

# TEST REPORT

**ACCORDING TO: FCC CFR 47 Part 15 subpart C, section 15.231 and subpart B  
RSS-210 issue 9 Annex A, ICES-003 Issue 6:2016**

**FOR:**

**Triple Plus Ltd.**

**Shut Off actuator of  
Cloud Leak Management system**

**Model: CLM-SHAMAP-1-20**

**FCC ID:2AFOICLMASOU20**

**IC:20798-CLMASOU20**

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## 1 Applicant information

**Client name:** Triple Plus Ltd.  
**Address:** 5 Hamada street, Yokneam 2069200, Israel  
**Telephone:** +972 72 211 7711  
**E-mail:** jacob.goren@tripleplus.io  
**Contact name:** Mr. Jacob Goren

## 2 Equipment under test attributes

**Product name:** Shut off actuator of Cloud Leak Management system  
**Product type:** Transceiver operating at 915 MHz  
**Model(s):** CLM-SHAMAP-1-20  
**Serial number:** C3E0009B  
**Hardware version:** 1.2  
**Software release:** 1.4.0.12  
**Receipt date** 06-Feb-17

## 3 Manufacturer information

**Manufacturer name:** Triple Plus Ltd.  
**Address:** 5 Hamada street, Yokneam 2069200, Israel  
**Telephone:** +972 72 211 7711  
**E-Mail:** Triple Plus Ltd.  
**Contact name:** Mr. Jacob Goren

## 4 Test details




**Project ID:** 29189  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 07-Feb-17  
**Test completed:** 07-Mar-17  
**Test specification(s):** FCC 47CFR part 15, subpart C, §15.231 and subpart B;  
RSS-210 issue 9 Annex A, RSS-Gen issue 4, ICES-003 issue 6:2016

## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
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
<b>Unintentional emissions</b>	
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.

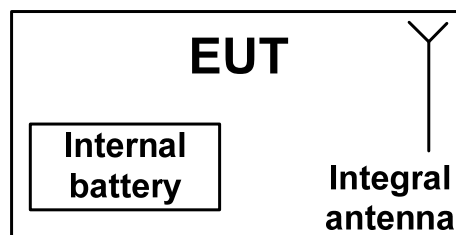
	Name and Title	Date	Signature
<b>Tested by:</b>	Mr. K. Zushchuk, test engineer	March 7, 2017	
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	March 19, 2017	
<b>Approved by:</b>	Mr. M. Nikishin, EMC and radio group leader	March 28, 2017	

## 6 EUT description

### 6.1 General information

The EUT, shut off actuator transceiver, is a part of Cloud Leakage Management (CLM) system. The EUT, installed on a water valve, shuts off the water pipe when receives a command from the HUB. The unit is powered by a battery and utilizes the integral antenna.

### 6.2 Test configuration



### 6.3 Changes made in EUT

No changes were implemented in the EUT during testing.

## 6.4 EUT test positions

Photograph 6.4.1 EUT in X-axis orthogonal position



Photograph 6.4.2 EUT in Y-axis orthogonal position



Photograph 6.4.3 EUT in Z-axis orthogonal position



## 6.5 Transmitter characteristics

<b>Type of equipment</b>					
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)				
<b>Operating frequencies</b>		915 MHz			
<b>Maximum rated output power</b>		At transmitter 50 $\Omega$ RF output connector		dBm	
		Field strength at 3 m distance		100.21 dB( $\mu$ V/m) -peak 74.53 dB( $\mu$ V/m)-average	
<b>Is transmitter output power variable?</b>		X	No		
		Yes		continuous variable	
				stepped variable with stepsize	
				dB	
				minimum RF power	dBm
				maximum RF power	dBm
<b>Antenna connection</b>					
unique coupling	standard connector	X	integral	X	with temporary RF connector without temporary RF connector
<b>Antenna/s technical characteristics</b>					
Type	Manufacturer	Model number			
Internal	Triple Plus	Helical			
<b>Type of modulation</b>		2GFSK			
<b>Transmitter aggregate data rate/s</b>		50 kbps			
<b>Transmitter power source</b>					
X	Battery	<b>Nominal rated voltage</b>	4 x 3V batteries (CR123)		
	DC	<b>Nominal rated voltage</b>	VDC		
	AC mains	<b>Nominal rated voltage</b>	VAC	Frequency	
<b>Common power source for transmitter and receiver</b>					
		X	yes	no	

<b>Test specification:</b> FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements			
<b>Test procedure:</b> Supplier declaration			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

## 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 7.1.1.

#### 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.

**Figure 7.1.1 Setup for transmitter shut down test**



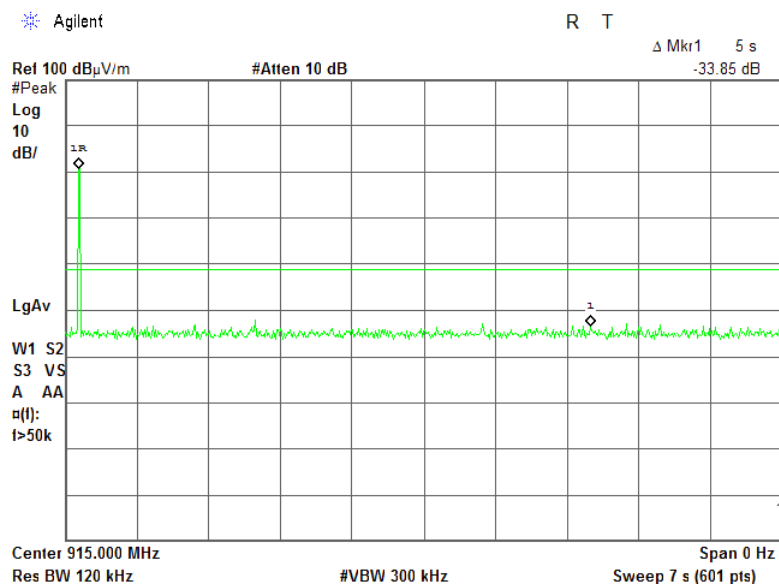


<b>Test specification:</b> FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements			
<b>Test procedure:</b> Supplier declaration			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

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	NA
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

