HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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NFC TEST REPORT

ACCORDING TO: FCC CFR 47 PART 15 subpart C, §15.225 and RSS-210 issue10 Annex B section B.6

FOR:

ARAD TECHNOLOGIES

Sonata Sprint

Model: Encoder

FCC ID: 2A7AASONSPR1MM

IC: 28664SON1SPRMM

Table of contents

1 Applicant information

Client name:	ARAD TECHNOLOGIES
Address:	POB 537, HaMada 4, Yokneam Ind. Zone, Yokneam Ilit 20692, Israel
Telephone:	04-9935222, Ext: 271
Fax:	04-9935227
E-mail:	viorel.negreanu@aradtec.com
Contact name:	Mr. Vily Negreanu

2 Equipment under test attributes

Product name:	Sonata Sprint
Product type:	Transceiver
Model(s):	Encoder
Serial number:	11512007
Hardware version:	V2.0
Software release:	5.01.49
Receipt date	22-Mar-22

3 Manufacturer information

Manufacturer name:	ARAD TECHNOLOGIES
Address:	POB 537, HaMada 4, Yokneam Ind. Zone, Yokneam Ilit 20692, Israel
Telephone:	04-9935222, Ext: 271
Fax:	04-9935227
E-Mail:	viorel.negreanu@aradtec.com
Contact name:	Mr. Vily Negreanu

4 Test details

Project ID:	46455
Location:	Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started:	23-Mar-22
Test completed:	13-Apr-22
Test specification(s):	FCC CFR 47 PART 15 subpart C, §15.225 class B RSS-210 issue10 Annex B section B.6

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions	Pass
FCC Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions	Pass
FCC Section 15.225(e) / RSS-210, Section B.6, Frequency stability	Pass
FCC Section 15.207(a) / RSS-Gen, Section 8.8, Conducted emission	Not required
FCC Section 15.215(c) / RSS-Gen, Section 6.6, Occupied bandwidth	Pass
FCC Section 15.203/ RSS-Gen, Section 8.3, Antenna requirements	Pass

This test report supersedes the previously issued test report identified by Doc ID: ARARAD_FCC.46455_NFC

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.

	Name and Title	Date	Signature
Tested by:	Mr. H.N. Abayev, test engineer, EMC & Radio	23-Mar-22 – 13-Apr-22	
Reviewed by:	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	08-Jun-22	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	17-Jul-22	

6 EUT description

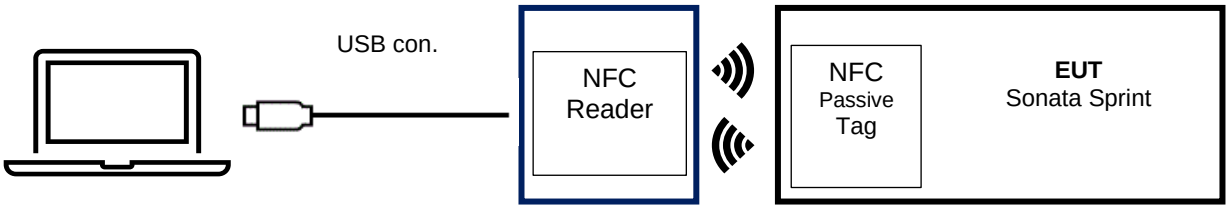
Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The EUT is s Sonata Sprint Encoder that is a battery-powered sub-system module allowed reading meter data through 2W or 3W interface.

It identifies the reader system type (2W or 3W) and converts the serially received data from the meter to the reader's string formats and transfer it in the Sensus reader type protocol.

6.2 Test configuration



Equipment Used in Tested System

Item	Equipment	Mfr./Brand	Model / Type	Series	Data Cable	Power Cord
1	Notebook	DELL	Latitude 7490	5991291002	N/A	Unshielded
2	NFC Test software	Arad Group	Arad Smart Meters	1.0.48.0	N/A	N/A
3	NFC Reader	Arad Group	N/A	1.0.1	Shielded	N/A

6.3 Changes made in EUT

No changes were implemented in the EUT during testing.

