

TEST REPORT

ACCORDING TO:

**FCC CFR 47 Part 15 subpart C, section 15.231 and subpart B, Class B;
RSS-210, issue 10 Annex A and ICES-003, Class B**

FOR:

Essence Security International Ltd.

Tag Reader with Keypad

Model: ES700TRKPD-ES-M02

FCC ID: YXG-ES700TRKPD

IC: 11061A-ES700TRKPD

This report is in conformity with ISO/IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested.
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1 Applicant information

Client name: Essence Security International Ltd.
Address: 12 Abba Eban Avenue, Ackerstein Towers Bldg. D, P.O.Box 2073, Herzliya 4612001, Israel
Telephone: +972 7324 47735
Fax: +972 9772 9962
E-mail: israelgo@essence-grp.com
Contact name: Mr. Israel Gottesman

2 Equipment under test attributes

Product name: Tag Reader with Keypad
Product type: Transceiver
Model(s): ES700TRKPD-ES-M02
Serial number: 3319093700002221
Hardware version: 3.E
Software release: 1.5.3
Receipt date 28-Aug-19

3 Manufacturer information

Manufacturer name: Essence Security International Ltd.
Address: 12 Abba Eban Avenue, Ackerstein Towers Bldg. D, P.O.Box 2073, Herzliya 4612001, Israel
Telephone: +972 7324 47735
Fax: +972 9772 9962
E-Mail: israelgo@essence-grp.com
Contact name: Mr. Israel Gottesman




4 Test details

Project ID: 33716
Location: Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started: 01-Sep-19
Test completed: 10-Sep-19
Test specification(s): FCC CFR 47 Part 15 subpart C, section 15.231 and subpart B, Class B; RSS-210, issue 10 Annex A and ICES-003, Class B

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements	Pass
FCC Part 15, Section 231(a) / RSS-210, Section A1.2, Field strength of emissions	Pass
FCC Part 15, Section 231(c) / RSS-210, Section A1.3, Occupied bandwidth	Pass
FCC Part 15, Section 207 / RSS-Gen, Section 8.8, Conducted emission	Not required
FCC Part 15, Section 203 / RSS-Gen, Section 8.3, Antenna requirements	Pass
Unintentional emissions	
FCC Part 15, Section 107 / ICES-003, Section 6.1 class B, Conducted emission at AC power port	Not required
FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2/ 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.

	Name and Title	Date	Signature
Tested by:	Mr. I. Zilberstein, test engineer, EMC & Radio	01-Sep-19 – 10-Sep-19	
Reviewed by:	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	03-May-20	
Approved by:	Mr. S. Samokha, technical manager, EMC & Radio	26-Aug-20	

6 EUT description

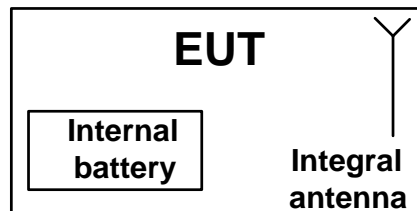
Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The EUT, ES700TRKPD-ES-M02 is an encrypted, wireless, access control RFID tag reader (13.56MHz) with a keypad and 5-button design to provides system activation controls and status indications.

The EUT is Grade 2 Class II, works on 916.5MHz with RFID on 13.56MHz.

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					
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)				
Operating frequencies		916.5 MHz			
Maximum rated output power		At transmitter 50 Ω RF output connector		dBm	
		Field strength at 3 m distance		101.83 dB(μ V/m) -peak 79.22 dB(μ V/m)-average	
Is transmitter output power variable?		X	No		
			Yes	continuous variable	
				stepped variable with stepsize dB	
				minimum RF power dBm	
				maximum RF power dBm	
Antenna connection					
unique coupling		standard connector		X	integral
				X	with temporary RF connector without temporary RF connector
Antenna/s technical characteristics					
Type	Manufacturer		Model number		Gain
Integral	BCONDUCT		NA		-0.2 dBi
Type of modulation		2FSK			
Transmitter aggregate data rate/s		38.4 kbps			
Transmitter power source					
X	Battery	Nominal rated voltage	6VDC	Battery type	4 x 1.5VDC Alkaline
	DC	Nominal rated voltage	VDC		
	AC mains	Nominal rated voltage	VAC		
Common power source for transmitter and receiver				X	yes no



Test specification:		FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements	
Test procedure:		Supplier declaration	
Test mode:		Compliance	Verdict: PASS
Date(s):		02-Sep-19	
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C requirements

7.1 Periodic operation requirements

7.1.1 General

The EUT was verified for compliance with periodic operation requirements listed below:

- Continuous transmissions such as voice, video and the radio control of toys are not permitted;
- A manually operated transmitter shall employ switch that will automatically deactivate the transmitter within not more than 5 seconds of being released;
- A transmitter activated automatically shall cease transmission within 5 seconds after activation;
- Periodic transmissions, excluding polling or supervision transmissions, at regular predetermined intervals are not permitted;
- Total duration of polling or supervision transmissions, including data, to determine system integrity in security or safety applications shall not exceed 2 seconds per hour;
- Transmission of set-up information for security systems may exceed the transmission duration limits of 5 seconds, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

The rationale for compliance with the above requirements was either test results or supplier declaration. The summary of results is provided in Table 7.1.1.

7.1.2 Test procedure for transmitter shut down test

7.1.2.1 The EUT was set up as shown in Figure 7.1.1.

7.1.2.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

7.1.2.3 The transmitter was activated either manually or automatically. Once manually operated transmitter was activated, the switch was immediately released.

