

TEST REPORT

ACCORDING TO: FCC 47 CFR Part 90, and RSS-119 Issue 12:2015

FOR:

ST Engineering Telematics Wireless Ltd

Allegro Wall Mount

Models: ALLWM, ALLRCD

FCC ID: NTAALLWM

IC: 4732A-ALLWM

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1 Applicant information

Client name: ST Engineering Telematics Wireless Ltd
Address: 26 Hamelacha street, POB 1911, Holon, 5811801, Israel
Telephone: +972 3557 5700
Fax: +972 3557 5703
E-mail: itsikk@telematics-wireless.com
Contact name: Mr. Itsik Kanner

2 Equipment under test attributes

Product name: Allegro Wall Mount
Product type: Transceiver
Model(s): ALLWM
Serial number: 02381063
Hardware version: REV B
Software release: 3A01
Receipt date 24-Sep-20

3 Manufacturer information

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

4 Test details

Project ID: 40685
Location: Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started: 14-Oct-20
Test completed: 01-Nov-20
Test specification(s): FCC 47 CFR part 90, RSS-119 issue 12

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Section 90.205 / RSS-119 Section 5.4, Maximum output power	Pass
FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth	Pass
FCC Section 90.210 / RSS-119 Section 5.8.4, Emission mask	Pass
FCC Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	Pass
FCC Section 90.213 / RSS-119 Section 5.3, Frequency stability	Pass
FCC Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	Pass
FCC Section 2.1091 / RSS-102 section 2.5, RF radiation exposure evaluation	Pass, Exhibit in application for certification provided

* The EUT model with a data cable is the worst case representative for testing.

This test report supersedes the previously issued test report identified by Doc ID: TELRAD_FCC.40685

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mr. I. Zilberstein, test engineer, EMC & Radio	14-Oct-20 – 01-Nov-20	
Reviewed by:	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	10-Jan-21	
Approved by:	Mr. S. Samokha, technical manager, EMC & Radio	11-Jan-21	

6 EUT description

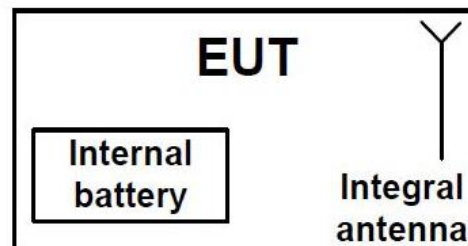
Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The EUT is an interface unit connected to a water meter. The EUT operates in Allegro system at 450-470MHz frequency band and it is powered by 3.6V battery. The EUT has two models ALLWM and ALLRCD.

According to manufacturer's declaration provided in Appendix F of the test report models ALLWM and ALLRCD are electrically/electronically identical and differ only that model ALLWM has a data cable connected to a water meter and a different battery size.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during testing.

6.4 Transmitter characteristics

Type of equipment						
X	Stand-alone (Equipment with or without its own control provisions)					
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)					
	Plug-in card (Equipment intended for a variety of host systems)					
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 ranges		450- 470 MHz				
Maximum rated output power		At transmitter 50 Ω RF output connector			32.56 dBm	
Is transmitter output power variable?		X	No			
			continuous variable			
		Yes	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		
Printed		ARAD		NA		
Transmitter aggregate data rate/s		4.8 kbps				
Type of modulation		4GFSK				
Modulating test signal (baseband)		PRBS				
Transmitter power source						
X	Battery	Nominal rated voltage	3.6 VDC	Battery type	Lithium	
	DC	Nominal rated voltage				
	AC mains	Nominal rated voltage		Frequency		

* The EUT model with a data cable is the worst case representative for testing.



Test specification: Section 90.205 / RSS-119 Section 5.4, Maximum output power			
Test procedure: 47 CFR, Section 2.1046			
Test mode: Compliance		Verdict: PASS	
Date(s): 15-Oct-20			
Temperature: 24 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 90 and RSS-119 requirements

7.1 Peak output power test

7.1.1 General

This test was performed to measure effective radiated power emanated by transmitter at carrier frequency. Specification test limits are given in Table 7.1.1

Table 7.1.1 Peak output power limits

Assigned frequency band, MHz	ERP	
	W	dBm
FCC		
450.0 – 470.0	2	33.00
RSS-119 Table 2		
450.0 – 470.0	60	47.78

* - Equivalent field strength limit was calculated from maximum allowed ERP as follows: $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

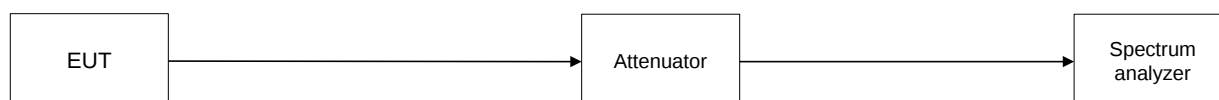
7.1.2 Test procedure for field strength measurements

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 adjusted to produce maximum available for end user RF output power.

7.1.2.3 The resolution bandwidth of spectrum analyzer was set wider than 6 dB bandwidth of the EUT and the maximum peak output power was measured as provided in Table 7.1.2 and associated plots.

Figure 7.1.1 Peak output power test setup





Test specification: Section 90.205 / RSS-119 Section 5.4, Maximum output power			
Test procedure: 47 CFR, Section 2.1046			
Test mode: Compliance		Verdict: PASS	
Date(s): 15-Oct-20			
Temperature: 24 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Table 7.1.2 Peak output power test results

ASSIGNED FREQUENCY: 450 - 470 MHz
 MODULATION: 4GFSK
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: > Resolution bandwidth

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	Peak output power,** dBm	Limit, dBm	Margin*, dB	Verdict
450.0031	32.05	Included	Included	32.05	33.0	-0.95	Pass
460.0000	32.52	Included	Included	32.52	33.0	-0.48	Pass
469.9969	32.56	Included	Included	32.56	33.0	-0.44	Pass

* - Margin = Peak output power – specification limit.