6.4 Transmitter characteristics

Type of equipment	
X	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)

Assigned frequency range	13.110-14.010 MHz
Operating frequency	13.56 MHz
Maximum field strength of carrier	65.45 dB(µV/m) at 3 m diatance

Is transmitter output power variable?	X	No			
		Yes		continuous variable	
				stepped variable with stepsize	
			minimum RF power		dBm
			maximum RF power		dBm

Antenna connection			
unique coupling	standard connector	X integral	with temporary RF connector
			X without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Internal	Landa Digital Printing	Printed loop	NA

Type of modulation	ASK
Transmitter duty cycle supplied for test	100%

Transmitter power source					
X	Battery	**Nominal rated voltage**	3.6 VDC	Battery type	
	DC	**Nominal rated voltage**		Via USB from PC	
	AC mains	**Nominal rated voltage**		Frequency	

* **Operating frequency range belongs to Near Field Communication.**

Test specification:	Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22		
Temperature: 22 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 requirements

7.1 In band radiated emissions

7.1.1 General

This test was performed to measure field strength of fundamental emission and modulation products from the EUT within the assigned band. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Radiated emission limits

Frequency, MHz	Field strength at 30 m distance*		Field strength at 3 m distance*	
	µV/m	dB(µV/m)	µV/m	dB(µV/m)**
13.110 – 13.410	106	40.5	10600	80.5
13.410 – 13.553	334	50.5	33400	90.5
13.553 – 13.567	15848	84.0	1584800	124.0
13.567 – 13.710	334	50.5	33400	90.5
13.710 – 14.010	106	40.5	10600	80.5

*- The limit is provided in quasi peak values.

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

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

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

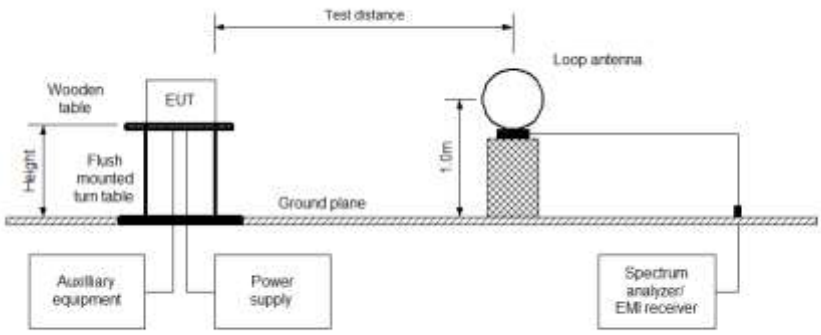
7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1 energized and the performance check was conducted.

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

7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

Figure 7.1.1 Setup for in band radiated emission measurements



Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	23-Mar-22		
Temperature: 22 ºC	**Relative Humidity:** 50 %	**Air Pressure:** 1012 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.1.2 In band radiated emission test results

TEST DISTANCE: 3 m
EUT POSITION: 3 orthogonal (X / Y / Z)
MODULATION: ASK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
INVESTIGATED FREQUENCY RANGE: 13.110 – 14.010 MHz
RESOLUTION BANDWIDTH: 1.0 kHz
VIDEO BANDWIDTH: 3.0 kHz

Carrier frequency, MHz	**Peak emission, dB(μV/m)**	**Quasi-peak**			**Antenna polarization**	**Azimuth**, degrees**	**Verdict**
		Measured emission, dB(μV/m)	**Limit, dB(μV/m)**	**Margin, dB***			
Unom							Pass
13.559	65.52	65.45	124	-58.55	Vertical	0	

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

Reference numbers of test equipment used

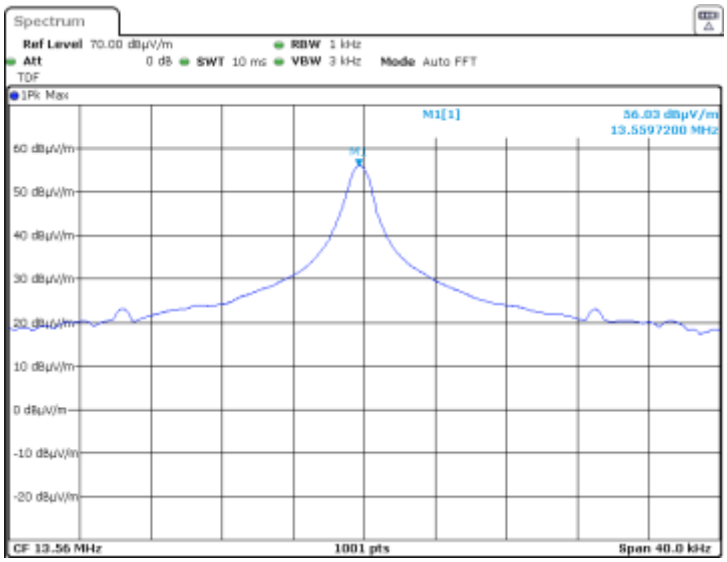
HL 0446	HL 3901	HL 4355	HL 5902				

Full description is given in Appendix A.

