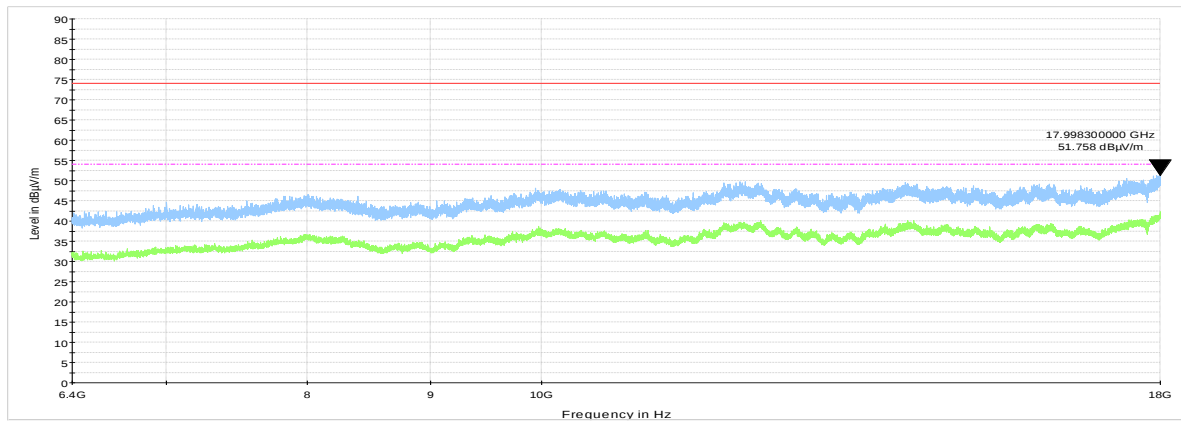




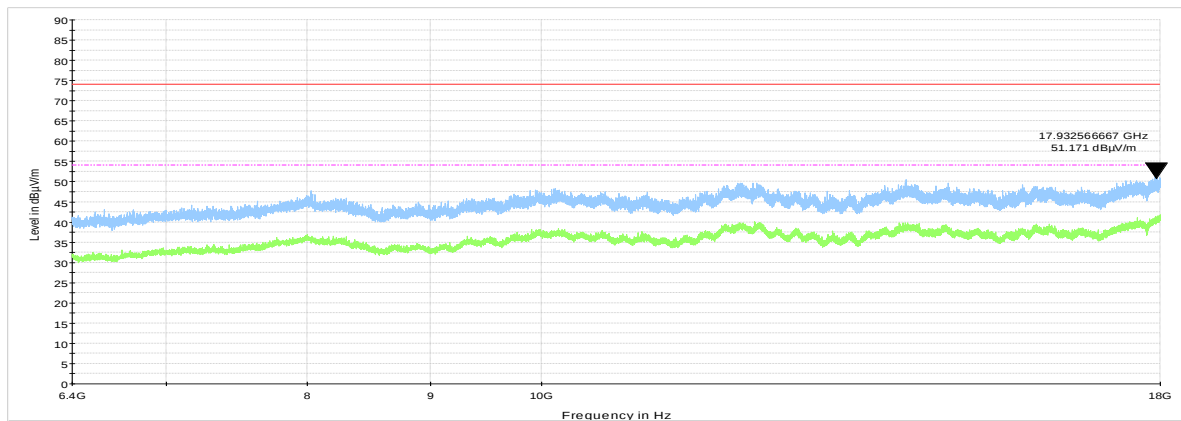
Test specification:		FCC section 15.407(b)4, RSS-247 section 6.2.4, Field strength of undesirable emissions	
Test procedure:		KDB 662911; KDB 789033, ANSI C63.10, section 12.7.6 & 12.7.7	
Test mode:		Verdict: PASS	
Date(s):			
07-Feb-19			
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1012 hPa	Power: 48 VDC
Remarks:			

Plot 7.14.13 Radiated emission measurements from 6.4 to 18 GHz at the low carrier frequency

TEST SITE: Semi Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

**Plot 7.14.14 Radiated emission measurements from 6.4 to 18 GHz at the mid carrier frequency**

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal





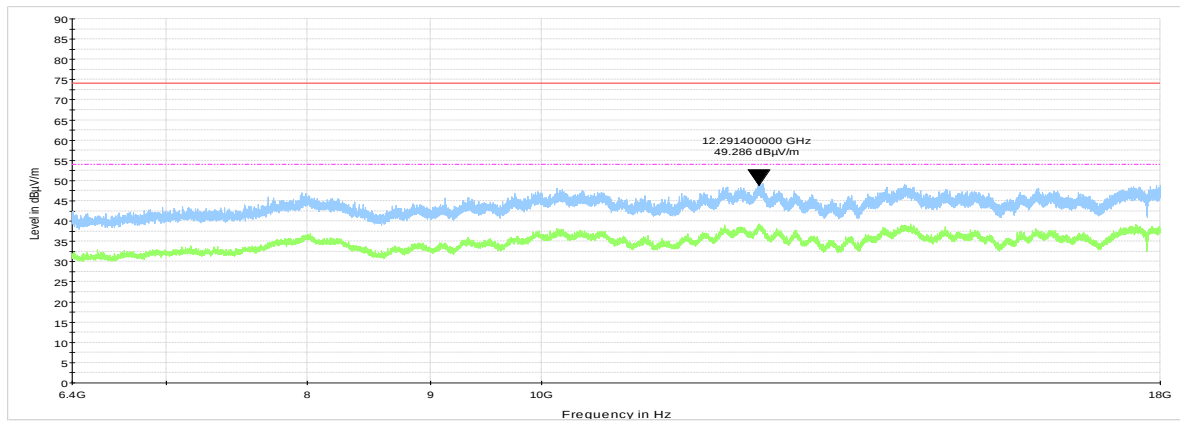
HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2
Date of Issue: 25-Jun-19

Test specification:		FCC section 15.407(b)4, RSS-247 section 6.2.4, Field strength of undesirable emissions	
Test procedure:		KDB 662911; KDB 789033, ANSI C63.10, section 12.7.6 & 12.7.7	
Test mode:		Verdict: PASS	
Date(s):			
07-Feb-19			
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1012 hPa	Power: 48 VDC
Remarks:			

Plot 7.14.15 Radiated emission measurements from 6.4 to 18 GHz at the high carrier frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