Plot 7.1.1 Transmitter shut down test result

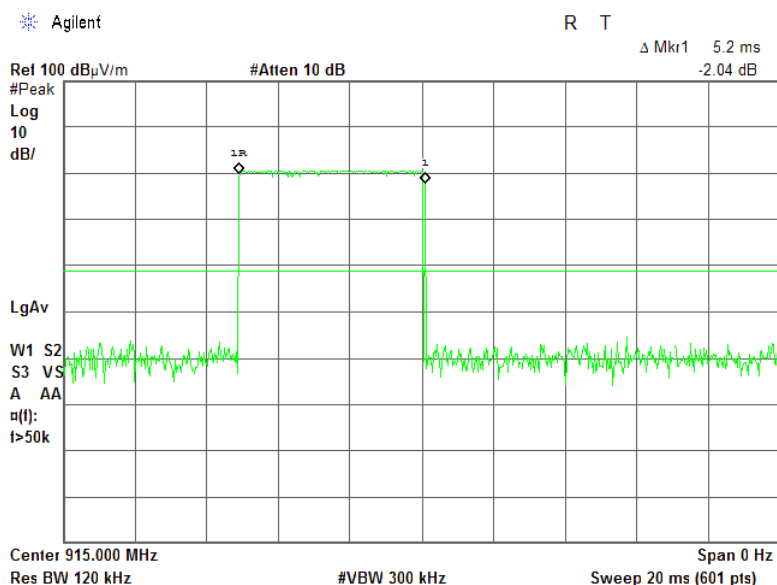




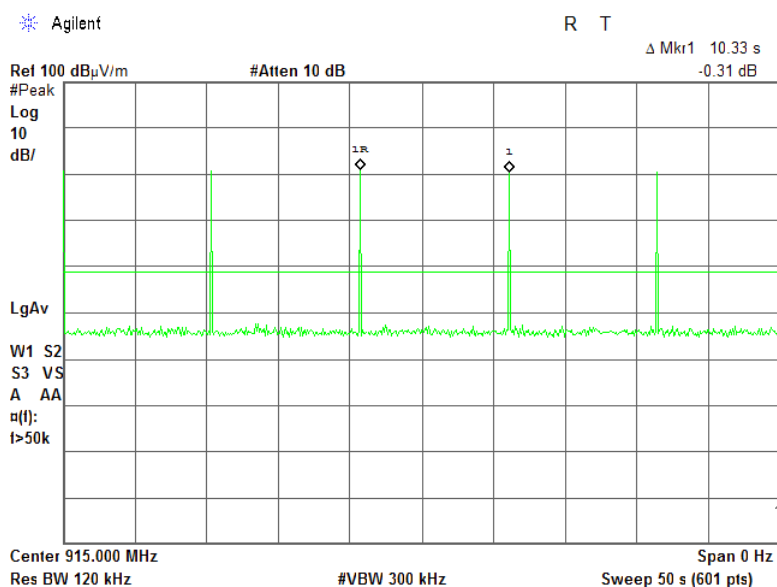
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Test specification: FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements			
Test procedure: Supplier declaration			
Test mode: Compliance		Verdict: PASS	
Date(s): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 43 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

Plot 7.1.2 Polling / supervision transmission duration



Plot 7.1.3 Total duration of polling / supervision transmissions





<b>Test specification:</b> FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements			
<b>Test procedure:</b> Supplier declaration			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

Table 7.1.2 Total duration of polling / supervision transmissions

Duration, ms	Repetition period, s	Maximum number of transmissions within 1 hour	Total duration within 1 hour, ms
5.20	10.33	348	1809.60

## Reference numbers of test equipment used

HL 3818							
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Full description is given in Appendix A.



<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

## 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
902.0 – 928.0	102.0	82.0

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**	82.0	62.0
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			
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.

<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

## 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 measurements were performed in three EUT orthogonal positions.

7.2.2.3 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.

7.2.2.4 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

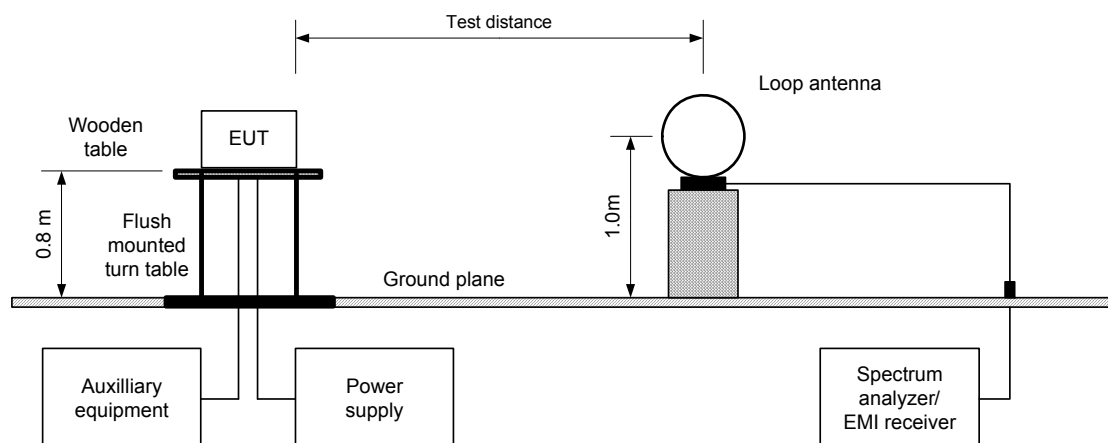
7.2.3.1 The EUT was set up as shown in Figure 7.2.2, Figure 7.2.3, energized and the performance check was conducted.

7.2.3.2 The measurements were performed in three EUT orthogonal positions.

7.2.3.3 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.

7.2.3.4 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



<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

Figure 7.2.2 Setup for spurious emission field strength measurements above 30 MHz

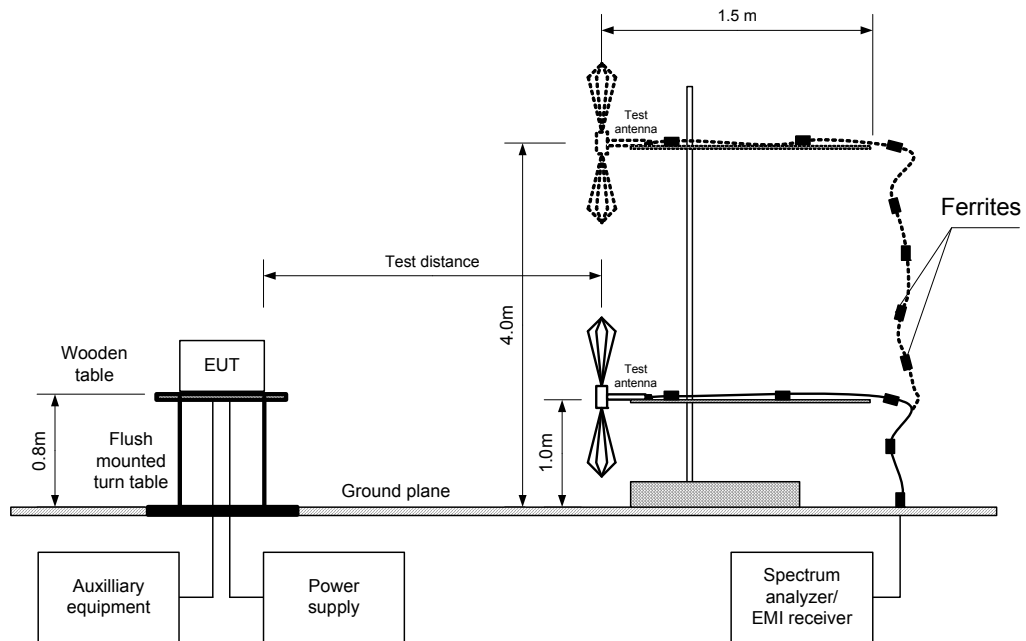
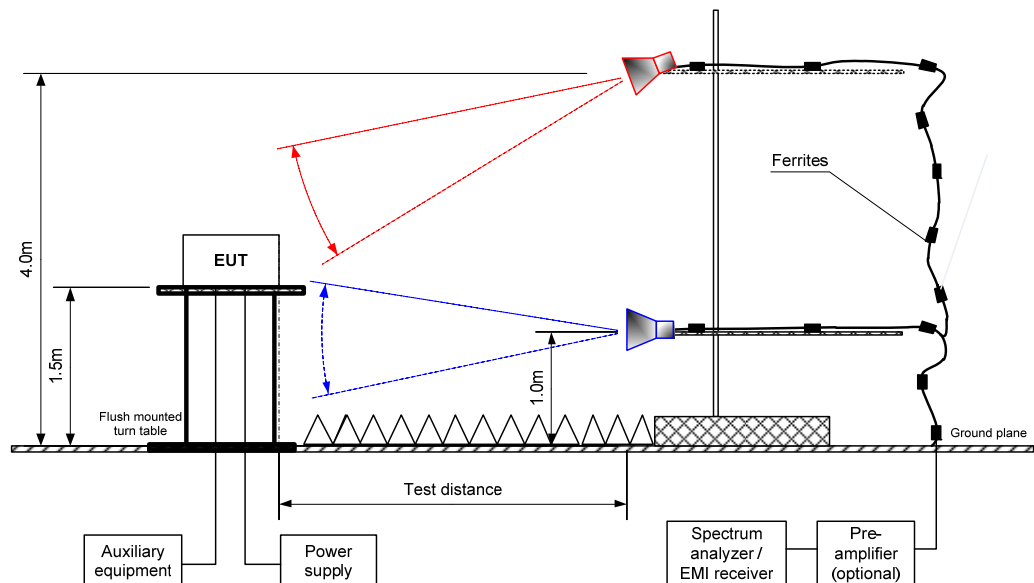


