HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

Hermon Laboratories Ltd.
P.O. Box 23, Binyamina 3055001, Israel
Tel. +972 4628 8001
Fax. +972 4628 8277
E-mail: mail@hermonlabs.com

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, ICES-003 Issue 6:2019

FOR:

Essence Smartcare Ltd.
Multi-Dimensional Fall Sense
Model: ES700MDS-US-M03
Part numbers: ES700MDS-US-M01
ES700MDS-US-M02
ES700MDS-US-M03
FCC ID: 2ARFP-MDS
IC: 24417-MDS

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1 Applicant information

Client name:	Essence Smartcare Ltd.
Address:	12 Abba Eban avenue, Ackerstein Tower Bldg. D, P.O.Box 2073, Herzliya 4612001, Israel
Telephone:	+972 732 447 735
Fax:	+972 9772 9962
E-mail:	israelgo@essence-grp.com
Contact name:	Mr. Israel Gottesman

2 Equipment under test attributes

Product name:	Multi-Dimensional Fall Sense
Product type:	Transceiver
Model(s):	ES700MDS-US-M03
Part numbers:	ES700MDS-US-M01, ES700MDS-US-M02, ES700MDS-US-M03
Serial number:	002
Hardware version:	1.I
Software release:	Host 1.14; Fall Detection 1.06
Receipt date	02-Nov-20

3 Manufacturer information

Manufacturer name:	Essence Smartcare Ltd.
Address:	12 Abba Eban avenue, Ackerstein Tower Bldg. D, P.O.Box 2073, Herzliya 4612001, Israel
Telephone:	+972 732 447 735
Fax:	+972 9772 9962
E-Mail:	israelgo@essence-grp.com
Contact name:	Mr. Israel Gottesman

4 Test details

Project ID:	40812
Location:	Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started:	02-Nov-20
Test completed:	10-Mar-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; ICES-003 Issue 6: 2019 (updated)

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*

*Note: tested during the transmitter radiated spurious emissions below 40 GHz.

Unintentional emissions	
FCC section n 15.107/ICES-003, Section 6.1, Class B, Conducted emission	Pass
FCC section 15.109/ICES-003, Section 6.2, Class B, Radiated emission	Pass

Testing was completed against all relevant requirements of the test standard. The 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.

This test report supersedes the previously issued test report identified by Doc ID:ESSRAD_FCC.40812_DXX_rev1

	Name and Title	Date	Signature
Tested by:	Mr. A. Morozov, test engineer, EMC & Radio Mr. I. Zilbestein, test engineer, EMC & Radio	10-Mar-21	
Reviewed by:	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	16-Aug-21	
Approved by:	Mr. S. Samokha, Technical Manager, EMC & Radio	16-Aug-21	

6 EUT description

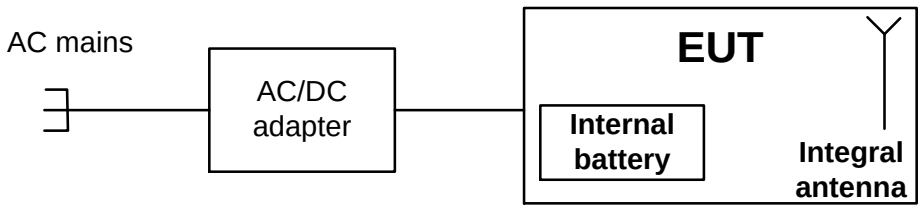
Note: The following data in this clause is provided by the customer and represents his sole responsibility.

6.1 General information

The EUT, model ES700MDS-US-M03, Part Numbers ES700MDS-US-M01, ES700MDS-US-M02.
The ES700MDS-US-M03, is a battery operated, bi-directional, wireless, multidimensional fall detector.
The MDsense can also be used with either an optional power cable or an optional emergency pull cord, but not both at the same time. The device comprises RF modules operating in 59 to 63 GHz and at 916.5 MHz.
In order to detect a fall, the device includes two sensors: a Passive infrared detector which detects movement and microwave Sensor which detects the position of body.
The operation is bases on continuous operation of PIR detector and intermittent operation of microwave sensor, also known as Radar.
Once the PIR detector does not detect a movement in the room is activates microwave sensor for few seconds to identify position of the body – if it lays down on a floor then it activates alarm, otherwise the event is ignored.
The device has three configurations:
1) Part Number ES700MDS-US-M01 with non-charging battery, includes fall detection functionality,
2) Part Number ES700MDS-US-M02 with non-charging battery and pull cord, includes fall detection functionality,
3) Part Number ES700MDS-US-M03 with non-charging battery and AC/DC adapter, includes fall detection functionality.

This test report represents test results for 59 to 63 GHz radio.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during testing.

6.4 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**
	fixed	Always at a distance more than 2 m from all people
V	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 – 71.0 GHz
Operating frequency range	59 - 63 GHz
Test frequency	61000 MHz
Maximum rated output power	EIRP 12.19 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
			V	without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Integral AoP	TI	XI6843ARQGALP	5 dBi

Transmitter 99% power bandwidth, MHz	**Transmitter aggregate data rate/s, Mbps**	**Type of modulation**
3176	12.5	FMCW

Transmitter power source					
V	Battery	**Nominal rated voltage**	6 VDC	Battery type	Alkaline
	DC	**Nominal rated voltage**			
		Voltage range			
V	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(c); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Mar-21		
Temperature: 23 ºC	Relative Humidity: 42 %	Air Pressure: 1015 hPa	Power: 120 VAC, 60 Hz
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(c); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	10-Mar-21		
Temperature: 23 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1015 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Figure 7.1.1 Peak output power test setup

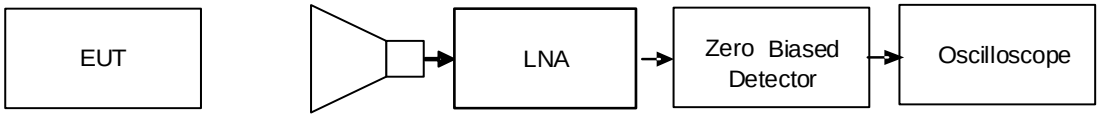


Figure 7.1.2 Peak output power test setup

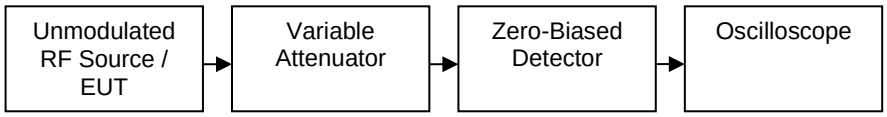
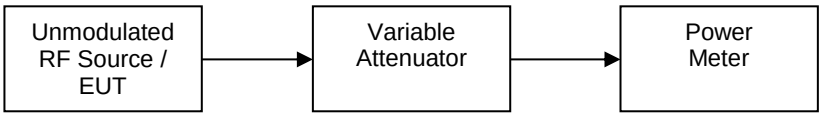


Figure 7.1.3 Peak output power test setup



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(c); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	10-Mar-21		
Temperature: 23 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1015 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE:	59-63 GHz
DETECTOR USED:	Peak
MEASUREMENTS DISTANCE:	1 m
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
EUT ANTENNA GAIN:	5 dBi
MODULATION:	FMCW

Frequency, MHz	λ*, m	DSO, mV	Power measured, dBm	Antenna Gain, dBi	E_{meas}**, dBuV/m	LNA Gain dB	EIRP***, dBm	Limit, dBm	Margin****, dB	Verdict
61000.0	0.004918	43.0	-7.07	24.0	141.894	25	12.19	43.0	-30.81	Pass

Note: Max peak conducted power is 12.19 dBm –5 dBi =7.19 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-LNA gain
**** - Margin = EIRP – Limit

Table 7.1.3 Average output power test results

OPERATING FREQUENCY RANGE:	59-63 GHz
DETECTOR USED:	Average
MEASUREMENTS DISTANCE:	1 m
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
EUT ANTENNA GAIN:	5 dBi
MODULATION:	FMCW

Frequency, MHz	λ*, m	DSO, mV	Power measured, dBm	Antenna Gain, dBi	E_{meas}**, dBuV/m	LNA Gain dB	EIRP***, dBm	Limit, dBm	Margin****, dB	Verdict
61000.0	0.004918	1.73	-22.1	24.0	126.86	25	-2.84	40.0	-42.84	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-LNA gain
**** - Margin = EIRP – Limit

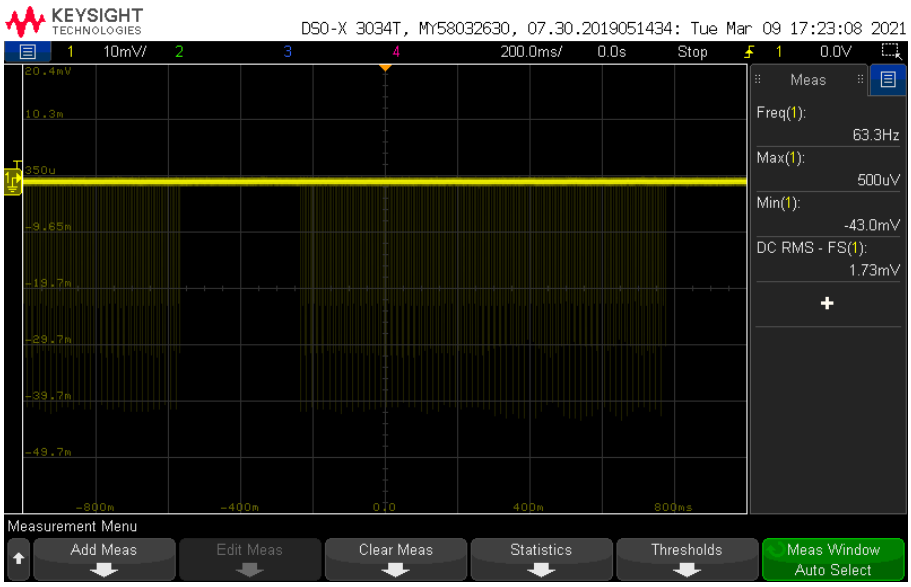
Reference numbers of test equipment used

HL 0771	HL 3290	HL 3291	HL 3293	HL 3301	HL 3302	HL 4343	HL 4856
HL 5360	HL 5409	HL 5380	HL 5376	HL 3727	HL 5377	HL 5369	HL 3304
HL 5958							

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(c); ANSI C63.10, Sections 9.4, 9.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Mar-21		
Temperature: 23 ºC	Relative Humidity: 42 %	Air Pressure: 1015 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.1.1 Output power test result



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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

7.2 Radiated emission measurements

7.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 7.2.1.

Table 7.2.1 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:

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

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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

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

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 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.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

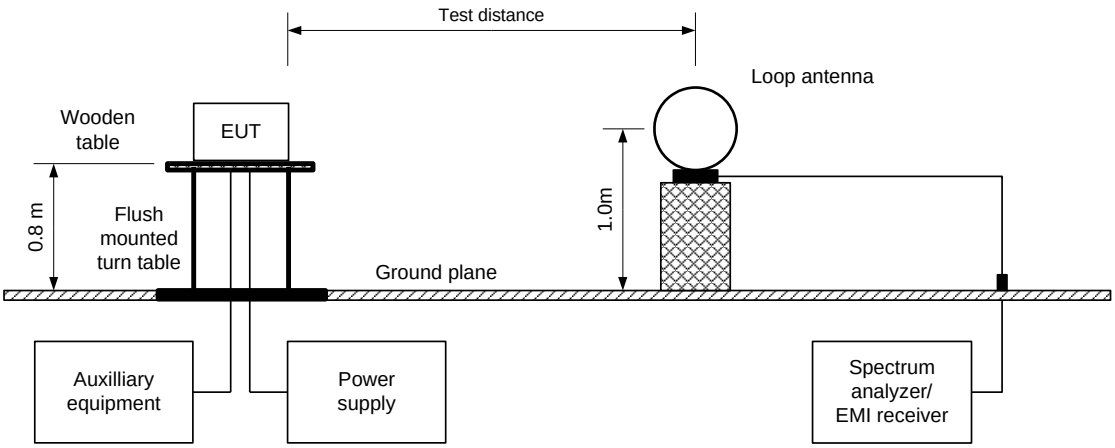
7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.2, Figure 7.2.3, energized and the performance check was conducted.

7.2.3.2 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.

7.2.3.3 The worst test results (the lowest margins) were recorded in Table 7.2.2, Table 7.2.3 and shown in the associated plots.

Figure 7.2.1 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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Figure 7.2.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz

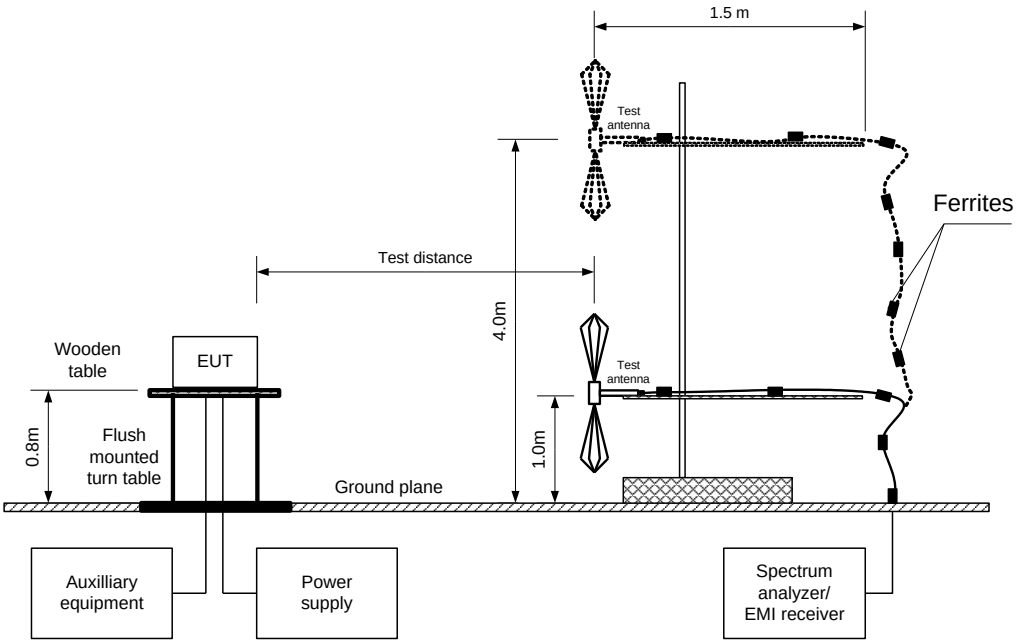
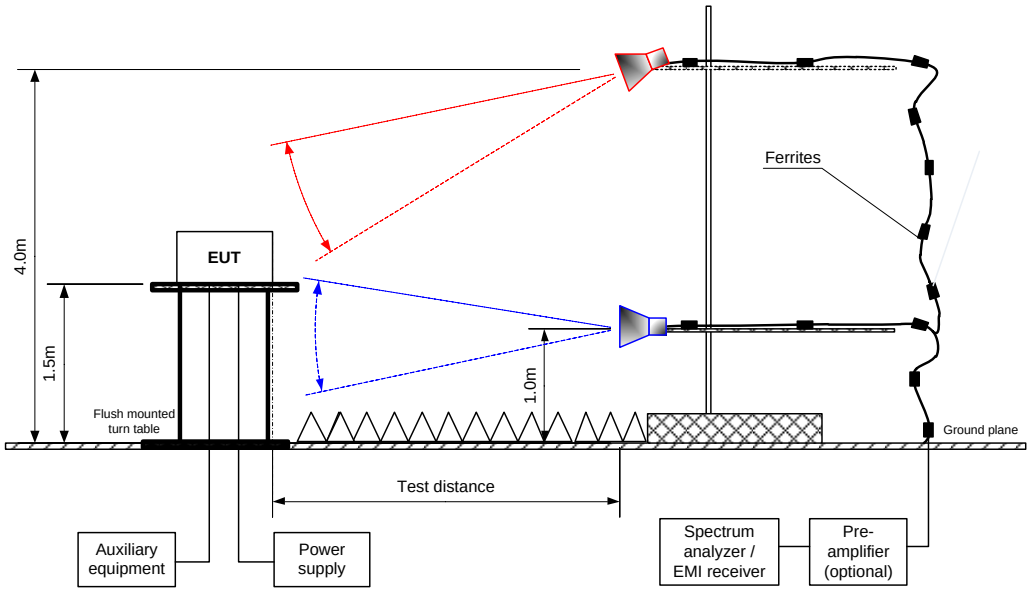


Figure 7.2.3 Setup for spurious emission field strength measurements above1000 MHz



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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.2.2 Field strength of emissions below 1 GHz

EUT SET UP: TABLE-TOP
EUT POSITION: Typical (Vertical)
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 9 kHz – 1000 MHz
VIDEO BANDWIDTH: ≥ Resolution bandwidth

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*				
Transmit with power adapter								Pass
32.75	33.29	28.63	40.0	-11.37	Vertical	1.01	131	
47.06	36.72	32.57	40.0	-7.43	Vertical	1.01	63	
64.37	36.55	33.37	40.0	-6.63	Vertical	1.02	243	
80.79	36.42	32.57	40.0	-7.43	Vertical	1.40	226	
119.77	33.76	28.11	43.5	-15.39	Vertical	1.26	92	
162.70	31.23	21.18	43.5	-22.32	Vertical	1.00	281	
259.46	33.23	27.43	46.0	-18.57	Vertical	1.25	172	
399.99	33.98	31.74	46.0	-14.26	Horizontal	1.00	180	
Transmit with battery power								Pass
No emissions were found.								

