

FCC - Title 47 CFR Part 15 FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

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

### Test Item

Kind of test item: Model name:	Digital K-Band Radar Sensor Phi-1
FCC ID:	2ASYV-PHI-1
Frequency:	24.00 GHz – 24.25 GHz
Technology tested:	FSK
Antenna:	Integrated PCB Patch Antenna
Power supply:	3.2 V DC to 5.5 V DC by 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:

Thomas Vogler
Lab Manager
Radio Labs

## Test performed:

Meheza Walla Lab Manager Radio Labs



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## 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. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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### 2.2 Application details

Date of receipt of order:	2024-01-04
Date of receipt of test item:	2024-02-02
Start of test:*	2024-02-06
End of test:*	2024-02-14
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

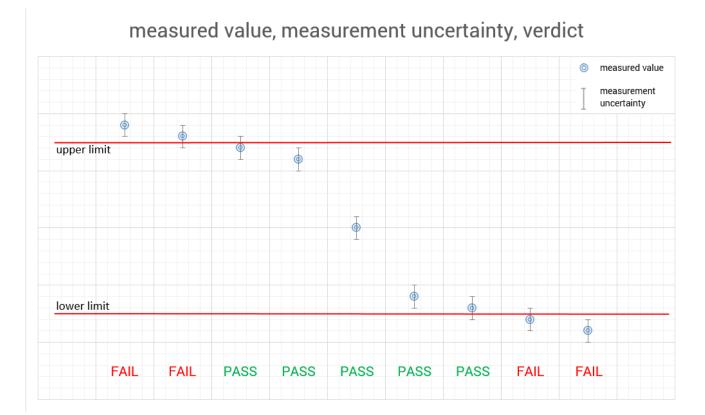
Date	Description
-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

Guidance	Version	Description
		American National Standard for Methods of Measurement of
ANSI C63.4-2014	-/-	Radio-Noise Emissions from Low-Voltage Electrical and
		Electronic Equipment in the Range of 9 kHz to 40 GHz
ANCI 062 10 2012	,	American National Standard of Procedures for Compliance
ANSI C63.10-2013	-/-	Testing of Unlicensed Wireless Devices

## **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 <sub>nom</sub> T <sub>max</sub> Tmin	<ul> <li>+22 °C during room temperature tests</li> <li>+50 °C during high temperature tests</li> <li>-20 °C during low temperature tests</li> </ul>
Relative humidity content	:		49 %
Barometric pressure	:		990 hPa to 1010 hPa
		$V_{\text{nom}}$	3.3 V DC by external power supply
Power supply	:	$V_{\text{max}}$	5.5 V
		$V_{min}$	3.2 V

## 6 Test item

## 6.1 General description

Kind of test item	:	Digital K-Band Radar Sensor
Model name	:	Phi-1
S/N serial number	:	-/- (serial module)
Hardware status	:	A
Software status	:	N/A
Firmware status	:	01
Frequency band	:	24.00 GHz – 24.25 GHz
Type of modulation	:	FSK
Number of channels	:	5
Antenna	:	Integrated PCB Patch Antenna
Power supply	:	3.2 V DC to 5.5 V DC by 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:

1-7290/23-01-01\_AnnexA 1-7290/23-01-01\_AnnexB 1-7290/23-01-01\_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

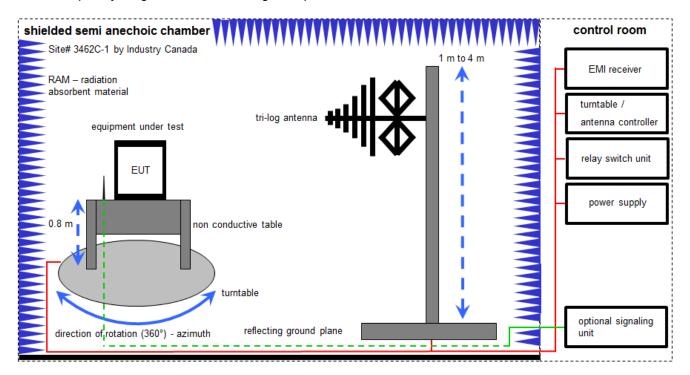
- k calibration / calibrated
- ne not required (k, ev, izw, zw not required)
- ev periodic self verification
- Ve long-term stability recognized
- vlkl! Attention: extended calibration interval
- NK! Attention: not calibrated

- EK limited calibration
- zw cyclical maintenance (external cyclical maintenance)
- izw internal cyclical maintenance
- g blocked for accredited testing
- \*) 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

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

### Example calculation:

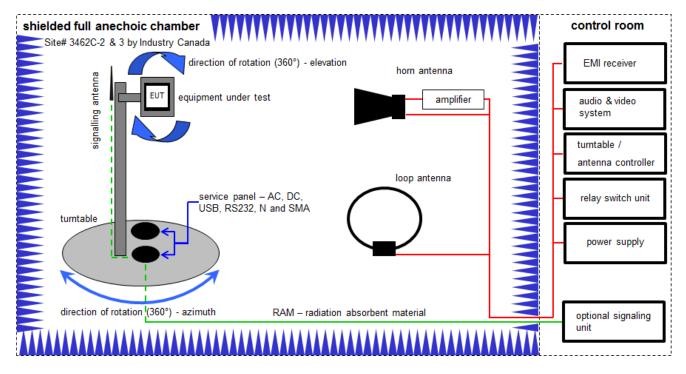
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)



## Equipment table:

No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Analyzer- Impedence-System	AIS16/1	Spitzenberger + Spies GmbH & Co. KG	UO2076 07/0 1023	400001751	k	19.10.2023	31.10.2025
2	n. a.	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
3	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
4	n. a.	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	06.12.2023	31.12.2024
5	n. a.	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	n. a.	Semi anechoic chamber	3000023	MWB AG		300000551	ne	-/-	-/-
7	n. a.	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
8	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	216	300003288	vlKI!	31.08.2023	31.08.2025
9	n. a.	Turntable	2089-4.0	EMCO		300004394	ne	-/-	-/-
10	n. a.	Turntable Interface- Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-

## 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)

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

OP = AV + D - G + CA

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

<u>Example calculation:</u> OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 μW) cetecom

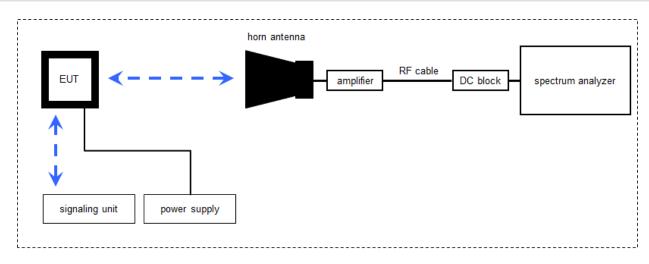


## Equipment table:

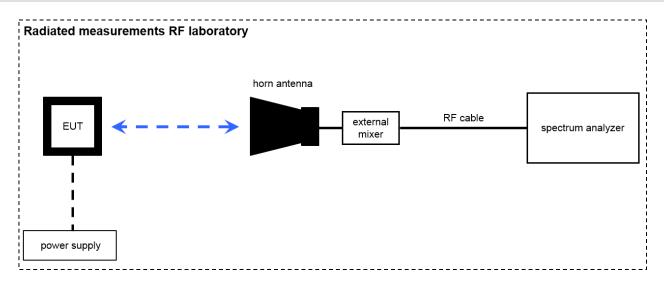
No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
2	n. a.	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	vlKl!	19.07.2023	31.07.2025
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
5	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vlKI!	05.12.2023	31.12.2026
6	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vlKl!	11.02.2022	29.02.2024
7	n.a.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2023	31.12.2024
8	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
9	n. a.	MXG Microwave Analog Signal Generator	N5183A	Agilent Technologies	MY47420220	300003813	vlKl!	07.12.2022	31.12.2025
10	n. a.	NEXIO EMV- Software	BAT EMC V2022.0.32.0	Nexio		300004682	ne	-/-	-/-
11	n. a.	RF-Amplifier	AMF-6F06001800- 30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
12	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
13	n. a.	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-



## 7.3 Radiated measurements > 18 GHz



## 7.4 Radiated measurements > 50/85 GHz



Measurement distance: horn antenna e.g. 75 cm

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

<u>Example calculation</u>: FS  $[dB\mu V/m] = 40.0 [dB\mu V/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dB\mu V/m] (6.79 µV/m)$ 

OP = AV + D - G + CA

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

<u>Example calculation:</u> OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 μW)

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

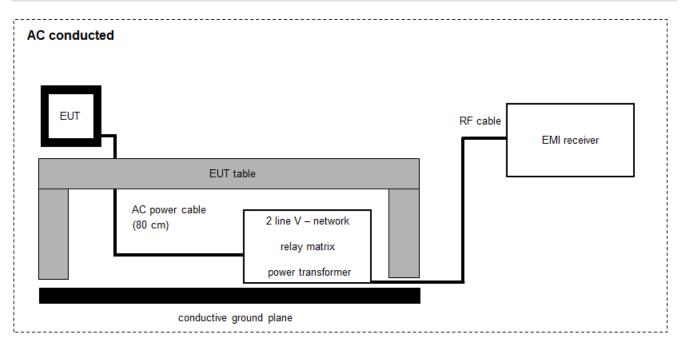


## Equipment table:

No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Broadband LNA 18- 50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	09.03.2022	08.03.2024
2	n. a.	Harmonic Mixer 3- Port, 50-75 GHz	FS-Z75	Rohde & Schwarz	101578	300005788	k	19.07.2023	31.07.2024
3	n. a.	Harmonic Mixer 3- Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	25.08.2023	31.08.2024
4	n. a.	Harmonic Mixer 3- Port, 75-110 GHz	FS-Z110	Rohde & Schwarz	101411	300004959	k	21.07.2023	31.07.2024
5	n. a.	Harmonic Mixer 3- port, 90-140 GHz	FS-Z140	Rohde & Schwarz	101119	300005581	k	03.08.2023	31.08.2024
6	n. a.	Horn Antenna 18,0- 40,0 GHz	LHAF180	Microw.Devel	39180-103-021	300001747	vlKl!	24.01.2024	23.01.2026
7	n. a.	Power supply	N5767A	Agilent Technologies	US14J1569P	300004851	vlKI!	06.12.2023	31.12.2026
8	n. a.	Signal- and Spectrum Analyzer 2 Hz - 50 GHz	FSW50	Rohde&Schwarz	101560	300006179	k	04.04.2023	30.04.2024
9	n. a.	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vlKl!	24.01.2024	23.01.2026
10	n. a.	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vlKl!	24.01.2024	23.01.2026
11	n. a.	Std. Gain Horn Antenna 33.0-50.1 GHz	2324-20	Flann	57	400000683	ne	-/-	-/-
12	n. a.	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
13	n. a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	ev	-/-	-/-
14	n. a.	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988	ne	-/-	-/-
15	n. a.	Std. Gain Horn Antenna 92.3-140 GHz	2824-20	Flann	*	300001993	ne	-/-	-/-



## 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)

<u>Example calculation</u>: 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	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	R&S	892475/017	300002209	vlKl!	12.12.2023	31.12.2025
2	n. a.	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	n. a.	EMI Test Receiver 3.6 GHz	ESR3	Rohde & Schwarz	102981	300006318	k	08.12.2023	31.12.2024
4	n. a.	EMI Test Receiver	ESCI 3	R&S	101240	300004427	k	08.12.2023	31.12.2024
5	n. 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.

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



## 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.

- 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.

- 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.



## 8.5 Sequence of testing radiated spurious above 50 GHz with external mixers

### Setup

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

### Premeasurement

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

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



# 9 Measurement uncertainty

Test case	Uncertainty
Equivalent isotropically radiated power (e.i.r.p.)	Conducted value ± 1 dB Radiated value ± 3 dB
Permitted range of operating frequencies	± 100 kHz
Conducted unwanted emissions in the spurious domain (up to 18 GHz)	± 1 dB
Radiated unwanted emissions in the spurious domain (up to 18 GHz)	± 3 dB
Conducted unwanted emissions in the spurious domain (18 to 40 GHz)	± 4 dB
Radiated unwanted emissions in the spurious domain (18 to 40 GHz)	± 4 dB
Conducted unwanted emissions in the spurious domain (40 to 50 GHz)	± 4.5 dB
Radiated unwanted emissions in the spurious domain (40 to 50 GHz)	± 4.5 dB
Conducted unwanted emissions in the spurious domain (above 50 GHz)	± 5 dB
Radiated unwanted emissions in the spurious domain (above 50 GHz)	± 5 dB
DC and low frequency voltages	± 3 %
Temperature	± 1 °C
Humidity	± 3 %



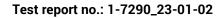
## **10** Summary of measurement results

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

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC 47 CFR Part 15	see below	2024-02-28	-/-

Test specification clause	Test case	Temperature conditions	Power supply	Pass	Fail	NA	NP	Remark
§15.215(c) / §15.249 (b)(2)	Bandwidth and frequency stability of the wanted signal	Nominal Extreme	Nominal Extreme	$\boxtimes$				complies
§15.249(b)(3)	Antenna gain & beam width	Nominal	Nominal			$\boxtimes$		
§15.249(a), (b)(1), (c), (e)	Field strength of fundamental emission	Nominal	Nominal	$\boxtimes$				complies
§15.209(a) / §15.249(d)	Field strength of emissions (radiated spurious)	Nominal	Nominal					complies
§15.207(a), (c)	Conducted emissions < 30 MHz	Nominal	Nominal	$\boxtimes$				complies

Note: NA = Not applicable; NP = Not performed





11 Additional	comments
---------------	----------

Kind of device:		Fixed, point-to-point operation system						
	intentio	Point-to-multipoint system, omnidirectional application or multiple co-located nal radiators transmitting the same information						
	$\boxtimes$	Other						
employing a fix	ked trans al applica	-to-point operation as referred to in this paragraph shall be limited to systems mitter transmitting to a fixed remote location. Point-to-multipoint systems, tions, and multiple co-located intentional radiators transmitting the same wed. []						
Test devices (EUT): • S1: EUT • S2: EUT spare • S3: EUT for int	ernal pic	ures						
Associated equipment • AE1: Evalkit PC	• •							
Additional test modes:		No test modes available						
		Special test modes/special software (see description below)						
		Stop-Modes (see description below)						

### Stop-Modes:

In addition to the normal operation mode, Stop-Modes are used in accordance with CFR 47 Part §15.31 (c) & (m), in which the frequency sweep is stopped at the following positions in the range of operation:

- Stop-Mode, low frequency: 24.135 GHz (FA)
- Stop-Mode, middle frequency: 24.175 GHz (FC)
- Stop-Mode, high frequency: 24.215 GHz (FE)

### Details on test mode settings:

• Refer to customer documentation "Phi-1 - Anleitung Messungen.pdf"

#### Software provided by the manufacturer:

• K-PHI1\_CTP-SED-0109.exe



## 12 Measurement results

## **12.1 Bandwidth and frequency stability of the wanted signal**

### **Description:**

Measurement of the bandwidth and the frequency stability of the wanted signal (fundamental emission) under temperature and supply voltage variations.

### Limits and provisions:

### §15.215(c):

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

Designated frequency bands of §15.249									
Kind of device	Fundamental frequency [GHz]	f∟[GHz]	fн [GHz]	Bandwidth [MHz]					
Fixed, point-to-point system (see also 15.249(b)(2))	24.05-24.25	> 24.05	< 24.25	< 200					
Other	0.902 - 0.928	> 0.902	< 0.928	< 26 MHz					
Other	2.400 - 2.4835	> 2.400	< 2.4835	< 83.5 MHz					
Other	5.725 - 5.875	> 5.725	< 5.875	< 150 MHz					
Other	24.0 - 24.25	> 24.0	< 24.25	<250 MHz					

### 15.249(b): Fixed point-to-point systems

[...] Fixed, point-to-point operation is permitted in the 24.05–24.25 GHz band subject to the following conditions: [...]

(2) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.001\%$  of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery. [...]