Figure 7.2.3 Setup for spurious emission field strength measurements above 1000 MHz





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<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

**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: 3 orthogonal ( X / Y / Z )  
MODULATION: 2GFSK  
BIT RATE: 50 kbps  
INVESTIGATED FREQUENCY RANGE: 0.009 - 9500 MHz  
DETECTOR USED: Peak  
RESOLUTION BANDWIDTH: 1.0 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 ended 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**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission***											
915.0	V	1.2	240	100.21	102.00	-1.79	NA	74.53	82.00	-7.47	Pass
Spurious emissions											
1830 080	V	1.6	120	48.83	82.00	-33.17	NA	23.15	62.00	-38.85	Pass

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

\*\* - Margin = dB below (negative if above) specification limit.

\*\*\* Max value was obtained in X-axis orthogonal position.

**Table 7.2.4 Average factor calculation**

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, s	Duration, ms	Period, ms		
5.2	10.33	NA	NA	NA	-25.68

\*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

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

for pulse train longer than 100 ms:

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

#### Reference numbers of test equipment used

HL 0446	HL 0521	HL 0604	HL 3818	HL 4353	HL 4933	HL 5103	
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Full description is given in Appendix A.



<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

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

TEST DISTANCE: 3 m  
 EUT POSITION: 3 orthogonal ( X / Y / Z )  
 MODULATION: 2GFSK  
 BIT RATE: 50 kbps  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 1 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)

Emissions (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.

**Reference numbers of test equipment used**

HL 0446	HL 0521	HL 0604	HL 3818	HL 4353	HL 4933	HL 5103	
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Full description is given in Appendix A.





<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

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	12.290 - 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	16.420 - 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

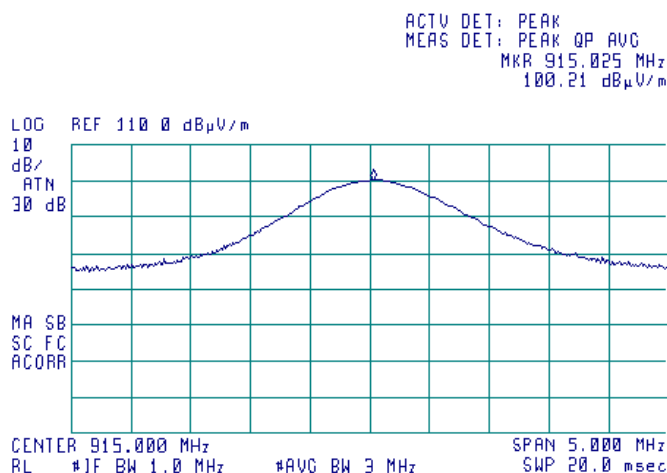


HERMON LABORATORIES

Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10 sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

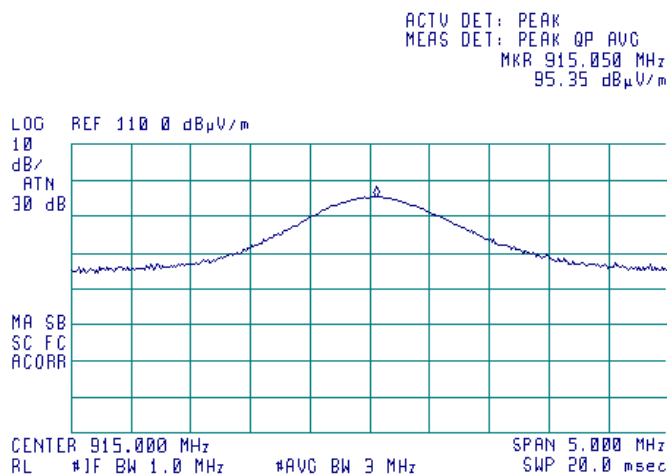
#### Plot 7.2.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: X-axis



#### Plot 7.2.2 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: X-axis



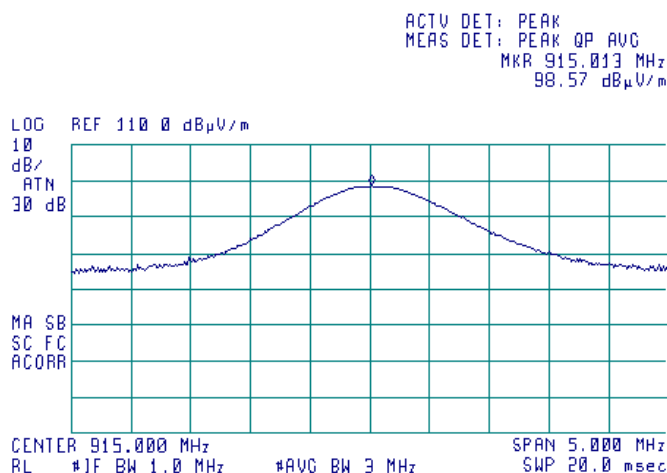


HERMON LABORATORIES

Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10 sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

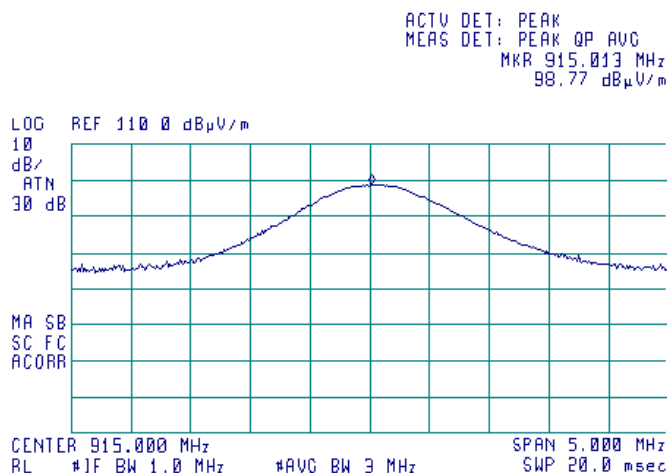
Plot 7.2.3 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Y-axis



Plot 7.2.4 Radiated emission measurements at the fundamental frequency

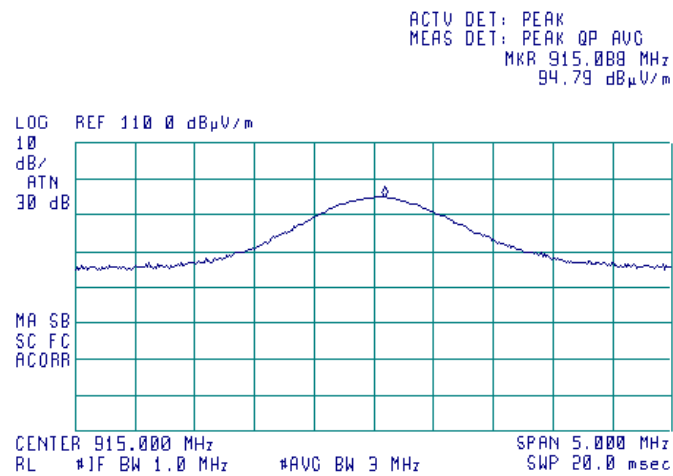
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Y-axis