Table 7.2.3 Field strength of spurious emissions at frequencies above 1 GHz

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 40000 MHz
VIDEO BANDWIDTH: ≥ Resolution bandwidth

Frequency, MHz	Peak			Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
Transmit with power adapter										Pass
2400.22	44.91	74.0	-29.09	42.05	54.0	-11.95	Horizontal	1.30	190	
14400.01	53.87	74.0	-20.13	49.17	54.0	-4.83	Vertical	1.02	153	
Transmit with battery power										Pass
2400.17	46.06	74.0	-27.94	43.72	54.0	-10.28	Horizontal	1.28	188	
14400.01	54.08	74.0	-19.92	48.55	54.0	-5.45	Vertical	1.02	152	

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

Reference numbers of test equipment used

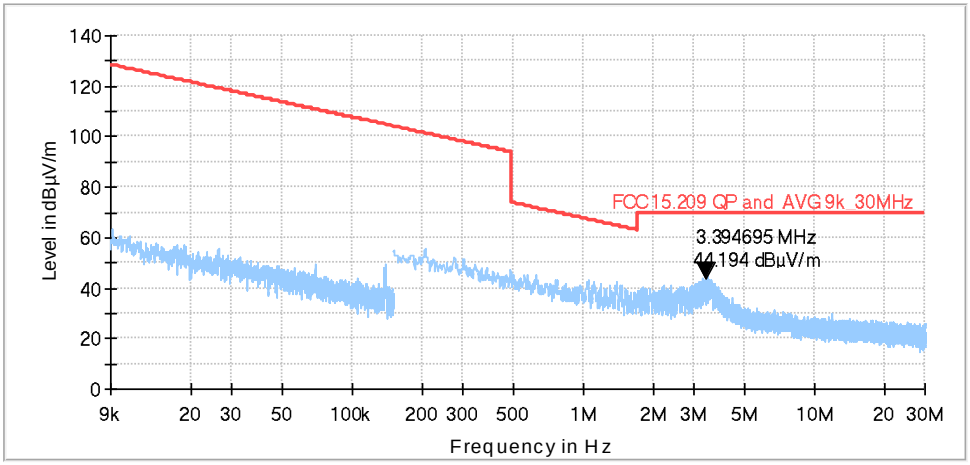
HL 5288	HL 5085	HL 3903	HL 4360	HL 4956	HL 4933	HL 5669	HL 5670
HL 0446							

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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

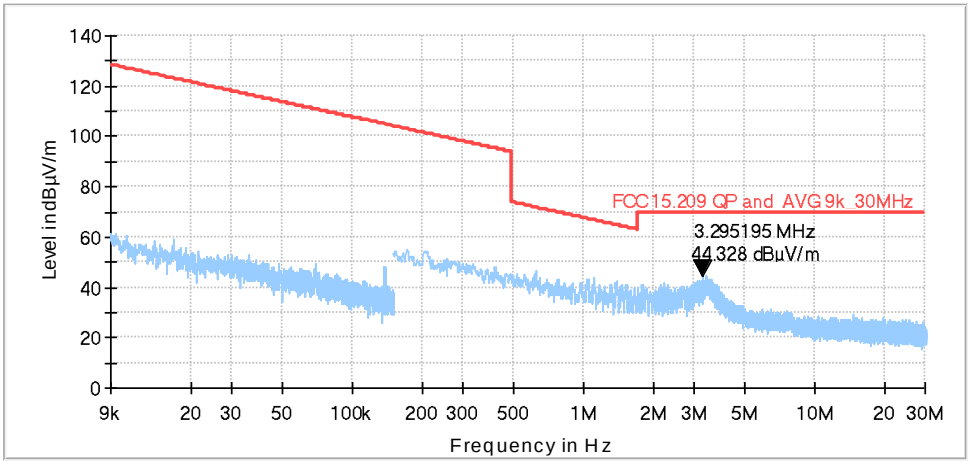
Plot 7.2.1 Radiated emission measurements in 9 kHz – 30 MHz, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with power adapter



Plot 7.2.2 Radiated emission measurements in 9 kHz – 30 MHz, vertical and horizontal antenna polarization

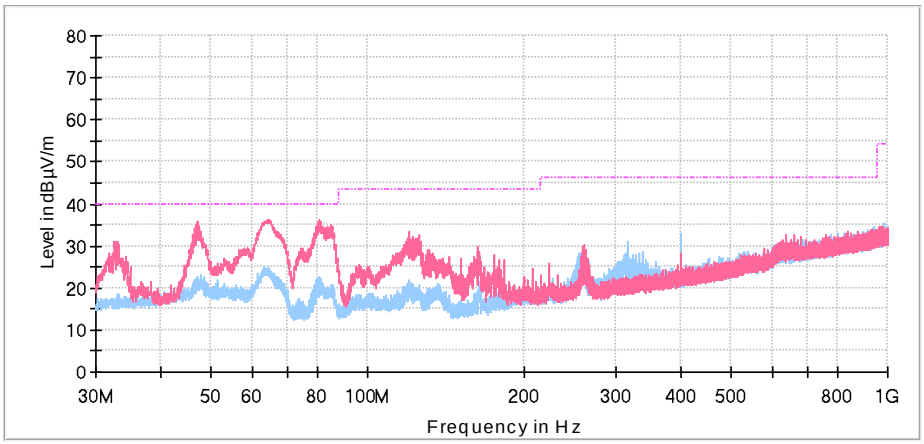
TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with battery power



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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

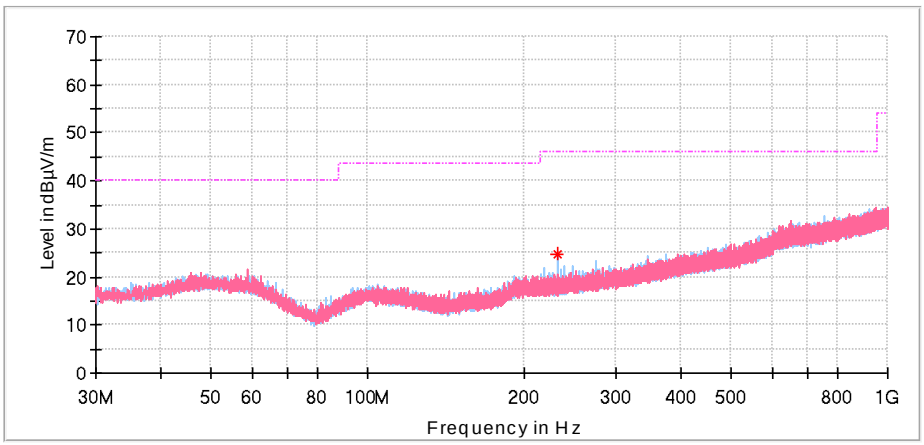
Plot 7.2.3 Radiated emission measurements in 30 - 1000 MHz range, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with power adapter



Plot 7.2.4 Radiated emission measurements in 30 - 1000 MHz range, vertical and horizontal antenna polarization

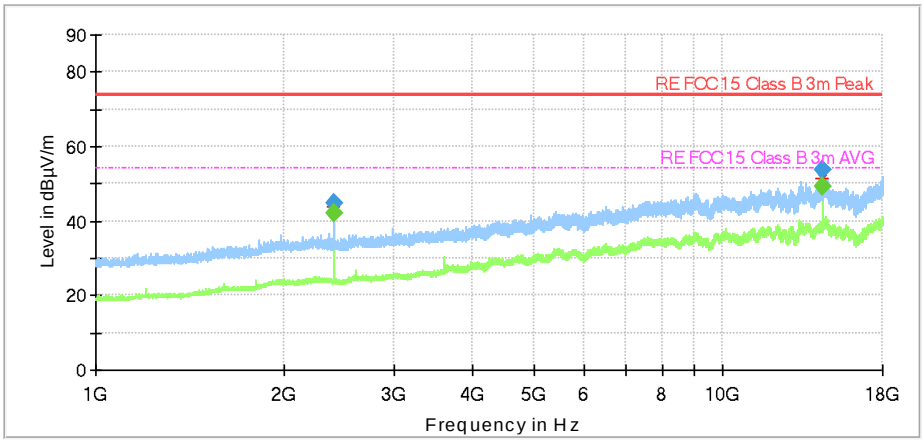
TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with battery power



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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

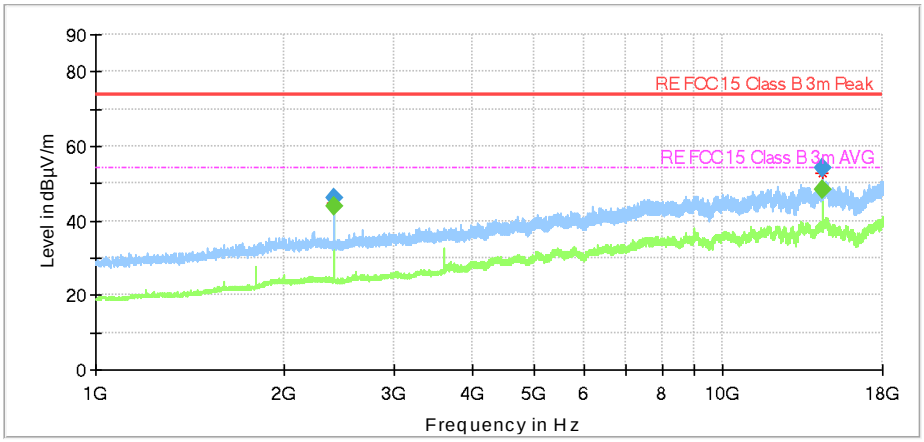
Plot 7.2.5 Radiated emission measurements in 1 – 18 GHz, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with power adapter



Plot 7.2.6 Radiated emission measurements in 1 – 18 GHz, vertical and horizontal antenna polarization

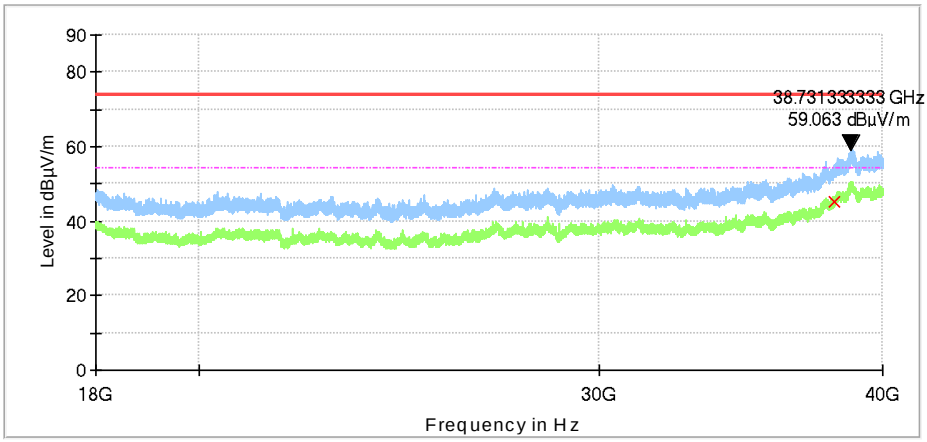
TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with battery power



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):	02-Nov-20 - 29-Nov-20		
Temperature: 24.3 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

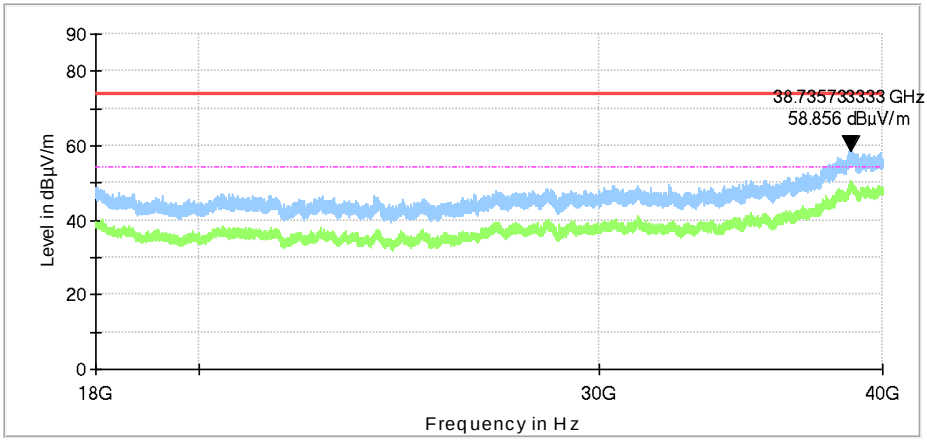
Plot 7.2.7 Radiated emission measurements in 18 – 40 GHz, vertical and horizontal antenna polarization

]TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with power adapter



Plot 7.2.8 Radiated emission measurements in 18 – 40 GHz, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
EUT POSITION:	Typical (Vertical)
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Transmit with battery power



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-Nov-20		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1016 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

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

7.3.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Radiated spurious emission test 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 – 220	90.0	3.0	105.30	85.30
75 - 110	90.0	0.50	120.90**	100.90**
110 - 140	90.0	0.05	140.90**	120.90**
140 - 200	90.0	0.01	154.80**	134.80**

* - Field strength was calculated per equation (26) of ANSI C63.10-2013 section 9 as follows: E=sqrt(PD×377), where PD is the power density at the distance specified by the limit in W/m^2, E- field strength in V/m.
**- The limit for other test distance was calculated using the inverse distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

7.3.2 Test procedure for spurious emission field strength measurements

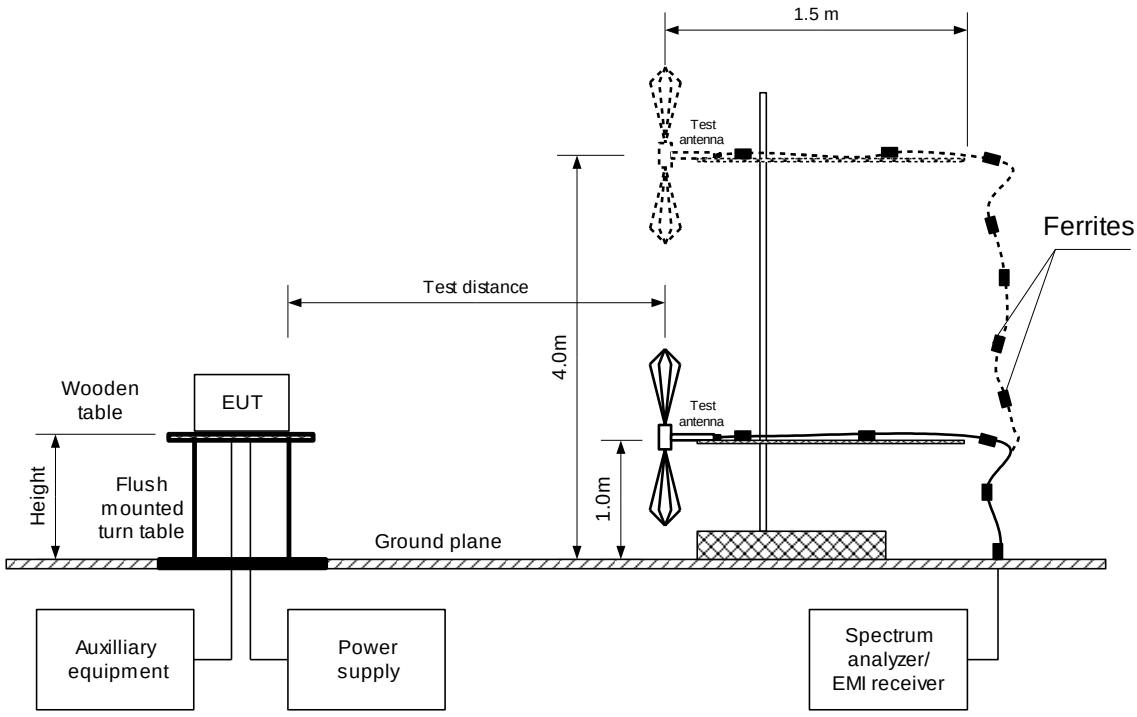
7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and the performance check was conducted.

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, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.3.2.3 The test results are given in Table 7.3.2 and 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-Nov-20		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1016 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Figure 7.3.1 Radiated emissions 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-Nov-20		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1016 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.3.2 Out of band radiated emissions test results

TEST DISTANCE:	0.05 - 3 m
EUT POSITION:	Typical (Vertical)
MODULATION:	FM CW
TRANSMITTER OUTPUT POWER:	Maximum
INVESTIGATED FREQUENCY RANGE:	40 – 200 GHz
RESOLUTION BANDWIDTH:	1000 kHz
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Standard Gain Horn 24dB (40-60 GHz) Standard Gain Horn 24dB (50-75 GHz) Standard Gain Horn 24dB (75-110 GHz) Standard Gain Horn 24dB (90-140 GHz) Standard Gain Horn 24dB (140-220 GHz)
CARRIER FREQUENCY:	61000 MHz

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=10 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**	
All emission were found at least 15 dB below the limit										Pass

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

Reference numbers of test equipment used

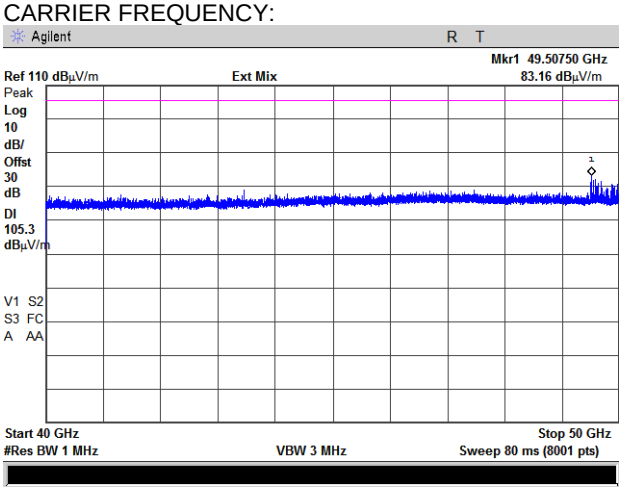
HL 2909	HL3433	HL 3434	HL 3235	HL 3290	HL 0770	HL 3305	HL 3294
HL 1301	HL 3291	HL 0771	HL 3306	HL 3297	HL 0747	HL 3536	HL 1312
HL 3329	HL 0772						

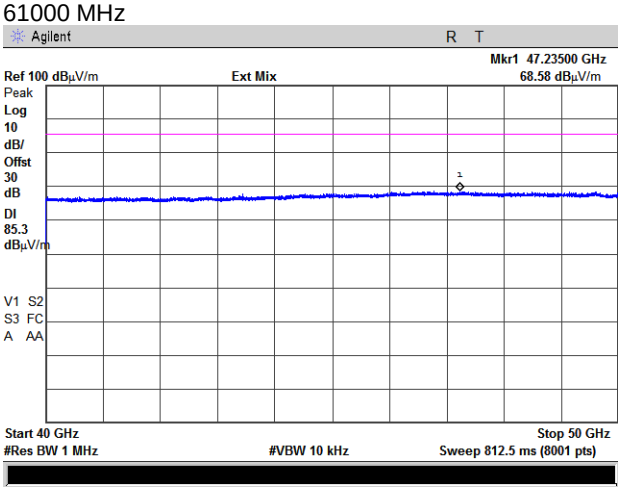
Full description is given in Appendix A.

