HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO:

FCC 47CFR part 15 subpart C § 15.247 (Hybrid) and subpart B, Class B

FOR:

Telematics Wireless Ltd.

Light Control Unit

Model: LCUN2LUS

FCC ID:NTALCUN2L

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1 Applicant information

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E-mail:	Emzari.Roketlishvili@telematics-wireless.com
Contact name:	Mr. Emzari Roketlishvili

2 Equipment under test attributes

Product name:	Light Control Unit
Product type:	Transceiver
Model(s):	LCUN2LUS
Serial number:	98300
Hardware version:	Rev. D
Software release:	1.0.2-9
Receipt date	01-Feb-19

3 Manufacturer information

Manufacturer name:	Telematics Wireless Ltd.
Address:	26 Hamelacha street, POB 1911, Holon, 5811801, Israel
Telephone:	+972 3557 5700
Fax:	+972 3557 5703
E-Mail:	Emzari.Roketlishvili@telematics-wireless.com
Contact name:	Mr. Emzari Roketlishvili

4 Test details

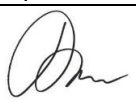
Project ID:	32272
Location:	Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started:	21-Mar-19
Test completed:	29-May-19
Test specification(s):	FCC 47CFR part 15 subpart C § 15.247 (Hybrid) and subpart B, Class B

5 Tests summary

Test	Status
Transmitter characteristics	
Section 15.247(a)1, 20 dB bandwidth	Pass
Section 15.247(a)1, Frequency separation	Pass
Section 15.247(a)1, Number of hopping frequencies	Pass
Section 15.247(a)1, Average time of occupancy	Pass
Section 15.247(b), Peak output power	Pass
Section 15.247(e), Peak spectral density	Pass
Section 15.247(d), Radiated spurious emissions	Pass
Section 15.247(i), RF exposure	Pass *
Section 15.247(d), Emissions at band edges	Pass
Section 15.207(a), Conducted emission	Pass
Section 15.203, Antenna requirements	Pass
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Pass
Section 15.109, Radiated emission	Pass

* - Pass, the exhibit to the application of certification is provided

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:	Mrs. E. Pitt, test engineer	29-Mar-19 – 29-May-19	
Reviewed by:	Mrs. Y. Rapin, technical writer	10-Jun-19	
Approved by:	Mr. S. Samokha, technical manager, EMC and Radio	28-Aug-19	

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 a wireless controlling unit installed outside at the top of the light fixture (twist-lock connector) which handles the data collection from the Luminaire and command transfer between the light unit and the street light management system.

The EUT operates in 902-928 MHz frequency range using LoRa modulation with 1kbps bit rate.

6.2 Test configuration

6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

6.4 Transmitter characteristics

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

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

Assigned frequency range	902-928 MHz
Operating frequency range	902.3-927.7 MHz

Maximum rated output power	At transmitter 50 Ω RF output connector	NA
	Peak output power	17.05 dBm

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
Printed	Telematics Wireless	NA	0 dBi

Transmitter aggregate data rate/s	1 kbps
Type of modulation	LoRa
Modulating test signal (baseband)	PRBS

Transmitter power source						
	Battery	**Nominal rated voltage**	VDC	Battery type		
	DC	**Nominal rated voltage**	VDC			
X	AC mains	**Nominal rated voltage**	110 VAC	Frequency	60 Hz	

Common power source for transmitter and receiver	X	yes		no

Spread spectrum technique used		Frequency hopping (FHSS)
		Digital transmission system (DTS)
	X	Hybrid

Spread spectrum parameters for transmitters tested per FCC 15.247 only		
FHSS	Total number of hops	8-128
	Bandwidth per hop	138.458 kHz
	Min. separation of hops	200.3 kHz

Test specification:	Section 15.247(a)1, 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C

7.1 20 dB bandwidth

7.1.1 General

This test was performed to measure 20 dB bandwidth of the transmitter hopping channel. Specification test limits are given in Table 7.1.1.

Table 7.1.1 The 20 dB bandwidth limits

Assigned frequency, MHz	Maximum bandwidth, kHz	Modulation envelope reference points*, dBc
902.0 – 928.0	250	20

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

7.1.2 Test procedure

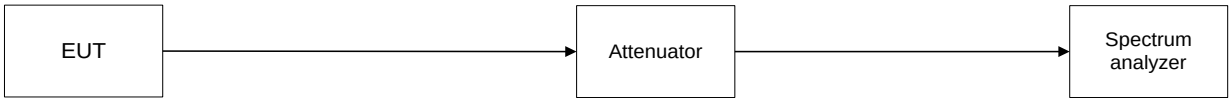
7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was set to transmit modulated carrier at maximum data rate.

7.1.2.3 The transmitter bandwidth was measured with spectrum an analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and associated plot.

7.1.2.4 The test was repeated for each data rate and each modulation format.

Figure 7.1.1 The 20 dB bandwidth test setup



Test specification:	Section 15.247(a)1, 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Table 7.1.2 The 20 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 902.0 – 928.0 MHz
DETECTOR USED: Peak
SWEEP TIME: Auto
VIDEO BANDWIDTH: ≥ RBW
MODULATION ENVELOPE REFERENCE POINTS: 20.0 dBc
FREQUENCY HOPPING: Disabled

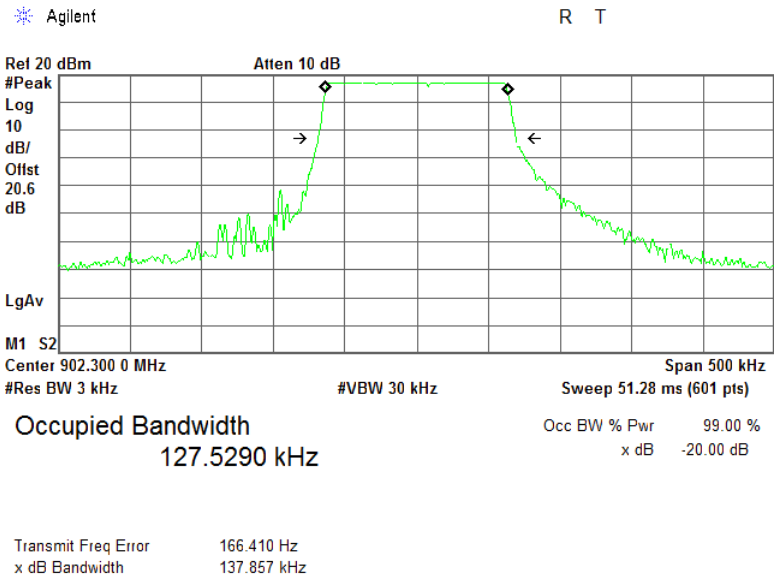
Carrier frequency, MHz	Type of modulation	Data rate, kbps	Symbol rate, Msymbols/s	20 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
902.3	LoRa	1	NA	137.857	250	-112.143	Pass
915.0	LoRa	1	NA	138.065	250	-111.935	Pass
927.7	LoRa	1	NA	138.458	250	-111.542	Pass

Reference numbers of test equipment used

HL 3818	HL 3440	HL 3433						

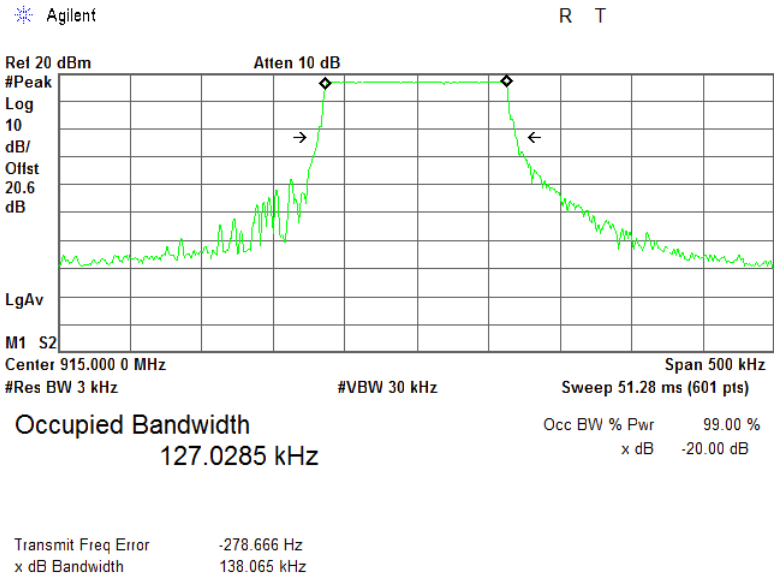
Full description is given in Appendix A.

Plot 7.1.1 The 20 dB bandwidth test result at low frequency

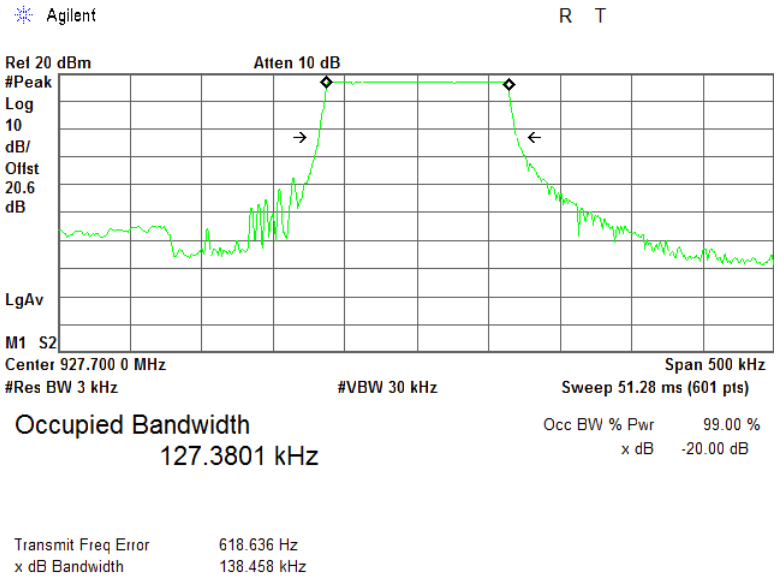


Test specification:	Section 15.247(a)1, 20 dB bandwidth		
Test procedure:	ANSI C63.10, section 7.8.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.1.2 The 20 dB bandwidth test result at mid frequency



Plot 7.1.3 The 20 dB bandwidth test result at high frequency



Test specification:	Section 15.247(a)1, Frequency separation		
Test procedure:	ANSI C63.10, section 7.8.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 50 Hz
Remarks:			

7.2 Carrier frequency separation

7.2.1 General

This test was performed to measure frequency separation between the peaks of adjacent channels. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Carrier frequency separation limits

Assigned frequency range, MHz	Carrier frequency separation
902.0 – 928.0	25 kHz or 20 dB bandwidth of the hopping channel, whichever is greater

7.2.2 Test procedure

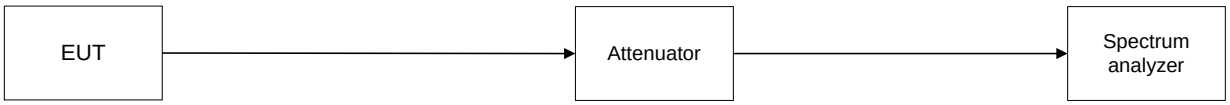
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized with frequency hopping function enabled and its proper operation was checked.

7.2.2.2 The spectrum analyzer span was set to capture the carrier frequency and both of adjacent channels, the lower and the higher. The resolution bandwidth was set wider than 1 % of the frequency span.

7.2.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

7.2.2.4 The frequency separation between the peaks of adjacent channels was measured as provided in Table 7.2.2 and associated plots.

Figure 7.2.1 Carrier frequency separation test setup



Test specification:	Section 15.247(a)1, Frequency separation		
Test procedure:	ANSI C63.10, section 7.8.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 50 Hz
Remarks:			

Table 7.2.2 Carrier frequency separation test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz
MODULATION: LoRa
BIT RATE: 1 kbps
DETECTOR USED: Peak
FREQUENCY HOPPING: Enabled
20 dB BANDWIDTH: 138.458 kHz

Carrier frequency separation, kHz	Limit, kHz	Margin*	Verdict
200.3	138.458	61.842	Pass

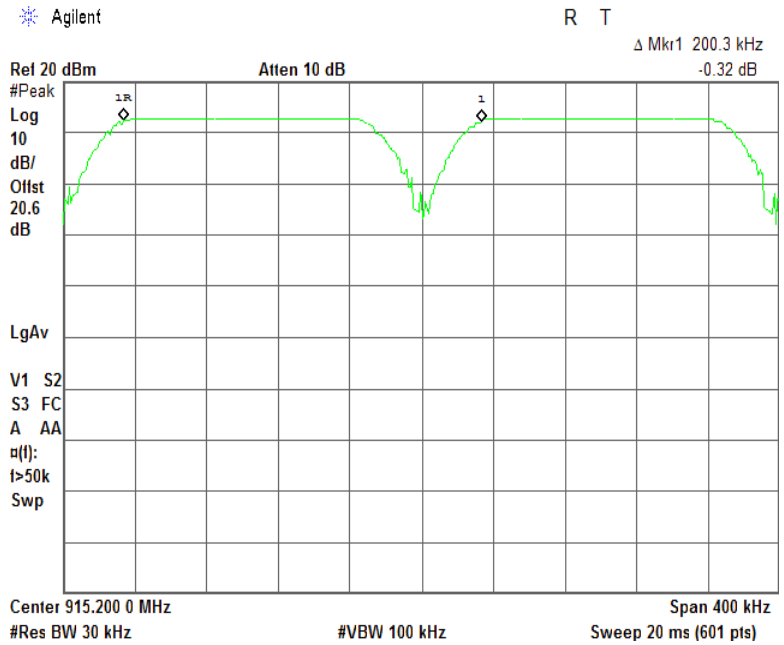
* - Margin = Carrier frequency separation – specification limit.

Reference numbers of test equipment used

HL 3818	HL 3440	HL 3433					

Full description is given in Appendix A.

Plot 7.2.1 Carrier frequency separation



Test specification:	Section 15.247(a)1, Number of hopping frequencies		
Test procedure:	ANSI C63.10, section 7.8.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

7.3 Number of hopping frequencies

7.3.1 General

This test was performed to calculate the number of hopping frequencies used by the EUT. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Minimum number of hopping frequencies

Assigned frequency range, MHz	Number of hopping frequencies
902.0 – 928.0	**50 (if the 20 dB bandwidth is less than 250 kHz)** 25 (if the 20 dB bandwidth is 250 kHz or greater)

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized with frequency hopping function enabled and its proper operation was checked.

