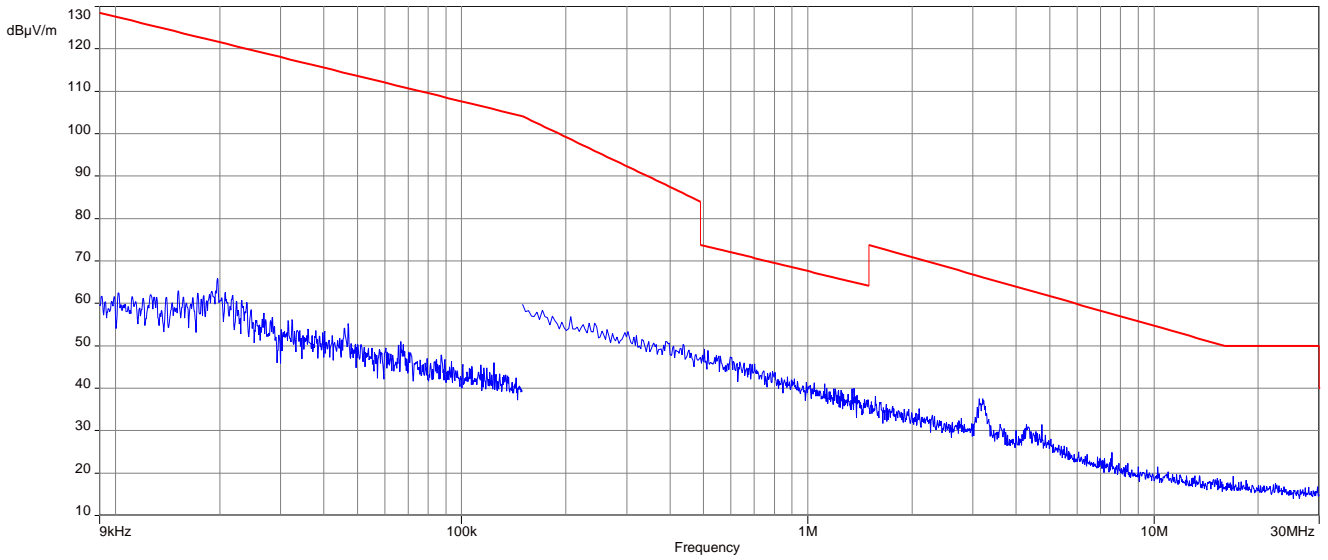


Plot 3: 9 kHz to 30 MHz, highest channel

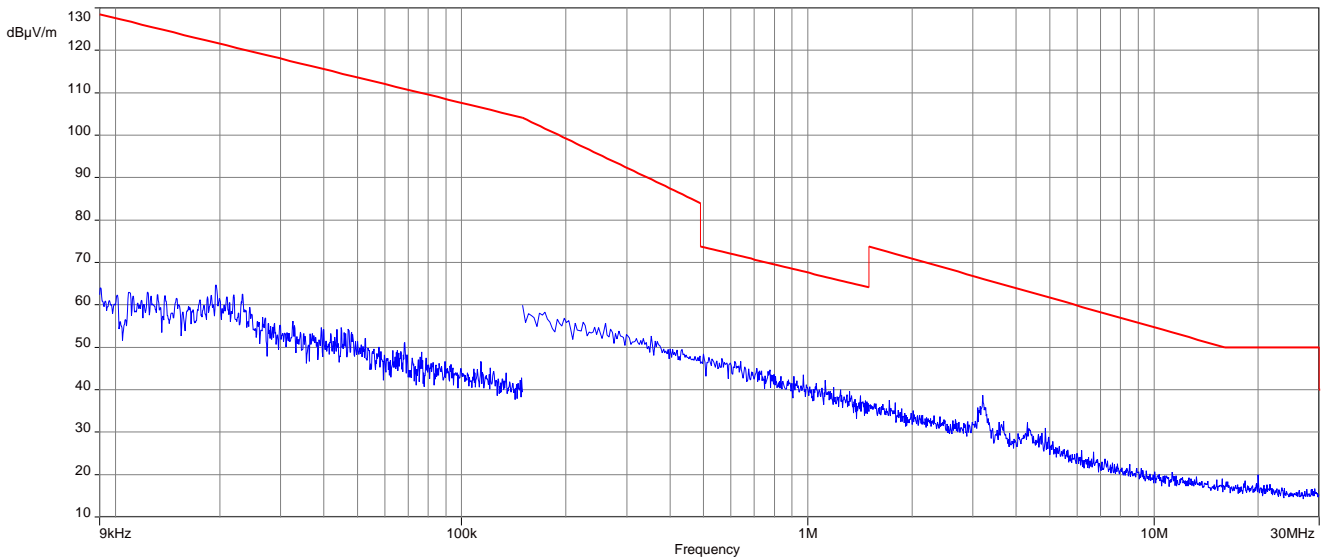


Plots: OFDM (40 MHz nominal channel bandwidth) (TAOGLAS (GW48.151))

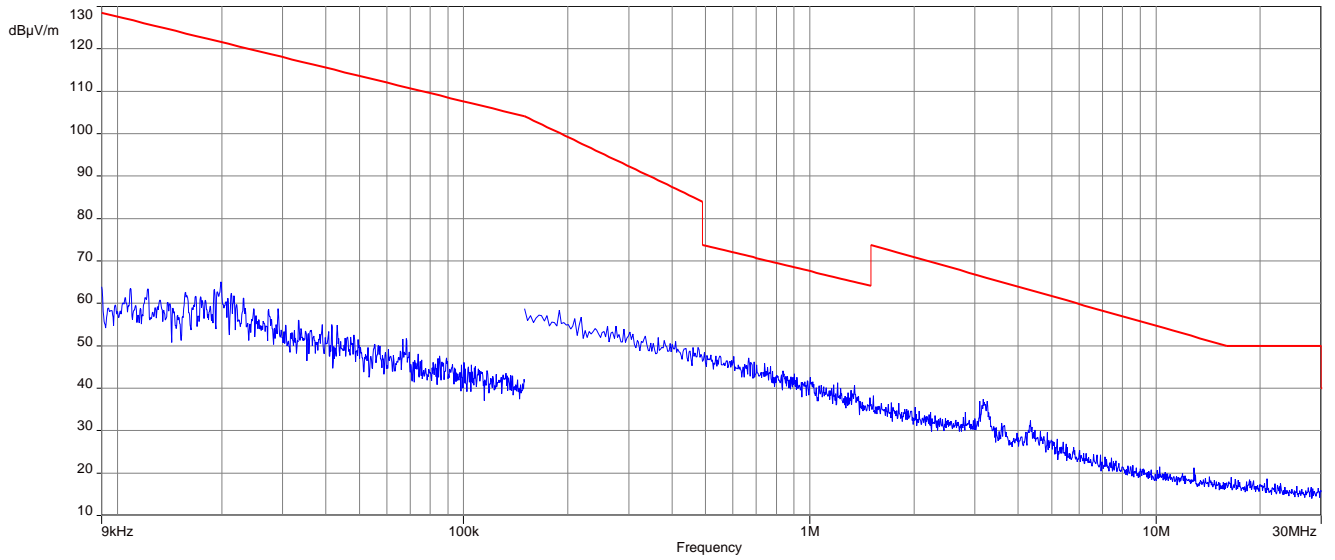
Plot 1: 9 kHz to 30 MHz, lowest channel



Plot 2: 9 kHz to 30 MHz, middle channel



Plot 3: 9 kHz to 30 MHz, highest channel



13.13 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.

Measurement:

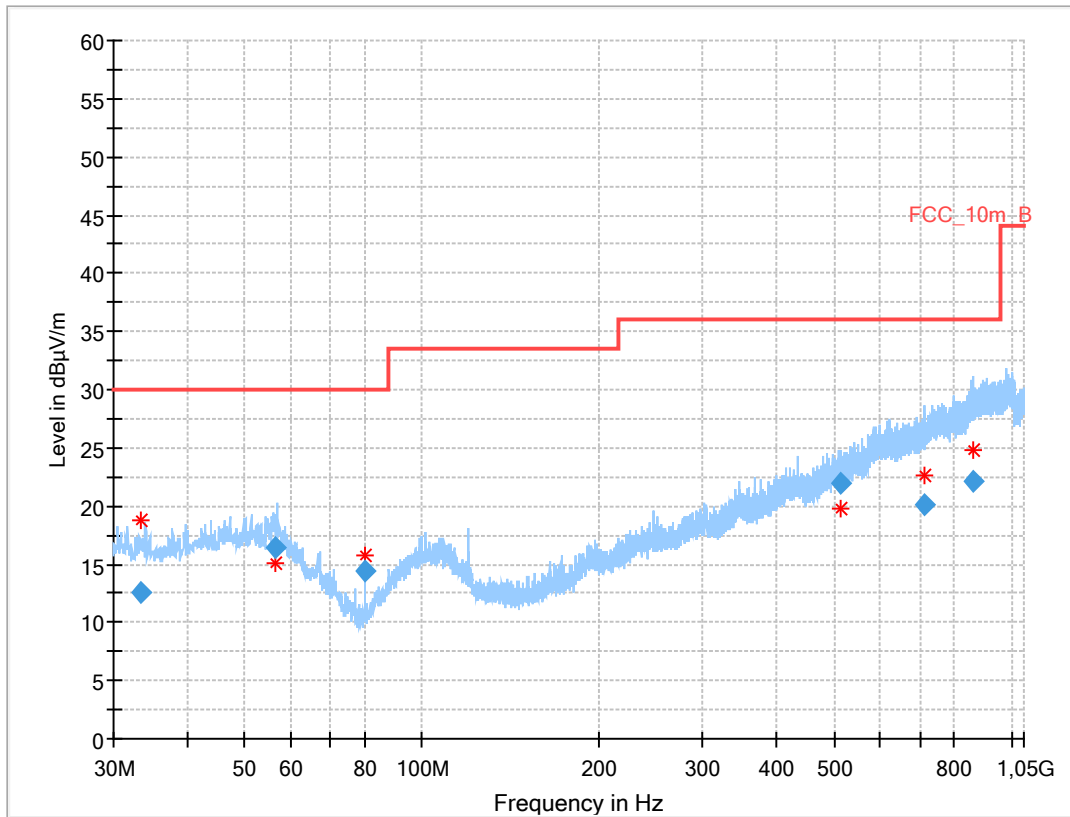
Measurement parameter	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	120 kHz
Video bandwidth	3 x RBW
Span	30 MHz to 1 GHz
Trace mode	Max Hold
Measured modulation	<input checked="" type="checkbox"/> DSSS b – mode <input type="checkbox"/> OFDM g – mode <input type="checkbox"/> OFDM n HT20 – mode <input checked="" type="checkbox"/> OFDM n HT40 – mode <input type="checkbox"/> RX / Idle – mode
Test setup	See chapter 7 1
Measurement uncertainty	See chapter 9

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. 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 / m
30 – 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10

Plot: DSSS (YAGEO ANTX100P001B24553)

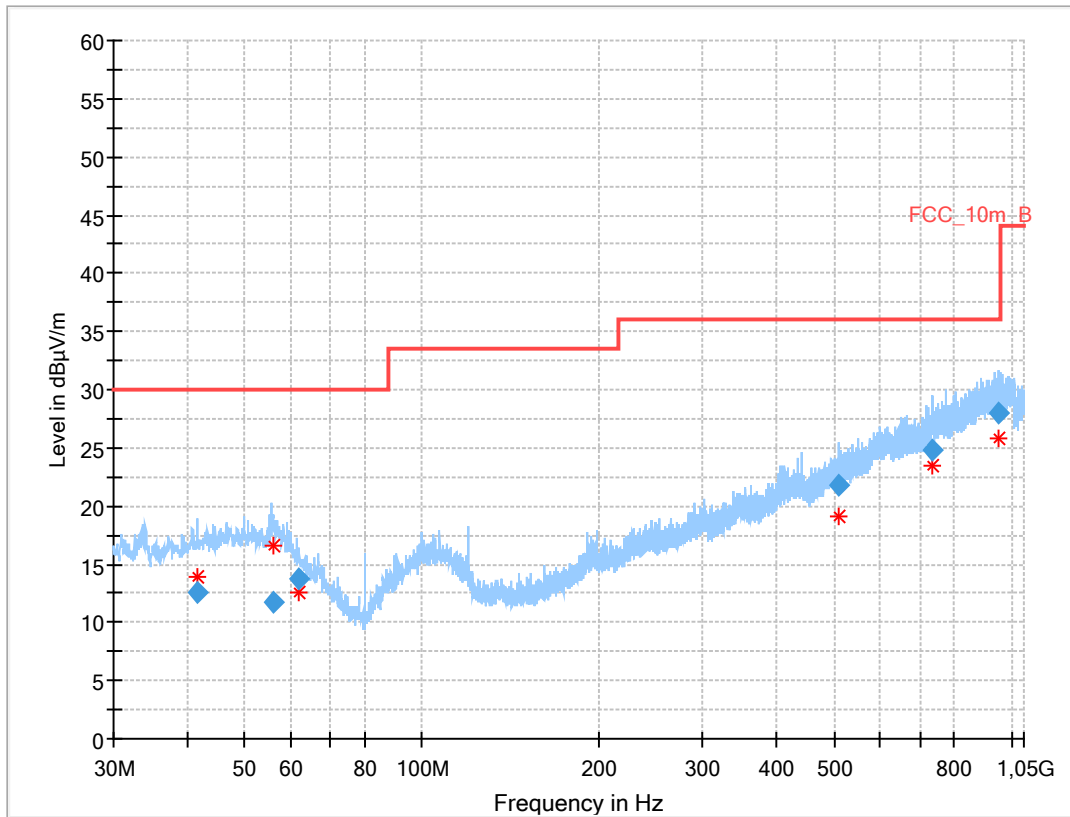
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, lowest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.457	12.53	30.0	17.5	1000	120.0	114.0	V	275	12
56.251	16.36	30.0	13.6	1000	120.0	170.0	H	247	15
80.000	14.49	30.0	15.5	1000	120.0	170.0	V	247	7
514.390	21.97	36.0	14.0	1000	120.0	170.0	H	-22	19
713.931	20.15	36.0	15.9	1000	120.0	170.0	H	67	21
858.541	22.19	36.0	13.8	1000	120.0	170.0	V	-22	23

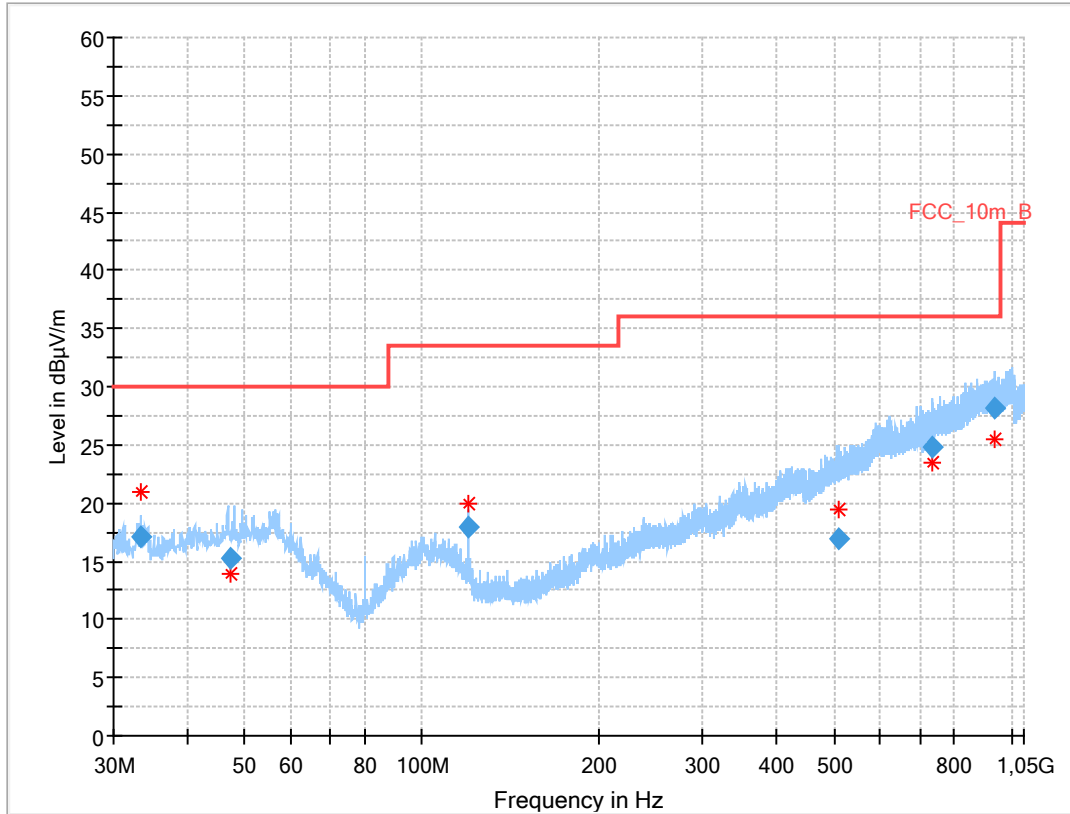
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, middle channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.639	12.57	30.0	17.4	1000	120.0	170.0	H	-2	14
55.979	11.78	30.0	18.2	1000	120.0	101.0	V	247	15
61.774	13.71	30.0	16.3	1000	120.0	165.0	H	247	12
509.140	21.84	36.0	14.2	1000	120.0	170.0	H	267	18
735.614	24.88	36.0	11.1	1000	120.0	159.0	H	157	22
952.020	27.98	36.0	8.0	1000	120.0	170.0	V	67	24

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, highest channel

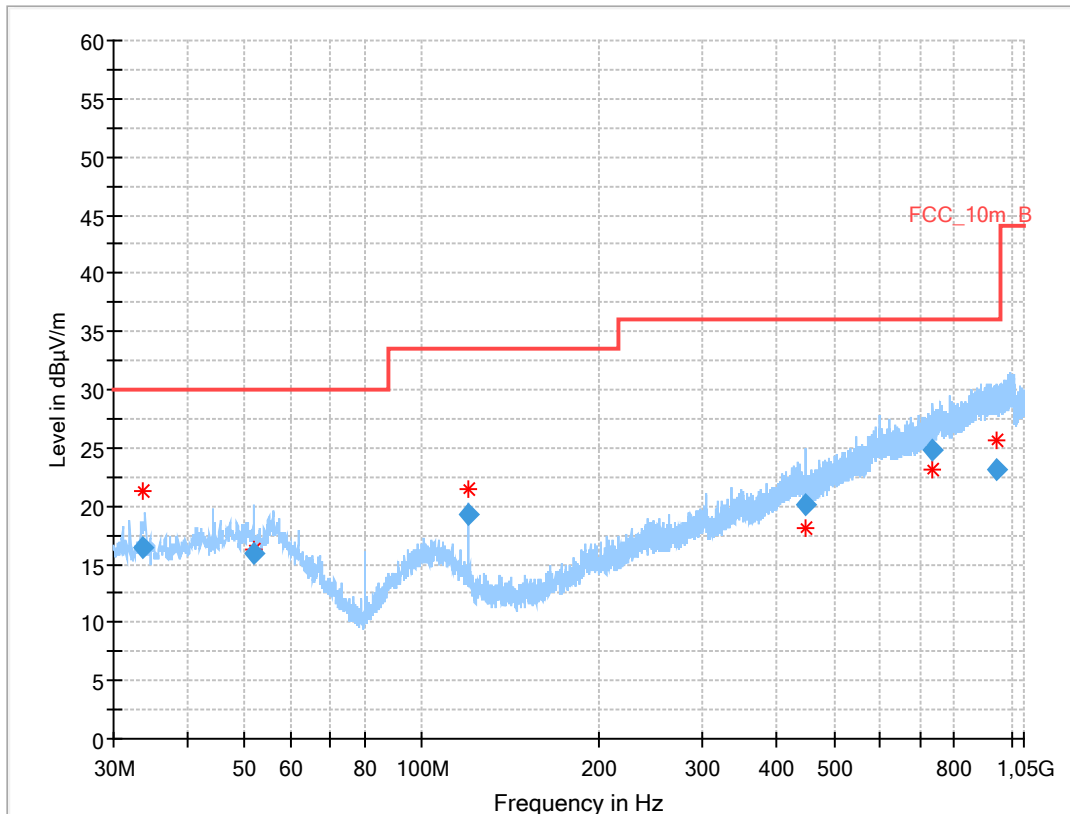


Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.423	17.10	30.0	12.9	1000	120.0	118.0	V	274	12
47.444	15.22	30.0	14.8	1000	120.0	170.0	H	247	14
120.001	17.98	33.5	15.5	1000	120.0	170.0	V	67	10
508.682	16.88	36.0	19.1	1000	120.0	166.0	V	157	18
735.070	24.82	36.0	11.2	1000	120.0	170.0	V	202	22
938.413	28.15	36.0	7.9	1000	120.0	170.0	V	67	24

