HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: FCC 47 CFR part 15 section 15.255 and subpart B;
RSS-210 issue 10 Annex J, RSS-Gen issue 5

FOR:

Siklu Communication Ltd.

Point-to-Multipoint Wireless V-band link operating in 57-64 GHz

Models:

MH-B100-CCS-PoE-MWB

MH-T200-CNN-PoE-MWB

MH-T200-CCC-PoE-MWB

MH-T200-CCS-PoE-MWB

FCC ID: 2ACYESK-MH60GE-A2

IC: 12353A-MH60GEA2

Table of contents

1 Applicant information

Client name:	Siklu Communication Ltd.
Address:	43 Hasivim street, Petach-Tikva 49517, Israel
Telephone:	+972 3921 4015
Fax:	+972 3921 4162
E-mail:	baruch@siklu.com
Contact name:	Mr. Baruch Schwarz

2 Equipment under test attributes

Product name:	Point-to-Multipoint wireless V-band link operating in 57-64 GHz
Product type:	Transceiver
Model(s):	MH-B100-CCS-PoE-MWB
Brand name:	MultiHaul
Serial number:	F052428273
Hardware version:	A3
Software release:	2.3.4
Receipt date	03-Jan-21

3 Manufacturer information

Manufacturer name:	Siklu Communication Ltd.
Address:	43 Hasivim street, Petach-Tikva 49517, Israel
Telephone:	+972 3921 4015
Fax:	+972 3921 4162
E-Mail:	baruch@siklu.com
Contact name:	Mr. Baruch Schwarz

4 Test details

Project ID:	41073
Location:	Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started:	27-Dec-20
Test completed:	19-Jan-21
Test specification(s):	FCC 47 CFR part 15 section 15.255 and subpart B; RSS-210 issue 10 Annex J; RSS-Gen issue 5 with Am.1

5 Tests summary

Test	Status
Transmitter characteristics	
FCC section 15.255(c)(1) (ii),(d)(1) / RSS-210 section J.2.2(b), J.4, Transmitter power and power spectral density	Pass
FCC section 15.215(c)/ RSS-210 section J.4(c), RSS-Gen, Section 6.7, Occupied bandwidth	Pass
FCC section 15.255(d)(2)/ RSS-210 section J.3, Radiated spurious emissions below 40 GHz	Pass
FCC section 15. 255(d)(3)/ RSS-210 section J.3, Radiated emissions outside assigned band and above 40 GHz up to 200 GHz	Pass
FCC section 15.255(f)/ RSS-210 section J.6, Frequency stability	Pass
FCC Section 15.207(a)/ RSS-Gen, section 8.8, Conducted emission	Pass
FCC section 15.255(g)/ RSS-Gen, section 3.4, RF exposure	Pass, exhibit included in Application for certification
RSS-Gen section 7.3, Receiver spurious emission	Pass*
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Pass
Section 15.109, Radiated emission	Pass

This test report supersedes the previously issued test report identified by Doc ID: SIKRAD_FCC.41073

Testing was completed against all relevant requirements of the test standard. However, results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer, EMC & Radio Mr. I. Zilberstein, test engineer, EMC & Radio	27-Dec-20 – 17-Jan-21	 
Reviewed by:	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	11-Mar-21	
Approved by:	Mr. S. Samokha, technical manager, EMC & Radio	11-Mar-21	

6 EUT description

Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The EUT is an outdoor unit of point-to-multipoint high BW system, based on WiGi technology, operating in the 57-64 GHz regulated V-Band. The EUT radio supports up to 2.5 Gbps.
There are two options for this system. Functionally, a system can serve as a base unit (BU) or as an end point ("Terminal Unit" – TU). In terms of HW, both types have identical Architecture, HW, and Low-Level SW drivers. The difference is only in the application layer.
Several combinations are possible for system assembly. Some of them are more P2P like, while others benefit from P2MP capability.
During the testing the EUT system was powered by POE+.
According to manufacturer's declaration provided in Appendig F of the test report, the model MH-B100-CCS-PoE-MWB, MH-T200-CNN-PoE-MWB, MH-T200-CCC-PoE-MWB, MH-T200-CCS-PoE-MWB are electronically / electrically / mechanically identical. That is why only the model MH-B100-CCS-PoE-MWB was tested.

6.2 Ports and lines

Port type	Port description	Conected from	Connected to	Qty.	Cable type	Cable length, m
Telecom	Ethernet-POE	EUT ETH1	POE+	1	Shielded	2
Telecom	Ethernet-PSE	EUT ETH2	Open circuit	1	Shielded	2
Telecom	Ethernet-PSE/SFP	EUT ETH3	Open circuit	1	Shielded/fiber optic	2

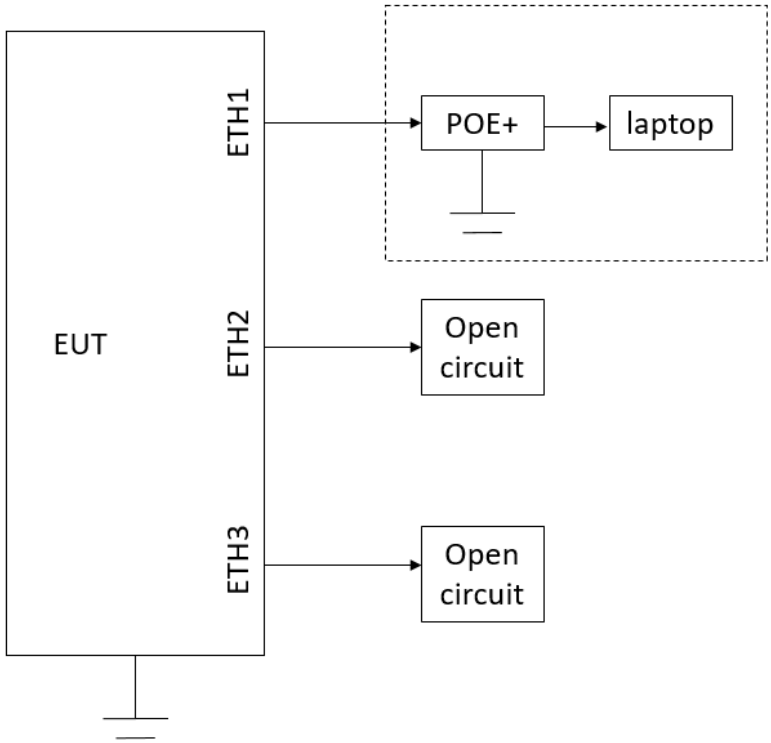
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	Lenovo	x201	5CFF35060620
Poe Adapter	Microsemi	PD-9001GR/AC	C13126561000001105

6.4 Changes made in the EUT

No changes were performed in the EUT during testing.

6.5 Test configuration



6.6 Transmitter characteristics

Type of equipment	
V	Stand-alone (Equipment with or without its own control provisions)
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)
	Plug-in card (Equipment intended for a variety of host systems)

Intended use		Condition of use
V	fixed	Always at a distance more than 2 m from all people
	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency range	57.0 GHz – 64.0 GHz				
Operating frequency range	58320 - 62640 MHz				
Test frequencies	58320 MHz, 60480 MHz, 62640 MHz				
Maximum rated output power	EIRP				40.11 dBm
Is transmitter output power variable?	**V**	No			
		Yes		continuous variable	
				stepped variable with stepsize	dB
			minimum RF power		dBm
			maximum RF power		

Antenna connection			
unique coupling	standard connector	**V** Integral	with temporary RF connector
			without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Integrated array of 32 dipole antenna	Siklu Ltd.	CCB001	24 dBi

Transmitter 99% power bandwidth, MHz	Transmitter aggregate data rate/s, Mbps	Type of modulation
1992.3	2500	QPSK

Type of multiplexing	TDD

Transmitter power source					
		Nominal rated voltage		Battery type	
V	DC	**Nominal rated voltage**	48 V via POE		
		Voltage range			
	AC mains	**Nominal rated voltage**	120 V	Frequency	60 Hz

Common power source for transmitter and receiver	**V** yes	no

Test specification:	FCC Section 15.255(c)(1)(ii),(d)(1), RSS-210 section J.2.2(b), J.4, Transmitter power and power spectral density		
Test procedure:	47 CFR, Section 2.1046; Section 15.255(b); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

7 Transmitter tests

7.1 Transmitter power test

7.1.1 General

This test was performed to measure the peak output power. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Output power limits

Assigned frequency range, MHz	Maximum output power			
	Peak conducted output power		EIRP, dBm	
	mW	dBm	Peak	Average
57000 – 71000	500	27.0	43	40

7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.1.2.3 The average and peak voltage was measured at the low and high frequency channels with oscilloscope connected to RF detector and provided in the associated plots.