7.1.2.4 The transmission time was captured and shown in Plot 7.1.2.

7.1.3 Test procedure for measurements of polling / supervision transmission duration

7.1.3.1 The EUT was set up as shown in Figure 7.1.1.

7.1.3.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

7.1.3.3 The transmission time was captured and shown in Plot 7.1.2, Plot 7.1.3.



Test specification:	FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Sep-19		
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Figure 7.1.1 Setup for transmitter shut down test**Table 7.1.1 Periodic operation requirements**

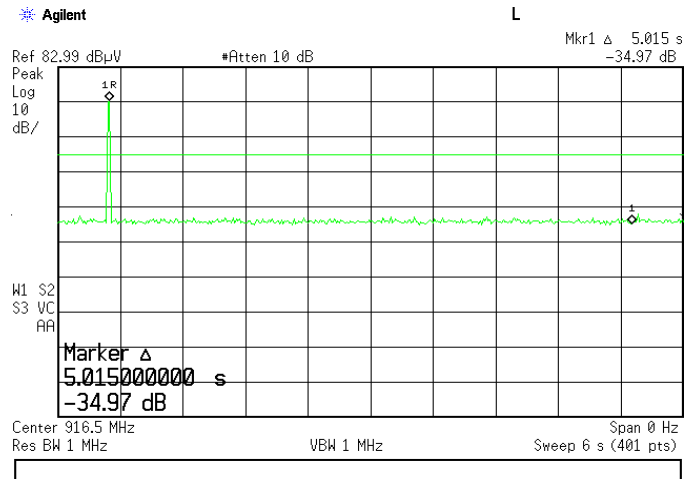
Requirement	Rationale	Verdict
Continuous transmissions are not permitted	Supplier declaration	Comply
A manually operated transmitter shall be deactivated within not more than 5 seconds of switch being released	NA	Comply
Transmitter activated automatically shall cease transmission within 5 seconds	Plot 7.1.1	Comply
Periodic transmissions at regular predetermined intervals are not permitted	Supplier declaration	Comply
Total duration of polling or supervision transmissions shall not exceed 2 seconds per hour	Plot 7.1.2, Plot 7.1.3	Comply
Transmission of set-up information for security systems may exceed the transmission duration limits of 5 seconds, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.	Supplier declaration	Comply



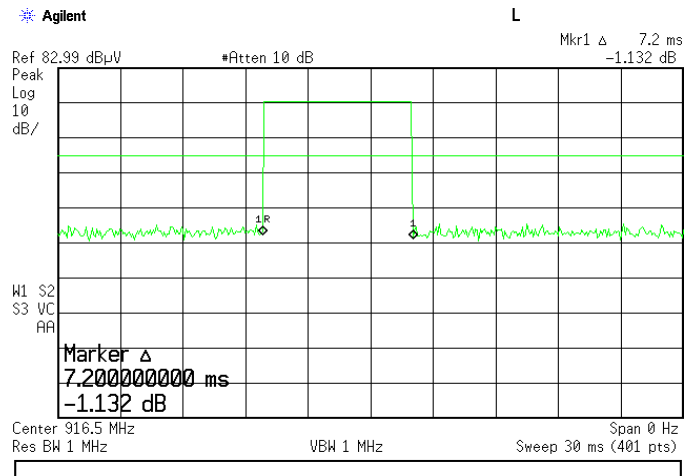
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Test specification:	FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements		
Test procedure:	Supplier declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	02-Sep-19		
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Plot 7.1.1 Transmitter shut down test result



Plot 7.1.2 Polling / supervision transmission duration





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Report ID: ESIRAD_FCC.33716_FCC15.231
Date of Issue: 26-Aug-20

Test specification:		FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements	
Test procedure:		Supplier declaration	
Test mode:		Compliance	Verdict: PASS
Date(s):		02-Sep-19	
Temperature: 25 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Table 7.1.2 Total duration of polling / supervision transmissions

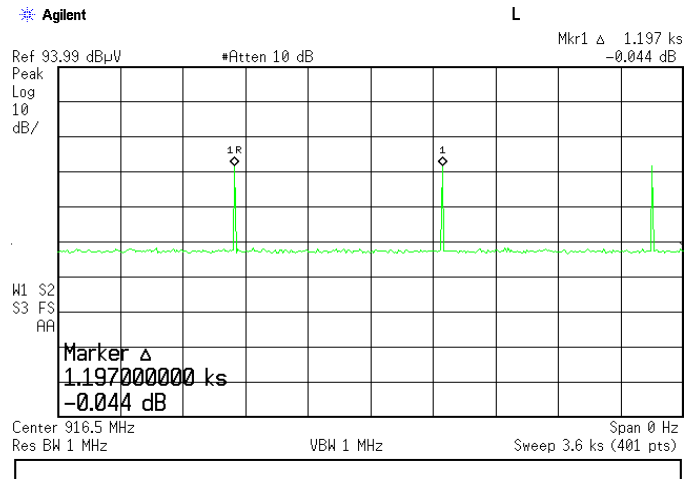


Table 7.1.3 Total duration of polling / supervision transmissions

Duration, ms	Repetition period, ms	Maximum number of transmissions within 1 hour	Total duration within 1 hour, ms
7.2	1197	4	28.8

Reference numbers of test equipment used

HL 2909	HL 4136	HL 3433	HL 1809	HL 337			
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Full description is given in Appendix A.



Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions	
Test procedure: ANSI C63.10, Section 6.5 / 6.6	
Test mode: Compliance	Verdict: PASS
Date(s): 01-Sep-19	
Temperature: 25.6 °C	Relative Humidity: 48 %
Air Pressure: 1006 hPa	
Power: 6 VDC	
Remarks:	

7.2 Field strength of emissions

7.2.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.2.1 and Table 7.2.2.

Table 7.2.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
916.5	102	82

Table 7.2.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)				
	Within restricted bands			Outside restricted bands	
	Peak	Quasi Peak	Average	Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	82	62
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			
Above 1000	74.0	NA	54.0		

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

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

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

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

Note 1: The fundamental emission limit in dB(μV/m) was calculated as follows:

$$\text{Lim}_{AVR} = 20 \times \log(56.81818 \times F - 6136.3636) \text{ - within } 130 - 174 \text{ MHz band;}$$

$$\text{Lim}_{AVR} = 20 \times \log(41.6667 \times F - 7083.3333) \text{ - within } 260 - 470 \text{ MHz band,}$$

where F is the carrier frequency in MHz.

The limit for spurious emissions was 20 dB lower than fundamental emission limit.