Table 7.1.3 Peak output power test results according to RSS-119 Table 2

ASSIGNED FREQUENCY: 450 - 470 MHz
 MODULATION: 4GFSK
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: > Resolution bandwidth

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	Peak output power,** dBm	Limit, dBm	Margin*, dB	Verdict
450.0031	32.05	Included	Included	32.05	47.78	-15.73	Pass
460.0000	32.52	Included	Included	32.52	47.78	-15.26	Pass
469.9969	32.56	Included	Included	32.56	47.78	-15.22	Pass

Reference numbers of test equipment used

HL 3818	HL 3787	HL 5608	HL 5637	HL 3521			
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Full description is given in Appendix A.



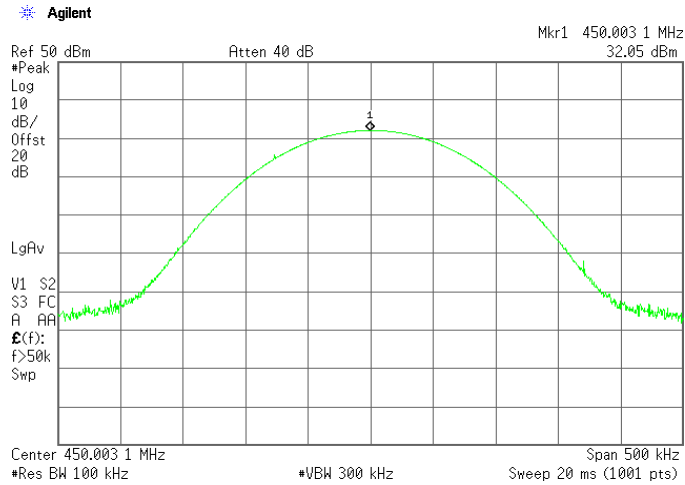
HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

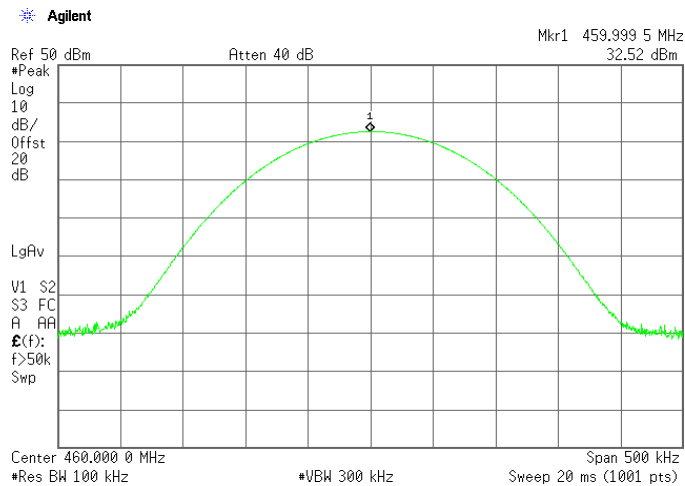
Date of Issue: 11-Jan-21

Test specification:		Section 90.205 / RSS-119 Section 5.4, Maximum output power	
Test procedure:		47 CFR, Section 2.1046	
Test mode:		Verdict: PASS	
Date(s):			
15-Oct-20			
Temperature: 24 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.1.1 Peak output power at low frequency and Unom



Plot 7.1.2 Peak output power at mid frequency and Unom





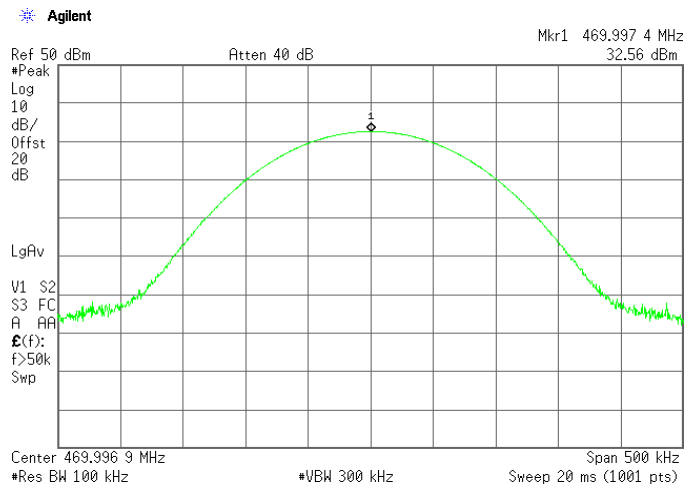
HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification:		Section 90.205 / RSS-119 Section 5.4, Maximum output power	
Test procedure:		47 CFR, Section 2.1046	
Test mode:		Verdict: PASS	
Date(s):			
15-Oct-20			
Temperature: 24 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.1.3 Peak output power at high frequency and Unom





Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 18-Oct-20			
Temperature: 25 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1

Table 7.2.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450.0 – 470.0	26	6

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.2.2 Test procedure

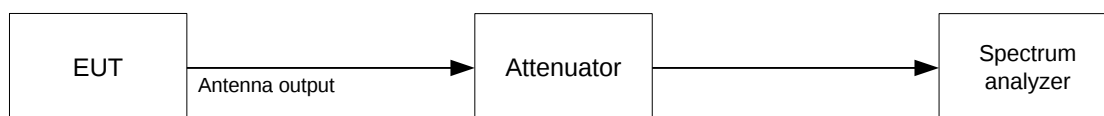
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.2.2.3 The EUT was set to transmit the normally modulated carrier.