### Measurement:

Measurement parameter					
Detector:	Pos-Peak				
Resolution bandwidth:	1 MHz				
Video bandwidth:	3 MHz				
Trace-Mode:	Max Hold				

Measurement procedures:

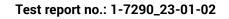
- Bandwidth: ANSI C63.10-2013 6.9
- Frequency stability: ANSI C63.10-2013 6.8

### Measurement results:

### 20 dB bandwidth at normal conditions:

Channels	Test condition	f∟ [GHz]	fн [GHz]	Bandwidth [MHz]
FA – 24.135 GHz	T <sub>nom</sub> / V <sub>nom</sub>	24.116 310	24.141 780	25.5
FC – 24.175 GHz	T <sub>nom</sub> / V <sub>nom</sub>	24.161 860	24.187 040	25.2
FE – 24.215 GHz	T <sub>nom</sub> / V <sub>nom</sub>	24.204 420	24.229 600	25.2

### Verdict: Compliant



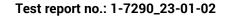


## Plot 1: 20dB bandwidth, Stop Mode (low frequency)

							\$
MultiView 📑 Spectrum	n × Spectrum 2	× Spectru	m 4 🗙				-
RefLevel 107.00 dBµV	RBW 1 MHz						_
● Att 0 dB ● S' TDF "LHAF180_CABLE502_0_5	WT3s●VBW 3MHz Mode	Auto Sweep					
1 Frequency Sweep	M_DB0V					⊙1Pk Ma	ax ⊜2Av Max
		Mź				M1[1]	99.90 dBµ\
100 dBµV		0.0	M				1.123 200 GHz
90 dBµV		(1)				M2[2]	98.95 dBµV <del>1.123 200 GHz</del>
50 GDD1						-	
80 dBµV		7	~ 12 7				
240 FCC PARTIE 240 JEED REC. 210			, M I				
24G FCC PART15_249_ISED RSS-210	_BIO PEAK	A day ward	- A mont	when			
		N N		Wheel where	mysh		
60 dBuV	B10 AVG				A MARCON AND AND AND AND AND AND AND AND AND AN	1999-1999-1999-1999-1999-1999-1999-199	10
50 dBµV	_						L
40 dBµV							
30 dBµV							
20 dBµV							
20 0600							
10 dBµV							
CF 24.125 GHz	1001	ots	30	.0 MHz/		Spa	an 300.0 MHz
2 Marker Table							
Type Ref Trc M1 1	X-Value 24.123 2 GHz	Y-Value 99.90 dBµV	ndB	Function		Function Re: 20.0 d	
T1 1	24.116 31 GHz	80.00 dBµV	ndB down B	W		25.47 MH	z
T2 1 M2 2	24.14178 GHz 24.123 2 GHz	79.34 dBµV 98.95 dBµV	Q Factor			947	.0
194 2					Moscuring		2024-02-07
~					measuring		21:17:25
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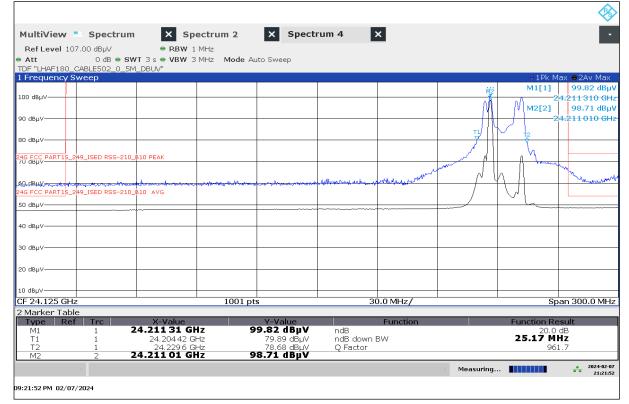
## Plot 2: 20dB bandwidth, Stop Mode (middle frequency)

MultiView	Spectrum	× Spect	rum 2 🗙	Spectr	'um 4	×			•
Ref Level 107	.00 dBµV	RBW 1 MH:	z		_	_			_
<ul> <li>Att</li> </ul>		/T 3 s 👄 VBW 3 MH:	z Mode Auto Sv	veep					
TDF "LHAF180_C		1_DBUV"							
1 Frequency Sv	veep							M1[1]	ах ●2Av Max 99.50 dBµV
100 dBµV						M2 M	1		4,184340 GHz
						l Mi M		M2[2]	98.30 dBµV
90 dBµV									4.168 460 GHz
							12		
80 dBµV						71	7		
24G FCC PART15_24 70 авµ∨	9 ISED RSS-210	B10 PEAK					M I		
70 dвµV					Multinet		handrender		
				an a statement office	abournant		and the second	and marken and	
50.dBuV			<u> <u> <u>an an a</u></u></u>	<del>oherdina, akaraha</del>	******				a, and a prophy in the state of the state
50 dBuV		pio Arg				$\bigvee$			
50 dBµv			·			-			
40 dBµV									
40 abp v									
30 dBµV									
So appr									
20 dBµV									
10 dBµV									
CF 24.125 GHz			1001 pts		30	).0 MHz/		Spa	an 300.0 MHz
2 Marker Table	;								
Type Ref	Trc	X-Value		Value		Function		Function Re	
M1		24.184 34 GHz		O dBµV	ndB			20.0 c 25.17 MH	
T1 T2	1	24.161 86 GHz 24.187 04 GHz		.07 dBµV .07 dBµV	ndB down I O Factor	BW		2 <b>3.17 M</b> 960	
M2	2 2	4.168 46 GHz		ΟdΒμV	Q. 4000				
	-						- Measuring		2024-02-07
									21:19:27
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### Plot 3: 20dB bandwidth, Stop Mode (high frequency)





## Frequency stability / tolerance:

Test condition Stop Mode (low frequency)	Frequency f∟ [GHz]	Frequency f <sub>⊦</sub> [GHz]	Bandwidth [MHz]	Carrier frequency* [GHz]	Frequency tolerance* [ppm]
-20 °C / V <sub>nom</sub>	24.100 120	24.124 100	24.0	-/-	-/-
-10 °C / V <sub>nom</sub>	24.104 620	24.130 390	25.8	-/-	-/-
0 °C / V <sub>nom</sub>	24.110 910	24.136 390	25.5	-/-	-/-
10 °C / V <sub>nom</sub>	24.113 910	24.139 390	25.5	-/-	-/-
20 °C / V <sub>nom</sub>	24.116 310	24.141 780	25.5	-/-	-/-
20 °C / V <sub>min</sub>	24.116 310	24.142 080	25.8	-/-	-/-
20 °C / V <sub>max</sub>	24.116 610	24.141 780	25.2	-/-	-/-
30 °C / V <sub>nom</sub>	24.116 610	24.142 380	25.8	-/-	-/-
40 °C / V <sub>nom</sub>	24.116 010	24.141 180	25.2	-/-	-/-
50 °C / V <sub>nom</sub>	24.113 610	24.138 490	24.9	-/-	-/-

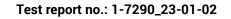
Bandwidth measurement for frequency stability tests: 20 dB bandwidth

Test condition Stop Mode (middle frequency)	Frequency f∟ [GHz]	Frequency f <sub>H</sub> [GHz]	Bandwidth [MHz]	Carrier frequency* [GHz]	Frequency tolerance* [ppm]
-20 °C / V <sub>nom</sub>	24.144 780	24.170 550	25.8	-/-	-/-
-10 °C / V <sub>nom</sub>	24.151 370	24.176 850	25.5	-/-	-/-
0 °C / V <sub>nom</sub>	24.156 770	24.182 540	25.8	-/-	-/-
10 °C / V <sub>nom</sub>	24.159 470	24.185 240	25.8	-/-	-/-
20 °C / V <sub>nom</sub>	24.161 860	24.187 040	25.2	-/-	-/-
20 °C / V <sub>min</sub>	24.161 860	24.187 040	25.2	-/-	-/-
20 °C / V <sub>max</sub>	24.161 560	24.186 740	25.2	-/-	-/-
30 °C / V <sub>nom</sub>	24.162 160	24.187 040	24.9	-/-	-/-
40 °C / V <sub>nom</sub>	24.160 660	24.185 540	24.9	-/-	-/-
50 °C / V <sub>nom</sub>	24.157 370	24.182 240	24.9	-/-	-/-

Test condition Stop Mode (high frequency)	Frequency f∟ [GHz]	Frequency f <sub>⊦</sub> [GHz]	Bandwidth [MHz]	Carrier frequency* [GHz]	Frequency tolerance* [ppm]
-20 °C / V <sub>nom</sub>	24.190 330	24.214 010	23.7	-/-	-/-
-10 °C / V <sub>nom</sub>	24.195 430	24.220 900	25.5	-/-	-/-
0 °C / V <sub>nom</sub>	24.200 220	24.225 700	25.5	-/-	-/-
10 °C / V <sub>nom</sub>	24.203 520	24.228 400	24.9	-/-	-/-
20 °C / V <sub>nom</sub>	24.204 420	24.229 600	25.2	-/-	-/-
20 °C / V <sub>min</sub>	24.204 720	24.229 600	24.9	-/-	-/-
20 °C / V <sub>max</sub>	24.204 420	24.229 600	25.2	-/-	-/-
30 °C / V <sub>nom</sub>	24.204 720	24.229 600	24.9	-/-	-/-
40 °C / V <sub>nom</sub>	24.202 920	24.227 200	24.3	-/-	-/-
50 °C / V <sub>nom</sub>	24.199 630	24.224 200	24.6	-/-	-/-

Note: \*only required for fixed point-to-point systems

## Verdict: Compliant



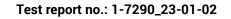


## Plot 4: 20dB bandwidth, Stop Mode (low frequency), -20 °C / Vnom

	· · ·
MultiView Spectrum X Spectrum 2 X Spectrum 4 X	•
Ref Level 107.00 dBµV • RBW 1 MHz	
● Att 0 dB ● SWT 3 s ● VBW 3 MHz Mode Auto Sweep	
TDF "LHAF180_CABLE502_0_5M_DBUV"	
MIT I	ax ●2Av Max 100.22 dBuV
	4,122,000 GHz
M2[2]	99.02 dBµV
90 dBµV	4.105 220 GHz
24G FCC PART15_249_ISED RSS-210_B10 PEAK	
	manner
50 dBuv	
40 dBuV-	
30 dBµV	
20 dBµV	
10 dBµV	
	an 300.0 MHz
2 Marker Table	
Type         Ref         Trc         X-Value         Y-Value         Function         Function Re           M1         1         24.122 GHz         100.22 dBµV         ndB         20.0	
T1 1 24.10012 GHz 80.04 dBµV ndB down BW 23.98 MI	Iz
T2         1         24.1241 GHz         80.76 dBµV         Q Factor         1006           M2         2         24.105 22 GHz         99.02 dBµV         1006         10	.1
	2024-02-07
Measuring	2024-02-07 20:59:39

## Plot 5: 20dB bandwidth, Stop Mode (low frequency), -10 °C / V<sub>nom</sub>

					Sector 1
MultiView 📑 Spectrum	× Spectrum 2	× Spectrur	n 4 🗙		•
Ref Level         107.00 dBμV           ● Att         0 dB ● SW           TDF "LHAF180_CABLE502_0_5M	● RBW 1 MHz T 3 s ● VBW 3 MHz Mode A _DBUV"	uto Sweep			_
1 Frequency Sweep					o1Pk Max ⊜2Av Max
100 dBµV		M2 M1			И1[1] 100.17 dBµV 24.128 000 GHz
90 dBµV		$\square$		N	и2[2] 98.97 dBµV —24.111 210 GHz
80 dBµV			2		
24G FCC PART15_249_ISED RSS-210_8	10 PEAK		Municipal		
160.dBµV	Anto AVG		What was a start w	have a series and the set of a series of the second	napala la conserve mare
50 dBµV			~		
40 dBµ∨					
30 dBµV					
20 dBµV					
10 dBµV					
CF 24.125 GHz	1001 pt	ts	30.0 MHz/	• •	Span 300.0 MHz
2 Marker Table					
Type Ref Trc M1 1	X-Value 24.128 GHz 1	Y-Value 00.17 dBµV	Function	Func	tion Result 20.0 dB
	24.10462 GHz	80.27 dBµV	ndB down BW	25.	.77 MHz
T2 1	24.13039 GHz	80.06 dBµV	Q Factor		936.1
M2 2 <b>2</b>	4.111 21 GHz	98.97 dBµV		- Measuring	2024-02-07
08:54:09 PM 02/07/2024					20:54:08



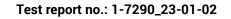


## Plot 6: 20dB bandwidth, Stop Mode (low frequency), 0 °C / V<sub>nom</sub>

		`						
1ultiView 📑 Spe	ctrum ×	Spectrum 2	× Spectru	um 4	×			
Ref Level 107.00 dBµ	V • BE	3W 1 MHz		-				
		3W 3 MHz Mode /	Auto Sweep					
DF "LHAF180_CABLE50			·					
Frequency Sweep								ax 🛛 2Av Ma
			Mž				M1[1]	100.13 dE
)0 dBµV			M	M			M2[2]	4.117510 ( 99.20 dE
) dBµV								1.117510 (
( dop v			11	~ 1			2	
) dвµV				¥				_
				h				
G FCC PART15_249_ISED P	RSS-210_810 PEAK		- mar -	A				
		allow	TNW		Market and			
G FCC PART15_249_ISED F	potentia manger Midhilan A	roberry and mary harder			hannahr	Mar a lagest grant of sample	and the second	<b>884</b> 00,460,000 - 14
G FCC PART15_249_ISED F	RSS-210_810 AVG			$\overline{\mathbf{A}}$				
) dBµV				- La				
) dBµV								
) dBµV								
dBuV								
павру								
) dBµV								
		1001 p	ots		30.0 MHz/		Spa	an 300.0 M
Marker Table		1001			/		opt	
Type Ref Trc		le	Y-Value		Function		Function Re	
M1 1	24.117 5		LOO.13 dBµV 80.05 dBµV	ndB ndB down	DW		20.0 c 25.47 MH	B
T1 1 T2 1	24.110 24.136		80.05 dBµV 80.57 dBµV	O Factor	DVV		2 <b>3.47</b> MF 946	
M2 2	24.117 5	1 GHz	99.20 dBµV					
						- Measuring		2024-0
								20:4

## Plot 7: 20dB bandwidth, Stop Mode (low frequency), 10 °C / V<sub>nom</sub>

MultiView 📑	Spectrum	× Spectrum 2	× Spectr	um 4	×			•
Ref Level 107.0	0 dBµV	• RBW 1 MHz			_			
🖷 Att		s ● VBW 3 MHz Mode	Auto Sweep					
TDF "LHAF180_CAE 1 Frequency Swe		V"					O 1 DL M	ax ⊜2Av Max
1 Frequency Swe	eh						M1[1]	100.06 dBµV
100 dBµV			M2					1.120 800 GHz
			- I (M I	[¥]			M2[2]	99.03 dBµV
90 dBµV							-24	4. <mark>120 500 GHz</mark>
			т1					
80 dBµ∨			<u> </u>					
24G FCC PART15_249_ 70 dBµV	ISED RSS-210_810 PE	AK		n V				
70 aBhA			in the second	- A harry	my .			
AD. dBy Ywmm		marchineses a level of a source	M NY	<u>)   </u>	Munner	Martiel Anne martie	NO	
24G FCC PART15_249_	ISED RSS-210_810 A	VG		ΥЛ				
50 dBµV								
40 dBμV								
30 dBµV								
20 dBµV								
10 dBµ∨								
CF 24,125 GHz		1001	nte	3(	0.0 MHz/		Sn	an 300.0 MHz
2 Marker Table		1001	pts	50	510 101127		30	an 500.0 Minz
Type Ref		<-Value	Y-Value		Function		Function Re	sult
M1			100.06 dBµV	ndB	D141		20.0 c 25.47 MH	
T1 T2		4.11391 GHz 4.13939 GHz	79.73 dBµV 80.16 dBµV	ndB down I O Factor	BW		2 <b>3.47 M</b> F 946	
M2	2 24.	120 5 GHz	99.03 dBµV					
~						- Measuring		2024-02-07
								21:09:20
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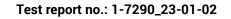