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-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.1 Spurious emission measurements in 40 – 50 GHz range

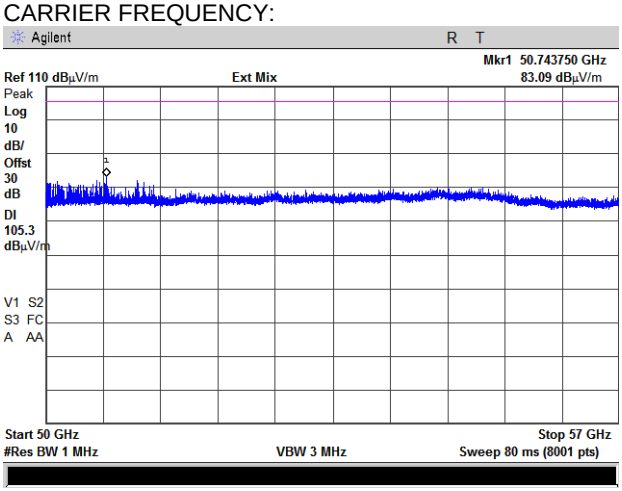
TEST SITE: OATS
TEST DISTANCE: 3 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
CARRIER FREQUENCY: 61000 MHz

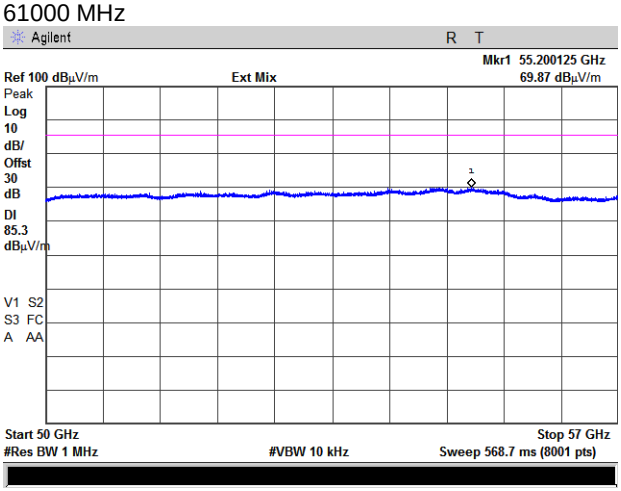




Plot 7.3.2 Spurious emission measurements in 50 – 57 GHz range

TEST SITE: OATS
TEST DISTANCE: 3 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
CARRIER FREQUENCY: 61000 MHz

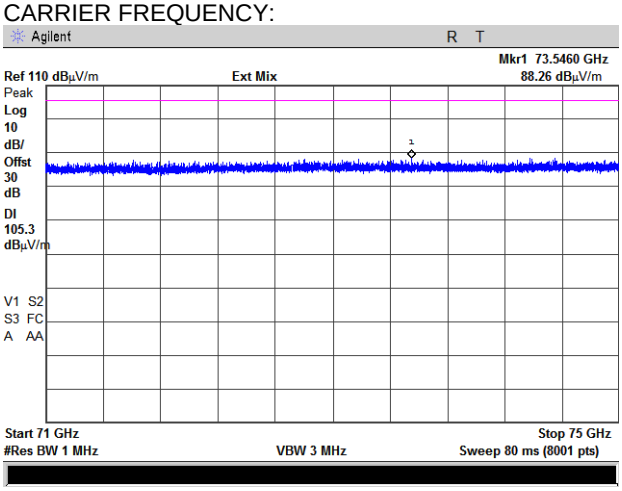


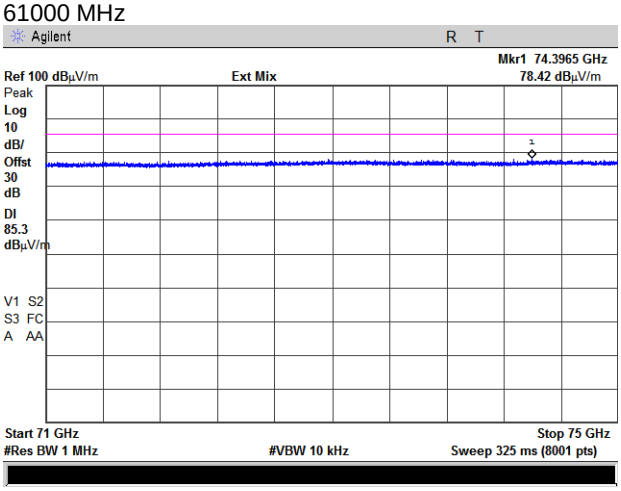


Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.3 Spurious emission measurements in 71 – 75 GHz range

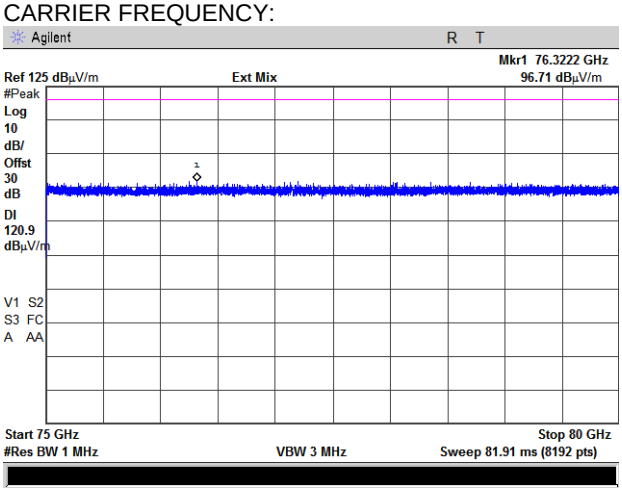
TEST SITE: OATS
TEST DISTANCE: 3 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

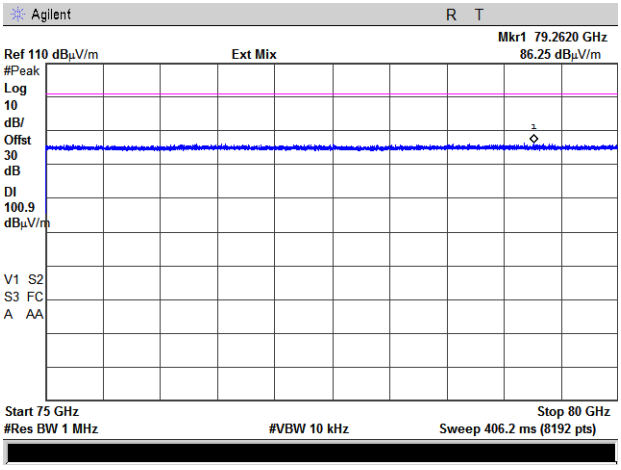




Plot 7.3.4 Spurious emission measurements in 75 – 80 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.5 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

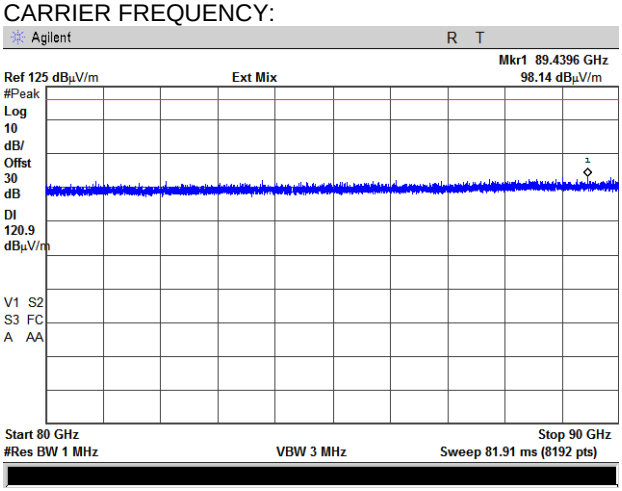


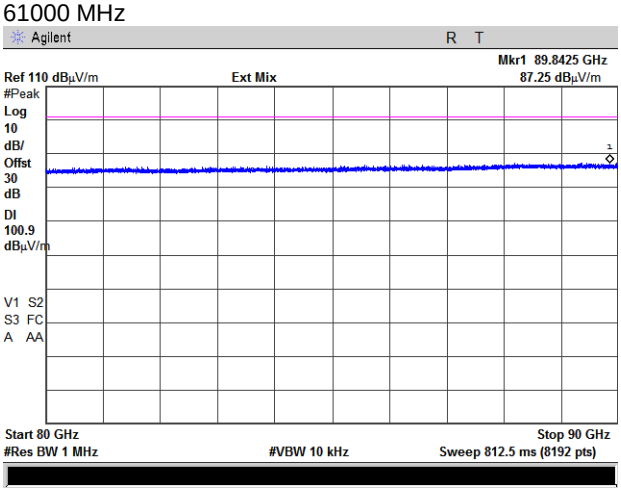


Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.5 Spurious emission measurements in 80 – 90 GHz range

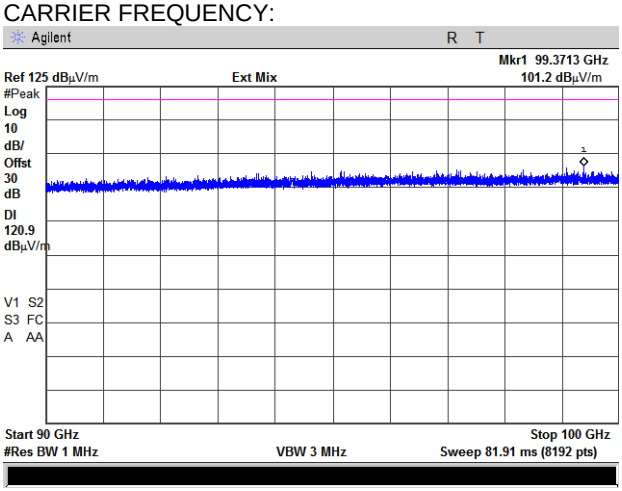
TEST SITE: OATS
TEST DISTANCE: 0.5 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

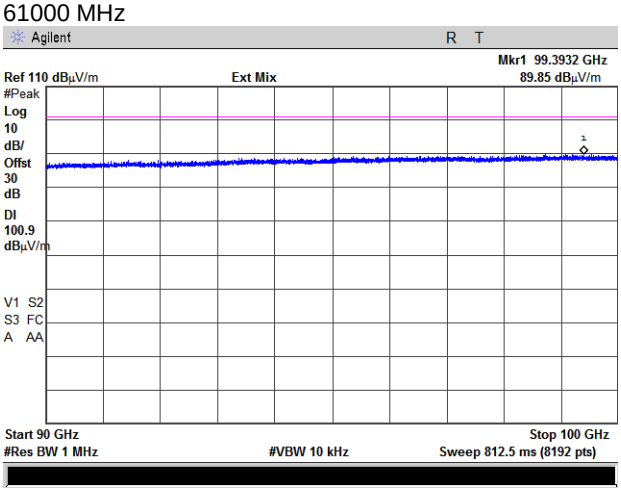




Plot 7.3.6 Spurious emission measurements in 90 - 100 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.5 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

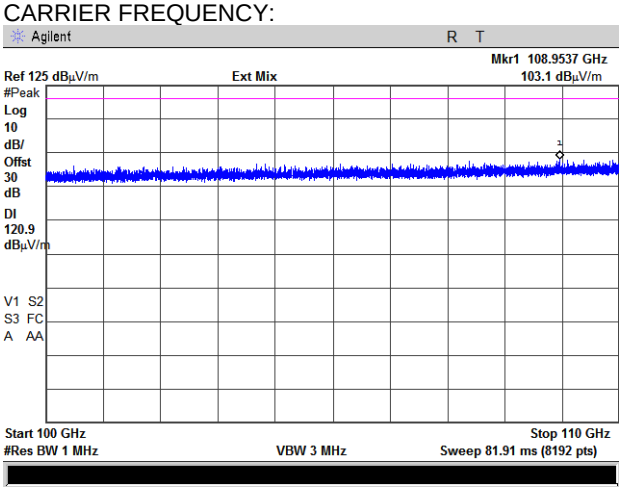


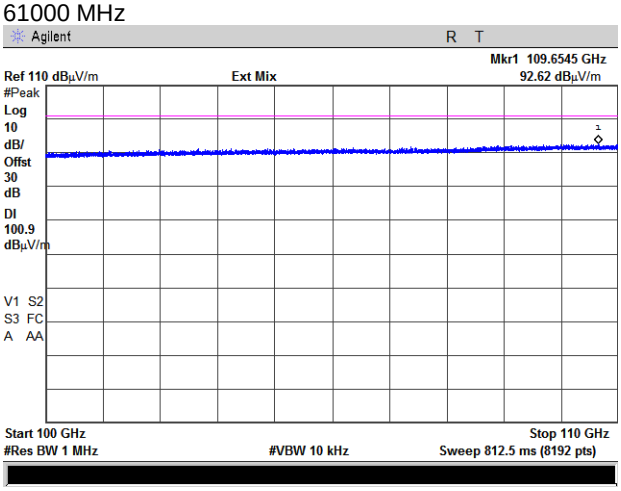


Test specification:	**FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz**		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1016 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 7.3.7 Spurious emission measurements in 100 - 110 GHz range

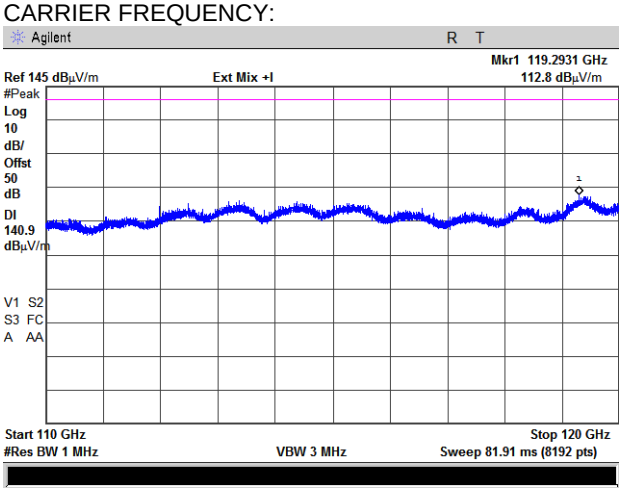
TEST SITE: OATS
TEST DISTANCE: 0.5 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

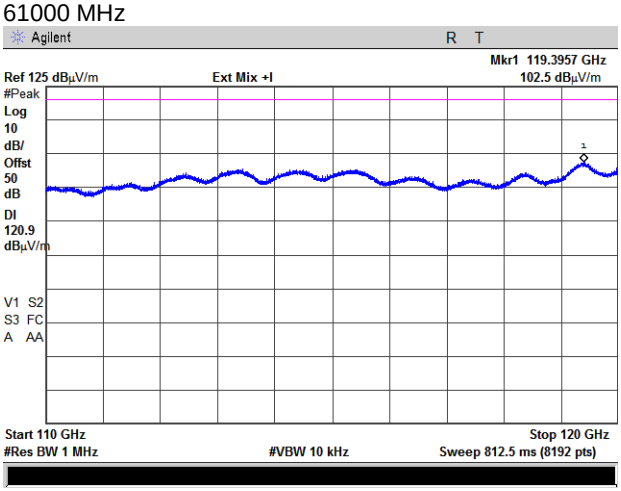




Plot 7.3.8 Spurious emission measurements in 110 - 120 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.05 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

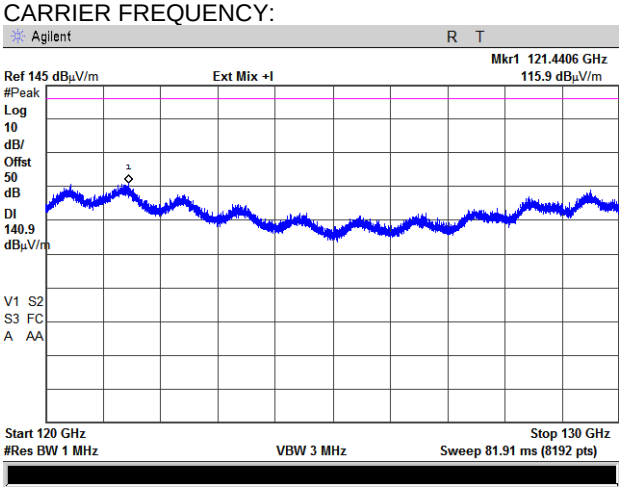


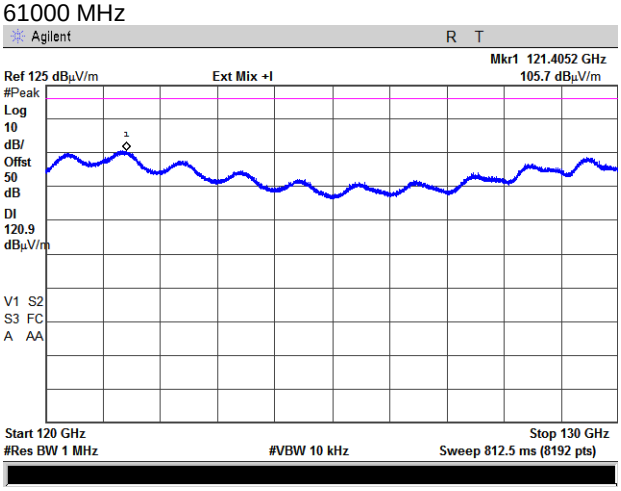


Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.9 Spurious emission measurements in 120 - 130 GHz range

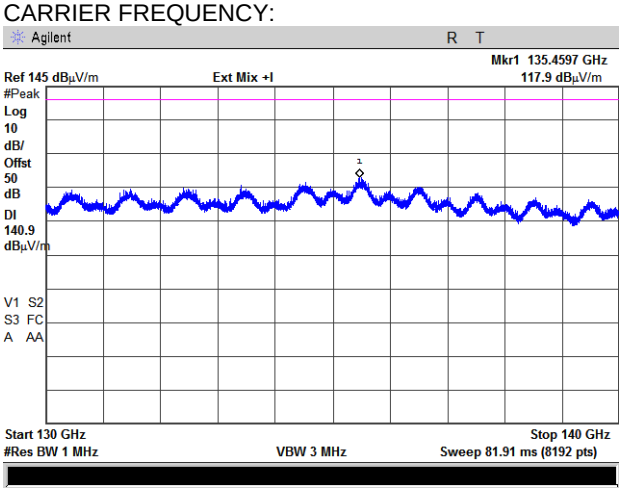
TEST SITE: OATS
TEST DISTANCE: 0.05 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

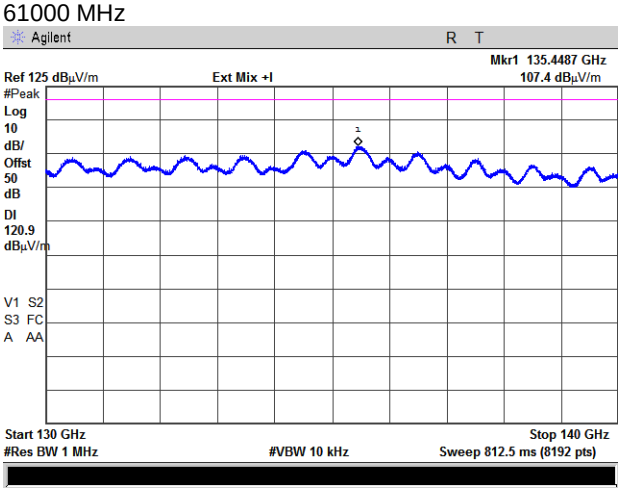




Plot 7.3.10 Spurious emission measurements in 130 - 140 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.05 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