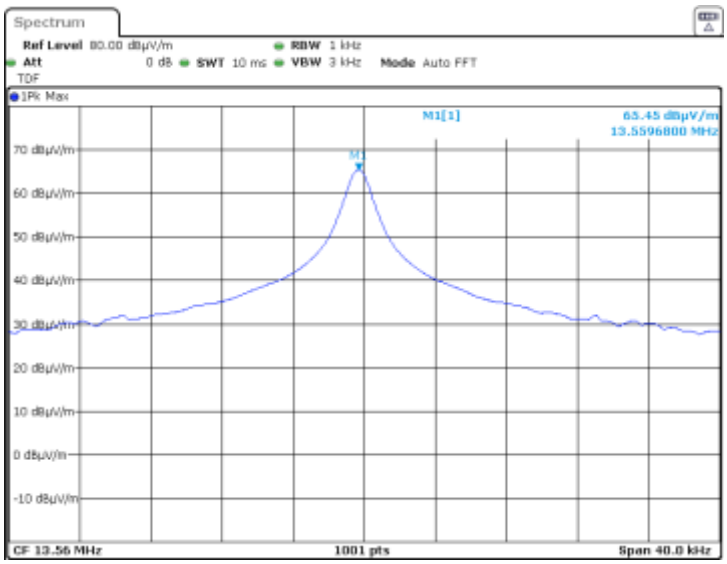
Test specification:	**Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions**		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	23-Mar-22		
Temperature: 22 ºC	**Relative Humidity:** 50 %	**Air Pressure:** 1012 hPa	**Power:** 3.6 VDC
Remarks:			

Plot 7.1.1 Fundamental emission test result

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold
EUT POSITION X
INPUT VOLTAGE: Unom



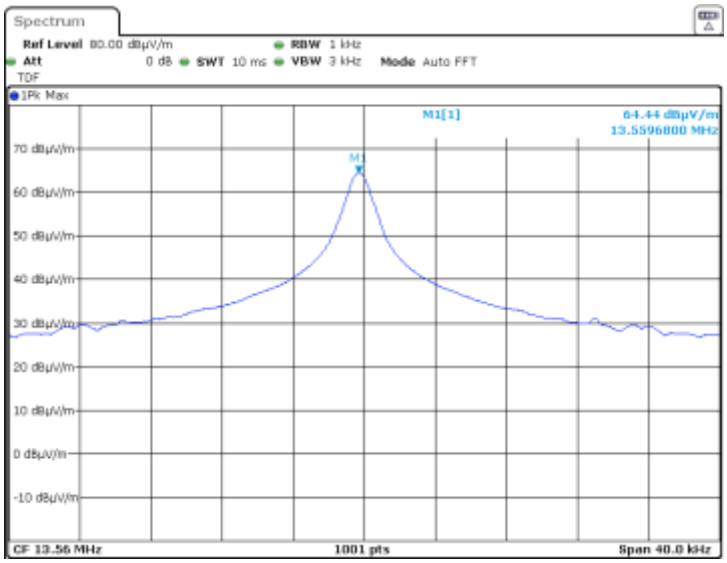
EUT POSITION Y (as worst from 3 orthogonal positions)



Test specification:	Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22		
Temperature: 22 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

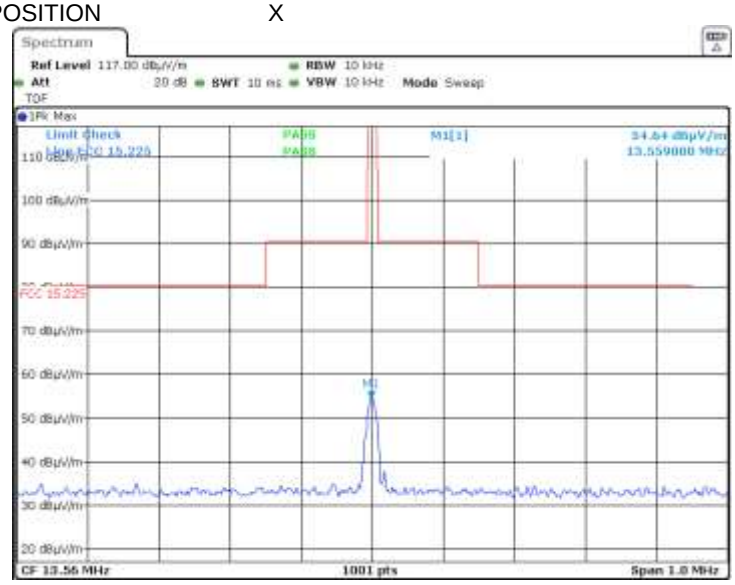
Plot 7.1.2 Fundamental emission test result (continuation)