<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

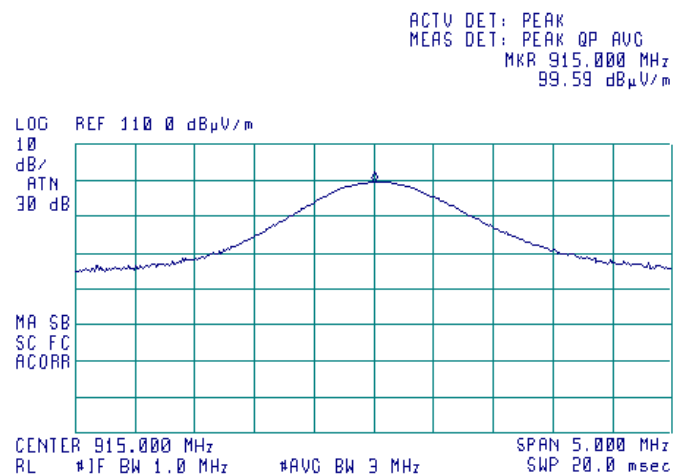
#### Plot 7.2.5 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Z-axis



#### Plot 7.2.6 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Z-axis



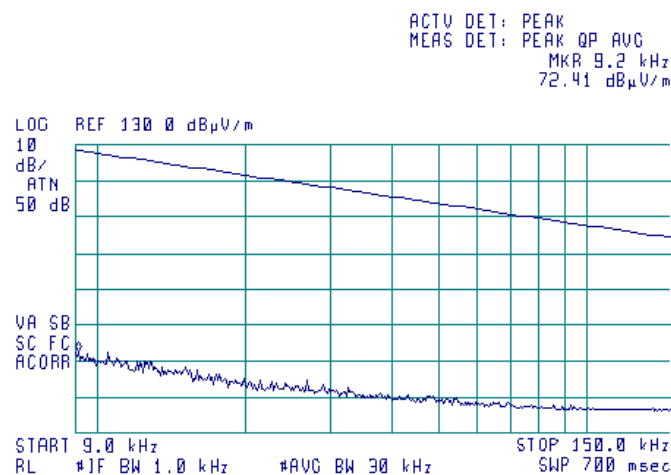


HERMON LABORATORIES

Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10 sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

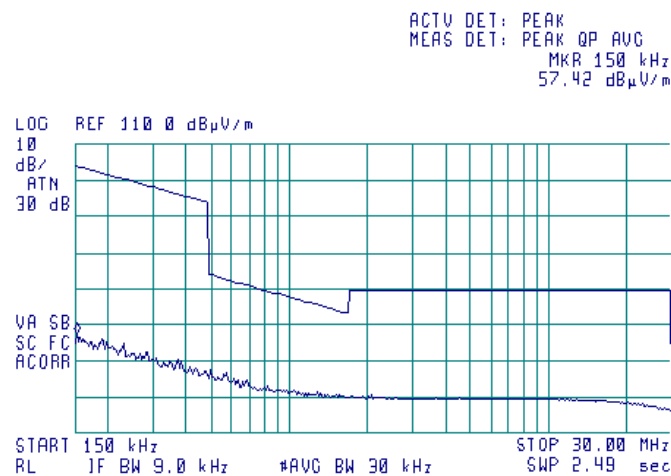
**Plot 7.2.7 Radiated emission measurements from 9 to 150 kHz**

TEST SITE: Fully anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: X-axis



**Plot 7.2.8 Radiated emission measurements from 0.15 to 30 MHz**

TEST SITE: Fully anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: X-axis



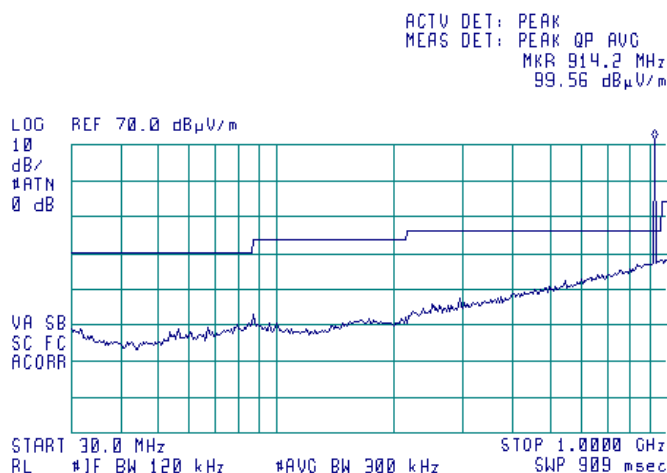


HERMON LABORATORIES

Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10 sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

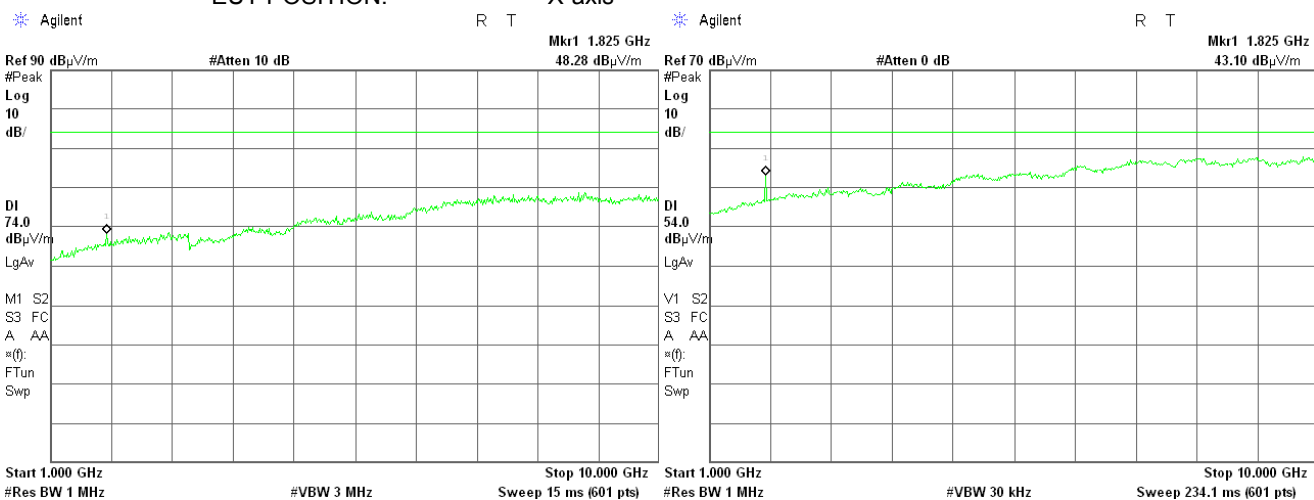
#### Plot 7.2.9 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: X-axis