7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup





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Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 18-Oct-20			
Temperature: 25 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 100 Hz
 VIDEO BANDWIDTH: 1 kHz
 MODULATION: 4GFSK
 MODULATING SIGNAL: ID code
 BIT RATE: 4.8 kbps

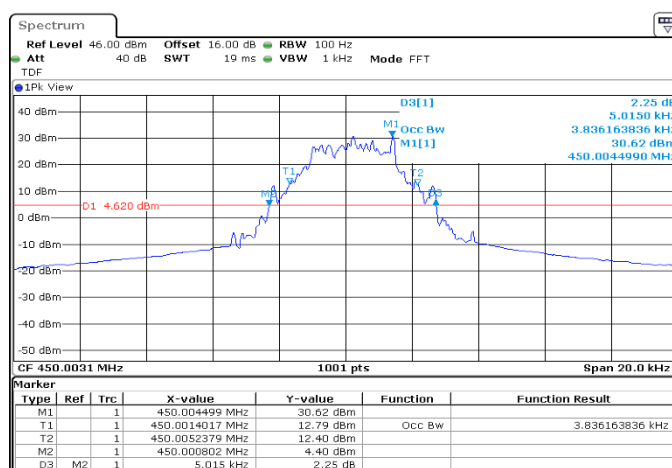
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
MODULATION ENVELOPE REFERENCE POINTS: 99%				
450.0031	3.836	6	-2.164	Pass
460.0000	3.816	6	-2.184	Pass
469.9969	3.816	6	-2.184	Pass
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc				
450.0031	5.015	6	-0.985	Pass
460.0000	5.035	6	-0.965	Pass
469.9969	5.035	6	-0.965	Pass

Reference numbers of test equipment used

HL 4355	HL 3901	HL 5608	HL 4413	HL 5397			
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Full description is given in Appendix A.

Plot 7.2.1 Occupied bandwidth test result at low frequency





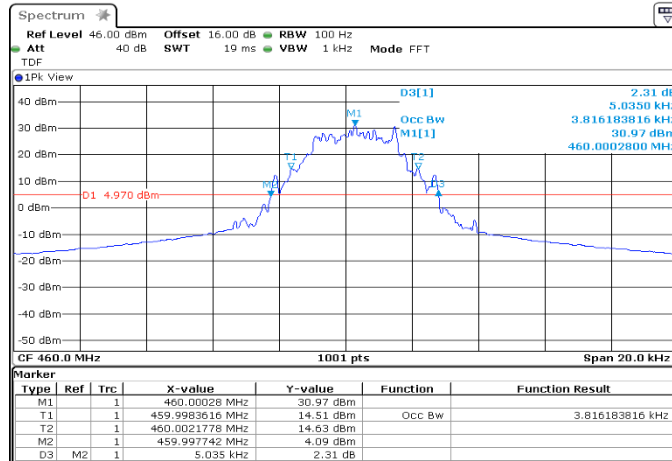
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Report ID: TELRAD_FCC.40685_Rev1

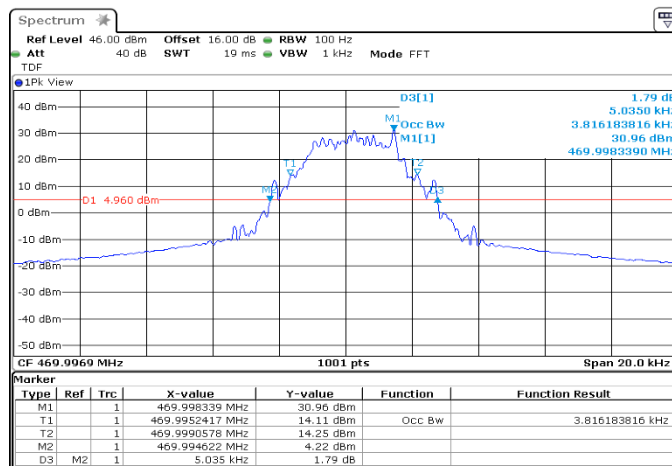
Date of Issue: 11-Jan-21

Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 18-Oct-20			
Temperature: 25 °C	Relative Humidity: 45 %	Air Pressure: 1006 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.2.2 Occupied bandwidth test result at mid frequency



Plot 7.2.3 Occupied bandwidth test result at high frequency





Test specification: Section 90.210 / RSS-119 Section 5.8.4, Emission mask			
Test procedure: 47 CFR, Sections 2.1051, 2.1047 and 90.210(e), TIA/EIA-603-E, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

7.3 Emission mask test

7.3.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.3.1 .

Table 7.3.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc
Emission mask E (Channel bandwidth 6.25 kHz, authorized bandwidth 6.0 kHz)	
0 – 3.0 kHz	0
3.0 – 4.6 kHz	$30 + 16.67(f_d^{**} - 3 \text{ kHz})$ or $55 + 10\log P(W)$ or 65 whichever is the lesser
More than 4.6 kHz	$55 + 10\log P(W)$ or 57 whichever is the lesser (RSS-119) $55 + 10\log P(W)$ or 65 whichever is the lesser (FCC)

* - linearly increase with frequency

** - displacement frequency

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 emission mask was measured with spectrum analyzer as provided in the associated plots.

7.3.2.3 The test results are provided in Table 7.3.2 and the the associated plots.

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450.0310	Emission mask E	Pass
460.0000		
469.9969		

Reference numbers of test equipment used

HL 4355	HL 3901	HL 5608	HL 4413	HL 5397			
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Full description is given in Appendix A.