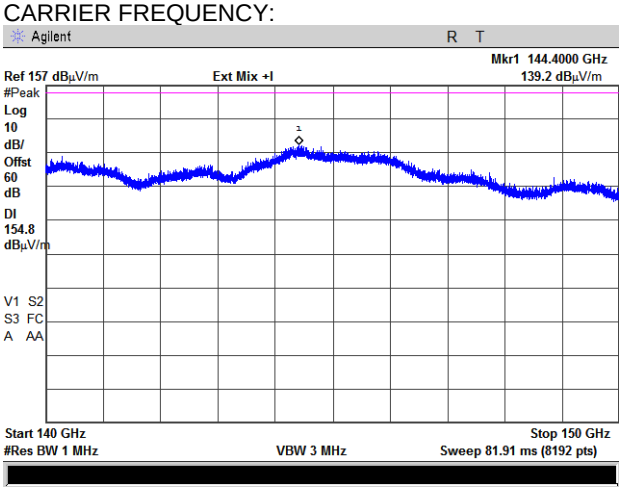


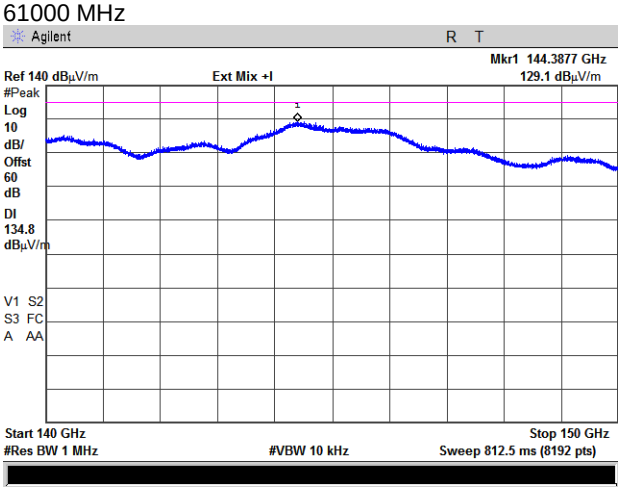


Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.11 Spurious emission measurements in 140 - 150 GHz range

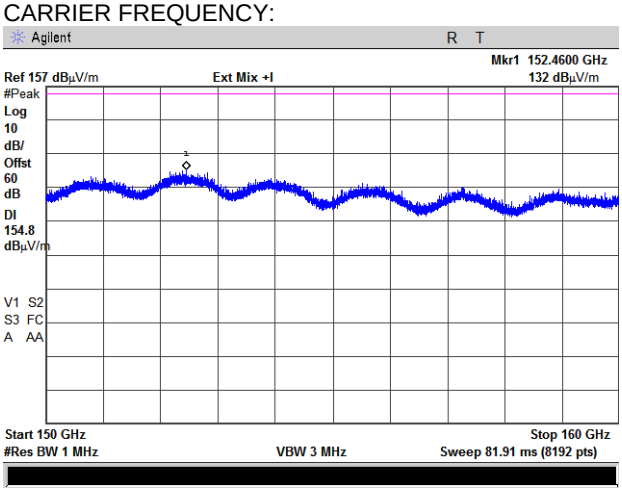
TEST SITE: OATS
TEST DISTANCE: 0.01 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
CARRIER FREQUENCY: 61000 MHz

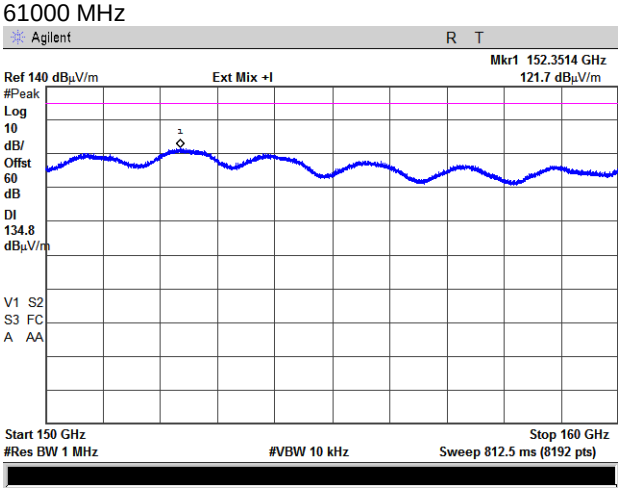




Plot 7.3.12 Spurious emission measurements in 150 - 160 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.01 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
CARRIER FREQUENCY: 61000 MHz

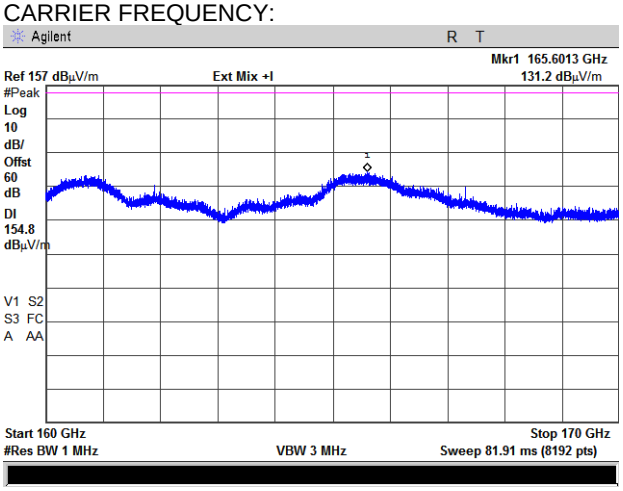


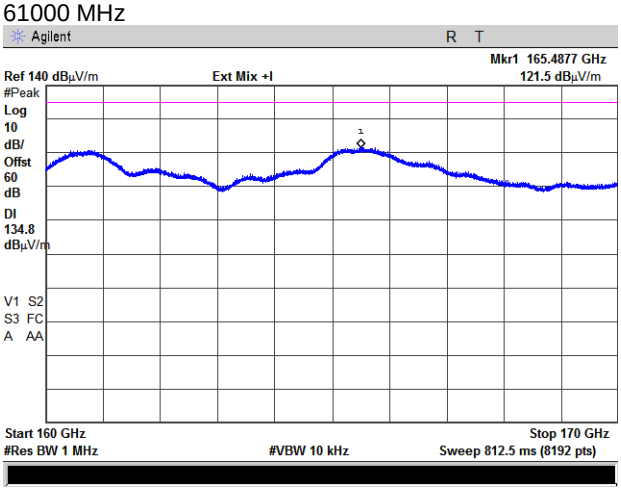


Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.13 Spurious emission measurements in 160 - 170 GHz range

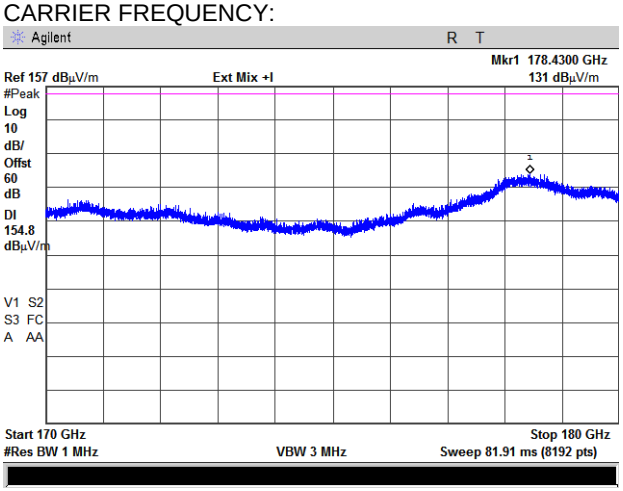
TEST SITE: OATS
TEST DISTANCE: 0.01 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

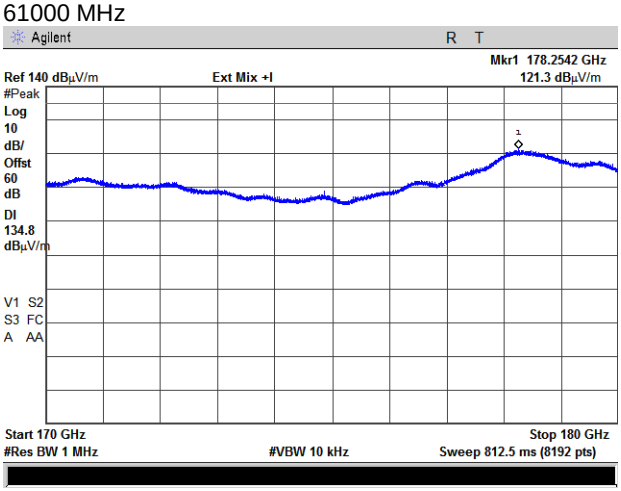




Plot 7.3.14 Spurious emission measurements in 170 - 180 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.01 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
CARRIER FREQUENCY: 61000 MHz

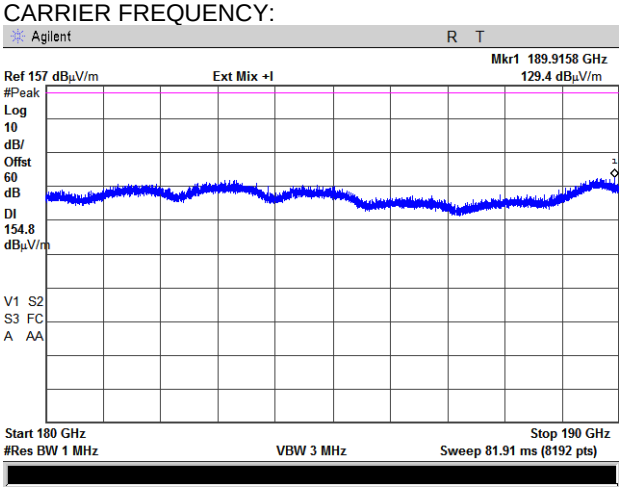


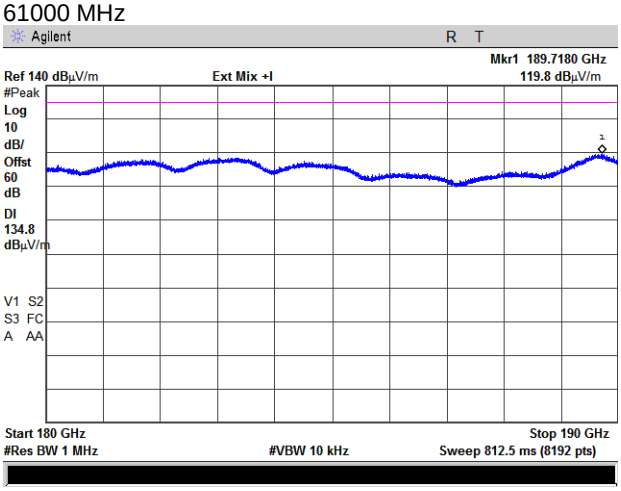


Test specification:	FCC Section 15.255(d)(3), RSS-210 section J.3, Out of band radiated emissions above 40 GHz		
Test procedure:	ANSI C63.10, Sections 9.9, 9.12		
Test mode:	Compliance	Verdict:	PASS
Date(s):	18-Nov-20		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1016 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.15 Spurious emission measurements in 180 - 190 GHz range

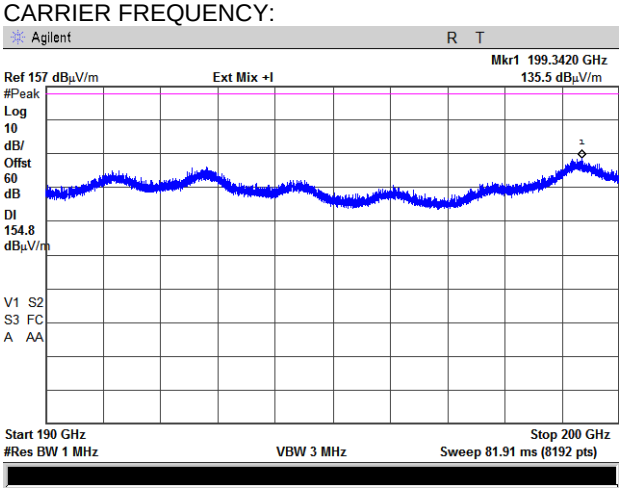
TEST SITE: OATS
TEST DISTANCE: 0.01 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
CARRIER FREQUENCY: 61000 MHz

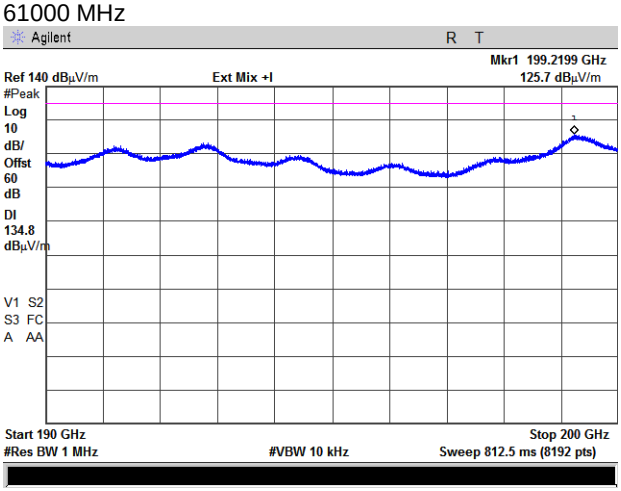




Plot 7.3.16 Spurious emission measurements in 190 - 200 GHz range

TEST SITE: OATS
TEST DISTANCE: 0.01 m
MODULATION: FM CW
ANTENNA POLARIZATION: Vertical and Horizontal
DETECTOR: Peak RBW = 1 MHz; VBW = 3 MHz
DETECTOR: Peak RBW = 1 MHz; VBW = 10 kHz
CARRIER FREQUENCY: 61000 MHz





Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

7.4 Frequency stability test

7.4.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Frequency stability limits

Assigned frequency band, MHz	Limit	Spurious emission limit			
		Power density at 3 m distance pW/cm^2	Distance, m	Field strength dB(μV/m)*, peak	Field strength dB(μV/m)*, average
57000 – 71000	The signal must be contained within assigned frequency band	90.0	3.0	105.30	85.30
		90.0	0.1	134.84**	114.84**

* - Field strength was calculated per equation (26) of ANSI C63.10-2013 section 9 as follows: E=sqrt(PD×377), where PD is the power density at the distance specified by the limit in W/m^2, E- field strength in V/m.
**- The limit for other test distance was calculated using the inverse distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

7.4.2.2 The EUT power was turned off. Temperature within test chamber was set to +20˚C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

7.4.2.3 The EUT was powered on and transmission frequency band was captured at start up moment and after 10 minutes of transmission.

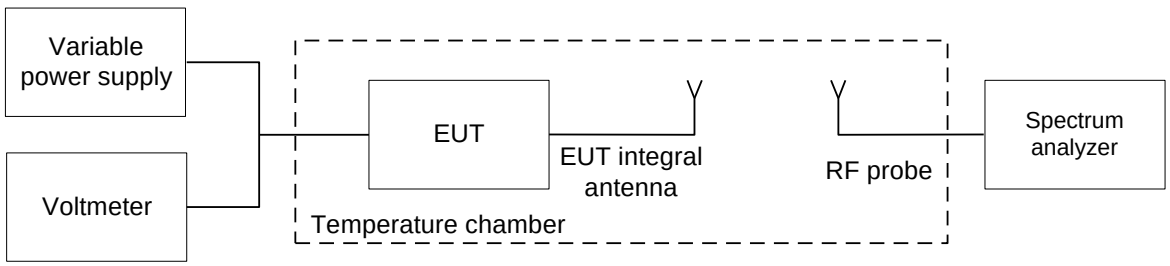
7.4.2.4 The EUT was powered off.

7.4.2.5 The above procedure was repeated at the rest of the test temperatures and voltages as provided in Table 7.4.2.

7.4.2.6 The EUT was powered off.

7.4.2.7 Transmission frequency band was compared with the limit as provided in Table 7.4.2.

Figure 7.4.1 Frequency stability test setup



Test specification:	**FCC section 15.255(f)/RSS-210 section J.6, Frequency stability**		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1013 hPa	**Power:** 6 VDC
Remarks:			

Table 7.4.2 Frequency stability test results

OPERATING FREQUENCY:	59000 – 63000 MHz
NOMINAL POWER VOLTAGE:	6 V
TEMPERATURE STABILIZATION PERIOD:	20 min
POWER DURING TEMPERATURE TRANSITION:	Off
RESOLUTION BANDWIDTH:	1 MHz
VIDEO BANDWIDTH:	3 MHz
MODULATION:	FMCW

T, ºC	**Voltage, V**	**Transmission frequency band, MHz**		**Assigned frequency band, MHz**	**Verdict**
		Start up	**After 10 min**		
-20	nominal	59422 - 62642	59422 - 62642	57000 - 71000	Pass
-10	nominal	59422 - 62642	59422 - 62642		
0	nominal	59422 - 62642	59422 - 62642		
10	nominal	59422 - 62642	59422 - 62642		
20	+15%	59418 - 62642	59418 - 62656		
20	nominal	59418 - 62642	59418 - 62642		
20	-15%	59418 - 62642	59418 - 62642		
30	nominal	59418 - 62642	59418 - 62642		
40	nominal	59418 - 62642	59418 - 62642		
50	nominal	59422 - 62642	59422 - 62642		
55	nominal	59422 - 62642	59422 - 62642		

* - Reference frequency

Reference numbers of test equipment used

HL 0771	HL 1842	HL 2171	HL 2909	HL 3305	HL 3433	HL3434	

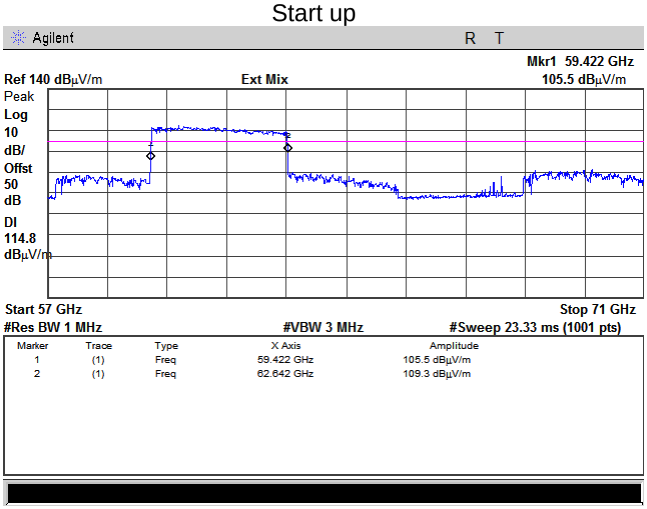
Full description is given in Appendix A.

Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

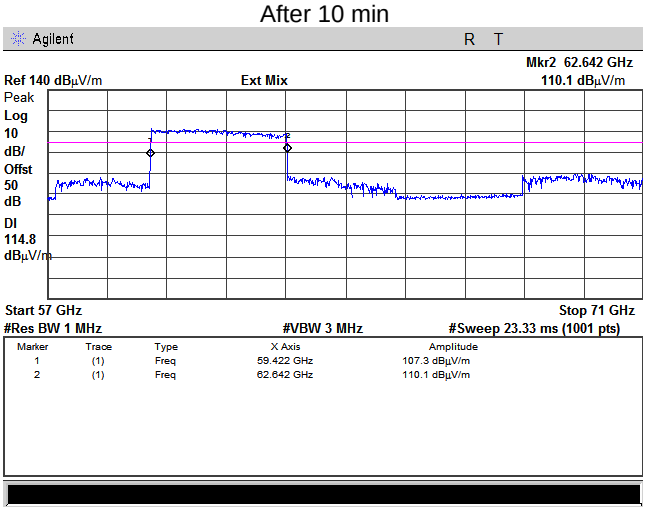
Plot 7.4.1 Frequency stability

TEMPERATURE: -20°C
VOLTAGE: Nominal

Start up



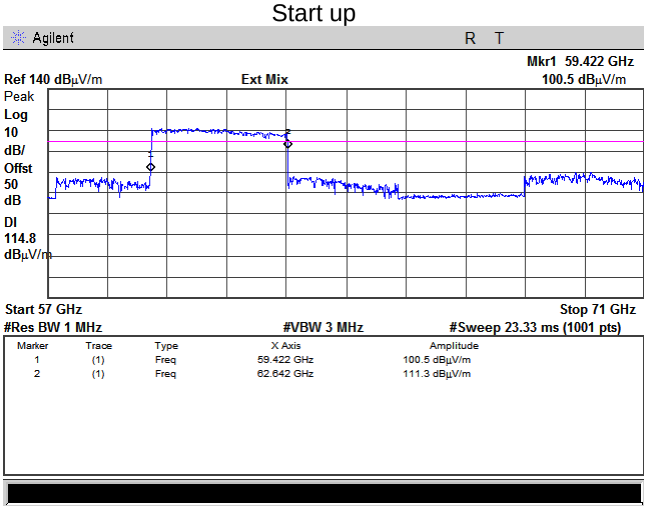
After 10 min



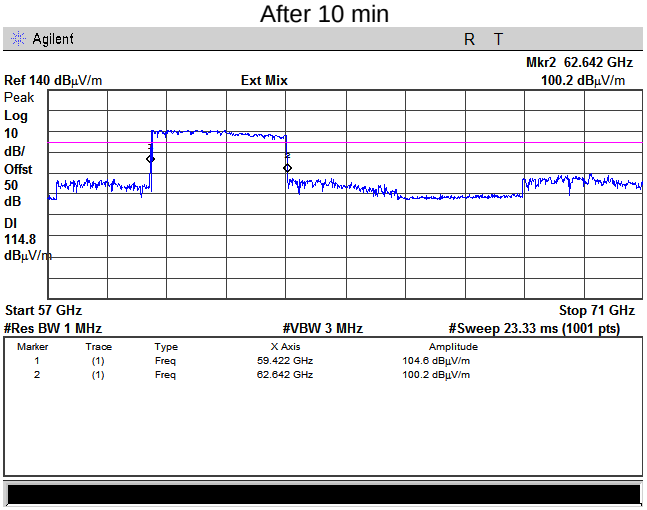
Plot 7.4.2 Frequency stability

TEMPERATURE: -10°C
VOLTAGE: Nominal

Start up



After 10 min

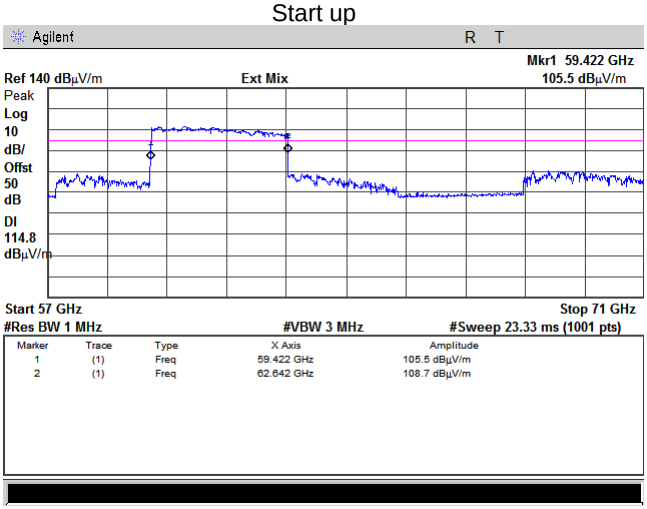


Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

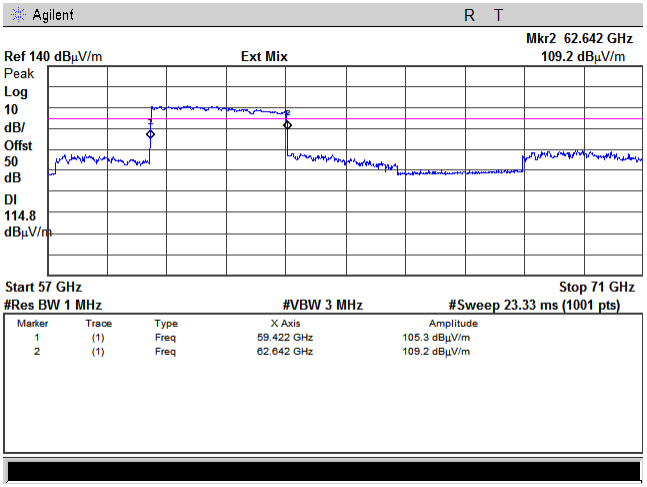
Plot 7.4.3 Frequency stability

TEMPERATURE: 0°C
VOLTAGE: Nominal

Start up



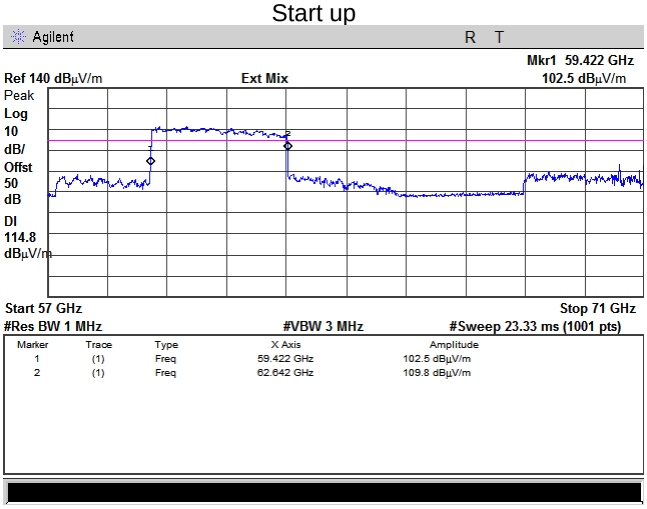
After 10 min



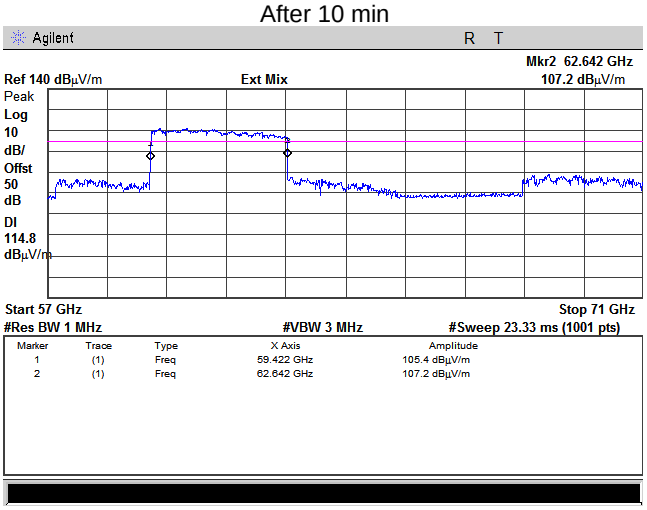
Plot 7.4.4 Frequency stability

TEMPERATURE: 10°C
VOLTAGE: Nominal

Start up



After 10 min

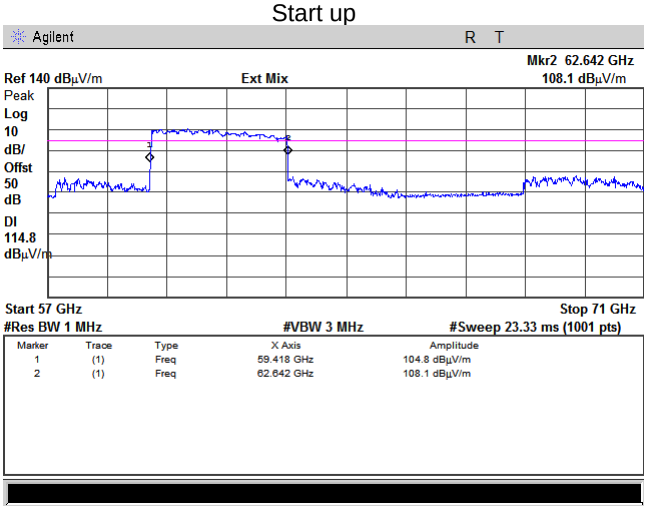


Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

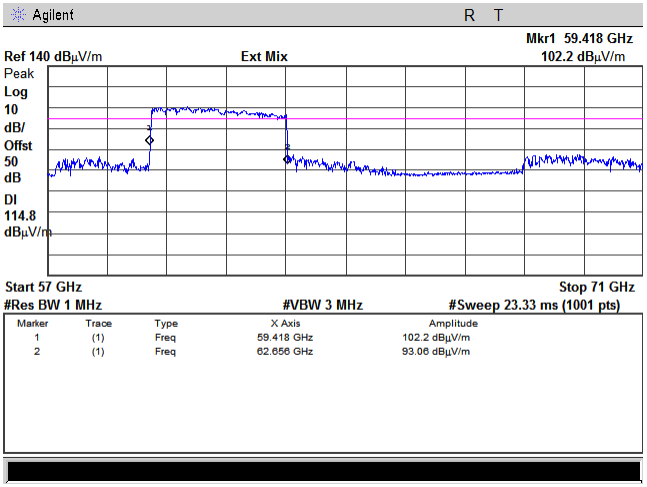
Plot 7.4.5 Frequency stability

TEMPERATURE: 20°C
VOLTAGE: +15%

Start up



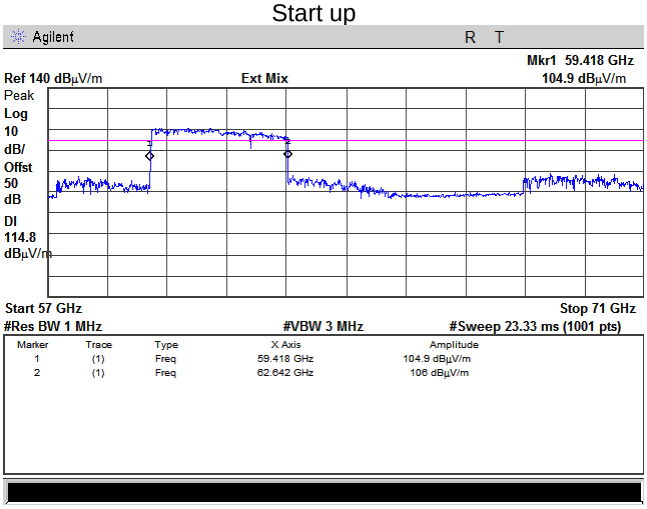
After 10 min



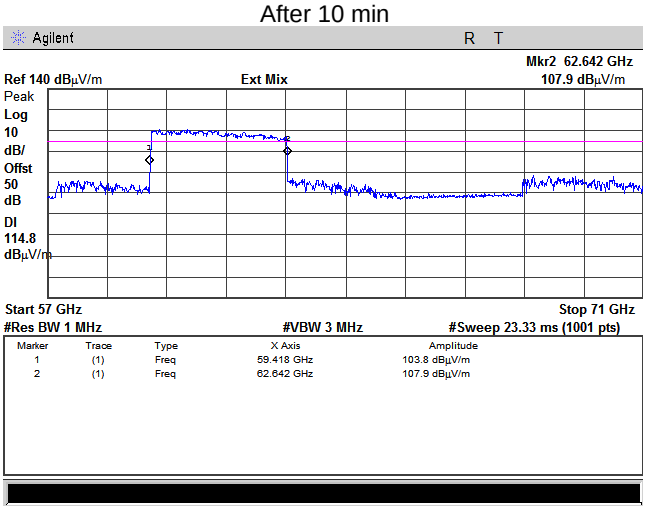
Plot 7.4.6 Frequency stability

TEMPERATURE: 20°C
VOLTAGE: Nominal

Start up



After 10 min

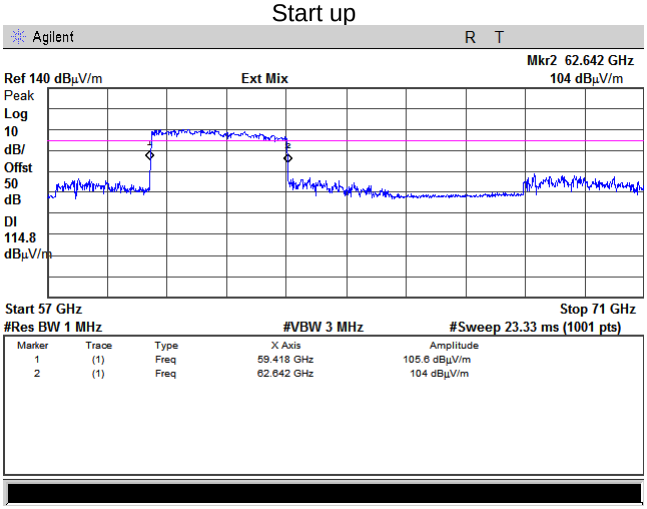


Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

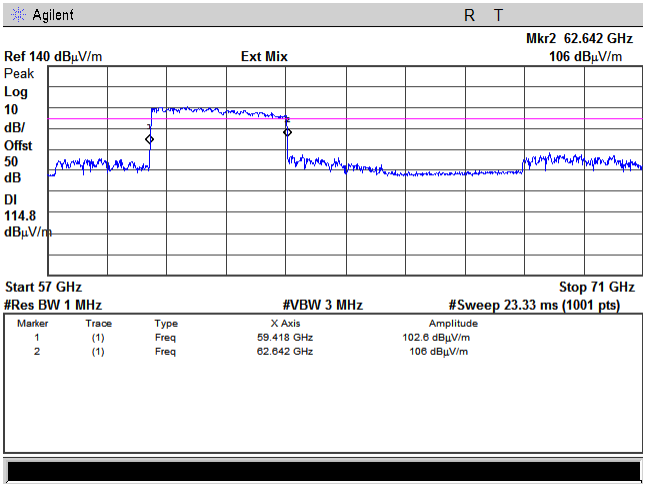
Plot 7.4.7 Frequency stability

TEMPERATURE: 20°C
VOLTAGE: -15%

Start up



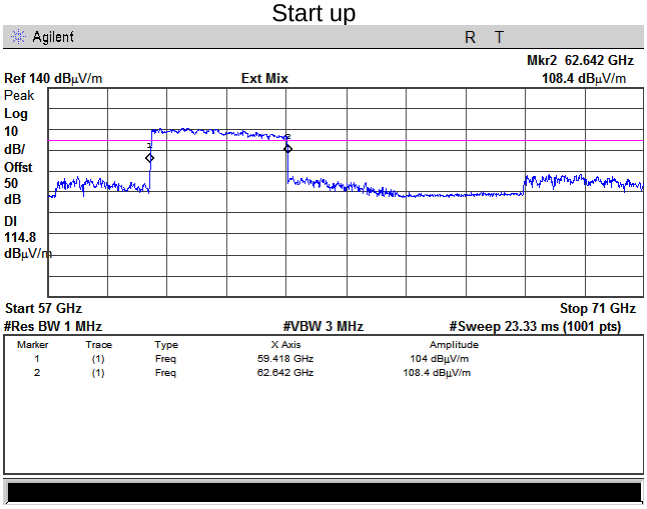
After 10 min



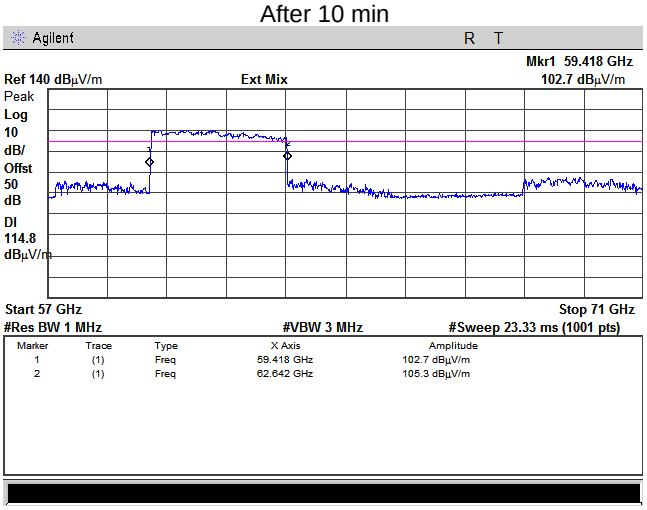
Plot 7.4.8 Frequency stability

TEMPERATURE: 30°C
VOLTAGE: Nominal

Start up



After 10 min

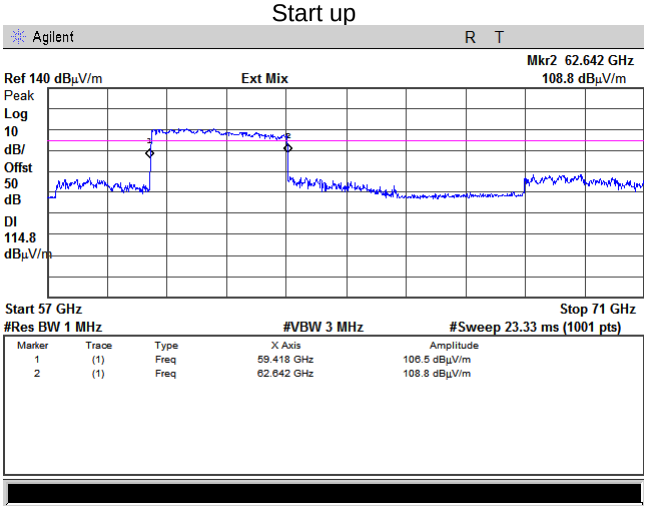


Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

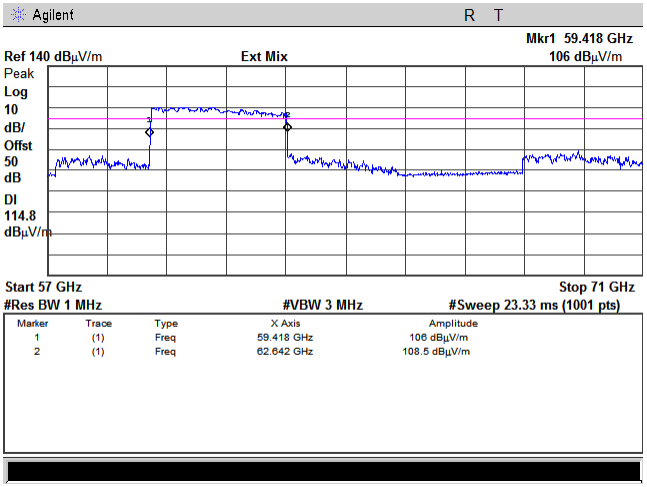
Plot 7.4.9 Frequency stability

TEMPERATURE: 40°C
VOLTAGE: Nominal

Start up



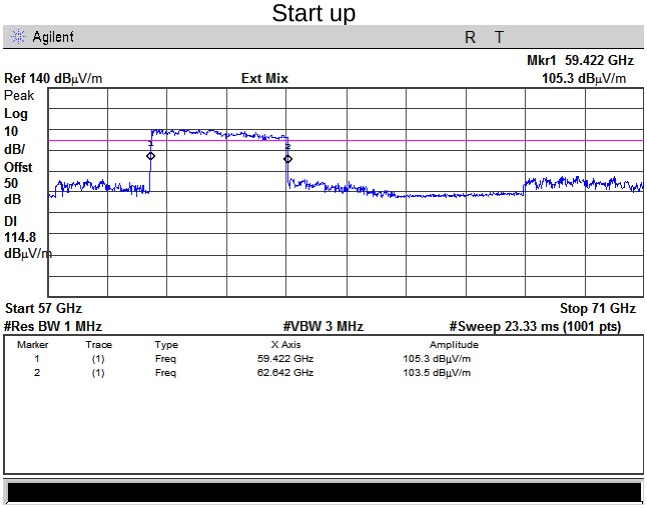
After 10 min



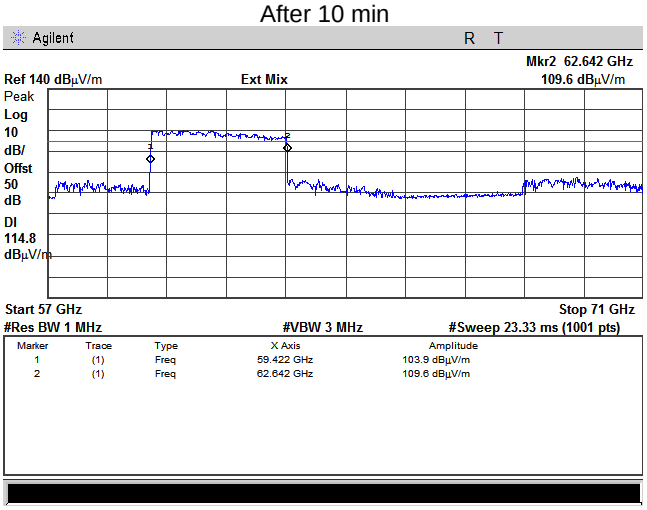
Plot 7.4.10 Frequency stability

TEMPERATURE: 50°C
VOLTAGE: Nominal

Start up



After 10 min

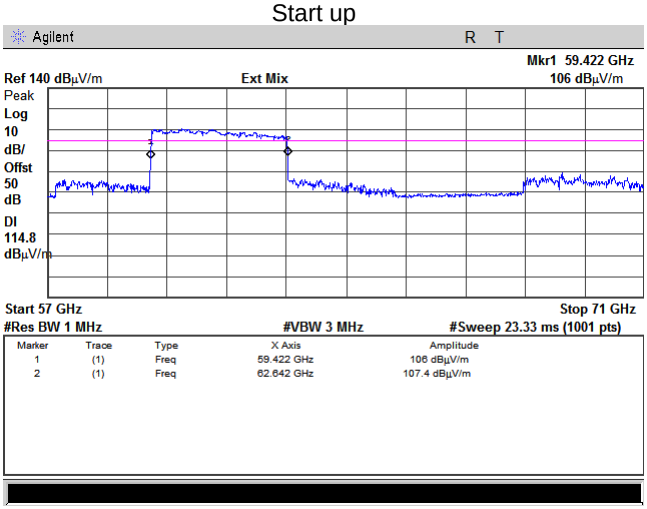


Test specification:	FCC section 15.255(f)/RSS-210 section J.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 9.14		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

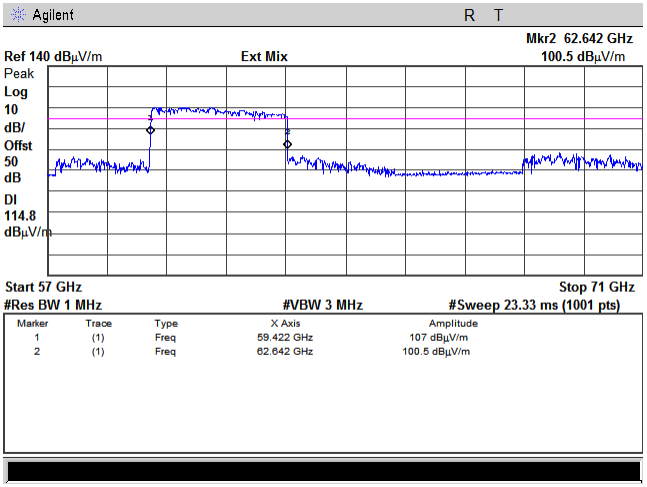
Plot 7.4.11 Frequency stability

TEMPERATURE: 55°C
VOLTAGE: Nominal

Start up



After 10 min



Test specification:	FCC Section 15.207(a)/RSS-Gen 8.8, Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	Relative Humidity: 51 %	Air Pressure: 1014 hPa	Power: 120 VAC, 60 Hz
Remarks:			

7.5 Conducted emissions

7.5.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5.0	56	46
5.0 - 30	60	50

* The limit decreases linearly with the logarithm of frequency.

7.5.2 Test procedure

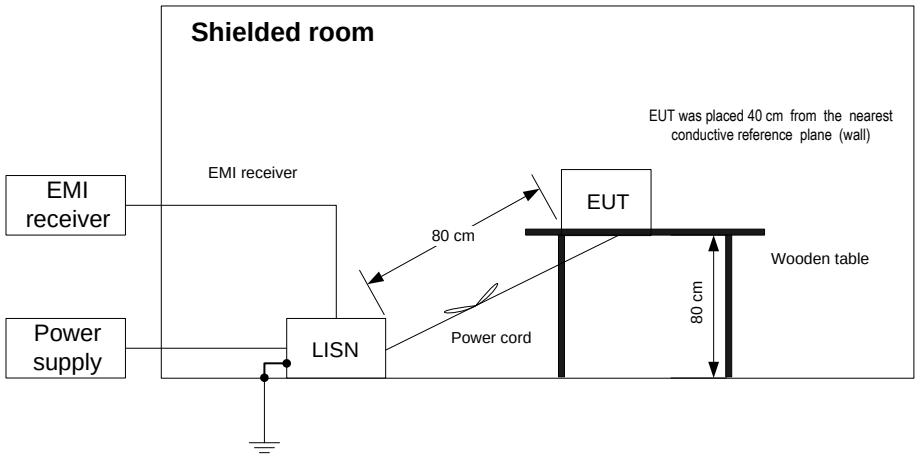
7.5.2.1 The EUT was set up as shown in Figure 7.5.1 and associated photographs, energized and the performance check was conducted.

7.5.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.5.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

7.5.2.3 The position of the device cables was varied to determine maximum emission level.

7.5.2.4 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

Figure 7.5.1 Setup for conducted emission measurements, table-top equipment



Test specification:	**FCC Section 15.207(a)/RSS-Gen 8.8, Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.5.2 Conducted emission test results

LINE: AC mains
EUT OPERATING MODE: Transmit