7.3.2.2 Initially the spectrum analyzer span was set equal to frequency band of operation and the resolution bandwidth was set wider than 1 % of the frequency span. If the separate hopping channels were not clearly resolved the frequency band of operation was broken to sections and the resolution bandwidth was set wider than 1 % of the frequency span of each section.

7.3.2.3 The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

7.3.2.4 The number of frequency hopping channels was calculated as provided in Table 7.3.2 and associated plots.

Figure 7.3.1 Hopping frequencies test setup

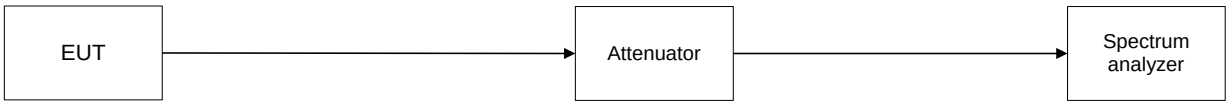


Table 7.3.2 Hopping frequencies test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz
MODULATION: LoRa
BIT RATE: 1 kbps
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ RBW
FREQUENCY HOPPING: Enabled

Maximum number of hopping frequencies	Minimum number of hopping frequencies	Margin	Verdict
128	NA for hybrid mode	NA	Pass

NOTE: Number of hopping frequencies is 8 to 128 as stated in section 6.4 of this report.

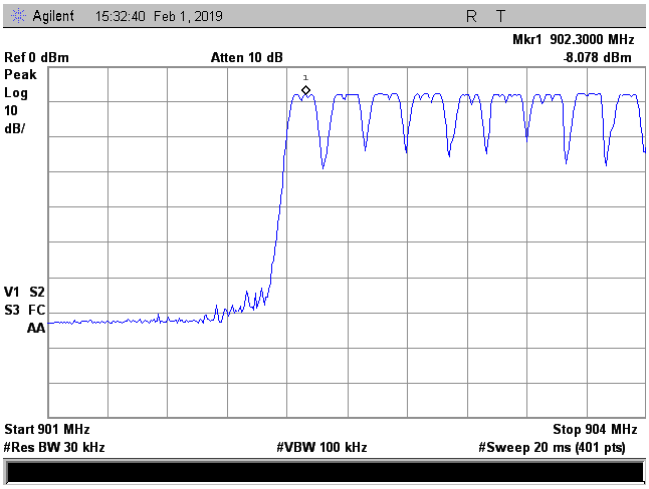
Reference numbers of test equipment used

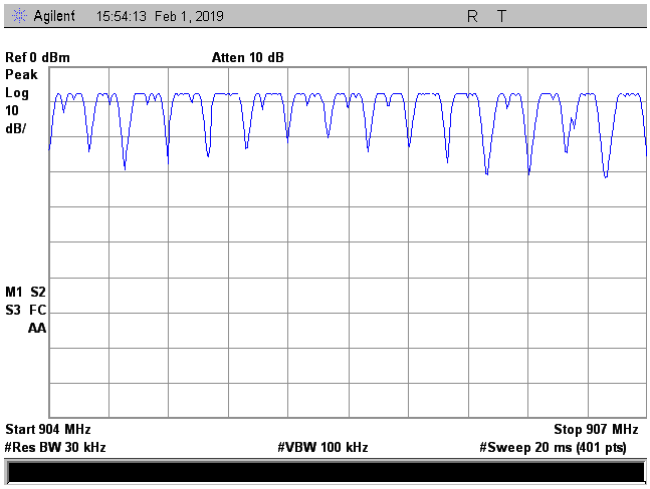
HL 2909	HL 3440	HL 3818	HL 3433				

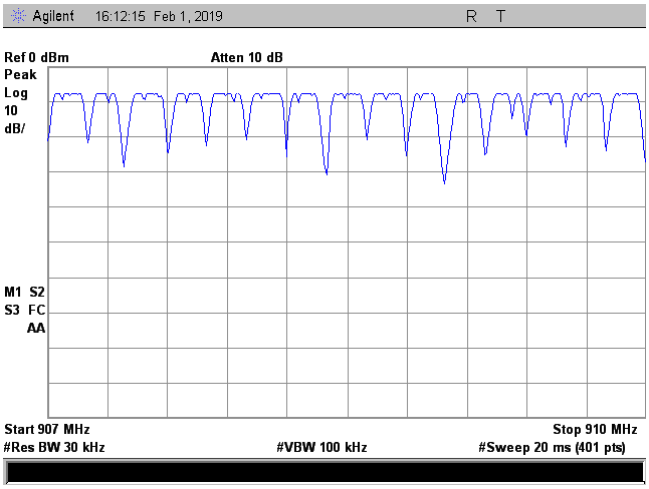
Full description is given in Appendix A.

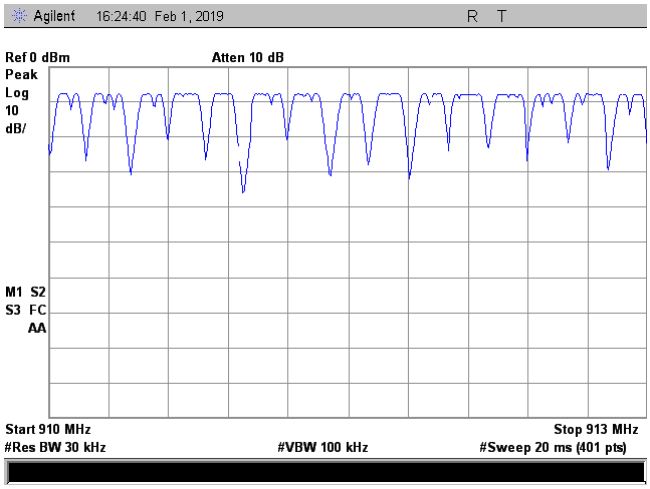
Test specification:	Section 15.247(a)1, Number of hopping frequencies		
Test procedure:	ANSI C63.10, section 7.8.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

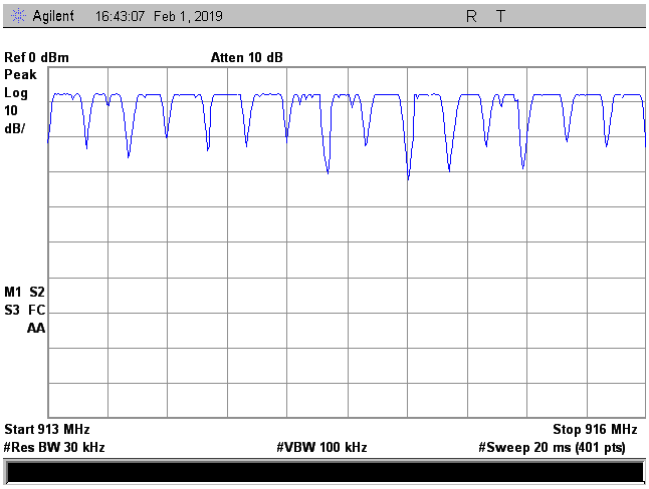
Plot 7.3.1 Number of hopping frequencies

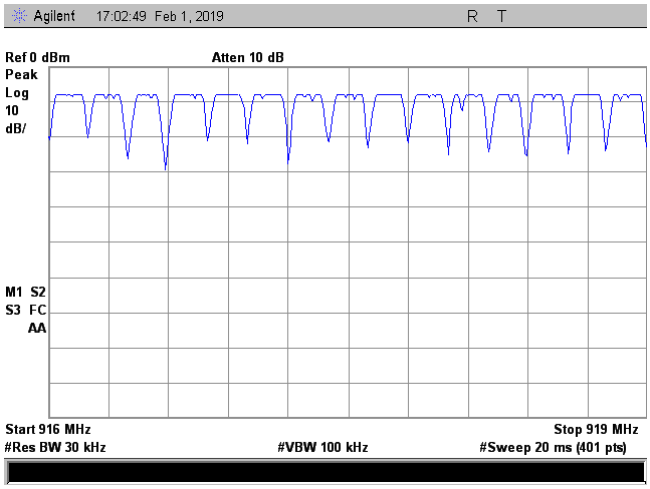






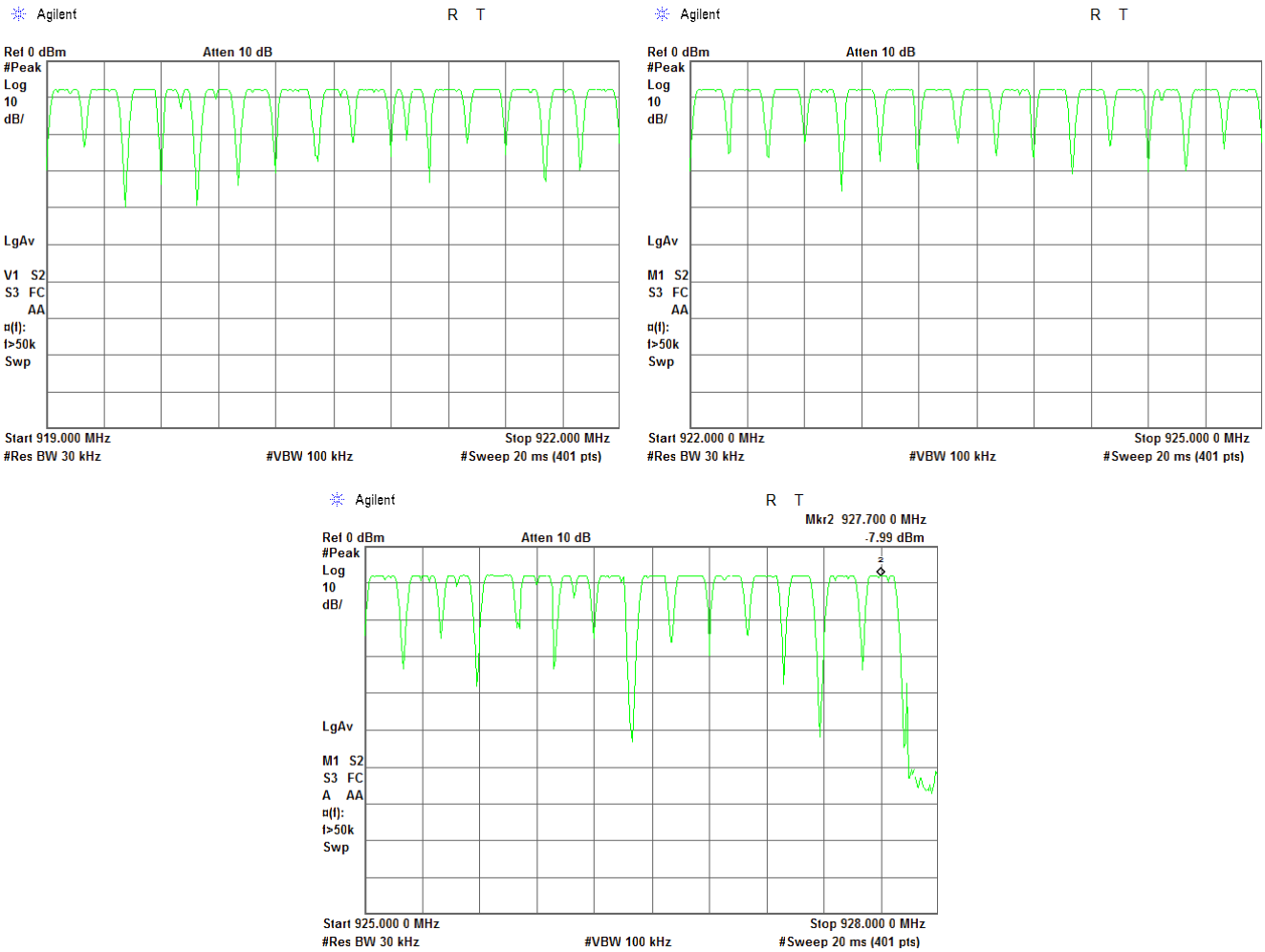






Test specification:	Section 15.247(a)1, Number of hopping frequencies		
Test procedure:	ANSI C63.10, section 7.8.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.3.2 Number of hopping frequencies



Test specification:	Section 15.247(a)1, Average time of occupancy		
Test procedure:	ANSI C63.10, section 7.8.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-May-19		
Temperature: 24.1 ºC	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

7.4 Average time of occupancy

7.4.1 General

This test was performed to calculate the average time of occupancy (dwell time) on any frequency channel of the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Average time of occupancy limits

Assigned frequency range, MHz	Maximum average time of occupancy, s	Investigated period, s	Number of hopping frequencies
902.0 – 928.0	0.4	20.0	≥ 50
902.0 – 928.0	0.4	10.0	< 50

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized with frequency hopping function enabled and its proper operation was checked.

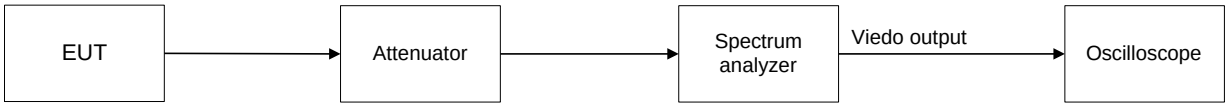
7.4.2.2 The spectrum analyzer span was set to zero centered on a hopping channel.

7.4.2.3 The single transmission duration and period were measured with oscilloscope.

7.4.2.4 The average time of occupancy was calculated as the single transmission time multiplied by the investigated period and divided by the single transmission period.

7.4.2.5 The test was repeated at each data rate and modulation type as provided in Table 7.4.2 and associated plots.

Figure 7.4.1 Average time of occupancy test setup



Test specification:	**Section 15.247(a)1, Average time of occupancy**		
Test procedure:	ANSI C63.10, section 7.8.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-May-19		
Temperature: 24.1 ºC	**Relative Humidity:** 47 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.4.2 Average time of occupancy test results

ASSIGNED FREQUENCY: 902-928 MHz
MODULATION: LoRa
DETECTOR USED: Average
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW

Carrier frequency, MHz	Single transmission duration, s	Single transmission period, s	Average time of occupancy*, s	Limit, s	Margin, s**	Verdict
Number of hopping channels >50 (50-128 channels)						
915.108	0.3706	> 20	0.3706	0.4	-0.0294	Pass
Number of hopping channels <50 (8 -49 channels)						
915.108	0.3706	> 10	0.3706	0.4	-0.0294	Pass

* - Average time of occupancy = (Single transmission duration × Investigated period) / (Single transmission period × number of hopping channels).
** - Margin = Average time of occupancy – specification limit.