EUT POSITION Z



Plot 7.1.3 In band radiated emission test results

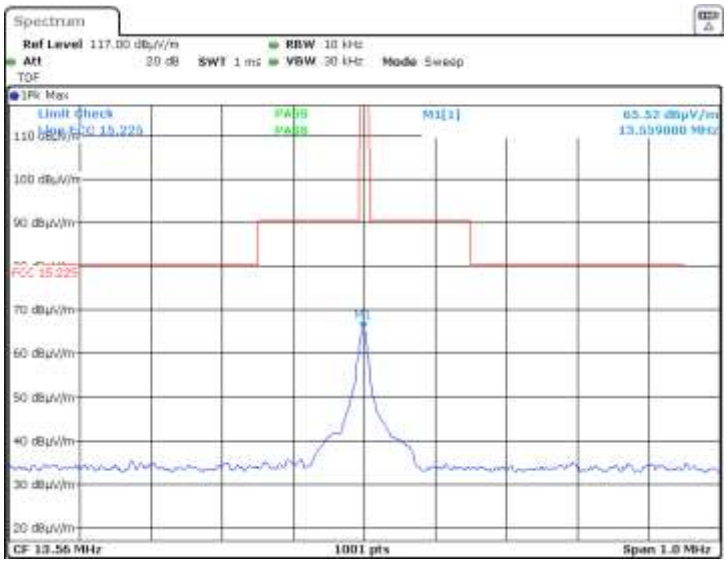
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
DETECTOR: Peak hold
EUT POSITION X



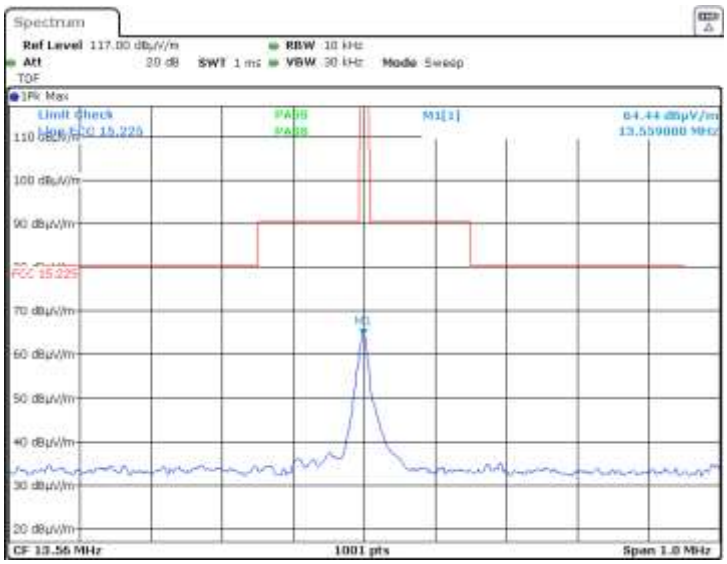
Test specification:	Sections 15.225(a) (b) (c) / RSS-210, Section B.6(a), (b), (c), In band radiated emissions		
Test procedure:	ANSI C63.10 sections 6.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22		
Temperature: 22 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.1.4 In band radiated emission test results (continuation)

EUT POSITION Y



EUT POSITION Z



Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10, Sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	23-Mar-22 - 03-Apr-22		
Temperature: 22 ºC	**Relative Humidity:** 50 %	**Air Pressure:** 1012 hPa	**Power:** 3.6 VDC
Remarks:			

7.2 Out of band radiated emissions

7.2.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Radiated emission limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m)***		
	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	

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

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

where S_1 and S_2 – standard defined and test distance respectively in meters.
***- The limit decreases linearly with the logarithm of frequency.

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 loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.
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, 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 and shown in the associated plots.