## Plot 8: 20dB bandwidth, Stop Mode (low frequency), 20 °C / V<sub>nom</sub>

					<
ultiView 📑 Spectr	rum 🗙 Spectru	m 2 🗙 Spe	ctrum 4 🗙		
Ref Level 107.00 dBµV	• RBW 1 MHz				
	SWT 3 s S VBW 3 MHz	Mode Auto Sweep			
F "LHAF180_CABLE502_C					
requency Sweep					⊙1Pk Max ⊖2Av M
0 dBuV			Ma		M1[1] 99.90 d
			M M		24.123200 M2[2] 98.95 d
i dBµV−−−−					24,123,200
app.		т1			
dBµV					
S FCC PART15_249_ISED RSS-	210_B10 PEAK	Mar Mar	f f man		
		W Martin		Nu i luur	
dBuV	me to marke marker and the source of the	www.well		Whot wash and ment	Marthal Martin and a second
3 FCC PART15_249_ISED RSS-	·210_810 AVG				
) dBµV					
I dBµV					
dB-11					
dBµV-					
і dBµV					
app v					
dBµV					
24.125 GHz		1001 pts	30.0 M	1Hz/	Span 300.0 M
Marker Table		· · · · · · · · · · · · · · · · · · ·		· · ·	
Type Ref Trc	X-Value	Y-Value		nction	Function Result
M1 1 T1 1	24.123 2 GHz 24.116 31 GHz	99.90 dBµ\ 80.00 dBu\			20.0 dB 25.47 MHz
T2 1	24.141 78 GHz	79.34 dBµ\	/ Q Factor		947.0
M2 2	24.123 2 GHz	98.95 dBµ\			

## Plot 9: 20dB bandwidth, Stop Mode (low frequency), 20 °C / V<sub>min</sub>

MultiView	Spectrum	× Spe	ectrum 2	× Spect	rum 4	×			•
Ref Level 107	7.00 dBµV	RBW 1	MHz		-	_			
<ul> <li>Att</li> </ul>		/T 3 s 👄 VBW 3	MHz Mode A	uto Sweep					
TDF "LHAF180_C 1 Frequency Sy		1_DBUV"							ax ⊜2Av Max
1 Frequency S	weep				1			M1[1]	ax ■2AV Max 99.94 dBuV
100 dBµ∨				M	2				4.122 900 GHz
				/ <u>(</u>	N (V)			M2[2]	98.90 dBµV
90 dBµV								2	4. <mark>123 200 GHz</mark>
				т1	∼ t²				
80 dBµ∨				1 71					
24G FCC PART15_2	49_ISED RSS-210_	810 PEAK		لم ممس	1 1				
70 авµv				and mind		n na suite			
6Q.dBuX		. un Breen Marca I	manya man	1 /	МП	Marine and	And many the second	a des an las soons	marker and a state of
24G FCC PART15_2	49_ISED RSS-210_	B10 AVG			$  \setminus    $		1000100000000000		
50 dBµV					$\downarrow$ $\downarrow$				
· · · · · · · · · · · · · · · · · · ·									
40 dBμV									
30 dBµV									
20 dBµV									
10 dBµV			1001 pt			30.0 MHz/			an 300.0 MHz
2 Marker Table			1001 p	13		50.0 Wil 127		эр	
Type Ref		X-Value		Y-Value		Function		Function Re	sult
M1	1	24.1229 GH		9.94 dBµV	ndB			20.0 25.77 MI	dB
T1 T2	1	24.116 31 GH 24.142 08 GH		79.70 dBµV 80.86 dBµV	ndB down Q Factor	BW		2 <b>5.77</b> Mi	
M2	2	24.123 2 GH	z 9	98.90 dBµV	्रावस्ता			500	
							- Measuring		2024-02-07
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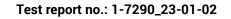


## Plot 10: 20dB bandwidth, Stop Mode (low frequency), 20 °C / V<sub>max</sub>

		<u> </u>						
								<
ultiView 🎫 S	Spectrum	× Spectrum 2	× Spect	rum 4	×			
Ref Level 107.00	dBuV	• RBW 1 MHz			_			
		VBW 3 MHz Mod	e Auto Sweep					
F "LHAF180_CABL	E502_0_5M_DBUV							
requency Swee	p							ix ⊜2Av Ma
io dBµV			N.	2			M1[1]	99.84 dE
o uspv			N	I M			Z4 M2[2]	. 123 200 ( 98.83 dE
I dBµ∨								123 200 (
app.							_	
и dBµV			7	~ ¥				
				I W				
GECC PART15_249_IS	ED RSS-210_810 PEA	K		1 A m	-			
			man N		and have been an			
dBWMmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	american the same	outer to war on the registry when	M	<u> </u>	Why days of	www.washaranahara	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	han an a
<u>G FCC PART1</u> 5_249_IS	ED RSS-210_810 AV	G						
) dBµV								
і dBµV								
I dBµ∨								
) dBµV								
appv								
dBµV								
24.125 GHz		100	1 pts	30	0.0 MHz/		Spa	in 300.0 M
Marker Table								
Type Ref T	Frc X-	-Value	Y-Value		Function		Function Res	
M1 T1		23 2 GHz 116 61 GHz	<b>99.84 dBμV</b> 79.56 dBμV	ndB ndB down l	DIA		20.0 c 25.17 MH	B
T2	1 24.	141 78 GHz	80.14 dBµV	Q Factor	DAA		2 <b>5.17 M</b> 958	
		23 2 GHz	98.83 dBµV					
						- Measuring		2024-0

## Plot 11: 20dB bandwidth, Stop Mode (low frequency), 30 $^\circ\text{C}$ / $V_{\text{nom}}$

									- 📀
MultiView	Spectrum	× Spe	ctrum 2	× Spect	rum 4	×			•
Ref Level 107.	.00 dBµV	RBW 1	ИНz			_			
Att		VT 3 s 👄 VBW 3 N	HZ Mode Au	uto Sweep					
TDF "LHAF180_C/ 1 Frequency Sw		I_DBUV"						o 1 Pk Ma	ax ⊜2Av Max
				M				M1[1]	99.83 dBµV
100 dBµV									4. 123 800 GHz
				1 19				M2[2]	98.82 dBµV
90 dBµ∨								24	4.123 800 GHz
80 dBµV				댗	V t₂				
24G FCC PART15_24	9_ISED RSS-210_	B10 PEAK		P	l A <sup>∨</sup> h	w			
			and a second	A man		and the second second			
60. dBµX	www.whawvollite	the state of the s	where the second for the second			" the water	manda de more	en and and	nor and the sea war
	9_ISED RSS-210_	B10 AVG							
50 dBµV									
40 dBµV									
30 dBµV									
20 dBµV									
10 dBµV СF 24.125 GHz			1001 pt		3	0.0 MHz/		Sn	an 300.0 MHz
2 Marker Table			1001 pt	.a	3	010 101127		эра	
Type Ref	Trc	X-Value		Y-Value		Function		Function Re	
M1 T1	1	24.1238 GH: 24.11661 GH		9.83 dBµV 79.95 dBµV	ndB ndB down	D)A/		20.0 c 25.77 MH	
T2	1	24.14238 GH	Z	79.39 dBµV	Q Factor	DAA		2 <b>3.77</b> PFF 936	
M2	2	24.1238 GH	z 9	8.82 dBµV	-				
							- Measuring		2024-02-07 21:27:54
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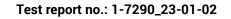


## Plot 12: 20dB bandwidth, Stop Mode (low frequency), 40 °C / Vnom

			•				
ultiView 📑 Spec	trum × Spec	trum 2 🗙	Spectrum 4	×			
Ref Level 107.00 dBµ\	/ ● <b>RBW</b> 1 MH	-17					
	s ● SWT 3 s ● VBW 3 MH		reep				
F "LHAF180_CABLE502							
Frequency Sweep						⊙1Pk Ma>	1
			Mź			M1[1]	99.58 di
O dBµV			ΛΛ <u>Λ</u> Λ				123 200
dB-44			J 4 1 1 4 1			M2[2]	98.65 d 1 <del>22 900 (</del>
dBµV						24.	122 900 1
dBµV			V \V \V				
FCC PART15_249_ISED R	SS-210_810 PEAK						
		and marked		- marken			
dBetVe	and a far the second	Mappedersteller		mumphan	monthly marken and	anno marchano alle	فسلمسبوهم
GRUY	SS-210_810 AVG						
i dBµV−−−−−			``L				
			-				
dBµV							
dBµ∨							
dBµV							
dBµV						_	
24.125 GHz		1001 pts		30.0 MHz/		Spai	א 300.0 M
Marker Table	X-Value		/alue	Function		Function Res	.14
Type Ref Trc M1 1	24.123 2 GHz		dBμV ndB	Function		20.0 df	
T1 1	24.116.01 GHz	78.	97 dBµV ndB d	own BW		25.17 MH	Z
T2 1	24.141 18 GHz 24.122 9 GHz		60 dBµV — Q Fac	tor		958.1	2
M2 2	24.122 9 682		5 dBµV				. 2024-0

## Plot 13: 20dB bandwidth, Stop Mode (low frequency), 50 °C / V<sub>nom</sub>

								Solution
MultiView = S	Spectrum ×	Spectrum 2	× Spectr	um 4	×			•
Ref Level 107.00	dBµV • RI	3W 1 MHz			_			_
	0 dB 🖷 SWT 3 s 🖷 VB	3W 3 MHz Mode A	Auto Sweep					
TDF "LHAF180_CABL 1 Frequency Swee							O LDK M	ax 😑 2Av Max
I frequency swee	ч: -			M1			M1[1]	99.12 dBµV
100 dBµ∨			M2	M1				4.136 090 GHz
				N			M2[2]	98.00 dBµV
90 dBµV							2	4. <mark>120 500 GHz</mark>
				~ 12				
80 dBµ∨			7 11	Ť.,				
24G FCC PART15_249_IS	SED RSS-210_810 PEAK		A A	- M				
70 abpv		~	Jum JU	1 men	m.			
60udBuV	where we are a second and the second	man and the market war	<u> </u>	\_{}	Markey Markey Markey	many marker	ب کانسردانی جانب مارد کار	marian
60000000000000000000000000000000000000	SED RSS-210_810 AVG			M				
50 dBµ∨								
40 dBµ∨								
30 dBµV								
20 dBµV								
10 dBµV								
CF 24.125 GHz		1001 p	ts	30	0.0 MHz/		Sp	an 300.0 MHz
2 Marker Table								
Type Ref 1 M1	Trc X-Valu 1 <b>24.1360</b>		Y-Value 99.12 dBμV	ndB	Function		Function Re 20.0	
T1	1 24.113	61 GHz	79.14 dBµV	ndB down	BW		24.88 MI	Hz
T2 M2	1 24.138 2 24.120		79.34 dBµV 98.00 dBµV	Q Factor			970	).3
	2 24.120	5 6112	55.50 abµ <b>v</b>					. 2024-02-07
~						<ul> <li>Measuring</li> </ul>		2024-02-07 21:46:19
09:46:19 PM 02/07/2024	ł							



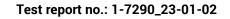


## Plot 14: 20dB bandwidth, Stop Mode (middle frequency), -20 °C / V<sub>nom</sub>

ultiView 🎫 Spectrum	× Spectrum 2	× Spectru	ım 4 🔉	٢			
RefLevel 107.00 dBµV	<ul> <li>RBW 1 MHz</li> </ul>						
	3s ● VBW 3MHz Mode	Auto Sweep					
F "LHAF180_CABLE502_0_5M_ Frequency Sweep	DBUV"					o t Dk Ms	ax ⊜2Av Ma>
requercy sweep			141			M1[1]	100.03 dB
) dBµV			Mż	.0			1.151670 GI
			(A)	$\{ \}$		M2[2]	98.96 dB
dBµV							I. 151 670 GI
			т1// М				
dBµ∨			<del>7√</del> {{	*			
				, X			
FCC PART15_249_ISED RSS-210_8	IO PEAK		www.		and		
		the way was a second		$\wedge$ $\Pi$	Margare at all	ma	
dBut not start and start a	and a superior of the second	and how have the	/ ľ	<u>\</u>	See Aurel - Marrie	" Whenderhand an ideal of	sale and and a
	IU AVG			$\nabla$			
dBµV							
dBµV							
ushv							
dBµV							
35 <u>5</u> 7							
dBµV							
dBµV							
24.125 GHz	1001	ots	30	.0 MHz/		Spa	an 300.0 MH
Aarker Table							
Type Ref Trc	X-Value	Y-Value		Function		Function Re	
M1 1 24 T1 1	1.151 67 GHz : 24.144 78 GHz	LOO.O3 dBµV 79.82 dBuV	ndB ndB down E	na/		20.0 c 25.77 MH	1B   7
T2 1	24.170 55 GHz	80.41 dBuV	Q Factor			937	
M2 2 24	4.15167 GHz	98.96 dBµV	-				
					Moasuring		2024-02-

## Plot 15: 20dB bandwidth, Stop Mode (middle frequency), -10 °C / V<sub>nom</sub>

MultiView 📑 Spectru	m × Spectrum 2	2 × Spectr	rum 4 🗙		
Ref Level 107.00 dBμV           ● Att         0 dB ● \$           TDF "LHAF180_CABLE502_0	● RBW 1 MHz SWT 3 s ● VBW 3 MHz Mo 5M_DBUV"	de Auto Sweep			
1 Frequency Sweep					●1Pk Max ●2Av Max
100 dBµV			Má		M1[1] 99.91 dBμV 24.158 270 GHz
90 dBµ∀			<u>M</u>		M2[2] 98.96 dBµV
80 dBµV	10 810 PEAK		M		
70 dBµV				and a survey	
50. dBµX	۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ ۱۵ ۹۱۵ - ۸۷۵	us som har Mallon as a super with		Manager Warth	Marcane and a day have made
50 dBµV					
40 dBμV					
30 dBµV					
20 dBµV					
10 dBµV					
CF 24.125 GHz	10	01 pts	30.0 MHz/		Span 300.0 MHz
2 Marker Table Type Ref Trc	X-Value	Y-Value	Function		nction Result
M1 1 T1 1	24.158 27 GHz 24.151 37 GHz	99.91 dBµV 80.05 dBµV	ndB ndB down BW		20.0 dB 5.47 MHz
T2 1 M2 2	24.176 85 GHz 24.176 85 GHz 24.158 27 GHz	80.33 dBµV 98.96 dBµV	Q Factor		948.3
				- Measuring	2024-02-07 20:53:17
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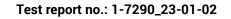


## Plot 16: 20dB bandwidth, Stop Mode (middle frequency), 0 °C / Vnom

ltiView 📑 Spectri	um 🗙 Spectru	m 2 X Spec	trum 4 🗙		
		in 2 Spec			
e <b>fLevel</b> 107.00 dBµV t 0 dB ●	<ul> <li>RBW 1 MHz</li> <li>SWT 3 s</li> <li>VBW 3 MHz</li> </ul>	Mode Auto Sween			
"LHAF180_CABLE502_0		Mode Auto Sweep			
equency Sweep					O1Pk Max ●2Av N
			M2 M2	1	M1[1] 99.85
lBµV			An fin		24.179.850 M2[2] 98.75
βµV					M2[2] 98.75
чч-					24.103.300
ωv			1	†2	
			X	1	
CC PART15_249_ISED RSS-2	210_810 PEAK			- Comment	
			I month of the P		
WM man man when the work	www.www.www.	programmer the the shall be a second of the		Mar after Mars	Maria Maria
CC PART15_249_ISED RSS-2	210_810 AVG				
3µ∨				۷ <b>۲</b>	
3μV					
βμ∨					
hhA					
4.125 GHz		1001 pts	30.0 MHz/		Span 300.0
arker Table		1001 pt3	5010 101127		opun boolo
pe Ref Trc	X-Value	Y-Value	Function	Fun	ction Result
11 1	24.179 85 GHz	99.85 dBµV	ndB	~ 7	20.0 dB
1 1 2 1	24.156 77 GHz 24.182 54 GHz	79.56 dBµV 79.22 dBµV	ndB down BW O Factor	25	5.77 MHz 938.1
12 2	24.163 36 GHz	98.75 dBµV			555.1
				- Measuring	2024