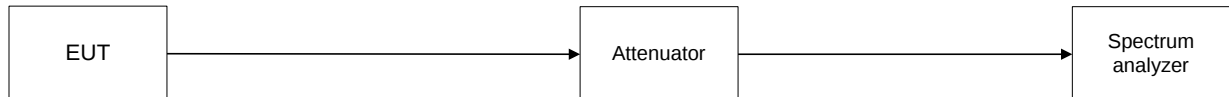
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Date of Issue: 11-Jan-21

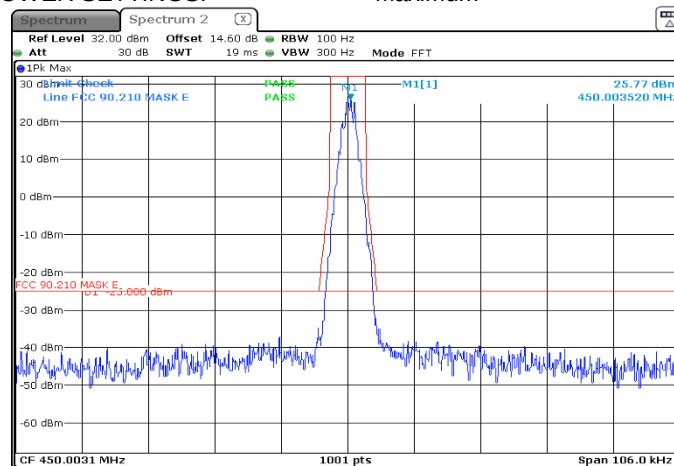
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Emission mask	
Test procedure: 47 CFR, Sections 2.1051, 2.1047 and 90.210(e), TIA/EIA-603-E, Section 2.2.13			
Test mode:		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.3.1 Emission mask test setup



Plot 7.3.1 Emission mask test results at low carrier frequency

OPERATING FREQUENCY RANGE: 450.0 – 470.0 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: ID code
BIT RATE: 4.8 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum





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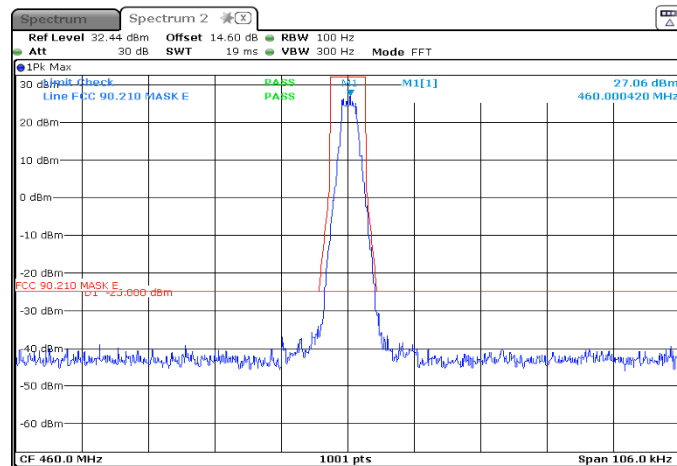
Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification: Section 90.210 / RSS-119 Section 5.8.4, Emission mask			
Test procedure: 47 CFR, Sections 2.1051, 2.1047 and 90.210(e), TIA/EIA-603-E, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 55 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

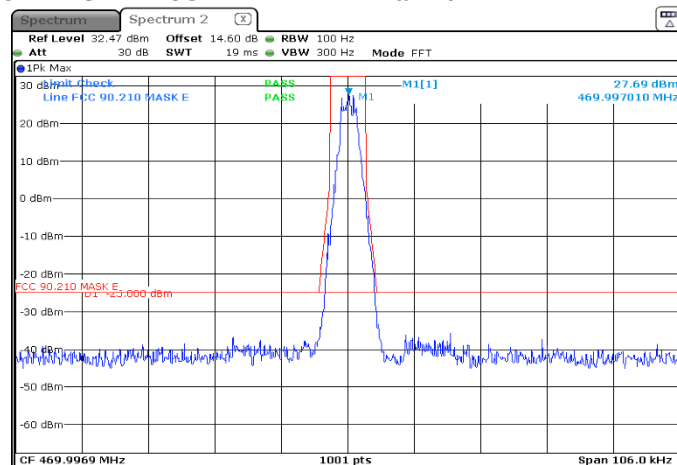
Plot 7.3.2 Emission mask test results at mid carrier frequency

OPERATING FREQUENCY RANGE: 450.0 – 470.0 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: ID code
BIT RATE: 4.8 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



Plot 7.3.3 Emission mask test results at high carrier frequency

OPERATING FREQUENCY RANGE: 450.0 – 470.0 MHz
DETECTOR USED: Peak
MODULATION: 4GFSK
MODULATING SIGNAL: ID code
BIT RATE: 4.8 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum





Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

7.4 Radiated spurious emission measurements

7.4.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10th harmonic*	55+10logP**	-25	72.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

** - P is transmitter output power in Watts

*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.4.2 Test procedure for radiated spurious emission measurements in 9 kHz to 30 MHz band

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

7.4.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.4.2.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

7.4.3 Test procedure for radiated spurious emission measurements above 30 MHz

7.4.3.1 The EUT was set up as shown in Figure 7.4.2, energized and the performance check was conducted.

7.4.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.4.3.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.



Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.4.1 Setup for radiated spurious emission measurements in 9 kHz to 30 MHz band

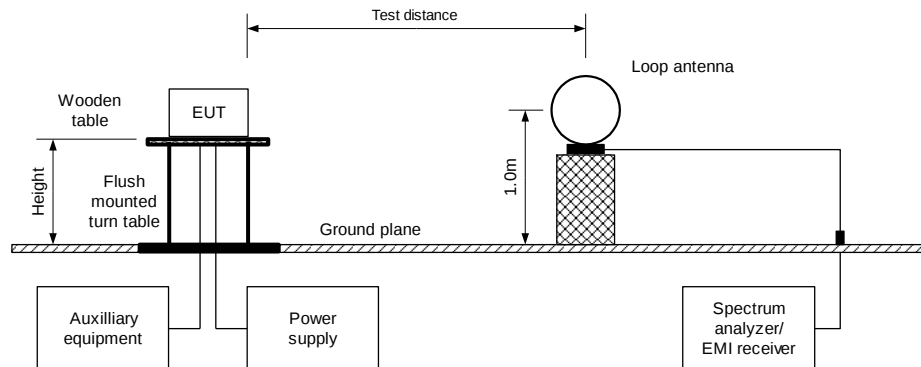
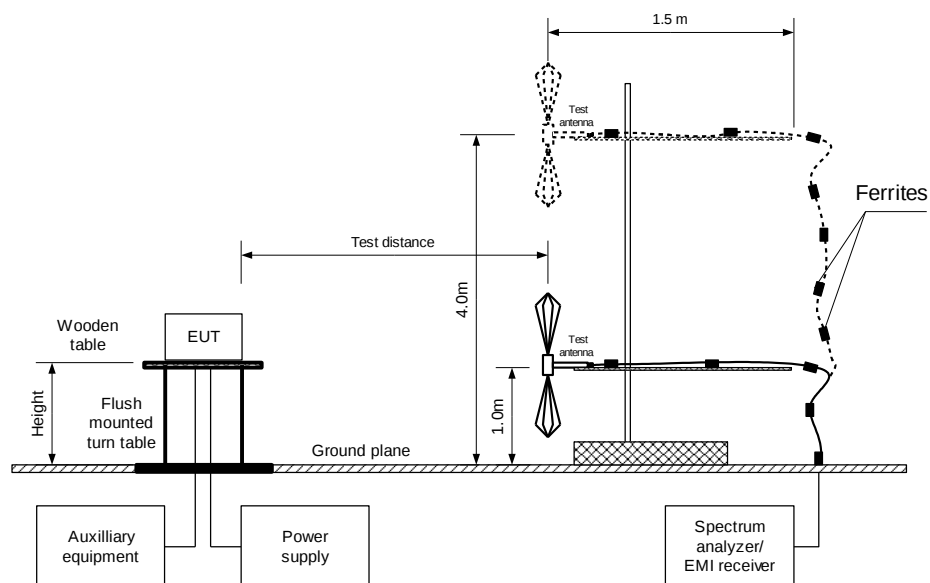


Figure 7.4.2 Setup for radiated spurious emission measurements above 30 MHz





Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Table 7.4.2 Radiated spurious emission test results

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)
 MODULATION: 4GFSK
 BIT RATE: 4.8 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
Low carrier frequency 450.0031 MHz								
900.019	62.59	72.4	-9.81	100	Vertical	1.0	0	Pass
1350.003	32.97	72.4	-39.43	1000	Vertical	1.7	20	Pass
1799.992	33.39	72.4	-39.01	1000	Vertical	1.5	0	
Mid carrier frequency 460.0000 MHz								
919.999	63.79	72.4	-8.61	100	Vertical	1.0	0	Pass
1379.964	27.25	72.4	-45.15	1000	Vertical	1.8	25	Pass
1840.000	32.90	72.4	-39.50	1000	Vertical	1.5	0	
High carrier frequency 469.9969 MHz								
1409.892	32.24	72.4	-40.16	1000	Vertical	1.6	0	Pass
1880.000	36.40	72.4	-36.00	1000	Vertical	1.5	15	Pass

*- Margin = Field strength of spurious – calculated field strength limit.

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

Reference numbers of test equipment used

HL 3903	HL 4355	HL 4360	HL 4933	HL 5288	HL 5112		
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Full description is given in Appendix A.



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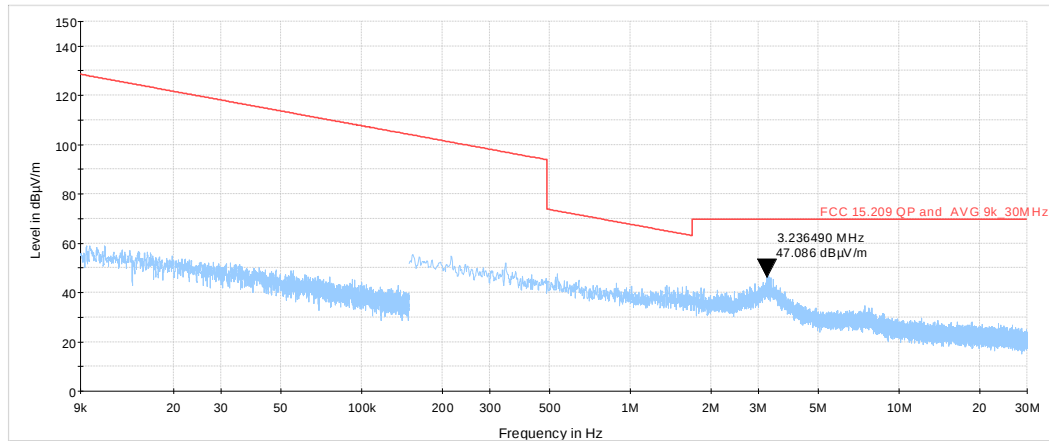
Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