Plot: OFDM (20 MHz nominal channel bandwidth) (YAGEO ANTX100P001B24553)

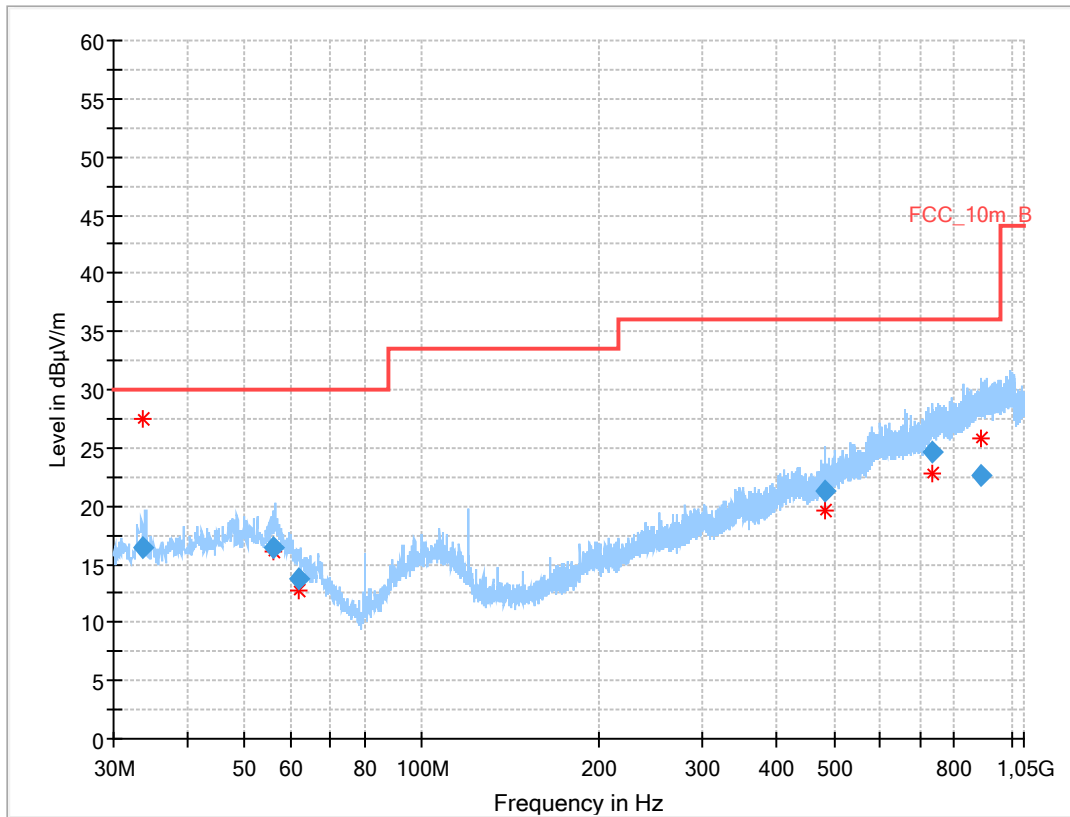
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, lowest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.736	16.49	30.0	13.5	1000	120.0	107.0	V	73	12
51.975	15.97	30.0	14.0	1000	120.0	113.0	V	-22	14
120.007	19.25	33.5	14.3	1000	120.0	101.0	V	160	10
448.544	20.12	36.0	15.9	1000	120.0	170.0	V	247	17
733.758	24.82	36.0	11.2	1000	120.0	161.0	V	292	22
944.081	23.14	36.0	12.9	1000	120.0	170.0	H	175	24

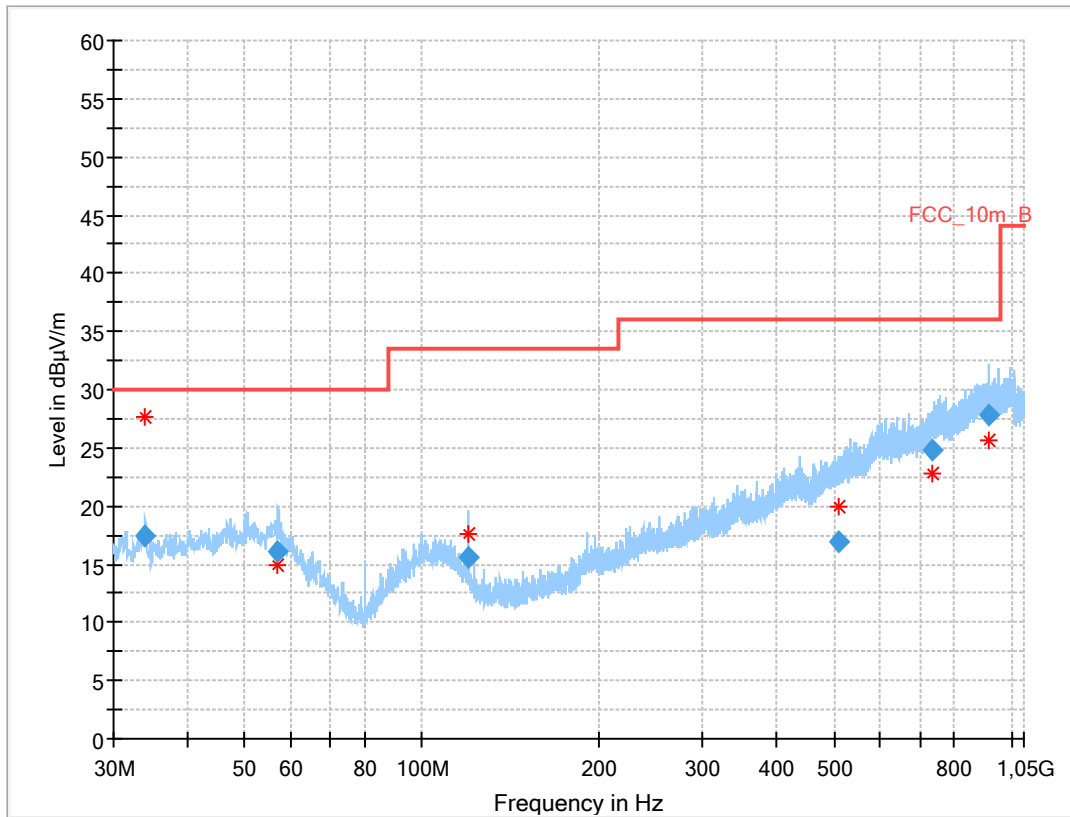
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, middle channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.509	16.50	30.0	13.5	1000	120.0	110.0	V	105	12
55.967	16.42	30.0	13.6	1000	120.0	166.0	V	247	15
61.847	13.69	30.0	16.3	1000	120.0	170.0	V	283	12
482.582	21.21	36.0	14.8	1000	120.0	145.0	V	-17	18
732.539	24.72	36.0	11.3	1000	120.0	170.0	H	106	22
888.616	22.57	36.0	13.4	1000	120.0	170.0	V	191	24

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, highest channel

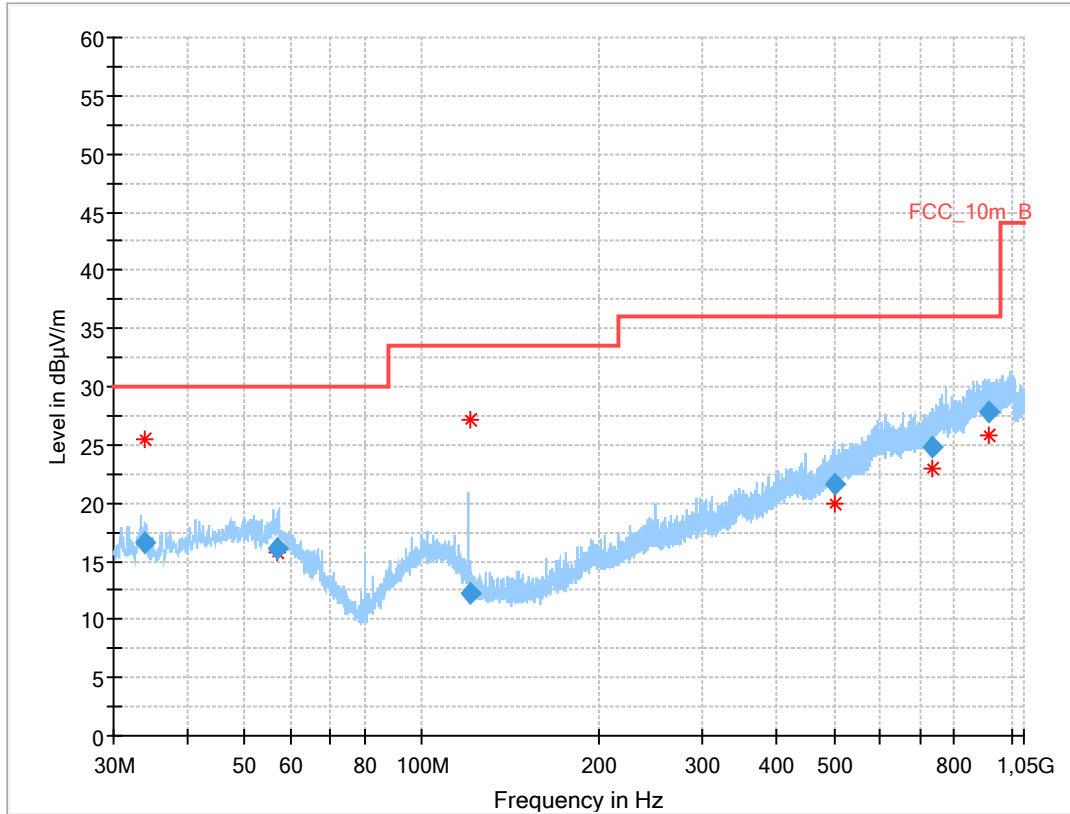


Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.977	17.45	30.0	12.6	1000	120.0	141.0	V	69	12
56.733	16.12	30.0	13.9	1000	120.0	170.0	V	157	15
119.993	15.64	33.5	17.9	1000	120.0	170.0	V	247	10
509.296	16.90	36.0	19.1	1000	120.0	170.0	V	247	18
735.893	24.82	36.0	11.2	1000	120.0	157.0	V	157	22
913.949	27.90	36.0	8.1	1000	120.0	170.0	H	169	24

Plot: OFDM (40 MHz nominal channel bandwidth) (YAGEO ANTX100P001B24553)

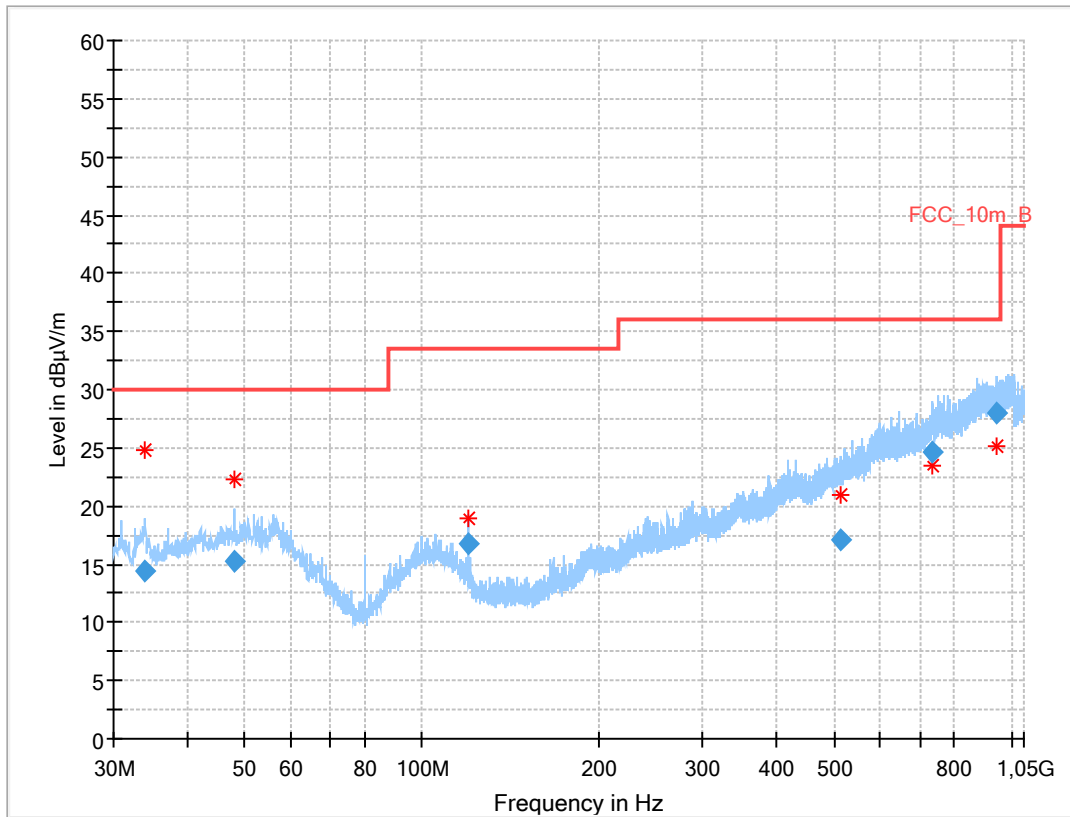
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, lowest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.821	16.52	30.0	13.5	1000	120.0	170.0	V	274	12
56.838	16.05	30.0	14.0	1000	120.0	166.0	H	157	15
120.518	12.28	33.5	21.2	1000	120.0	170.0	V	157	10
500.163	21.67	36.0	14.3	1000	120.0	170.0	V	157	18
734.095	24.86	36.0	11.1	1000	120.0	156.0	V	284	22
915.586	27.84	36.0	8.2	1000	120.0	170.0	V	86	24

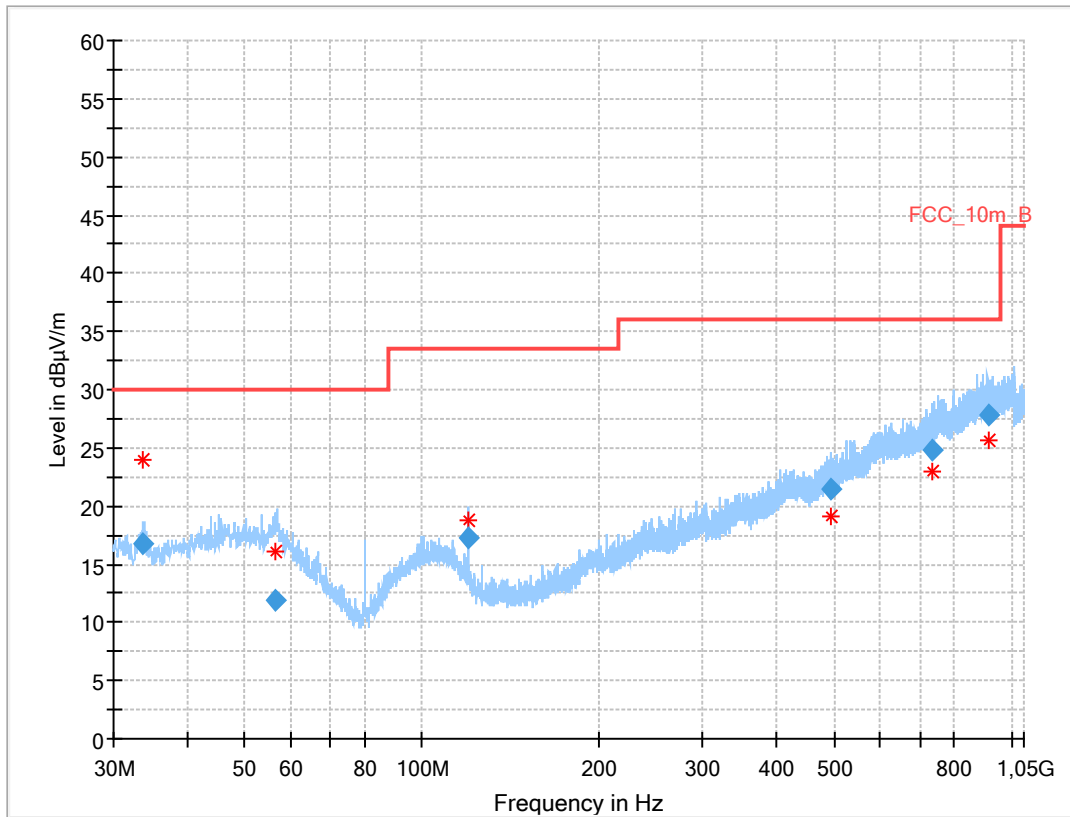
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, middle channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.995	14.41	30.0	15.6	1000	120.0	118.0	V	168	12
47.947	15.19	30.0	14.8	1000	120.0	118.0	V	81	14
119.995	16.72	33.5	16.8	1000	120.0	170.0	V	173	10
513.349	17.07	36.0	18.9	1000	120.0	170.0	V	-22	19
732.581	24.67	36.0	11.3	1000	120.0	170.0	V	67	22
942.708	28.06	36.0	7.9	1000	120.0	170.0	H	-4	24