## Plot 17: 20dB bandwidth, Stop Mode (middle frequency), 10 $^\circ\text{C}$ / $V_{\text{nom}}$

							<ul> <li>Image: A start of the start of</li></ul>
MultiView	Spectrum	× Spectru	m 2 × Spect	rum 4 🗙			•
Ref Level 107	.00 dBµV	RBW 1 MHz					
🖷 Att		T3s 👄 VBW 3 MHz	Mode Auto Sweep				
TDF "LHAF180_C		_DBUV"					
1 Frequency Sv	veep					0 1 PK Ma M1[1]	ax ●2Av Max 99.85 dBuV
100 dBµV				M2 M	1		1.182 540 GHz
				N M 1		M2[2]	98.70 dBµV
90 dBµV							1.166 660 GHz
					T2		
80 dBµV				· · · · · · · · · · · · · · · · · · ·	1		
24C ECC PART15 24					М		
24G FCC PART15_24 70 авµ∨	P_1320 K33 210_0	10 PEAK			han police and		
			a dember of the serve week thank on a	MAN NA		non many me	an contribution on
24G FCC PART15 24	which have all	and a second	<u></u>		1	ADMARK POINT	kie a Costa Children an
· · · · · · · · · · · · · · · · · · ·	12ED K22-510 <sup>E</sup>	DID AVG			1		
50 dBµV							
40 dBµV							
40 UBHV							
30 dBµV							
56 dbp (							
20 dBµV							
co appr							
10 dBµV							
CF 24.125 GHz			1001 pts	30.0 MHz/		Spa	an 300.0 MHz
2 Marker Table	;			· · · ·			
Type Ref	Trc	X-Value	Y-Value	Function		Function Res	sult
M1 T1	1 2	4.182 54 GHz 24.159 47 GHz	99.85 dBμV 78.65 dBμV	ndB ndB down BW		20.0 c 25.77 MH	iB I 7
T2	1	24.13947 GHz 24.18524 GHz	79.86 dBuV	Q Factor		938	
M2	2 2	4.166 66 GHz	98.70 dBµV				
					- Measuring		2024-02-07
					_		21:10:58
09:10:58 PM 02/07/:	2024						



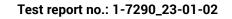


## Plot 18: 20dB bandwidth, Stop Mode (middle frequency), 20 °C / V<sub>nom</sub>

ultiView 🎫 Spec	trum 🗙 Spectru	ım 2 🗙 Spect	rum 4 🗙			
. <b>ef Level</b> 107.00 dBµ∿	• RBW 1 MHz		_			
	● SWT 3 s ● VBW 3 MHz	Mode Auto Sweep				
"LHAF180_CABLE502 equency Sweep	_U_SM_DBUV"				o 1 Pk Max (	2Av M
			M2	M1	M1[1] 9	9.50
звил Лан			0.0	A.		34340
						98.30
ЗµV					24.16	8 460
3µV				12		
				L.		
CC PART15_249_ISED R	S-210_810 PEAK			1 m		
			mmm			
W Xoon management	month and the second second	Maring marine way and a second a	V V	The way	muntheman	
CC PART15_249_ISED R	S-210_810 AVG			/1) I		
ЗµV				1		
ВµV						
ЗµV						
3µV						
лчч-						
3µV						
4.125 GHz		1001 pts	30.0 MHz/		Span 3	300.0
arker Table						
/pe Ref Trc	X-Value	Y-Value	Function		Function Result	
/1 1 <sup>-</sup> 1 1	24.184 34 GHz 24.161 86 GHz	99.50 dBμV 79.07 dBμV	ndB ndB down BW		20.0 dB 25.17 MHz	
		79.07 dBµV	O Factor		960.7	
- <u>2</u> <u>1</u> 12 <u>2</u>	24.187 04 GHz 24.168 46 GHz	98.30 dBµV				

## Plot 19: 20dB bandwidth, Stop Mode (middle frequency), 20 °C / V<sub>min</sub>

MultiView	Spectrum	× Spe	ectrum 2	× Spect	rum 4	×			•
Ref Level 107.	00 dBµV	RBW 1	MHz		_	_			_
🖷 Att		7T3s <b>● VBW</b> 3	MHz Mode A	Auto Sweep					
TDF "LHAF180_CA		_DBUV"							
1 Frequency Sw	reep							• IPK M M1[1]	ax ●2Av Max 99.47 dBµV
100 dBµV						M2 M	1		4,184640 GHz
						I M M		M2[2]	98.45 dBµV
90 dBµV								2	4.168 760 GHz
						т1	T2		
80 dBµV						+ <del>7   </del>	X		
24G FCC PART15_249 70 dBµV	9 ISED RSS-210 F	810 PEAK					M		
70 dBµV					and and a second second		have an		
60:d0:02				hallow the same the	and the second second		The state	manufare port	a and a blook the way
24G FCC PART15_249	9 ISED RSS-210 E	B10 AVG	Chi Carros da A						
50 dBuV							1		
						1			
40 dBµV									
30 dBµV									
20 dBµV									
10 dBµV СF 24,125 GHz			1001 p	to	2	0.0 MHz/		6.5	an 300.0 MHz
2 Marker Table			1001 p	ls	ان			sh	
Type Ref	Trc	X-Value		Y-Value		Function		Function Re	sult
M1	1 2	4.184 64 GH		99.47 dBµV	ndB			20.0	dB
T1 T2	1	24.161 86 GH 24.187 04 GH		79.72 dBµV 80.47 dBµV	ndB down O Factor	BW		25.17 MI 960	
M2	2 2	4.168 76 GH	Z	98.45 dBµV					
-	~						Measuring		2024-02-07
							j.		21:20:17
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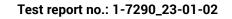


## Plot 20: 20dB bandwidth, Stop Mode (middle frequency), 20 $^\circ\text{C}$ / $V_{\text{max}}$

ultiView 🎫 Spec	trum 🗙 Spectru	ım 2 X Spec	trum 4 🛛 🗙		
<b>ef Level</b> 107.00 dBµV	• RBW 1 MHz				
.tt 0 dB = "LHAF180_CABLE502_	● SWT 3 s ● VBW 3 MHz	Mode Auto Sweep			
equency Sweep	_0_3M_0000				⊙1Pk Max ⊜2Av M
				M2 M1	M1[1] 99.49
звил				A A	24.184340
				A (M	M2[2] 98.39 24.168.460
3µ∨			т		
3µ∨			7	ľ.	
CC PART15_249_ISED RS	S-210_810 PEAK		P P	N N	
		. under a work	N manufacture N		mune energiante an a second
CC PART15 249 ISED RS		where and the second show the second shows the second second second second second second second second second s	harmed (	<u> </u>	have been and the second of the second secon
	5-210_810 AVG				
ЗμV					
3µV					
3µV					
3µV					
Vul					
4.125 GHz		1001 pts	30.0 MH	lz/	Span 300.0
arker Table					
/pe Ref Trc	X-Value 24.184 34 GHz	Y-Value 99.49 dBμV	Func	tion	Function Result 20.0 dB
1 1	24.161 56 GHz	79.19 dBµV			25.17 MHz
2 1	24.18674 GHz 24.168 46 GHz	80.13 dBµV 98.39 dBµV	Q Factor		960.7
12 2					

## Plot 21: 20dB bandwidth, Stop Mode (middle frequency), 30 $^\circ\text{C}$ / $V_{\text{nom}}$

									<ul> <li>Image: A start of the start of</li></ul>
MultiView	Spectrum	× Spec	trum 2	× Spect	rum 4	×			•
Ref Level 107	.00 dBµV	RBW 1 MI	Hz			_			_
🖷 Att		VT 3 s <b>⊖ VBW</b> 3 MH	Hz Mode Au	ito Sweep					
TDF "LHAF180_C		1_DBUV"						O 1 DL M	
1 Frequency Sv	weep							M1[1]	ax ●2Av Max 99.32 dBµV
100 dBµV						M2 M	1		4,184340 GHz
						I AA A		M2[2]	98.25 dBµV
90 dBµV									4.168 760 GHz
80 dBµV						₹    <sup>*</sup>	ŧ.		
240 500 242715		010 DE 4K					И		
24G FCC PART15_24 70 авµу	H9_15ED R55-210_	BIU PEAK					howard		
					and the second states of the		- Marine	mar warmen and	
6Q.dβyV <del>∽~~~</del>	- hard a state of the state of	months the man	www.wayanayaaanayaaanayaa	any warden and and and and	wert	+	1	What have a way and the second	and a second
24G FCC PART15_24	HaTIRED KRR-510	B10 AVG							
50 dBµ∨			···· ·				1-m		
40 dBµV									
30 dвµV									
30 UBHV									
20 dBµV									
20 0001									
10 dBµV									
CF 24.125 GHz			1001 pt	S	3	0.0 MHz/		Sp	an 300.0 MHz
2 Marker Table	2							· · · · ·	
Type Ref		X-Value		Y-Value		Function		Function Re	
M1 T1	1 2	24.184 34 GHz 24.16216 GHz		9.32 dBµV 78.97 dBµV	ndB ndB down	DW		20.0 24.88 MH	
	ī	24.18704 GHz		79.33 dBµV	O Factor	DVV		2 <b>4.00</b> FT	
M2	2 2	24.168 76 GHz	9	8.25 dBµV					
							- Measuring		2024-02-07
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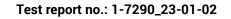


## Plot 22: 20dB bandwidth, Stop Mode (middle frequency), 40 °C / V<sub>nom</sub>

ltiView 📑 Specti		m 2 × Spec	trum 4 🗙		
f <b>Level</b> 107.00 dBµV t 0 dB €	<ul> <li>RBW 1 MHz</li> <li>SWT 3 s</li> <li>VBW 3 MHz</li> </ul>	Mada Auto Curran			
LHAF180_CABLE502_0		Mode Auto Sweep			
equency Sweep					⊖1Pk Max ⊖2Av I
10.11			M2	м1	M2[2] 98.03
івµ∨			Δ.	δÅ	24.167.560
			1 191 1		M1[1] 99.08 24.182.840
3µV				T2	24.102 840
βμν				Î.	
CC PART15_249_ISED RSS	-210 B10 PEAK			. M	
чиv			- when the second	A man	
			from the	11 manual	When all man and and and and and and and and and a
CC PART15 249 ISED RSS		alan da an		11	The state of the second second
	-210_B10 AVG			N	
<u>вн∧</u>			+		
3uV					
мч.					
3μV					
* 4					
3µV					
·P ·					
чиV————————————————————————————————————					
4.125 GHz		1001 pts	30.0 MHz/		Span 300.0
arker Table					
/pe Ref Trc	X-Value	Y-Value	Function		Function Result
11 1	24.18284 GHz	99.08 dBµV	ndB ndB down BW		20.0 dB 24.88 MHz
1 1 2 1	24.16066 GHz 24.18554 GHz	79.33 dBµV 78.88 dBµV	O Factor		24.00 PINZ 972.2
	24.167 56 GHz	98.03 dBµV	- · · · · · · · · · · · · · · · · · · ·		

## Plot 23: 20dB bandwidth, Stop Mode (middle frequency), 50 $^\circ\text{C}$ / $V_{\text{nom}}$

							<ul> <li>Image: A start of the start of</li></ul>
MultiView	Spectrum	× Spectrum	12 X Spect	rum 4 🗙			•
Ref Level 107	.00 dBµV	• RBW 1 MHz					_
🖷 Att		T3s <b>⊜VBW</b> 3MHz I	Mode Auto Sweep				
TDF "LHAF180_C		_DBUV"				o t Dh Mar	x ⊜2Av Max
1 Frequency Sv	weep					M1[1]	x ● 2AV Max 98.81 dBµV
100 dBµV				Mįž			,164260 GHz
						M2[2]	97.80 dBµV
90 dBµV							.164 560 GHz
				L/1N/2-1			
80 dвµV							
				/	Lh I		
24G FCC PART15_24 70 dBµV	19_ISED RSS-210_8	10 PEAK			man		
			man - manufacture and and and	manuff of the fill	and the second s	whether when when when when when when when when	
6Q. dBNY	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	and the how the second s	man when and a second s		- myour	mann and	and the state of the second second
24G FCC PART15_24	H9_ISED RSS-210_8	10 AVG					
50 dBµV					-		
40 dBµV							
30 dBµV							
20 dBµV							
10 dBµV							
CF 24,125 GHz			1001 pts	30.0 MHz/		- Ena	n 300.0 MHz
2 Marker Table			1001 pts	30.0 MH27		эра	11 300 10 MHZ
Type Ref		X-Value	Y-Value	Function		Function Res	ult
M1	1 24	4.164 26 GHz	98.81 dBµV	ndB		20.0 d	В
T1 T2	1	24.15737 GHz 24.18224 GHz	78.55 dBµV 78.96 dBµV	ndB down BW O Factor		24.88 MH: 971.	
M2	2 24	4.18224 GHz	97.80 dBµV	ų Factor		971.	4
<u> </u>							2024-02-07
					<ul> <li>Measuring</li> </ul>		21:48:06
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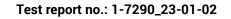


# Plot 24: 20dB bandwidth, Stop Mode (high frequency), -20 °C / Vnom

iView 📑 Spectru	m 🗙 Spectrun	12 X Spectr	rum 4 🗙		
Level 107.00 dBµV	• RBW 1 MHz				
0 dB 👄 😫	SWT3s 🗢 VBW 3 MHz 1	Mode Auto Sweep			
HAF180_CABLE502_0_	5M_DBUV"				
quency Sweep				MO M1	o1Pk Max ●2Av
υv				M2 T	M1[1] 100.57 24,21161
				I M M	M2[2] 99.19
v					24.195.43
v					
				K II . M	
PART15_249_ISED RSS-21	IU_BIU PEAK		Northernord New York		man and a second
			a sub-		Muney warments
Hoter warmen warmen warden	and a construction of the second	and the state of the second	White and the state of the stat		Mar Marine Marin
C PART15_249_ISED RSS-21	10_810 AVG			$V = \nabla V$	
V				1 1~	
V					
v					
v					
v					
v					
.125 GHz		1001 pts	30.0 MHz/		Span 300.
ker Table					
e Ref Trc	X-Value	Y-Value	Function	Fu	Inction Result
. 1	24.211 61 GHz 24.190 33 GHz	<b>100.57 dBμV</b> 80.64 dBμV	ndB ndB down BW	-	20.0 dB 3.68 MHz
1	24.21401 GHz	80.39 dBuV	Q Factor		1 022.6
2	24.19543 GHz	99.19 dBµV	<u> </u>		

# Plot 25: 20dB bandwidth, Stop Mode (high frequency), -10 °C / V<sub>nom</sub>

									Solution
MultiView	Spectrun	n X Spec	trum 2	× Spectr	um 4	×			
RefLevel	107.00 dBµV	■ RBW 1 MH	Ηz		_	_			_
<ul> <li>Att</li> </ul>		WT3s 👄 VBW 3 MH	Hz Mode Au	to Sweep					
	0_CABLE502_0_5	M_DBUV"						O I DL M	
1 Frequency	/ Sweep							M1 M1[1]	lax ● 2Av Max 100.39 dBuV
100 dBµV							M2		4.218 210 GHz
							I M I	M2[2]	99.17 dBµV
90 dBµV									4.202 320 GHz
								T2	
80 dBµ∨							7	<u> </u>	
24G FCC PART1	5_249_ISED RSS-210	810 PEAK						A M	
170 dBµV		-						11 month	
eo douvo					monal management	What we wanted		11	manummers
24G FCC PART15	5_249_ISED RSS-210	_810 AVG		1000 Mar 400 CD - 00 CD				Л	
50 dBµV									
·····									
40 dBµ∨									
30 dBµ∨									
20 dBµV									
10 dBµV									
CF 24.125 G	H7		1001 pts		3(	0.0 MHz/		Sr	an 300.0 MHz
2 Marker Ta			1001 pt	•		510 1011 127		0	
Type R	tef Trc	X-Value		Y-Value		Function		Function Re	esult
M1 T1		24.218 21 GHz 24.195 43 GHz	10	0.39 dBµV	ndB ndB down I	D14/		20.0 25.47 M	
	1	24.19543 GHZ 24.2209 GHz		80.17 dBµV 80.19 dBµV	Q Factor	BW		2 <b>3.47 M</b> 95	
M2	2	24.202 32 GHz	9	9.17 dBµV					
							- Measuring		2024-02-07
									20.32119
08:52:20 PM 02/	07/2024								