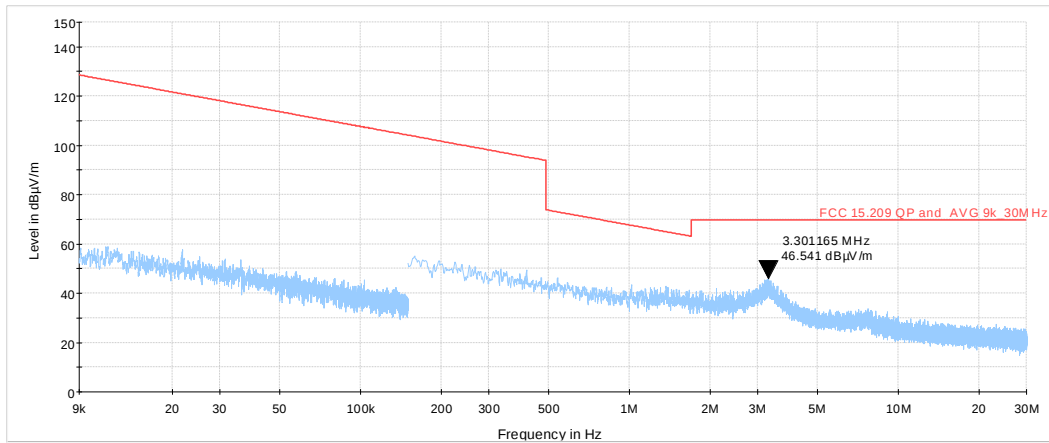
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.1 Radiated spurious emission measurements in 9 kHz – 30 MHz range

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



CARRIER FREQUENCY: Mid





HERMON LABORATORIES

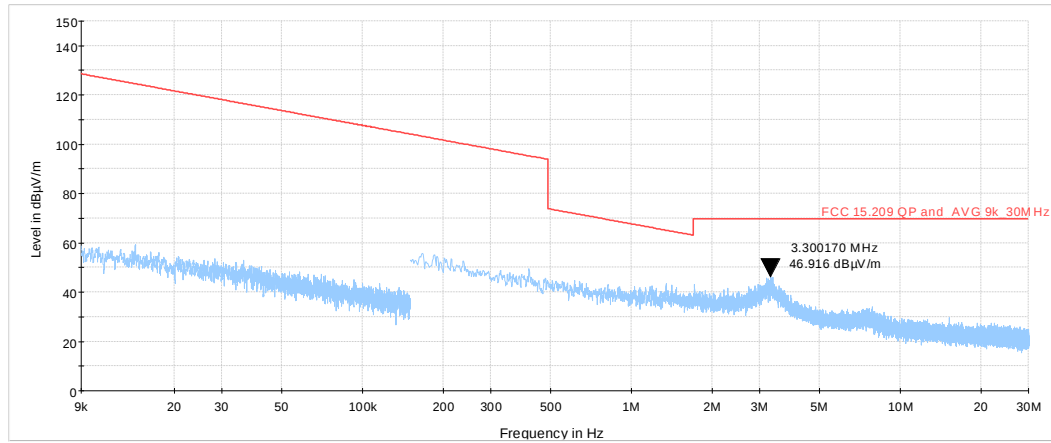
Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	
Test procedure:		47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12	
Test mode:		Verdict: PASS	
Date(s):			
01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

CARRIER FREQUENCY:

High





HERMON LABORATORIES

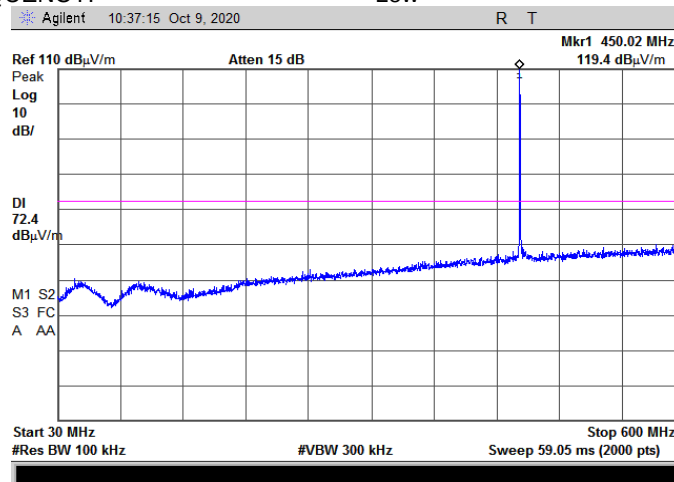
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Date of Issue: 11-Jan-21

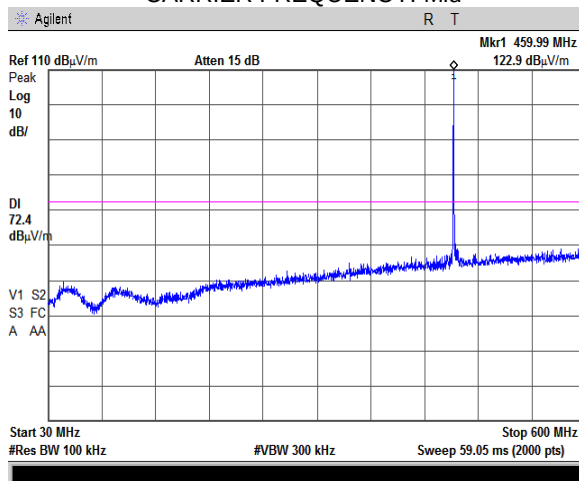
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.2 Radiated spurious emission measurements in 30 - 600 MHz range