7.1.2.4 The unmodulated signal was applied to Zero-Biased Detector via variable attenuator as shown in Figure 7.1.2.

7.1.2.5 The variable attenuator was adjusted such that the oscilloscope indicated a voltage equal to the peak voltage recorded in the step 7.1.2.3.

7.1.2.6 The variable attenuator was disconnected from the Zero-Biased Detector.

7.1.2.7 Without changing any settings, the variable attenuator was connected to a power meter as shown in Figure 7.1.3.

7.1.2.8 The power was measured and result was recorded in Table 7.1.2 and Table 7.1.3.

7.1.2.9 The steps 7.1.2.4 through 7.1.2.8 were repeated for the average voltage recorded in the step 7.1.2.3 and 7.1.2.4.

Test specification:	FCC Section 15.255(c)(1)(ii),(d)(1), RSS-210 section J.2.2(b), J.4, Transmitter power and power spectral density		
Test procedure:	47 CFR, Section 2.1046; Section 15.255(b); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

Figure 7.1.1 Peak output power test setup

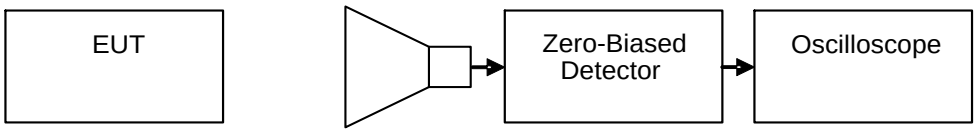


Figure 7.1.2 Peak output power test setup

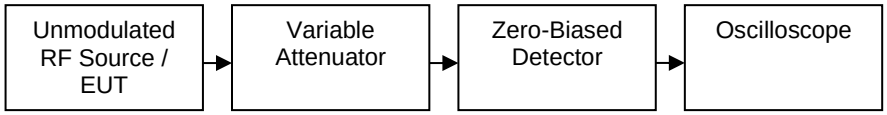
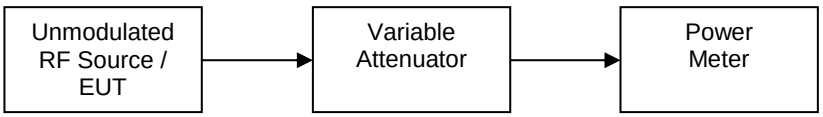


Figure 7.1.3 Peak output power test setup



Test specification:	**FCC Section 15.255(c)(1)(ii),(d)(1), RSS-210 section J.2.2(b), J.4, Transmitter power and power spectral density**		
Test procedure:	47 CFR, Section 2.1046; Section 15.255(b); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

Table 7.1.2 Peak output power test results

ASSIGNED FREQUENCY RANGE: 57.0 – 71.0 GHz
DETECTOR USED: Peak
MEASUREMENTS DISTANCE: 0.7 m
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
EUT ANTENNA GAIN: 24 dBi
MODULATION: QPSK

Frequency, MHz	λ*, m	DSO, mV	Power measured, dBm	Antenna Gain, dBi	E_{meas}**, dBuV/m	EIRP***, dBm	Limit, dBm	Margin****, dB	Verdict
58320	0.00514	6.8	-0.92	24.00	147.65	39.86	43.00	-3.14	Pass
60480	0.00496	6.4	-0.98	24.00	147.91	40.11	43.00	-2.89	Pass
62640	0.00479	6.3	-1.51	24.00	147.68	39.89	43.00	-3.11	Pass

Note: Max peak conducted power is 40.11 dBm – 24 dBi = 16.11 dBm
* - λ = 300/Frequency(MHz)
** - E_{meas}= 126.8 – 20log(λ) + Power measured – Measurement Antenna Gain (24 dBi)
*** - EIRP= E_{meas} + 20log(Measurements distance) – 104.7
**** - Margin = EIRP – Limit

Table 7.1.3 Average output power test results

ASSIGNED FREQUENCY RANGE: 57.0 – 71.0 GHz
DETECTOR USED: Average
MEASUREMENTS DISTANCE: 0.7 m
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
EUT ANTENNA GAIN: 24 dBi
MODULATION: QPSK

Frequency, MHz	λ*, m	DSO, mV	Power measured, dBm	Antenna Gain, dBi	E_{meas}**, dBuV/m	EIRP***, dBm	Limit, dBm	Margin****, dB	Verdict
58320	0.00514	3.39	-2.05	24.00	146.52	38.73	40.00	-1.27	Pass
60480	0.00479	3.05	-2.37	24.00	146.82	39.03	40.00	-0.97	Pass
62640	0.00463	3.27	-3.24	24.00	146.25	38.45	40.00	-1.55	Pass

* - λ = 300/Frequency(MHz)
** - E_{meas}= 126.8 – 20log(λ) + Power measured – Measurement Antenna Gain (24 dBi)
*** - EIRP= E_{meas} + 20log(Measurements distance) – 104.7
**** - Margin = EIRP – Limit

Reference numbers of test equipment used

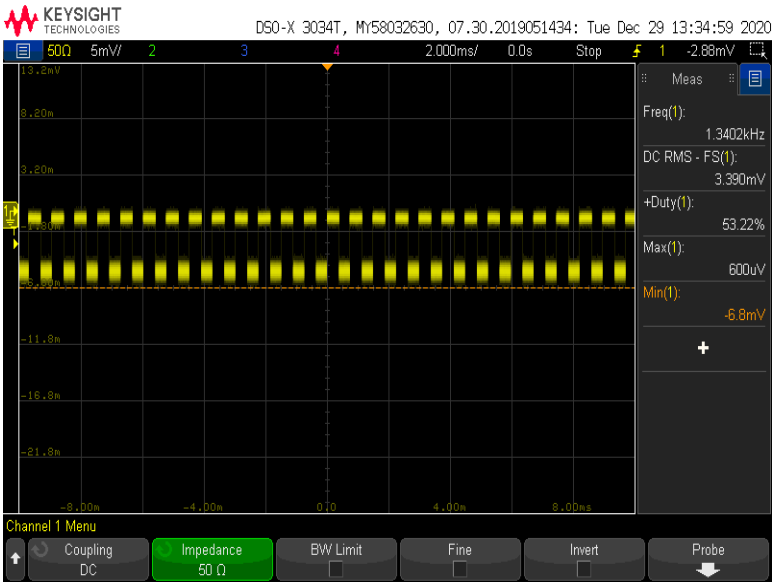
HL 5360	HL 3301	HL 3291	HL 4856	HL 5377	HL 5376		
HL 0771	HL 5380	HL 3727	HL 5369	HL 3304			

Full description is given in Appendix A.

Test specification:	FCC Section 15.255(c)(1)(ii),(d)(1), RSS-210 section J.2.2(b), J.4, Transmitter power and power spectral density		
Test procedure:	47 CFR, Section 2.1046; Section 15.255(b); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

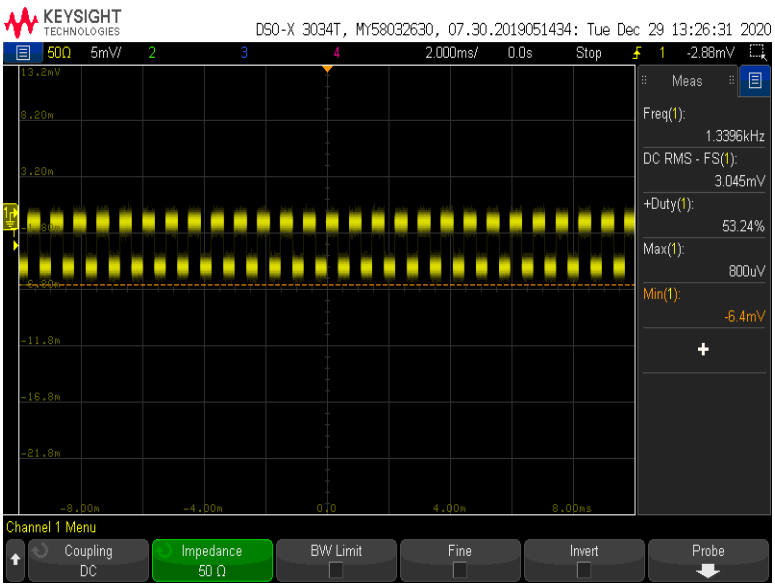
Plot 7.1.1 Output power test result at the 58.32 GHz frequency