The above limits provided in terms of average values, peak limit was 20 dB above the average limit.

Note 2: 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.



Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10, Section 6.5 / 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
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° 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 7.2.3, Table 7.2.5 and shown in the associated plots.

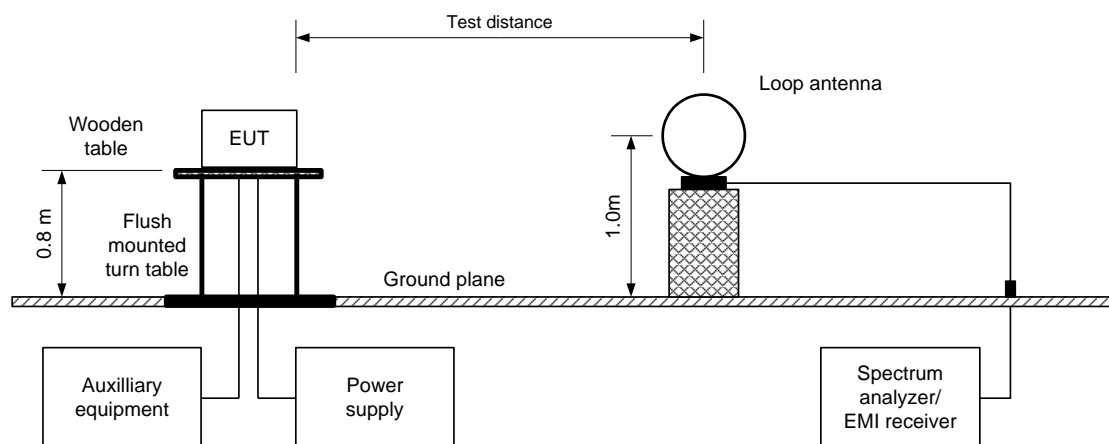
7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.1, 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°, 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 7.2.3, Table 7.2.5 and shown in the associated plots.

Figure 7.2.1 Setup for spurious emission field strength measurements below 30 MHz





Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10, Section 6.5 / 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

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

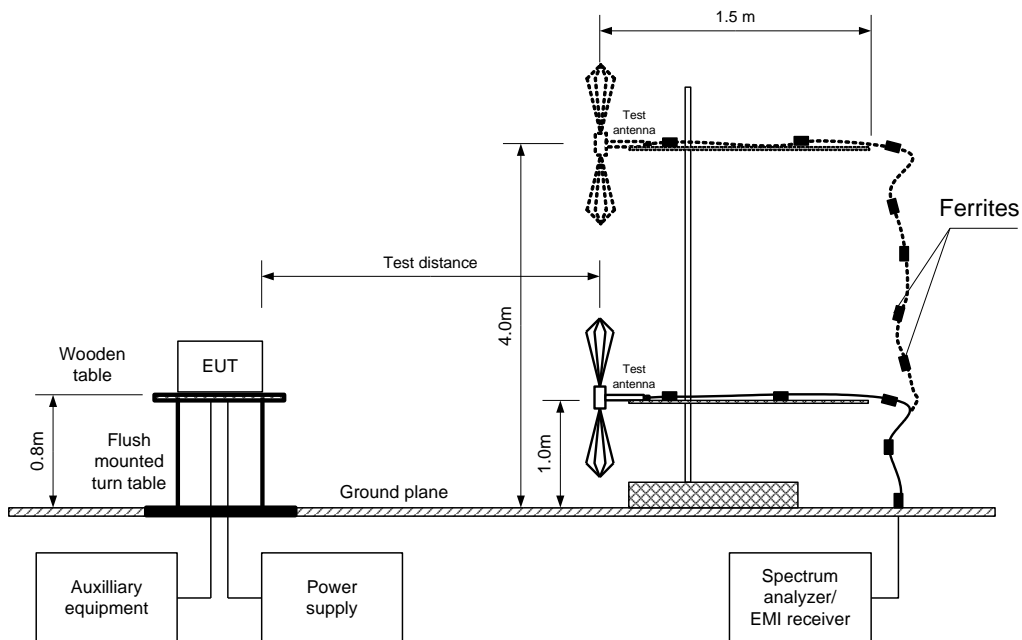
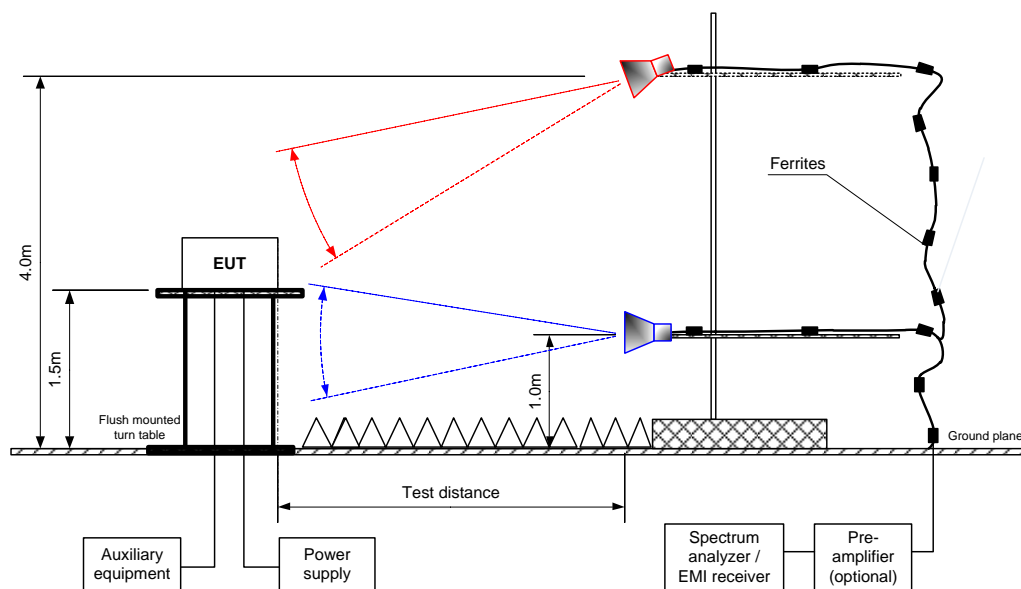