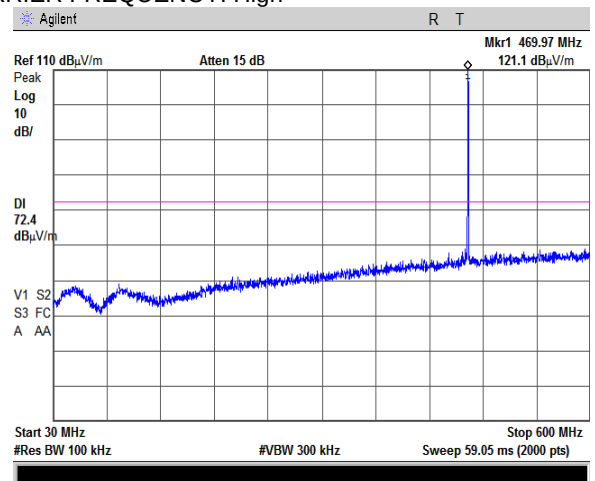
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

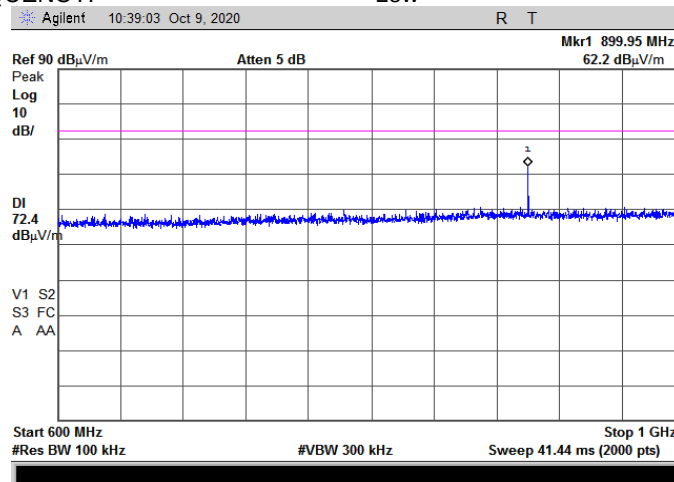
Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

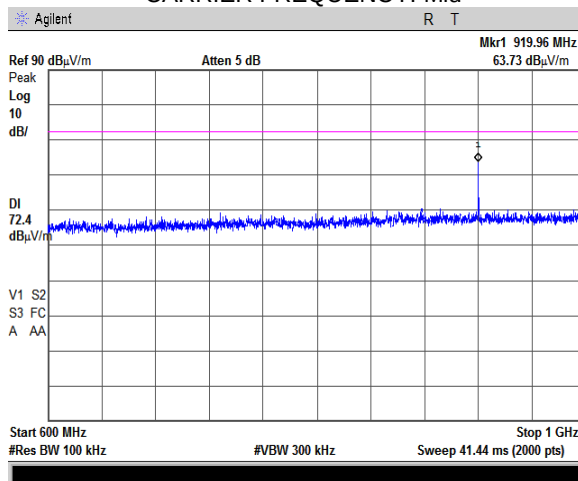
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	
Test procedure:		47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12	
Test mode:		Verdict: PASS	
Date(s):			
01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.3 Radiated spurious emission measurements in 600 - 1000 MHz range

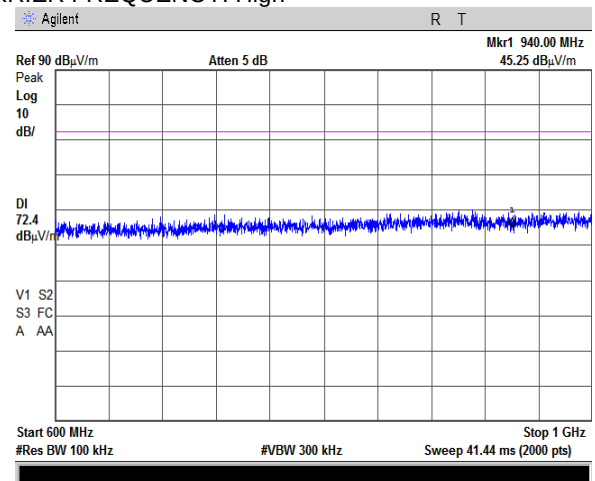
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	
Test procedure:		47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12	
Test mode:		Verdict: PASS	
Date(s):			
01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.4 Radiated spurious emission measurements in 1000 – 5000 MHz range

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

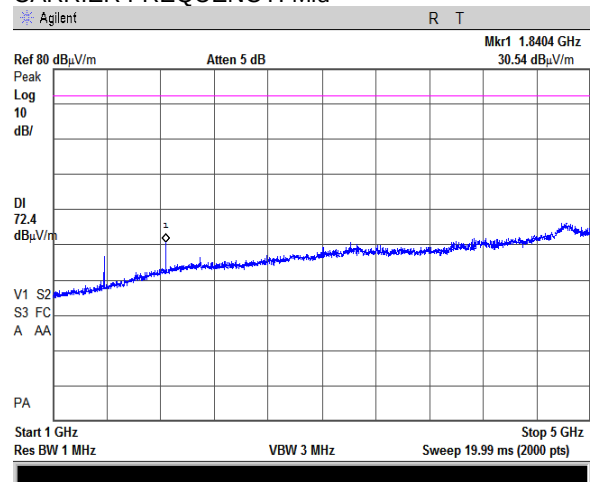
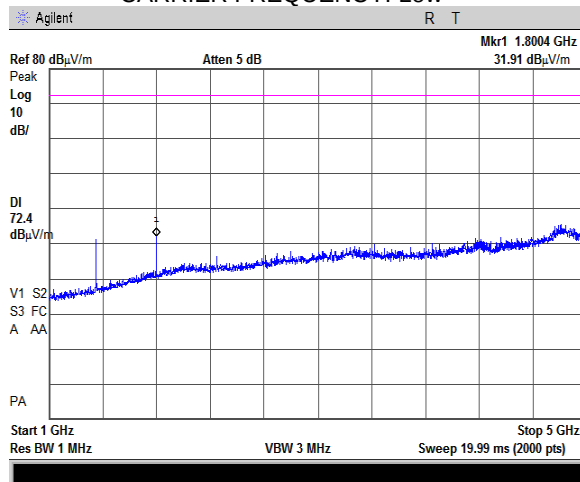
CARRIER FREQUENCY: Low