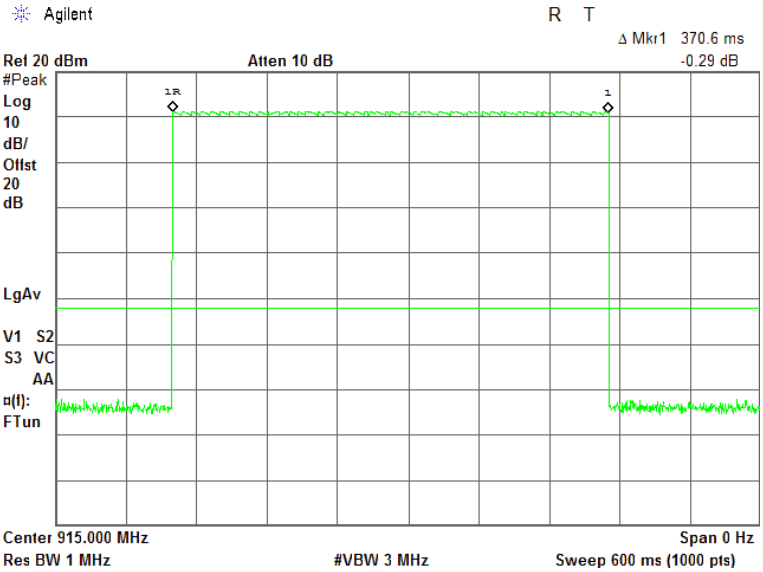
Reference numbers of test equipment used

HL 5112	HL 5174	HL 5376					

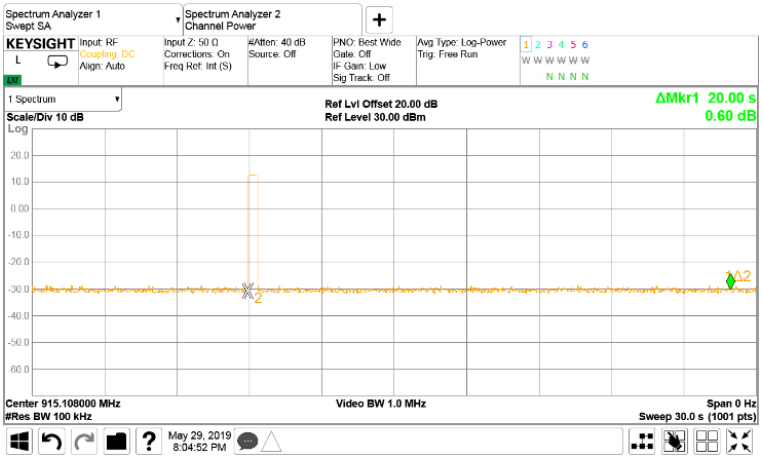
Full description is given in Appendix A.

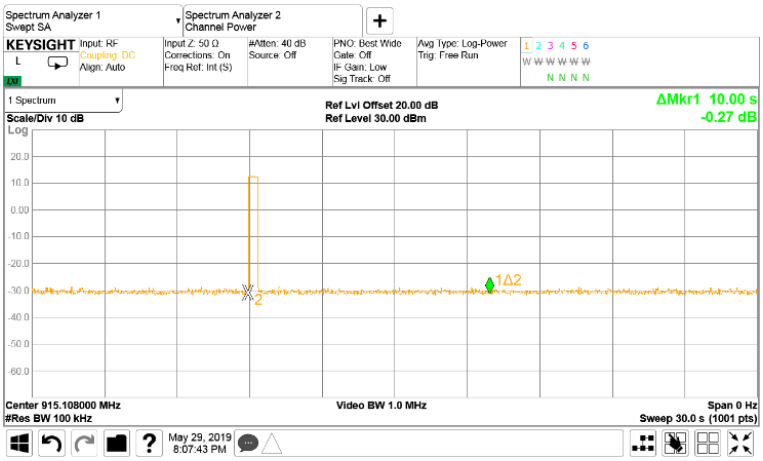
Test specification:	Section 15.247(a)1, Average time of occupancy		
Test procedure:	ANSI C63.10, section 7.8.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-May-19		
Temperature: 24.1 ºC	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.4.1 Single transmission duration



Plot 7.4.2 Single transmission period





Test specification:	**Section 15.247(b)2, Peak output power**		
Test procedure:	ANSI C63.10, section 11.9.2.2.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	28-May-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

7.5 Peak output power

7.5.1 General

This test was performed to measure the maximum peak output power at RF antenna connector. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Peak output power limits

Assigned frequency range, MHz	Maximum antenna gain, dBi	Peak output power*	
		W	dBm
902.0 – 928.0	6.0	0.25	24.0

*- If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

by the amount in dB that the directional gain of antenna exceeds 6 dBi.

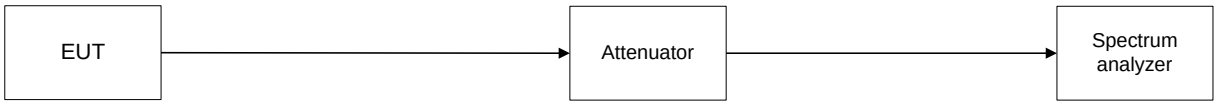
7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

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

7.5.2.3 The resolution bandwidth of spectrum analyzer was set 1-5% of the occupied bandwidth of the EUT and the maximum average output power was measured as provided in Table 7.5.2 and associated plots.

Figure 7.5.1 Peak output power test setup



Test specification:	**Section 15.247(b)2, Peak output power**		
Test procedure:	ANSI C63.10, section 11.9.2.2.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	28-May-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.5.2 Peak output power test results

ASSIGNED FREQUENCY: 902-928 MHz
MODULATION: LoRa
DETECTOR USED: RMS with power averaging
BIT RATE: 1 kbps

Carrier frequency, MHz	Spectrum analyzer reading, dBm	20 dB BW kHz	Duty cycle factor, dB	Peak output power,** dBm	Limit, dBm	Margin*, dB	Verdict
902.3	9.69	137.857	7.30	16.99	24.0	-7.01	Pass
916.0	9.71	138.065	7.30	17.01	24.0	-6.99	Pass
927.7	9.75	138.458	7.30	17.05	24.0	-6.95	Pass

* - Margin = Peak output power – specification limit
** - Peak output power = SA reading + DC factor

Table 7.5.3 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	DC factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
383.3	2058	NA	NA	NA	7.3

*- Duty cycle factor was calculated as follows:
DC factor=10LOG (1/DC), *where* DC=TXon/TXon+TXoff

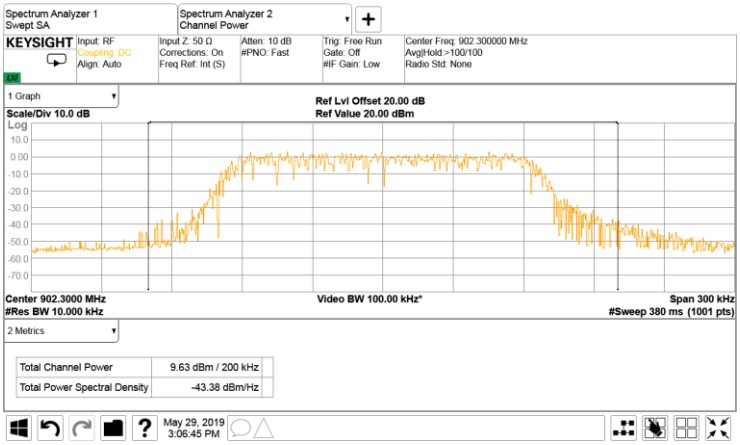
Reference numbers of test equipment used

HL 5112	HL 5174	HL 5371					

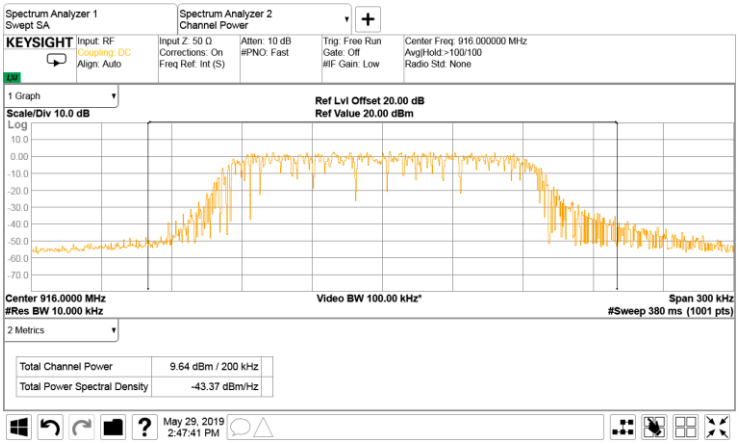
Full description is given in Appendix A.

Test specification:	Section 15.247(b)2, Peak output power		
Test procedure:	ANSI C63.10, section 11.9.2.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-May-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

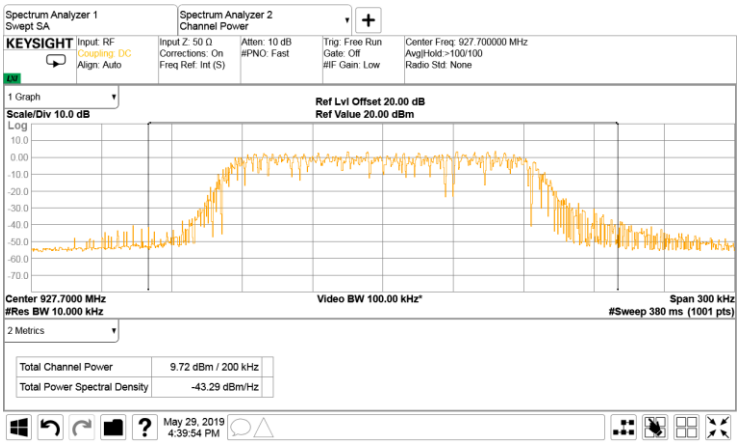
Plot 7.5.1 Peak output power at low frequency and Unom



Plot 7.5.2 Peak output power at mid frequency and Unom

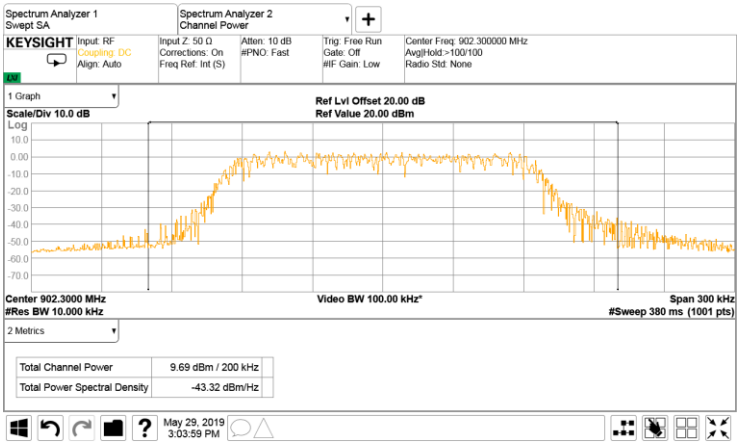


Plot 7.5.3 Peak output power at high frequency and Unom

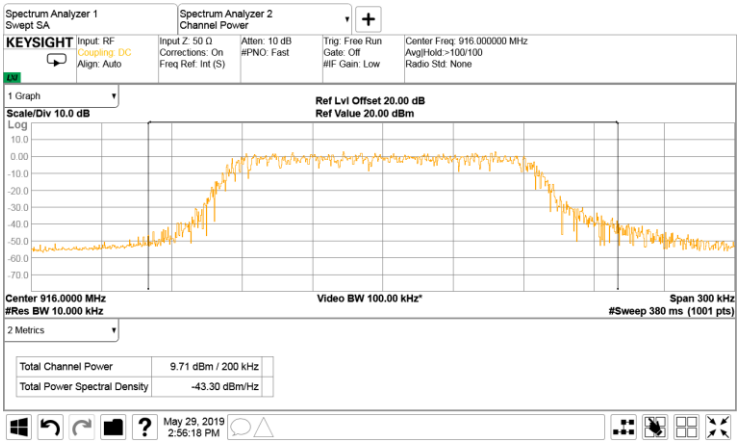


Test specification:	Section 15.247(b)2, Peak output power		
Test procedure:	ANSI C63.10, section 11.9.2.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-May-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

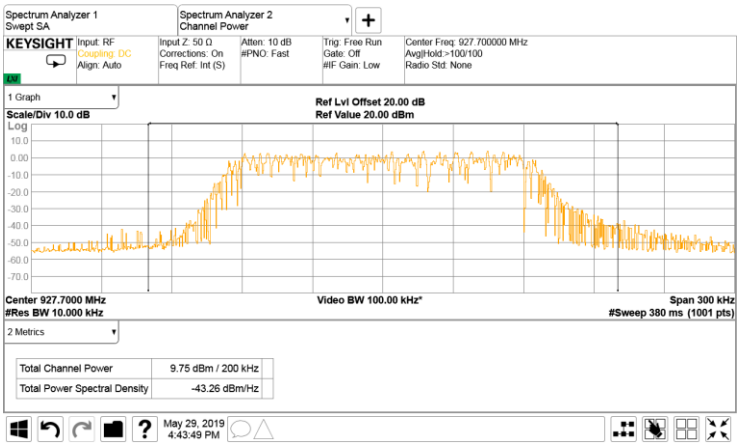
Plot 7.5.4 Peak output power at low frequency and 115%Unom



Plot 7.5.5 Peak output power at mid frequency and 115%Unom

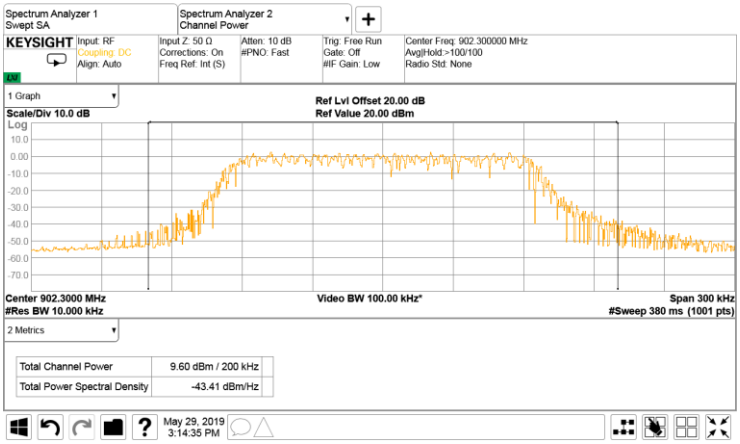


Plot 7.5.6 Peak output power at high frequency and 115%Unom

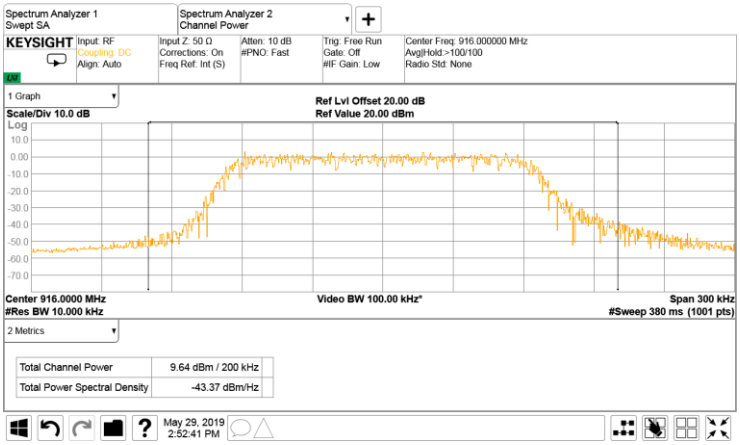


Test specification:	Section 15.247(b)2, Peak output power		
Test procedure:	ANSI C63.10, section 11.9.2.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-May-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