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	**Peak emission, dB(µV)**	**Quasi-peak**			**Average**			**Line ID**	**Verdict**
		Measured emission, dB(µV)	**Limit, dB(µV)**	**Margin, dB***	**Measured emission, dB(µV)**	**Limit, dB(µV)**	**Margin, dB***		
All emission were found at least 20 dB below the limit								L1	Pass
All emission were found at least 20 dB below the limit								L2	Pass

*****- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

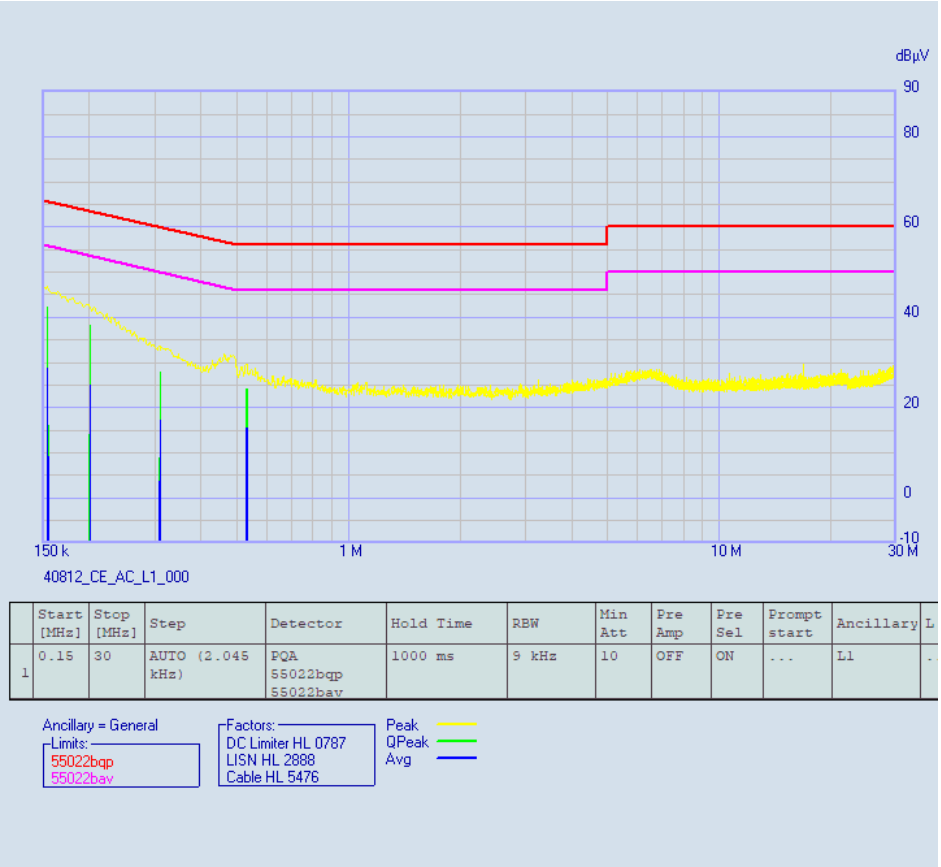
HL 5707	HL 5476	HL 2888	HL 0787				

Full description is given in Appendix A.

Test specification:	**FCC Section 15.207(a)/RSS-Gen 8.8, Conducted emission**		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 7.5.1 Conducted emission measurements

LINE: L1
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK

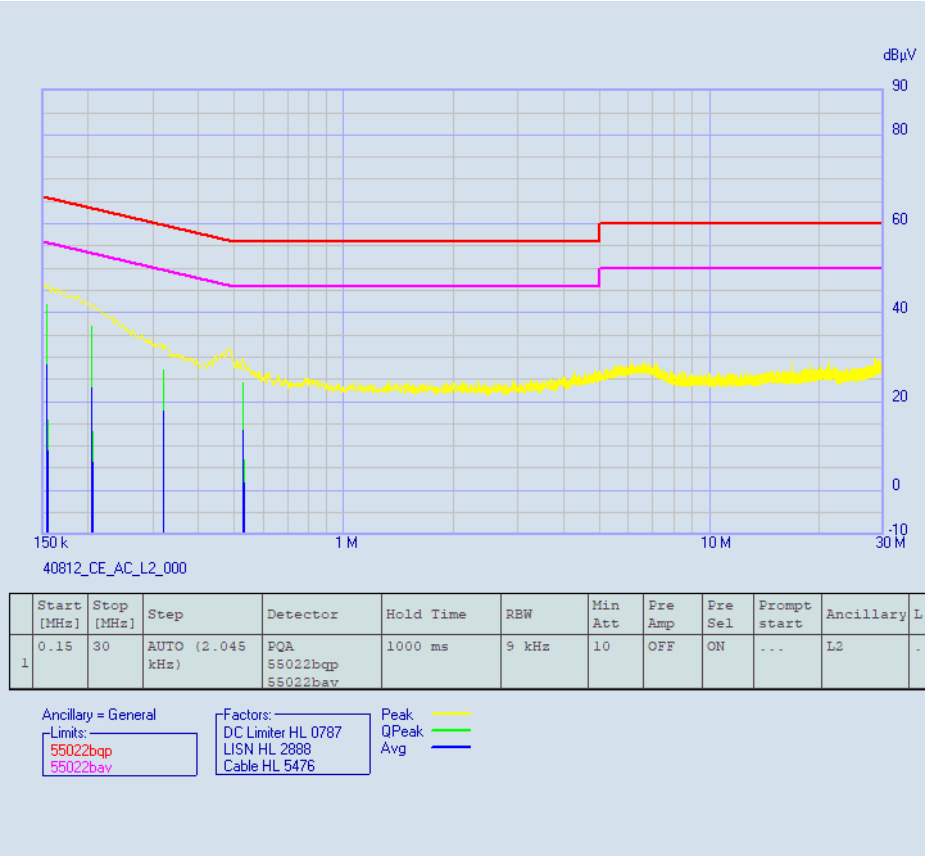


	Start [MHz]	Stop [MHz]	Step	Detector	Hold Time	RBW	Min Att	Pre Amp	Pre Sel	Prompt start	Ancillary	L
1	0.15	30	AUTO (2.045 kHz)	PQA 55022bqp 55022bav	1000 ms	9 kHz	10	OFF	ON	...	L1	.

Test specification:	FCC Section 15.207(a)/RSS-Gen 8.8, Conducted emission		
Test procedure:	ANSI C63.4, Section 13.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	Relative Humidity: 51 %	Air Pressure: 1014 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.2 Conducted emission measurements

LINE: L2
EUT OPERATING MODE: Transmit
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	**FCC section 15.203/ RSS-Gen, Section 6.8, Antenna requirement**		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

7.6 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.
The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.6.1.

Table 7.6.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	

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):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

7.7 Occupied bandwidth test

7.7.1 General

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

Table 7.7.1 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.

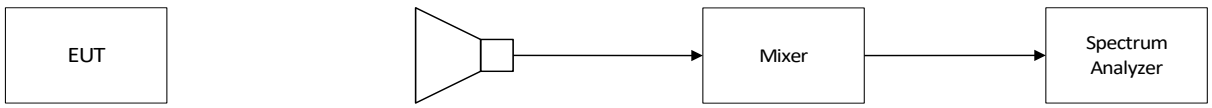
7.7.2 Test procedure

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

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

7.7.2.3 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 7.7.1 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):	02-Dec-20		
Temperature: 24 ºC	**Relative Humidity:** 42 %	**Air Pressure:** 1013 hPa	**Power:** 6 VDC
Remarks:			

Table 7.7.2 Occupied bandwidth test results

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

Occupied bandwidth 6 dBc, MHz	Occupied bandwidth 99%, MHz	Verdict
3205.0	3176.1	Pass

Fcenter = 61 GHz
OBW = 3205 MHz
Low band edge = 61000 – 3205/2 = 59397 MHz
High band edge = 61000 + 3205/2 = 62602 MHz

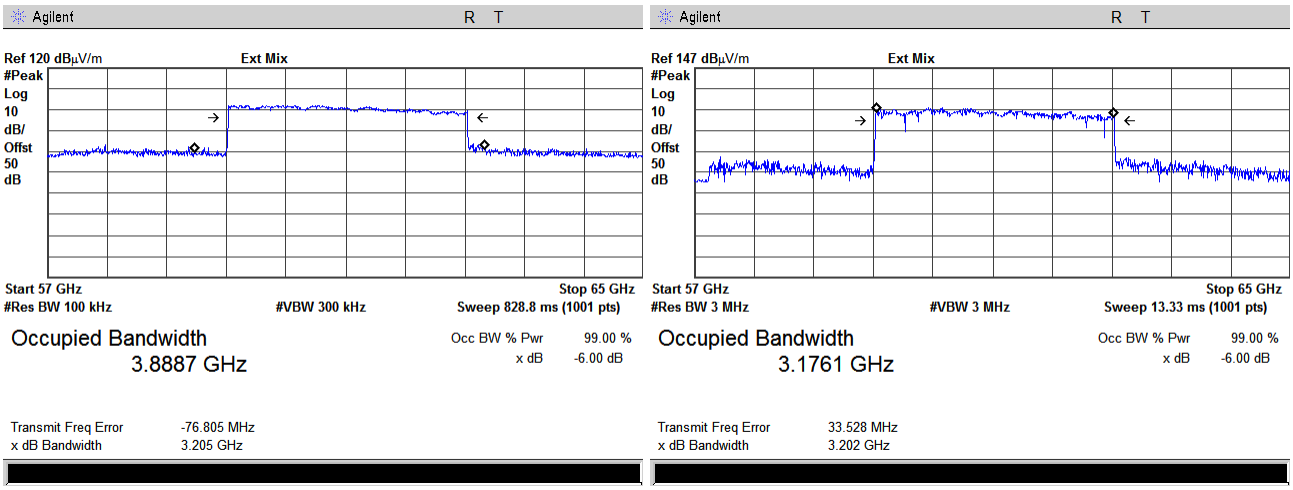
Reference numbers of test equipment used

HL 0771	HL 2909	HL 3433	HL 3434	HL 3305			

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):	02-Dec-20		
Temperature: 24 ºC	Relative Humidity: 42 %	Air Pressure: 1013 hPa	Power: 6 VDC
Remarks:			

Plot 7.7.1 The 6dBc and 99% occupied bandwidth



Test specification:	**FCC 47 CFR, Section 15.107 / ICES-003, Section 6.1, Class B, Conducted emissions**		
Test procedure:	ANSI C63.4, Section 7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

8 Emission tests according to 47CFR part 15 subpart B requirements

8.1 Conducted emissions

8.1.1 General

This test was performed to measure common mode conducted emissions at the mains power port. Specification test limits are given in Table 8.1.1.