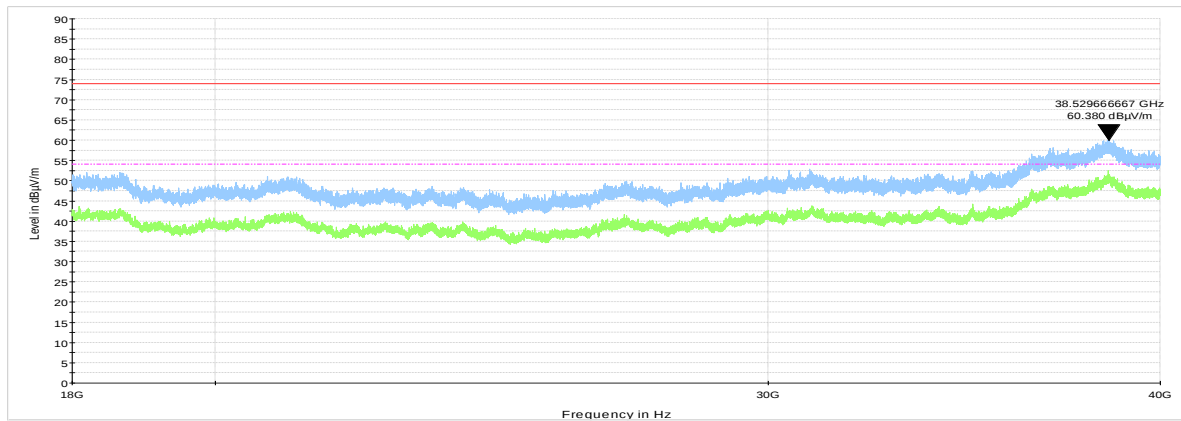




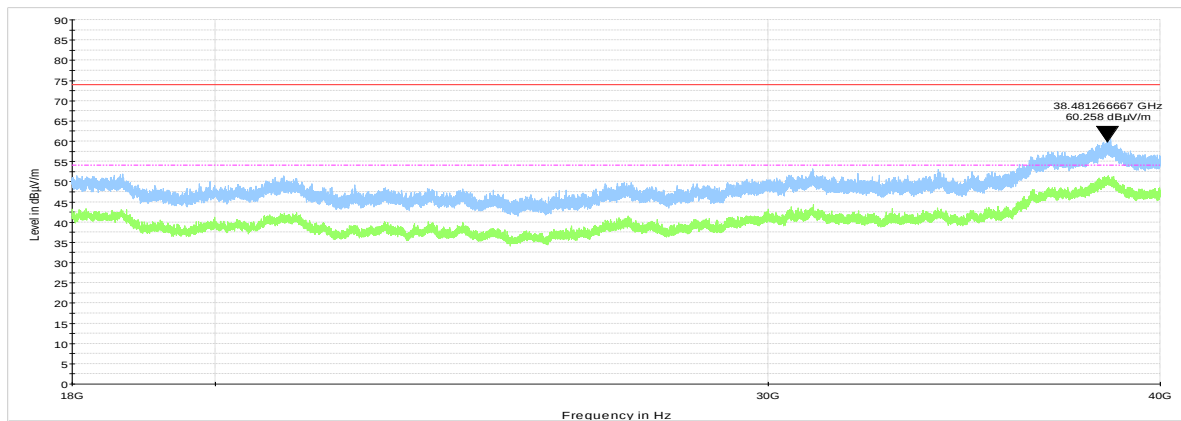
Test specification:		FCC section 15.407(b)4, RSS-247 section 6.2.4, Field strength of undesirable emissions	
Test procedure:		KDB 662911; KDB 789033, ANSI C63.10, section 12.7.6 & 12.7.7	
Test mode:		Verdict: PASS	
Date(s):			
07-Feb-19			
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1012 hPa	Power: 48 VDC
Remarks:			

Plot 7.14.16 Radiated emission measurements from 18 to 40 GHz at the low carrier frequency

TEST SITE: Semi Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

**Plot 7.14.17 Radiated emission measurements from 18 to 40 GHz at the mid carrier frequency**

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal





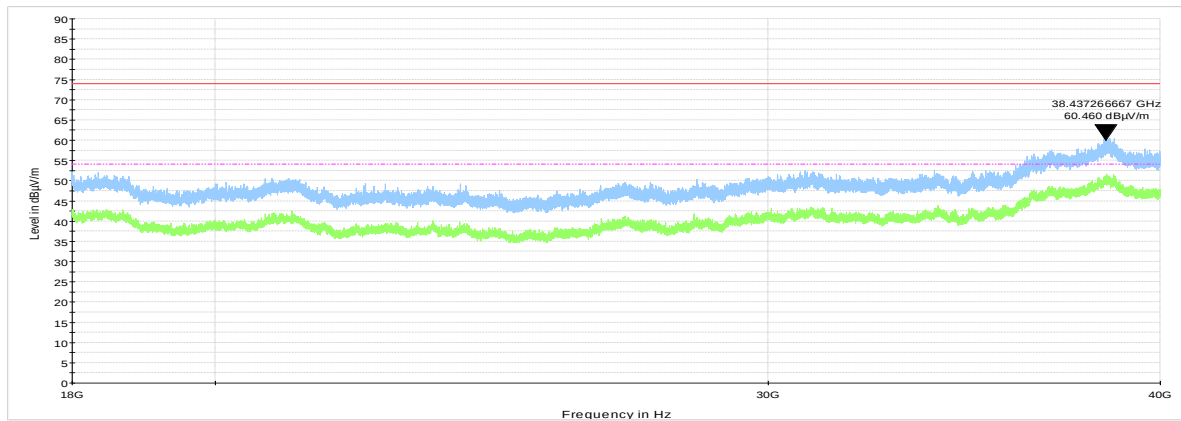
HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2
Date of Issue: 25-Jun-19

Test specification:		FCC section 15.407(b)4, RSS-247 section 6.2.4, Field strength of undesirable emissions	
Test procedure:		KDB 662911; KDB 789033, ANSI C63.10, section 12.7.6 & 12.7.7	
Test mode:		Verdict: PASS	
Date(s):			
07-Feb-19			
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1012 hPa	Power: 48 VDC
Remarks:			

Plot 7.14.18 Radiated emission measurements from 18 to 40 GHz at the high carrier frequency

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal





Test specification: FCC section 15.407(b)(6), 15.207(a), RSS-Gen section 7.2 Conducted emissions			
Test procedure: ANSI C63.10, Section 12.7.4.1, KDB 789033			
Test mode: Compliance		Verdict: PASS	
Date(s): 21-Jan-19			
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 48 VDC
Remarks:			

7.15 Conducted emissions at 5150 – 5250 MHz range

7.15.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.15.1.

**Table 7.15.1 Limits for conducted emissions
according to FCC Part 15, Section 207 / RSS-Gen, Section 7.2**

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.

7.15.2 Test procedure

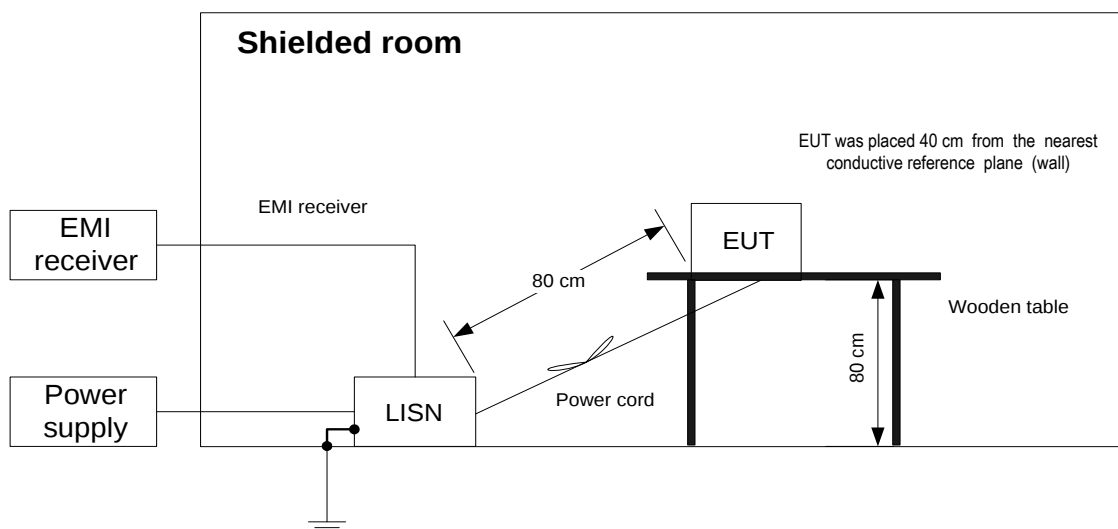
7.15.2.1 The EUT was set up as shown in Figure 7.15.1, energized and the performance check was conducted.