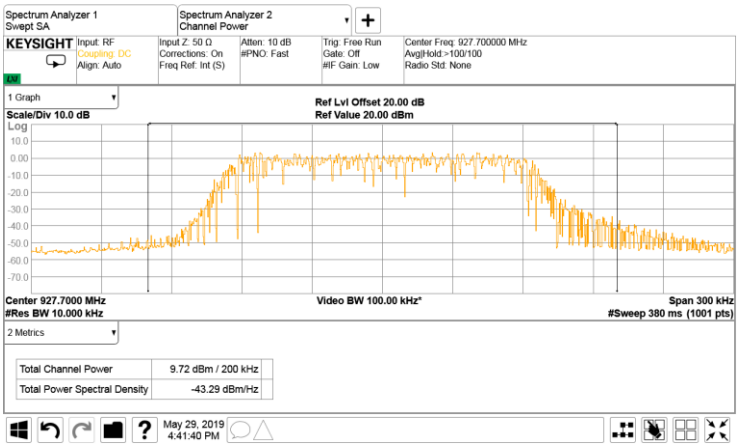
Plot 7.5.7 Peak output power at low frequency and 85%Unom



Plot 7.5.8 Peak output power at mid frequency and 85%Unom

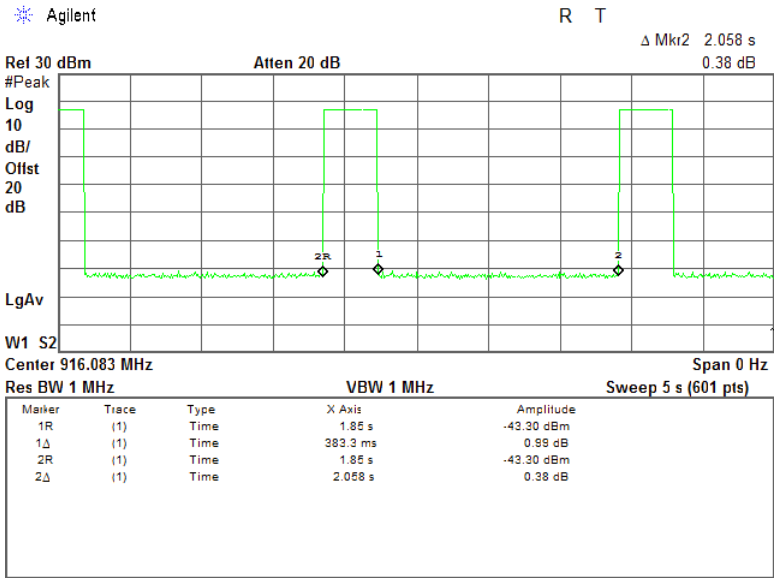


Plot 7.5.9 Peak output power at high frequency and 85%Unom



Test specification:	Section 15.247(b)2, Peak output power		
Test procedure:	ANSI C63.10, section 11.9.2.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-May-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.5.10 Transmission pulse duration and pulse period



Test specification:	**Section 15.247(e), Peak power density**		
Test procedure:	ANSI C63.10, section 11.10.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-May-19		
Temperature: 24.2 ºC	**Relative Humidity:** 49 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

7.6 Peak spectral power density

7.6.1 General

This test was performed to measure the peak spectral power density radiated by the transmitter RF antenna. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Peak spectral power density limits

Assigned frequency range, MHz	Measurement bandwidth, kHz	Peak spectral power density, dBm
902.0 – 928.0	3.0	8.0

7.6.2 Test procedure for field strength measurements

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

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

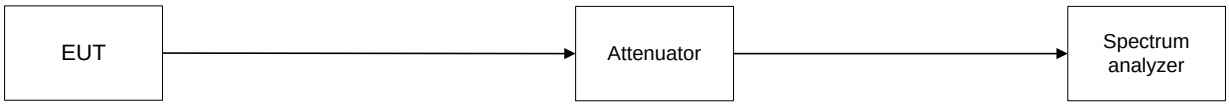
7.6.2.3 The frequency span of spectrum analyzer was set to capture the entire 6 dB band of the transmitter, in averaging mode with resolution bandwidth set to 100.0 kHz, video bandwidth wider than resolution bandwidth, sweep time and sufficient number of sweeps was allowed for trace stabilization.

7.6.2.4 The peak spectral power density was measured as provided in Table 7.6.2 and associated plots.

7.6.2.5 If measured value exceeds required limit, then RBW was reduced (but no less than 3 kHz) and repeated with new RBW.

7.6.2.6 The duty cycle factor was added to the measured PSD to compute the average PSD during the actual transmission time.

Figure 7.6.1 Peak spectral power density test setup



Test specification:	**Section 15.247(e), Peak power density**		
Test procedure:	ANSI C63.10, section 11.10.5		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-May-19		
Temperature: 24.2 ºC	**Relative Humidity:** 49 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.6.2 Peak spectral power density test results

ASSIGNED FREQUENCY: 902-928 MHz
MODULATION: LoRa
BIT RATE: 1 kbps
DETECTOR USED: RMS with power averaging
RESOLUTION BANDWIDTH: 3 kHz
VIDEO BANDWIDTH: 30 kHz

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Duty cycle factor, dB	Peak power density, dB(mW/3 kHz)**	Limit, dBm	Margin*, dB	Verdict
902.320	0.11	including	7.3	7.41	8.0	-0.59	Pass
915.992	0.21	including	7.3	7.51	8.0	-0.49	Pass
927.692	0.51	including	7.3	7.81	8.0	-0.19	Pass

* - Margin = Peak power density – specification limit
** - PSD = SA reading + DC factor

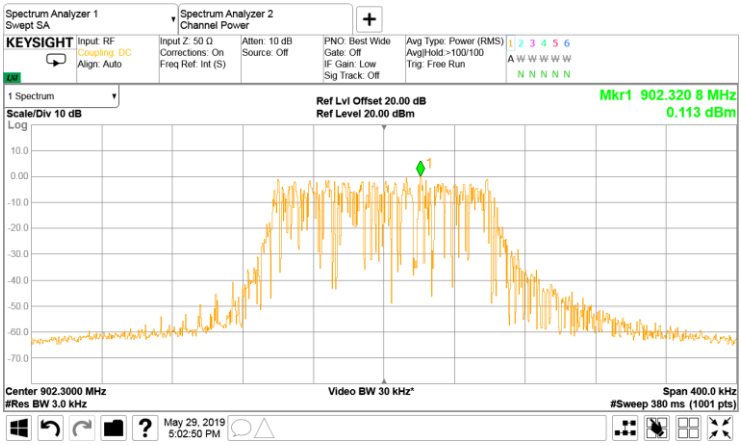
Reference numbers of test equipment used

HL 5112	HL 5174	HL 5371					

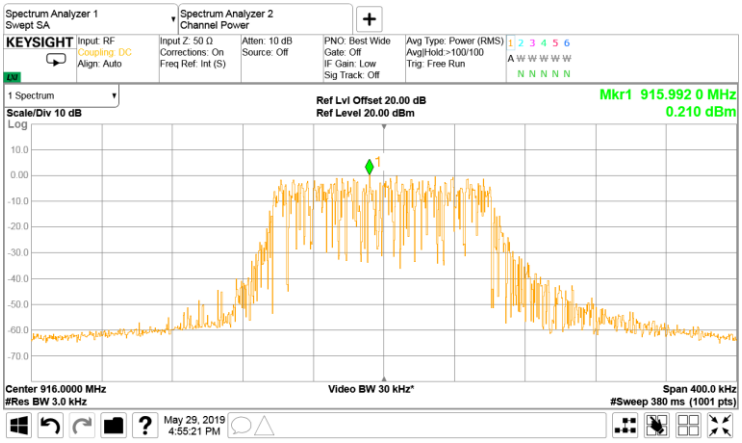
Full description is given in Appendix A.

Test specification:	Section 15.247(e), Peak power density		
Test procedure:	ANSI C63.10, section 11.10.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-May-19		
Temperature: 24.2 ºC	Relative Humidity: 49 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

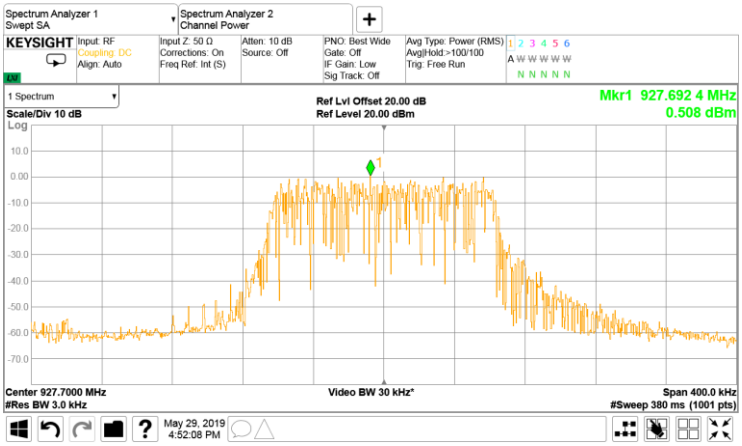
Plot 7.6.1 Peak spectral power density at low frequency



Plot 7.6.2 Peak spectral power density at mid frequency

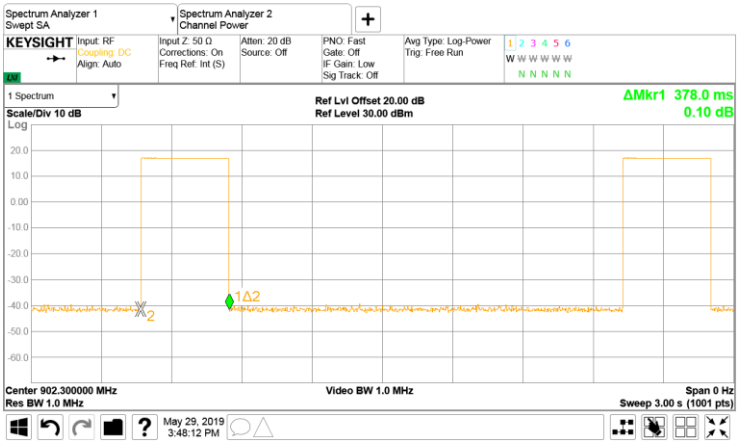


Plot 7.6.3 Peak spectral power density at high frequency

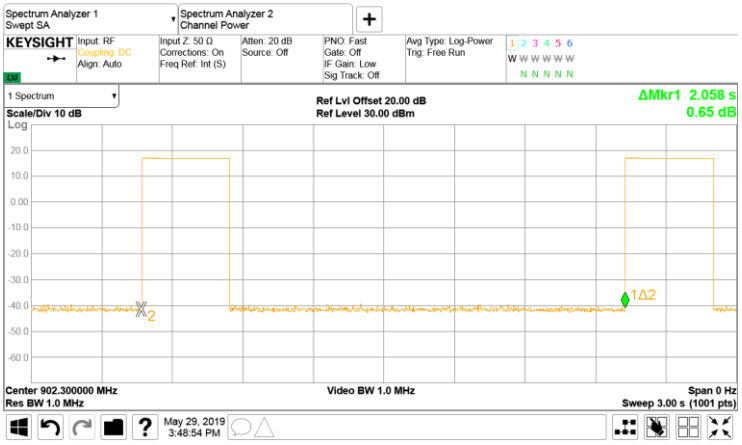


Test specification:	Section 15.247(e), Peak power density		
Test procedure:	ANSI C63.10, section 11.10.5		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-May-19		
Temperature: 24.2 ºC	Relative Humidity: 49 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.6.4 Transmitter pulse duration



Plot 7.6.5 Transmitter pulse period



Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

7.7 Field strength of spurious emissions

7.7.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m)***			Attenuation of field strength of spurious versus carrier outside restricted bands, dBc***
	Peak	Quasi Peak	Average	
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	30.0
0.090 – 0.110	NA	108.5 – 106.8**	NA	
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**	
0.490 – 1.705	NA	73.8 – 63.0**	NA	
1.705 – 30.0*		69.5		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
1000 – 10thharmonic	74.0	NA	54.0	

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

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

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

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

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and the performance check was conducted.

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

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

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

7.7.3.1 The EUT was set up as shown in Figure 7.7.2 / Figure 7.7.3, energized and the performance check was conducted.

7.7.3.2 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.