DETECTOR:	Peak/Average
MODULATION:	QPSK



Plot 7.1.2 Output power test result at the 60.48 GHz frequency

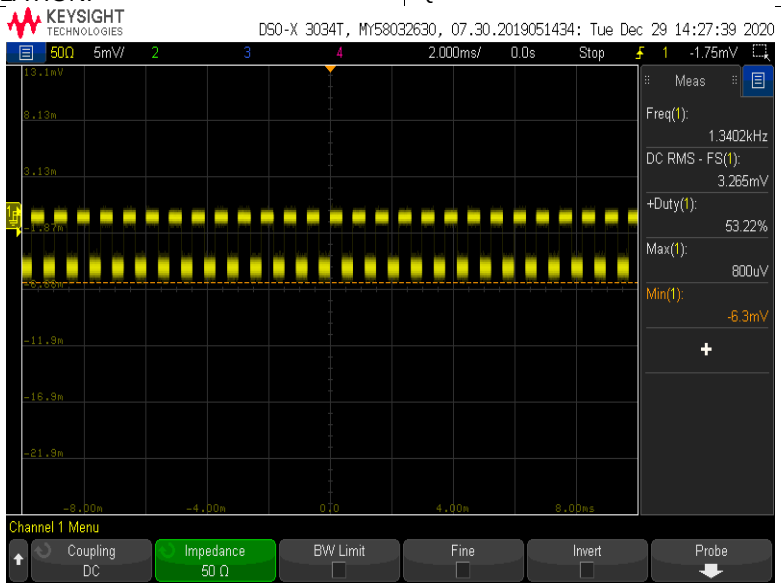
DETECTOR:	Peak/Average
MODULATION:	QPSK



Test specification:	FCC Section 15.255(c)(1)(ii),(d)(1), RSS-210 section J.2.2(b), J.4, Transmitter power and power spectral density		
Test procedure:	47 CFR, Section 2.1046; Section 15.255(b); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

Plot 7.1.3 Output power test result at the 62.64 GHz frequency

DETECTOR:	Peak/Average
MODULATION:	QPSK



Test specification:	FCC Section 15.215(c), RSS-210 section J.4(c), RSS-Gen section 6.7, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049, ANSI C63.10, Section 9.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Occupied bandwidth limits

Assigned frequency range, MHz	Modulation envelope reference points	
57000 - 71000	6 dBc	99%

NOTE: Modulation envelope reference points provided in terms of attenuation below unmodulated carrier.

7.2.2 Test procedure

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was set to transmit modulated carrier as provided in Table 7.2.2.

7.2.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope. The test results are provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup

Test specification:	**FCC Section 15.215(c), RSS-210 section J.4(c), RSS-Gen section 6.7, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049, ANSI C63.10, Section 9.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

ASSIGNED FREQUENCY RANGE: 57000 –71000 MHz
DETECTOR USED: Peak

Frequency, GHz	Occupied bandwidth 6 dBc, MHz	Occupied bandwidth 99%, MHz	Verdict
58.32	1398.0	1966.8	Pass
60.48	1449.0	1977.9	Pass
62.64	1305.0	1992.3	Pass

Reference numbers of test equipment used

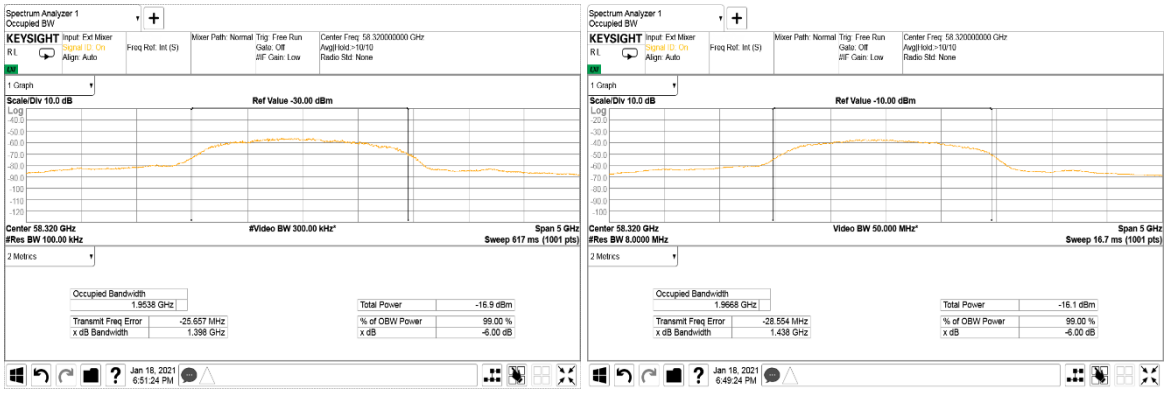
HL 0770	HL 0771	HL 3290	HL 3291	HL 5376			
Waveguide harmonic mixer M1971E S/N MY56130269 Calibration due 15-Jan-2022							

Full description is given in Appendix A.

Test specification:	**FCC Section 15.215(c), RSS-210 section J.4(c), RSS-Gen section 6.7, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049, ANSI C63.10, Section 9.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

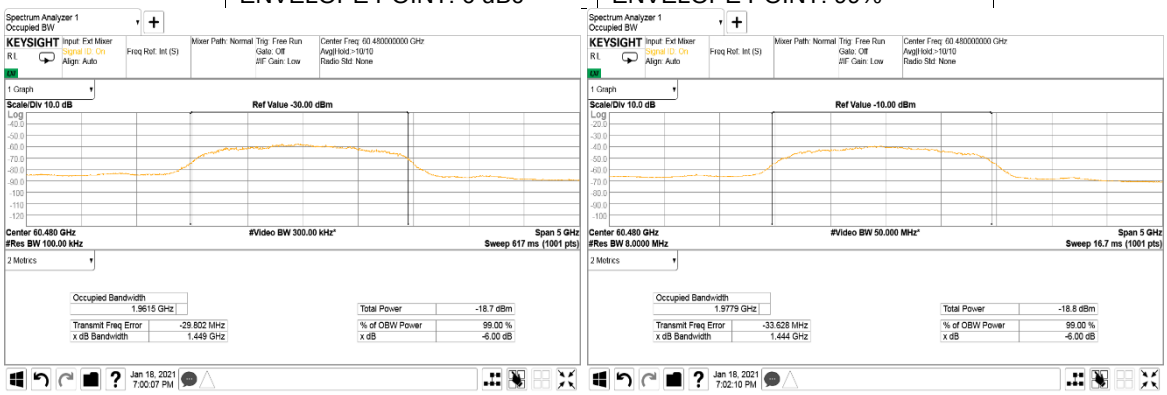
Plot 7.2.1 The 6dBc and 99% occupied bandwidth

FREQUENCY:	58.32 GHz
MODULATION:	QPSK
ENVELOPE POINT: 6 dBc	ENVELOPE POINT: 99%



Plot 7.2.2 The 6dBc and 99% occupied bandwidth

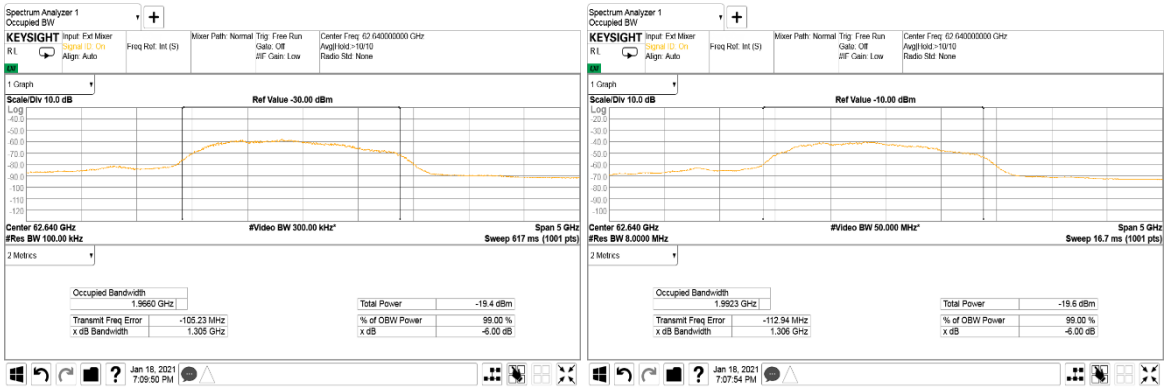
FREQUENCY:	60.48 GHz
MODULATION:	QPSK
ENVELOPE POINT: 6 dBc	ENVELOPE POINT: 99%



Test specification:	**FCC Section 15.215(c), RSS-210 section J.4(c), RSS-Gen section 6.7, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049, ANSI C63.10, Section 9.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

Plot 7.2.3 The 6dBc and 99% occupied bandwidth

FREQUENCY:	62.64 GHz
MODULATION:	QPSK
ENVELOPE POINT: 6 dBc	ENVELOPE POINT: 99%



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

7.3 Field strength of emissions

7.3.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)*		
	Within restricted bands		
	Peak	Quasi Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**
0.090 – 0.110	NA	108.5 – 106.8**	NA
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**
0.490 – 1.705	NA	73.8 – 63.0**	NA
1.705 – 30.0*		69.5	
30 – 88		40.0	
88 – 216		43.5	
216 – 960		46.0	
960 - 1000		54.0	
1000 – 40000	74.0	NA	54.0

*- The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$Lim_{S2} = Lim_{S1} + 40 \log (S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

**- The limit decreases linearly with the logarithm of frequency.

Note: The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency but not exceeding 40 Ghz for intentional radiators operated below 10 GHz and up to the fifth harmonic of the highest fundamental frequency but not exceeding 100 Ghz for intentional radiators operated above 10 GHz.

Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

7.3.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and the performance check was conducted.

7.3.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna was rotated around its vertical axis.

7.3.2.3 The worst test results (the lowest margins) were recorded in Table 7.3.2 and shown in the associated plots.

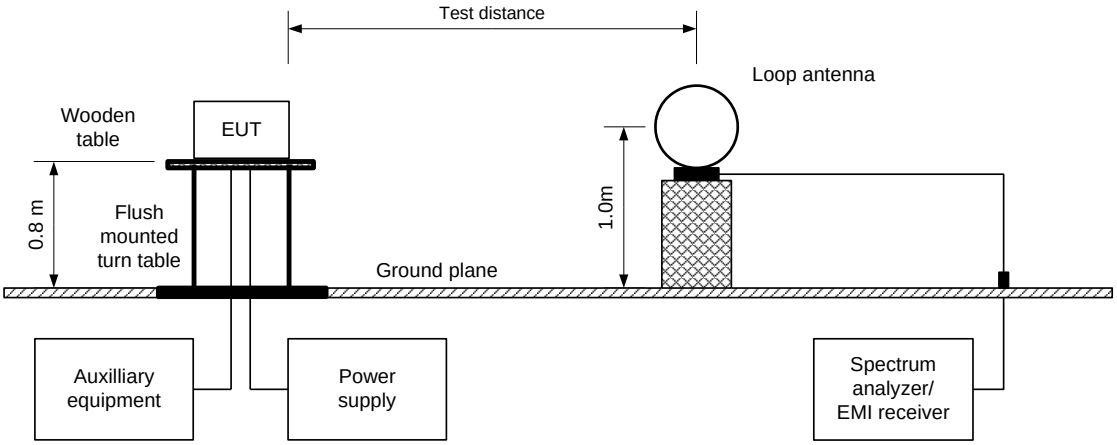
7.3.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.3.3.1 The EUT was set up as shown in Figure 7.3.2, Figure 7.3.3, energized and the performance check was conducted.

7.3.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.3.3.3 The worst test results (the lowest margins) were recorded in Table 7.3.2 and shown in the associated plots.

Figure 7.3.1 Setup for spurious emission field strength measurements below 30 MHz



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

Figure 7.3.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz

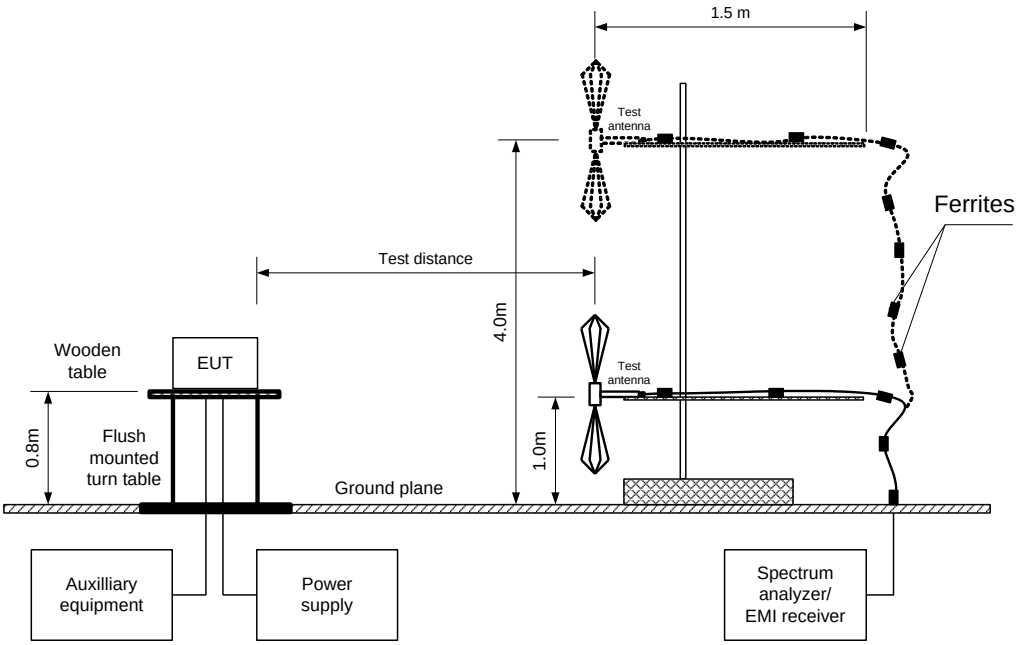
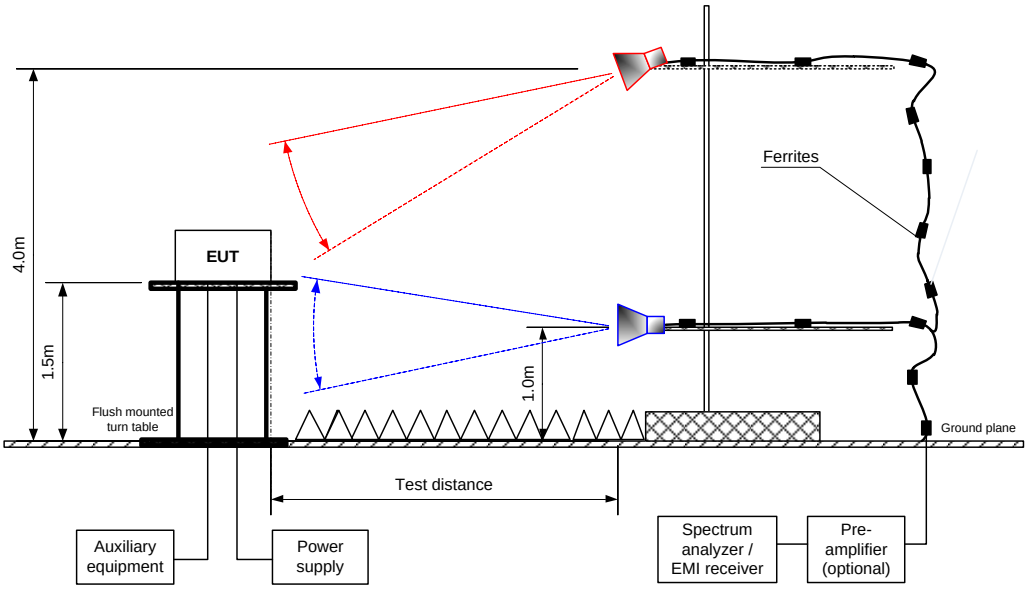


Figure 7.3.3 Setup for spurious emission field strength measurements above1000 MHz



Test specification:	**FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz**		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

Table 7.3.2 Field strength of spurious emissions at frequencies above 1 GHz

TEST DISTANCE: 3 m
EUT POSITION: Typical (Vertical)
MODULATION: QPSK
INVESTIGATED FREQUENCY RANGE: 1000 - 40000 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Avr factor, dB	Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Low Frequency											
4000.0	H	1.5	-32	47.4	74	-26.6	0	43.5	54	-10.5	
7289.8	V	1.5	-67	53.9	74	-20.1	0	51.5	54	-2.5	
Mid Frequency											
4000.0	H	1.5	-38	47.6	74	-26.4	0	44.2	54	-9.8	Pass
7559.7	V	1.6	-69	48.7	74	-25.3	0	44.4	54	-9.6	
High Frequency											
4000.0	H	1.5	-34	46.8	74	-27.2	0	43.2	54	-10.8	
7830.0	V	1.5	-67	46.8	74	-27.2	0	44.3	54	-9.7	

*****- EUT front panel refers to 0 degrees position of turntable.
******- Margin = dB below (negative if above) specification limit.