#### Plot 7.2.10 Radiated emission measurements from 1000 to 9500 MHz

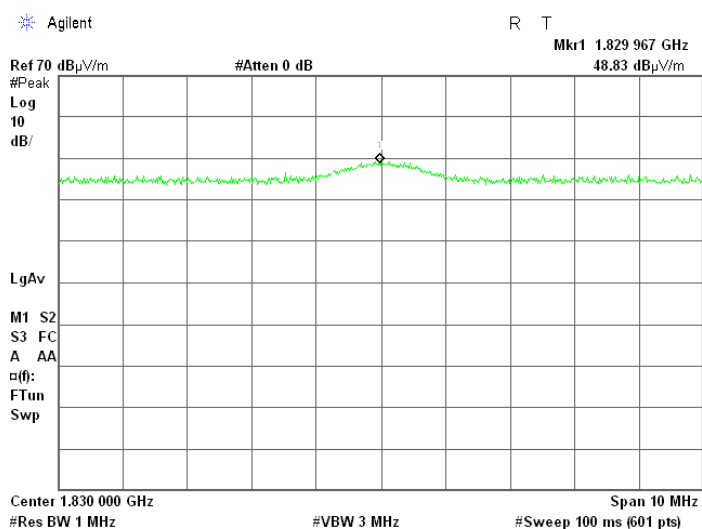
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: X-axis



<b>Test specification:</b> FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
<b>Test procedure:</b> ANSI C63.10 sections 6.5, 6.6			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

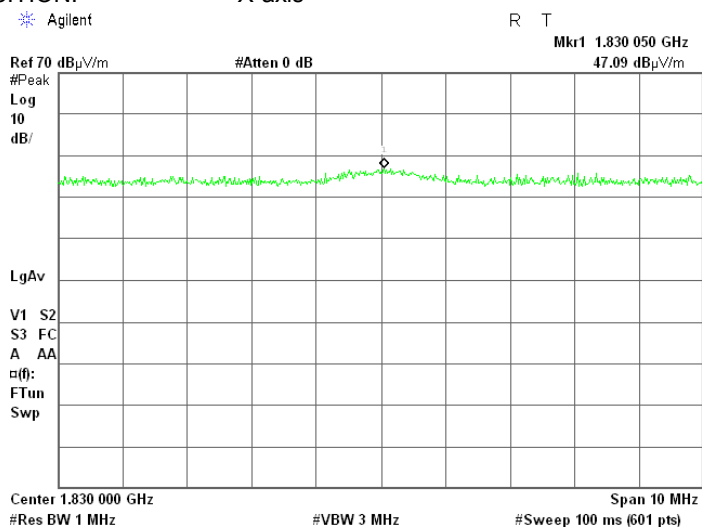
**Plot 7.2.11 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: X-axis



**Plot 7.2.12 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: X-axis

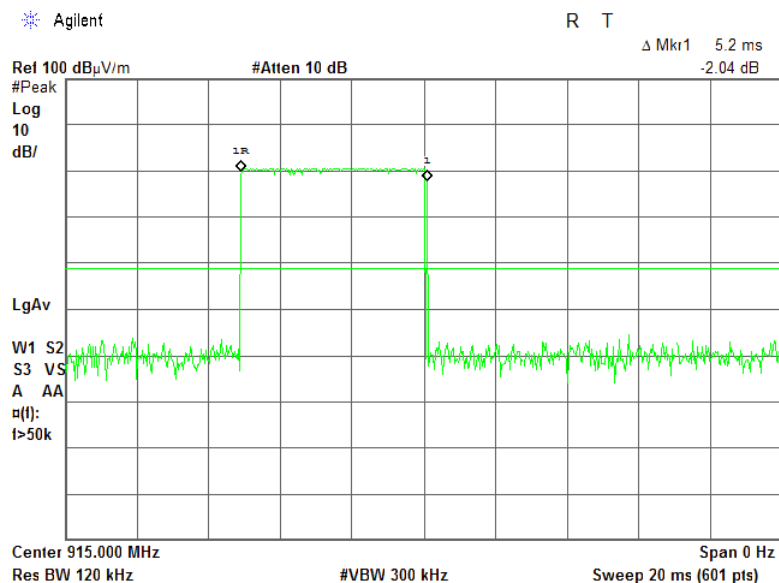




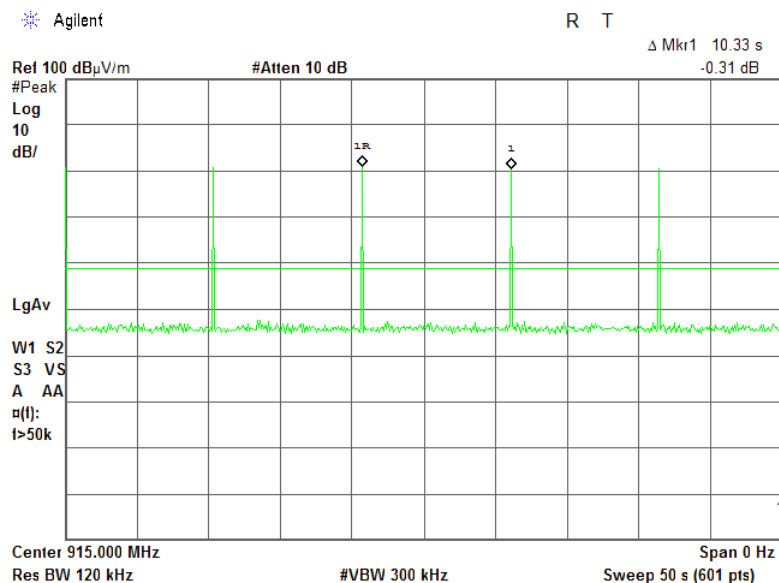
HERMON LABORATORIES

Test specification: FCC Part 15, Section 231(b) / RSS-210, Section A1.2, Field strength of emissions			
Test procedure: ANSI C63.10 sections 6.5, 6.6			
Test mode: Compliance		Verdict: PASS	
Date(s): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

Plot 7.2.13 Transmission pulse duration



Plot 7.2.14 Transmission pulse period





<b>Test specification:</b> FCC Part 15, Section 231(c) / RSS-210, Section A1.3, Occupied bandwidth			
<b>Test procedure:</b> ANSI C63.10 section 6.9.2			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

## 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





<b>Test specification:</b> FCC Part 15, Section 231(c) / RSS-210, Section A1.3, Occupied bandwidth			
<b>Test procedure:</b> ANSI C63.10 section 6.9.2			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold  
 RESOLUTION BANDWIDTH: 5.1 kHz  
 VIDEO BANDWIDTH: 15.0 kHz  
 MODULATION: 2GFSK  
 BIT RATE: 50 kbps

MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
915.00	84.425	0.5	457.500	-373.075	Pass

MODULATION ENVELOPE REFERENCE POINTS: 99 %

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
915.00	80.304	0.5	457.500	-377.196	Pass

## Reference numbers of test equipment used

HL 3818								
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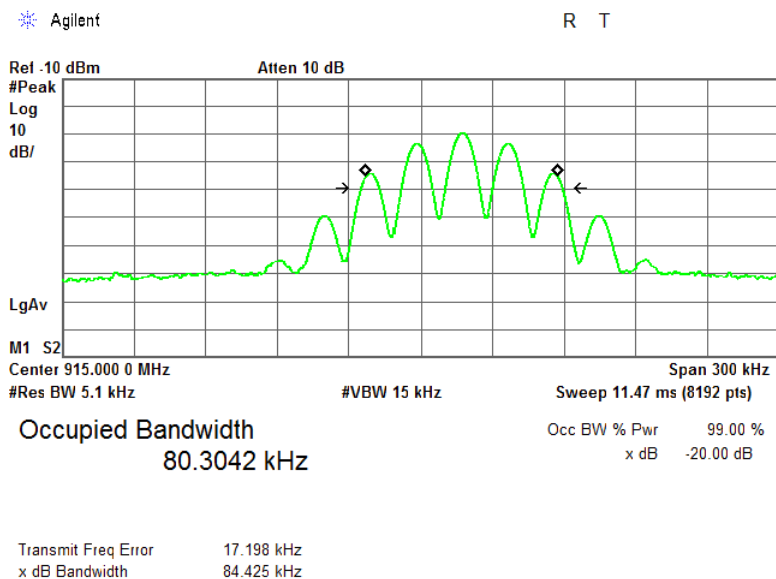
Full description is given in Appendix A.