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, highest channel

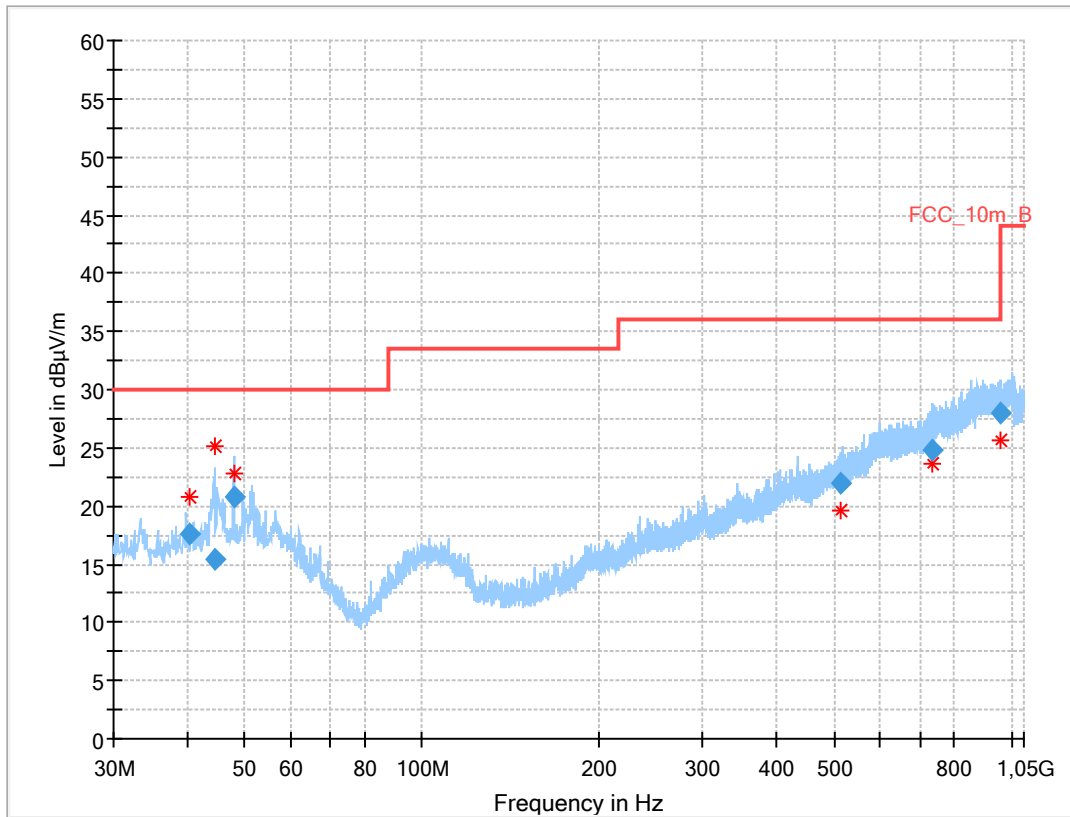


Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.591	16.80	30.0	13.2	1000	120.0	124.0	V	202	12
56.585	11.87	30.0	18.1	1000	120.0	170.0	V	157	15
119.997	17.30	33.5	16.2	1000	120.0	170.0	V	67	10
493.772	21.50	36.0	14.5	1000	120.0	111.0	H	67	18
734.910	24.76	36.0	11.2	1000	120.0	170.0	V	157	22
912.077	27.80	36.0	8.2	1000	120.0	170.0	H	5	24

Plot: DSSS (TAOGLAS (GW48.151))

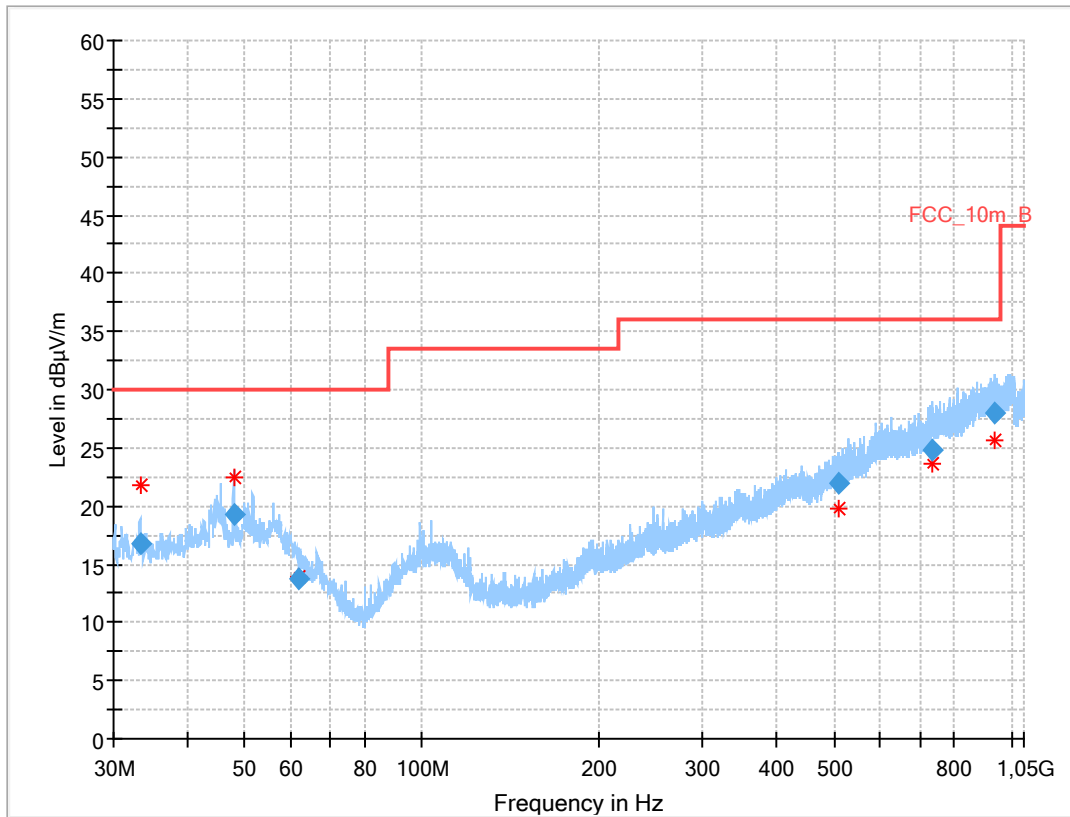
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, lowest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.309	17.53	30.0	12.5	1000	120.0	150.0	V	193	13
44.465	15.47	30.0	14.5	1000	120.0	101.0	V	81	14
48.015	20.71	30.0	9.3	1000	120.0	124.0	V	67	14
513.771	22.01	36.0	14.0	1000	120.0	170.0	V	292	19
734.777	24.76	36.0	11.2	1000	120.0	170.0	V	67	22
956.569	27.97	36.0	8.0	1000	120.0	170.0	H	-4	24

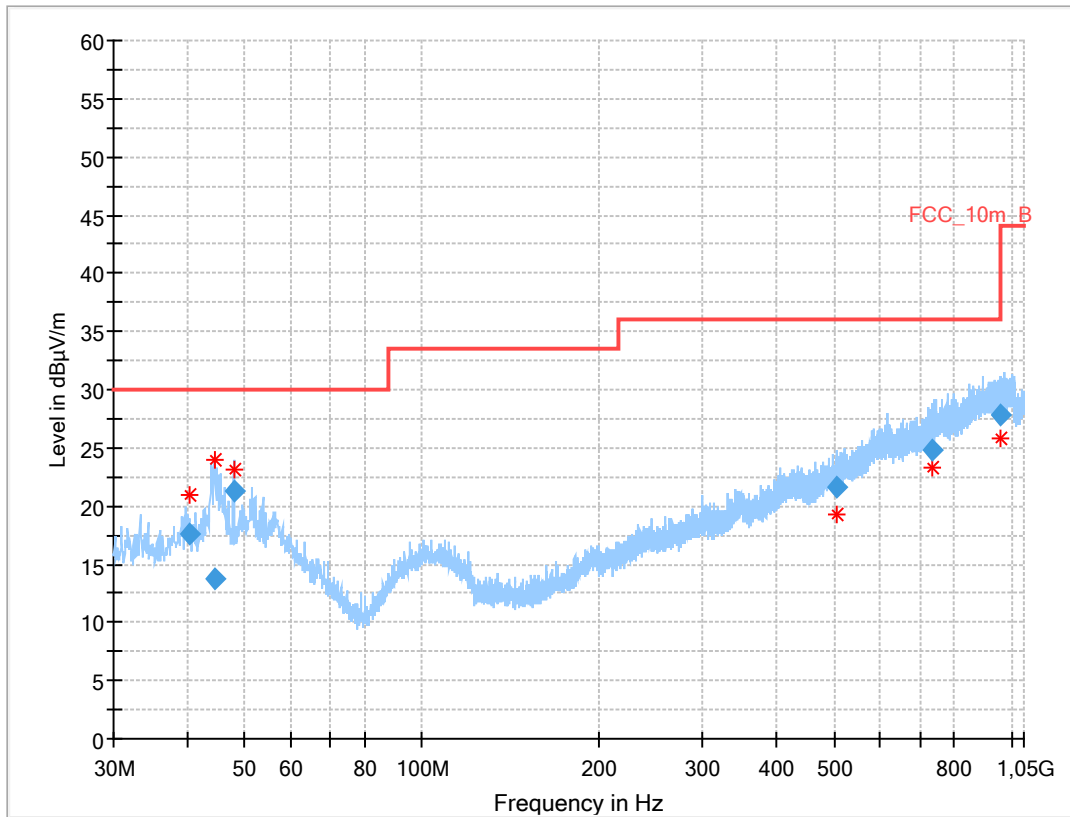
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, middle channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.414	16.76	30.0	13.2	1000	120.0	105.0	V	-22	12
48.001	19.23	30.0	10.8	1000	120.0	105.0	V	157	14
61.953	13.68	30.0	16.3	1000	120.0	121.0	V	157	12
510.927	21.88	36.0	14.1	1000	120.0	114.0	V	67	19
734.286	24.76	36.0	11.2	1000	120.0	130.0	H	247	22
934.895	27.99	36.0	8.0	1000	120.0	128.0	V	67	24

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, highest channel

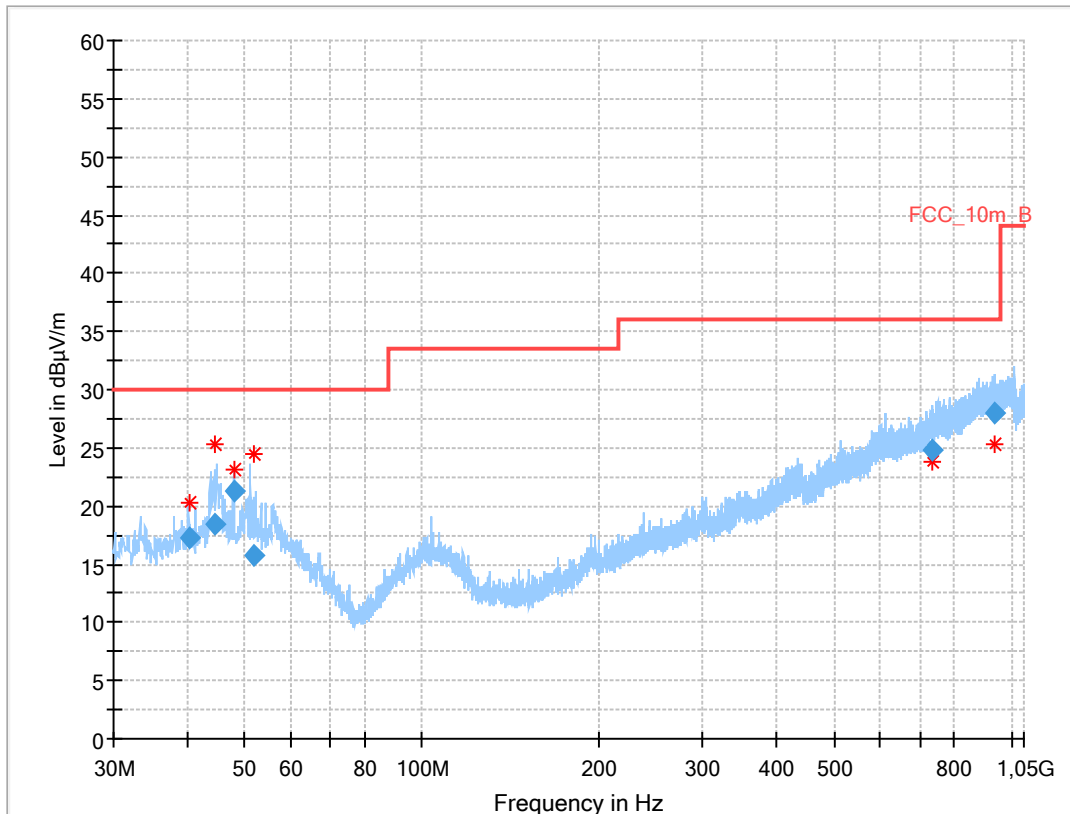


Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.306	17.65	30.0	12.4	1000	120.0	109.0	V	202	13
44.694	13.66	30.0	16.3	1000	120.0	118.0	V	22	14
48.003	21.36	30.0	8.6	1000	120.0	98.0	V	-22	14
506.456	21.67	36.0	14.3	1000	120.0	170.0	H	247	18
734.911	24.76	36.0	11.2	1000	120.0	126.0	H	276	22
959.295	27.88	36.0	8.1	1000	120.0	161.0	V	247	24

Plot: OFDM (20 MHz nominal channel bandwidth) (TAOGLAS (GW48.151))

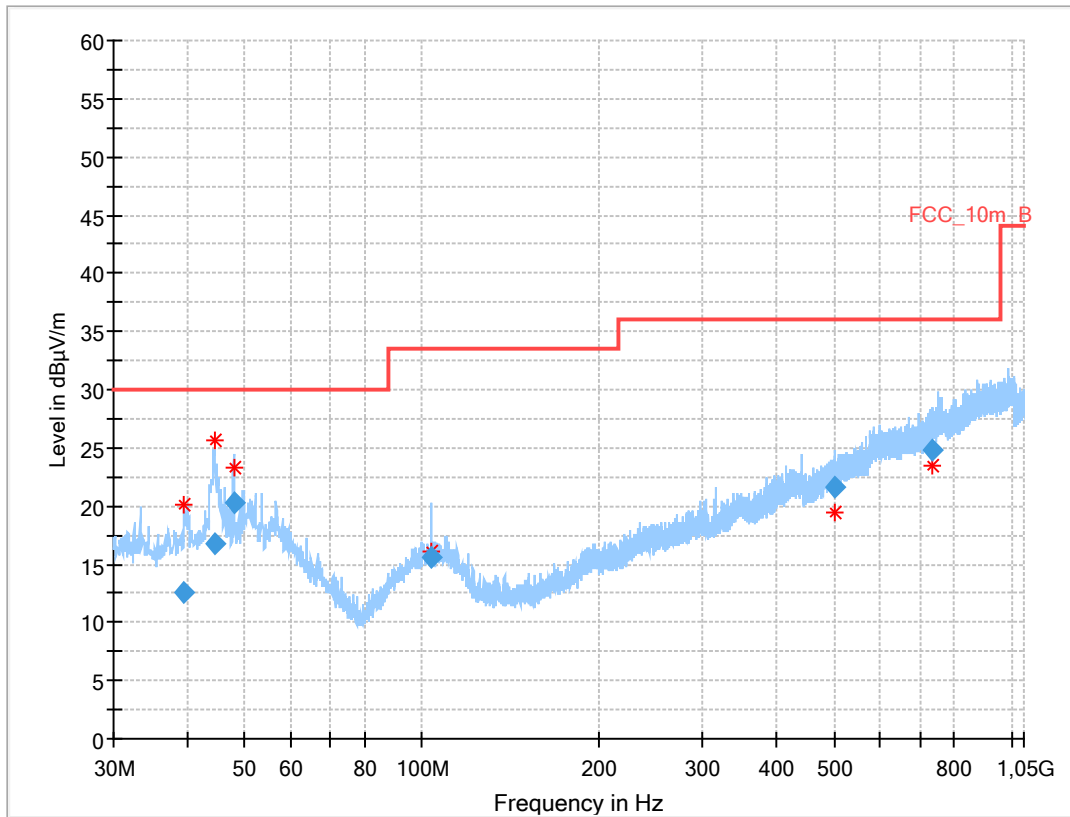
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, lowest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.237	17.32	30.0	12.7	1000	120.0	170.0	V	22	13
44.473	18.48	30.0	11.5	1000	120.0	98.0	V	-22	14
48.013	21.36	30.0	8.6	1000	120.0	101.0	V	-22	14
51.723	15.83	30.0	14.2	1000	120.0	98.0	V	202	14
734.868	24.81	36.0	11.2	1000	120.0	170.0	H	254	22
937.434	28.03	36.0	8.0	1000	120.0	157.0	V	112	24

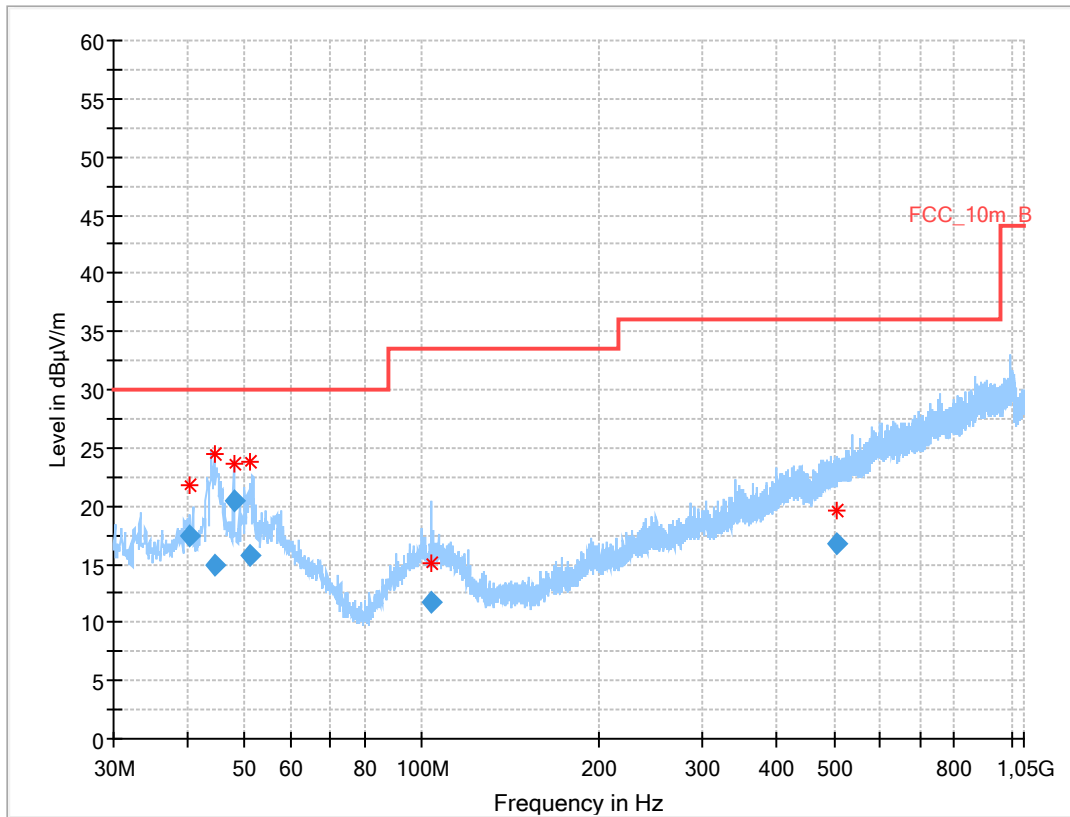
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, middle channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
39.607	12.60	30.0	17.4	1000	120.0	161.0	V	-13	13
44.557	16.72	30.0	13.3	1000	120.0	98.0	V	0	14
48.003	20.29	30.0	9.7	1000	120.0	114.0	V	67	14
103.741	15.61	33.5	17.9	1000	120.0	170.0	V	22	13
501.286	21.60	36.0	14.4	1000	120.0	170.0	H	7	18
734.009	24.74	36.0	11.3	1000	120.0	170.0	V	67	22