Test specification:	**FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz**		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	**Relative Humidity:** 33 %	**Air Pressure:** 1016 hPa	**Power:** 48 VDC
Remarks:			

Table 7.3.3 Field strength of emissions below 1 GHz

TEST DISTANCE:	3 m
EUT POSITION:	Typical (Vertical)
MODULATION:	QPSK
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	0.2 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconical (30 MHz – 200 MHz) Log periodic (200 MHz – 1000 MHz) Biconilog (30 MHz – 1000 MHz)

Frequency, MHz	**Peak emission, dB(μV/m)**	**Quasi-peak**			**Antenna polarization**	**Antenna height, m**	**Turn-table position**, degrees**	**Verdict**
		Measured emission, dB(μV/m)	**Limit, dB(μV/m)**	**Margin, dB***				
Low frequency 58320 MHz								
1000.000	48.57	46.90	54.0	-7.10	Horizontal	1.02	-172	Pass
Mid frequency 60480 MHz								
999.999	50.56	49.12	54.0	-4.88	Horizontal	1.02	-180	Pass
High frequency 62640 MHz								
37.687	25.02	21.18	40.0	-18.82	Vertical	1.04	94	Pass
999.999	49.29	47.98	54.0	-6.02	Horizontal	1.02	-180	Pass

*****- Margin = Measured emission - specification limit.
******- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

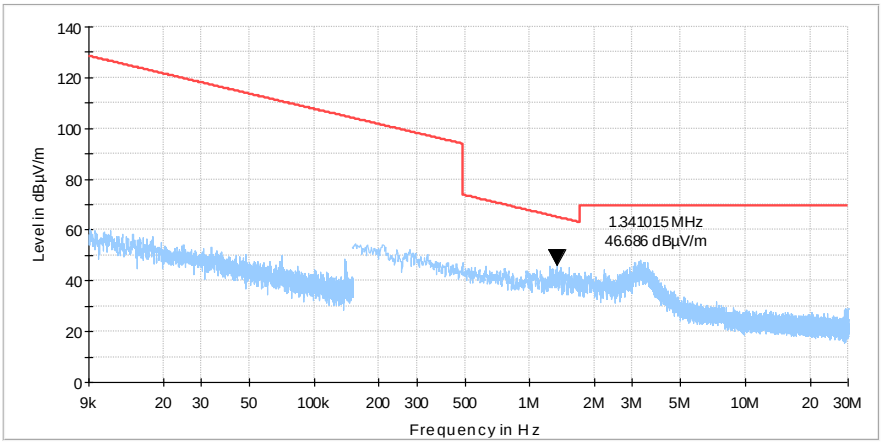
HL 0446	HL 3903	HL 4360	HL 4933	HL 4956	HL 5085		
HL 5288	HL 5112	HL 5669	HL 5670	HL 4011			

Full description is given in Appendix A.

Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

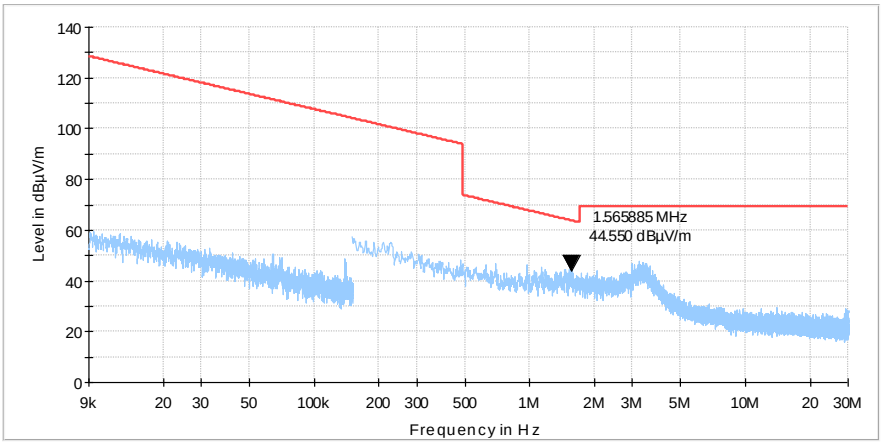
Plot 7.3.1 Radiated emission measurements from 9 kHz to 30 MHz at low frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical



Plot 7.3.2 Radiated emission measurements from 9 kHz to 30 MHz at mid frequency

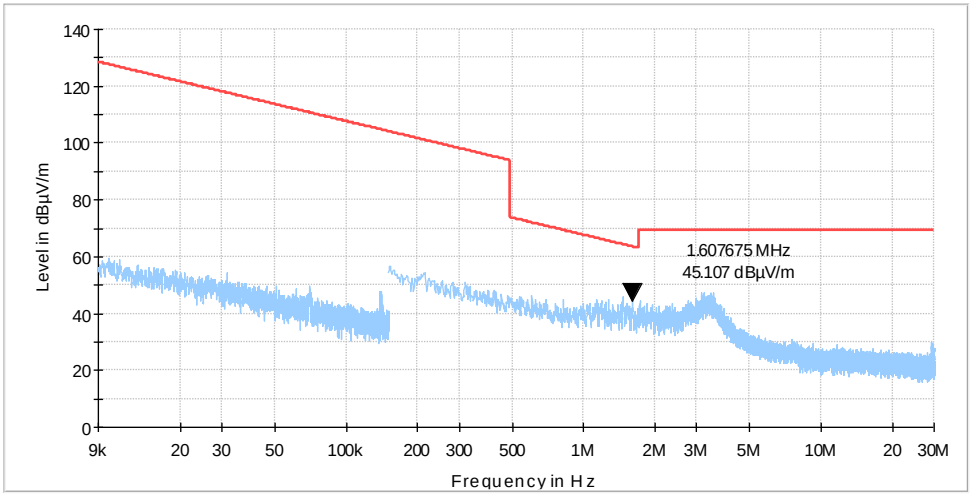
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

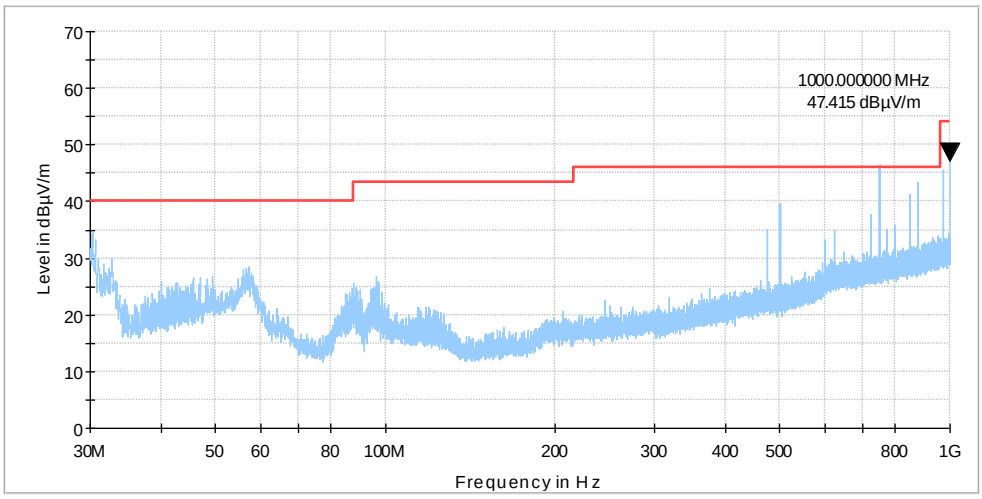
Plot 7.3.3 Radiated emission measurements from 9 kHz to 30 MHz at high frequency

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical
EUT POSITION:	Typical



Plot 7.3.4 Radiated emission measurements from 30 to 1000 MHz at low frequency

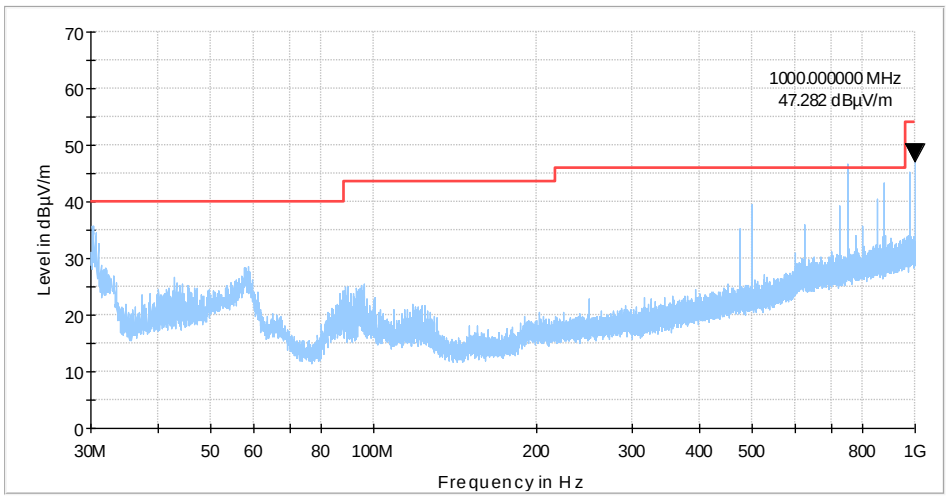
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Typical