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

Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Figure 7.7.1 Setup for spurious emission field strength measurements below 30 MHz

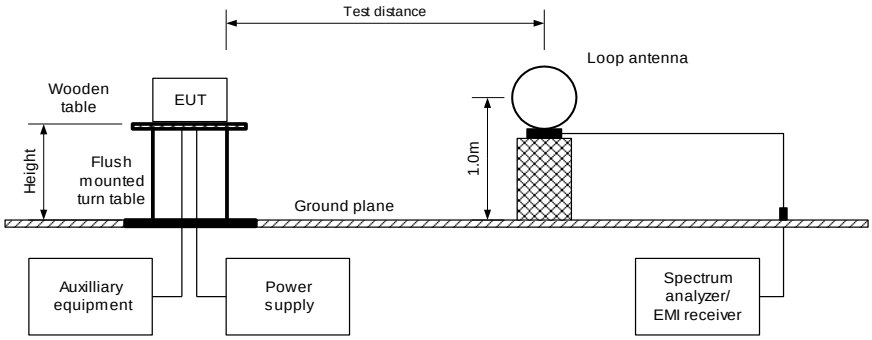


Figure 7.7.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz

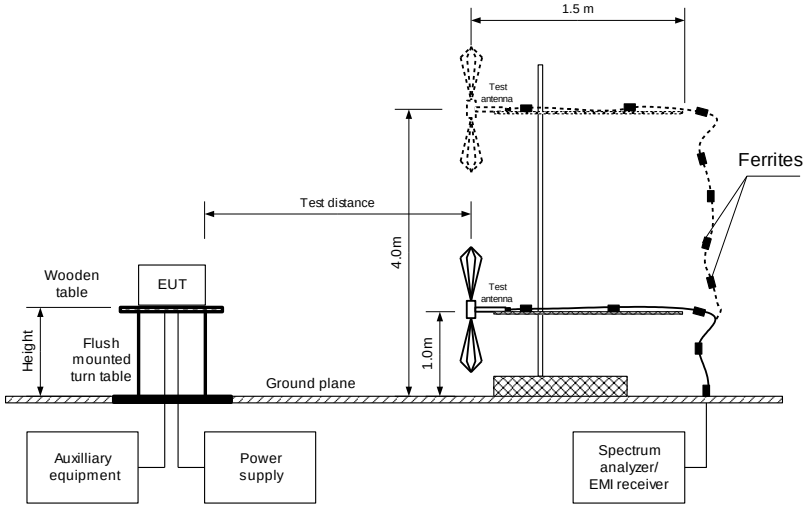
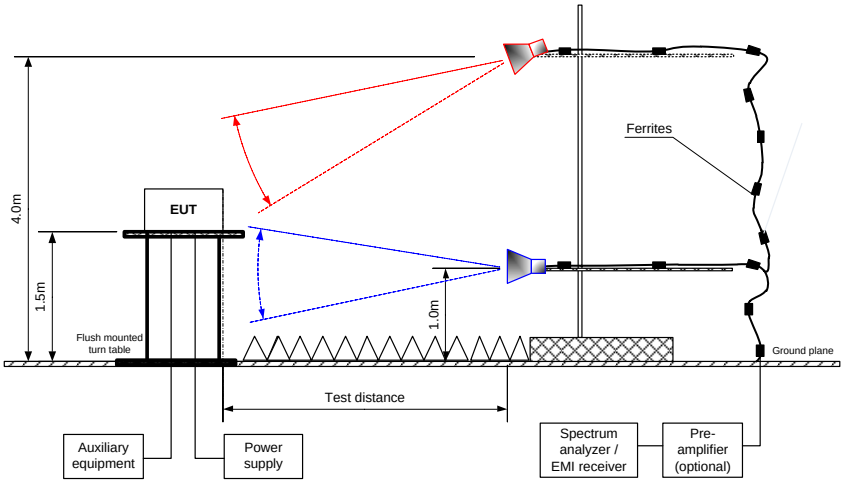


Figure 7.7.3 Setup for spurious emission field strength measurements above1000 MHz



Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.7.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 9500 MHz
TEST DISTANCE: 3 m
MODULATION: LoRa
FREQUENCY HOPPING: Disabled
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: RMS with max hold
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength of spurious, dB(µV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	Field strength of carrier, dB(µV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB**	Verdict
Low carrier frequency									
1804.6	43.90	Vertical	1.8	33	114.6	70.70	30.0	40.70	Pass
6316.1	58.73	Vertical	2.6	-81		55.87		25.87	
7218.4	51.70	Vertical	1.8	35		62.90		32.90	
Mid carrier frequency									
1830.0	44.34	Horizontal	1.3	-65	114.3	69.96	30.0	39.96	Pass
5490.0	47.01	Vertical	2.1	-76		67.29		37.29	
6405.0	50.17	Vertical	1.5	-89		64.13		34.13	
High carrier frequency									
1855.4	48.90	Vertical	2.1	-101	113.3	64.40	30.0	34.40	Pass
5566.2	48.05	Vertical	2.3.	-89		65.25		35.25	
6493.9	50.38	Vertical	2.9	-76		62.92		32.92	
9277.0	49.17	Vertical	2.4	-88		64.13		34.13	

*****- EUT front panel refers to 0 degrees position of turntable.
******- Margin = Attenuation below carrier – specification limit.

Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.7.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz
INVESTIGATED FREQUENCY RANGE: 1000 – 9500 MHz
TEST DISTANCE: 3 m
MODULATION: LoRa
FREQUENCY HOPPING: Disabled
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1 MHz
TEST ANTENNA TYPE: Double ridged guide

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength			Verdict
	Polarization	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Low carrier frequency										
2706.9	Vertical	1.5	-130	47.22	74.00	-26.78	42.52	54.00	-11.48	Pass
4511.5	Vertical	1.4	-112	44.17	74.00	-29.83	40.83	54.00	-13.17	
8120.7	Vertical	1.5	-80	56.23	74.00	-17.77	51.48	54.00	-2.52	
9023.0	Vertical	1.6	-81	46.35	74.00	-27.65	42.16	54.00	-11.84	
Mid carrier frequency										
2745	Vertical	2.9	86	46.77	74.00	-27.23	42.11	54.00	-11.89	Pass
4575	Vertical	2.3	4	45.73	74.00	-28.27	39.83	54.00	-14.17	
7320	Vertical	2.6	-130	55.06	74.00	-18.94	50.34	54.00	-3.66	
8235	Vertical	1.5	-88	54.85	74.00	-19.15	49.09	54.00	-4.91	
9150	Vertical	2.3	35	50.44	74.00	-23.56	45.58	54.00	-8.42	
High carrier frequency										
2783.1	Vertical	2.4	-88	51.55	74.00	-22.45	47.29	54.00	-6.71	Pass
4638.5	Vertical	2.6	-86	43.87	74.00	-30.13	38.14	54.00	-15.86	
7421.6	Vertical	2.3	-118	56.86	74.00	-17.14	52.09	54.00	-1.91	
8349.3	Vertical	2.8	-65	49.16	74.00	-24.84	43.86	54.00	-10.14	

* - EUT front panel refers to 0 degrees position of turntable.
** - Margin = Measured field strength - specification limit.

Test specification:	**Section 15.247(d), Radiated spurious emissions**		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.7.4 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY:	902.0 – 928.0 MHz
INVESTIGATED FREQUENCY RANGE:	0.009 – 1000 MHz
TEST DISTANCE:	3 m
MODULATION:	LORA
MODULATING SIGNAL:	PRBS
BIT RATE:	1 kbps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
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 HOPPING:	Disabled

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 signals were found								**Pass**

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

Table 7.7.5 Restricted bands according to FCC section 15.205

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	

Reference numbers of test equipment used

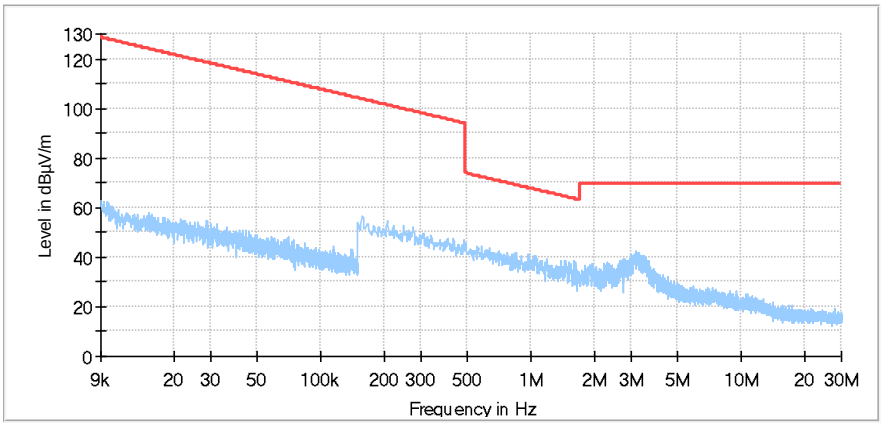
HL 1915	HL 3615	HL 4277	HL 4339	HL 4360	HL 4933	HL 5111	HL 5288
HL 2909	HL 446						

Full description is given in Appendix A.

Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.7.1 Radiated emission measurements from 9 kHz to 30 MHz at the low; mid; high carrier frequency

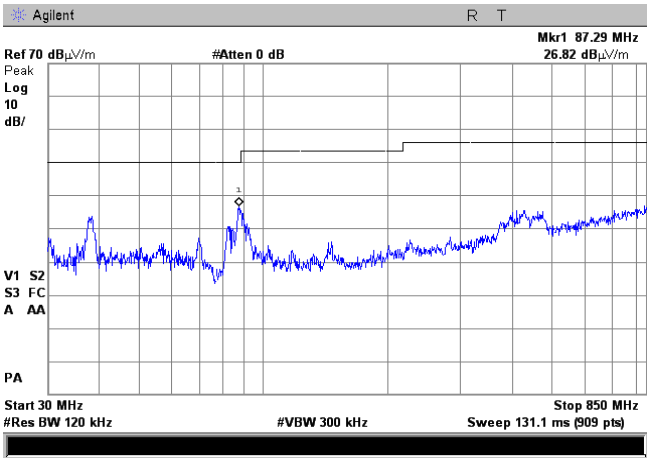
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
CS=200 kHz

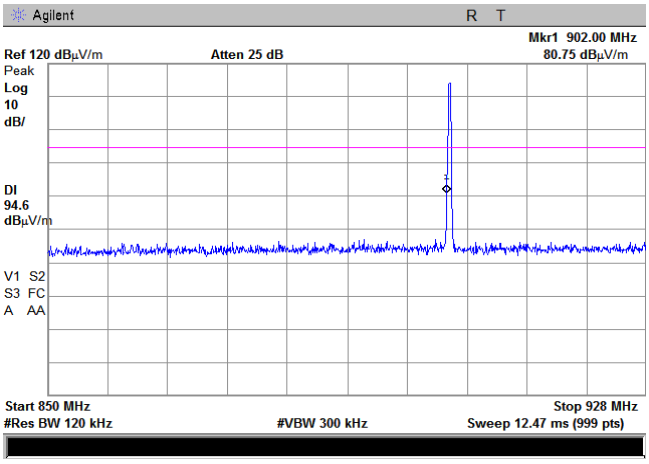


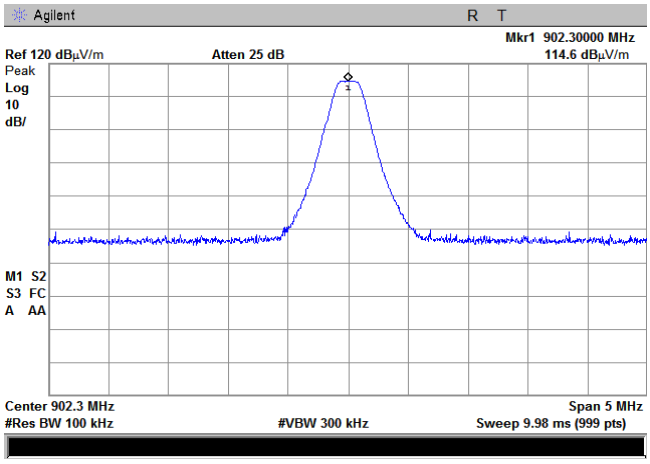
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

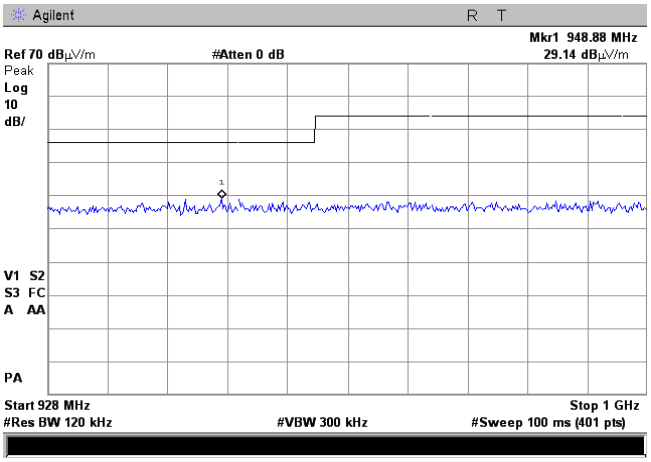
Plot 7.7.2 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

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





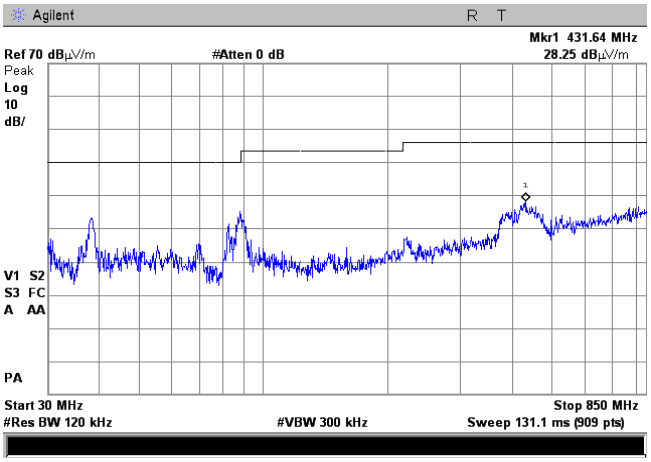


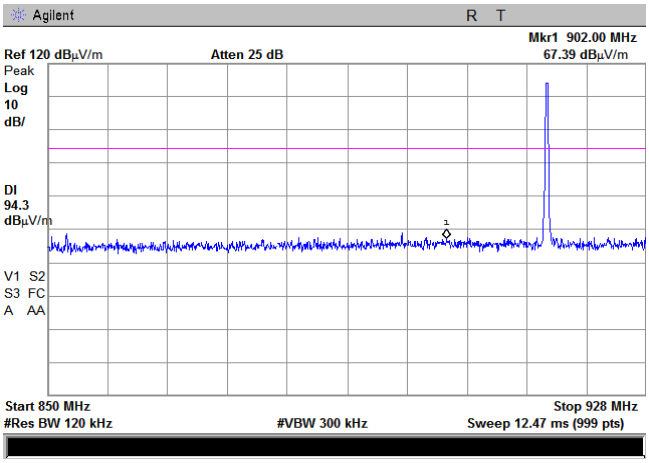


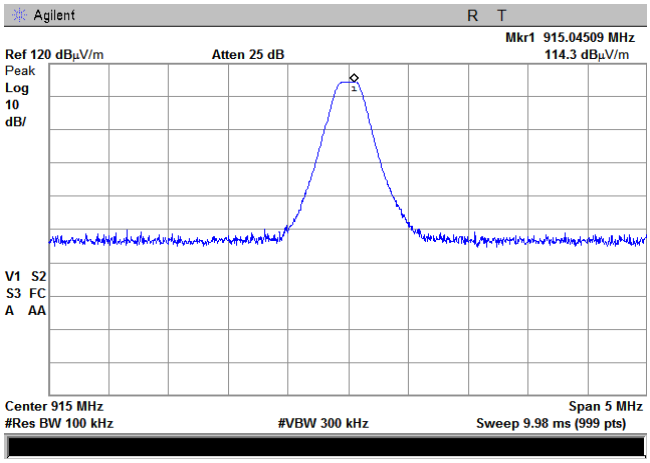
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