Figure 7.2.3 Setup for spurious emission field strength measurements above 1000 MHz





Test specification:	FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions		
Test procedure:	ANSI C63.10, Section 6.5 / 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	01-Sep-19		
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Table 7.2.3 Field strength of fundamental emission, spurious emissions outside restricted bands and within restricted bands at frequencies above 1 GHz

TEST DISTANCE: 3 m
 EUT POSITION: Typical (Vertical)
 MODULATION: 2FSK
 BIT RATE: 38.4 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 - 9000 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 1.0 MHz (above 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

Double sided guide (above 1000 MHz)										
F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength			Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Calculated, dB(μV/m)***	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission***										
916.5250	H	1.65	22.0	101.83	102.00	-0.17	79.22	82	-2.78	Pass
Spurious emissions										
No emissions were found										Pass

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

** - Margin, dB = Measured (calculated) value, dB(μV/m) - Limit, dB(μV/m)

*** - Calculated average field strength = Measured peak field strength + Average factor

Table 7.2.4 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
7.4	100	NA	NA	NA	-22.61

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulseduration}}{\text{Pulse period}} \times \frac{\text{Burstduration}}{\text{Trainduration}} \times \text{Number of bursts within pulse train} \right)$$

for pulse train longer than 100 ms:

$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulseduration}}{\text{Pulse period}} \times \frac{\text{Burstduration}}{100\text{ms}} \times \text{Number of bursts within 100ms} \right)$$

Reference numbers of test equipment used

HL 4360	HL 3903	HL 4011	HL 3047	HL 5311	HL 5309		
HL 5288	HL 5085	HL 5405	HL 4933	HL 446			

Full description is given in Appendix A.



Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10, Section 6.5 / 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Table 7.2.5 Field strength of emissions below 1 GHz within restricted bands

TEST DISTANCE: 3 m
 EUT POSITION: Typical (Vertical)
 MODULATION: 2FSK
 BIT RATE: 38.4 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Typical (Vertical)
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 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*				
No emissions were found								Pass

*- Margin = Measured emission - specification limit.

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



Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10, Section 6.5 / 6.6			
Test mode: Compliance	Verdict: PASS		
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Table 7.2.6 Restricted bands according to FCC 15, Section 205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

Table 7.2.7 Restricted bands according to RSS-Gen, Table 3

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.190	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 - 3339	13.25 - 13.4
3.020 - 3.026	8.37625 - 8.38675	37.5 - 38.25	960 - 1427	3345.8 - 3358	14.47 - 14.5
4.125 - 4.128	8.41425 - 8.41475	73 - 74.6	1435 - 1626.5	3500 - 4400	15.35 - 16.2
4.17725 - 4.17775	12.290 - 12.293	74.8 - 75.2	1645.5 - 1646.5	4500 - 5150	17.7 - 21.4
4.20725 - 4.20775	12.51975 - 12.52025	108 - 138	1660 - 1710	5350 - 5460	22.01 - 23.12
5.677 - 5.683	12.57675 - 12.57725	156.52475 - 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24.0
6.215 - 6.218	13.36 - 13.41	156.7 - 156.9	2200 - 2300	8025 - 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

Reference numbers of test equipment used

HL 4360	HL 3903	HL 4011	HL 3047	HL 5311	HL 5309		
HL 5288	HL 5085	HL 5405	HL 4933	HL 446			

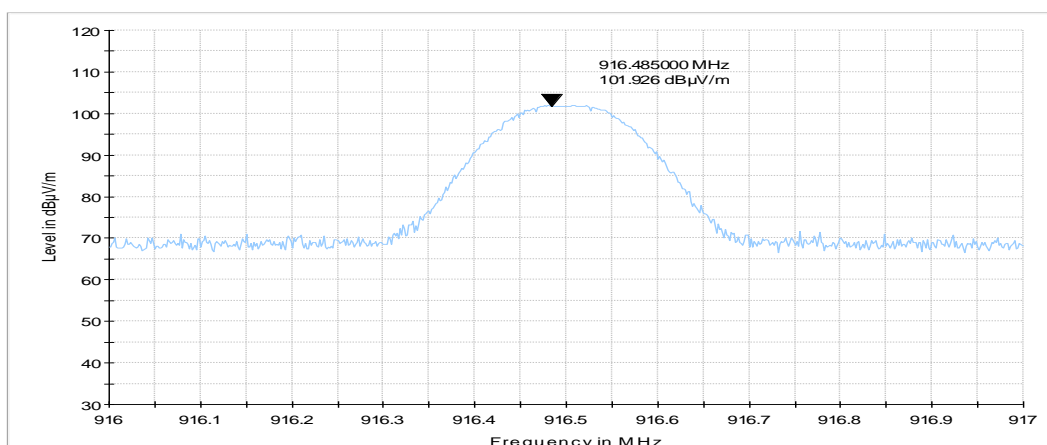
Full description is given in Appendix A.



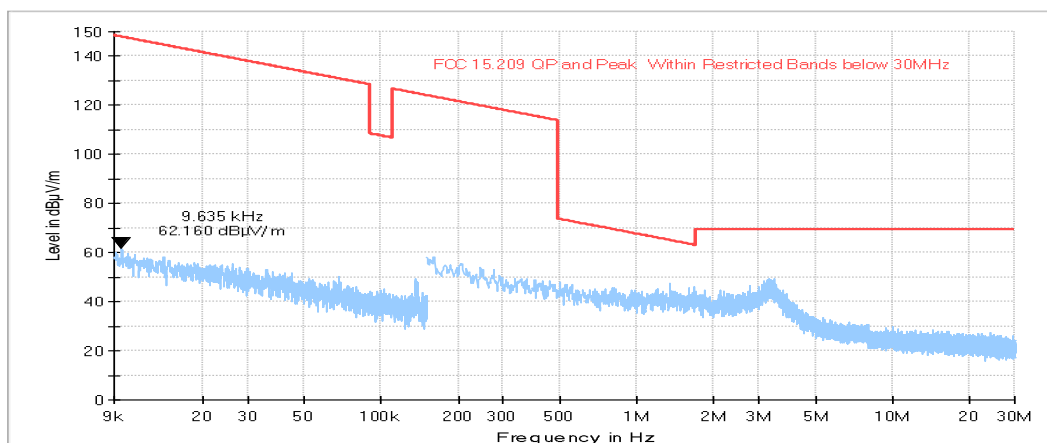
Test specification:		FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions	
Test procedure:		ANSI C63.10, Section 6.5 / 6.6	
Test mode:		Verdict: PASS	
Date(s):			
01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Plot 7.2.1 Radiated emission measurements at the fundamental frequency