Test specification:	Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions		
Test procedure:	ANSI C63.10, Sections 6.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22 - 03-Apr-22		
Temperature: 22 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.2.1 Radiated emissions below 30 MHz test set up

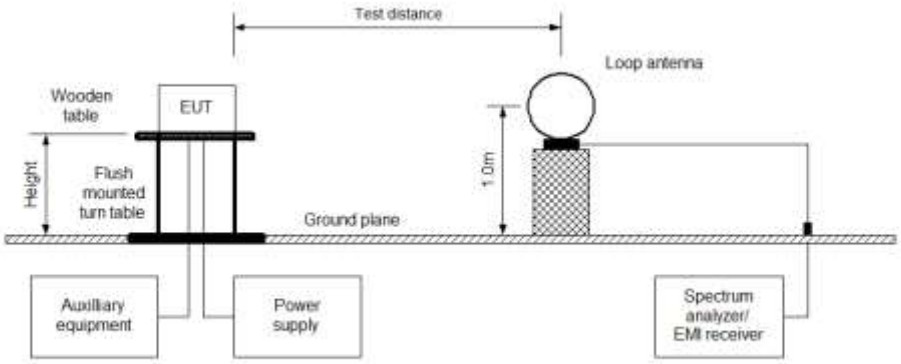
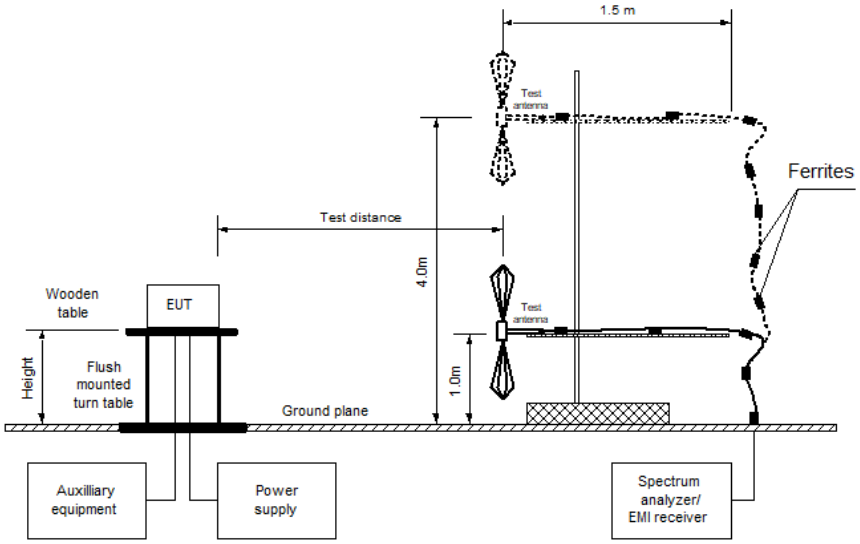


Figure 7.2.2 Radiated emissions above 30 MHz test set up



Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10, Sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	23-Mar-22 - 03-Apr-22		
Temperature: 22 ºC	**Relative Humidity:** 50 %	**Air Pressure:** 1012 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.2.2 Out of band radiated emissions test results

TEST DISTANCE:	3 m
EUT POSITION:	Giving the worst case
MODULATION:	ASK
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
RESOLUTION BANDWIDTH:	0.2 kHz (9 kHz – 150 kHz) 9.0 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1000 MHz)
VIDEO BANDWIDTH:	≥ Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconical (30 MHz – 200 MHz) Log periodic (200 MHz – 1000 MHz) Biconilog (30 MHz – 1000 MHz)

Frequency, MHz	**Peak emission, dB(μV/m)**	**Quasi-peak**			**Antenna polarization**	**Antenna height, m**	**Turn-table position**, degrees**	**Verdict**
		Measured emission, dB(μV/m)	**Limit, dB(μV/m)**	**Margin, dB***				
54.263	35.94	33.99	40.0	-6.01	Vertical	1.19	-175	Pass
120.008	44.73	42.49	43.5	-1.01	Vertical	1.00	-18	Pass
216.972	43.07	41.93	46.0	-4.07	Horizontal	1.19	-129	Pass