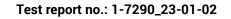


# Plot 26: 20dB bandwidth, Stop Mode (high frequency), 0 °C / V<sub>nom</sub>

b) (income and a company			Chastrum 4				
tiView 📩 Spectr		ım 2 ×	Spectrum 4	×			
Level 107.00 dBµV	<ul> <li>RBW 1 MHz</li> </ul>						
0 dB ● LHAF180_CABLE502_C	SWT 3 s = VBW 3 MHz	Mode Auto Swee	:P				
quency Sweep						O1Pk M	ax ⊜2Av
					M2	M1 M1[1]	100.36
ынл.						2	4.223 00
					1 1/1 1	M2[2]	99.21
IV				-		<del>}   2</del>	4. <mark>206 82</mark> 0
						12	
v					7		
C PART15 249 ISED RSS-	210 B10 PEAK					a W	
v						A many	
				and the second		- 11	Whynadial
C PART15 249 ISED RSS-				and the second and			" Shadaad
	210_810 AVG					$\checkmark$	
IV							
IV							
IV							
14							
IV							
Ŷ							
IV							
.125 GHz		1001 pts		30.0 MHz/		Sr	an 300.0
ker Table							
be Ref Trc	X-Value	Y-Va		Function		Function Re	
1 1	24.223 GHz	100.36		DIAL		20.0	dB
L 1 2 1	24.200 22 GHz 24.225 7 GHz		9 dBµV ndB dowi 1 dBuV O Factor	ηΒ₩		25.47 M 95	
2 2	24.206 82 GHz	99.21					
					- Measuring		202
							** 2

# Plot 27: 20dB bandwidth, Stop Mode (high frequency), 10 $^\circ\text{C}$ / $V_{\text{nom}}$

MultiView	Spectrum	× Spe	ctrum 2	× Spectr	um 4	×			-
Ref Level 107	.00 dBµV	- RBW 1 M	1Hz		_	_			
<ul> <li>Att</li> </ul>		T3s 🗢 VBW 3 M	1Hz Mode A	uto Sweep					
TDF "LHAF180_C 1 Frequency Sv		_DBUV"						o 1 Pk M	∕lax ⊜2Av Max
	1000						M2	M1 M1[1]	100.11 dBµV
100 dBµV								- 1 - 2	4.226 000 GHz
							I // I	M2[2]	98.98 dBµV
90 dBµV								7 2	24.209 820 GHz
80 dBµV							말()	✓ <sup>†</sup> <sub>2</sub>	
								J.	
24G FCC PART15_24 70 авµV	9_ISED RSS-210_	B10 PEAK					- I have the	A	
						wen		. // ~~	Mr.
60.dBuX	and the second second	www.www.www.www.	Mar Mar and show	www.www.www.www.www.www.www.www.www.ww	wanadaadtaalkeennadyn	All more really and		\  }	Walnut willing
24G FCC PART15_24	9_ISED RSS-210_	810 AVG						$\nabla$	
50 dBµV									
40 dBμV									
40 dBpv									
30 dBµV									
20 dBµV									
10 dBµ∨									+
CF 24.125 GHz 2 Marker Table			1001 p	is	30	0.0 MHz/		Sp	ban 300.0 MHz
Z Marker Table	Trc	X-Value		Y-Value		Function		Function Re	esult
M1	1	24.226 GHz		00.11 dBµV	ndB			20.0	dB
T1 T2	1	24.203 52 GH: 24.228 4 GH:		79.88 dBµV 79.41 dBµV	ndB down I O Factor	ЗW		24.88 M	HZ '3.9
M2	2 2	4.209 82 GHz	<u> </u>	98.98 dBµV				37	3.2
	~						- Measuring		2024-02-07
									21:12:32
09:12:32 PM 02/07/:	2024								



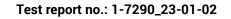


# Plot 28: 20dB bandwidth, Stop Mode (high frequency), 20 °C / Vnom

								~
MultiView 📑 Spe	ctrum 🗙 s	pectrum 2	× Spectr	um 4	×			-
Ref Level 107.00 dBµ\	/ • RBW	1 MHz						
	3 🖷 SWT 3 s 🖷 VBW	3 MHz Mode A	uto Sweep					
IDF "LHAF180_CABLE502 I Frequency Sweep	2_0_5M_DBUV"						0.101-1	1ax ⊜2Av Max
requency sweep							M1[1]	99.82 dBu
LOO dBµV						Mž		4.211310 GH
						M.	М <u>м2[2]</u>	98.71 dBµ
90 dBµV								4.211010 GH
30 dBµV							la	
4G FCC PART15_249_ISED R	SS-210_810 PEAK					- P	A hours	
					ame			Marken .
50. dBµX	-much much m	www.www.www.www.www.www.	and the way	الميطعصص محمله المراجع	- marter dand as more	/* V	$\gamma \mu$	Mushermer
4G FCC PART15_249_ISED R	SS-210_810 AVG					/	$\nabla$	
50 dBµV								
40 dBμV								
30 dBµV								
20 dBµV								
20 0000								
ιο dBμV								
CF 24.125 GHz		1001 p	ts		30.0 MHz/		Sc	) an 300.0 MH:
2 Marker Table							r	
Type Ref Trc	X-Value		Y-Value		Function		Function Re	
M1 1 T1 1	24.211 31 24.204 42		<b>9.82 dBµV</b> 79.89 dBuV	ndB ndB dowr	D RIAI		20.0 25.17 M	dB H7
T2 1	24.2296	GHz	78.68 dBuV	Q Factor				1.7
M2 2	24.211 01	GHz 9	98.71 dBµV	<u> </u>				
						- Measuring		2024-02-0
								2112113

# Plot 29: 20dB bandwidth, Stop Mode (high frequency), 20 $^\circ\text{C}$ / $V_{min}$

					Solution
MultiView 📑 Spectru	m × Spectrum	2 × Spectr	um 4 🗙		•
● Att 0 dB ● 9	● RBW 1 MHz SWT 3 s ● VBW 3 MHz Mo	ode Auto Sweep			_
TDF "LHAF180_CABLE502_0_5	5M_DBUV"				⊙1Pk Max ⊜2Av Max
1 Frequency Sweep					M1[1] 99.86 dBµV
100 dBµV					24:226 600 GHz M2[2] 98.80 dBµV
90 dBµ∨				+	24.211.010 GHz
80 dBµV				<u> </u>	2
24G FCC PART15_249_ISED RSS-21	0_810 PEAK			A A	Norman Marine Ma
60.dBHX	0 B10 AVG	ry. All had a state and a state of the state	and the second second second second second		Man den vie
50 dBµV					~~~~~
40 dBμV					
30 dBµV					
20 dBµ∨					
10 dBµV					
CF 24.125 GHz	10	01 pts	30.0 MHz/		Span 300.0 MHz
2 Marker Table					
Type Ref Trc	X-Value	Y-Value	Function	Fun	ction Result
M1 1 T1 1	24.226 6 GHz 24.20472 GHz	<b>99.86 dBμV</b> 79.27 dBμV	ndB ndB down BW	24	20.0 dB .88 MHz
T2 1	24.2296 GHz	78.79 dBµV	Q Factor		973.9
M2 2	24.211 01 GHz	98.80 dBµV		- Measuring	2024-02-07
09:22:32 PM 02/07/2024					21:22:31



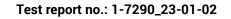


# Plot 30: 20dB bandwidth, Stop Mode (high frequency), 20 °C / V<sub>max</sub>

						~
AultiView 📑 Spectrum	× Spectrum 2	× Spectr	um 4 🗙			
Ref Level 107.00 dBµV	RBW 1 MHz					
	T3s ● VBW 3MHz Mode	Auto Sweep				
DF "LHAF180_CABLE502_0_5M Frequency Sweep	_DBUV"				O I DL M	ax 😑 2Av Max
rrequency sweep					M1M1[1]	99.86 dBL
00 dBµV				M2		1.226 600 GI
				- M	M2[2]	98.79 dBµ
0 dBµV					2	4. <mark>211310 G</mark> F
				그 말 []		
0 dBµV					Ĭ.	
G FCC PART15_249_ISED RSS-210_E	10 PEAK					
o uspv					- I man	No.
QldBµy <del>wels welse were ware were were and and a second sec</del>			man mather Amara	N I		- Manya per
IG FCC PART15_249_ISED RSS-210_E	10 AVG					
0 dвµV						
0 dвµV						
0 dвµV						
0 dBµV						
0 UBHV						
0 dBµV						
F 24.125 GHz	1001	pts	30.0 MH	lz/	Sp	an 300.0 MH
Marker Table		·				
Type Ref Trc	X-Value 24.226 6 GHz	Y-Value	ndB Func	tion	Function Re	
M1 1 T1 1	24.220 0 GHZ 24.20442 GHz	<b>99.86 dBµV</b> 80.29 dBuV	naB ndB down BW		20.0 25.17 MH	IZ
T2 1	24.2296 GHz	80.24 dBuV	Q Factor		962	
M2 2 <b>2</b>	4.211 31 GHz	98.79 dBµV				
				<ul> <li>Measuring.</li> </ul>		2024-02-0

# Plot 31: 20dB bandwidth, Stop Mode (high frequency), 30 $^\circ\text{C}$ / $V_{\text{nom}}$

									Solution
MultiView	Spectrum	× Spe	ctrum 2	× Spect	rum 4	×			•
Ref Level 107.	.00 dBµV	- RBW 11	ИHz			_			_
<ul> <li>Att</li> </ul>		T3s 👄 VBW 31	Hz Mode A	uto Sweep					
TDF "LHAF180_CA 1 Frequency Sw		_DBUV"						O LDK N	∕lax ⊜2Av Max
Thequency 3w	чеер							M1M1[1]	99.63 dBuV
100 dBµV							M2		24.226 900 GHz
							I (M	[ M2[2]	98.55 dBµV
90 dBµ∨									24.211610 GHz
							1 I	w 12	
80 dBµV								Ĩ.	
24G FCC PART15_249	9_ISED RSS-210_8	10 PEAK						Am	
									1~4
60, dBuX	mannet	www.www.www.horesto	<del>~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~</del>	nongund warder all	مكمتيهم ومريارية ومريارية	alunnere Marin	[[	<u>n 1</u>	March March March
24G FCC PART15_249	9_ISED RSS-210_B	10 AVG							
50 dBµ∨									
40 dBµV									
30 dBµV									
20 dBµV									
10 dBµV									
CF 24.125 GHz			1001 p	ts	31	0.0 MHz/		S	pan 300.0 MHz
2 Marker Table Type Ref	Trc	X-Value		Y-Value		Function		Function R	ocult
M1		24.226 9 GH		99.63 dBµV	ndB			20.0	I dB
T1 TO	1	24.20472 GH		79.31 dBµV	ndB down l	BW		24.88 M	Hz 3.9
T2 M2	2 2	24.2296 GH 4.21161 GH	z g	79.22 dBµV 98.55 dBµV	Q Factor			97	3.9
	~						- Measuring.		2024-02-07
									21:30:51
09:30:51 PM 02/07/2	2024								





# Plot 32: 20dB bandwidth, Stop Mode (high frequency), 40 °C / V<sub>nom</sub>

						<u>×</u>
AultiView 📑 Spectrum	× Spectrum 2	× Spectru	ım 4 🗙			
RefLevel 107.00 dBµV	RBW 1 MHz					
	3s ● VBW 3MHz Mode	Auto Sweep				
DF "LHAF180_CABLE502_0_5M_E Frequency Sweep	BUV"				o t Dk M	ax ⊜2Av Ma×
Frequency sweep					M1 M1[1]	99.39 dBi
00 dвµv				M2		4.224800 GI
					∭ м2[2]	98.25 dB
D dBµV					2	4. <mark>209 520 G</mark> l
				<u>⊒</u> /[∖		
) dBµV					Ň.	
G FCC PART15_249_ISED RSS-210_81	) PEAK			A A A A A A A A A A A A A A A A A A A	a M	
) gBhA				man 1	min	
a.dBpX	the second of the second s		man have been and man of the owner	μ.Υ. [ <sup></sup>		mounder
IG FCC PART15_249_ISED RSS-210_810	) AVG				$\square$	
0 dBµV						
) dBµV						
0 dBµV						
0 dBµV						
0 dBµV						
F 24,125 GHz	1001	ots	30.0 MHz/		Sp	an 300.0 MH
Marker Table						
Type Ref Trc	X-Value	Y-Value	Function	1	Function Re	
M1 1 <b>2</b> T1 1	4.224 8 GHz 24.202 92 GHz	99.39 dBµV 79.79 dBuV	ndB ndB down BW		20.0 24.28 Mi	dB 47
T2 1	24.227 2 GHz	80.02 dBuV	Q Factor		997	
M2 2 24	.209 52 GHz	98.25 dBµV				
				- Measuring		2024-02-0

# Plot 33: 20dB bandwidth, Stop Mode (high frequency), 50 °C / V<sub>nom</sub>

					Solution
MultiView 📑 Spe	ectrum × Spec	trum 2 × Spect	rum 4 🗙		•
Ref Level 107.00 dB	JV ● RBW 1 MH				
	dB ● SWT 3 s ● VBW 3 MH	Hz Mode Auto Sweep			
TDF "LHAF180_CABLE50 1 Frequency Sweep	J2_U_5M_DBUV"			o 1 Pl	k Max ⊜2Av Max
				M1[1	
100 dBµV				M2 M1 -	24.221 500 GHz
				M2[2	
90 dBµV					-24.206 220 GHz
00 d0.42					
80 dBµV					
24G FCC PART15_249_ISED	RSS-210_B10 PEAK				
			and and the mark the way that the way was the second states and the second states and the second states and the		Margaret .
60_dBµX <del>orrowo</del>		. تتقابل منطق البر أممر ، بالم	and anna you have an addition on the other than		Mugualian
24G FCC PART15_249_ISED	RSS-210_B10 AVG				
50 dBµV					
40 dBµV					
30 dBµV					
20 dBµV					
10 dBµV					
CF 24.125 GHz		1001 pts	30.0 MHz/		Span 300.0 MHz
2 Marker Table Type Ref Trc	X-Value	Y-Value	Function	Function	Booult
M1 1	24.221 5 GHz	98.93 dBµV	ndB	20	).0 dB
T1 1	24.19963 GHz	78.58 dBµV	ndB down BW	24.58	
T2 1 M2 2	24.2242 GHz 24.206 22 GHz	77.80 dBμV 97.85 dBμV	Q Factor		985.6
				- Measuring	2024-02-07
					21:50:29
09:50:29 PM 02/07/2024					



# 12.2 Antenna gain & beam width

### **Description:**

Information on the minimum antenna gain and maximum beam width.

### Limits and provisions:

### 15.249(b): Fixed point-to-point systems

[...] Fixed, point-to-point operation is permitted in the 24.05–24.25 GHz band subject to the following conditions: [...]

(3) Antenna gain must be at least 33 dBi. Alternatively, the main lobe beamwidth must not exceed 3.5 degrees. The beamwidth limit shall apply to both the azimuth and elevation planes. At antenna gains over 33 dBi or beamwidths narrower than 3.5 degrees, power must be reduced to ensure that the field strength does not exceed 2500 millivolts/meter.

Option 1: Antenna gain requirement							
Kind of device	Antenna gain [dBi]	Limit on minimum antenna gain [dBi]	Margin [dB]				
Other	Not required	No limit	-/-				

Option 2: Beam width requirement							
Kind of device	Beam width of the main lobe [°]	Limit on maximum beam width [°]					
Other	Not required	No limit					

### Verdict: Not required



# 12.3 Field strength of fundamental emission

### **Description:**

Measurement of the maximum radiated field strength of the wanted signal (fundamental emission).

### Limits and provisions:

### 15.249(b): Fixed point-to-point systems

[...] Fixed, point-to-point operation is permitted in the 24.05–24.25 GHz band subject to the following conditions: [...]

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

Kind of device	Fundamental frequency (GHz)	Field strength of fundamental (mV/m)
Fixed point-to-point system	24.05-24.25	2500

### §15.249 (a):

Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Kind of device	Fundamental frequency (GHz)	Field strength of fundamental (mV/m)
Other	0.902-0.928	50
Other	2.400-2.4835	50
Other	5.725-5.875	50
Other	24.0-24.25	250

### §15.249 (c):

Field strength limits are specified at a distance of 3 meters.

### §15.249 (e):

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

For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.



### §15.35(b):

Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

#### §15.31 (c):

Except as otherwise indicated in §15.256, for swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.