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

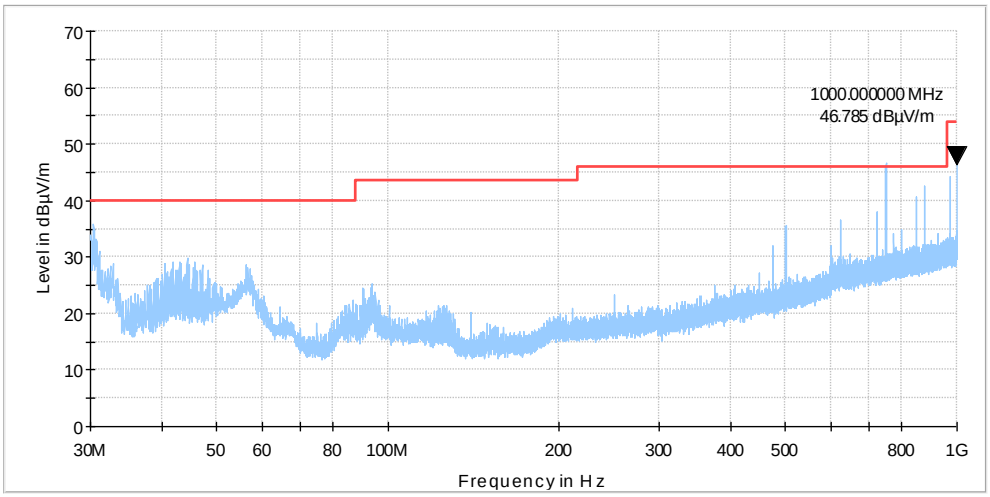
Plot 7.3.5 Radiated emission measurements from 30 to 1000 MHz at mid frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



Plot 7.3.6 Radiated emission measurements from 30 to 1000 MHz at high frequency

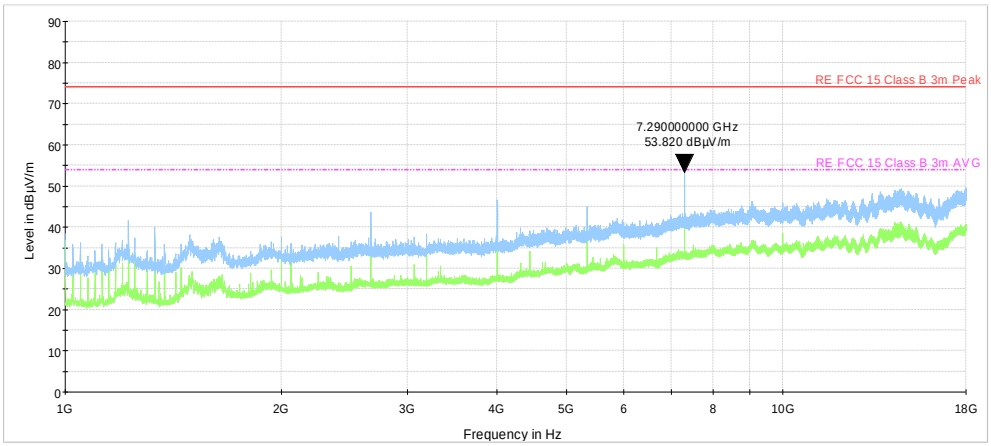
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

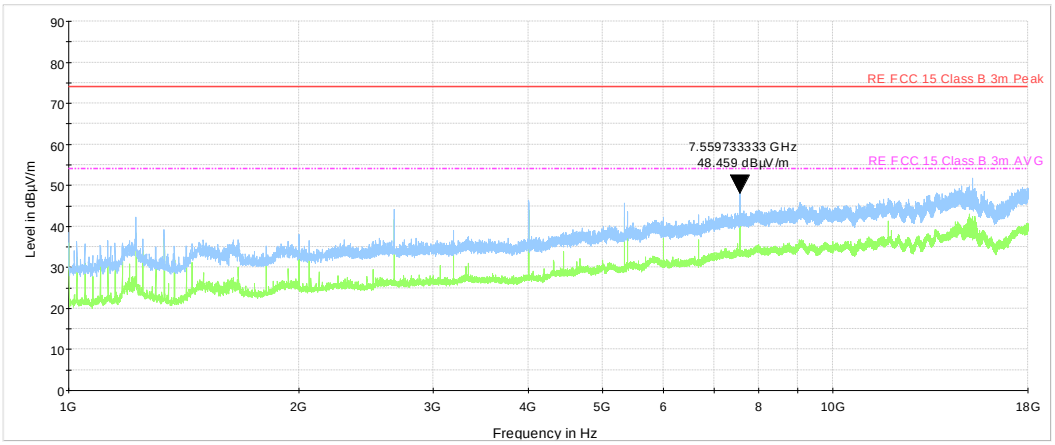
Plot 7.3.7 Radiated emission measurements from 1.0 to 18.0 GHz at low frequency

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Typical (Vertical)



Plot 7.3.8 Radiated emission measurements from 1.0 to 18.0 GHz at mid frequency

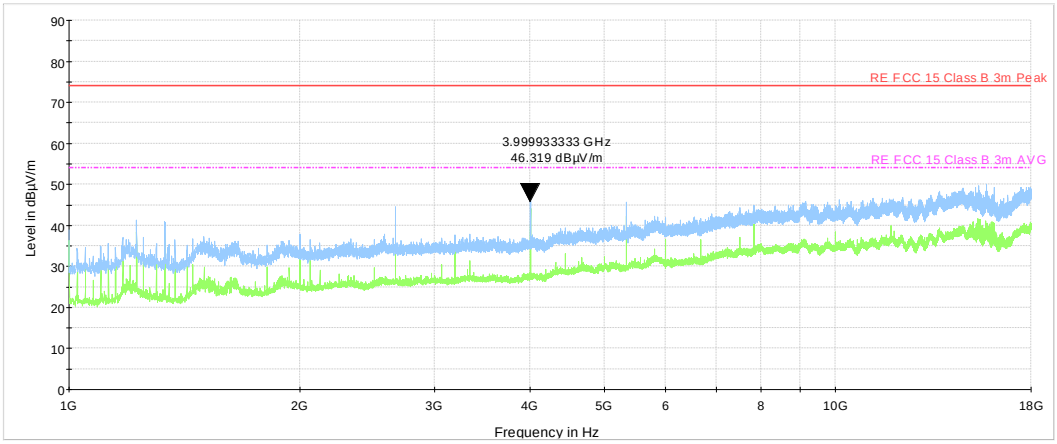
TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Typical



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

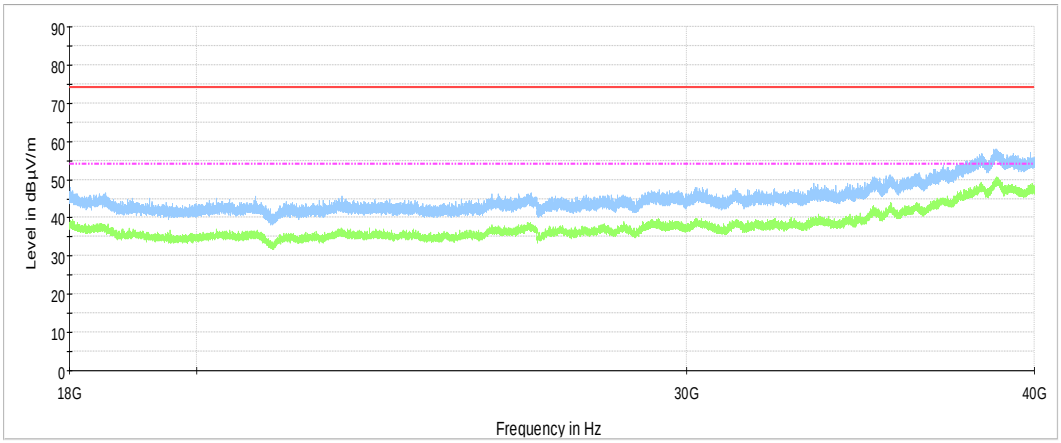
Plot 7.3.9 Radiated emission measurements from 1.0 to 18.0 GHz at high frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