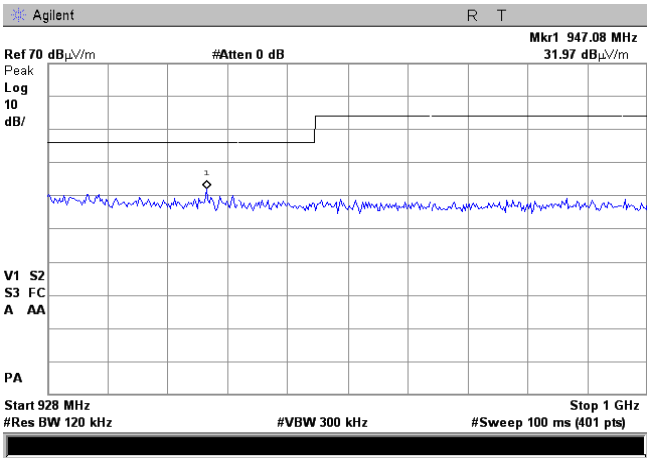
Plot 7.7.3 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

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





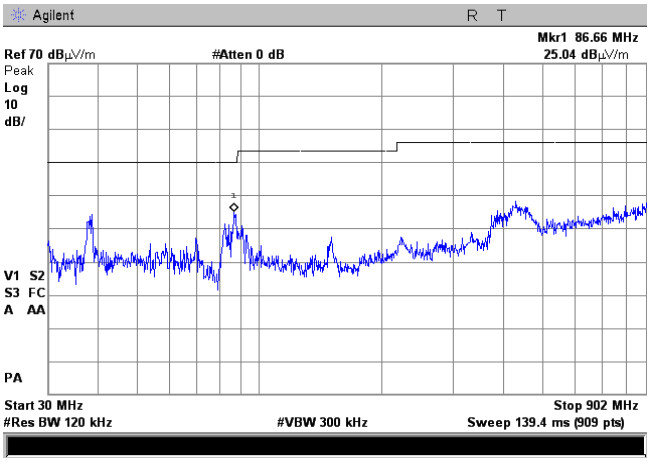


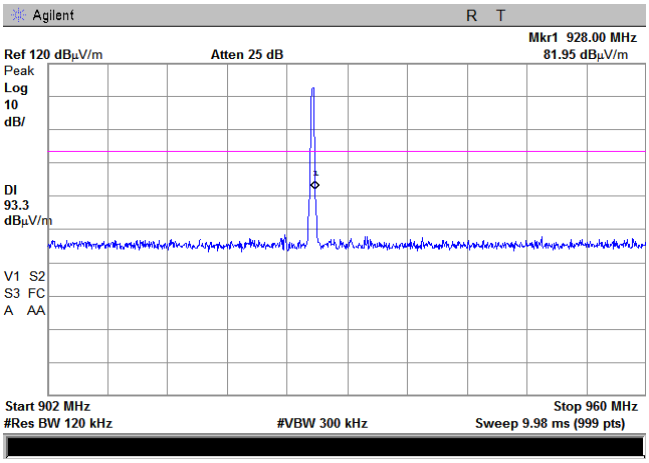


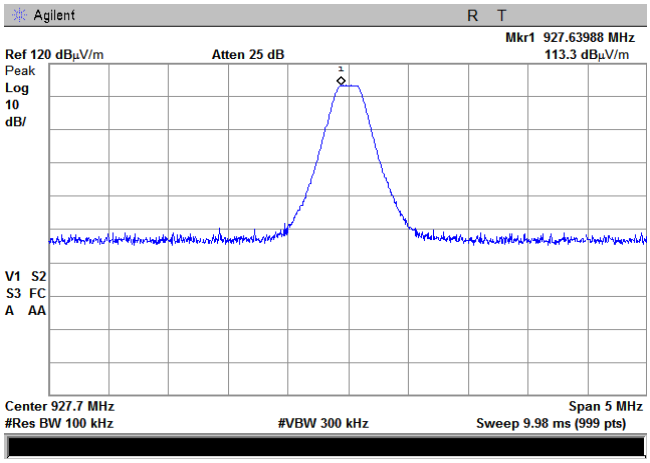
Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

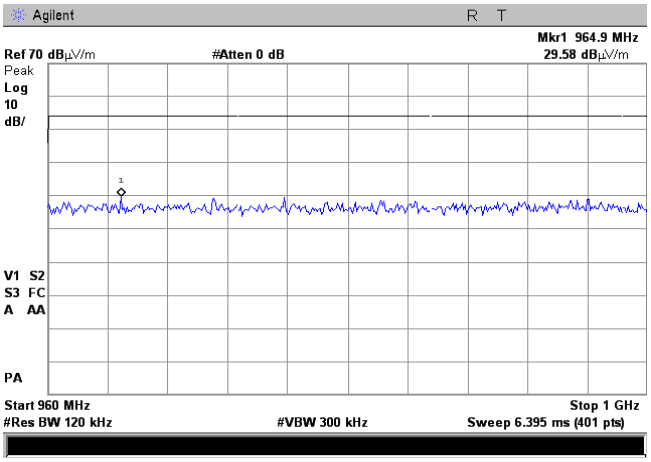
Plot 7.7.4 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

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





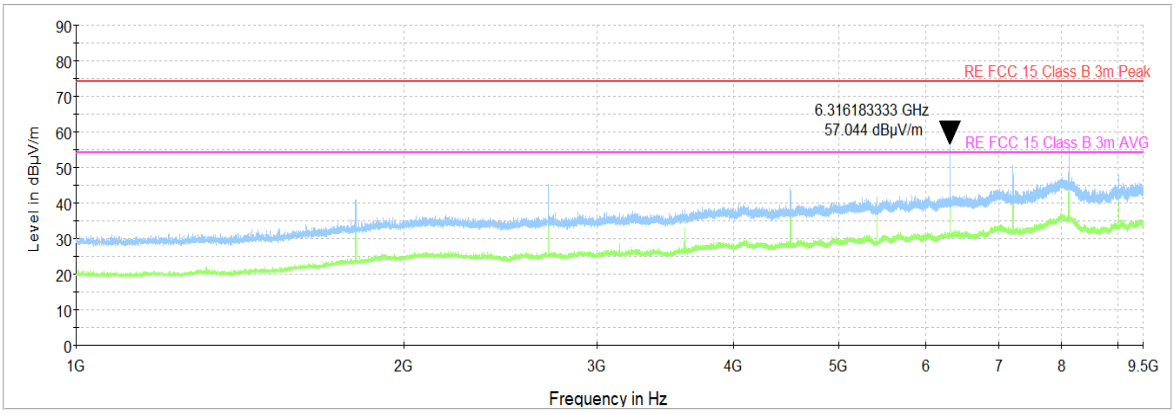




Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

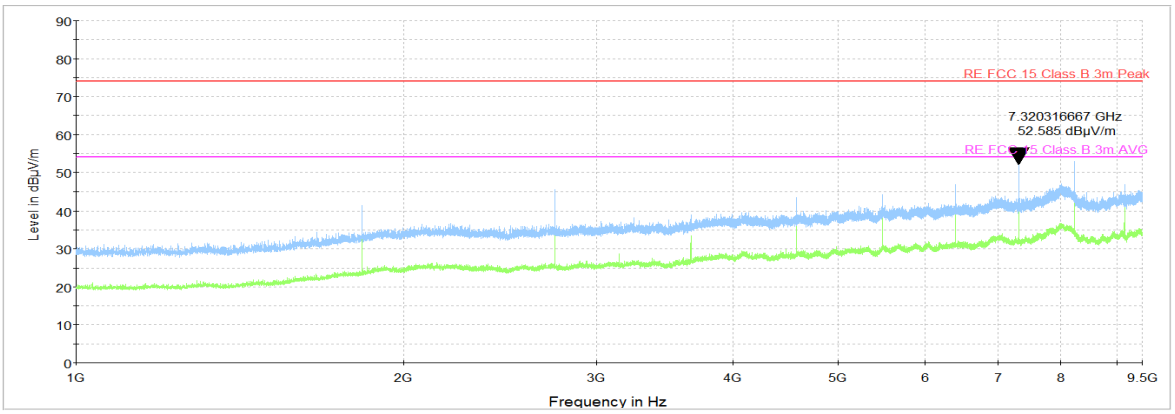
Plot 7.7.5 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency

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



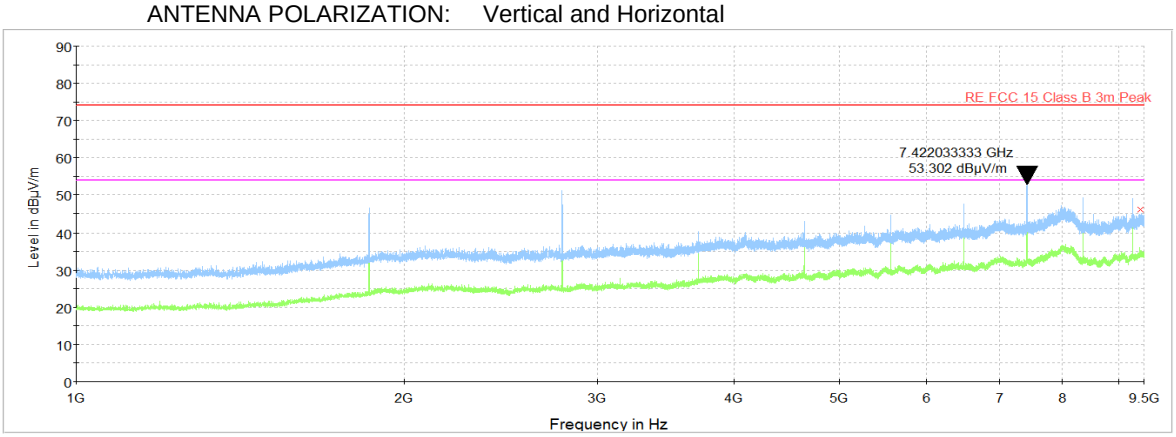
Plot 7.7.6 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency

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



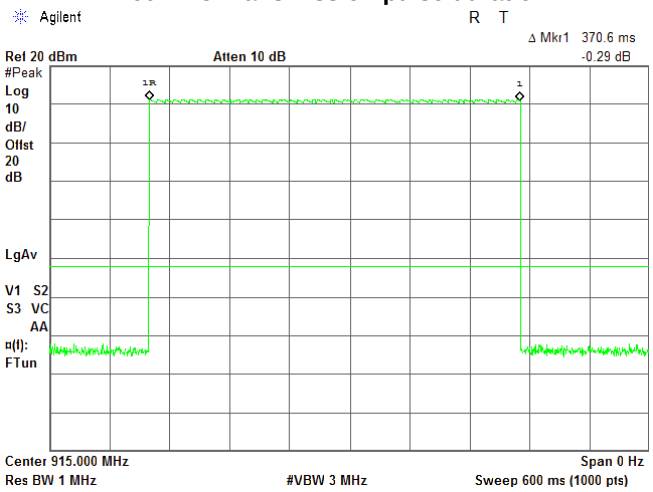
Plot 7.7.7 Radiated emission measurements from 1000 to 9500 MHz at the high carrier frequency

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



Test specification:	Section 15.247(d), Radiated spurious emissions		
Test procedure:	ANSI C63.10, sections 6.5, 6.6		
Test mode:	Compliance	Verdict:	PASS
Date(s):	15-Mar-19		
Temperature: 24 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Plot 7.7.8 Transmission pulse duration



Test specification:	Section 15.247(d), Emissions at band edges		
Test procedure:	ANSI C63.10, Section 6.10		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-May-19		
Temperature: 24.2 ºC	Relative Humidity: 49 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

7.8 Band edge radiated emissions

7.8.1 General

This test was performed to measure emissions, radiated from the EUT at the assigned frequency band edges. Specification test limits are given in Table 7.8.1.

Table 7.8.1 Band edge emission limits

Output power	Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB(μV/m)	
			Peak	Average
Averaged over a time interval	902.0 – 928.0	30.0	74.0	54.0

* - Band edge emission limit is provided in terms of attenuation below the peak of modulated carrier measured with the same resolution bandwidth.

7.8.2 Test procedure

7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized normally modulated at the maximum data rate and its proper operation was checked.

7.8.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.

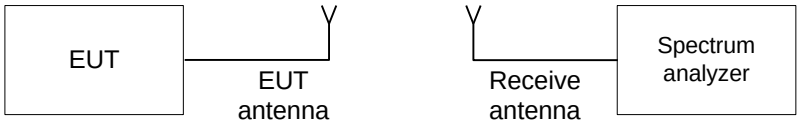
7.8.2.3 The spectrum analyzer span was set to capture the carrier frequency and associated modulation products. The resolution bandwidth was set wider than 1 % of the frequency span.

7.8.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.

7.8.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.8.2 and associated plots and referenced to the highest emission level measured within the authorized band.

7.8.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.

Figure 7.8.1 Band edge emission test setup



Test specification:	Section 15.247(d), Emissions at band edges		
Test procedure:	ANSI C63.10, Section 6.10		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-May-19		
Temperature: 24.2 ºC	Relative Humidity: 49 %	Air Pressure: 1009 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Table 7.8.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902.0 – 928.0 MHz
DETECTOR USED: RMS with max hold
MODULATION: LoRa
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz	Band edge emission, dBm	Emission at carrier, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Averaged over a time interval power						
902.0	-52.55	8.20	60.75	30.0	30.75	Pass
928.0	-44.37	9.02	53.39		23.39	

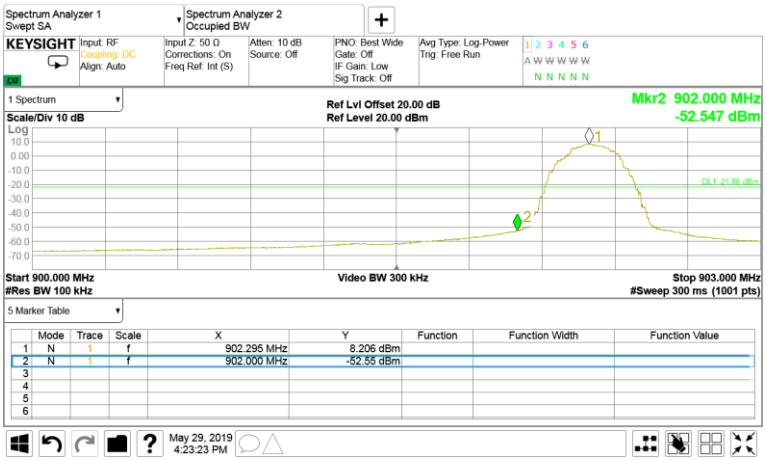
*- Margin = Attenuation below carrier – specification limit.