# Applicable limits according to §15.249 (b):

Kind of device	Fundamental frequency	Field strength of fundamental		y Field strength of fundamental		Measurement	Power delivered
Kind of device	(GHz)	average value	peak value	distance	to the antenna		
Other	24.0-24.25	108 dBµV/m	128 dBµV/m	3 m	-/-		

### Measurement:

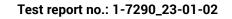
Measurement parameter				
Detector:	Peak / Linear average			
Resolution bandwidth:	1 MHz			
Video bandwidth:	3 MHz			
Trace-Mode:	Max Hold			

### Measurement results:

Mode	Frequency [GHz]	Field strength of fundamental @ 3m [dBµV/m] Average value	Applicable limit	Margin [dB]	Plot
FA	24.135	98.95		9.05	14
FC	24.175	98.30	108 dBµV/m	9.70	15
FE	24.215	98.71		9.29	16

EUT	Frequency [GHz]	Field strength of fundamental @ 3m [dBµV/m] Peak value	Applicable limit	Margin [dB]	Plot
FA	24.135	99.90		28.1	14
FC	24.175	99.50	128 dBµV/m	28.5	15
FE	24.215	99.82		28.2	16

Verdict: Compliant





# Plot 34: Field strength of fundamental emission, Stop Mode (low frequency)

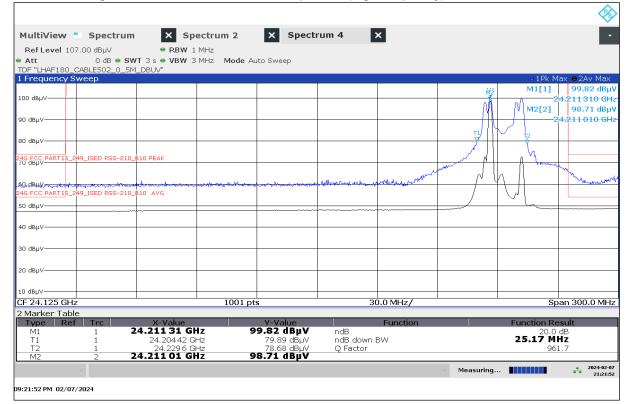
ultiView 📑 Spectrum	× Spectrum 2	× Spectru	m 4 🗙			
RefLevel 107.00 dBµV	• RBW 1 MHz					
	T3s ● VBW 3 MHz Mode	Auto Sweep				
F "LHAF180_CABLE502_0_5M Frequency Sweep	_DBUV"				o t Dk Mov	●2Av Max
requency sweep		14.			M1[1]	99.90 dBL
0 dBµV		M2				123 200 GI
		M	M I		M2[2]	98.95 dB
dвµ∨						123 200 GI
		т1				
dBµV		71	· 12			
			- M			
ECC PART15_249_ISED RSS-210_F	B10 PEAK	- www.mil	A			
		where N/1	N N N N			
dBut a how and the state of the second	and a stand a stand and and a stand and and a stand and an			you and and the man work	and the state of t	-adaptoria adapte al
FCC PART15_249_ISED RSS-210_F	310 AVG		$\nabla I$			
dBµV			· .			
dBµV						
dBµV						
dBµV						
dBµV						
24.125 GHz	1001	pts	30.0 MHz/	/	Spar	n 300.0 M⊢
Marker Table						
Type Ref Trc M1 1	X-Value 24.123 2 GHz	Y-Value 99.90 dBµV	ndB Functio	n	Function Resu 20.0 dB	
T1 1	24.116 31 GHz	80.00 dBµV	ndB down BW		25.47 MHz	
T2 1	24.141 78 GHz	79.34 dBuV	Q Factor		947.0	
M2 2	24.123 2 GHz	98.95 dBµV				
				Measuring	g	2024-02-
						2111/1

### Plot 35: Field strength of fundamental emission, Stop Mode (middle frequency)

MultiView	Spectrum	× Spectru	ım 2 X Spect	rum 4	×			•
Ref Level 10	07.00 dBµV	RBW 1 MHz			_			_
<ul> <li>Att</li> </ul>		T 3 s 👄 VBW 3 MHz	Mode Auto Sweep					
1 Frequency S	CABLE502_0_5M	_DBUV"					0 1 Dk M	ax ⊜2Av Max
Trequency c	Sweep				MO M		M1[1]	99.50 dBµV
100 dBµV					M2 M	-	2	4.184340 GHz
					וא אין ו		M2[2]	98.30 dBµV
90 dBµV							2	4.168 460 GHz
						12		
80 dBµV						Ľ.		
24G FCC PART15_	249_ISED RSS-210_8	B10 PEAK				n		
				. M. M. Market		and the second second		
60rdBuV	warman and the	an month or man and the	water and a second and a second and a second and a second	and the second			handrafterman	an and the second s
24G FCC PART15_	249_ISED RSS-210_6	810 AVG			$ / \vee $			
50 dBµ∨						L-~		
40 dBµ∨								
30 dBµV								
00 app 1								
20 dBµV								
10 dBμV								
CF 24.125 GH			1001 pts	30	D.0 MHz/		Sp	an 300.0 MHz
2 Marker Tab Type Re		X-Value	Y-Value		Function		Function Re	
M1		4.184 34 GHz	99.50 dBµV	ndB	Function		20.0	
T1	1	24.161 86 GHz	79.07 dBµV	ndB down I	BW		25.17 M	
T2 M2	2 2	24.187 04 GHz 4.168 46 GHz	79.07 dBμV 98.30 dBμV	Q Factor			960	J. /
P						Measuring		2024-02-07
						measuring		21:19:27
09:19:28 PM 02/07	7/2024							



### Plot 36: Field strength of fundamental emission, Stop Mode (high frequency)





# 12.4 Field strength of emissions (radiated outside of the specified frequency bands)

### **Description:**

Measurement of the field strength of emissions radiated outside of the specified frequency bands (in transmit mode).

## Limits and provisions:

### §15.249 (a):

Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (GHz)	Field strength of harmonics (mV/m)
0.902-0.928	0.5
2.400-2.4835	0.5
5.725-5.875	0.5
24.0-24.25	2.5

### §15.249 (c):

Field strength limits are specified at a distance of 3 meters.

### §15.249 (c):

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

### §15.249 (e):

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

### §15.205(d)(9):

Devices operated in the 24.0–24.25 GHz band under § 15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in § 15.249(a).



### §15.209 (a):

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (µV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241

### §15.209(b):

In the emission table above, the tighter limit applies at the band edges.

#### §15.209(c):

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

#### §15.209(d):

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

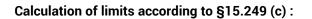
#### §15.31 (c):

Except as otherwise indicated in §§ 15.255 and 15.256, for swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.

#### §15.33(a):

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph: [...]

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.



### Epot = Efund - 50 dB

- Epot: Potential limit according to §15.249 (c)
- E<sub>fund</sub>: Measured field strength of fundamental emission @ 3m (see chapter 12.3)

EUT	Measured field strength of fundamental emission @ 3m [dBµV/m]	Potential limit according to §15.249 (c) [dBµV/m]	Limit according to §15.209 [dBµV/m]
	average value	average value	average value
1	98.95	48.95	54 (f > 1GHz)

Note:

- The limit value with the lesser attenuation compared to the fundamental field strength applies.
- The level of any unwanted emissions shall not exceed the level of the fundamental frequency.

### Applicable limits according to §15.249 (a),(c):

EUT	Harm	onics		outside of the specified except for harmonics)
	average value	peak value	average value	peak value
1	68 dBµV/m	88 dBµV/m	54 dBµV/m	74 dBµV/m

### Measurement:

Measureme	nt parameter
Detector:	Quasi Peak / Peak / Linear average
Resolution bandwidth:	F < 1 GHz: 100 kHz
Resolution bandwidth.	F > 1 GHz: 1 MHz
Video bandwidth:	F < 1 GHz: 300 kHz
	F > 1 GHz: 3 MHz
Trace-Mode:	Max Hold

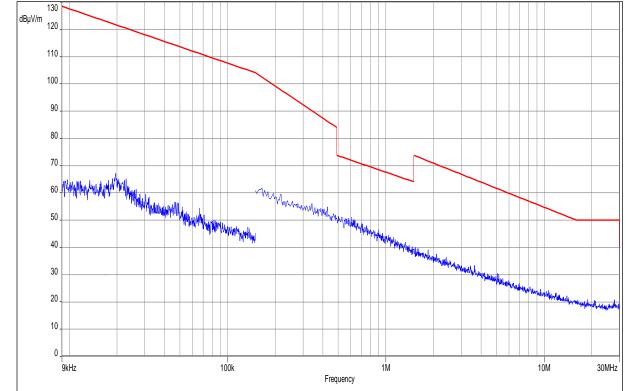
#### Measurement results:

Emissions radiated outside of the specified frequency bands:

Frequency f [MHz]	Detector	Measured level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
Please	refer to the follo	owing plots for more information on the	level of spurious	s emissions
96.673 708	Peak	65.00	88	23.0
(worst Case)	Average	59.64	68	8.36

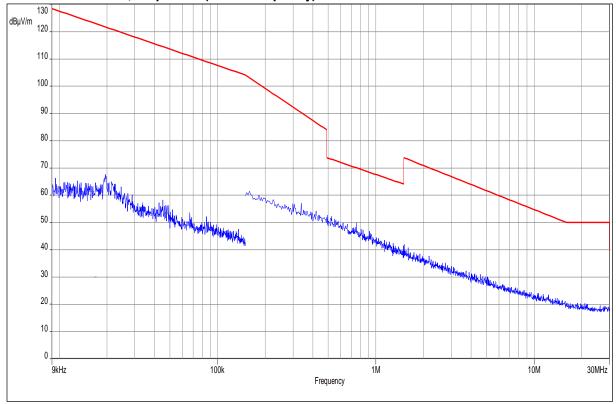
### Verdict: Compliant

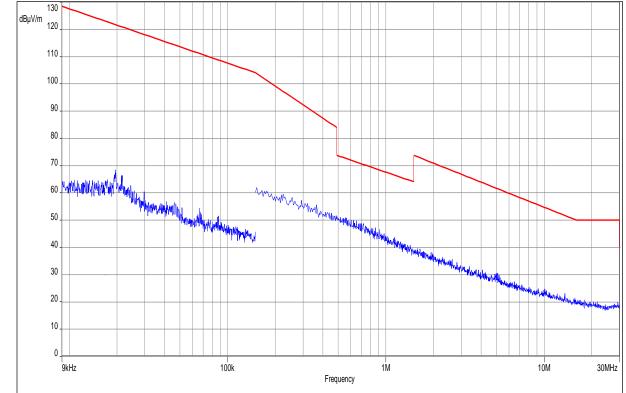
© cetecom advanced GmbH



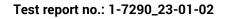
Plot 37: 9 kHz to 30 MHz, Stop Mode (low frequency)

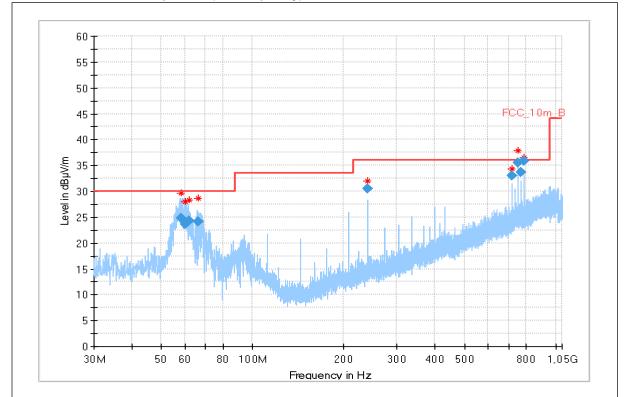






Plot 39: 9 kHz to 30 MHz, Stop Mode (high frequency)

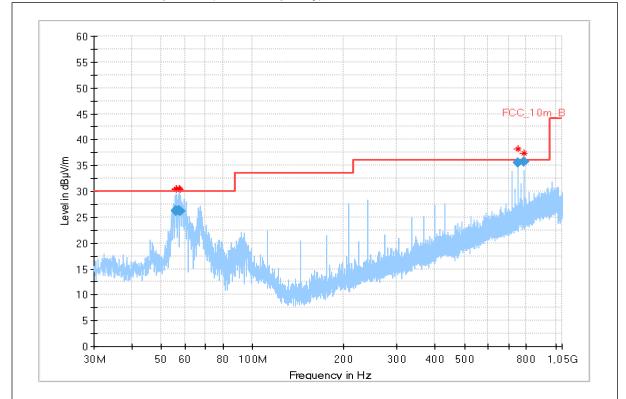




Plot 40: 30 MHz to 1 GHz, Stop Mode (low frequency)

Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
58.240	24.80	30.0	5.2	1000	120.0	170.0	V	94	15
59.776	23.64	30.0	6.4	1000	120.0	98.0	V	52	14
61.870	24.31	30.0	5.7	1000	120.0	102.0	V	97	13
66.184	24.11	30.0	5.9	1000	120.0	195.0	V	111	12
240.001	30.50	36.0	5.5	1000	120.0	195.0	Н	179	14
719.993	33.02	36.0	3.0	1000	120.0	139.0	н	65	23
751.991	35.47	36.0	0.5	1000	120.0	107.0	Н	52	23
767.997	33.66	36.0	2.3	1000	120.0	125.0	Н	61	24
783.981	35.94	36.0	0.1	1000	120.0	127.0	Н	232	23

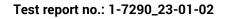
### Test report no.: 1-7290\_23-01-02

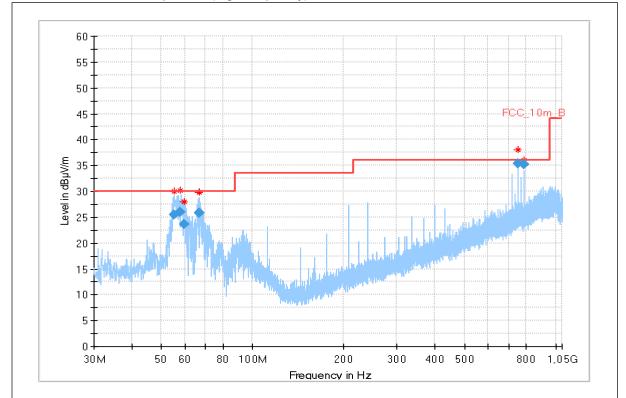


Plot 41: 30 MHz to 1 GHz, Stop Mode (middle frequency)

Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
56.005	26.26	30.0	3.7	1000	120.0	101.0	V	60	16
56.148	26.09	30.0	3.9	1000	120.0	105.0	V	65	16
57.339	26.31	30.0	3.7	1000	120.0	101.0	V	54	15
57.533	26.15	30.0	3.9	1000	120.0	101.0	V	65	15
751.988	35.48	36.0	0.5	1000	120.0	102.0	Н	78	23
783.993	35.73	36.0	0.3	1000	120.0	123.0	Н	246	23

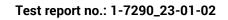
cetecom advanced

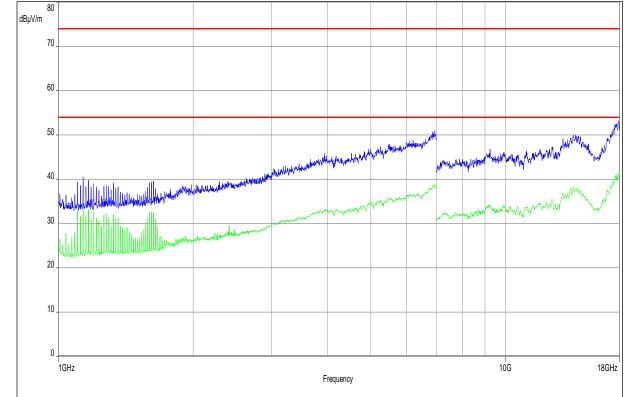




Plot 42: 30 MHz to 1 GHz, Stop Mode (high frequency)