Plot 7.3.10 Radiated emission measurements from 18 to 40GHz at low frequency

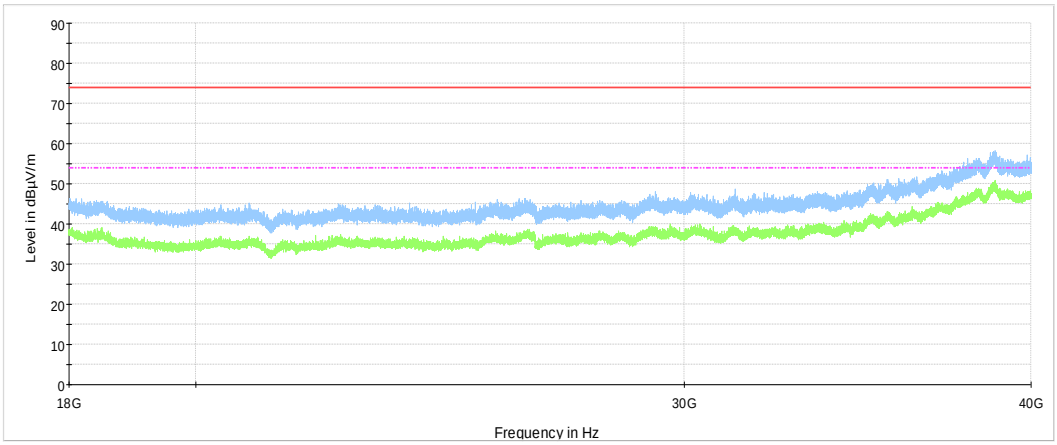
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical (Vertical)



Test specification:	FCC Section 15.255(d)(2), RSS-210 section J.3, Out of band radiated emissions below 40 GHz		
Test procedure:	47 CFR, Section 2.1053; ANSI C63.10, Section 9.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Dec-20 - 12-Jan-21		
Temperature: 22 ºC	Relative Humidity: 33 %	Air Pressure: 1016 hPa	Power: 48 VDC
Remarks:			

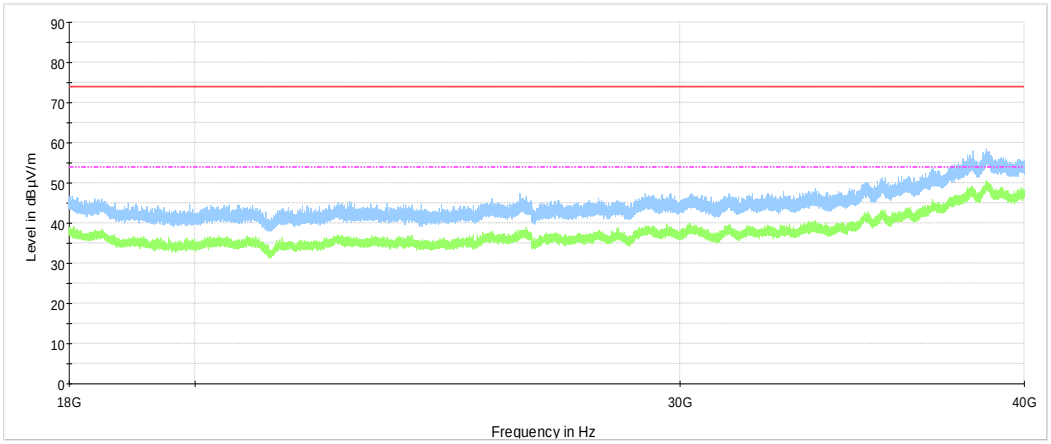
Plot 7.3.11 Radiated emission measurements from 18 to 40GHz at mid frequency

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Typical (Vertical)



Plot 7.3.12 Radiated emission measurements from 18 to 40GHz at high frequency

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical and Horizontal
EUT POSITION:	Typical (Vertical)



Test specification:	**FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz**		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Jan-21		
Temperature: 20 ºC	**Relative Humidity:** 68 %	**Air Pressure:** 1015 hPa	**Power:** 48 VDC
Remarks:			

7.4 Out of band radiated emissions above 40 GHz up to 200 GHz

7.4.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.4.1

Table 7.4.1 Spurious emission field strength limits

Frequency, GHz	Power density at 3 m distance pW/cm^2	Distance, m	Field strength dB(µV/m)*, peak	Field strength dB(µV/m)*, average
40 – 200	90.0	3.0	105.30	85.30
90 - 110	90.0	0.5	120.9**	100.9**
110 - 140	90.0	0.05	140.9**	120.9**
140 - 200	90.0	0.01	154.8**	134.8**

*- The limit is provided in average values.

**- The limit for 1 m and other test distance was calculated using the inverse distance extrapolation factor as follows:

for far field: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,

where S_1 – standard defined distance in meters;

S_2 – measurement distance in meters (according to ANSI C63.10)

7.4.2 Test procedure for spurious emission field strength measurements

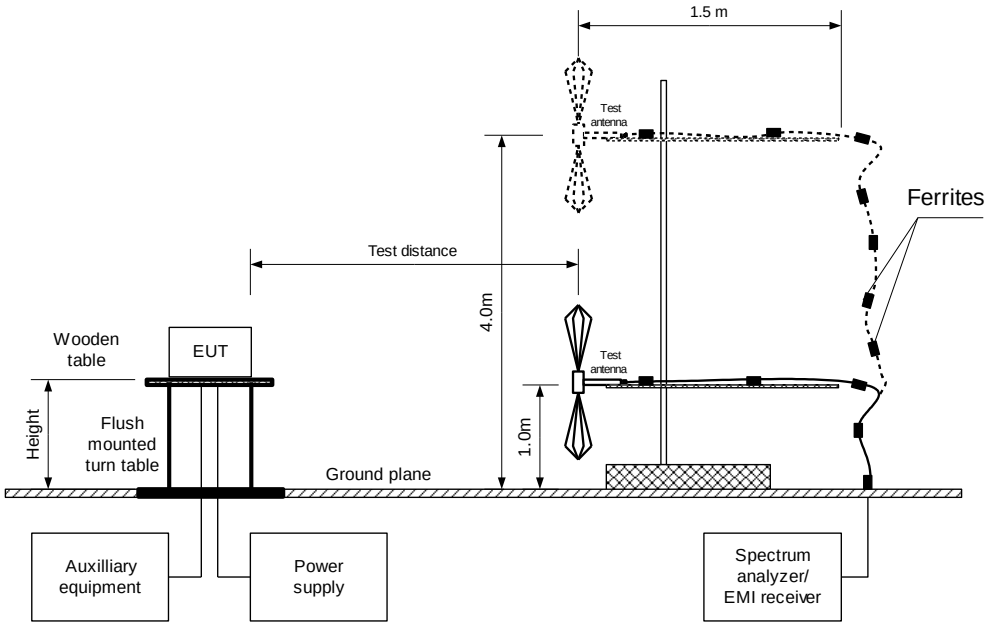
7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

7.4.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.4.2.3 The test results were recorded in Table 7.4.2 and are shown in the associated plots.

Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Jan-21		
Temperature: 20 ºC	Relative Humidity: 68 %	Air Pressure: 1015 hPa	Power: 48 VDC
Remarks:			

Figure 7.4.1 Spurious emission field strength above 40 GHz test set up



Test specification:	**FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz**		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Jan-21		
Temperature: 20 ºC	**Relative Humidity:** 68 %	**Air Pressure:** 1015 hPa	**Power:** 48 VDC
Remarks:			

Table 7.4.2 Spurious emission field strength test results

TEST DISTANCE:	0.005 - 3 m
EUT POSITION:	Typical (Vertical)
MODULATION:	QPSK
TRANSMITTER OUTPUT POWER:	Maximum
INVESTIGATED FREQUENCY RANGE:	40 – 200 GHz
RESOLUTION BANDWIDTH:	1000 kHz
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Standard Gain Horn 24 dB (40-60 GHz) Standard Gain Horn 24 dB (60-90 GHz) Standard Gain Horn 24dB (90-140 GHz) Standard Gain Horn 24 dB (140-220 GHz)

Frequency, MHz	**Antenna**		**Azimuth, degrees***	**Peak field strength(VBW=3 MHz)**			**Average field strength(VBW=1 kHz)**			**Verdict**
	Polariz.	**Height, m**		**Measured, dB(µV/m)**	**Limit, dB(µV/m)**	**Margin, dB****	**Measured, dB(µV/m)**	**Limit, dB(µV/m)**	**Margin, dB****	
Low carrier frequency 58320 MHz										
No emissions were found										Pass
Mid carrier frequency 60480 MHz										
No emissions were found										Pass
High carrier frequency 62640 MHz										
No emissions were found										Pass

***- EUT front panel refer to 0 degrees position of turntable.
****- Margin = Measured emission – specification limit.

Reference numbers of test equipment used

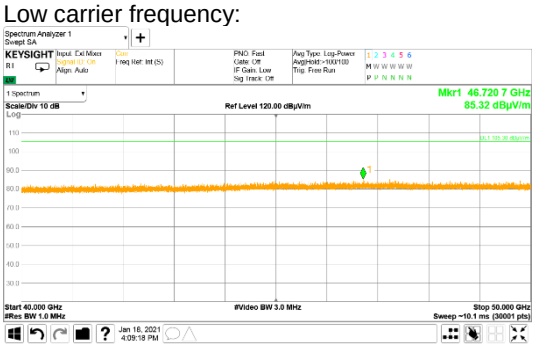
HL 0747	HL 0770	HL 0771	HL 0772	HL 1312	HL 2909	HL 3235	HL 3291
HL 3306	HL 3329	HL 3433	HL 3434	HL 3536	HL 4023	HL 5376	HL 5380

Full description is given in Appendix A.