7.15.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer while unused coaxial connector of the LISN was terminated with 50 Ohm.

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

7.15.2.4 The worst test results (the lowest margins) were recorded in Table 7.15.2 and shown in the associated plots.

Figure 7.15.1 Setup for conducted emission measurements, table-top equipment





HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2
Date of Issue: 25-Jun-19

Test specification: FCC section 15.407(b)(6), 15.207(a), RSS-Gen section 7.2 Conducted emissions			
Test procedure: ANSI C63.10, Section 12.7.4.1, KDB 789033			
Test mode: Compliance		Verdict: PASS	
Date(s): 21-Jan-19			
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 48 VDC
Remarks:			

Table 7.15.2 Conducted emission test results according to FCC Part 15, Section 207 / RSS-Gen, Section 7.2

LINE: AC mains
 EUT OPERATING MODE: Transmit
 ASSIGNED FREQUENCY BAND: 5.15-5.25GHz
 OPERATING FREQUENCY: 5.2GHz
 EUT SET UP: TABLE-TOP
 TEST SITE: SHIELDED ROOM
 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*		
0.157	69.8	61.4	65.7	-4.3	29.9	55.7	-25.8	L1	Pass
0.178	67.0	59.3	64.6	-5.3	28.1	54.6	-26.5		
0.230	57.3	49.5	62.5	-13.0	20.4	52.5	-32.1		
0.498	44.8	36.1	56.0	-19.9	5.3	46.0	-40.7		
2.116	36.7	30.9	56.0	-25.1	19.4	46.0	-26.6		
24.600	33.2	27.5	60.0	-32.5	20.4	50.0	-29.6		
0.153	69.9	62.5	65.9	-3.4	31.0	55.9	-24.9	L2	Pass
0.186	66.5	58.9	64.2	-5.3	27.3	54.2	-26.9		
0.439	43.4	36.4	57.1	-20.7	4.8	47.1	-42.3		
1.648	37.6	26.9	56.0	-29.1	1.4	46.0	-44.6		
4.364	37.3	30.9	56.0	-25.1	21.7	46.0	-24.3		
11.253	36.9	28.1	60.0	-31.9	17.3	50.0	-32.7		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HI 0787	HL 1500	HL 2358	HL 2888	HL 4778			
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Full description is given in Appendix A.



Test specification:		FCC section 15.407(b)(6), 15.207(a), RSS-Gen section 7.2, Conducted emissions	
Test procedure:		ANSI C63.10, Section 12.7.4.1, KDB 789033	
Test mode:		Verdict: PASS	
Date(s):			
21-Jan-19			
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

7.16 Conducted emissions at 5725 – 5850 MHz range

7.16.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.15.1.

**Table 7.16.1 Limits for conducted emissions
according to FCC Part 15, Section 207 / RSS-Gen, Section 7.2**

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.

7.16.2 Test procedure

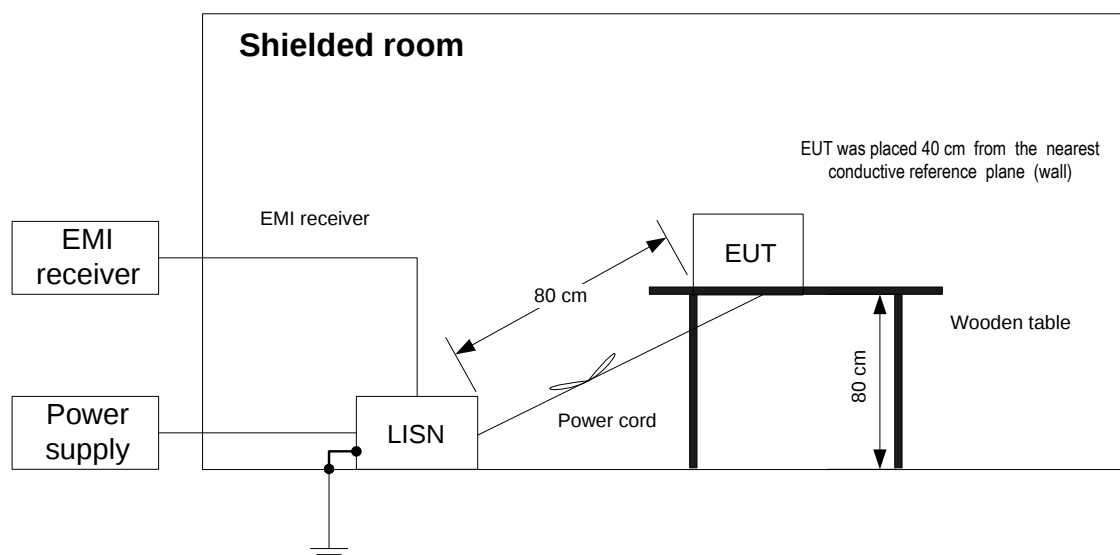
7.16.2.1 The EUT was set up as shown in Figure 7.16.1, energized and the performance check was conducted.

7.16.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer while unused coaxial connector of the LISN was terminated with 50 Ohm.

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

7.16.2.4 The worst test results (the lowest margins) were recorded in Table 7.16.2 and shown in the associated plots.

Figure 7.16.1 Setup for conducted emission measurements, table-top equipment





HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2
Date of Issue: 25-Jun-19

Test specification: FCC section 15.407(b)(6), 15.207(a), RSS-Gen section 7.2, Conducted emissions			
Test procedure: ANSI C63.10, Section 12.7.4.1, KDB 789033			
Test mode: Compliance		Verdict: PASS	
Date(s): 21-Jan-19			
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

Table 7.16.2 Conducted emission test results according to FCC Part 15, Section 207 / RSS-Gen, Section 7.2

LINE: AC mains
EUT OPERATING MODE: Transmit
ASSIGNED FREQUENCY BAND: 5.725-5.850 GHz
OPERATING FREQUENCY: 5.788 MHz
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
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*		
0.151	69.8	62.2	66.0	-3.8	31.0	56.0	-25.0	L1	
0.179	67.6	60.3	64.6	-4.3	28.8	54.6	-25.8		
0.438	49.5	39.3	57.1	-17.8	10.5	47.1	-36.6		
1.022	37.8	28.8	56.0	-27.2	3.6	46.0	-42.4		
11.272	39.6	35.6	60.0	-24.4	30.7	50.0	-19.3		
24.311	33.1	27.0	60.0	-33.0	19.6	50.0	-30.4		
0.152	70.5	62.7	65.9	-3.2	31.3	55.9	-24.6	L2	
0.183	67.3	60.3	64.4	-4.1	28.8	54.4	-25.6		
0.427	47.1	36.6	57.4	-20.8	7.2	47.4	-40.2		
1.631	37.0	27.0	56.0	-29.0	1.1	46.0	-44.9		
4.469	42.4	33.5	56.0	-22.5	24.2	46.0	-21.8		
11.191	38.1	33.9	60.0	-26.1	28.5	50.0	-21.5		

*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HI 0787	HL 1500	HL 2358	HL 2888	HL 4778			
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Full description is given in Appendix A.