HERMON LABORATORIES

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): 07-Feb-17			
Temperature: 25 °C	Relative Humidity: 43 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

Plot 7.3.1 Occupied bandwidth test result



<b>Test specification:</b> FCC Part 15, Section 203 / RSS-Gen, Section 8.3, Antenna requirements			
<b>Test procedure:</b> Visual inspection / supplier declaration			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Mar-17			
<b>Temperature:</b> 23 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

## 7.4 Antenna requirements

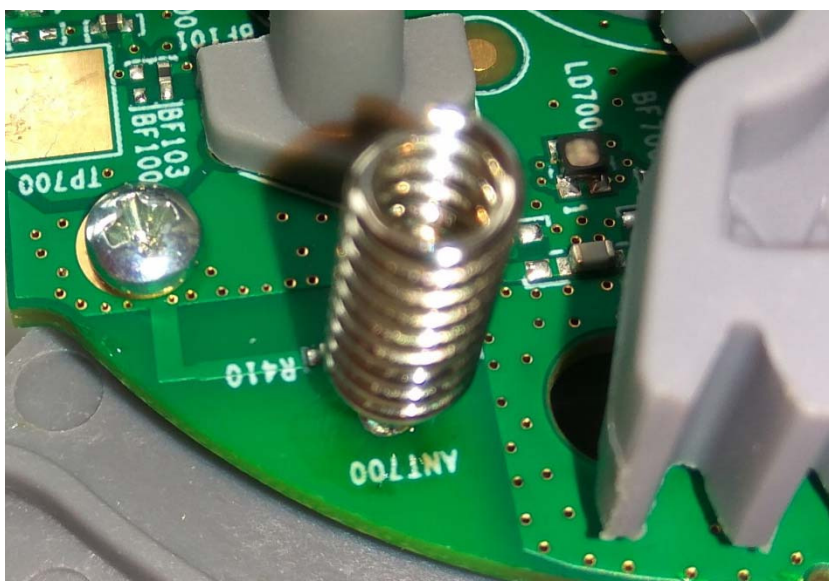
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed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





<b>Test specification:</b> FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 8.3 and 12.2.5			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 07-Feb-17			
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

## 8 Unintentional emissions

### 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 8.1.2.

**Table 8.1.1 Radiated emission limits according to FCC Part 15, Section 109 and ICES-003, Section 6.2**

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*
960 - 5 <sup>th</sup> harmonic**	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 <sup>th</sup> harmonic**	54.0

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

#### 8.1.2 Test procedure

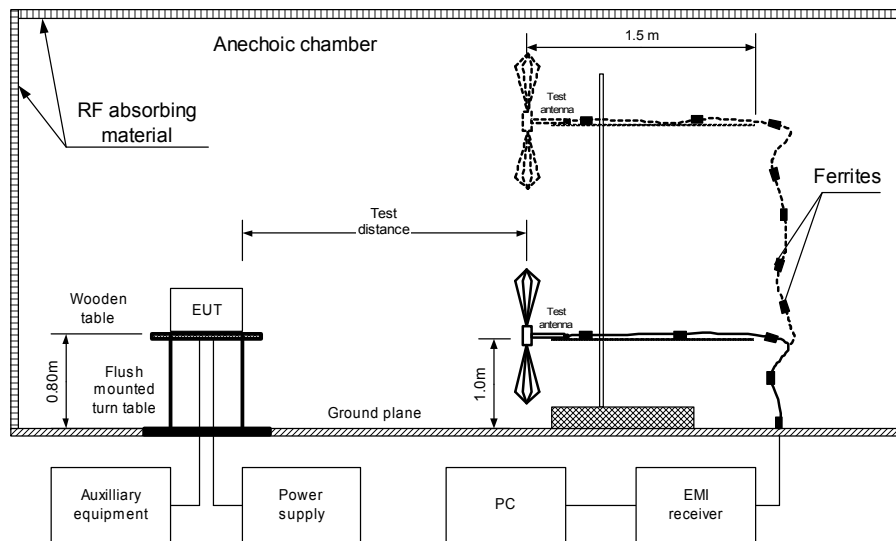
**8.1.2.1** The EUT was set up as shown in Figure 8.1.1 and associated photograph/s, energized and the performance check was conducted.

**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 provided in the associated tables and plots.

Test specification:		FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Radiated emission	
Test procedure:		ANSI C63.4, Sections 8.3 and 12.2.5	
Test mode:		Verdict: PASS	
Date(s):			
07-Feb-17			
Temperature: 25 °C	Relative Humidity: 43 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

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

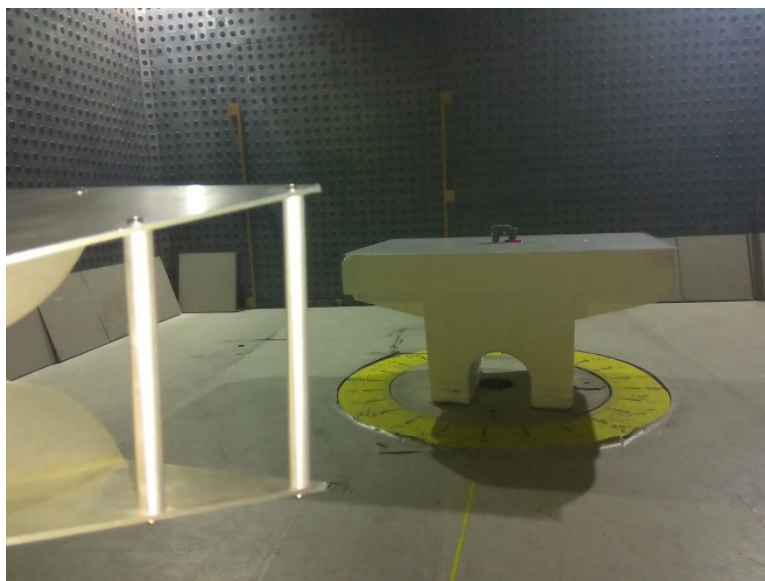


**Photograph 8.1.1 Setup for radiated emission measurements**



<b>Test specification:</b>		<b>FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Radiated emission</b>	
<b>Test procedure:</b>		ANSI C63.4, Sections 8.3 and 12.2.5	
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	07-Feb-17		
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

Photograph 8.1.2 Setup for radiated emission measurements



Photograph 8.1.3 Setup for radiated emission measurements, EUT close view





HERMON LABORATORIES

<b>Test specification:</b> FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 8.3 and 12.2.5			
<b>Test mode:</b>	Compliance	<b>Verdict:</b> PASS	
<b>Date(s):</b>	07-Feb-17		
<b>Temperature:</b> 25 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1020 hPa	<b>Power:</b> Battery
<b>Remarks:</b>			

**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  
FREQUENCY RANGE: 30 MHz – 1000 MHz  
RESOLUTION BANDWIDTH: 120 kHz

RECESSION 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 MHz – 6000 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 0521	HL 0604	HL 3818	HL 4353	HL 4933	HL 5103		
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Full description is given in Appendix A.