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

**Plot 7.2.2 Radiated emission measurements from 9 kHz to 30 MHz**

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

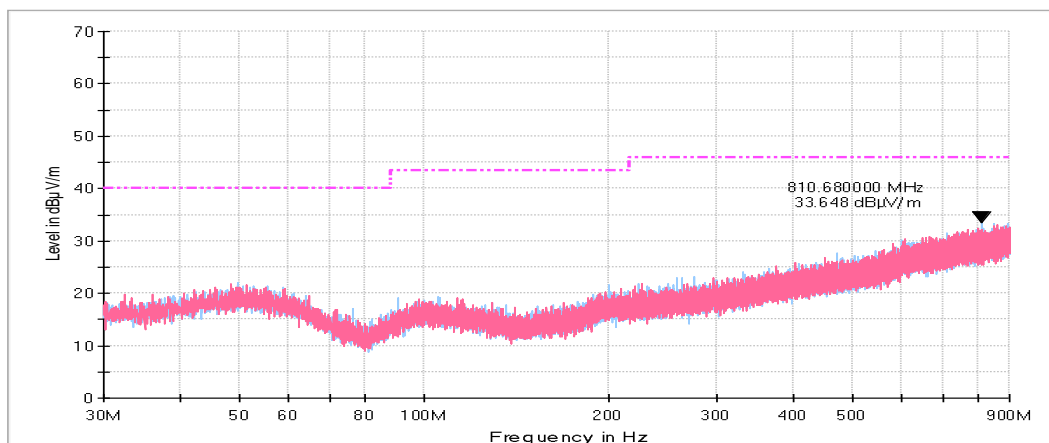




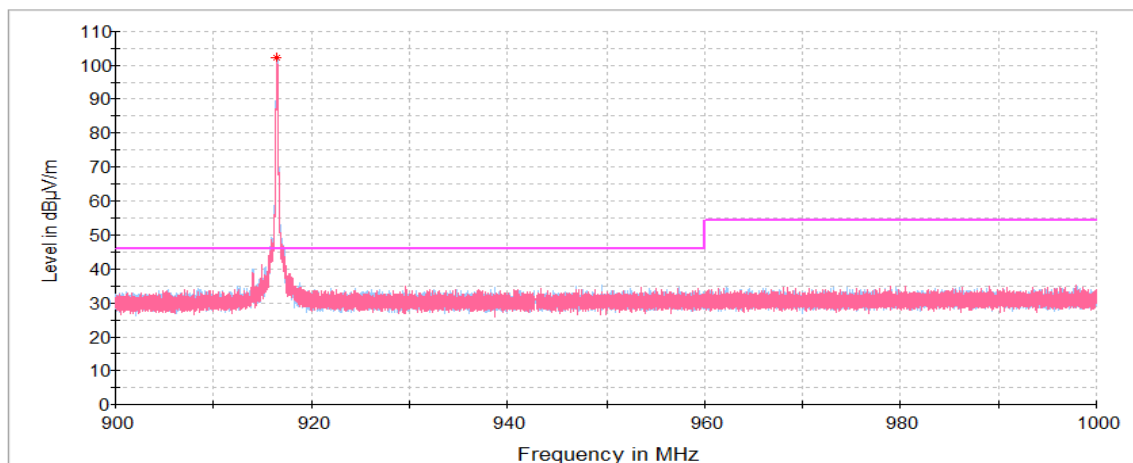
Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10, Section 6.5 / 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Plot 7.2.3 Radiated emission measurements from 30 to 900 MHz