HERMON LABORATORIES

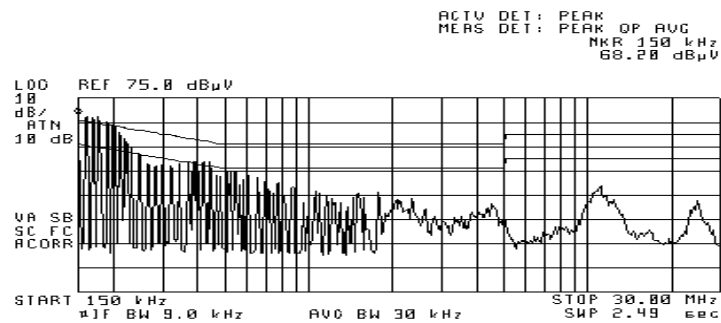
Report ID: TelRad_FCC_31832_rev2

Date of Issue: 25-Jun-19

Test specification:		FCC section 15.407(b)(6), 15.207(a), RSS-Gen section 7.2, Conducted emissions	
Test procedure:		ANSI C63.10, Section 12.7.4.1, KDB 789033	
Test mode:		Verdict: PASS	
Date(s):			
21-Jan-19			
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

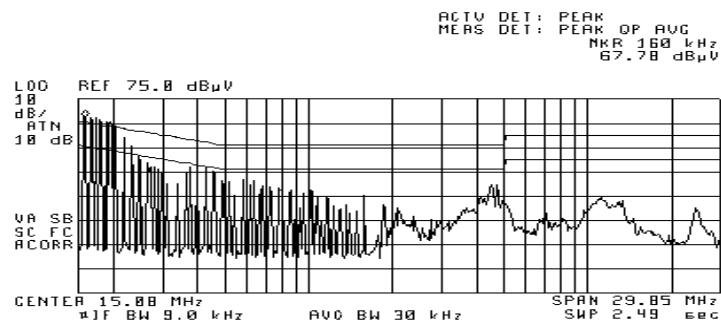
Plot 7.16.1 Conducted emission measurements

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



Plot 7.16.2 Conducted emission measurements

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





Test specification: FCC 15.407, FCC section 15.203, RSS-Gen section 7.1.4, The maximum EIRP at any elevation angle above 30 degrees			
Test procedure:			
Test mode:	Compliance	Verdict: PASS	
Date(s):	21-Jan-19		
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

7.17 The maximum EIRP at any elevation angle above 30 degrees

The EUT was verified for compliance with the maximum EIRP at any elevation angle above 30 degrees. The summary of antenna pattern results is provided in Table 7.17.1.

Table 7.17.1 The maximum EIRP at any elevation angle above 30 degrees test results

Operating frequency	Antenna chain	Total EIRP, dBm		Limit, dBm	Margin, dB	Verdict
		Maximum	Above 30 degrees			
5150.0	1	26.80	11.74	21	-9.26	Pass
	2	26.80	11.54	21	-9.46	Pass
	3	26.80	10.91	21	-10.09	Pass
	4	26.80	11.98	21	-9.02	Pass
5250	1	33.82	19.79	21	-1.21	Pass
	2	33.82	17.35	21	-3.65	Pass
	3	33.82	19.09	21	-1.91	Pass
	4	33.82	17.71	21	-3.29	Pass



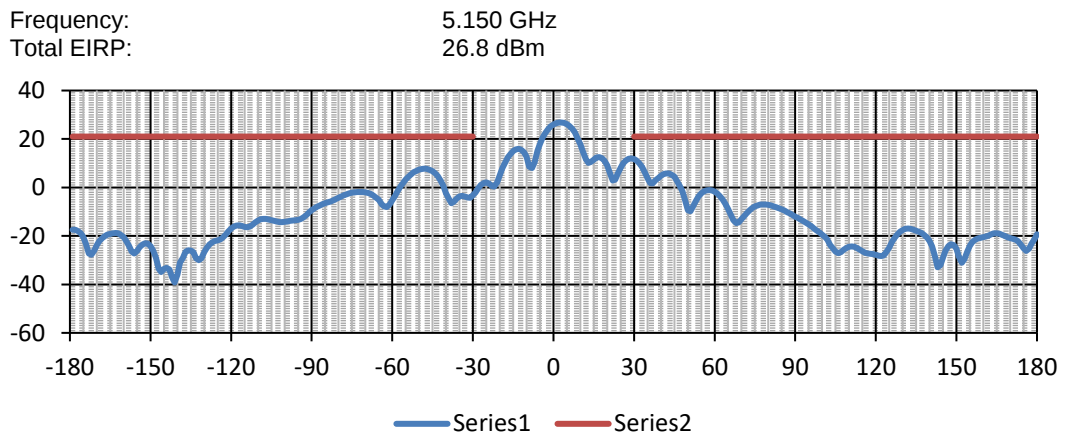
HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2

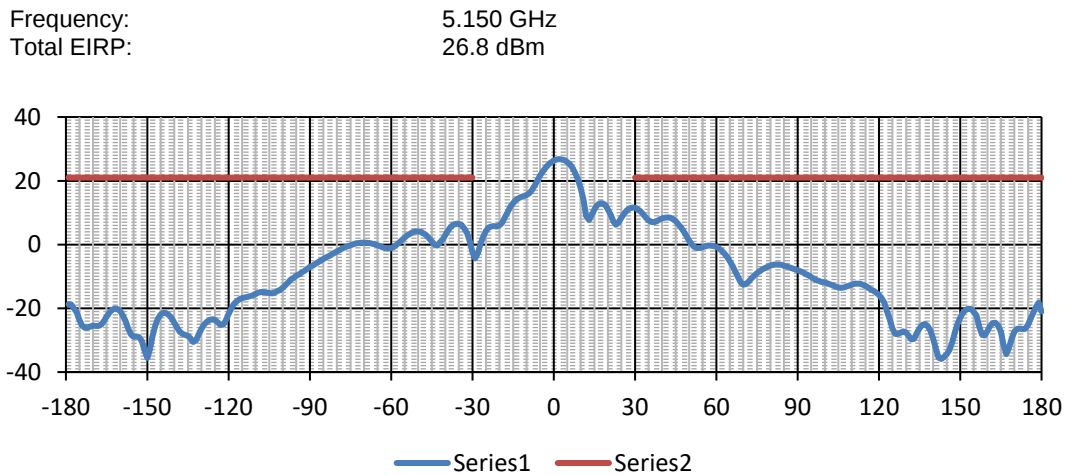
Date of Issue: 25-Jun-19

Test specification: FCC 15.407, FCC section 15.203, RSS-Gen section 7.1.4, The maximum EIRP at any elevation angle above 30 degrees			
Test procedure:			
Test mode:	Compliance	Verdict: PASS	
Date(s):	21-Jan-19		
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

Plot 7.17.1 Antenna pattern test results, Antenna #1



Plot 7.17.2 Antenna pattern test results, Antenna #2





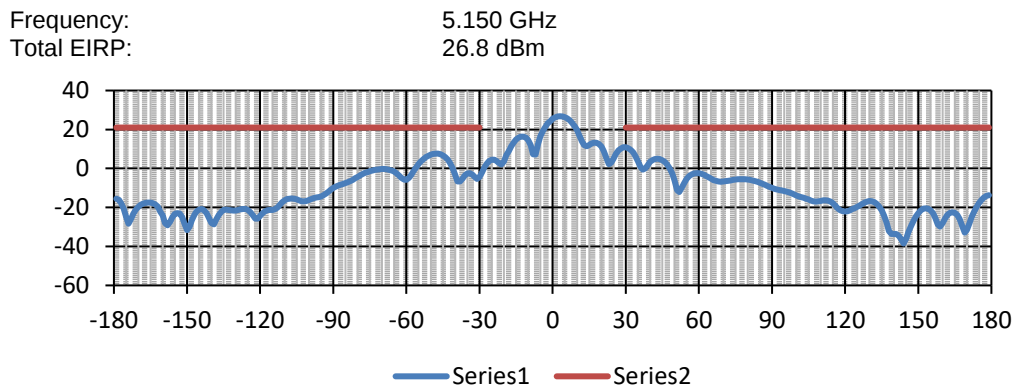
HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2