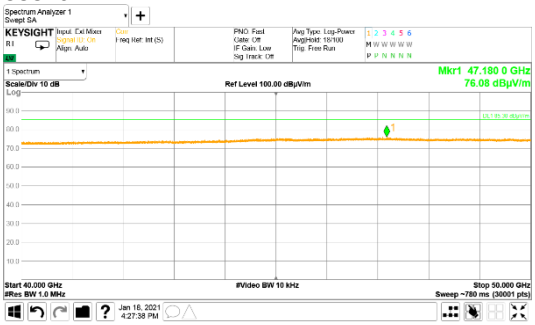
Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Jan-21		
Temperature: 20 ºC	Relative Humidity: 68 %	Air Pressure: 1015 hPa	Power: 48 VDC
Remarks:			

Plot 7.4.1 Spurious emission measurements in 40 – 50 GHz range

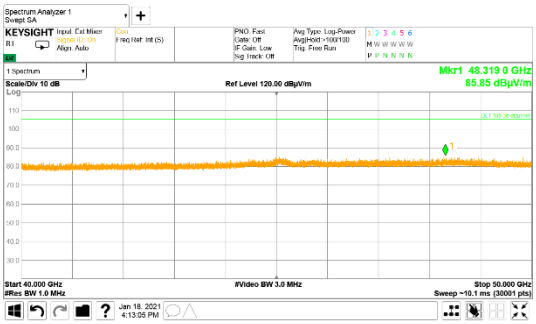
TEST SITE: OATS
TEST DISTANCE: 3 m
MODULATION: QPSK
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
Low carrier frequency:



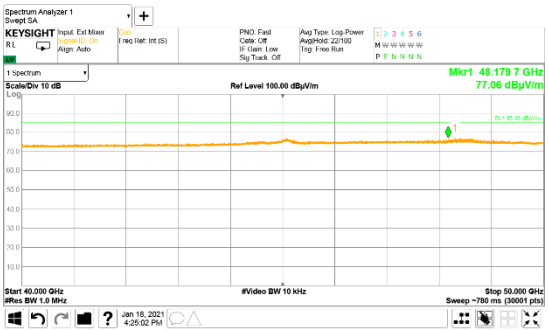
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
58320 MHz



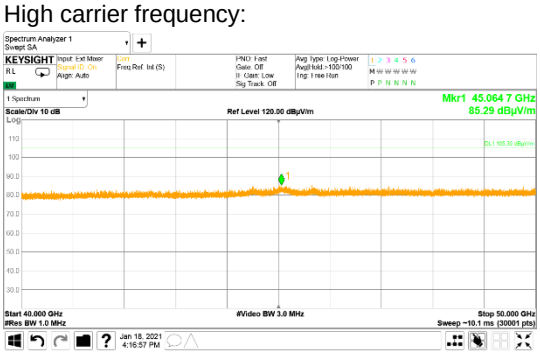
Mid carrier frequency:



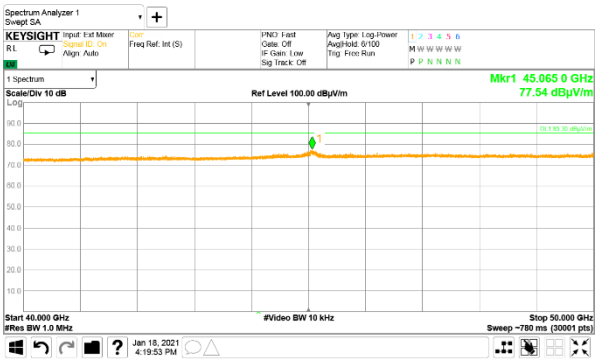
60480 MHz



High carrier frequency:



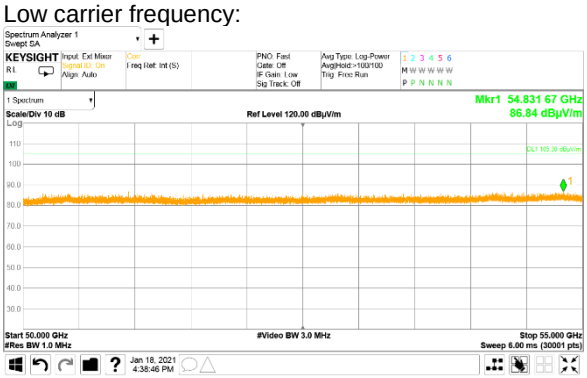
62640 MHz



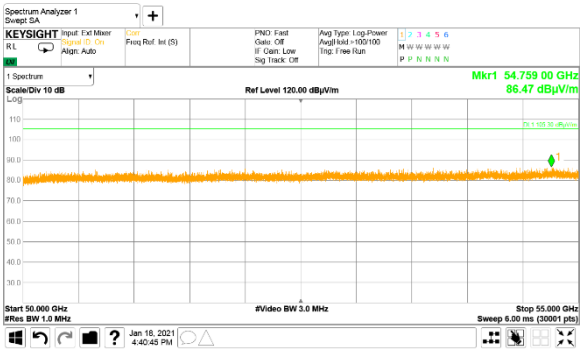
Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Jan-21		
Temperature: 20 ºC	Relative Humidity: 68 %	Air Pressure: 1015 hPa	Power: 48 VDC
Remarks:			

Plot 7.4.2 Spurious emission measurements in 50 – 55 GHz range

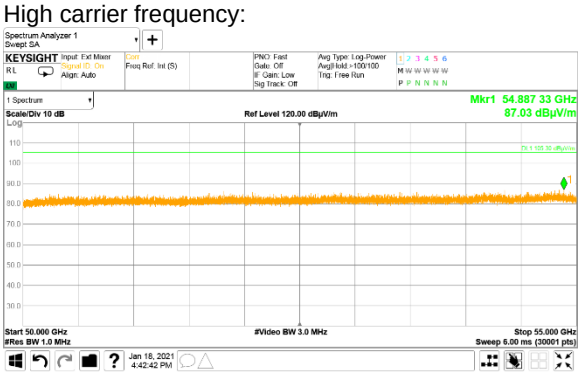
TEST SITE: OATS
TEST DISTANCE: 3 m
MODULATION: QPSK
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
Low carrier frequency:



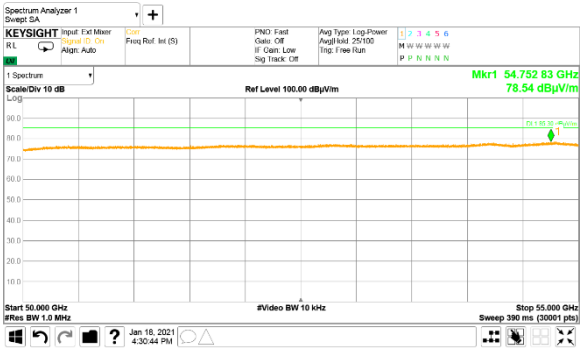
Mid carrier frequency:



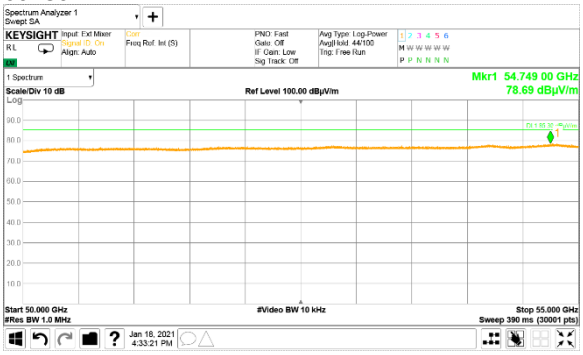
High carrier frequency:



DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
58320 MHz



60480 MHz



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