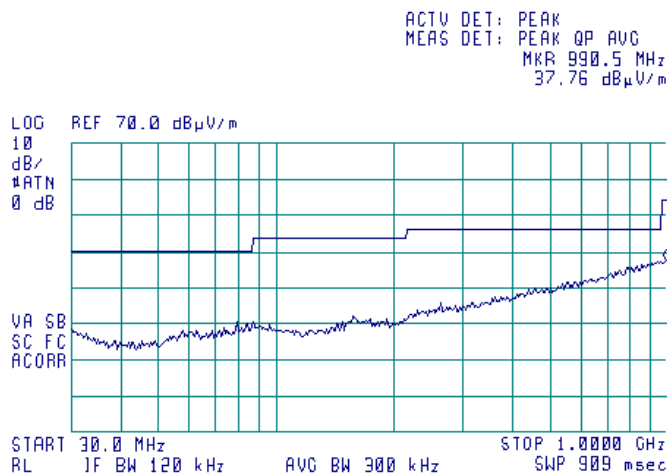


HERMON LABORATORIES

Test specification:		FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Radiated emission	
Test procedure:		ANSI C63.4, Sections 8.3 and 12.2.5	
Test mode:		Verdict: PASS	
Date(s):			
07-Feb-17			
Temperature: 25 °C	Relative Humidity: 43 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

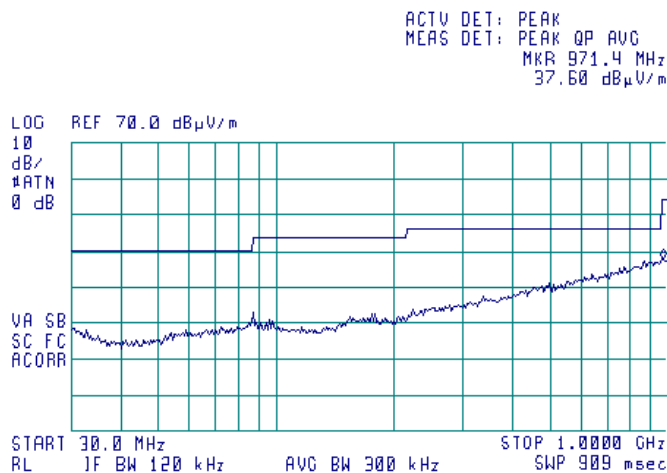
Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

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



Plot 8.1.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization

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





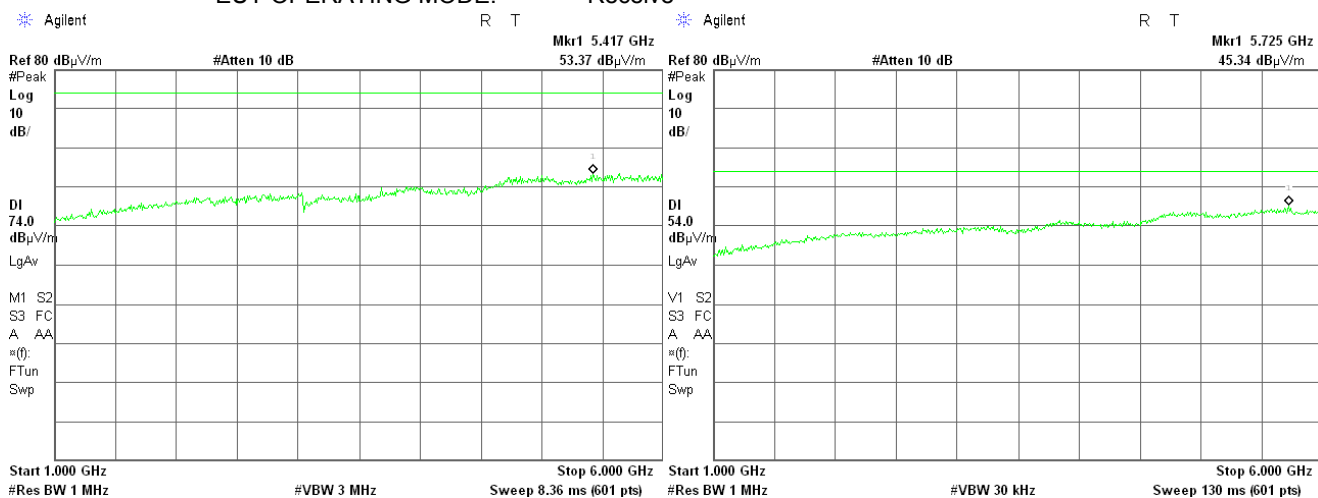
HERMON LABORATORIES

Report ID: TRIRAD\_FCC.29189.docx  
Date of Issue: 28-Mar-17

Test specification:		FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Radiated emission	
Test procedure:		ANSI C63.4, Sections 8.3 and 12.2.5	
Test mode:		Compliance	Verdict: PASS
Date(s):		07-Feb-17	
Temperature: 25 °C	Relative Humidity: 43 %	Air Pressure: 1020 hPa	Power: Battery
Remarks:			

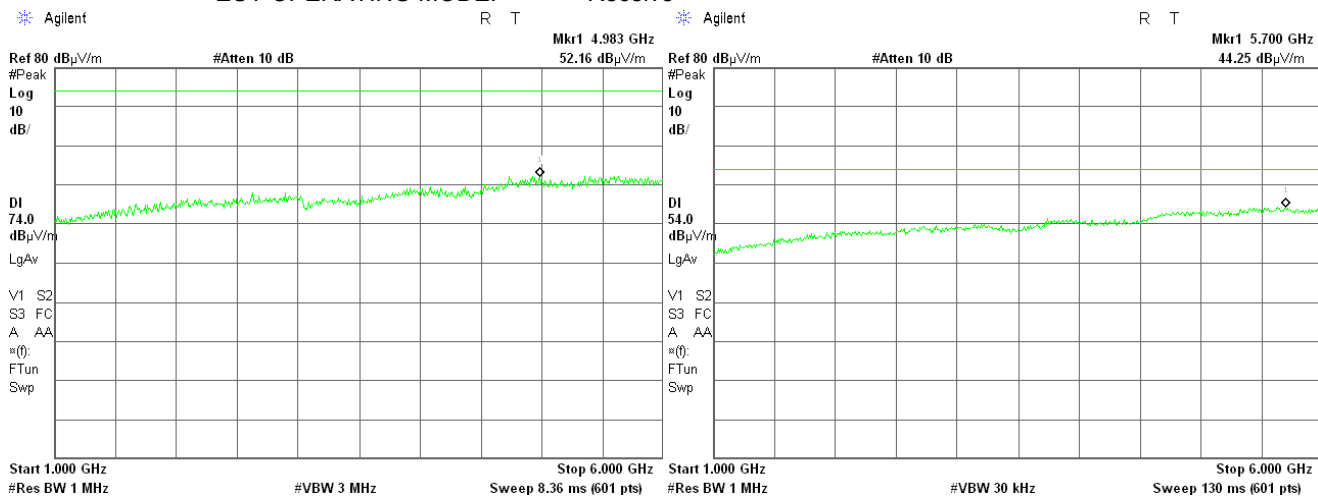
Plot 8.1.3 Radiated emission measurements above 1000 MHz, vertical antenna polarization

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



Plot 8.1.4 Radiated emission measurements above 1000 MHz, 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
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	19-Jan-17	19-Jan-18
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Oct-16	27-Oct-17
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	10-May-16	10-May-17
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	03-May-16	03-May-17
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	15-Mar-17	15-Mar-18
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	14-Oct-16	14-Oct-17
5103	RF cable, 18 GHz, 6 m, N-type	Huber-Suhner	SF106A/1 1N/11N/6 000MM	500849/6A	26-Jul-16	26-Jul-17