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

**Plot 7.2.4 Radiated emission measurements from 900 to 1000 MHz**

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

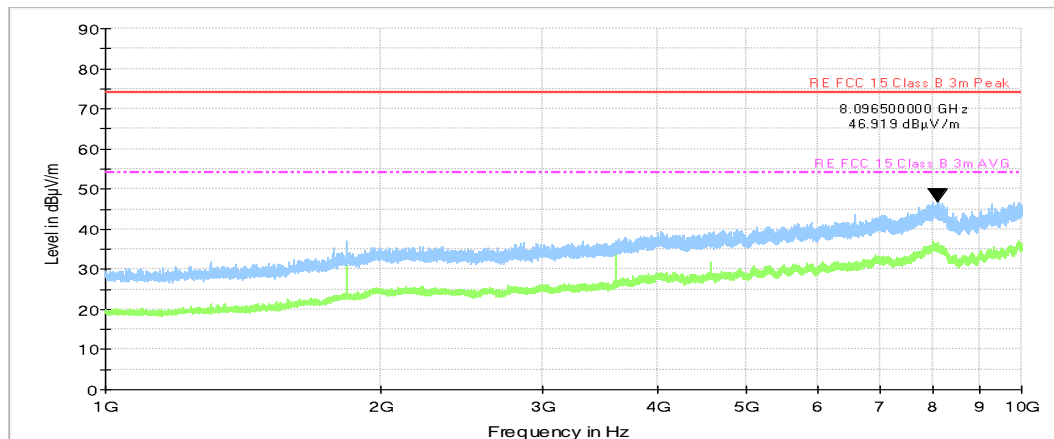




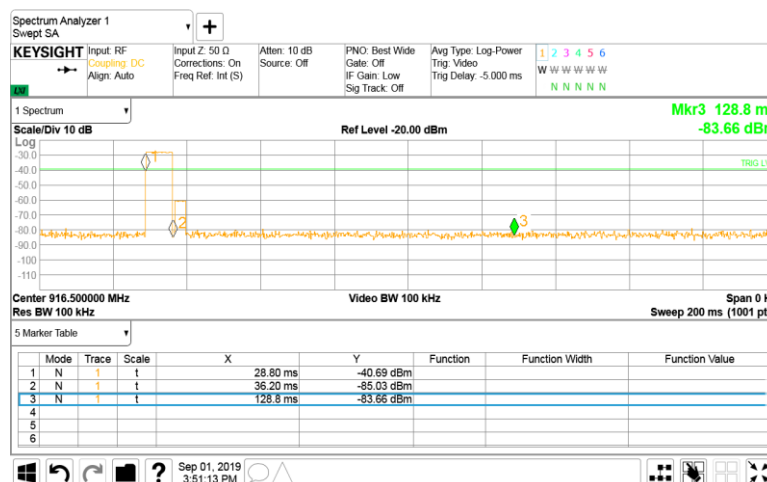
Test specification:		FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions	
Test procedure:		ANSI C63.10, Section 6.5 / 6.6	
Test mode:		Compliance	Verdict: PASS
Date(s):		01-Sep-19	
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Plot 7.2.5 Radiated emission measurements from 1000 to 10000 MHz

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



Plot 7.2.6 Transmission pulse duration





Test specification: FCC Part 15, Section 231(c) / RSS-210, Section A1.3, Occupied bandwidth			
Test procedure: ANSI C63.10, Section 6.9.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 10-Sep-19			
Temperature: 24.2 °C	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 6 VDC
Remarks:			

7.3 Occupied bandwidth test

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, % of the carrier frequency
70 - 900	20.0	0.25
Above 900		0.50

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

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 was set to transmit modulated carrier.

7.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.3.2 and associated plot.

Figure 7.3.1 Occupied bandwidth test setup



Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 3 kHz
 VIDEO BANDWIDTH: 300kHz
 MODULATION: 2 FSK
 BIT RATE: 38kbps
 MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
916.5	83.479	0.05	4582.5	-4499.021	Pass

Reference numbers of test equipment used

HL 2909	HL 4136	HL 3433	HL 1809	HL 337				
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Full description is given in Appendix A.

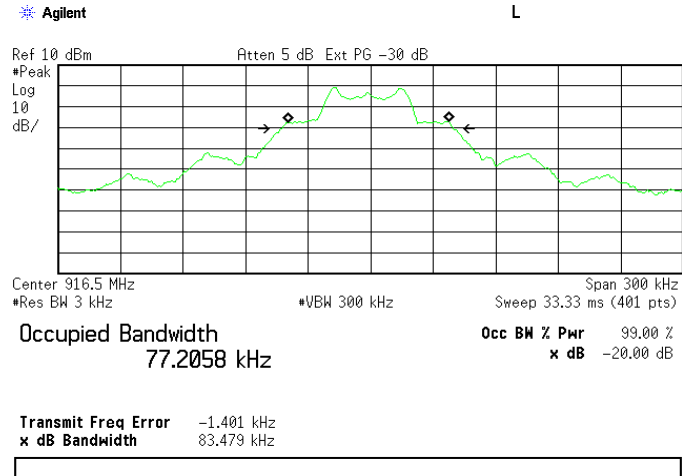


HERMON LABORATORIES

Report ID: ESIRAD_FCC.33716_FCC15.231
Date of Issue: 26-Aug-20

Test specification: FCC Part 15, Section 231(c) / RSS-210, Section A1.3, Occupied bandwidth			
Test procedure: ANSI C63.10, Section 6.9.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 10-Sep-19			
Temperature: 24.2 °C	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 6 VDC
Remarks:			

Plot 7.3.1 Occupied bandwidth test result





Test specification: FCC Part 15, Section 203 / RSS-Gen, Section 6.8, Antenna requirements			
Test procedure: Visual inspection / supplier declaration			
Test mode: Compliance		Verdict: PASS	
Date(s): 10-Sep-19			
Temperature: 24.2 °C	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 6 VDC
Remarks:			

7.4 Antenna requirements

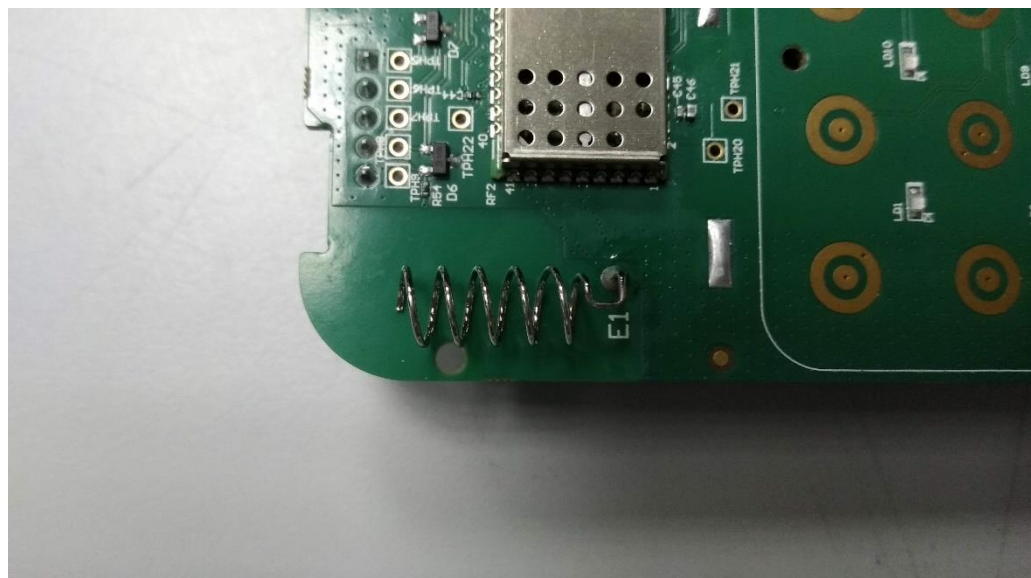
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed 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 7.4.1.