**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

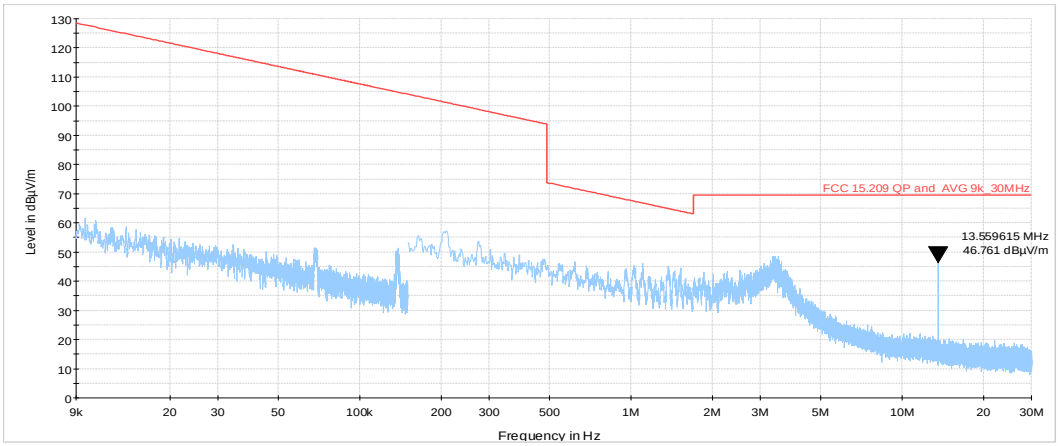
HL 0446	HL 0604	HL 4360	HL 5902				

Full description is given in Appendix A.

Test specification:	**Sections 15.225(d) / RSS-210, Section B.6(d), Out of band radiated emissions**		
Test procedure:	ANSI C63.10, Sections 6.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	23-Mar-22 - 03-Apr-22		
Temperature: 22 ºC	**Relative Humidity:** 50 %	**Air Pressure:** 1012 hPa	**Power:** 3.6 VDC
Remarks:			

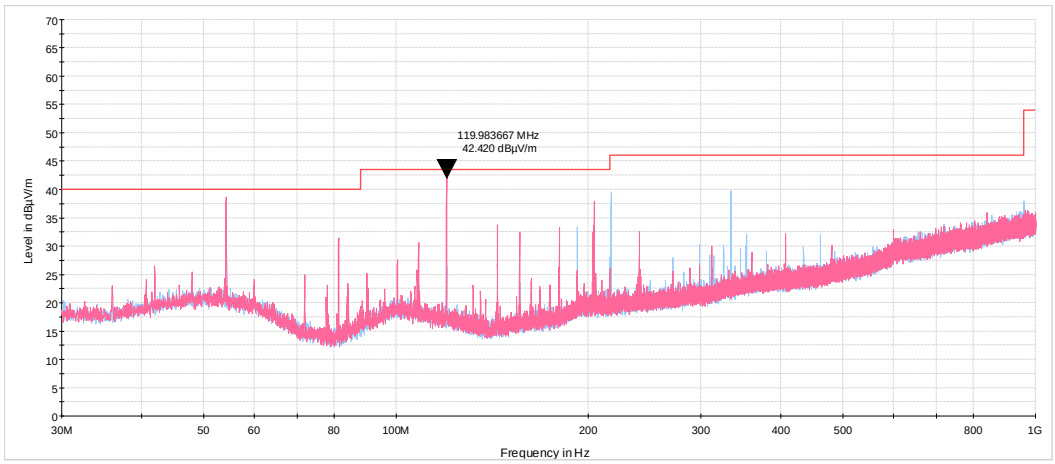
Plot 7.2.1 Radiated emission measurements from 0.009 to 30 MHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Circular
DETECTOR:	Peak hold
EUT POSITION:	Giving the worst case



Plot 7.2.2 Radiated emission measurements from 30 to 1000 MHz

TEST SITE:	Semi anechoic chamber
TEST DISTANCE:	3 m
ANTENNA POLARIZATION:	Vertical/Horizontal
DETECTOR:	Peak hold
EUT POSITION:	Giving the worst case



Test specification:	Section 15.225(e) / RSS-210, Section B.6, Frequency stability		
Test procedure:	ANSI C63.10, Section 6.8		
Test mode:	Compliance	Verdict:	PASS
Date(s):	04-Apr-22		
Temperature: 25 ºC	Relative Humidity: 39 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