## 10 APPENDIX B Measurement uncertainties

### Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Radiated emissions at 10 m measuring distance Horizontal polarization  Vertical polarization	Biconilog antenna: $\pm 5.0$ dB Biconical antenna: $\pm 5.0$ dB Log periodic antenna: $\pm 5.1$ dB Double ridged horn antenna: $\pm 5.3$ dB Biconilog antenna: $\pm 5.5$ dB Biconical antenna: $\pm 5.5$ dB Log periodic antenna: $\pm 5.6$ dB Double ridged horn antenna: $\pm 5.8$ dB
Radiated emissions at 3 m measuring distance Horizontal polarization  Vertical polarization	Biconilog antenna: $\pm 5.3$ dB Biconical antenna: $\pm 5.0$ dB Log periodic antenna: $\pm 5.3$ dB Double ridged horn antenna: $\pm 5.3$ dB Biconilog antenna: $\pm 6.0$ dB Biconical antenna: $\pm 5.7$ dB Log periodic antenna: $\pm 6.0$ dB Double ridged horn antenna: $\pm 6.0$ dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: $\pm 2.6$ dB 2.9 GHz to 6.46 GHz: $\pm 3.5$ dB 6.46 GHz to 13.2 GHz: $\pm 4.3$ dB 13.2 GHz to 22.0 GHz: $\pm 5.0$ dB 22.0 GHz to 26.8 GHz: $\pm 5.5$ dB 26.8 GHz to 40.0 GHz: $\pm 4.8$ dB
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0$ %
Occupied bandwidth	$\pm 8.0$ %

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

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

## **11 APPENDIX C Test laboratory description**

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 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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## **12 APPENDIX D Specification references**

47CFR part 15: 2016	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.2: 1996	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
RSS-210 Issue 9: 2016	Licence- Exempt Radio Apparatus:Category I Equipment
RSS-Gen Issue 4: 2014	General Requirements for Compliance of Radio Apparatus
ICES-003: 2016, Issue 6	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement

## 13 APPENDIX E Test equipment correction factors

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

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

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

**Antenna factor**  
**Biconilog antenna EMCO Model 3141**  
**Ser.No.1011, HL 0604**

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
26	7.8	580	20.6	1320	27.8
28	7.8	600	21.3	1340	28.3
30	7.8	620	21.5	1360	28.2
40	7.2	640	21.2	1380	27.9
60	7.1	660	21.4	1400	27.9
70	8.5	680	21.9	1420	27.9
80	9.4	700	22.2	1440	27.8
90	9.8	720	22.2	1460	27.8
100	9.7	740	22.1	1480	28.0
110	9.3	760	22.3	1500	28.5
120	8.8	780	22.6	1520	28.9
130	8.7	800	22.7	1540	29.6
140	9.2	820	22.9	1560	29.8
150	9.8	840	23.1	1580	29.6
160	10.2	860	23.4	1600	29.5
170	10.4	880	23.8	1620	29.3
180	10.4	900	24.1	1640	29.2
190	10.3	920	24.1	1660	29.4
200	10.6	940	24.0	1680	29.6
220	11.6	960	24.1	1700	29.8
240	12.4	980	24.5	1720	30.3
260	12.8	1000	24.9	1740	30.8
280	13.7	1020	25.0	1760	31.1
300	14.7	1040	25.2	1780	31.0
320	15.2	1060	25.4	1800	30.9
340	15.4	1080	25.6	1820	30.7
360	16.1	1100	25.7	1840	30.6
380	16.4	1120	26.0	1860	30.6
400	16.6	1140	26.4	1880	30.6
420	16.7	1160	27.0	1900	30.6
440	17.0	1180	27.0	1920	30.7
460	17.7	1200	26.7	1940	30.9
480	18.1	1220	26.5	1960	31.2
500	18.5	1240	26.5	1980	31.6
520	19.1	1260	26.5	2000	32.0
540	19.5	1280	26.6		
560	19.8	1300	27.0		

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



HERMON LABORATORIES

Antenna factor, HL 4933

**Active Horn Antenna Factor Calibration**

1 GHz to 18 GHz

<b>Equipment:</b>			<b>ACTIVE HORN ANTENNA</b>		
<b>Model:</b>			<b>AHA-118</b>		
<b>Serial Number:</b>			<b>701046</b>		
<b>Calibration Distance:</b>			<b>3 Meter</b>		
<b>Polarization:</b>			<b>Horizontal</b>		
<b>Calibration Date:</b>			<b>11/12/2014</b>		
Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)	Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)
1	40.96	-16.47	10	40.94	-1.97
1.5	41.21	-14.53	10.5	40.63	-1.06
2	41.44	-13.30	11	40.74	-1.50
2.5	41.71	-12.87	11.5	40.65	-0.52
3	41.96	-12.26	12	40.76	-0.15
3.5	42.14	-11.77	12.5	41.03	-0.85
4	42.13	-10.91	13	41.37	-0.81
4.5	41.79	-9.41	13.5	41.18	0.05
5	41.44	-7.54	14	40.98	0.36
5.5	40.91	-6.47	14.5	40.81	1.26
6	40.69	-5.48	15	40.65	0.25
6.5	40.64	-5.53	15.5	40.93	-1.05
7	40.76	-4.12	16	41.31	-1.44
7.5	40.94	-3.12	16.5	40.96	-0.80
8	40.68	-1.69	17	40.64	-0.02
8.5	40.08	-1.71	17.5	40.57	1.81
9	40.41	-1.86	18	40.08	3.63
9.5	41.21	-2.73			
Calibration according to ARP 958					
<b>Antenna Factor to be added to receiver reading:</b>					
Meter Reading (dBuV) + Antenna Factor (dB/m) = Corrected Reading (dBuV/m)					



**Cable loss**  
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**  
**NC29-N1N1-244S/N 12025101 003,**  
**HL 4353**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.71
100	0.27	9500	2.81
300	0.47	10000	2.90
500	0.61	10500	2.97
1000	0.87	11000	3.06
1500	1.07	11500	3.13
2000	1.24	12000	3.20
2500	1.39	12500	3.26
3000	1.53	13000	3.34
3500	1.65	13500	3.39
4000	1.77	14000	3.47
4500	1.89	14500	3.54
5000	1.99	15000	3.62
5500	2.07	15500	3.69
6000	2.20	16000	3.76
6500	2.30	16500	3.83
7000	2.39	17000	3.86
7500	2.51	17500	3.94
8000	2.58	18000	4.02
8500	2.65		



**Cable loss**  
**RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,**  
**SF106A/11N/11N/6000MM, S/N 500849/6A**  
**HL 5103**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	5500	2.43
50	0.22	6000	2.54
100	0.31	6500	2.66
200	0.43	7000	2.76
300	0.53	7500	2.87
400	0.62	8000	2.97
500	0.69	8500	3.07
600	0.76	9000	3.17
700	0.82	9500	3.27
800	0.88	10000	3.36
900	0.94	10500	3.45
1000	0.99	11000	3.54
1100	1.04	11500	3.62
1200	1.08	12000	3.71
1300	1.13	12500	3.79
1400	1.17	13000	3.88
1500	1.21	13500	3.97
1600	1.26	14000	4.05
1700	1.30	14500	4.13
1800	1.33	15000	4.22
1900	1.37	15500	4.30
2000	1.41	16000	4.38
2500	1.59	16500	4.45
3000	1.75	17000	4.52
3500	1.90	17500	4.61
4000	2.04	18000	4.72
4500	2.17		
5000	2.30		

## 14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB( $\mu$ V)	decibel referred to one microvolt
dB( $\mu$ V/m)	decibel referred to one microvolt per meter
dB( $\mu$ 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
$\mu$ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
$\Omega$	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