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, highest channel

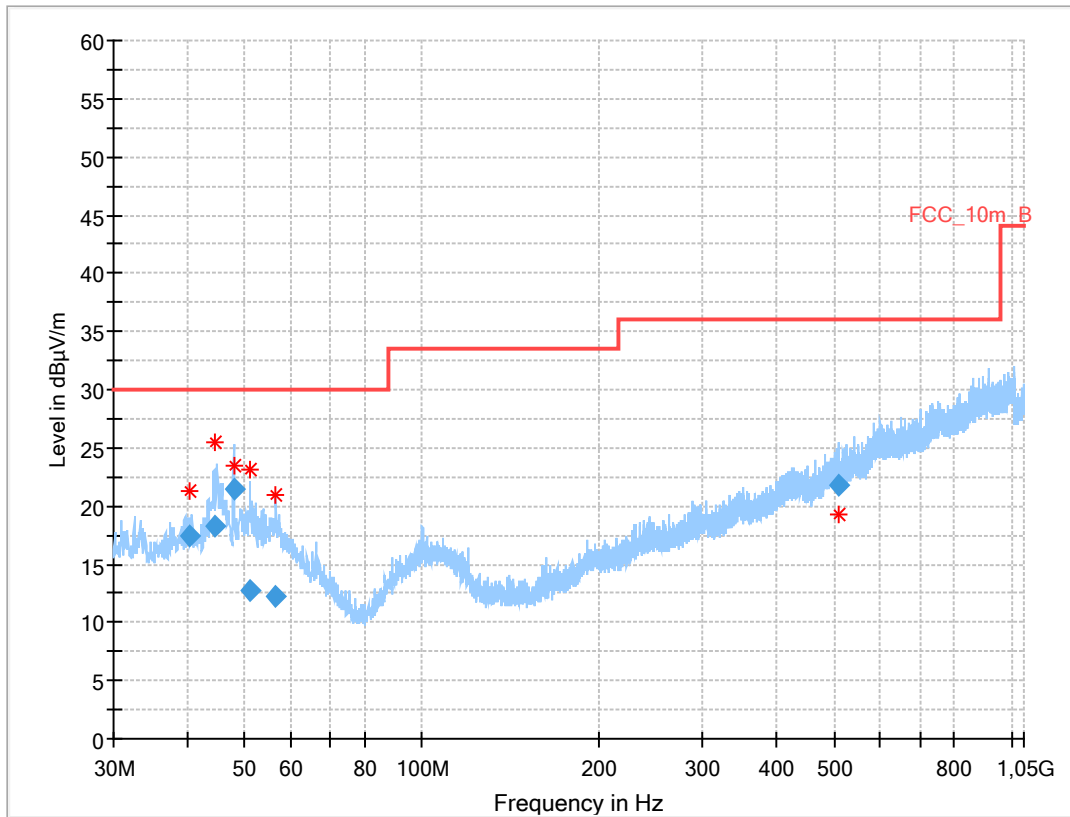


Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.345	17.42	30.0	12.6	1000	120.0	107.0	V	2	13
44.423	14.88	30.0	15.1	1000	120.0	101.0	V	158	14
47.994	20.51	30.0	9.5	1000	120.0	110.0	V	67	14
51.191	15.78	30.0	14.2	1000	120.0	126.0	V	202	14
103.732	11.65	33.5	21.9	1000	120.0	136.0	V	15	13
505.333	16.79	36.0	19.2	1000	120.0	158.0	H	85	18

Plot: OFDM (40 MHz nominal channel bandwidth) (TAOGLAS (GW48.151))

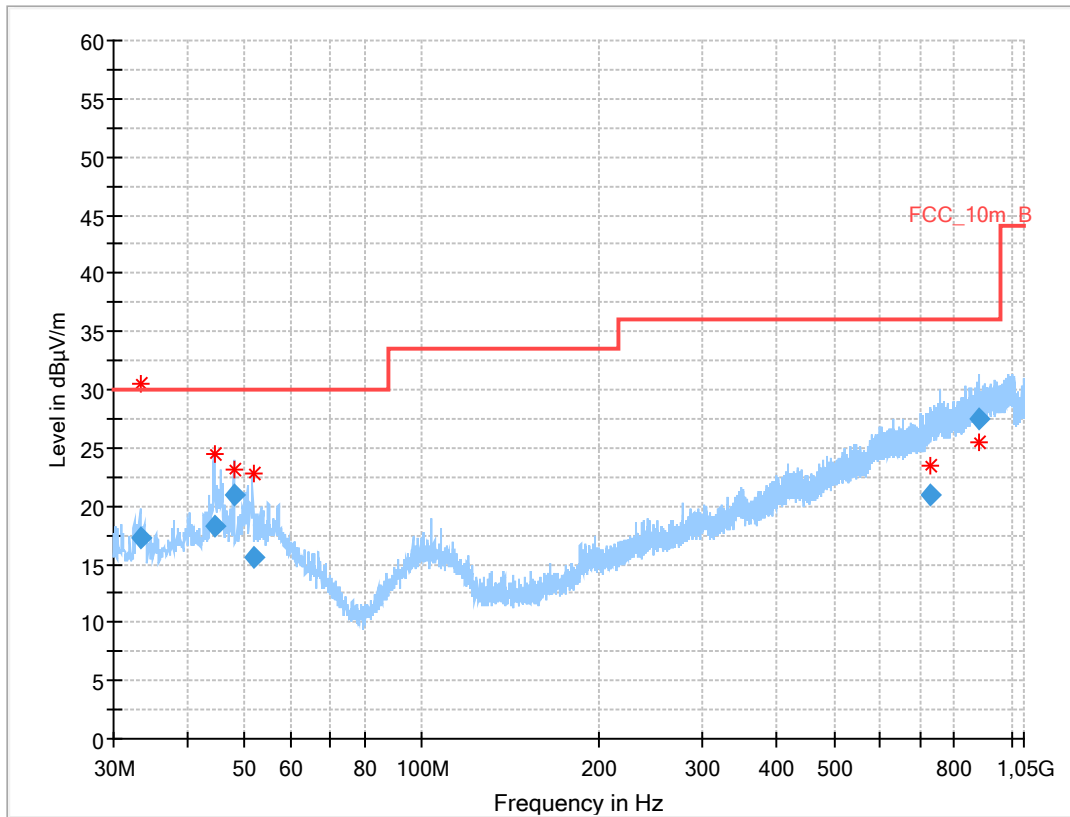
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, lowest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.336	17.40	30.0	12.6	1000	120.0	105.0	V	-17	13
44.498	18.23	30.0	11.8	1000	120.0	109.0	V	13	14
47.993	21.52	30.0	8.5	1000	120.0	101.0	V	157	14
51.087	12.66	30.0	17.3	1000	120.0	170.0	V	194	14
56.553	12.21	30.0	17.8	1000	120.0	170.0	V	67	15
508.059	21.82	36.0	14.2	1000	120.0	170.0	H	67	18

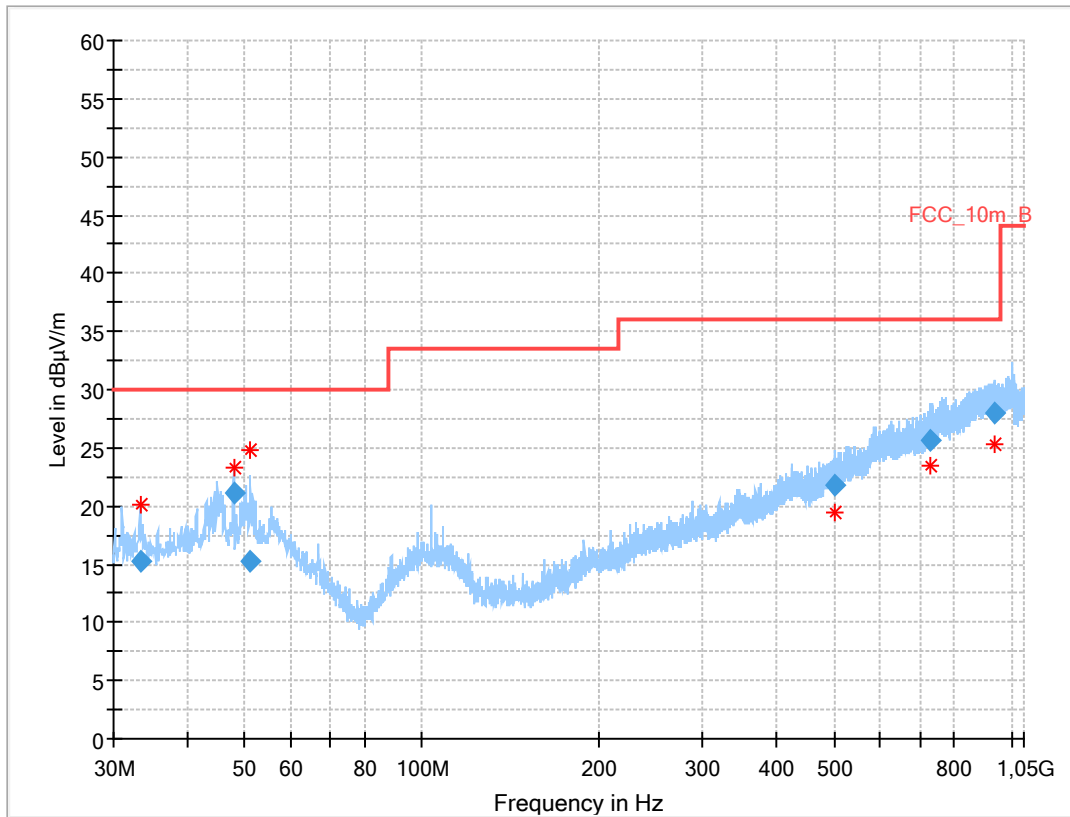
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, middle channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.310	17.24	30.0	12.8	1000	120.0	113.0	V	186	12
44.495	18.21	30.0	11.8	1000	120.0	98.0	V	112	14
47.983	20.98	30.0	9.0	1000	120.0	118.0	V	157	14
51.725	15.62	30.0	14.4	1000	120.0	105.0	V	202	14
729.323	20.96	36.0	15.0	1000	120.0	170.0	H	90	21
884.300	27.45	36.0	8.6	1000	120.0	170.0	H	78	23

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, highest channel



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.329	15.25	30.0	14.8	1000	120.0	131.0	V	-6	12
47.999	21.05	30.0	9.0	1000	120.0	170.0	V	247	14
51.207	15.29	30.0	14.7	1000	120.0	98.0	V	255	14
502.433	21.71	36.0	14.3	1000	120.0	170.0	H	247	18
726.983	25.71	36.0	10.3	1000	120.0	147.0	H	202	21
937.006	27.95	36.0	8.1	1000	120.0	170.0	V	247	24

13.14 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions above 1 GHz in transmit mode and receiver / idle mode.

Measurement:

Measurement parameter	
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	<input checked="" type="checkbox"/> DSSS b – mode <input checked="" type="checkbox"/> OFDM g – mode <input type="checkbox"/> OFDM n HT20 – mode <input checked="" type="checkbox"/> OFDM n HT40 – mode <input type="checkbox"/> RX / Idle – mode
Test setup	See chapter 7.2 A & 7.4 A
Measurement uncertainty	See chapter 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 30 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)).		
Frequency / MHz	Field Strength / (dBµV / m)	Measurement distance / m
Above 960	54.0 (AVG)	3
	74.0 (peak)	

Results: DSSS (YAGEO ANTX100P001B24553)

TX spurious emissions radiated / dBµV/m @ 3 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
4824	Peak	56.2	4874	Peak	54.4	4924	Peak	56.0
	AVG	52.9		AVG	50.1		AVG	52.7

Results: OFDM (20 MHz nominal channel bandwidth) (YAGEO ANTX100P001B24553)

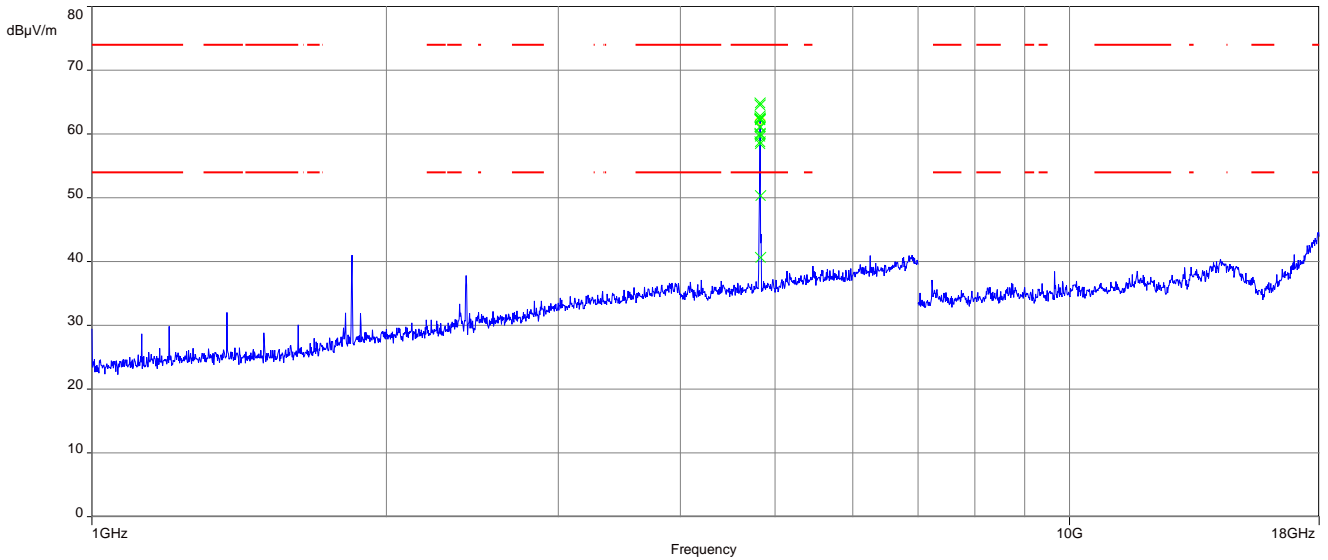
TX spurious emissions radiated / dBµV/m @ 3 m								
lowest channel			middle channel			highest channel		
f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m
4819	Peak	60.8	4874	Peak	52.6	4922	Peak	59.0
	AVG	48.9		AVG	40.7		AVG	47.0

Results: OFDM (40 MHz nominal channel bandwidth) (YAGEO ANTX100P001B24553)

TX spurious emissions radiated / dBµV/m @ 3 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 >10 dB below limit			4875	Peak	52.4	4903	Peak	53.6
				AVG	40.3		AVG	42.3

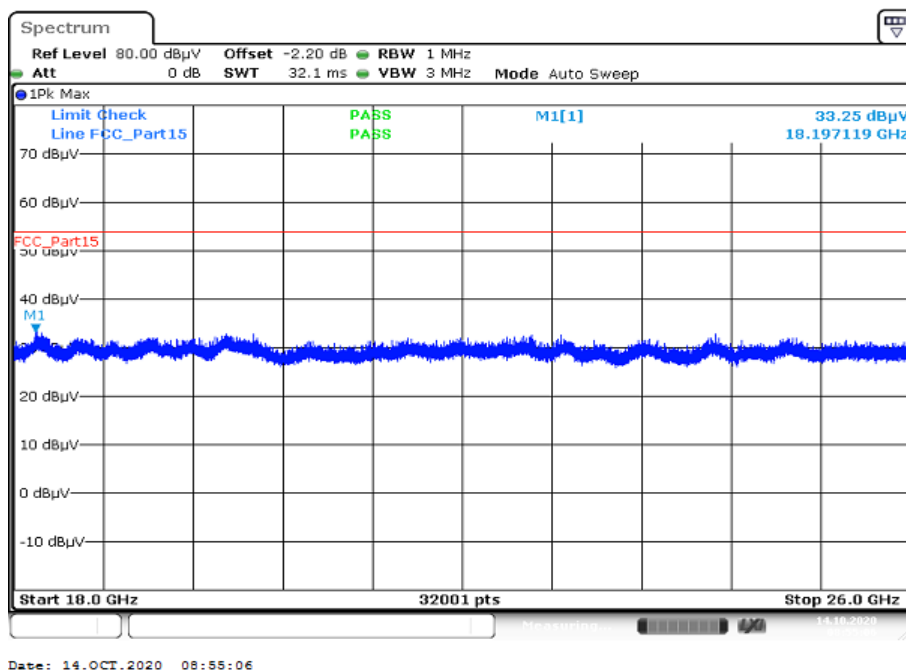
Plots: DSSS (YAGEO ANTX100P001B24553)