Reference numbers of test equipment used

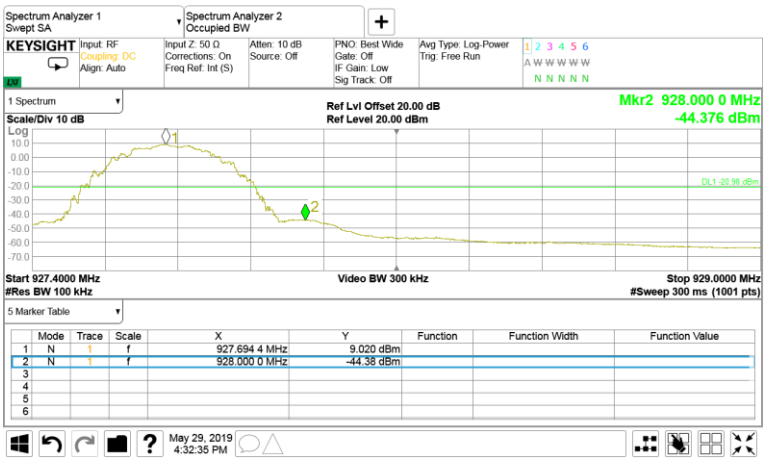
HL 3433	HL 3440	HL 5376					

Full description is given in Appendix A.

Plot 7.8.1 The highest band edge emission at low carrier frequency



Plot 7.8.2 The highest band edge emission at high carrier frequency



Test specification:	Section 15.207, Conducted emission at AC power port		
Test procedure:	ANSI C63.10, Section 6.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

7.9 Conducted emissions

7.9.1 General

This test was performed to measure common mode conducted emissions at the mains power port.
Specification test limits are given in Table 7.9.1. The worst test results (the lowest margins) were recorded in Table 7.9.2 and shown in the associated plots.

Table 7.9.1 Limits for conducted emissions

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

* The limit decreases linearly with the logarithm of frequency.

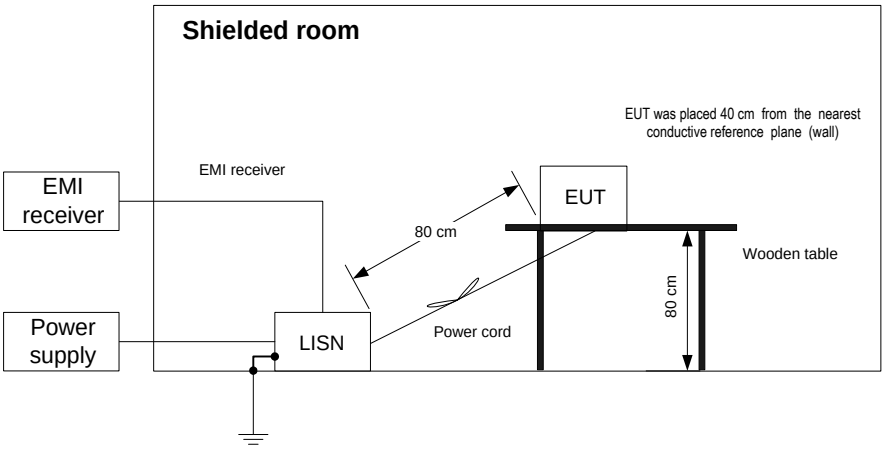
7.9.2 Test procedure

7.9.2.1 The EUT was set up as shown in Figure 7.9.1 and associated photograph, energized and the performance check was conducted.

7.9.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.9.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

Figure 7.9.1 Setup for conducted emission measurements



Photograph 7.9.1 Setup for conducted emission measurements

Test specification:	**Section 15.207, Conducted emission at AC power port**		
Test procedure:	ANSI C63.10, Section 6.7		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 7.9.2 Conducted emission test results

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

Frequency, MHz	Peak emission, dB(mV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(mV)	Limit, dB(mV)	Margin, dB*	Measured emission, dB(mV)	Limit, dB(mV)	Margin, dB*		
0.184	49.8	47.6	64.3	-16.7	34.7	54.3	-19.6	L1	Pass
0.220	49.7	47.6	62.9	-15.3	33	52.9	-19.9		
0.367	46.8	44.5	58.6	-14.1	37.2	48.6	-11.4		
0.489	41.9	39.9	56.1	-16.2	32.8	46.2	-13.4		
0.981	44.4	42.3	56	-13.7	40.1	46	-5.9		
1.958	43.2	40.7	56	-15.3	39.4	46	-6.6		
0.185	47.6	41.9	64.3	-22.4	33.2	54.3	-21.1	L2	Pass
0.220	47.8	44.4	62.9	-18.5	35.7	52.9	-17.2		
0.360	48.6	46.4	58.8	-12.4	41.3	48.8	-7.5		
0.400	46.2	44.4	57.9	-13.5	38.2	47.9	-9.7		
0.979	46.5	43.9	56	-12.1	41.9	46	-4.1		
1.958	43.7	40.8	56	-15.2	39.2	46	-6.8		

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

Reference numbers of test equipment used

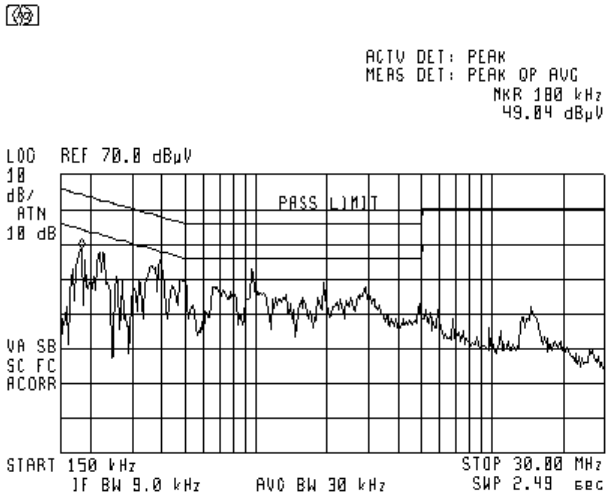
HL 3016	HL 4778	HL 4787					

Full description is given in Appendix A.

Test specification:	**Section 15.207, Conducted emission at AC power port**		
Test procedure:	ANSI C63.10, Section 6.7		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

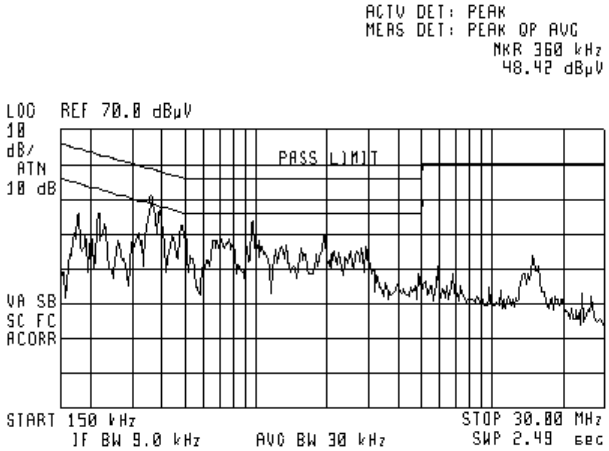
Plot 7.9.1 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Tx / Rx
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 7.9.2 Conducted emission measurements

LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Tx / Rx
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	FCC Part 15, Section 203, Antenna requirements		
Test procedure:	Visual inspection		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: NA
Remarks:			

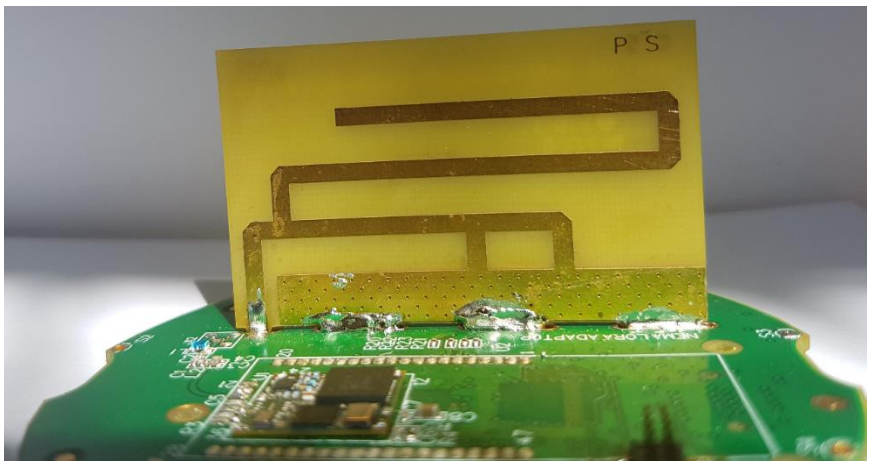
7.10 Antenna requirements

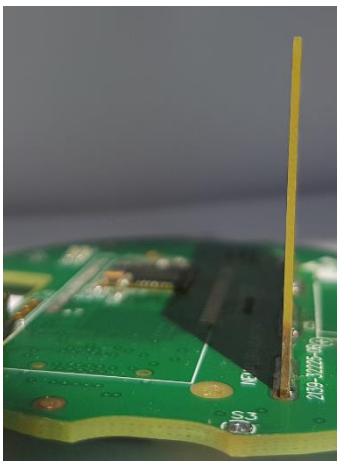
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed 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 7.10.1.

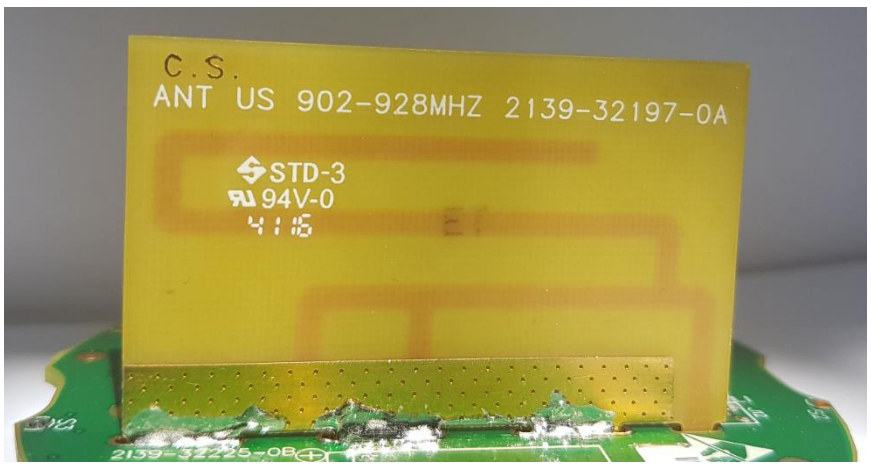
Table 7.10.1 Antenna requirements

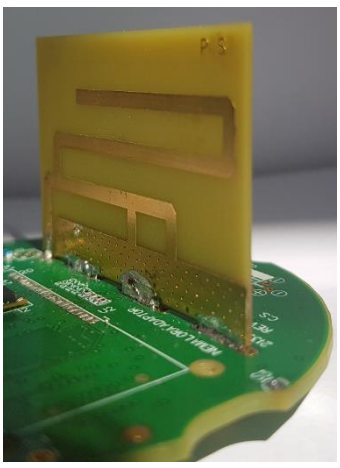
Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	

Photograph 7.10.1 Antenna assembly









Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

8 Unintentional emissions according to 47CFR part 15 subpart B

8.1 Conducted emissions at AC power port

8.1.1 General

This test was performed to measure common mode conducted emissions at the mains power port.
Specification test limits are given in Table 8.1.1. The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

Table 8.1.1 Limits for conducted emissions

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

* The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

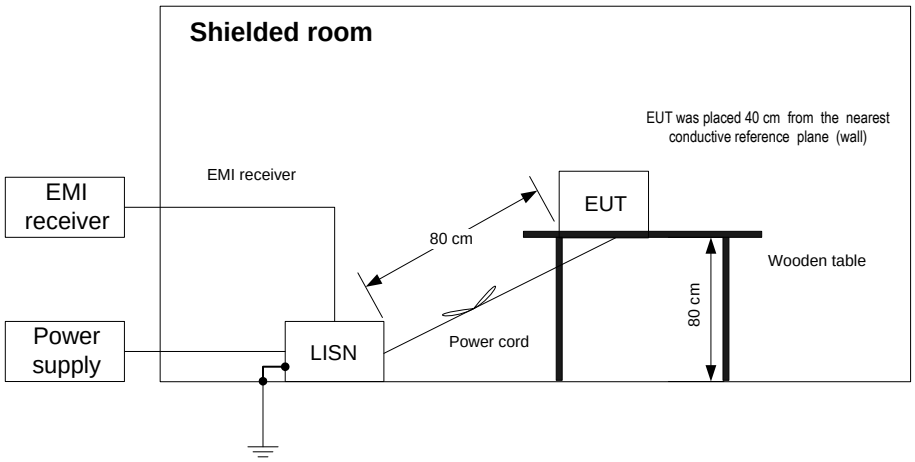
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photographs, energized and the performance check was conducted.

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

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

Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

Figure 8.1.1 Setup for conducted emission measurements



Photograph 8.1.1 Setup for conducted emission measurements

Test specification:	**Section 15.107, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 8.1.2 Conducted emission test results

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

Frequency, MHz	Peak emission, dB(µV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*	Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*		
0.184	49.7	47.5	64.3	-16.8	34.6	54.3	-19.7	L1	Pass
0.220	49.7	47.6	62.9	-15.3	33.0	52.9	-19.9		
0.367	46.8	44.5	58.6	-14.1	37.2	48.6	-11.4		
0.489	41.8	39.8	56.2	-16.4	32.2	46.2	-14.0		
0.981	44.5	42.2	56.0	-13.8	40.0	46.0	-6.0		
1.958	43.1	40.6	56.0	-15.4	39.3	46.0	-6.7		
0.185	47.6	41.9	64.3	-22.4	33.2	54.3	-21.1	L2	Pass
0.220	47.7	44.3	62.9	-18.6	35.6	52.9	-17.3		
0.360	48.5	46.2	58.8	-12.6	41.3	48.8	-7.5		
0.400	46.1	44.4	57.9	-13.5	38.0	47.9	-9.9		
0.979	46.4	43.9	56.0	-12.1	41.8	46.0	-4.2		
1.958	43.6	40.7	56.0	-15.3	39.1	46.0	-6.9		

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

Reference numbers of test equipment used

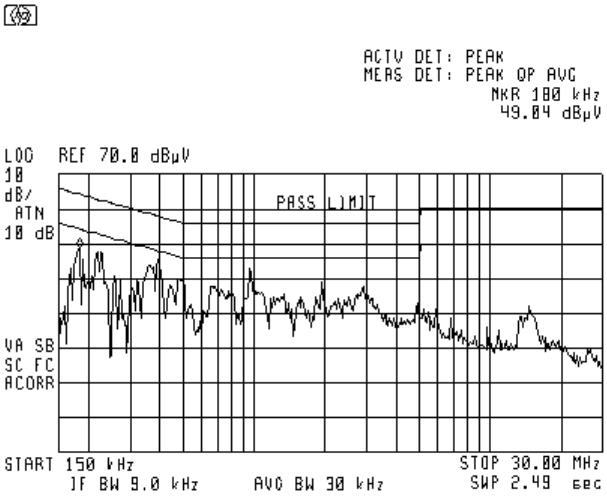
HL 0787	HL 3016	HL 4778					

Full description is given in Appendix A.