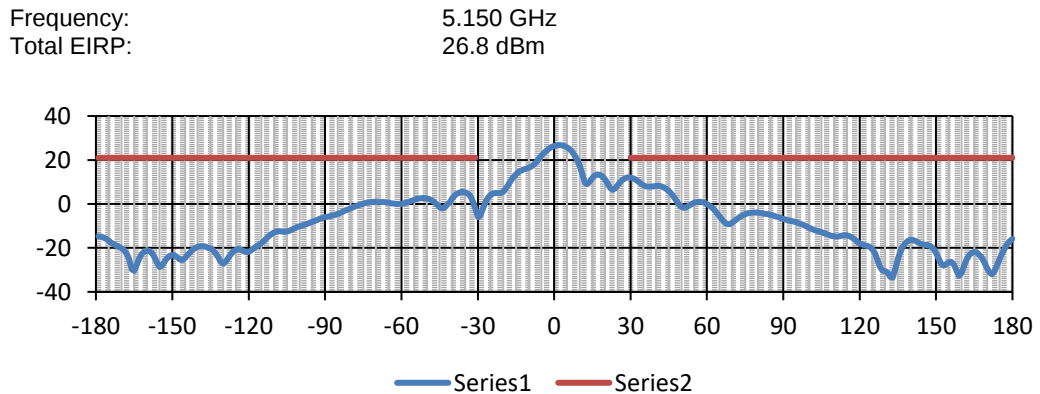
Date of Issue: 25-Jun-19

Test specification: FCC 15.407, FCC section 15.203, RSS-Gen section 7.1.4, The maximum EIRP at any elevation angle above 30 degrees			
Test procedure:			
Test mode:	Compliance	Verdict: PASS	
Date(s):	21-Jan-19		
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

Plot 7.17.3 Antenna pattern test results, Antenna #3



Plot 7.17.4 Antenna pattern test results, Antenna #4





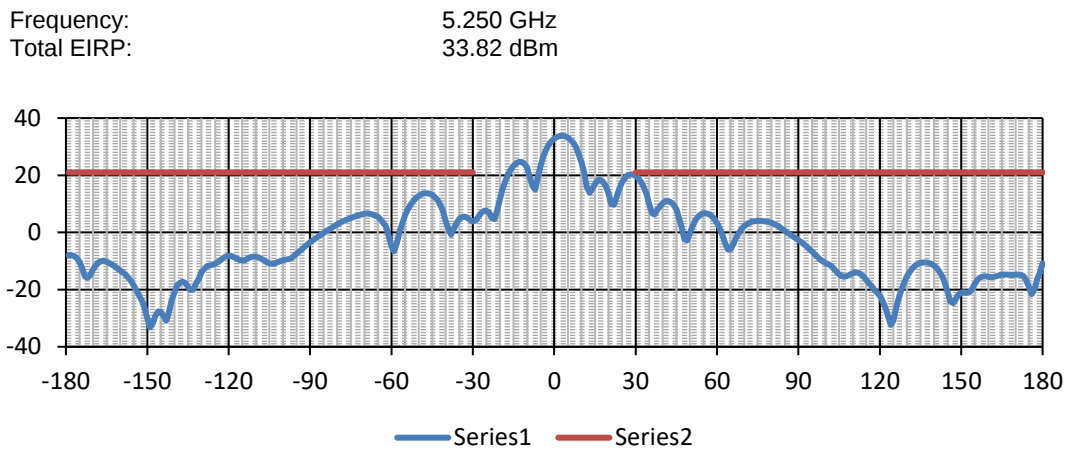
HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2

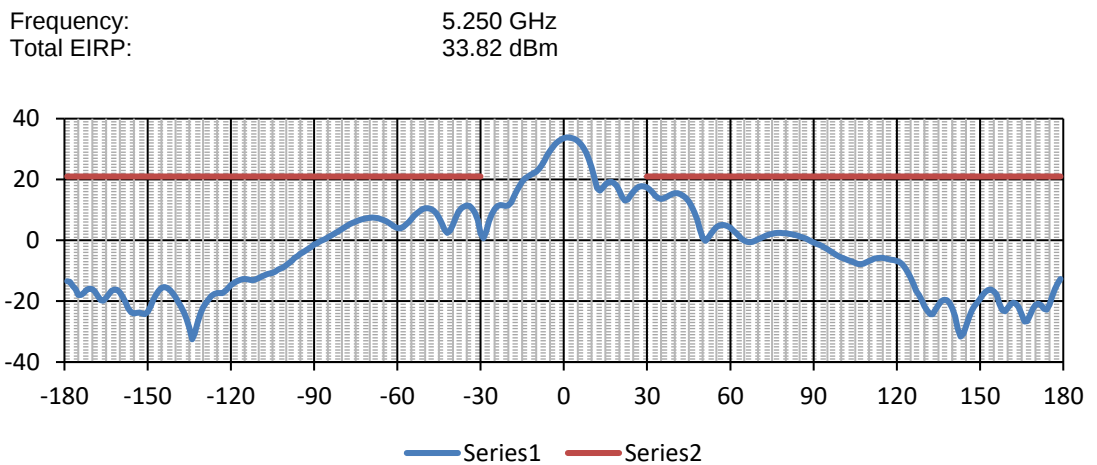
Date of Issue: 25-Jun-19

Test specification: FCC 15.407, FCC section 15.203, RSS-Gen section 7.1.4, The maximum EIRP at any elevation angle above 30 degrees			
Test procedure:			
Test mode:	Compliance	Verdict: PASS	
Date(s):	21-Jan-19		
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