Table 7.4.1 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	

Photograph 7.4.1 Antenna assembly





Test specification: Section 15.109, ICES-003 , section 6.2 , Class B Radiated emission			
Test procedure: ANSI C63.4, Sections 8.3 and 12.2.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

8 Emissions tests according to FCC 47CFR part 15 subpart B and ICES-003 requirements

8.1 Radiated emission measurements

8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1.

Table 8.1.1 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: $\text{Lim}_{S2} = \text{Lim}_{S1} + 20 \log(S1/S2)$, where $S1$ and $S2$ – standard defined and test distance respectively in meters.

Table 8.1.2 Radiated emission limits according to RSS-Gen, Section 7.1.2

Frequency, MHz	Field strength limit at 3 m test distance, dB(μV/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 - 5 th harmonic**	54.0

** - harmonic of the highest frequency the EUT generates, uses, operates or tunes to.

8.1.2 Test procedure for measurements in semi-anechoic chamber

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

8.1.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, 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.

8.1.2.3 The worst test results (the lowest margins) were recorded in Table 8.1.3 and shown in the associated plots.



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Test specification: Section 15.109, ICES-003 , section 6.2 , Class B Radiated emission			
Test procedure: ANSI C63.4, Sections 8.3 and 12.2.5			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment

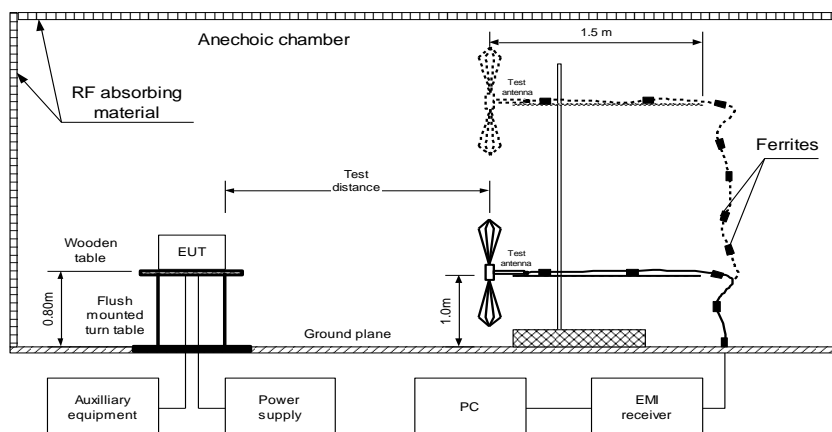


Table 8.1.3 Radiated emission test results

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*				
No emissions were found								Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 – 5000 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*				
No emissions were found										Pass

*- Margin = Measured emission - specification limit.

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

Reference numbers of test equipment used

HL 4360	HL 3903	HL 4011	HL 3047	HL 5311	HL 5309		
HL 5288	HL 5085	HL 5405	HL 4933				

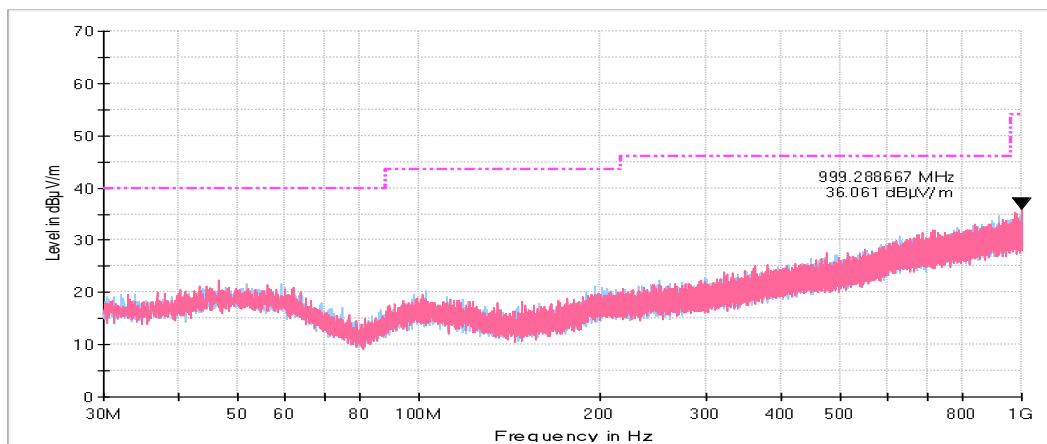
Full description is given in Appendix A.



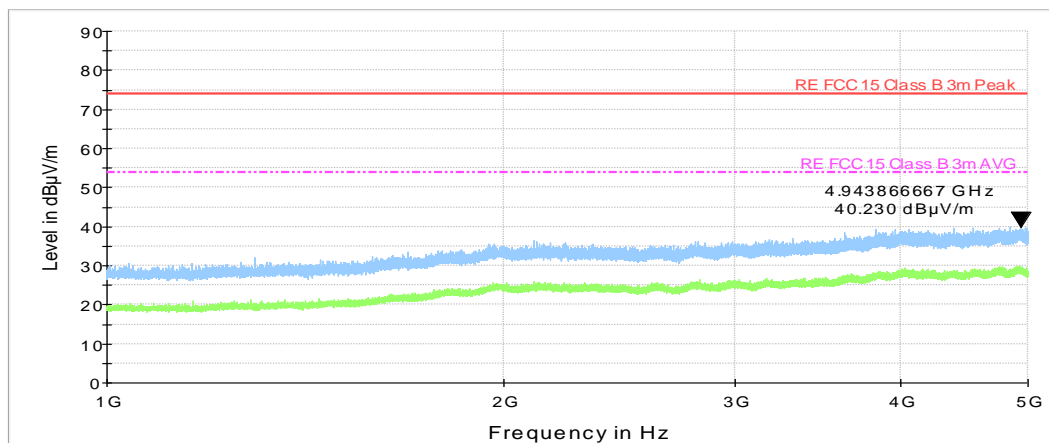
Test specification:		Section 15.109, ICES-003 , section 6.2 , Class B Radiated emission	
Test procedure:		ANSI C63.4, Sections 8.3 and 12.2.5	
Test mode:		Verdict: PASS	
Date(s):			
01-Sep-19			
Temperature: 25.6 °C	Relative Humidity: 48 %	Air Pressure: 1006 hPa	Power: 6 VDC
Remarks:			