7.3 Frequency stability test

7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	%	Hz
13.560	± 0.01 %	1356

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

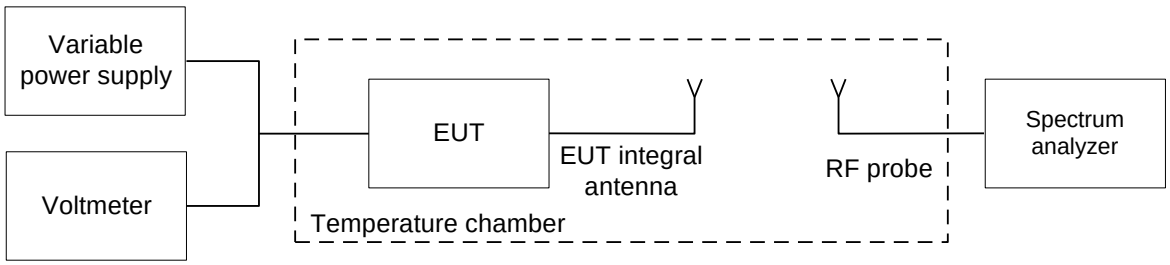
7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to the required one and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then after 2, 5 and 10 minutes. The EUT was powered off.

7.3.2.4 The above procedure was repeated at the rest of the test temperatures and voltages as provided in Table 7.3.2.

7.3.2.5 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup



Test specification:	**Section 15.225(e) / RSS-210, Section B.6, Frequency stability**		
Test procedure:	ANSI C63.10, Section 6.8		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	04-Apr-22		
Temperature: 25 ºC	**Relative Humidity:** 39 %	**Air Pressure:** 1010 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY:	13.560 MHz
NOMINAL POWER VOLTAGE:	5.0 V
TEMPERATURE STABILIZATION PERIOD:	20 min
POWER DURING TEMPERATURE TRANSITION:	Off
SPECTRUM ANALYZER MODE:	Counter
RESOLUTION BANDWIDTH:	100 Hz
VIDEO BANDWIDTH:	300 Hz
MODULATION:	Modulated

Temperature, ºC	Voltage, V	Frequency, MHz				Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	2nd min	5th min	10th min	Positive	Negative			
-20	nominal	13.559785	13.559756	13.559783	13.559762	38	0	1356	-1318	Pass
20	nominal +15%	13.559739	13.559747	13.559729	13.559738	0	-18		-1338	
20	nominal	13.559761	13.559742	13.559756	13.559747	14	-5		-1342	
20	nominal -15%	13.559735	13.559755	13.559743	13.559733	8	-14		-1342	
50	nominal	13.559747	13.559750	13.559760	13.559749	13	0		-1343	

* - Reference frequency

Reference numbers of test equipment used

HL 2780	HL 5397						

Full description is given in Appendix A.

Test specification:	Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth		
Test procedure:	ANSI C63.10 section 6.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22 - 04-Apr-22		
Temperature: 24 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

7.4 Occupied bandwidth test

7.4.1 General

This test was performed to verify that the 20 dB bandwidth of the emissions was contained within the standard specified frequency band according to FCC §15.215 requirements. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc
13.110 – 13.410	20.0
13.410 – 13.553	
13.553 – 13.567	
13.567 – 13.710	
13.710 – 14.010	

*- Modulation envelope reference points provided in terms of attenuation below modulated carrier.

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 spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.4.2.3 The peak of emission was measured. The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.4.2 and associated plot.

7.4.2.4 Modulation bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained modulation bandwidth was verified to be within the allowed frequency range.

Figure 7.4.1 Occupied bandwidth test setup

Test specification:	**Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth**		
Test procedure:	ANSI C63.10 section 6.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	23-Mar-22 - 04-Apr-22		
Temperature: 24 ºC	**Relative Humidity:** 50 %	**Air Pressure:** 1012 hPa	**Power:** 3.6 VDC
Remarks:			

Table 7.4.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND	13.11 – 14.01 MHz
DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	200 Hz
VIDEO BANDWIDTH:	500 Hz
MODULATION ENVELOPE REFERENCE POINTS:	20 dBc
MODULATION:	ASK
MODULATING SIGNAL:	enable

Band edge	Cross point frequency, MHz	Frequency drift, kHz		Modulation band edge, MHz	Assigned band edge, MHz	Verdict
		Negative	Positive			
Low	13.559171	-0.018	NA	13.559153	13.553	Pass
High	13.560170	NA	0.038	13.560208	13.567	Pass