Plot 7.17.5 Antenna pattern test results, Antenna #1



Plot 7.17.6 Antenna pattern test results, Antenna #2





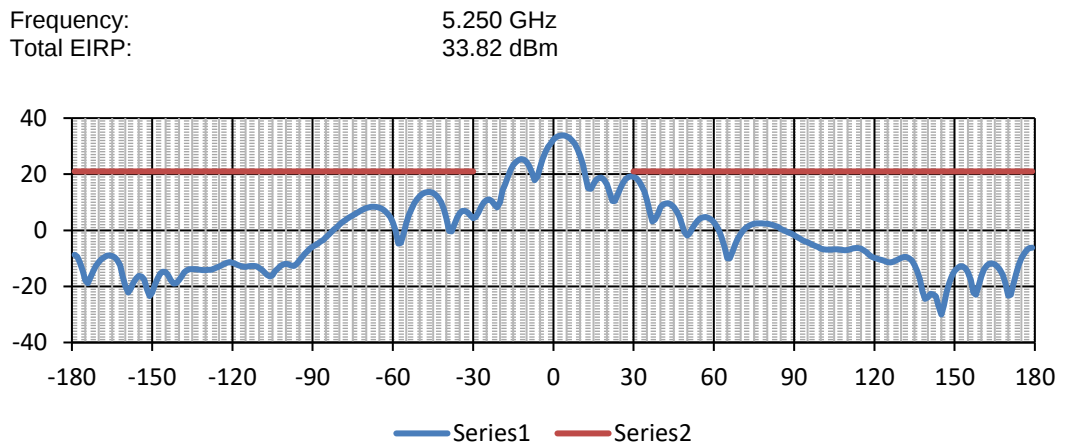
HERMON LABORATORIES

Report ID: TelRad_FCC_31832_rev2

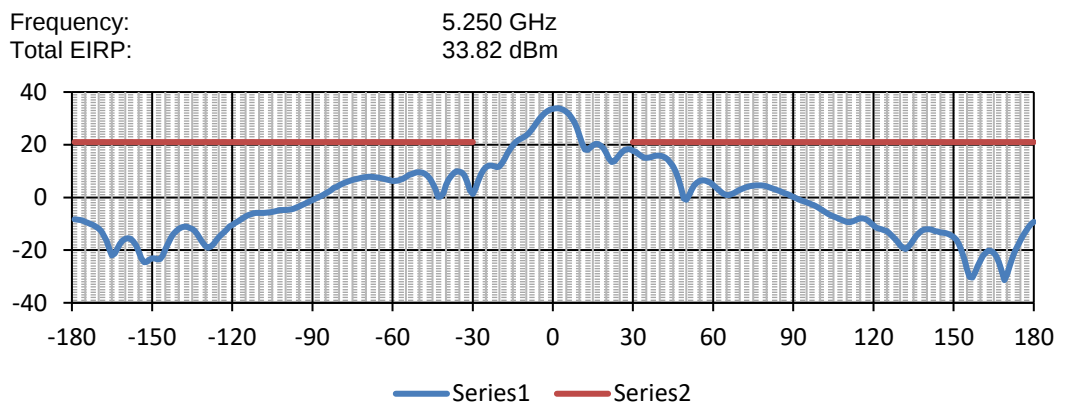
Date of Issue: 25-Jun-19

Test specification: FCC 15.407, FCC section 15.203, RSS-Gen section 7.1.4, The maximum EIRP at any elevation angle above 30 degrees			
Test procedure:			
Test mode:	Compliance	Verdict: PASS	
Date(s):	21-Jan-19		
Temperature: 26 °C	Relative Humidity: 48 %	Air Pressure: 1018 hPa	Power: 115 VAC, 60 Hz
Remarks:			

Plot 7.17.7 Antenna pattern test results, Antenna #3



Plot 7.17.8 Antenna pattern test results, Antenna #4





The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.18.1.

Table 7.18.1 Antenna requirements

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

Photograph 7.18.1 Antenna assembly



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1225/2A	07-Apr-19	07-Apr-20
4068	Attenuator, SMA, 30 dB, DC to 12.4 GHz	Midwest Microwave	ATT-0527-30-SMA-07	NA	09-Aug-18	09-Aug-19
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	04-Apr-19	04-Apr-20
3655	Ferrite Clamp	Luthi	FTC 101	4855	17-Jan-19	17-Jan-20
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	28-Jun-18	28-Jun-19
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY45101057	02-May-18	02-May-19
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	28-May-18	28-May-19
0446	Antenna, Loop, Active, 10 (9) kHz - 30 MHz	EMCO	6502	2857	24-Feb-19	24-Feb-20
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	03-Jun-18	03-Jun-19
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1226/2A	07-Apr-19	07-Apr-20
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	31-Dec-18	31-Dec-19
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	06-Jan-19	06-Jan-20
4956	Active horn antenna, 18 to 40 GHz	COM-POWER CORPORATION	AHA-840	105004	25-Jan-19	25-Jan-20
5405	RF cable, 18 GHz, N-N, 6 m	Huber-Suhner	SF118/11 N(x2)	500023/118	01-Aug-18	01-Aug-19
1500	Cable RF, 15 m, N/N-type	Suhner Switzerland	RG 214/U	1500	11-Feb-19	11-Feb-20
2358	Power Supply, 2 X 0-36VDC / 5A, 5VDC / 5A	Horizon Electronics	DHR3655D	767469	03-Jun-18	03-Jun-19
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	19-Mar-19	19-Mar-20
4778	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL4777	Hewlett Packard	8542E	30807A00262, 3427A00123	28-Oct-18	28-Oct-19

9 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
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Occupied bandwidth	± 8.0 %

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.

10 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 are R-10808 for OATS, R-1082 for anechoic chamber, 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).

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11 APPENDIX D Specification references

FCC 47CFR part 15:2017	Radio Frequency Devices.
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-247:2017, Issue 2	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License Exempt Local Area Network (LE-LAN) Devices
RSS-Gen:2018, Issue 5	General Requirements for Compliance of Radio Apparatus
KDB 662911:2013	Guidance for Emissions Testing of Transmitters with Multiple Outputs in the Same Band under section 15.407 of the FCC rules
KDB 789033:2017	Guidance for compliance testing of unlicensed national information infrastructure (U-NII) devices Part 15, Subpart E

12 APPENDIX E Test equipment correction factors

HL 0446: Active Loop Antenna
EMCO, model: 6502, s/n 2857

Frequency,	Measured antenna factor, dBS/m	Measurement uncertainty, dB
10	-33.4	±1.0
20	-37.8	±1.0
50	-40.5	±1.0
75	-41.0	±1.0
100	-41.2	±1.0
150	-41.2	±1.0
250	-41.1	±1.0
500	-41.2	±1.0
750	-41.3	±1.0
1000	-41.3	±1.0

Frequency,	Measured antenna factor, dBS/m	Measurement uncertainty, dB
2000	-41.4	±1.0
3000	-41.4	±1.0
4000	-41.5	±1.0
5000	-41.5	±1.0
10000	-41.7	±1.0
15000	-42.1	±1.0
20000	-42.7	±1.0
25000	-44.2	±1.0
30000	-45.8	±1.0

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

HL 0604: Antenna BiconiLog Log-Periodic/T Bow-TIE
EMCO, model 3141, serial number 9611-1011

Frequency, MHz	Antenna factor, dB/m		
	Measured	Last	Deviation
30	12.1	12.6	-0.5
35	9.1	9.5	-0.4
40	8.0	8.3	-0.3
45	8.3	8.6	-0.3
50	9.0	9.1	-0.1
60	10.5	10.7	-0.2
70	11.4	11.3	0.1
80	12.3	12.2	0.1
90	13.4	13.2	0.2
100	13.0	13.0	0.0
120	11.4	11.4	0.0
140	12.5	12.4	0.1
160	14.9	14.8	0.1
180	14.4	14.0	0.4
200	13.7	13.9	-0.2
250	16.3	16.4	-0.1
300	17.2	17.5	-0.3
400	19.8	20.2	-0.4
500	22.0	22.4	-0.4
600	24.3	24.5	-0.2
700	25.8	25.6	0.2
800	26.9	26.6	0.3
900	27.3	28.0	-0.7
1000	28.5	29.3	-0.8

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

HL 4933: Active Horn Antenna
COM-POWER CORPORATION, model: AHA-118, s/n 701046

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 dB μ V to obtain field strength in dB μ V/m.