Plot 8.1.1 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

**Plot 8.1.2 Radiated emission measurements above 1000 MHz, vertical and horizontal antenna polarization**

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



9 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0337	Probe Set, Hand held, 5 probes	Electro-Metrics	EHFP-30	238	26-Jun-19	26-Jun-20
0446	Antenna, Loop, Active, 10 (9) kHz - 30 MHz	EMCO	6502	2857	24-Feb-19	24-Feb-20
1809	HygroThermometer, Min/Max Memory	Delta TRAK	13301	NA	11-Aug-19	11-Aug-20
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	04-Apr-19	04-Apr-20
3047	AC Power Supply, 0 - 130 & 260v, 45 - 2000 Hz	BEHLMAN	150-C-202	5033	28-Oct-19	28-Oct-20
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	15-Apr-19	15-Apr-20
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
4011	Temp. & Humidity Meter, (-50 - +70) deg, (20 - 99)% RH	Mad Electronics	HTC-1	NA	11-Aug-19	11-Aug-20
4136	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000137	24-Apr-19	24-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
5085	Attenuator, 4 dB, DC - 6 GHz, 1 W	Mini-Circuits	UNAT-4+	NA	08-Feb-19	08-Feb-20
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	08-Feb-19	08-Feb-22
5309	Antenna Mast, 1-4 meter, Pneumatic polarization	Dolev Ltd	FMB 1-4	NA	24-Apr-19	24-Apr-20
5311	Controller	Dolev Ltd	FC-06	FC06.1-2016-024	24-Apr-19	24-Apr-20
5405	RF cable, 18 GHz, N-N, 6 m	Huber-Suhner	SF118/11 N(x2)	500023/118	11-Aug-19	11-Aug-20

10 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 dB μ V to obtain field strength in dB μ A/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 5288: Trilog Antenna
Frankonia, model: ALX-8000E, s/n: 00809
30-1000 MHz

Frequency, MHz	Antenna factor, dB/m
30	14.96
35	15.33
40	16.37
45	17.56
50	17.95
60	16.87
70	13.22
80	10.56
90	13.61
100	15.46
120	14.03
140	12.23

Frequency, MHz	Antenna factor, dB/m
160	12.67
180	13.34
200	15.40
250	16.42
300	17.28
400	19.98
500	21.11
600	22.90
700	24.13
800	25.25
900	26.35
1000	27.18

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

above 1000 MHz

Frequency, MHz	Antenna factor, dB/m
1000	26.9
1100	28.1
1200	28.4
1300	29.6
1400	29.1
1500	30.4
1600	30.7
1700	31.5
1800	32.3
1900	32.6
2000	32.5
2100	32.9
2200	33.5
2300	33.2
2400	33.7
2500	34.6
2600	34.7
2700	34.6
2800	35.0
2900	35.5
3000	36.2
3100	36.8
3200	36.8
3300	37.0
3400	37.5
3500	38.2

Frequency, MHz	Antenna factor, dB/m
3600	38.9
3700	39.4
3800	39.4
3900	39.6
4000	39.7
4100	39.8
4200	40.5
4300	40.9
4400	41.1
4500	41.4
4600	41.3
4700	41.6
4800	41.9
4900	42.3
5000	42.7
5100	43.0
5200	42.9
5300	43.5
5400	43.6
5500	44.3
5600	44.7
5700	45.0
5800	45.0
5900	45.3
6000	45.9

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

HL 5288: Trilog Antenna
Frankonia, model: ALX-8000E, s/n: 00809
30-1000 MHz

Frequency, MHz	Antenna factor, dB/m
30	14.96
35	15.33
40	16.37
45	17.56
50	17.95
60	16.87
70	13.22
80	10.56
90	13.61
100	15.46
120	14.03
140	12.23

Frequency, MHz	Antenna factor, dB/m
160	12.67
180	13.34
200	15.40
250	16.42
300	17.28
400	19.98
500	21.11
600	22.90
700	24.13
800	25.25
900	26.35
1000	27.18

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

above 1000 MHz

Frequency, MHz	Antenna factor, dB/m
1000	26.9
1100	28.1
1200	28.4
1300	29.6
1400	29.1
1500	30.4
1600	30.7
1700	31.5
1800	32.3
1900	32.6
2000	32.5
2100	32.9
2200	33.5
2300	33.2
2400	33.7
2500	34.6
2600	34.7
2700	34.6
2800	35.0
2900	35.5
3000	36.2
3100	36.8
3200	36.8
3300	37.0
3400	37.5
3500	38.2

Frequency, MHz	Antenna factor, dB/m
3600	38.9
3700	39.4
3800	39.4
3900	39.6
4000	39.7
4100	39.8
4200	40.5
4300	40.9
4400	41.1
4500	41.4
4600	41.3
4700	41.6
4800	41.9
4900	42.3
5000	42.7
5100	43.0
5200	42.9
5300	43.5
5400	43.6
5500	44.3
5600	44.7
5700	45.0
5800	45.0
5900	45.3
6000	45.9

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

11 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
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.

12 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 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered by Industry Canada for electromagnetic emissions, file number IC 2186A-1 for OATS, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-869 for RE measurements above 1 GHz, C-845 for conducted emissions site and T-1606 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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website: www.hermonlabs.com

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

13 APPENDIX E

Specification references

47CFR part 15: 2019

ANSI C63.10: 2013

ANSI C63.4: 2014

RSS-210 Issue 10: 2010

RSS-Gen Issue 5: 2019

ICES-003 Issue 6: 2016

Radio Frequency Devices.

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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.

Low Power Licence- Exempt Radiocommunication Devices

General Requirements for Compliance of Radio Apparatus

Digital Apparatus

14 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
WB	wideband

END OF DOCUMENT