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

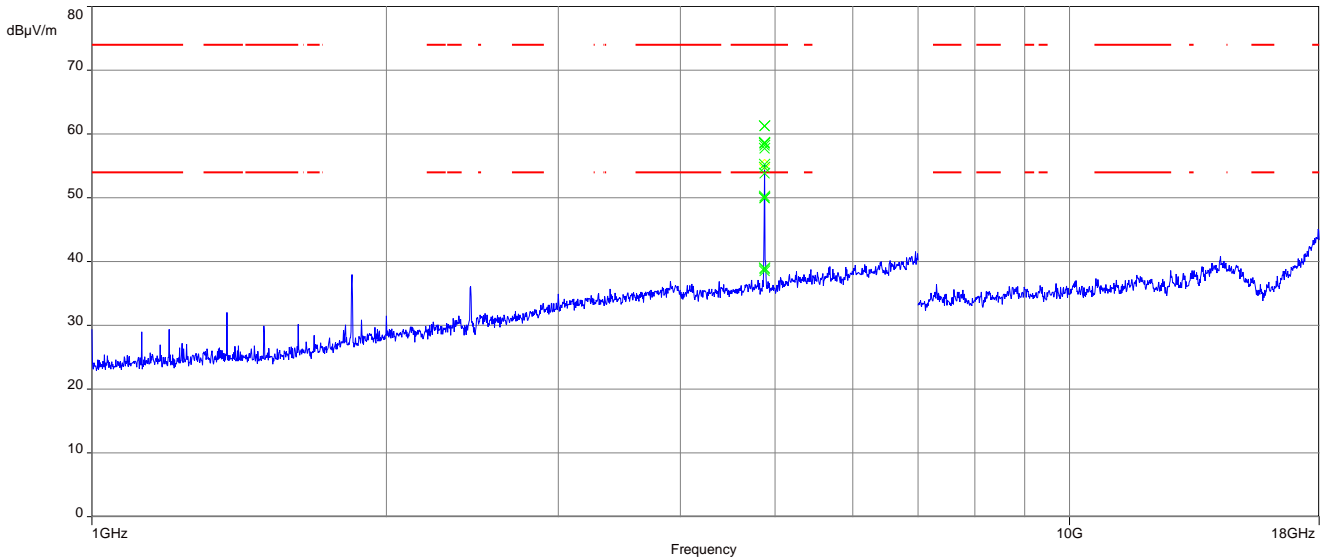


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

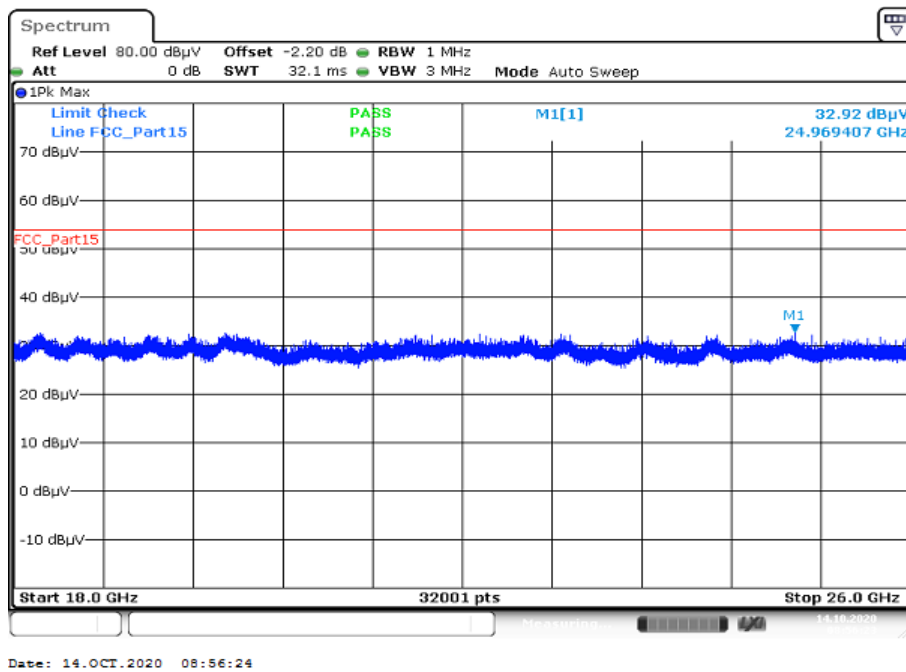


Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

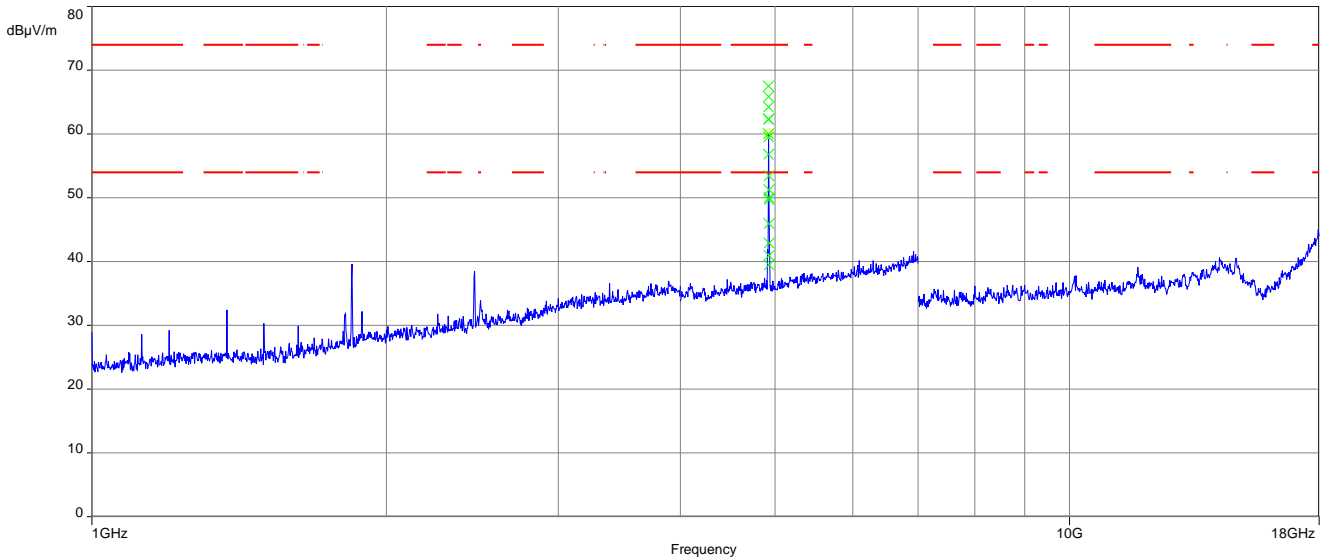


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

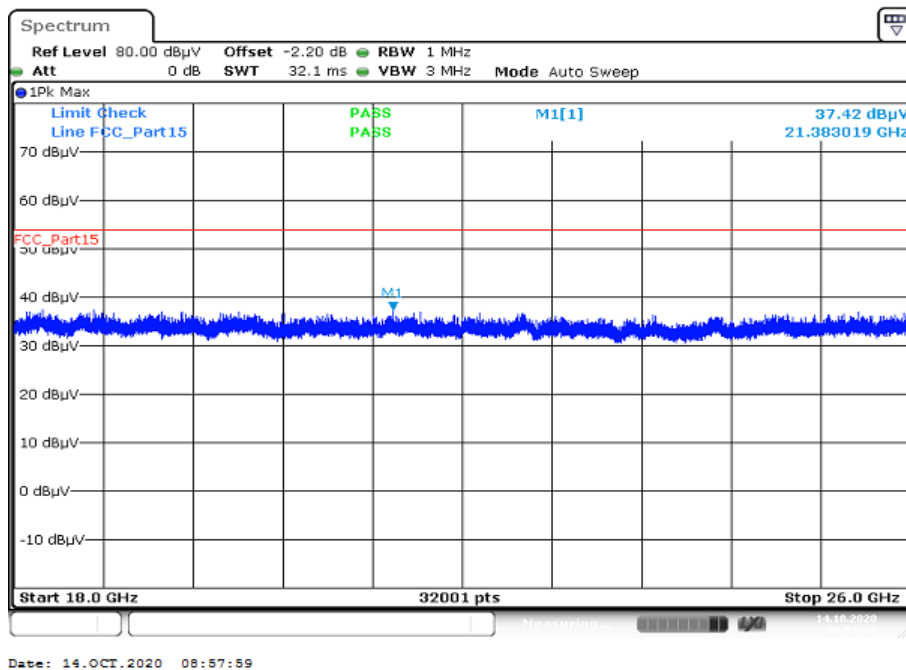


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



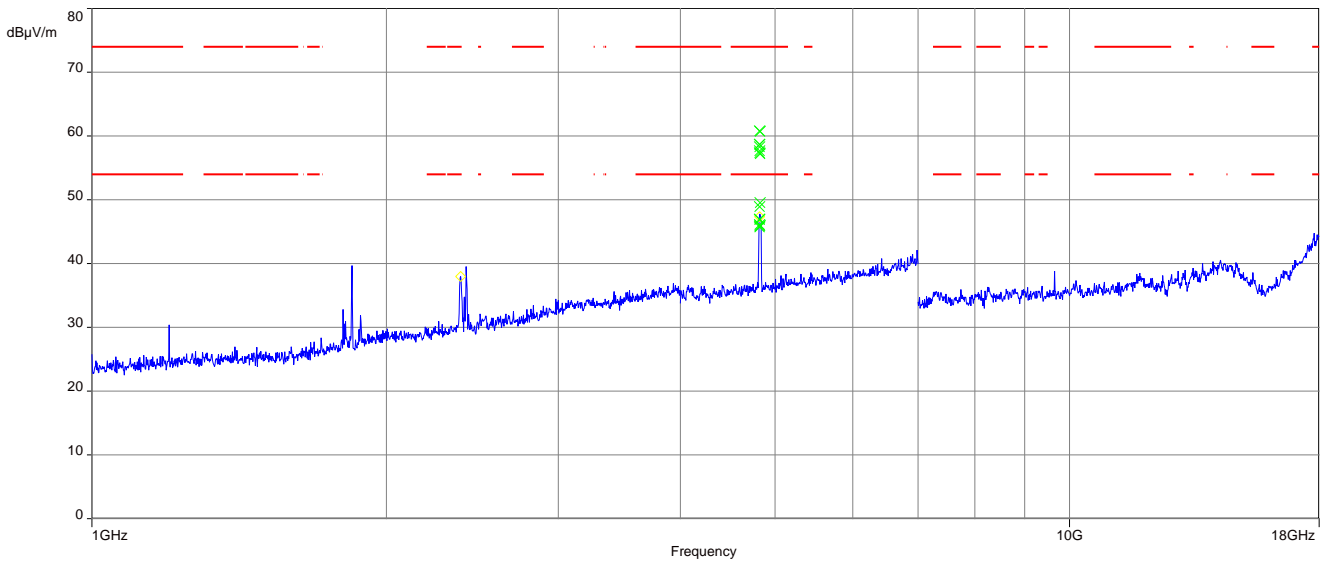
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



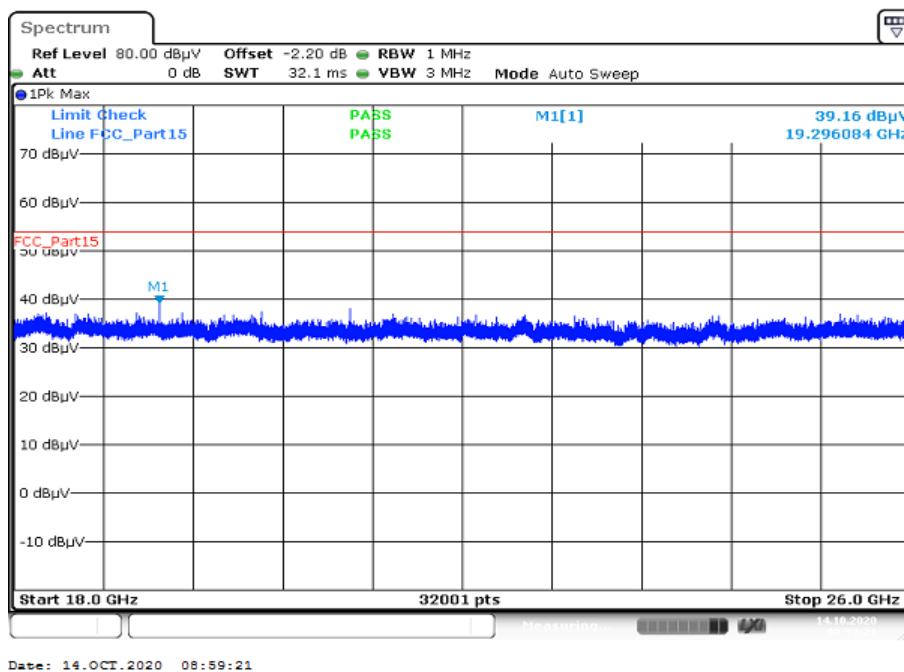
Plots: OFDM (20 MHz bandwidth) (YAGEO ANTX100P001B24553)

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

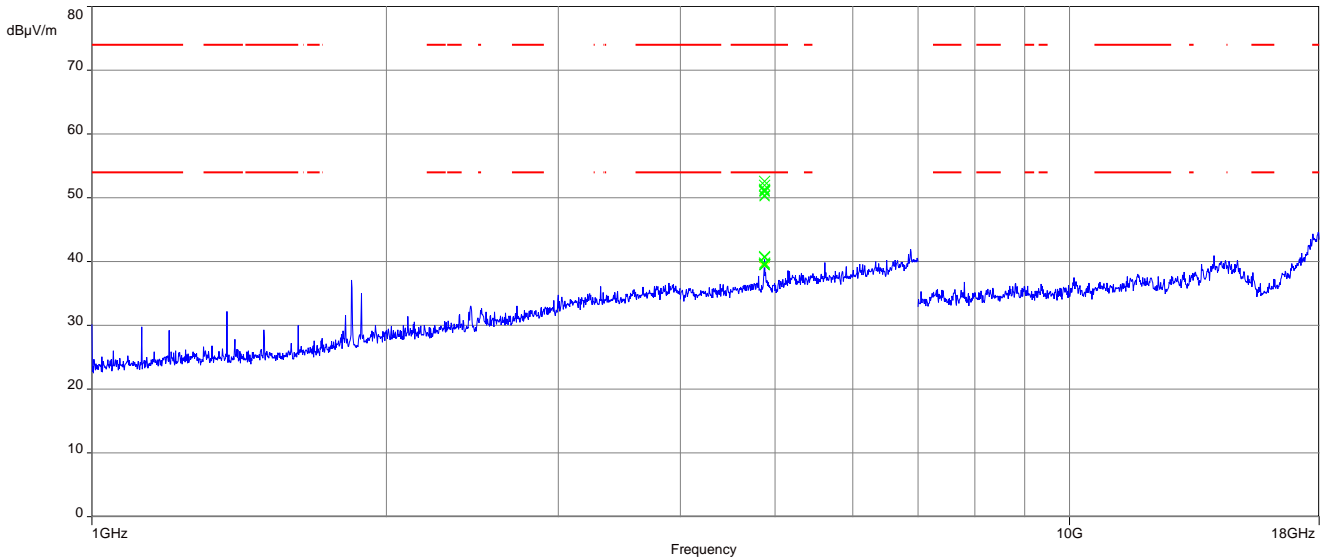


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

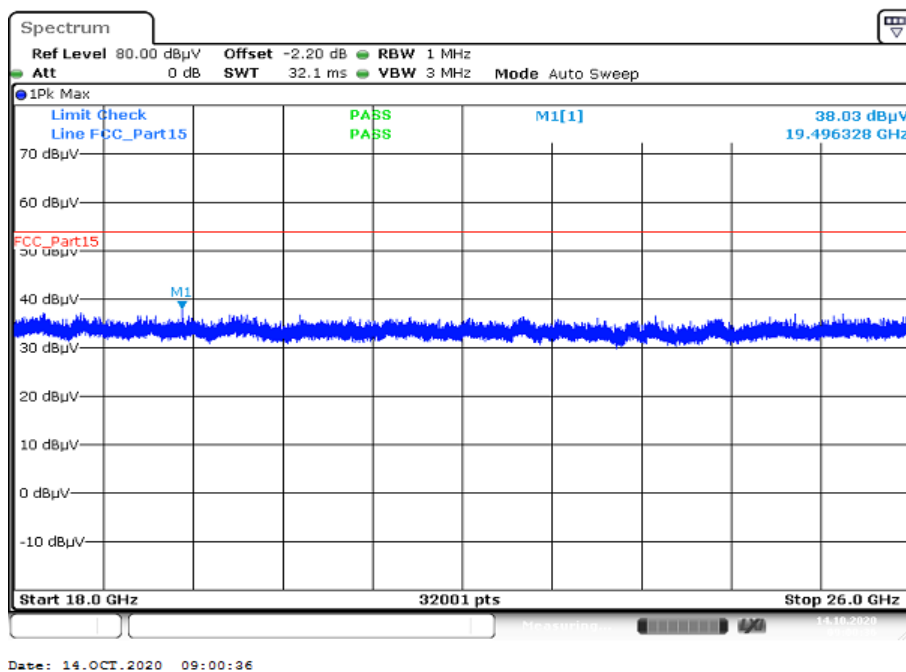


Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

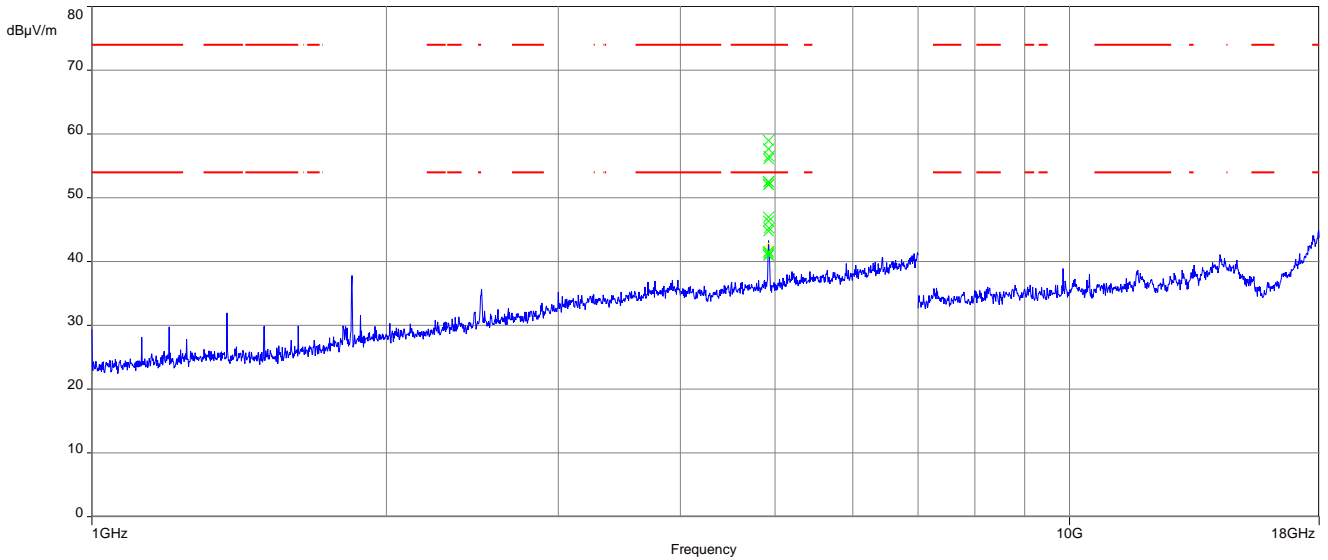


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

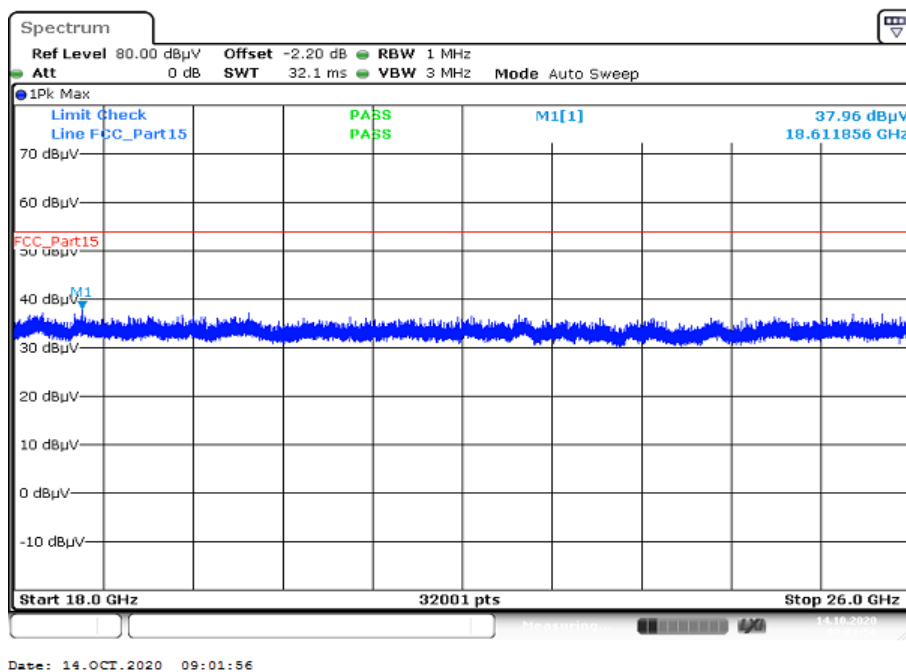


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



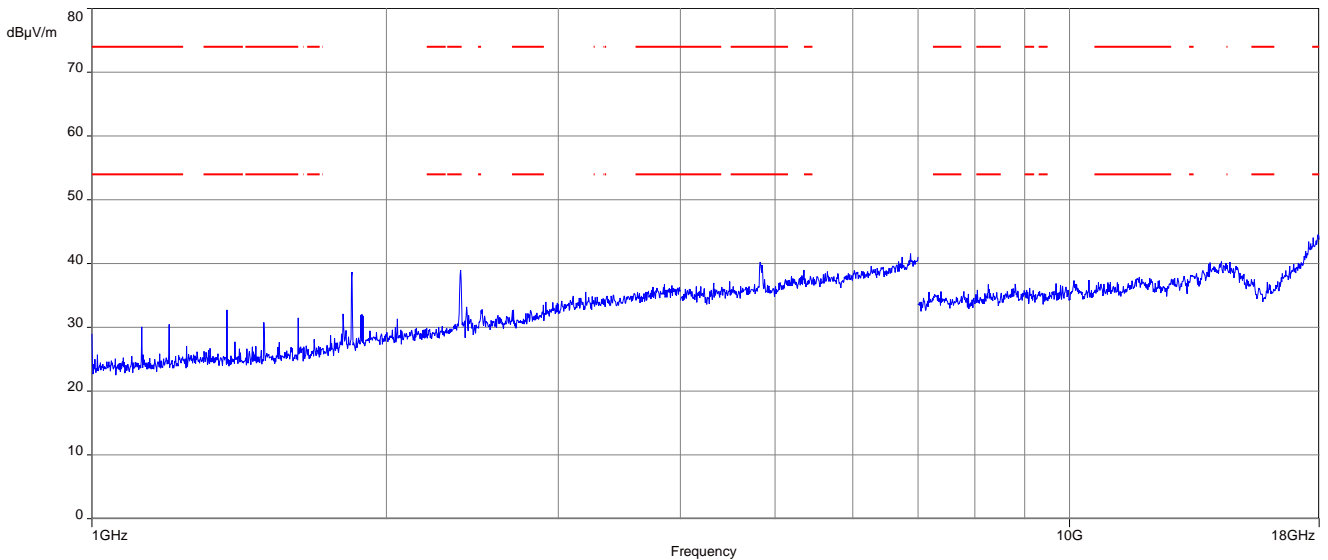
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