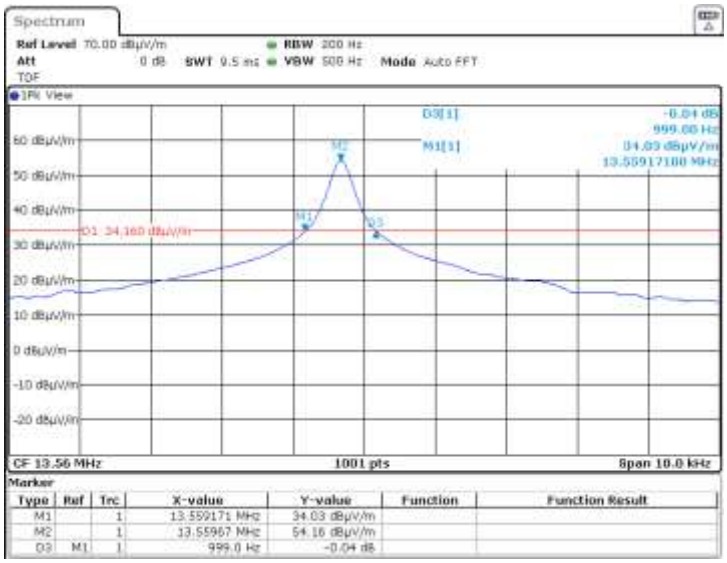
Reference numbers of test equipment used

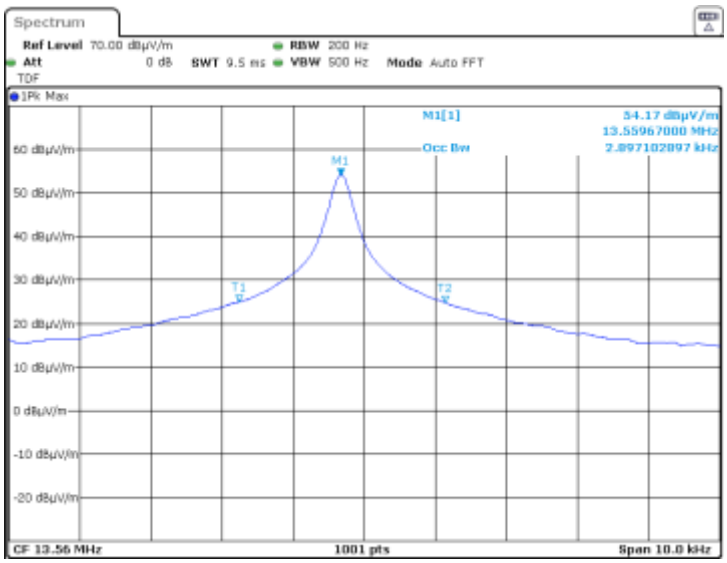
HL 0446	HL 3901	HL 4355	HL 5902					

Full description is given in Appendix A.

Test specification:	Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth		
Test procedure:	ANSI C63.10 section 6.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22 - 04-Apr-22		
Temperature: 24 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.1 Occupied bandwidth test result





Test specification:	FCC Section 15.203/ RSS-Gen, Section 7.1.4, Antenna requirement		
Test procedure:	Visual inspection / supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Mar-22 - 04-Apr-22		
Temperature: 24 ºC	Relative Humidity: 50 %	Air Pressure: 1012 hPa	Power: 3.6 VDC
Remarks:			

7.5 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 7.5.1.

Table 7.5.1 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	

8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 (9) kHz - 30 MHz	EMCO	6502	2857	28-Feb-22	28-Feb-23
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	11-May-21	11-May-22
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY45102462	03-Mar-22	03-Mar-23
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1225/2A	06-Apr-21	06-Apr-22
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	20-Sep-21	20-Sep-22
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	13-Jan-22	13-Jan-23
5397	H-field near field probe, 3 cm	ETS Lindgren	7405-902	NA	16-Aug-20	16-Aug-22
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/11N/11N/6000	NA	16-Jan-22	16-Jan-23

9 APPENDIX B 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 dBμV to obtain field strength in dBμA/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 dBµV to obtain field strength in dBµV/m.

10 APPENDIX C 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 D 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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12 APPENDIX E Specification references

FCC 47CFR part 15: 2020	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-210 Issue 10: 2019	Licence- Exempt Radio Apparatus: Category I Equipment
RSS-Gen Issue 5 with_amendment_1_2: 2021	General Requirements and Information for the Certification of Radiocommunication Equipment

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
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
OATS	open area test site
Ω	Ohm
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