Table 8.1.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)		Class A limit, dB(μV)	
	QP	AVRG	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*	79	66
0.5 - 5.0	56	46	73	60
5.0 - 30	60	50	73	60

* The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photographs, energized and the performance check was conducted.

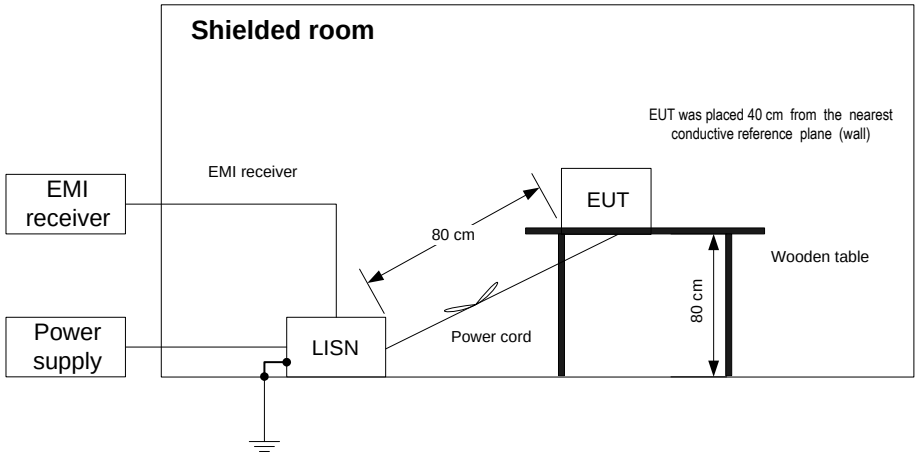
8.1.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

8.1.2.3 The position of the device cables was varied to determine maximum emission level.

8.1.2.4 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

Test specification:	**FCC 47 CFR, Section 15.107 / ICES-003, Section 6.1, Class B, Conducted emissions**		
Test procedure:	ANSI C63.4, Section 7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Figure 8.1.1 Setup for conducted emission measurements, table-top equipment



Test specification:	**FCC 47 CFR, Section 15.107 / ICES-003, Section 6.1, Class B, Conducted emissions**		
Test procedure:	ANSI C63.4, Section 7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 8.1.2 Conducted emission test results

LINE:	AC mains
LIMIT:	Class B
EUT OPERATING MODE:	Receive
EUT SET UP:	TABLE-TOP
TEST SITE:	SHIELDED ROOM
DETECTORS USED:	PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE:	150 kHz - 30 MHz
RESOLUTION BANDWIDTH:	9 kHz

Frequency, MHz	**Peak emission, dB(µV)**	**Quasi-peak**			**Average**			**Line ID**	**Verdict**
		Measured emission, dB(µV)	**Limit, dB(µV)**	**Margin, dB***	**Measured emission, dB(µV)**	**Limit, dB(µV)**	**Margin, dB***		
All emission were found 20dB below the limit								L1	Pass
All emission were found 20dB below the limit								L2	Pass

***- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

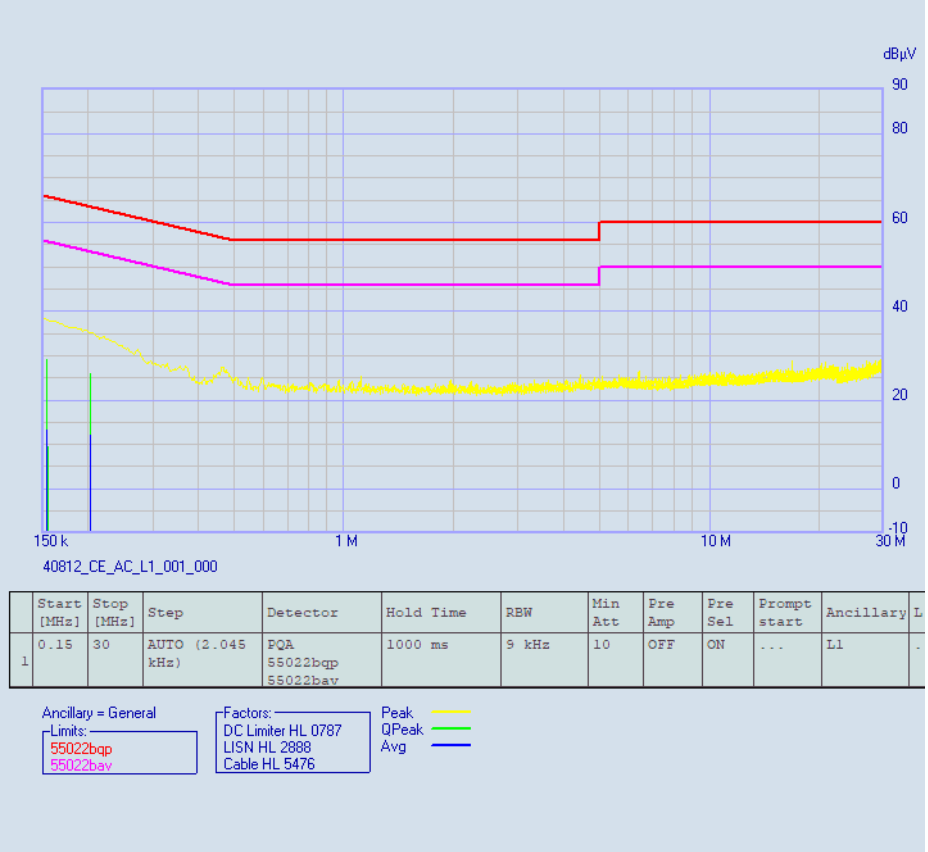
HL 5707	HL 5476	HL 0787	HL 2888				

Full description is given in Appendix A.

Test specification:	**FCC 47 CFR, Section 15.107 / ICES-003, Section 6.1, Class B, Conducted emissions**		
Test procedure:	ANSI C63.4, Section 7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 8.1.1 Conducted emission measurements

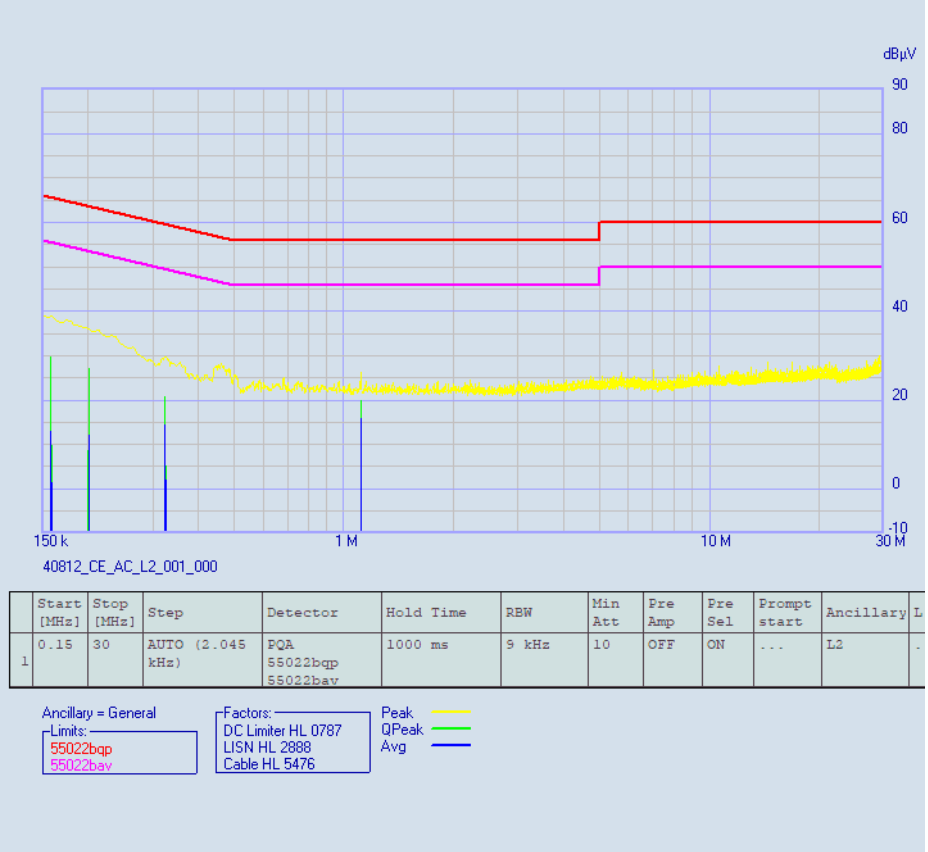
LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Receive
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	**FCC 47 CFR, Section 15.107 / ICES-003, Section 6.1, Class B, Conducted emissions**		
Test procedure:	ANSI C63.4, Section 7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Nov-20		
Temperature: 22.6 ºC	**Relative Humidity:** 51 %	**Air Pressure:** 1014 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 8.1.2 Conducted emission measurements

LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Receive
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	**FCC 47 CFR, Section 15.109 / ICES-003, Section 6.2, Class B, Radiated emissions**		
Test procedure:	ANSI C63.4, Section 8.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Nov-20		
Temperature: 22.1 ºC	**Relative Humidity:** 53 %	**Air Pressure:** 1015 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters.

8.2.2 Test procedure for measurements in semi-anechoic chamber

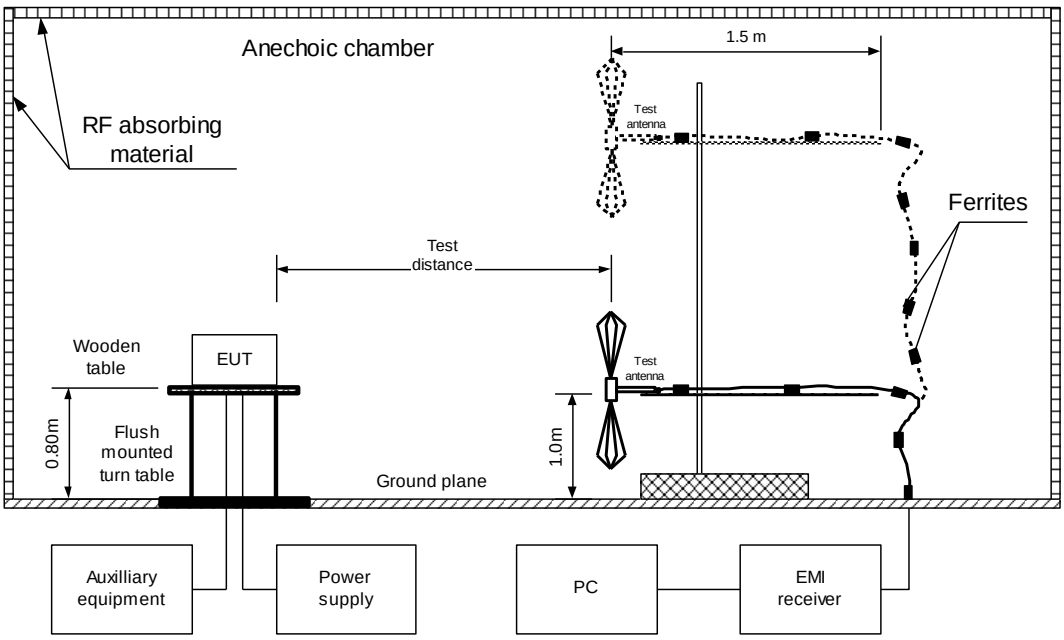
8.2.2.1 The EUT was set up as shown in Figure 8.2.1 and associated photographs, energized and the performance check was conducted.

8.2.2.2 The specified frequency range was investigated with biconilog antenna connected to 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 and the EUT cables position was varied.

8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Test specification:	**FCC 47 CFR, Section 15.109 / ICES-003, Section 6.2, Class B, Radiated emissions**		
Test procedure:	ANSI C63.4, Section 8.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Nov-20		
Temperature: 22.1 ºC	**Relative Humidity:** 53 %	**Air Pressure:** 1015 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



Test specification:	**FCC 47 CFR, Section 15.109 / ICES-003, Section 6.2, Class B, Radiated emissions**		
Test procedure:	ANSI C63.4, Section 8.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Nov-20		
Temperature: 22.1 ºC	**Relative Humidity:** 53 %	**Air Pressure:** 1015 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

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*				
Receive with power adapter								
34.56	30.12	21.08	40.0	-18.92	Vertical	1.02	137	Pass
54.06	32.63	25.67	40.0	-14.33	Vertical	1.00	65	
62.16	32.44	26.53	40.0	-13.47	Vertical	1.04	265	
79.43	30.53	22.75	40.0	-17.25	Vertical	1.02	256	
120.144	29.16	20.39	43.5	-23.11	Vertical	1.00	106	
139.14	28.78	22.71	43.5	-20.79	Vertical	1.02	92	

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 40000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak			Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
Receive with power adapter										Pass
No emissions were found										

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

Reference numbers of test equipment used

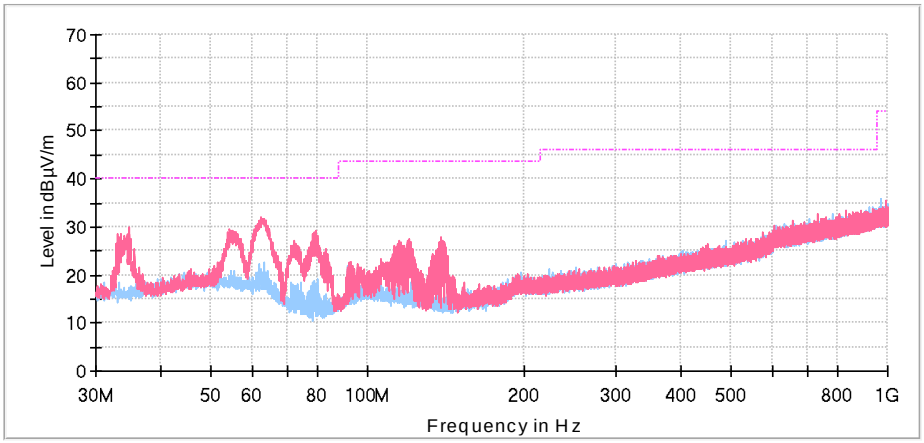
HL 5288	HL 5085	HL 3903	HL 4360	HL 4956	HL 4933	HL 5669	HL 5670

Full description is given in Appendix A.

Test specification:	FCC 47 CFR, Section 15.109 / ICES-003, Section 6.2, Class B, Radiated emissions		
Test procedure:	ANSI C63.4, Section 8.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Nov-20		
Temperature: 22.1 ºC	Relative Humidity: 53 %	Air Pressure: 1015 hPa	Power: 120 VAC, 60 Hz
Remarks:			

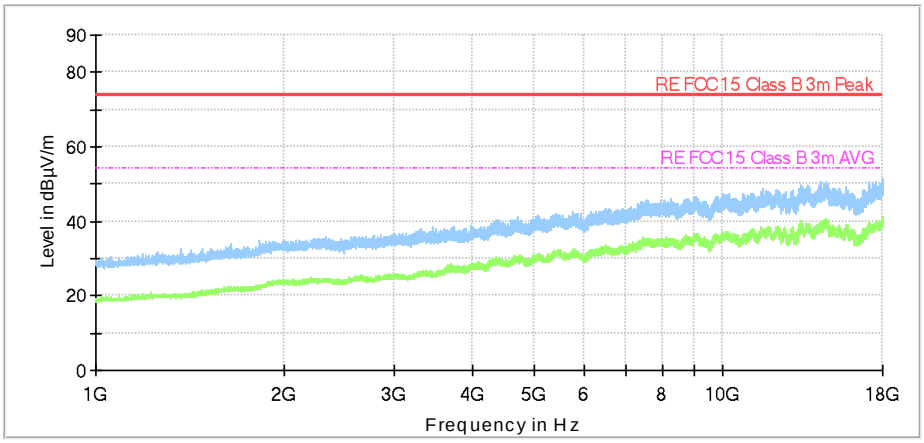
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive with power adapter



Plot 8.2.2 Radiated emission measurements in 1 – 18 GHz, vertical and horizontal antenna polarization

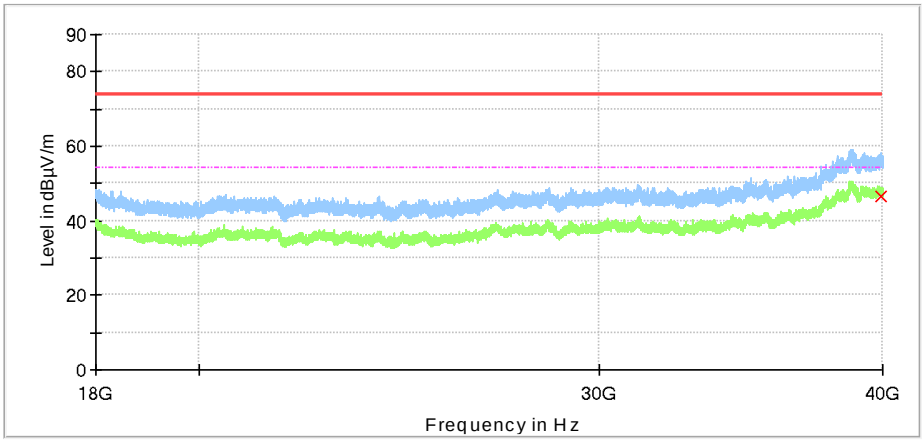
TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive with power adapter



Test specification:	**FCC 47 CFR, Section 15.109 / ICES-003, Section 6.2, Class B, Radiated emissions**		
Test procedure:	ANSI C63.4, Section 8.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Nov-20		
Temperature: 22.1 ºC	**Relative Humidity:** 53 %	**Air Pressure:** 1015 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 8.2.3 Radiated emission measurements in 18 – 40 GHz, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive with power adapter