HL 4956: Active horn antenna
COM-POWER Corp., model: AHA-840, s/n 105004

Frequency, MHz	Measured antenna factor, dB/m
18000	5.1
18500	3.6
19000	2.2
19500	0.7
20000	0.7
20500	0.8
21000	0.5
21500	-1.3
22000	-2.1
22500	-2.0
23000	-1.6
23500	-2.9
24000	-2.3
24500	-2.6
25000	-1.8
25500	-1.2
26000	-0.5
26500	-1.2
27000	-0.1
27500	-1.0
28000	-0.7
28500	0.5

Frequency, MHz	Measured antenna factor, dB/m
29500	1.4
30000	2.9
30500	2.9
31000	2.9
31500	1.2
32000	0.7
32500	0.2
33000	-1.7
33500	-2.2
34000	2.3
34500	-1.1
35000	0.7
35500	-1.1
36000	0.1
36500	1.4
37000	3.7
37500	5.8
38000	6.6
38500	7.3
39000	6.5
39500	7.3
40000	7.1

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

HL 1500: Cable , 15 m, N/N-type,
Suhner Switzerland RG214/U, s/n 1500 HL 1500

Insertion loss

Set / Applied, MHz	Measured, dB	Uncertainty, dB
10	0.30	±0.07
50	0.71	±0.07
100	1.03	±0.07
150	1.28	±0.07
200	1.51	±0.07
250	1.71	±0.07
300	1.89	±0.07
350	2.06	±0.08
400	2.23	±0.08
450	2.38	±0.08
500	2.54	±0.08
550	2.68	±0.08
600	2.83	±0.08
650	2.96	±0.08
700	3.10	±0.08
750	3.23	±0.08
800	3.36	±0.08
850	3.49	±0.08
900	3.61	±0.08
950	3.74	±0.08
1000	3.86	±0.08
1050	3.98	±0.12
1100	4.10	±0.12
1150	4.22	±0.12
1200	4.35	±0.12
1250	4.46	±0.12
1300	4.58	±0.12

Set / Applied, MHz	Measured, dB	Uncertainty, dB
1350	4.71	±0.12
1400	4.82	±0.12
1450	4.95	±0.12
1500	5.06	±0.12
1550	5.18	±0.12
1600	5.30	±0.12
1650	5.42	±0.12
1700	5.53	±0.12
1750	5.64	±0.12
1800	5.77	±0.12
1850	5.87	±0.12
1900	6.00	±0.12
1950	6.12	±0.12
2000	6.23	±0.12

HL 3901: Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA
Huber-Suhner, model: SUCOFLEX 102A, s/n: 1225/2A

HL 3901: Insertion loss

Set / Applied, MHz	Measured, dB	Uncertainty, dB
50	0.34	±0.06
100	0.47	±0.06
150	0.58	±0.07
200	0.67	±0.07
300	0.82	±0.07
400	0.94	±0.07
500	1.05	±0.07
600	1.15	±0.07
700	1.24	±0.07
800	1.33	±0.07
900	1.41	±0.07
1000	1.49	±0.07
1100	1.56	±0.07
1200	1.62	±0.07
1300	1.69	±0.07
1400	1.76	±0.07
1500	1.82	±0.07
1600	1.88	±0.07
1700	1.94	±0.07
1800	2.00	±0.07
1900	2.05	±0.07
2000	2.11	±0.07
2100	2.16	±0.07
2200	2.21	±0.07
2300	2.26	±0.07
2400	2.32	±0.07
2500	2.36	±0.09
2600	2.42	±0.09
2700	2.47	±0.09
2800	2.52	±0.09
2800	2.52	±0.09
2900	2.57	±0.09
3000	2.62	±0.09
3100	2.67	±0.09
3200	2.72	±0.09
3300	2.76	±0.09
3400	2.80	±0.09
3500	2.84	±0.09
3600	2.88	±0.09
3700	2.93	±0.09
3800	2.96	±0.09
3900	3.00	±0.09
4000	3.04	±0.09
4100	3.08	±0.13
4200	3.11	±0.13
4300	3.15	±0.13
4400	3.19	±0.13
4500	3.22	±0.13
4600	3.26	±0.13

Set / Applied, MHz	Measured, dB	Uncertainty, dB
4700	3.29	±0.13
4800	3.33	±0.13
4900	3.36	±0.13
5000	3.40	±0.13
5100	3.43	±0.13
5200	3.46	±0.13
5300	3.50	±0.13
5400	3.53	±0.13
5500	3.56	±0.13
5600	3.59	±0.13
5700	3.62	±0.13
5800	3.65	±0.13
5900	3.68	±0.13
6000	3.71	±0.13
6100	3.74	±0.13
6200	3.78	±0.13
6300	3.81	±0.13
6400	3.84	±0.13
6500	3.88	±0.13
6600	3.91	±0.13
6700	3.95	±0.13
6800	3.99	±0.13
6900	4.02	±0.13
7000	4.05	±0.13
7100	4.09	±0.13
7200	4.12	±0.13
7300	4.16	±0.13
7400	4.19	±0.13
7500	4.23	±0.13
7600	4.26	±0.13
7700	4.30	±0.13
7800	4.33	±0.13
7900	4.36	±0.13
8000	4.39	±0.13
8100	4.42	±0.13
8200	4.45	±0.13
8300	4.48	±0.13
8400	4.50	±0.13
8500	4.53	±0.13
8600	4.56	±0.13
8700	4.58	±0.13
8800	4.61	±0.13
8900	4.63	±0.13
9000	4.66	±0.13
9100	4.67	±0.13
9200	4.69	±0.13
9300	4.72	±0.13
9400	4.75	±0.13
9500	4.77	±0.13

HL 3901: Insertion loss

Set / Applied, MHz	Measured, dB	Uncertainty, dB
9600	4.79	±0.13
9700	4.81	±0.13
9800	4.84	±0.13
9900	4.87	±0.13
10000	4.89	±0.13
10100	4.92	±0.13
10200	4.94	±0.13
10300	4.96	±0.13
10400	4.98	±0.13
10500	5.01	±0.13
10600	5.02	±0.13
10700	5.05	±0.13
10800	5.07	±0.13
10900	5.10	±0.13
11000	5.12	±0.13
11100	5.15	±0.13
11200	5.18	±0.13
11300	5.21	±0.13
11400	5.23	±0.13
11500	5.26	±0.13
11600	5.30	±0.13
11700	5.33	±0.13
11800	5.36	±0.13
11900	5.39	±0.13
12000	5.42	±0.13
12100	5.45	±0.16
12200	5.48	±0.16
12300	5.52	±0.16
12400	5.56	±0.16
12500	5.59	±0.22
12600	5.61	±0.22
12700	5.65	±0.22
12800	5.69	±0.22
12900	5.72	±0.22
13000	5.74	±0.22
13100	5.78	±0.22
13200	5.80	±0.22
13300	5.83	±0.22
13400	5.85	±0.22
13500	5.87	±0.22
13600	5.89	±0.22
13700	5.91	±0.22
13800	5.94	±0.22
13900	5.95	±0.22
14000	5.97	±0.22
14100	5.99	±0.22
14200	6.02	±0.22
14300	6.02	±0.22
14400	6.04	±0.22
14500	6.06	±0.22

Set / Applied, MHz	Measured, dB	Uncertainty, dB
14600	6.08	±0.22
14700	6.09	±0.22
14800	6.12	±0.22
14900	6.14	±0.22
15000	6.15	±0.22
15100	6.18	±0.22
15200	6.21	±0.22
15300	6.23	±0.22
15400	6.25	±0.22
15500	6.28	±0.22
15600	6.31	±0.22
15700	6.33	±0.22
15800	6.36	±0.22
15900	6.39	±0.22
16000	6.40	±0.22
16100	6.43	±0.22
16200	6.47	±0.22
16300	6.50	±0.22
16400	6.52	±0.22
16500	6.55	±0.22
16600	6.58	±0.22
16700	6.62	±0.22
16800	6.63	±0.22
16900	6.67	±0.22
17000	6.69	±0.22
17100	6.72	±0.22
17200	6.74	±0.22
17300	6.74	±0.22
17400	6.76	±0.22
17500	6.79	±0.22
17600	6.82	±0.22
17700	6.80	±0.22
17800	6.81	±0.22
17900	6.82	±0.22
18000	6.85	±0.22
18500	6.95	±0.42
19000	7.08	±0.42
19500	7.15	±0.42
20000	7.19	±0.42
20500	7.24	±0.42
21000	7.32	±0.42
21500	7.42	±0.42