Test specification:	**Section 15.107, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	04-Apr-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

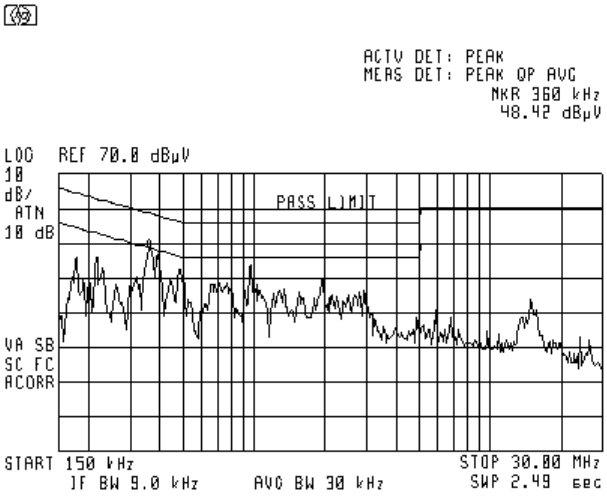
Plot 8.1.1 Conducted emission measurements

LINE: L1
LIMIT: Class B
EUT OPERATING MODE: Tx / Rx
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.2 Conducted emission measurements

LINE: L2
LIMIT: Class B
EUT OPERATING MODE: Tx / Rx
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

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

Table 8.2.1 Radiated emission test limits

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

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

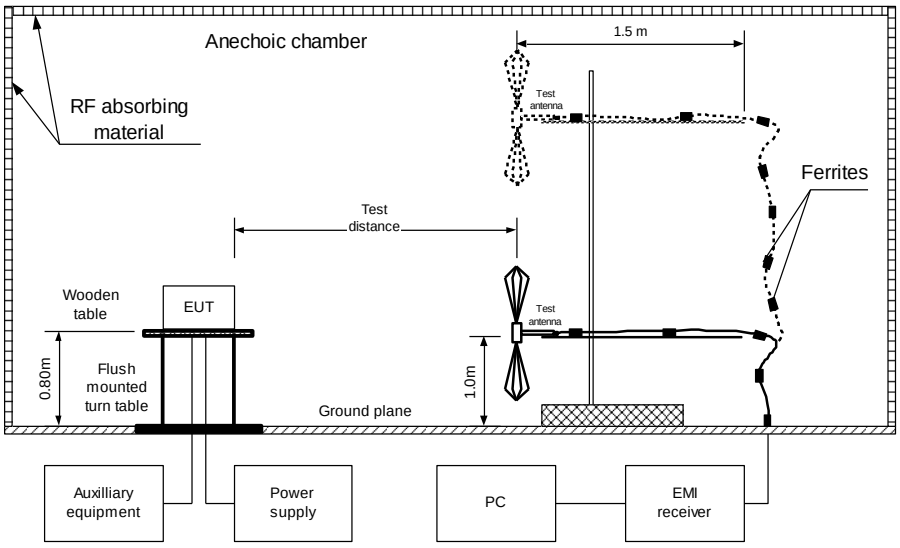
8.2.2 Test procedure for measurements in semi-anechoic chamber

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

8.2.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

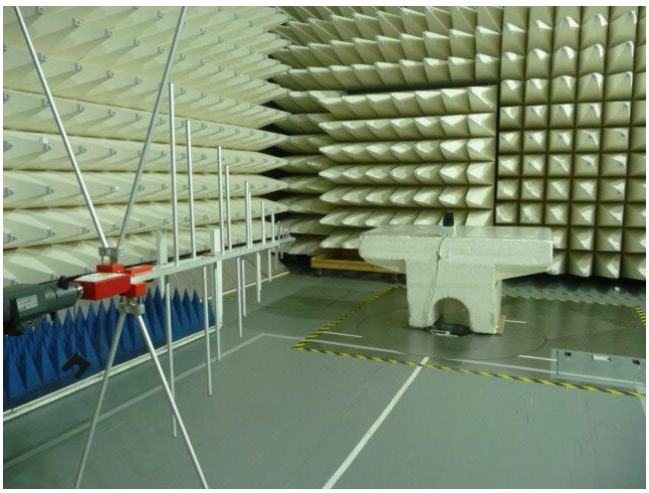
8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber

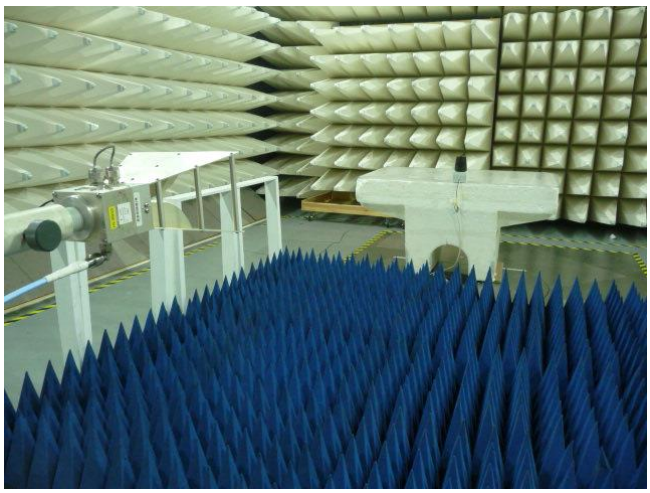


Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Photograph 8.2.1 Setup for radiated emission measurements, general view

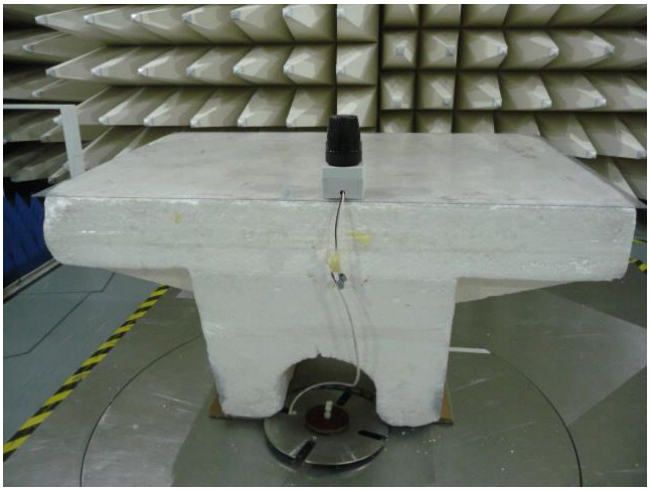


Below 1 GHz



Above 1 GHz

Photograph 8.2.2 Setup for radiated emission measurements, EUT cabling



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	**Relative Humidity:** 55 %	**Air Pressure:** 1008 hPa	**Power:** 110 VAC, 60 Hz
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
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***				
At least 20 dB bellow limit								Pass

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 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***				
At least 20 dB bellow limit										Pass

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

Reference numbers of test equipment used

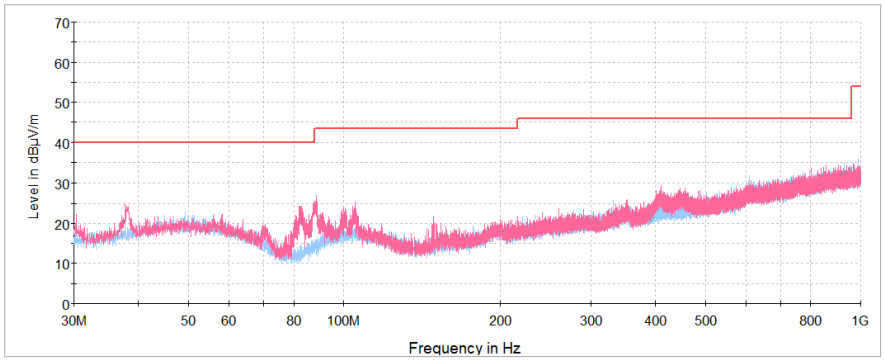
HL 3903	HL 4360	HL 4933	HL 5288	HL 5404			

Full description is given in Appendix A.

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Mar-19		
Temperature: 23 ºC	Relative Humidity: 55 %	Air Pressure: 1008 hPa	Power: 110 VAC, 60 Hz
Remarks:			

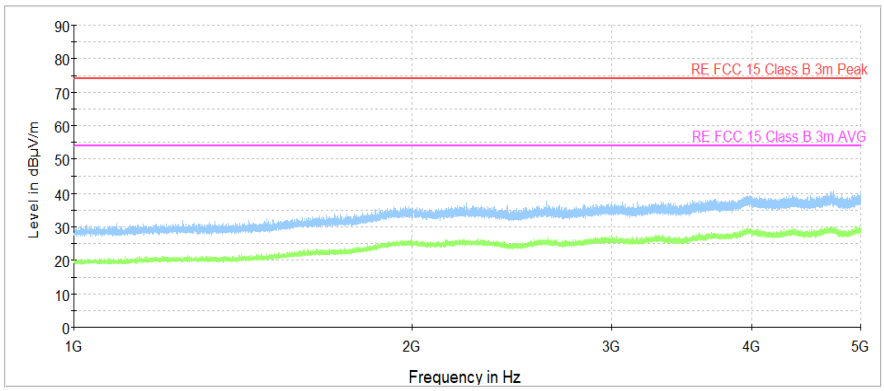
Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
ANTENNA POLARIZATION: Vertical & Horizontal



Plot 8.2.2 Radiated emission measurements above 1000 MHz

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
ANTENNA POLARIZATION: Vertical & Horizontal



9 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	24-Feb-19	24-Feb-20
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A01877	08-Oct-18	08-Oct-19
1915	Antenna, Loop, Active Receiving, 1 kHz - 30 MHz	EMC Test Systems	6507	1457	24-Feb-19	24-Feb-20
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	04-Apr-19	04-Apr-20
3016	LISN, Two-line V-network, 9 kHz to 30 MHz, (50 uH+5 Ohm)	Rohde & Schwarz	ESH 3-Z5	892239/002	27-Jan-19	27-Jan-20
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	28-Mar-18	28-Mar-19
3434	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25683	28-Mar-18	28-Mar-19
3440	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini-Circuits	BW-S20W5+	NA	10-Dec-18	10-Dec-19
3615	Cable RF, 6.5 m, N type-N type, DC-6 GHz	Suhner Switzerland	RG 214/U	NA	10-Jun-18	10-Jun-19
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	28-May-18	28-May-19
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	07-Apr-19	07-Apr-20
4277	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0748A	01-Aug-18	01-Aug-19
4339	High pass Filter, 50 Ohm, 1-18 GHz, SMA-FM / SMA-M	Micro-Tronics	HPM50115-02	1	14-May-17	14-Mar-19
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	31-Dec-18	31-Dec-19
4778	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL4777	Hewlett Packard	8542E	30807A00262 3427A00123	28-Oct-18	28-Oct-19
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	06-Jan-19	06-Jan-20
5111	RF cable, 40 GHz, 5.5 m, K-type	Huber-Suhner	SF102EA/11SK/11SK/5500MM	502493/2EA	09-Apr-18	09-Apr-19
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	809	08-Feb-19	08-Feb-22
5404	RF cable, 18 GHz, N-N, 6 m	Huber-Suhner	SF118/11N(x2)	500024/18	01-Aug-18	01-Aug-19

10 APPENDIX B 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), CAB identifier is IL1001, ISED# number 2186A; 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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e-mail: mail@hermonlabs.com
website: www.hermonlabs.com

Person for contact: Mr. M. Nikishin, EMC and radio group leader

11 APPENDIX C 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 1915: Loop Antenna
EMC Test Systems, model: 6507, s/n 1457

Frequency,	Antenna factor, dB/m
9	-21.8
10	-23.0
20	-27.3
50	-31.3
75	-32.0
100	-32.2
150	-32.5
250	-32.8
500	-33.1
750	-33.2

Frequency, MHz	Antenna factor, dB/m
1000	-33.3
2000	-33.7
3000	-34.0
4000	-34.3
5000	-34.6
10000	-35.4
15000	-36.0
20000	-36.3
25000	-37.3
30000	-37.8

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

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

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 dBμV to obtain field strength in dBμV/m.

12 APPENDIX D Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted carrier power at RF antenna connector	Below 12.4 GHz: ± 1.7 dB 12.4 GHz to 40 GHz: ± 2.3 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
Occupied bandwidth	± 8.0 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 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

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.

13 APPENDIX E Specification references

FCC 47CFR part 15:2018	Radio Frequency Devices.
ANSI C63.2:2016	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 DTS Meas_Guidance v05	Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC rules

14 APPENDIX F Abbreviations and acronyms

A	ampere	LISN	line impedance stabilization network
AC	alternating current	m	meter
A/m	ampere per meter	MHz	megahertz
AM	amplitude modulation	MIL	military
ASSL	abnormal steady state limits	mm	millimeter
ATP	acceptance test procedure	ms	millisecond
AVRG	average (detector)	μF	microfarad
BB	broad band	μs	microsecond
cm	centimeter	NA	not applicable
dB	decibel	NB	narrow band
dBm	decibel referred to one milliwatt	NP	normal performance
dB(μA)	decibel referred to one microampere	NSSL	normal steady state limits
dBμV	decibel referred to one microvolt	NT	not tested
dBμV/m	decibel referred to one microvolt per meter	OATS	open area test site
DC	direct current	Ω	Ohm
EMI	electromagnetic interference	QP	quasi-peak
ESS	environmental stress screening	PBIT	periodic built in test
ESSL	emergency steady state limits	PM	pulse modulation
EUT	equipment under test	PS	power supply
FTE	functional test equipment	RE	radiated emission
GHz	gigahertz	RF	radio frequency
GND	ground	rms	root mean square
H	height	s	second
HL	Hermon laboratories	STD	standard
Hz	hertz	TBD	to be defined
k	kilo	V	volt
kHz	kilohertz	VA	volt-ampere
kV	kilovolt	W	width
L	length	W	watt

END OF DOCUMENT