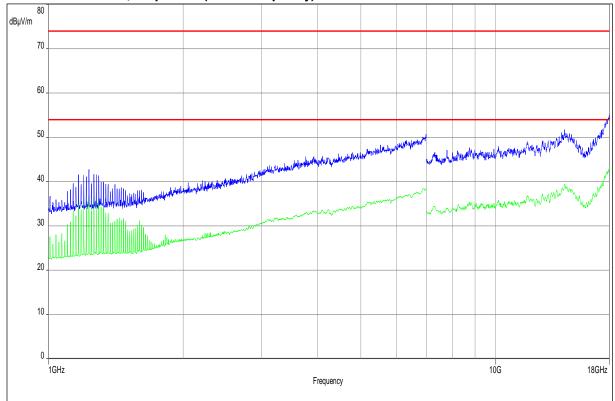
Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
55.010	25.52	30.0	4.5	1000	120.0	118.0	V	53	15
57.587	25.97	30.0	4.0	1000	120.0	102.0	V	66	15
59.644	23.63	30.0	6.4	1000	120.0	101.0	V	232	14
66.638	25.81	30.0	4.2	1000	120.0	102.0	V	84	12
66.848	25.81	30.0	4.2	1000	120.0	101.0	V	119	12
751.992	35.30	36.0	0.7	1000	120.0	110.0	Н	81	23
783.997	35.23	36.0	0.8	1000	120.0	124.0	Н	76	23

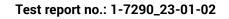


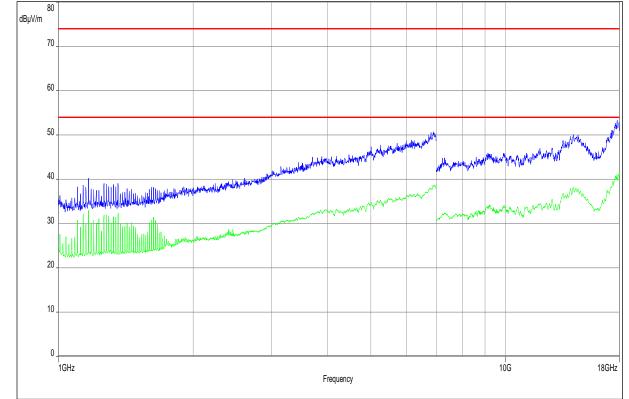


Plot 43: 1 GHz to 18 GHz, Stop Mode (low frequency)

Plot 44: 1 GHz to 18 GHz, Stop Mode (middle frequency)

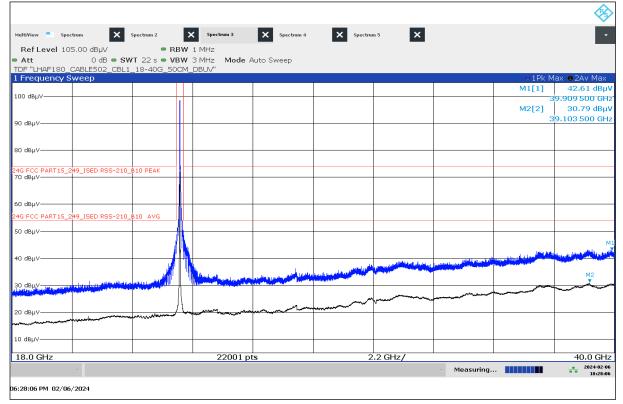


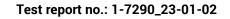




Plot 45: 1 GHz to 18 GHz, Stop Mode (high frequency)

Plot 46: 18 GHz to 40 GHz, Stop Mode (low frequency)





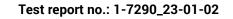


# Plot 47: Band Edge Low, Stop Mode (low frequency)

DF "LHAF180_CABLE502_CBL1_18-40G_50CM_DBLV" Frequency Sweep										\$
Att         30 dB         SWT         1 s         VBW 3 MHz         Mode Auto Sweep           DF "LHAF180_CABLESO_CH_IS-40G_SOCM_DBU/"	MultiView Spe	ctrum X	Spectrum 2	Spectrum 3	X Spectrum 4	× Spectra	m 5 🗙			
DP "LHAF130_CABLE502_CBL1_18-40G_50CM_DBUV"       0 1Pk Msx 0 2Av Max         Frequency Sweep       M1[1]       58.03 dBp         00 dBpV       M1[1]       58.03 dBp         00 dBpV       M2[2]       43.35 dBp         00 dBpV       24.047 150 0 GP         00 dBpV       24.047 150 0 GP         00 dBpV       0 dBpV										
Frequency Sweep         a 1Pk Max         > 24V Max           00 dBµV         M1[1]         58.03 dBµ         24/045 750 0 G           00 dBµV         M2[2]         43.35 dBµ         24/045 750 0 G           00 dBµV         M2[2]         43.35 dBµ         24/047 150 0 G           00 dBµV         M2[2]         43.35 dBµ         24/047 150 0 G           00 dBµV         M2[2]         43.35 dBµ         24/047 150 0 G           00 dBµV         M3         M3         M3         M3           10 dBµV         M3         M3         M3         M4           10 dBµV         M3         M3         M3         M4           10 dBµV         M3         M3         M4         M4           10 dBµV         M3         M3         M3         M3           10 dBµV         M3         M3         M3         M3           10 dBµV         M3         M3         M3         M3           10 dBµV         M3         M3	Att				uto Sweep					
00 dBµV       M1[1]       58.03 dBµ         00 dBµV       M1[1]       58.03 dBµ         00 dBµV       M2[2]       43.53 dBµ         10 dBµV       M2[2]       43.53 dBµ         10 dBµV       M2[2]       10.00 dBµ         10 dBµV       M2       M2[2]         10 dBµV       M2       M2[2]         10 dBµV       M2       M2         10 dBµV       M3       M4         10 dBµV       M3       M4         10 dBµV       M3       M3         10 dBµV       M3       M4			_18-40G_50CM	_DBUV					⊖1Pk M	ax 😑 2Av Max
M2[2]     43.35 dB       10 dBµV     1       10 dBµV <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>M1[1]</td> <td>58.03 dBµV</td>									M1[1]	58.03 dBµV
00 dBµv	100 dBµ∨									
10     dBµV										
AG FCC PARTIS_249_ISED RSS-210_B10 PEAK     M1       10 dBµv     M1       46 FCC PARTIS_249_ISED RSS-210_B10_AVG     M2       40 Bµv     ISED RSS-210_B10_AVG       40 Bµv     ISED RSS-210_B10_AVG <td< td=""><td>90 dBµ∨</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>24</td><td>.0471500 GHz</td></td<>	90 dBµ∨								24	.0471500 GHz
AG FCC PARTIS_249_ISED RSS-210_B10 PEAK     M1       10 dBµv     M1       46 FCC PARTIS_249_ISED RSS-210_B10_AVG     M2       40 Bµv     ISED RSS-210_B10_AVG       40 Bµv     ISED RSS-210_B10_AVG <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>										
00 dBµv	80 dBµV									
00 dBµv										
10     dBµv     10		249_ISED RSS-210_	B10 PEAK							
100 0B/V       100 0B/V <td< td=""><td>70 ubpv</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	70 ubpv									
100 0B/V       100 0B/V <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>										
50 dBµ/     -     -     -     -     -     -     -     M2       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -	60 dBµ∨									-
50 dBµ/     -     -     -     -     -     -     -     M2       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -       10 dBµ/     -     -     -     -     -     -     -     -	24G FCC PART15	249_ISED RSS7210_	B10 AVG	man mar an all have	adat marganet	mmummusha	andwardendend	malandundra	when when a state of the state o	a nacrosal san the stand
	50 dBµ∨									
										M2
	40 dBµV	•								
	an drive									
	30 авµv									
0 dBµv	20 dBµ∨									
0 dBµV										
	10 dBµ∨									
				1001	_	1/			0	100 0 MU
	CF 24.0 GHz			1001 pt	s		J.U MHZ/			an IUU.U MHZ
Measuring 202402-		~						Measuring		18:33:32
:33:32 PM 02/06/2024	06:33:32 PM 02/06	ō/2024								

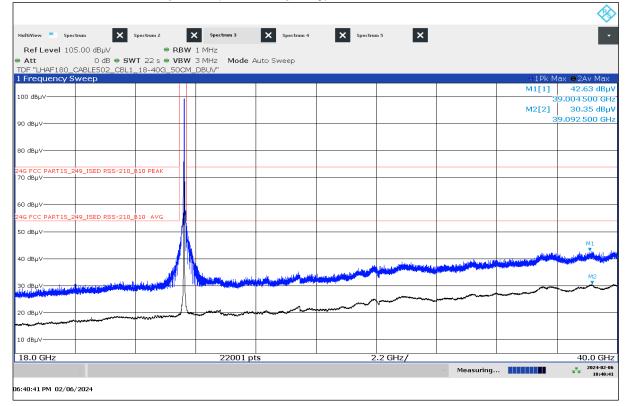
# Plot 48: Band Edge High, Stop Mode (low frequency)

MultiView - Spe	ctrum 🗙	Spectrum 2	X Spectrum 3	X Spectrum 4	X Spectra	m 5 X			×3
				- Spectrum 4					
RefLevel 10 Att		RBW RBW	'1 MHz '3 MHz <b>Mode</b> A	ute Course					
	CABLE502_CBL1			uto sweep					
1 Frequency 9	Sweep							o1Pk M	lax ⊜2Av Max
	249_ISED RSS-210_	B10 PEAK						M1[1]	57.36 dBµ\
100 dBµ∨									260 690 0 GH
								M2[2]	44.37 dBµ\
90 dBµV								24	299 850 0 GH
00.40.41									
80 dBµV									
70 dBμV									
60 dBµV						M1			
mannan	mandanarana	happymaker	menterstandenser	. then when the mouth	Andre to marine marine	Time web aborn	- mound to real	Munimaturation	ah and an and a second
and the second of the second		. Mak and here an	almanda amala da ana tana ana an					and a second	
50 dBµ∨									M
									10 
40 dBµV									
io app :									
30 dBµ∨									
20 dBµV									
•									
10 dBμV									
CF 24.25 GHz	1	I	1001 p	ts	11	0.0 MHz/		Sr	an 100.0 MHz
5. 2 H20 0H2	~		1001 p				- Measuring	. <b> </b>	2024-02-06
									10134130
6:34:30 PM 02/0	5/2024								



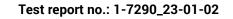


### Plot 49: 18 GHz to 40 GHz, Stop Mode (middle frequency)



### Plot 50: Band Edge Low, Stop Mode (middle frequency)

									~~
MultiView Spe		Spectrum 2	Spectrum 3	Spectrum 4	× Spectru	m 5 🗙			
RefLevel 10 Att			1 MHz 3 MHz Mode Au	Ito Sween					
	CABLE502_CBL1			ло эмеер					
1 Frequency S	Sweep			I					lax ⊜2Av Max
100 dBµV								M1[1]	56.75 dBµ\
200 dept								Z4 M2[2]	.026 770 0 GH: 43.30 dBµ\
									041 760 0 GH
90 dBµ∨									
80 dBµ∨									
94C ECC DART1E	249_ISED RSS-210_	B10 DEAK							
70 dBµV	249_1320 K33-210_	DIO PEAK							
60 dBµV							M1		
24G FCC PART15	249, ISED RSS-210	B10 AVG	mathematic	where whether we record	a	In		A have a show a had	mon hundred
50 dBµV									
50 UBH V									M2
	+								
40 dBµ∨									
30 dBµ∨									
20 dBµV									
10 dBµV									
10 0001									
CF 24.0 GHz		•	1001 pt	s	. 10	0.0 MHz/		Sp	an 100.0 MHz
							- Measuring		2024-02-06
6.43.47 DM 02/04	/2024								
06:43:47 PM 02/06	0/ 2024								



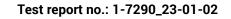


# Plot 51: Band Edge High, Stop Mode (middle frequency)

									<b>\$</b>
Multi¥iew - Spe	ctrum X	Spectrum 2	Spectrum 3	X Spectrum 4	× Spectra	m 5 🗙			•
Ref Level 10	5.00 dBµV	RBW	1 MHz						
<ul> <li>Att</li> </ul>			3 MHz Mode Au	uto Sweep					
	CABLE502_CBL1	_18-40G_50CM	_DBUV"						
1 Frequency S	weep 249_ISED RSS-210_								ax ⊜2Av Max
100 dBµV	19_10E0 K00 210_	DIOPERA						M2[2]	44.22 dBµV
100 0001									296 950 0 GHz 59.21 dBµV
									254 800 0 GHz
90 dBµ∨								24	23480000012
80 dBµV									
70 dBµ∨									
march applease									
60 dBµ∨	When you and a second s	- AND	And the man and the second sec		M1				
	M. Marine Marine	Munth	And a service an	moundement	manaphenraph	water Manual Maria	memoria	when when the work	Montenbergerender
50 dBµ∨									M2
									M2
40 dBµV									
30 dBµ∨	1		-						
20 dBµV									
10 dBµ∨	1		1						
CF 24.25 GHz	I		1001 pt	<u> </u>	11	) 0.0 MHz/			an 100.0 MHz
01 2 120 012			1001 pt	-		515 111127	Mongurine	<b></b>	
	V.						measuring.	•••	2024-02-06 18:43:07
06:43:07 PM 02/06	/2024								

# Plot 52: 18 GHz to 40 GHz, Stop Mode (high frequency)

										<b>I</b>
Multi¥iew Spe	ctrum 🗙	Spectrum 2	×	Spectrum 3	Spectrum 4	× Spectru	m 5 🗙			•
Ref Level 10			3W 1			_	_			
Att     TDF "LHAF180	0 dB 👄 SV CABLE502_CBL1			MHz Mode A	uto Sweep					
1 Frequency S	Sweep								o 1Pk M	ax ⊜2Av Max
									M1[1]	43.22 dBµV
100 dBµ∨										8.907 500 GHz
									M2[2]	30.45 dBµV
90 dBµV									3	9.087 500 GHz
80 dBµV										
80 ubµv										
24G FCC PART15_	249 ISED RSS-210	B10 PEAK								
70 dBµV		_								
60 dBµV										
24G FCC PART15_2	240 ISED PSS-210	BID AVC								
	215_1320 K33 210		<u>k – </u>							
50 dBμV										
										M1
40 dBμV								and the state of the state	And the second second second	territe ( Stanley States)
		1 🖌				المحمد العبار والمسالية والمسالية والمسالية المسالية المسالية المسالية والمسالية والمسالية والمسالية والمسالية	State of the second state of the		and the second	
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30 dBµY		and the second sec								
			ΔL			and the second	hanne			
20 dBµV		-	/ <b>`~</b>			- and the second second				
10 dBµV										
To appy										
18.0 GHz				22001 pt	s	2	.2 GHz/	•		40.0 GHz
								- Measuring.		2024-02-06
										10.40:10
06:48:18 PM 02/06	5/2024									



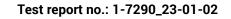


# Plot 53: Band Edge Low, Stop Mode (high frequency)

								<b>I</b>
MultiView Spectrum	Spectrum 2	Spectrum 3	X Spectrum 4	× Spectru	m 5 🗙			-
RefLevel 105.00 dBµV		/ 1 MHz						
	SWT 1 s 🗢 VBW		uto Sweep					
TDF "LHAF180_CABLE502_C 1 Frequency Sweep	CBL1_18-40G_50C	:M_DBUV"					O LDK M	ax ●2Av Max
Threquency Sweep							M1[1]	56.44 dBµV
100 dBµV								018 280 0 GHz
							M2[2]	43.30 dBµV
90 dBµV							24	046 150 0 GHz
90 GDD 1								
80 dBµV								
24G FCC PART15_249_ISED RSS- 70 dBµV	-210_B10 PEAK							
60 dBµV					M1			
24G FCC PART 15_249_ISED RSS	210_810_AVG	way and part and a	An examplement of the	mounderstanding	warmented metal	when which	andmannapadar	mound
50 dBµV								
								M2
40 dBµV								
40 dbp V								
30 dBµV								
20 dBµV								
10 dBµV								
CF 24.0 GHz	1	1001 p	ts	10	).0 MHz/	1	Sc	an 100.0 MHz
~					·	- Measuring.		2024-02-06
						<b>.</b>		18:45:03
06:45:03 PM 02/06/2024								