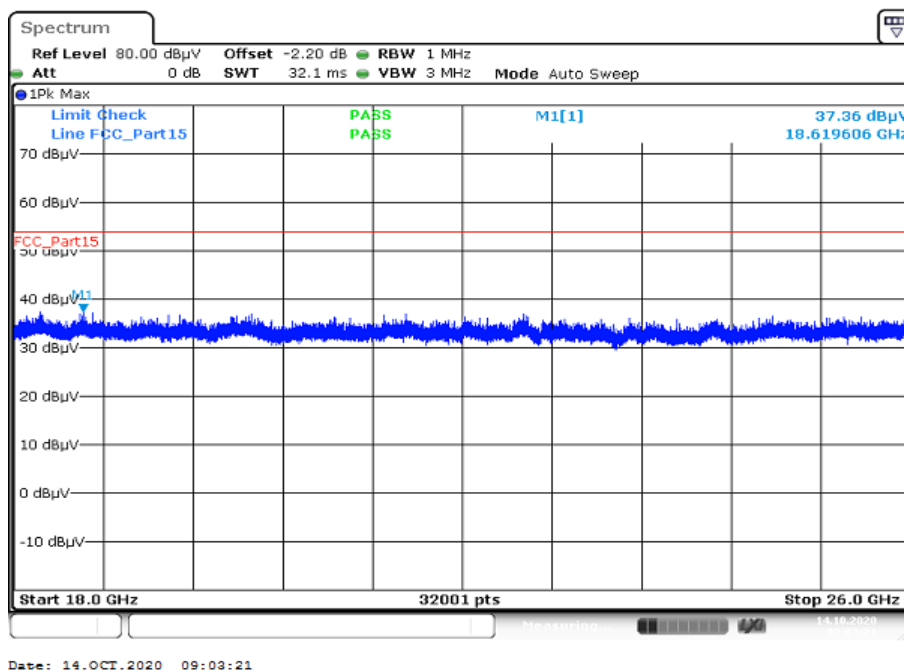
Plots: OFDM (40 MHz bandwidth) (YAGEO ANTX100P001B24553)

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

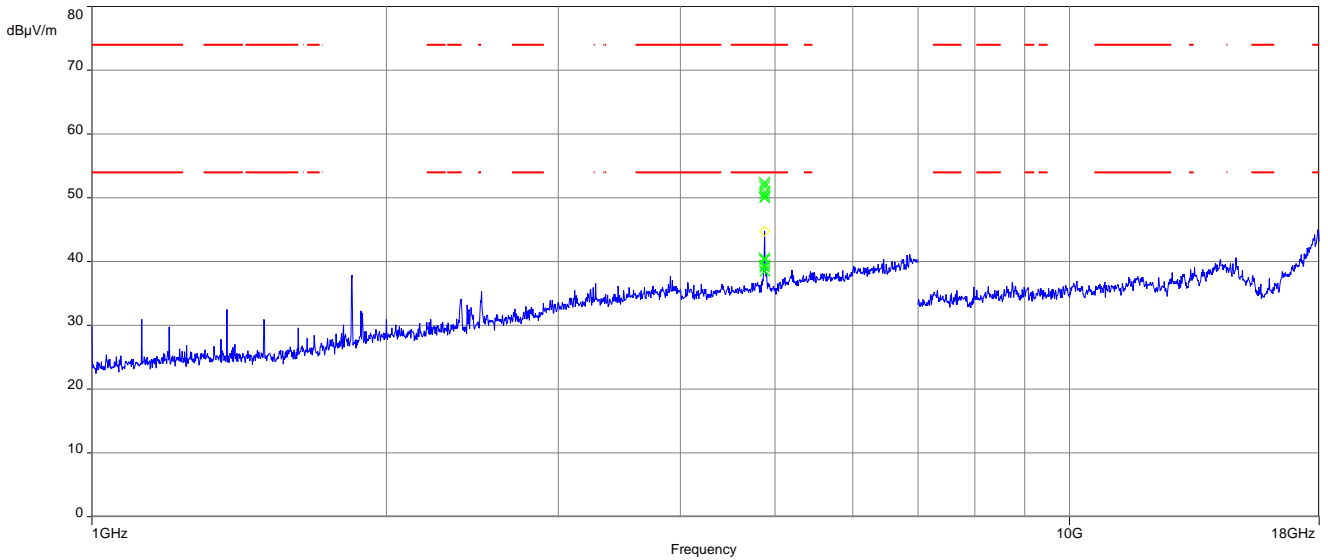


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

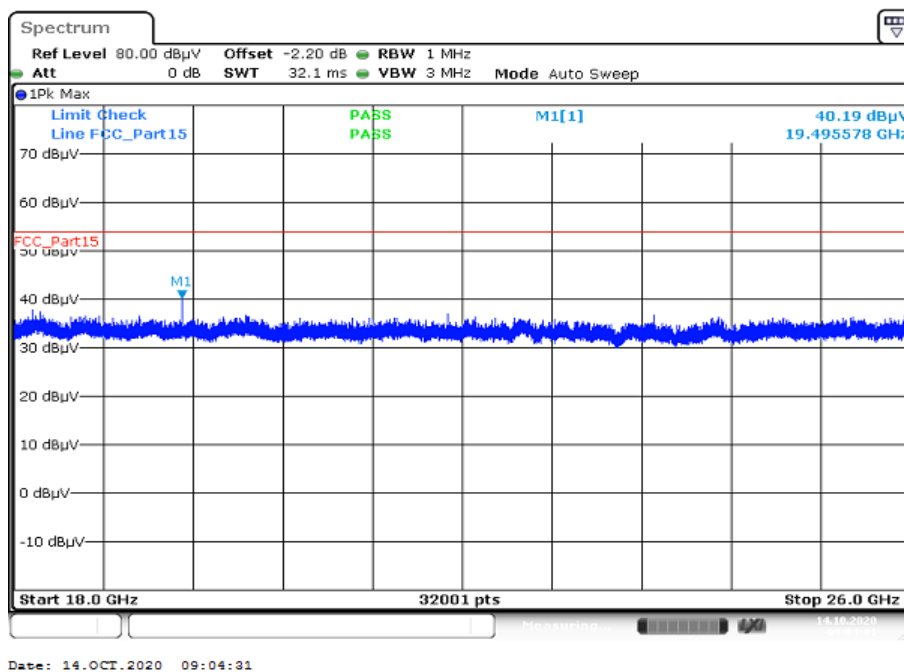


Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

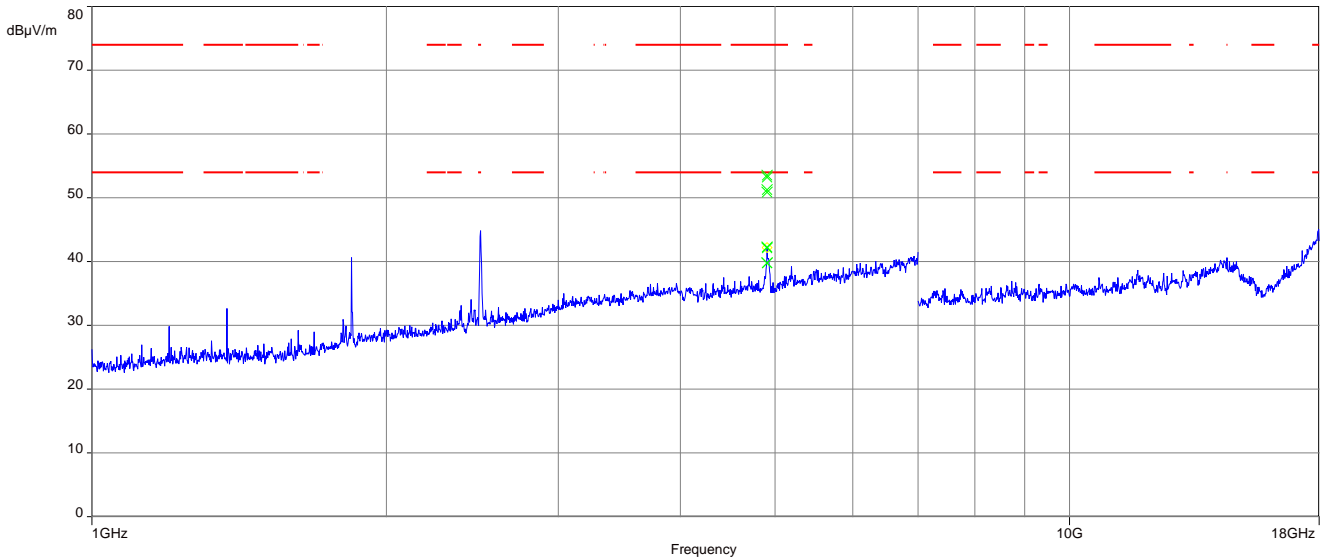


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

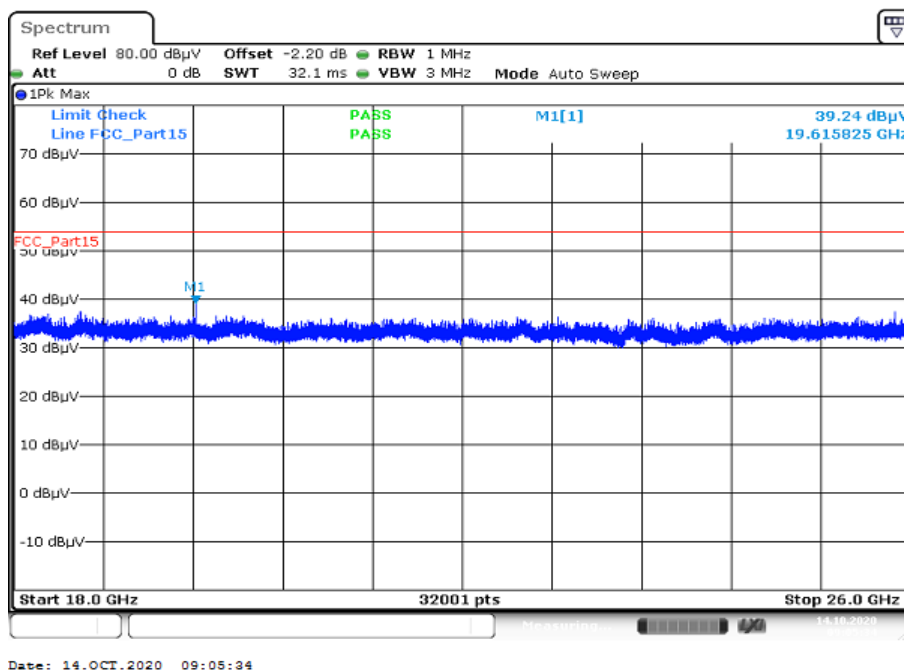


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



Results: DSSS (TAOGLAS (GW48.151))

TX spurious emissions radiated / dBµV/m @ 3 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
4824	Peak	55.4	4874	Peak	56.4	4929	Peak	55.1
	AVG	51.2		AVG	52.3		AVG	50.34
20880	Peak	41.9	20880	Peak	44.4	20880	Peak	46.0
	AVG	-/-		AVG	-/-		AVG	-/-

Results: OFDM (20 MHz nominal channel bandwidth) (TAOGLAS (GW48.151))

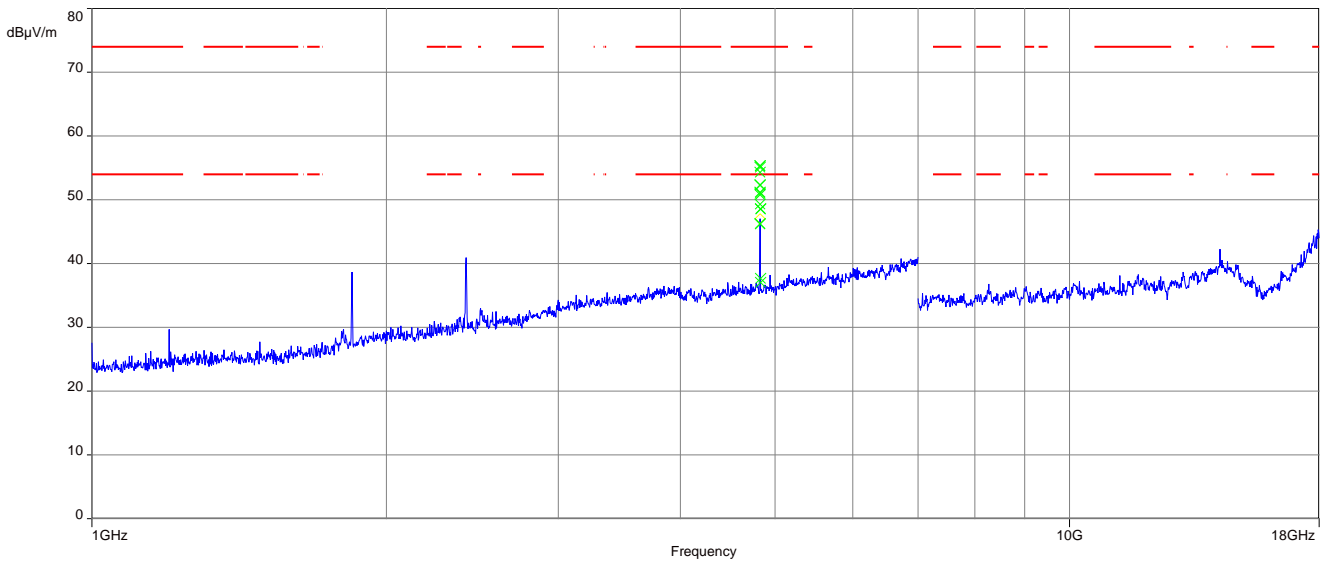
TX spurious emissions radiated / dBµV/m @ 3 m								
lowest channel			middle channel			highest channel		
f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m	f / MHz	Detector	Level / dBµV/m
4821	Peak	58.7	4880	Peak	58.1	4921	Peak	46.5
	AVG	46.2		AVG	44.5		AVG	-/-
20880	Peak	44.9	20880	Peak	46.3	20880	Peak	46.5
	AVG	-/-		AVG	-/-		AVG	

Results: OFDM (40 MHz nominal channel bandwidth) (TAOGLAS (GW48.151))

TX spurious emissions radiated / dBµV/m @ 3 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
20880	Peak	46.2	20880	Peak	43.8	20880	Peak	47.0
	AVG	-/-		AVG	-/-		AVG	-/-

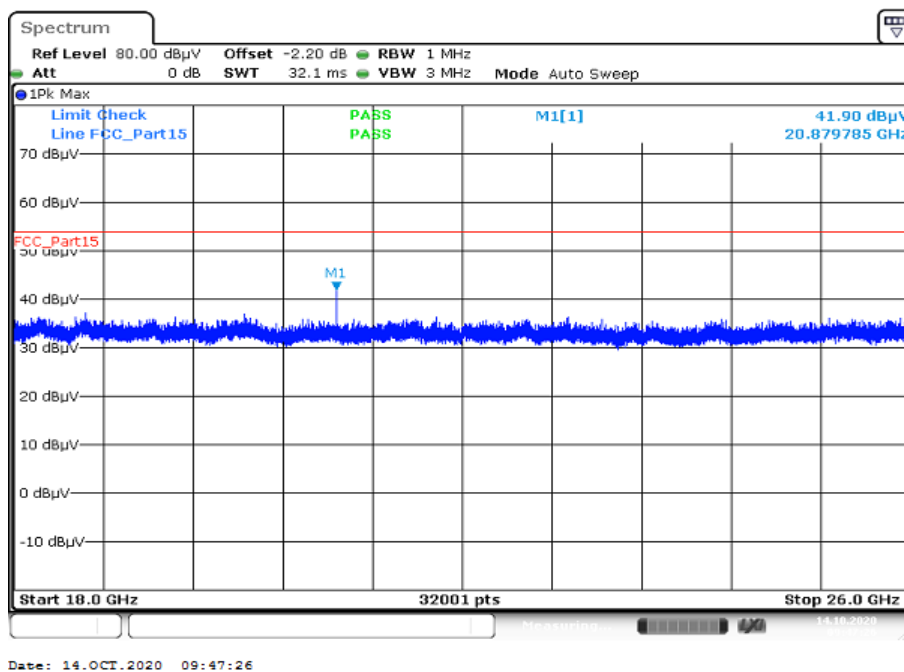
Plots: DSSS (TAOGLAS (GW48.151))