HL 3901: Insertion loss

Set / Applied, MHz	Measured, dB	Uncertainty, dB
22000	7.57	±0.42
22500	7.70	±0.42
23000	7.81	±0.42
23500	7.85	±0.42
24000	7.86	±0.42
24500	7.94	±0.42
25000	8.02	±0.42
25500	8.12	±0.42
26000	8.23	±0.42
26500	8.33	±0.42
27000	8.39	±0.57
27500	8.42	±0.57
28000	8.43	±0.57
28500	8.48	±0.57
29000	8.57	±0.57
29500	8.65	±0.57
30000	8.70	±0.57
30500	8.77	±0.57

Set / Applied, MHz	Measured, dB	Uncertainty, dB
31000	8.84	±0.57
31500	8.93	±0.57
32000	9.07	±0.57
33500	9.25	±0.57
34000	9.32	±0.57
34500	9.39	±0.57
35000	9.49	±0.57
35500	9.59	±0.57
36000	9.68	±0.57
36500	9.76	±0.57
37000	9.85	±0.57
37500	9.98	±0.57
38000	10.07	±0.57
38500	10.12	±0.57
39000	10.19	±0.57
39500	10.29	±0.57
40000	10.36	±0.57

**HL 3903: Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA
Huber-Suhner SUCOFLEX 102A, s/n: 1226/2A**

Set / Applied, MHz	Measured, dB	Uncertainty, dB	Set / Applied, MHz	Measured, dB	Uncertainty, dB
50	0.14	±0.06	4400	1.31	±0.13
100	0.19	±0.06	4500	1.33	±0.13
150	0.24	±0.07	4600	1.34	±0.13
200	0.28	±0.07	4700	1.36	±0.13
300	0.34	±0.07	4800	1.37	±0.13
400	0.39	±0.07	4900	1.39	±0.13
500	0.44	±0.07	5000	1.40	±0.13
600	0.49	±0.07	5100	1.41	±0.13
700	0.52	±0.07	5200	1.43	±0.13
800	0.56	±0.07	5300	1.45	±0.13
900	0.59	±0.07	5400	1.46	±0.13
1000	0.62	±0.07	5500	1.47	±0.13
1100	0.65	±0.07	5600	1.48	±0.13
1200	0.68	±0.07	5700	1.50	±0.13
1300	0.71	±0.07	5800	1.51	±0.13
1400	0.74	±0.07	5900	1.52	±0.13
1500	0.76	±0.07	6000	1.54	±0.13
1600	0.78	±0.07	6100	1.55	±0.13
1700	0.81	±0.07	6200	1.56	±0.13
1800	0.83	±0.07	6300	1.58	±0.13
1900	0.86	±0.07	6400	1.59	±0.13
2000	0.88	±0.07	6500	1.60	±0.13
2100	0.90	±0.07	6600	1.61	±0.13
2200	0.92	±0.07	6700	1.63	±0.13
2300	0.94	±0.07	6800	1.64	±0.13
2400	0.96	±0.07	6900	1.65	±0.13
2500	0.98	±0.09	7000	1.66	±0.13
2600	1.00	±0.09	7100	1.68	±0.13
2700	1.02	±0.09	7200	1.69	±0.13
2800	1.04	±0.09	7300	1.70	±0.13
2900	1.06	±0.09	7400	1.71	±0.13
3000	1.08	±0.09	7500	1.73	±0.13
3100	1.10	±0.09	7600	1.74	±0.13
3200	1.11	±0.09	7700	1.76	±0.13
3300	1.14	±0.09	7800	1.76	±0.13
3400	1.15	±0.09	7900	1.78	±0.13
3500	1.17	±0.09	8000	1.78	±0.13
3600	1.19	±0.09	8100	1.80	±0.13
3700	1.20	±0.09	8200	1.81	±0.13
3800	1.21	±0.09	8300	1.82	±0.13
3900	1.23	±0.09	8400	1.82	±0.13
4000	1.25	±0.09	8500	1.85	±0.13
4100	1.27	±0.13	8600	1.86	±0.13
4200	1.28	±0.13	8700	1.87	±0.13
4300	1.30	±0.13			

Set / Applied, MHz	Measured, dB	Uncertainty, dB
8800	1.87	±0.13
8900	1.89	±0.13
9000	1.90	±0.13
9100	1.91	±0.13
9200	1.92	±0.13
9300	1.93	±0.13
9400	1.95	±0.13
9500	1.95	±0.13
9600	1.97	±0.13
9700	1.98	±0.13
9800	1.99	±0.13
9900	2.00	±0.13
10000	2.01	±0.13
10100	2.02	±0.13
10200	2.02	±0.13
10300	2.04	±0.13
10400	2.05	±0.13
10500	2.06	±0.13
10600	2.07	±0.13
10700	2.08	±0.13
10800	2.09	±0.13
10900	2.10	±0.13
11000	2.11	±0.13
11100	2.12	±0.13
11200	2.13	±0.13
11300	2.14	±0.13
11400	2.15	±0.13
11500	2.15	±0.13
11600	2.17	±0.13
11700	2.17	±0.13
11800	2.19	±0.13
11900	2.19	±0.13
12000	2.20	±0.13
12100	2.21	±0.16
12200	2.22	±0.16
12300	2.23	±0.16
12400	2.25	±0.16
12500	2.26	±0.22
12600	2.26	±0.22
12700	2.27	±0.22
12800	2.29	±0.22
12900	2.30	±0.22
13000	2.30	±0.22
13100	2.31	±0.22
13200	2.32	±0.22
13400	2.34	±0.22

Set / Applied, MHz	Measured, dB	Uncertainty, dB
13500	2.35	±0.22
13600	2.36	±0.22
13700	2.36	±0.22
13800	2.38	±0.22
13900	2.38	±0.22
14000	2.40	±0.22
14100	2.40	±0.22
14200	2.41	±0.22
14300	2.42	±0.22
14400	2.43	±0.22
14500	2.44	±0.22
14600	2.45	±0.22
14700	2.46	±0.22
14800	2.47	±0.22
14900	2.48	±0.22
15000	2.49	±0.22
15100	2.49	±0.22
15200	2.51	±0.22
15300	2.51	±0.22
15400	2.52	±0.22
15500	2.53	±0.22
15600	2.54	±0.22
15700	2.54	±0.22
15800	2.55	±0.22
15900	2.56	±0.22
16000	2.57	±0.22
16100	2.58	±0.22
16200	2.59	±0.22
16300	2.60	±0.22
16400	2.61	±0.22
16500	2.62	±0.22
16600	2.63	±0.22
16700	2.63	±0.22
16800	2.63	±0.22
16900	2.65	±0.22
17000	2.66	±0.22
17100	2.66	±0.22
17200	2.67	±0.22
17300	2.68	±0.22
17400	2.69	±0.22
17500	2.70	±0.22
17600	2.71	±0.22
17700	2.71	±0.22
17800	2.72	±0.22
17900	2.74	±0.22

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	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
μ s	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

END OF DOCUMENT