# Plot 54: Band Edge High, Stop Mode (high frequency)

Multi¥iew 📮 Spectrum 🗙 Spectrum 2	Spectrum 3	× Spectrum 4	× Spectru	m 5 🗙			-
Ref Level 105.00 dBµV ● RBW	1 MHz						
● Att 30 dB ● SWT 1 s ● VBW 3	3 MHz Mode AL	ito Sweep					
TDF "LHAF180_CABLE502_CBL1_18-40G_50CM	_DBUV"						
1 Frequency Sweep 24G FCC PART15_249_ISED RSS-210_810 PEAK							ax ●2Av Max
						M1[1]	64.35 dBµV
						24 M2[2]	250 200 0 GHz 44.19 dBµV
90 dBµV							267 680 0 GHz
	Jan 199 Marine						
		n marine and a second and as	1		the day work to be a		
50 dBuV			Marken heart war	week where		Maythanenewith	mannahan
				M2			
40 dBµV							
30 dBµV							
20 dBµV							
20 0000							
10 dBµV							
CF 24.25 GHz	1001 pt	<u> </u>	10	).0 MHz/		Sn	an 100.0 MHz
~	1001 pt	3			- Measuring	 . <b>الد</b>	2024-02-06
D6:46:08 PM 02/06/2024							10:40:08





# Plot 55: 40 GHz to 50 GHz, Stop Mode (low/middle/high frequency)

								<b></b>
MultiView	Spectrum	× Spectrum 2	×					
Ref Level 100.	00 dBµV	RBW 1 MHz						_
		s 🖷 VBW 3 MHz 🛛 Mode A	uto Sweep					
	_CABLE502_CBL1_4	40-50G_1M_DBUV"						DI. Mar. 0.04. Mar.
1 Frequency Sw	reep							Pk Max ●2Av Ma> [1] 61.34 dBj
							IVIII	48.247 700 G
90 dвµV							M2	[2] 59.09 dB
an neha						-		48.247 700 G
80 dBµ∨								
24G FCC PART15_24! 70 dBµV	9_ISED RSS-210_810 P	EAK						
							M1 M2	
60 dBµ∨							111	
	9_ISED RSS-210_810 .							
50 dBµV	9_ISED RSS-210_810 .	AVG						والمتلقية المتعادية
المحتيدة والمعالية والمتعالية المراجعات	and the state of t	And a state of the	والبر ويرتد وموقد وليروق فلاقتس	a designation of the second second second	and a second second second second	والمتنافع والمتعادية والمساور والمتنافع الم	indian in the	And the state of the
						Contracting the particular of the		
40 dBµ∨	~							
					have		anner Hall Laboratory	
30 dBµV								
20 dBµV								
20 00011								
10 dBµ∨								
10.0.011								
40.0 GHz		10001 p	ts	1	.0 GHz/	_		50.0 GH
						<ul> <li>Measuring</li> </ul>		2024-02-

## Plot 56: 48 GHz, Stop Mode (low frequency)

MultiView 📑 Spectru	m × Spectru	m 2 🗙					
RefLevel 100.00 dBµV							
● Att 0 dB ● 5 TDF "FLANN2324_CABLE502_	SWT 1 s  VBW 3 MHz CBL1_40-50G_1M_DBUV						
Zero Span							ax 🛛 2Av Max
						M1[1]	
							496.000 n
90 dBµV						M2[2	—59.60 dB <sub>l</sub>
							902.000 n
30 dвµV							
30 app *							
70 dBµ∨							
			M1				
60-dBµV			- <b>T</b>			Λ	2
ло-аврл							
50 dBµV							
40 dBµV							
ю uspv							
30 dBµV							
20 dBµV							
ю авил							
CF 48.247675 GHz		10	01 pts	1	1	1	100.0 ms
~					- Measuring.		2024-02- 18:19:
							- 18:19:

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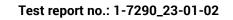


# Plot 57: 48 GHz, Stop Mode (middle frequency)

lultiView 🎫 S	nectrum	X Spectrum 2	×				
Ref Level 100.00		RBW 1 MHz					
	0 dB 👄 SWT 1 s 🖷						
DF "FLANN2324_CA	BLE502_CBL1_40-5						
Zero Span							ax ⊜2Av M
						M1[1]	61.73 d 192.000
dBµV						M2[2]	
abpv							779.000
dBµ∨							
dBµV							
	M1						
dBµV	¥				 M2		
-							
dBµV							
ивру							
dBµV							
dBµV							
dBµV							
-							
dBµV							
uph .							
48.337675 GHz	I		100	1 pts	 		100.0
					Measuring.		2024

Plot 58: 48 GHz, Stop Mode (high frequency)

								(*)
MultiView	Spectrum	× Sp	ectrum 2	×				•
Ref Level 100		• RBW 1		_				_
	0 dB 👄 SW 4_CABLE502_CBI							
1 Zero Span							o1Pk M	ax 😑 2Av Max
							M1[1]	61.01 dBµ\ 830.000 ms
90 dBµV							M2[2]	—58,44 dBµ\
								918.000 m
80 dBµV								
70 dBµV								
							M1	. M2.
60 dBµV						 		<u> </u>
50 dBµV								
40 dBµV								
40 UBHV								
30 dBµV								
20 dBµV								
10 dBµV								
CF 48.421675	GHz			1001	l pts			100.0 ms/
	÷					- Measuring		2024-02-13 18:25:45
06:25:46 PM 02/13/	/2024							10123.45
30.23.40 PM 02/13/	/ 2024							





# Plot 59: 50 GHz to 75 GHz, Stop Mode (low/middle/high frequency)

						**
MultiView 📑	Spectrum >	Spectrum 2	×			
Ref Level 90.00 de	3μV <b>Offset</b> 24.36					_
Inp: ExtMix V		)s <b>⊜VBW</b> 3 MHz Moo	de Auto Sweep			
1 Frequency Swee	р				⊜1Pk Ma	k Auto ID ⊜2Av Max Auto ID
						M2[2] 56.43 dBL 72.505 600 GF
						M1[1] 61.02 dB
во dвµV						72,371 600 G
	SED RSS-210_810 PEAK					
70 dBµ∨						
						MI
60 dBµV						Ma
24G FCC PART15_249_15	ED RES-210 810 AVC					li i i i i i i i i i i i i i i i i i i
	210_010 AVG					
50 dBµV				تعرفه والمتعادية والمتحد والمحالية والمحالية والتحري	in the second	
	وموراع فالقاق أوار والمراجع والمرجع والقرار والمراجع	A Description of the other sectors and a sector of the sec			And the second se	
40 dBμV						and the second designed and th
			and the second design of the s	Second		
30 dBµV						
50.0 GHz	1	25001 pt	s	2.5 GHz/	· · · · ·	75.0 GH
					Measuring	2024-02- 22:34:

Plot 60: 72 GHz, Stop Mode (low frequency)

MultiView	-		ectrum 2	×					
Ref Level 90.00	)dBµV Offset ● SWT		BW 1 MHz BW 3 MHz						
np: ExtMix V . Zero Span								o i Pk M	ax 😑 2Av Ma
								M1[1]	
									269.000 i
ю dвµv								M2[2]	<u>—56.12 dB</u>
									751.000
o dbuv									
o uspv									
		M1							
о авру	·····	uran marine	mar mar	- Anales Marine Andrew Marine		and the second		-am-mantraspotente	
							•	·····	
о авµv									
‡O dBµ∨									
80 dBµV									
20 dBµ∨									
o uspv									
ιο dBμV									
) dвµV									
F 72.3709 GHz	:		L	1001	l pts				100.0 m
-	~						- Measuring		2024-02

Test report no.:	1-7290	_23-01-02
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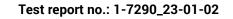


# Plot 61: 72 GHz, Stop Mode (middle frequency)

lultiView 📑 Spe			×					
Ref Level 90.00 dBµV		B ● RBW 1 MHz s ● VBW 3 MHz						
p: ExtMix V	- 5WI 1	S UBW SMHZ						
Zero Span								ax ⊜2Av M
							M1[1]	61.70 d 646.000
dBµV							M2[2]	
abh								893.000
dBµV								
					M1			
ββ₽∇ <u>-^</u>	en management	man and a second se	hemonicanon	man han han han han han han han han han h	moto more al margaret de la	share when the state of the sta	M2	man
dBµ∨								
dBµV								
dBµV								
do								
dвµ∨								
dBµV								
ВµV								
72.5054 GHz			11	001 pts				100.0
72100010112				501 pt5		- Measuring		2024

Plot 62: 72 GHz, Stop Mode (high frequency)

MultiView	Spectrum	× Sp	ectrum 2	×					•
Ref Level 90	0.00 dBµV Offse	et 24.36 dB 🖷 R	BW 1 MHz						
Inp: ExtMix V	● SWT	1 s 🖷 V	BW 3 MHz						
1 Zero Span								⊖1Pk M	ax 😑 2Av Max
								M1[1]	61.79 dBµV
									199.000 ms
80 dBµV								M2[2]	—56.86 dBµV
									167.000 ms
70 dBµV									
70 dbµv									
		11							
60 dBµV	M2-M2		hand have a straight and the second			the second second second	and the second second	and some and	and the second
50 dвµV									
oo app :									
40 dBµV									
30 dвµV									
20 dBµV									
10 dBµV									
0 dBµV									
CF 72.6326 0		I	I	100					100.0 ms/
CF 72.0326 U	2012			100.	i pis				
	~						Measuring.		2024-02-07 22:38:51
10:38:52 PM 02/0	17/2024								





# Plot 63: 75 GHz to 110 GHz, Stop Mode (low/middle/high frequency)

MultiView S	pectrum 🗙	Spectrum 2	×						•
Ref Level 90.00 dBµ									
Inp: ExtMix W	● SWT 35 s	• VBW 3 MHz Mo	de Auto Sweep						
1 Frequency Sweep			1				●1Pk Ma		v Max Auto ID
								M1[1]	
								M2[2]	6.842 900 GH 58.75 dBµ'
									58.75 авр 6.842 900 GH
80 dBµV									
24G FCC PART15_249_ISE	D RSS-210_810 PEAK								
70 dBμV									
					MI				
					цÅ				
60 dBµV					M2		and the state of the state	المعالية ماللهم المالية	
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50 dBµV	And and a second s								
						للسبيل			
									<u> </u>
40 dBµV									
40 UBHV									
30 dBµV									
75.0 GHz		35001 p	l	د ا	.5 GHz/				110.0 GHz
7010 0112		55001 p					leasuring		2024-02-08
									10:01:38

# Plot 64: 96 GHz, Stop Mode (low frequency)

IltiView 📑 Spe			×					
fLevel 97.00 dBµV		s = RBW 1 MHz s = VBW 3 MHz						
ExtMix W								
ero Span						отьк ма	ax Auto ID ●2Av	Max Auto 1] 64.73
							IN LL	710.00
3μV							M2[	2] 59.59
								675.00
ΒμV								
Вµ∨						M1		
mannam	man and a second and	m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.m.		and the second second	M2	and any and	mannama	m
Βμν					M2			
ЗµV								
вµ∨								
ВµV								
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000								
ЗµV								
μν								
	_		100	1				100.0
96.493708188 GH	Z		100	1 pts				100.0

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# Plot 65: 96 GHz, Stop Mode (middle frequency)

	Spectrum		ectrum 2	×					
Ref Level 97.	00 dBµV Offset :	23.19 dB ● RB 1 s ● VB							
np: ExtMix W	• 341	13 - 10	<b>11</b> 3 14112						
Zero Span							●1Pk Ma	ax Auto ID ●2Av	
								M1[1]	65.00 dE 62.000
0 dBµ∨———								M2[2]	59.64 dE
									438.000
0 dBµV									
0 dвµV									
mannahum	underson man man	unanappen	-	M2 man		monument	monenande	manne	www.wheel
0.dBµX				X					
0 dBµV									
0 dвµV									
0 dBµV									
0 dBµV									
0 0001									
) dBµV									
тару									
dBµV				1	1				
F 96.673708	188 GHz			100	1 pts			_	100.0 n
							<ul> <li>Measuring.</li> </ul>		2024-0

# Plot 66: 96 GHz, Stop Mode (high frequency)

MultiView 📑 S RefLevel 97.00 dE		Spectrum 2	2 ×					
		1 s • VBW 3 MHz						
np: ExtMix W Zero Span						o 1 Pk Ma	ax Auto ID 😐 2Av	Max Auto II
							M1[1]	
о dвµv								973.000 i
							M2[2]	
								621.000
ю dBµV								
о dвµv								
		and the second free						мı 
o deuv					M2 M2			
o dopv								
0 dBµV								
о двил								
0 dBμV								
0 dBµV								
0 dBµV								
dBµ∨								
F 96.843308188	GHz		10	01 pts				100.0 m
						- Measuring.		2024-0:



## 12.5 Conducted emissions < 30MHz (AC power line)

### **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.

#### Limits and provisions:

#### §15.207(a):

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of omission (MHz)	Conducted limit (dBµV)				
Frequency of emission (MHz)	Quasi-peak	Average			
0.15 - 0.5	66 to 56*	56 to 46*			
0.5 – 5	56	46			
5 – 30	60	50			

\* Decreases with the logarithm of the frequency

### §15.207(c):

Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

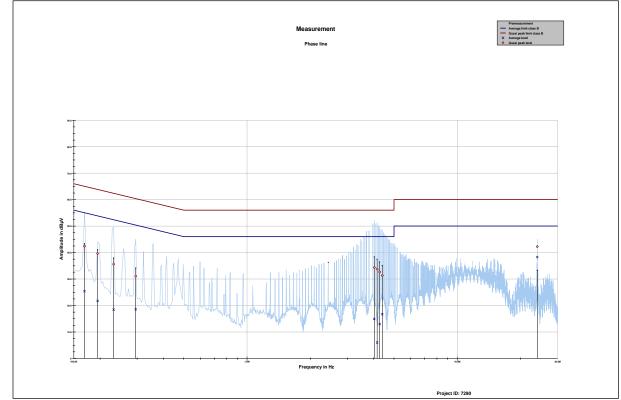
#### Measurement:

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

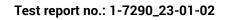


# Measurement results:



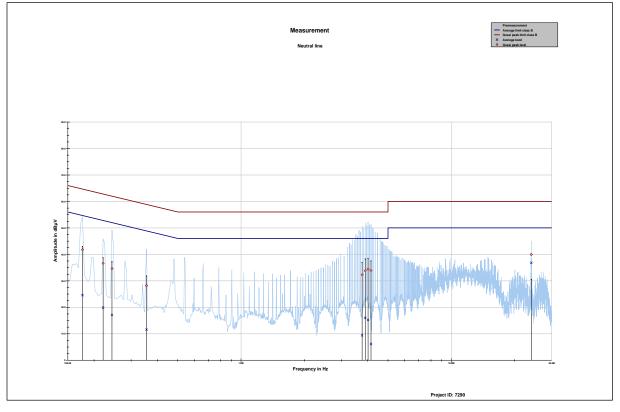


Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.168656	42.42	22.60	65.026	25.38	30.09	55.467
0.194775	39.63	24.20	63.830	21.72	33.00	54.721
0.232088	35.61	26.77	62.375	18.42	35.24	53.655
0.295519	31.06	29.31	60.368	18.53	33.31	51.842
4.026769	34.34	21.66	56.000	14.90	31.10	46.000
4.157362	33.73	22.27	56.000	5.98	40.02	46.000
4.273031	32.69	23.31	56.000	12.95	33.05	46.000
4.396162	31.32	24.68	56.000	16.67	29.33	46.000
24.003881	42.23	17.77	60.000	38.29	11.71	50.000





Plot 68: Neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.176119	41.77	22.90	64.667	24.58	30.67	55.254
0.220894	36.64	26.14	62.785	19.87	34.11	53.974
0.243281	34.63	27.35	61.983	17.10	36.24	53.335
0.355219	28.18	30.66	58.840	11.54	38.59	50.137
3.765581	32.27	23.73	56.000	9.38	36.62	46.000
3.896175	33.81	22.19	56.000	16.00	30.00	46.000
4.019306	34.41	21.59	56.000	15.21	30.79	46.000
4.149900	33.89	22.11	56.000	6.12	39.88	46.000
24.007613	39.94	20.06	60.000	36.79	13.21	50.000

Verdict: Compliant



# 13 Glossary

FUT	Environment under test
EUT	Equipment under test Device under test
DUT	
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
00	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/N <sub>0</sub>	Carrier to noise-density ratio, expressed in dB-Hz



# 14 Document history

Version	Applied changes	Date of release
-/-	Initial release - DRAFT	2024-02-23
-/-	Initial release	2024-02-28