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

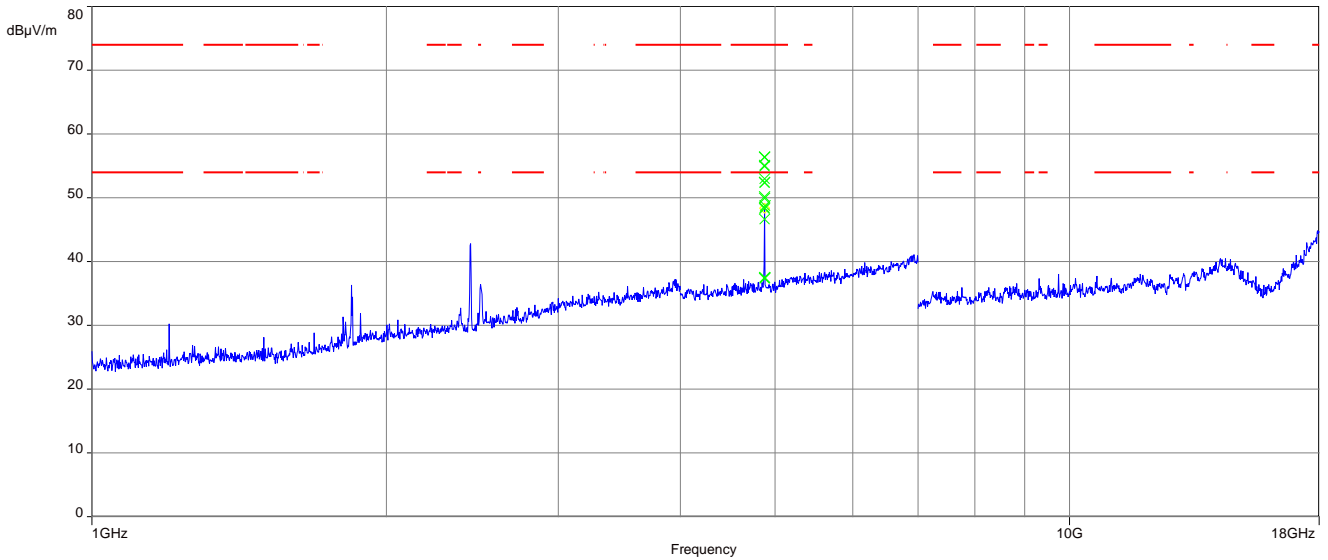


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

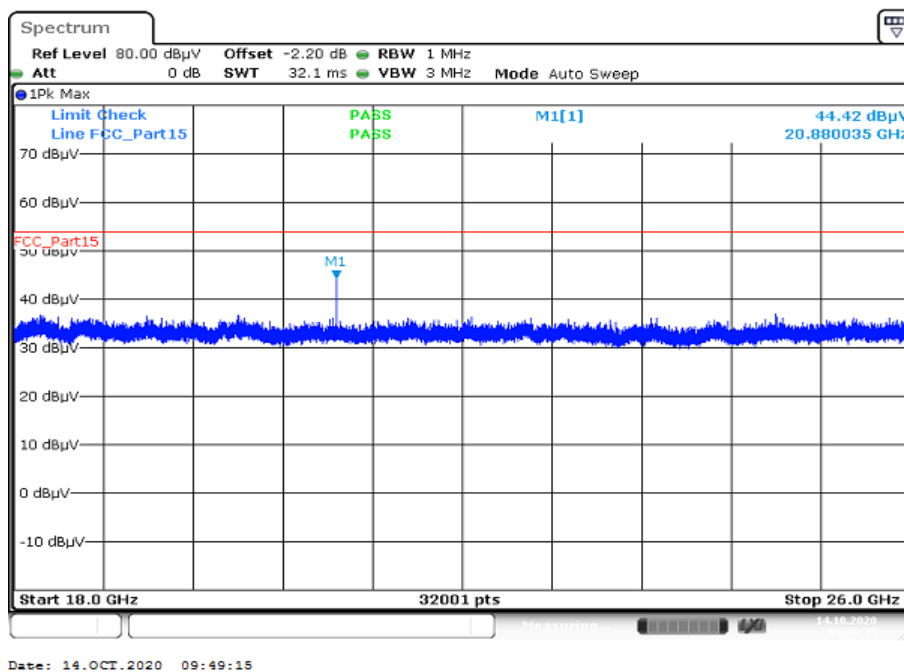


Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

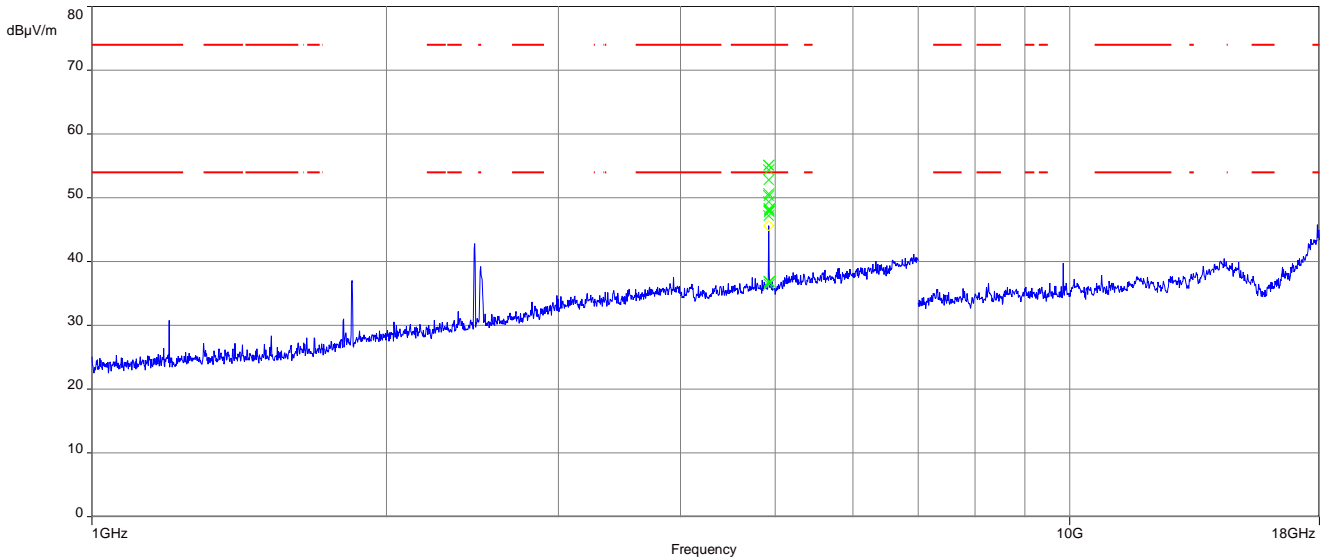


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

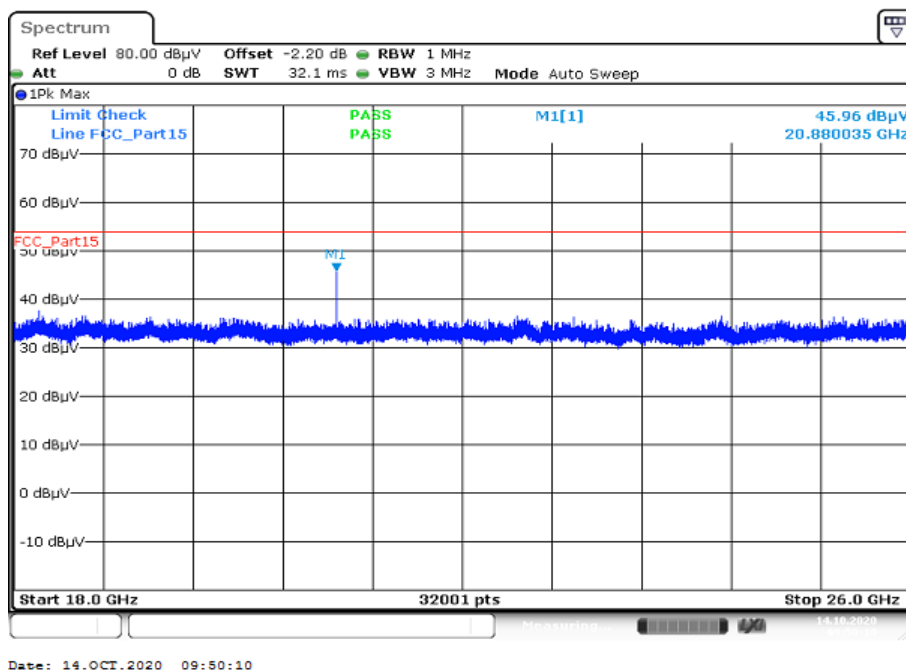


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



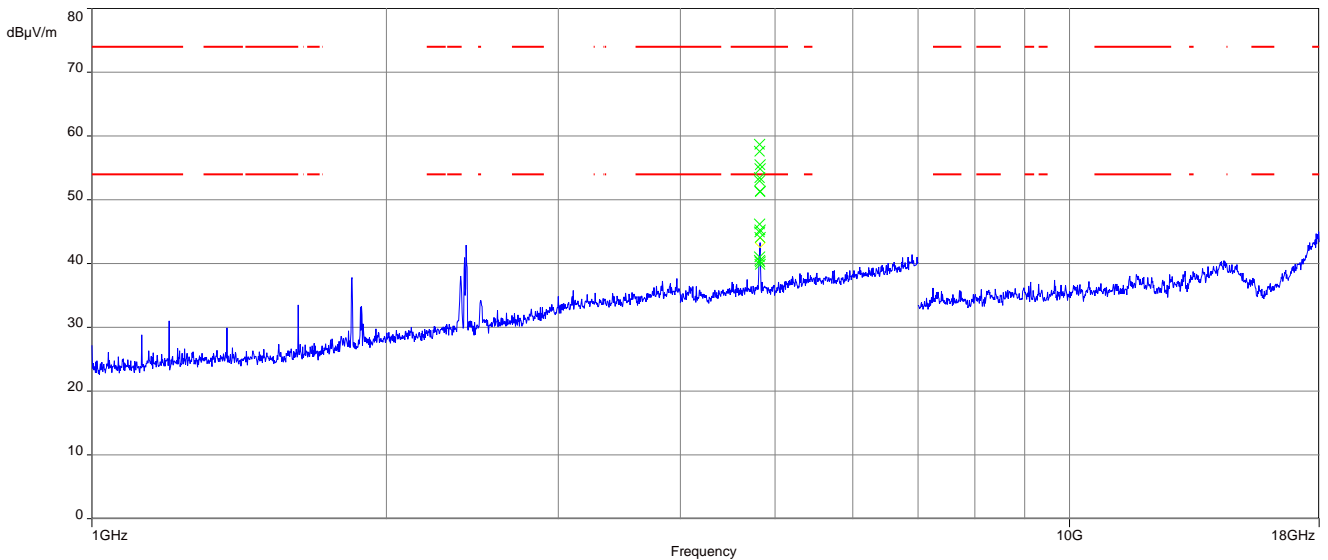
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



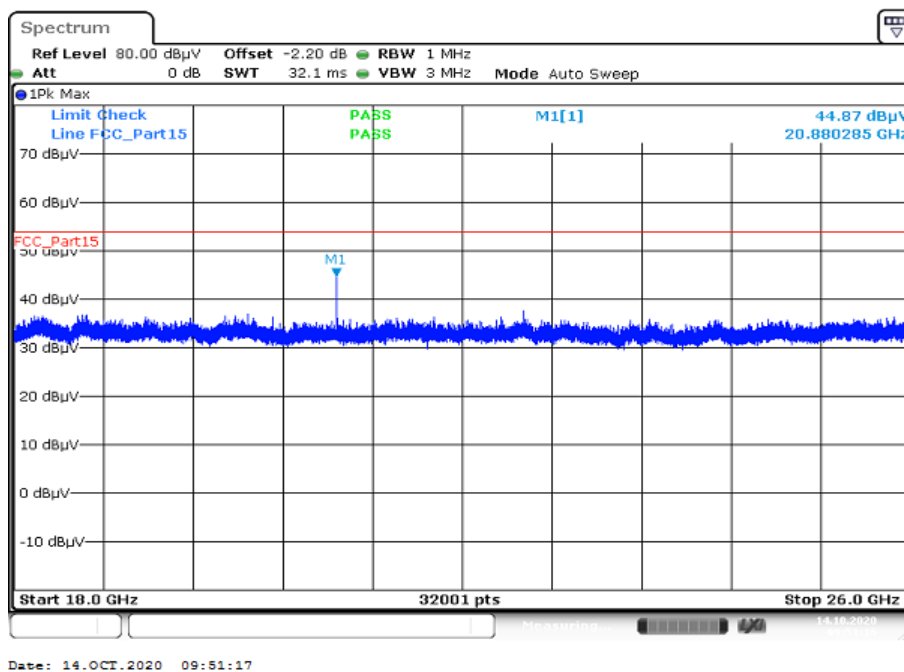
Plots: OFDM (20 MHz bandwidth) (TAOGLAS (GW48.151))

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

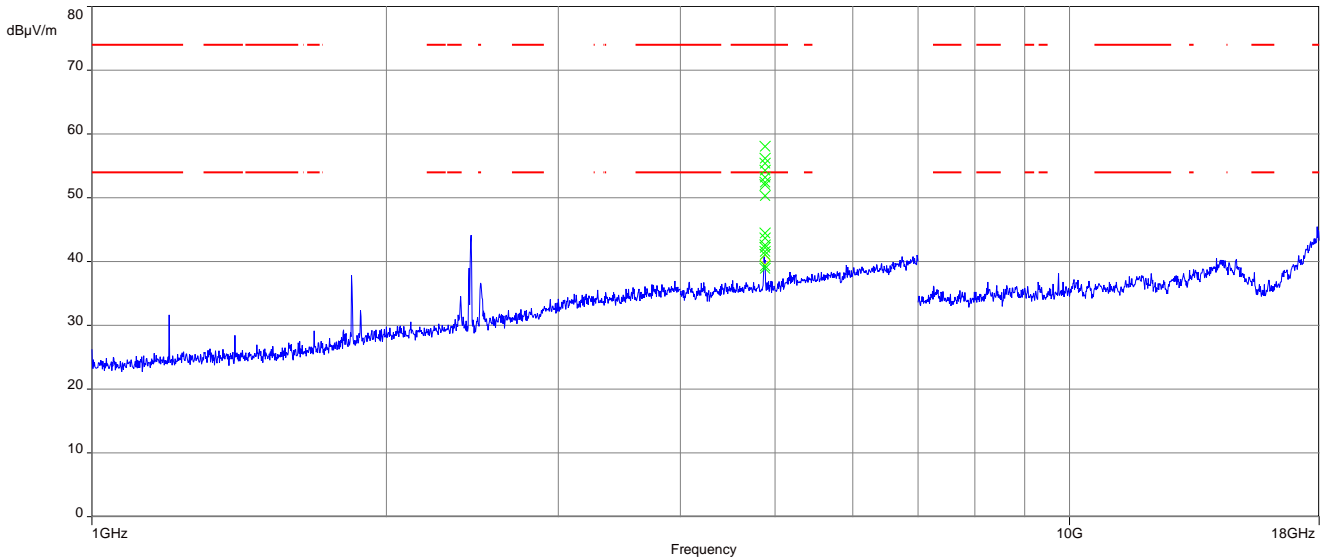


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

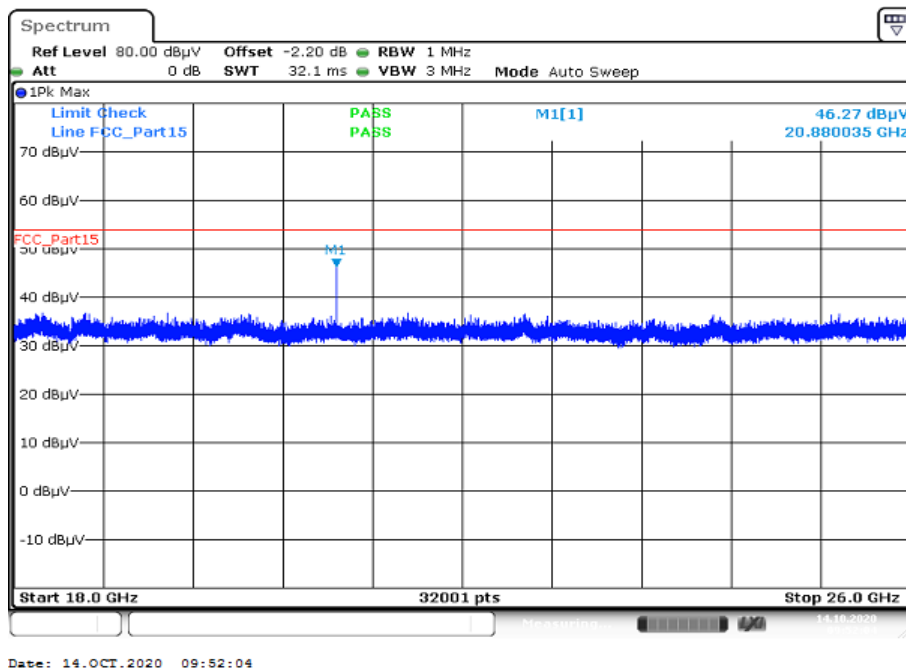


Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

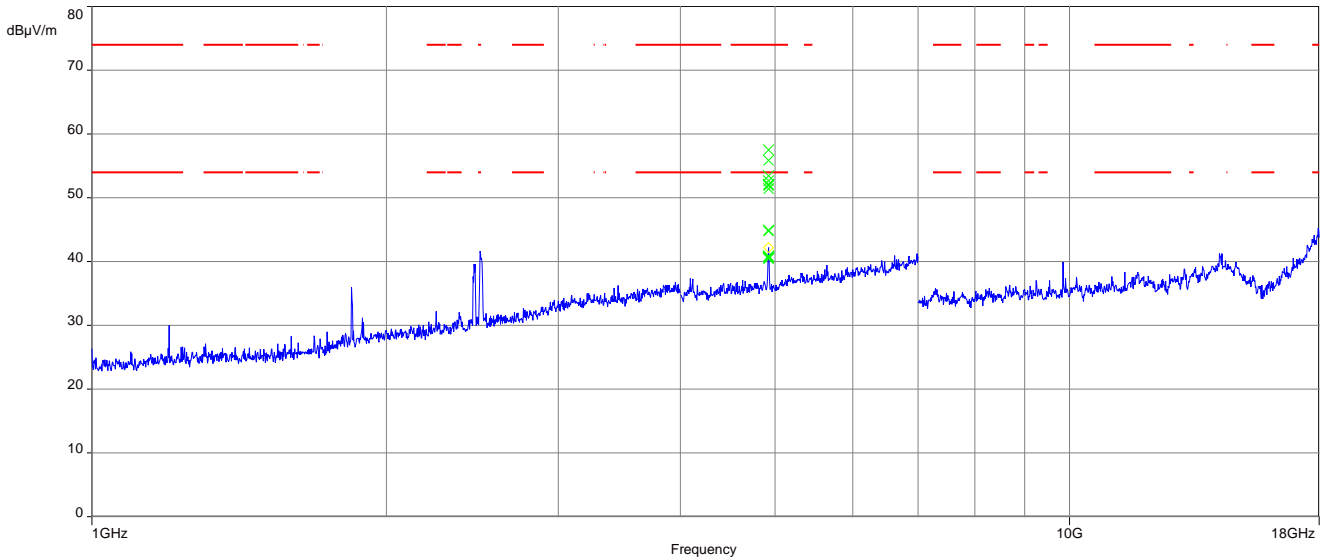


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

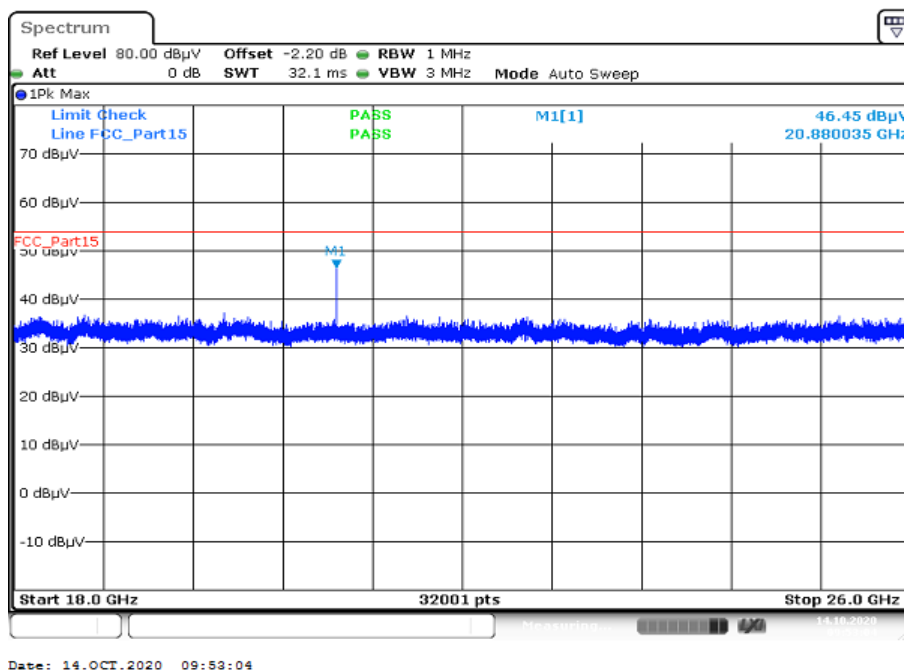


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



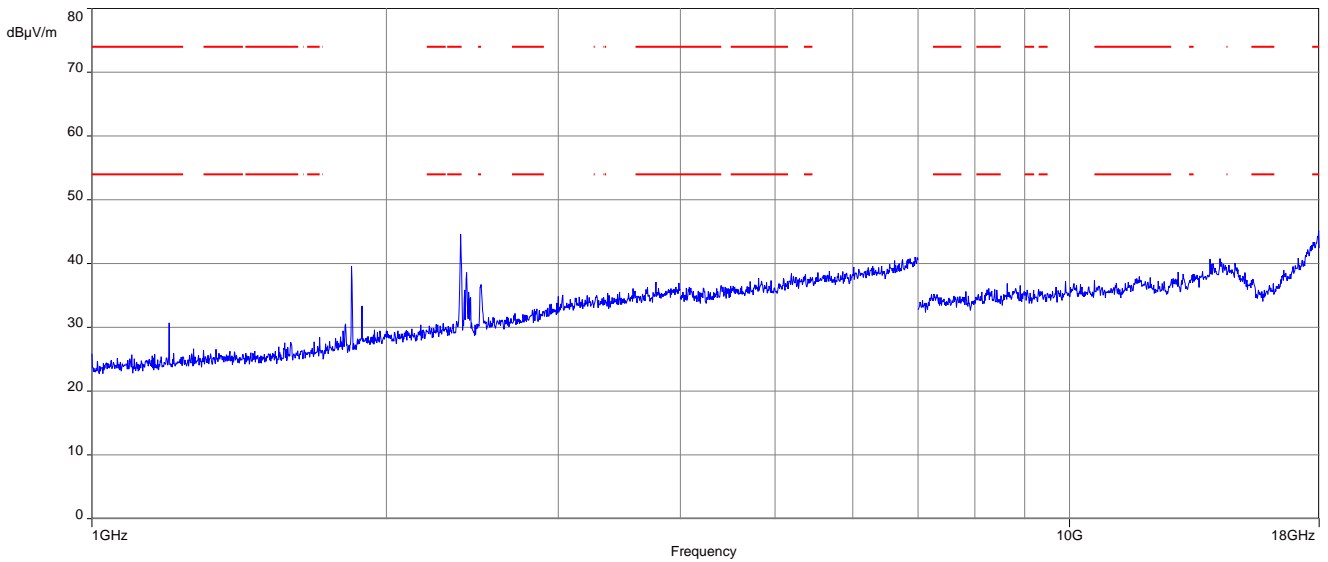
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