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0747	Mixer, Millimeter Wave Harmonic 90 - 140 GHz	Oleson Microwave Labs	M08HW	F80429-1	19-May-20	19-May-23
0770	Antenna Standard Gain Horn, 40-60 GHz WR-19, U-band, 24 dB mid-band gain	Quinstar Technology	QWH-1900-AA	118	05-Aug-20	05-Aug-21
0771	Antenna Standard Gain Horn, 60-90 GHz, WR-12, 24 dB mid-band gain	Quinstar Technology	QWH-1200-AA	111	05-Aug-20	05-Aug-21
0772	Antenna Standard Gain Horn, 75-110 GHz, WR-10, 24 dB mid-band gain	Quinstar Technology	QWH-0800-AA	110	05-Aug-20	05-Aug-21
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A01877	06-Oct-20	06-Oct-21
1301	Transition waveguide ET28S -12R	Custom Microwave	ET28S -12R	1301	22-Nov-20	22-Nov-21
1312	Mixer Millimeter Wave Harmonic 140-220 GHz	Oleson Microwave Labs	M05HWD	G91112-1	19-May-20	19-May-23
1842	Power Supply, Dual Regulated, 18V, 2A	Horizon Electronics	DHR 18-2	51824226	18-Jan-21	18-Jan-22
2171	Multimeter	Fluke	177	79960418	15-Jul-20	15-Jul-21
2888	LISN Two-line V-Network 50 Ohm / 50 uH + 5 Ohm, 16A, MIL STD 461E, CISPR 16-1	Rolf Heine	NNB-2/16Z	02/10018	17-Mar-20	17-Mar-21
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	05-Apr-20	05-Apr-21
3235	Harmonic mixer 40 to 60 GHz	Agilent Technologies	11970U	MY30030182	30-Jan-20	30-Jan-23
3290	Attenuator, direct reading, 40 to 60 GHz, 0.4 W	Quinstar Technology	QAD-U00000	10381008	24-Sep-19	24-Sep-21
3291	Attenuator, direct reading, 60 to 90 GHz, 0.2 W	Quinstar Technology	QAD-E00000	10381009	24-Sep-19	24-Sep-21
3293	Frequency multiplier, input 20-30 GHz, output 60-90 GHz	Quinstar Technology	QPM-75003E	10381003	17-Nov-20	17-Nov-21
3294	Tapered transition, WR-28, UG-599 to WR-15, UG-385 (26.5-40 GHz to 50-75 GHz)	Quinstar Technology	QWP-AV0000	10381004	22-Nov-20	22-Nov-21
3297	Tapered transition, WR-28, UG-599 to WR-10, UG-387 (26.5-40 GHz to 75-100 GHz)	Quinstar Technology	QWP-AW0000	10381007	17-Nov-20	17-Nov-21
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY45101057	16-Apr-20	16-Apr-21
3302	Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm	Agilent Technologies	N1922A	MY45240586	16-Apr-20	16-Apr-21
3304	Power Supply, 100-250 V / 50-60 Hz - 12 VDC / 1.5 A	HL	UPO1811120	3304	30-Mar-20	30-Mar-21

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
3305	Harmonic mixer 50 to 75 GHz	Agilent Technologies	11970V	MY30030149	29-Jan-20	29-Jan-23
3306	Harmonic mixer 75 to 110 GHz	Agilent Technologies	11970W	MY25210273	30-Jan-20	30-Jan-23
3329	Antenna Standard Gain Horn, 140-220 GHz, WR-5, 24 dB mid-band gain	Quinstar Technology	NA	NA	20-Aug-20	20-Aug-21
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	13-Apr-20	13-Apr-21
3434	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25683	13-Apr-20	13-Apr-21
3536	Antenna Standard Gain Horn, 90-140 GHz, WR-8, 24 dB mid-band gain	Quinstar Technology	QWH-FPRR00	11159004001	25-Jun-20	25-Jun-21
3727	Oscilloscope, 1 GHz, 4 channels	LeCroy Corporation	LC584AL	10449	1-Jul-20	1-Jul-21
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	06-Apr-20	06-Apr-21
4343	Signal Generator, 100 kHz to 40 GHz	Rohde & Schwarz	SMB 100A	175291	29-Mar-20	29-Mar-21
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	19-Jan-21	19-Jan-22
4856	Amplifier, solid state, 18 GHz to 40 GHz, 20 dBm output power	Quinstar Technology	QGW-18402023-JO	16779001001	27-May-20	27-May-21
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	26-Jan-21	26-Jan-22
4956	Active horn antenna, 18 to 40 GHz	Com-Power Corporation	AHA-840	105004	26-Jan-21	26-Jan-22
5085	Attenuator, 4 dB, DC - 6 GHz, 1 W	Mini-Circuits	UNAT-4+	NA	22-May-20	22-May-21
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	08-Feb-19	08-Feb-22
5360	Broadband detector, 55 to 90 GHz	Pacific Millimeter Products, Inc	ED	200	30-Dec-20	30-Dec-21
5369	Digital storage oscilloscope, 350 MHz	Keysight Technologies	DSOX3034T	MY58032630	1-Jun-20	1-Jun-21
5376	EXA Signal Analyzer, 10 Hz - 32 GHz	Keysight Technologies	N9010B	MY57470404	22-Oct-20	22-Oct-21
5377	USB Thermocouple Power Sensor, DC-120 GHz	Keysight Technologies	U8489A	US56430158	21-Oct-20	21-Oct-21
5380	Wavequide Harmonic Mixer 55-90GHz	Keysight Technologies	M1971E	MY56130239	13-Nov-20	13-Nov-21
5409	RF cable, 40 GHz, SMA-SMA, 2 m	Huber-Suhner	SF102EA/11SK/11SK/2000MM	503973/2EA	03-Aug-20	03-Aug-21
5476	Cable, BNC/BNC, 10.5 m	Western wire	MIL-C-17G	NA	14-May-20	14-May-21

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
5669	Cable SF126EA/11N(x2)/3.0M, 18 GHz	Huber-Suhner	SF126EA	506775/126EA	25-Oct-20	25-Oct-21
5670	Cable SF126EA/11N(x2)/3M, 18 GHz	Huber-Suhner	SF126EA	506774/126EA	25-Oct-20	25-Oct-21
5707	EMI receiver	PMM / Narda	PMM 9010F	060WW91101	1-Feb-21	1-Feb-22
5958	Low nose amplifier, 60-90 GHz, 25 dB Gain	Eravant Corp.	SBL-6039032550-1212-E1	09168-01	28-Jan-21	28-Jan-22

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 10 m measuring distance Horizontal polarization Vertical polarization	 Biconilog antenna: ± 5.0 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.1 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 5.5 dB Biconical antenna: ± 5.5 dB Log periodic antenna: ± 5.6 dB Double ridged horn antenna: ± 5.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization	 Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

11 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.
Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers for OATS are R-10808 for RE measurements below 1 GHz, G-20112 for RE measurements above 1 GHz, R-11082 for anechoic chamber for RE measurements below 1 GHz, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 for conducted emissions at telecommunication ports).
The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

Address: P.O. Box 23, Binyamina 3055001, Israel.
Telephone: +972 4628 8001
Fax: +972 4628 8277
e-mail: mail@hermonlabs.com
website: www.hermonlabs.com

Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

12 APPENDIX D Specification references

FCC 47CFR part 15: 2019	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4: 2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
RSS-210 Issue 10: 2019	Licence-Exempt Radio Apparatus:Category I Equipment
RSS-Gen Issue 5 with Am.1: 2019	General Requirements for Compliance of Radio Apparatus
ICES-003 Issue 6: 2019 (updated)	Information Technology Equipment (Including Digital Apparatus)— Limits and Methods of Measurement

13 APPENDIX E Test equipment correction factors

Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446

Frequency, MHz	Measured antenna factor, dBS/m
0.009	-32.5
0.010	-33.4
0.020	-37.9
0.050	-40.6
0.075	-41.0
0.100	-41.2
0.150	-41.2
0.250	-41.2
0.500	-41.3
0.750	-41.3
1.000	-41.4
2.000	-41.4
3.000	-41.4
4.000	-41.5
5.000	-41.5
10.000	-41.8
15.000	-42.2
20.000	-42.9
25.000	-43.9
30.000	-45.4

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field strength in dB(μV/m).

Antenna factor
Standard gain horn antenna
Quinstar Technology
Model QWH
Ser.No.112, HL 0768, 0769, 0770, 0771, 0772

Frequency min, GHz	Frequency max, GHz	Antenna factor, dB(1/m)
18.000	26.500	32.01
26.500	40.000	35.48
40.000	60.000	39.03
60.000	90.000	42.55
90.000	140.000	46.23
140.000	220.000	50.11

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/m).

Antenna factor
Trilog antenna
Model ALX-8000E, Frankonia, S/N 00809, HL 5288, 30-1000 MHz

Frequency, MHz	Antenna factor, dB/m		
	Vert Up	Vert Down	Delta
30	-51.19	-51.28	0.09
35	-44.03	-44.12	0.09
40	-43.07	-43.12	0.05
45	-39.61	-39.79	0.18
50	-37.84	-38.14	0.3
60	-34.93	-34.9	0.03
70	-29.76	-29.66	0.1
80	-27.69	-27.82	0.13
90	-29.05	-29.07	0.02
100	-31.19	-31.19	0
120	-31.61	-31.6	0.01
140	-28.13	-28.06	0.07
160	-27.71	-27.75	0.04
180	-26.19	-26.15	0.04
200	-28.2	-28.15	0.05
250	-27.45	-27.47	0.02
300	-29.61	-29.63	0.02
400	-31.77	-31.78	0.01
500	-32.81	-32.81	0
600	-33.64	-33.61	0.03
700	-34.21	-34.21	0
800	-35.66	-35.66	0
900	-36.99	-36.91	0.08
1000	-38	-37.91	0.09

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/m).

Antenna factor
Active Horn Antenna,
Com-Power Corporation, model: AHA-118, s/n 701046, HL 4933

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
1000	-16.1
1500	-15.1
2000	-10.9
2500	-11.9
3000	-11.1
3500	-10.6
4000	-8.6
4500	-8.3
5000	-5.9
5500	-5.7
6000	-3.3
6500	-4.0
7000	-2.2
7500	-1.7
8000	1.1
8500	-0.8
9000	-1.5
9500	-0.2

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
10000	1.8
10500	1.0
11000	0.3
11500	-0.5
12000	3.1
12500	1.4
13000	-0.3
13500	-0.4
14000	2.5
14500	2.2
15000	1.9
15500	0.5
16000	2.1
16500	1.2
17000	0.6
17500	3.1
18000	4.2

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

Antenna factor
Active Horn Antenna,
Com-Power Corporation, model: AHA-840, s/n 105004, HL 4956

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
18000	2.5
18500	0.5
19000	-1.0
19500	-2.4
20000	-2.5
20500	-2.2
21000	-2.0
21500	-2.7
22000	-3.7
22500	-3.8
23000	-3.7
23500	-5.0
24000	-4.5
24500	-5.0
25000	-4.7
25500	-4.4
26000	-4.3
26500	-5.6
27000	-4.3
27500	-4.9
28000	-5.2
28500	-4.4

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
29000	-2.7
29500	-2.6
30000	-1.4
30500	-1.5
31000	-1.0
31500	-2.6
32000	-3.3
32500	-3.3
33000	-5.1
33500	-5.2
34000	-1.5
34500	-5.4
35000	-3.3
35500	-4.2
36000	-2.8
36500	-2.6
37000	-1.0
38000	1.8
38500	2.8
39000	1.3
39500	1.3
40000	0.3

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

Cable loss
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25679
Mini-Circuits, HL 3433

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	2.01
100	0.17	9500	2.06
500	0.41	10000	2.05
1000	0.58	10500	2.18
1500	0.72	11000	2.26
2000	0.86	11500	2.28
2500	0.96	12000	2.43
3000	1.04	12500	2.53
3500	1.13	13000	2.52
4000	1.23	13500	2.56
4500	1.31	14000	2.60
5000	1.41	14500	2.59
5500	1.49	15000	2.67
6000	1.55	15500	2.76
6500	1.63	16000	2.86
7000	1.71	16500	2.91
7500	1.78	17000	2.95
8000	1.86	17500	3.02
8500	1.92	18000	3.07

Cable loss
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25683
Mini-Circuits, HL 3434

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	1.96
100	0.16	9500	2.01
500	0.40	10000	2.01
1000	0.57	10500	2.14
1500	0.72	11000	2.21
2000	0.85	11500	2.24
2500	0.95	12000	2.36
3000	1.03	12500	2.47
3500	1.11	13000	2.46
4000	1.21	13500	2.50
4500	1.29	14000	2.53
5000	1.39	14500	2.53
5500	1.46	15000	2.62
6000	1.52	15500	2.70
6500	1.60	16000	2.80
7000	1.68	16500	2.86
7500	1.75	17000	2.88
8000	1.83	17500	2.94
8500	1.88	18000	3.00

Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A
HL 3903

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.02	9500	1.84	21000	2.98
100	0.15	10000	1.86	22000	3.07
500	0.38	10500	1.93	23000	3.13
1000	0.56	11000	1.99	24000	3.21
1500	0.69	11500	2.04	25000	3.26
2000	0.82	12000	2.10	26000	3.48
2500	0.90	12500	2.15	27000	3.44
3000	0.98	13000	2.21	28000	3.53
3500	1.06	13500	2.25	29000	3.59
4000	1.11	14000	2.29	30000	3.66
4500	1.17	14500	2.34	31000	3.70
5000	1.24	15000	2.36	32000	3.79
5500	1.32	15500	2.40	33000	3.88
6000	1.40	16000	2.45	34000	3.94
6500	1.50	16500	2.48	35000	3.91
7000	1.56	17000	2.56	36000	4.05
7500	1.62	17500	2.58	37000	4.22
8000	1.68	18000	2.60	38000	4.25
8500	1.74	19000	2.84	39000	4.27
9000	1.78	20000	2.88	40000	4.33

Cable loss
RF Cable, Huber-Suhner, 40 GHz, 2 m, ,
SF102EA/11SK/11SK/2000MM, S/N 503973/2EA
HL 5409

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
100	0.26	20500	3.75
200	0.36	21000	3.80
300	0.45	21500	3.85
500	0.58	22000	3.90
1000	0.82	22500	3.95
1500	0.99	23000	4.00
2000	1.15	23500	4.04
2500	1.28	24000	4.09
3000	1.40	24500	4.13
3500	1.51	25000	4.19
4000	1.61	25500	4.25
4500	1.71	26000	4.30
5000	1.80	26500	4.37
5500	1.89	27000	4.45
6000	1.98	27500	4.47
6500	2.06	28000	4.45
7000	2.14	28500	4.49
7500	2.22	29000	4.57
8000	2.29	29500	4.60
8500	2.36	30000	4.59
9000	2.43	30500	4.63
9500	2.50	31000	4.68
10000	2.58	31500	4.74
10500	2.63	32000	4.81
11000	2.70	32500	4.89
11500	2.76	33000	4.89
12000	2.82	33500	4.92
12500	2.87	34000	4.94
13000	2.94	34500	4.99
13500	3.00	35000	5.07
14000	3.06	35500	5.12
14500	3.11	36000	5.14
15000	3.17	36500	5.22
15500	3.23	37000	5.28
16000	3.29	37500	5.30
16500	3.35	38000	5.39
17000	3.41	38500	5.48
17500	3.47	39000	5.44
18000	3.51	39500	5.45
18500	3.56	40000	5.51
19000	3.60		
19500	3.66		
20000	3.71		

Cable loss
Cable, BNC/BNC, 10.5 m MIL-C-17G
Western wire, HL 5476

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.01	0.12	270	3.07
10	0.56	280	3.13
20	0.79	290	3.19
30	0.97	300	3.26
40	1.11	310	3.32
50	1.25	320	3.40
60	1.37	330	3.46
70	1.48	340	3.52
80	1.58	350	3.58
90	1.68	360	3.62
100	1.79	370	3.70
110	1.88	380	3.75
120	1.96	390	3.82
130	2.05	400	3.87
140	2.12	410	3.93
150	2.20	420	3.98
160	2.29	430	4.06
170	2.37	440	4.11
180	2.44	450	4.18
190	2.51	460	4.22
200	2.58	470	4.27
210	2.66	480	4.35
220	2.74	490	4.39
230	2.80	500	4.45
240	2.87		
250	2.93		
260	3.01		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m,
SF126EA/11N(x2), S/N 506775/126EA
HL 5669

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	8750	2.43
30	0.04	9000	2.39
50	0.12	9250	2.54
100	0.21	9500	2.59
250	0.27	9750	2.52
500	0.38	10000	2.70
750	0.54	10250	2.70
1000	0.66	10500	2.67
1250	0.76	10750	2.83
1500	0.85	11000	2.75
1750	0.92	11250	2.93
2000	1.01	11500	2.81
2250	1.07	11750	2.97
2500	1.16	12000	2.92
2750	1.20	12250	2.97
3000	1.30	12500	3.03
3250	1.35	12750	3.01
3500	1.41	13000	3.19
3750	1.47	13250	3.12
4000	1.52	13500	3.23
4250	1.57	13750	3.11
4500	1.61	14000	3.37
4750	1.64	14250	3.25
5000	1.73	14500	3.31
5250	1.78	14750	3.28
5500	1.78	15000	3.34
5750	1.85	15250	3.33
6000	1.96	15500	3.31
6250	1.97	15750	3.44
6500	2.05	16000	3.34
6750	2.05	16250	3.56
7000	2.13	16500	3.47
7250	2.19	16750	3.57
7500	2.26	17000	3.55
7750	2.16	17250	3.56
8000	2.28	17500	3.53
8250	2.32	17750	3.49
8500	2.39	18000	6.13

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m,
SF126EA/11N(x2), S/N 506774/126EA
HL 5670

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	8750	2.35
30	0.04	9000	2.41
50	0.10	9250	2.46
100	0.17	9500	2.50
250	0.24	9750	2.61
500	0.37	10000	2.59
750	0.52	10250	2.73
1000	0.64	10500	2.65
1250	0.74	10750	2.80
1500	0.83	11000	2.76
1750	0.92	11250	2.86
2000	0.99	11500	2.83
2250	1.06	11750	2.87
2500	1.13	12000	2.93
2750	1.20	12250	2.88
3000	1.26	12500	3.07
3250	1.32	12750	2.92
3500	1.38	13000	3.15
3750	1.44	13250	3.04
4000	1.49	13500	3.30
4250	1.54	13750	3.22
4500	1.59	14000	3.30
4750	1.64	14250	3.24
5000	1.68	14500	3.22
5250	1.72	14750	3.28
5500	1.78	15000	3.21
5750	1.82	15250	3.31
6000	1.93	15500	3.26
6250	1.92	15750	3.36
6500	2.03	16000	3.42
6750	2.01	16250	3.44
7000	2.15	16500	3.57
7250	2.10	16750	3.44
7500	2.22	17000	3.61
7750	2.17	17250	3.46
8000	2.26	17500	3.59
8250	2.28	17750	3.51
8500	2.35	18000	3.59

14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

END OF DOCUMENT