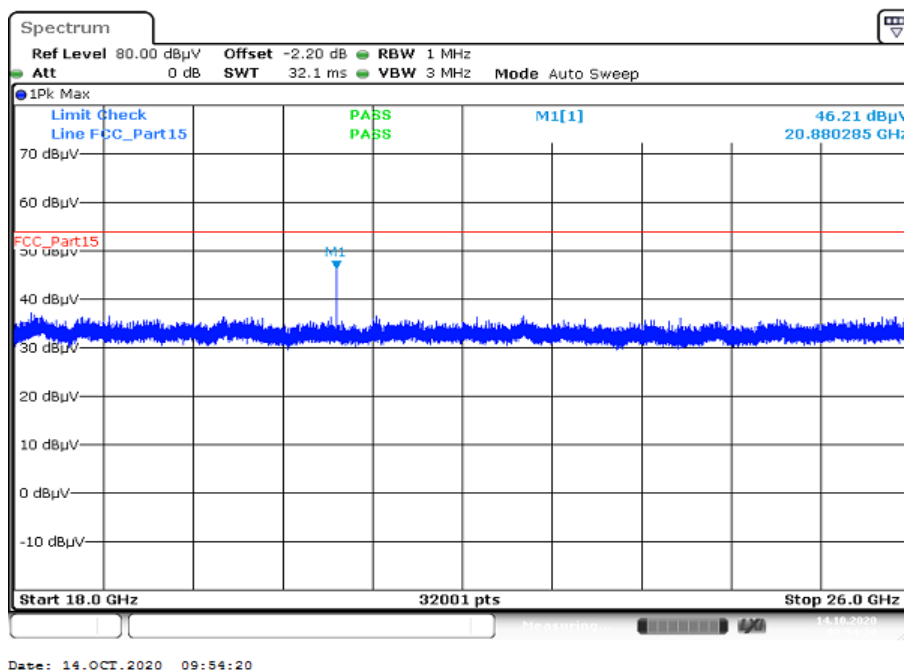
Plots: OFDM (40 MHz bandwidth) (TAOGLAS (GW48.151))

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

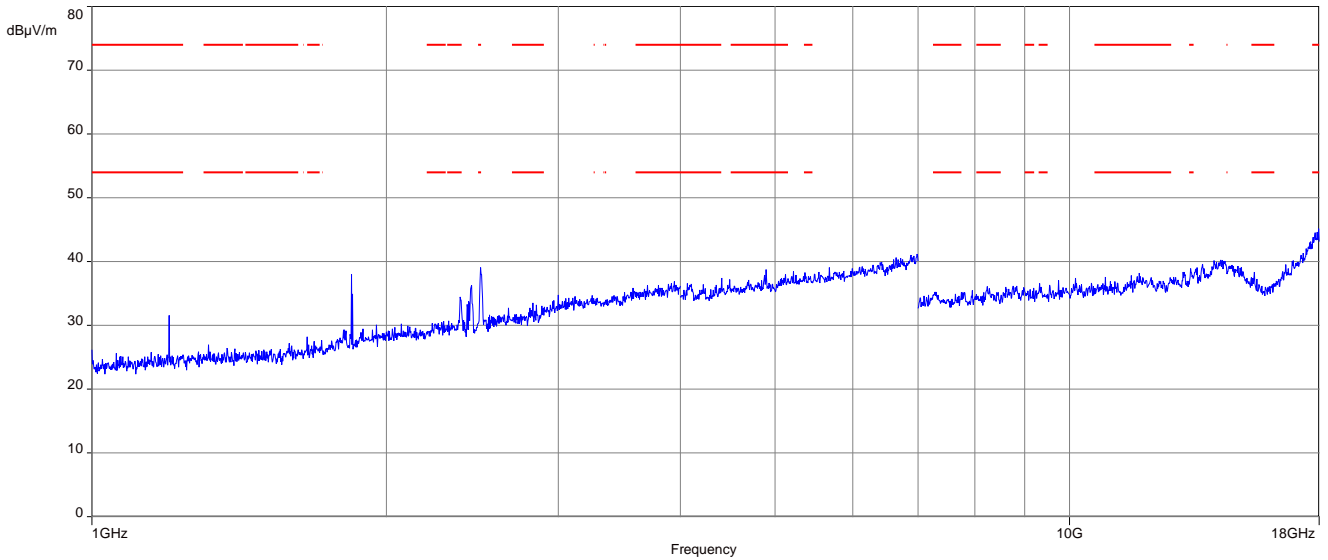


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

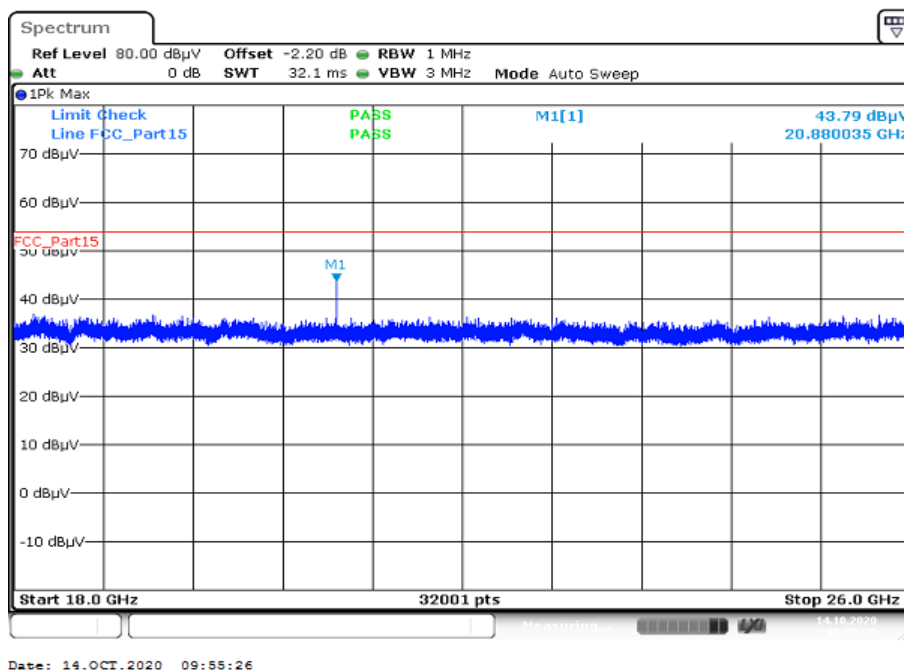


Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

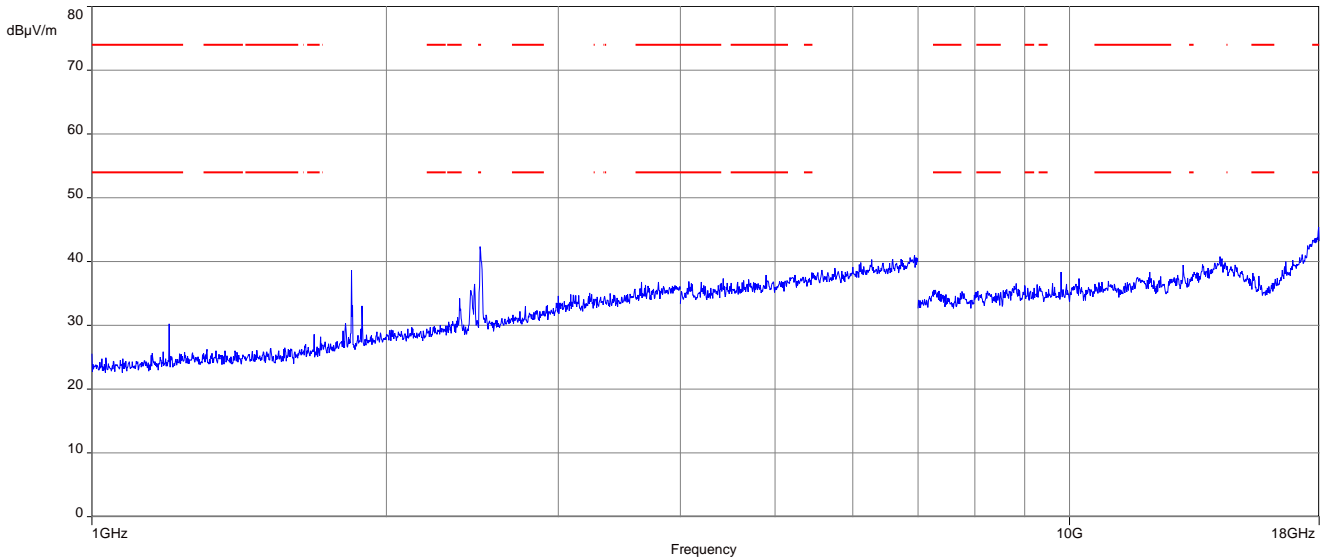


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 4: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

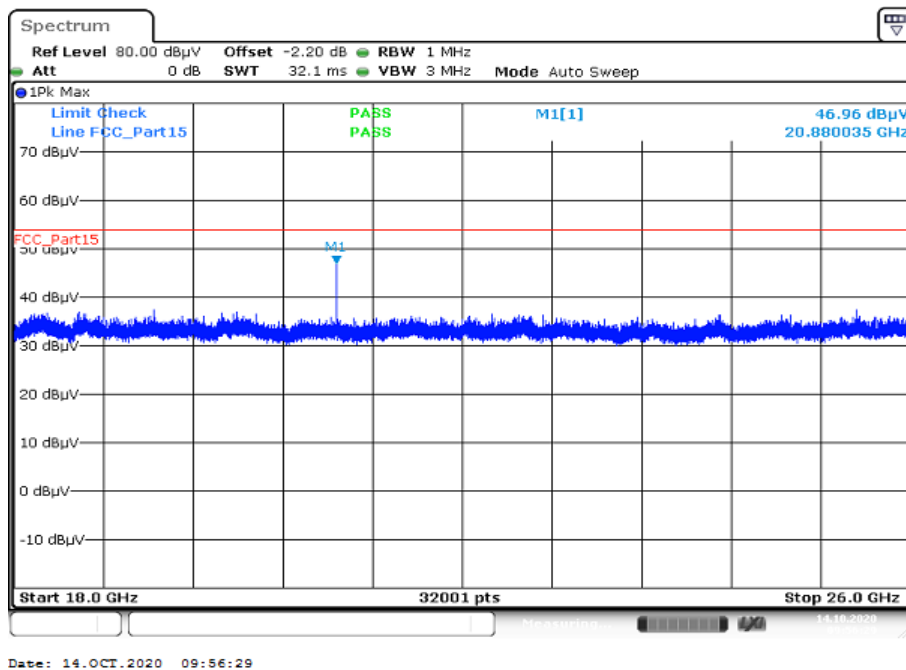


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



13.15 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

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

Measurement:

Measurement parameter	
Detector	Peak - Quasi Peak / Average
Sweep time	Auto
Resolution bandwidth	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span	9 kHz to 30 MHz
Trace mode	Max. hold
Test setup	See chapter 7.5 A
Measurement uncertainty	See chapter 9

Limits:

FCC		IC
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

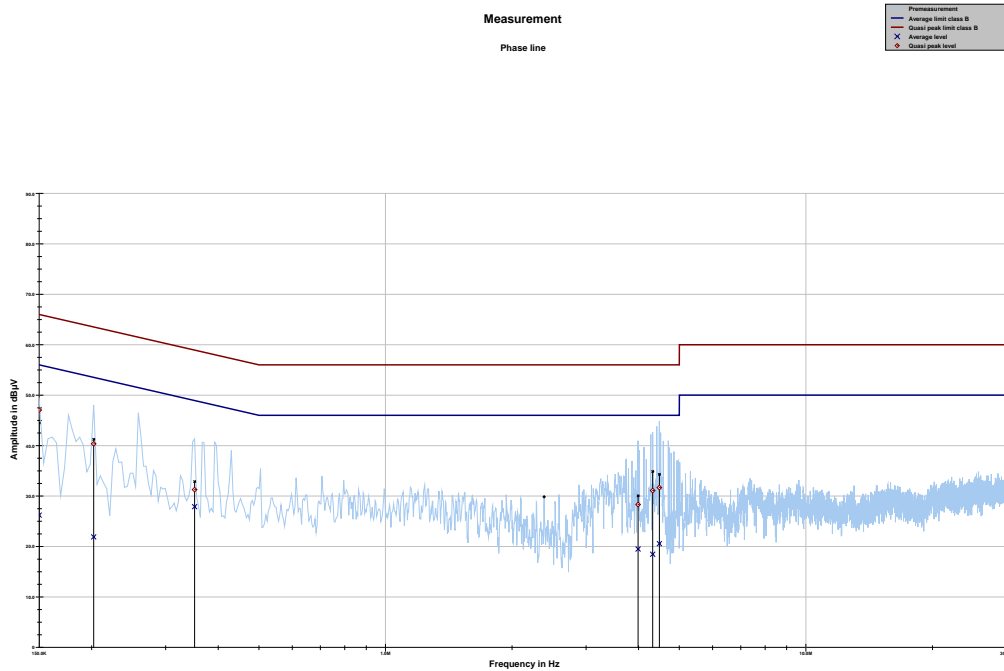
*Decreases with the logarithm of the frequency

Results:

TX spurious emissions conducted < 30 MHz / (dBµV / m) @ 3m		
f / MHz	Detector	Level / dBµV/m
All detected peaks are more than 20 dB below the limit.		

Plots:

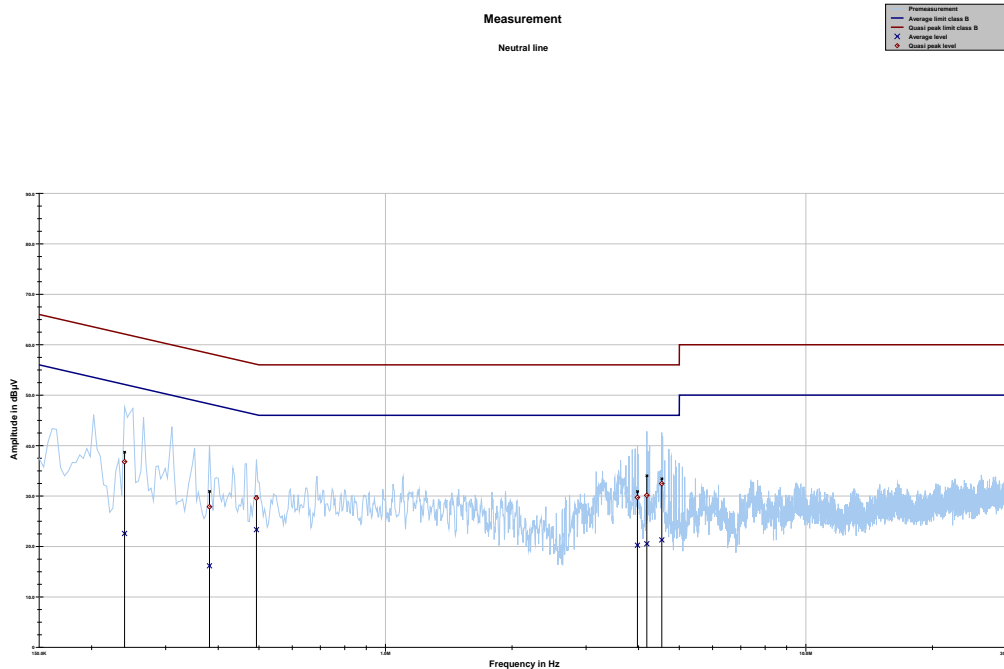
Plot 1: 150 kHz to 30 MHz, phase line



Project ID: 1-8974/19-01-07

Frequency MHz	Quasi peak level dBµV	Margin quasi peak dB	Limit QP dBµV	Average level dBµV	Margin average dB	Limit AV dBµV
0.150000	47.03	18.97	66.000	26.21	29.79	56.000
0.202237	40.34	23.18	63.518	21.88	32.63	54.508
0.351488	31.27	27.66	58.927	27.89	22.36	50.243
3.989456	28.31	27.69	56.000	19.49	26.51	46.000
4.321537	31.08	24.92	56.000	18.46	27.54	46.000
4.481981	31.66	24.34	56.000	20.56	25.44	46.000

Plot 2: 150 kHz to 30 MHz, neutral line



Project ID: 1-8974/19-01-07

Frequency MHz	Quasi peak level dBµV	Margin quasi peak dB	Limit QP dBµV	Average level dBµV	Margin Average dB	Limit AV dBµV
0.239550	36.81	25.30	62.112	22.57	30.87	53.441
0.381337	27.87	30.38	58.250	16.16	33.23	49.390
0.493275	29.60	26.51	56.112	23.32	22.87	46.192
3.974531	29.74	26.26	56.000	20.24	25.76	46.000
4.183481	30.15	25.85	56.000	20.53	25.47	46.000
4.541681	32.46	23.54	56.000	21.30	24.70	46.000

14 Observations

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

15 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N₀	Carrier to noise-density ratio, expressed in dB-Hz

16 Document history

Version	Applied changes	Date of release
-/-	Initial release	2021-03-02
A	Applicant and manufacturer changed, antenna gain documentation in chapter 6.1 changed	2021-03-16

17 Accreditation Certificate – D-PL-12076-01-04

first page	last page
 <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p>Accreditation </p> <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory</p> <p>CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken</p> <p>is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:</p> <p>Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards</p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 07 pages.</p> <p>Registration number of the certificate: D-PL-12076-01-04</p> <p>Frankfurt am Main, 09.06.2020</p> <p>by order:  Prof.-Ing. (FH) Ralf Egner Head of Division</p> <p><small>The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH. https://www.dakks.de/en/content/accredited-bodies-dakks See notes overall.</small></p>	<p>Deutsche Akkreditierungsstelle GmbH</p> <p>Office Berlin Spittelmarkt 10 10117 Berlin</p> <p>Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main</p> <p>Office Braunschweig Bundesallee 100 38116 Braunschweig</p> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkks). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkks.</p> <p>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2525) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkks is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</p> <p>The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu</p>

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkks or may be received by CTC advanced GmbH on request

<https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf>

18 Accreditation Certificate – D-PL-12076-01-05

first page	last page			
 <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p>Accreditation </p> <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields: Telecommunication (FCC Requirements)</p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages. Registration number of the certificate: D-PL-12076-01-05</p> <p>Frankfurt am Main, 09.06.2020  by Dipl.-Ing. (FH) Alf Egner Head of Division</p> <p><small>The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH. https://www.dakks.de/en/content/accredited-bodies-dakks See note 10 on page 1.</small></p>	<p>Deutsche Akkreditierungsstelle GmbH</p> <table border="0"> <tr> <td>Office Berlin Spittelmarkt 10 10117 Berlin</td> <td>Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main</td> <td>Office Braunschweig Bundesallee 100 38116 Braunschweig</td> </tr> </table> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkKS.</p> <p>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkKS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</p> <p>The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu</p>	Office Berlin Spittelmarkt 10 10117 Berlin	Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main	Office Braunschweig Bundesallee 100 38116 Braunschweig
Office Berlin Spittelmarkt 10 10117 Berlin	Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main	Office Braunschweig Bundesallee 100 38116 Braunschweig		

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkKS or may be received by CTC advanced GmbH on request

<https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf>

END OF TEST REPORT