Semi anechoic chamber

Vertical and Horizontal

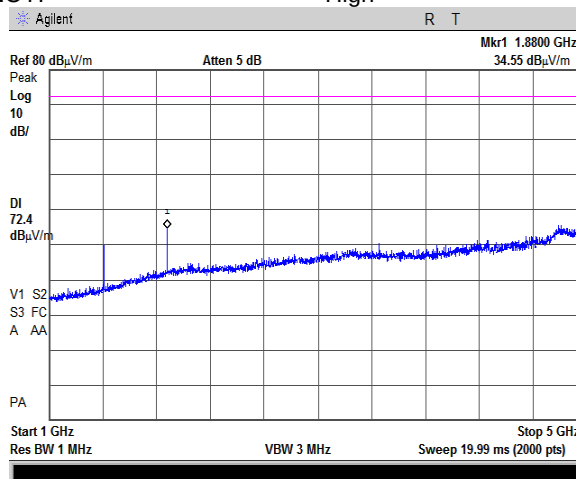
3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY:

High





HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.5 Radiated spurious emission measurements at the 2nd harmonic

TEST SITE:

Semi anechoic chamber

ANTENNA POLARIZATION:

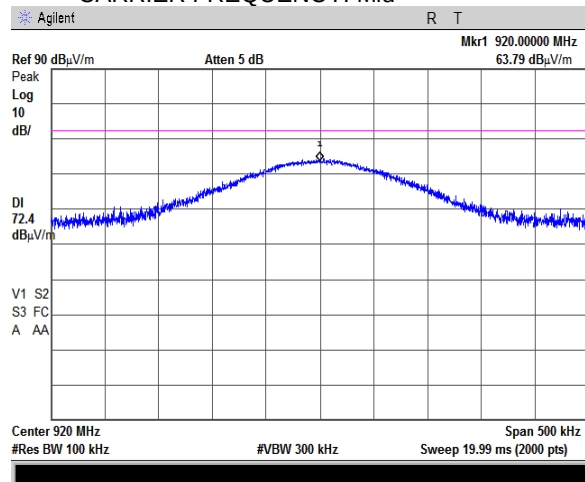
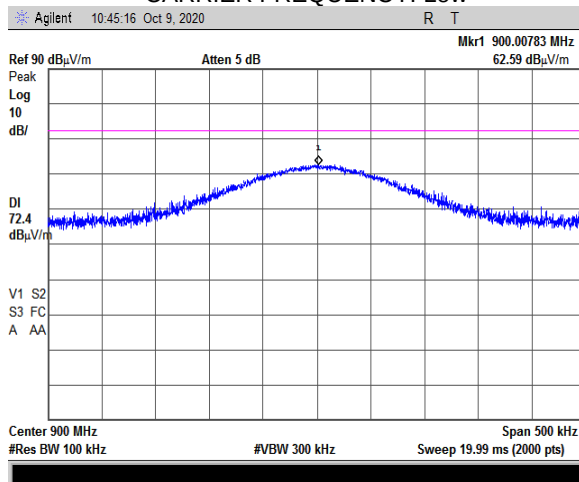
Vertical and horizontal

TEST DISTANCE:

3 m

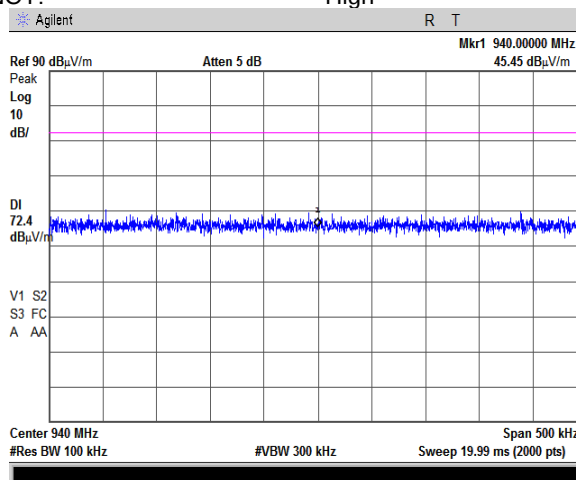
CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY:

High





HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.6 Radiated spurious emission measurements at the 3rd harmonic

TEST SITE:

Semi anechoic chamber

ANTENNA POLARIZATION:

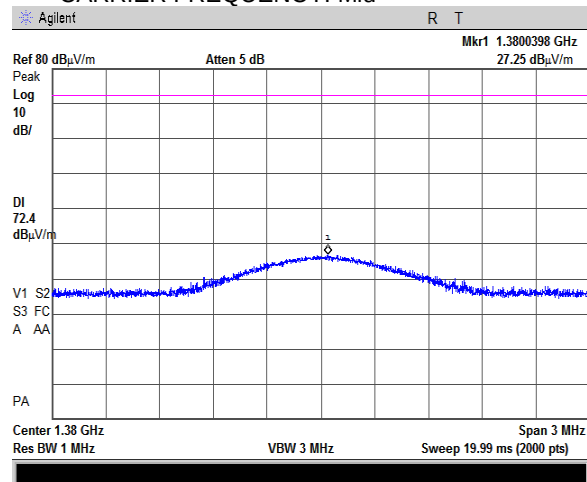
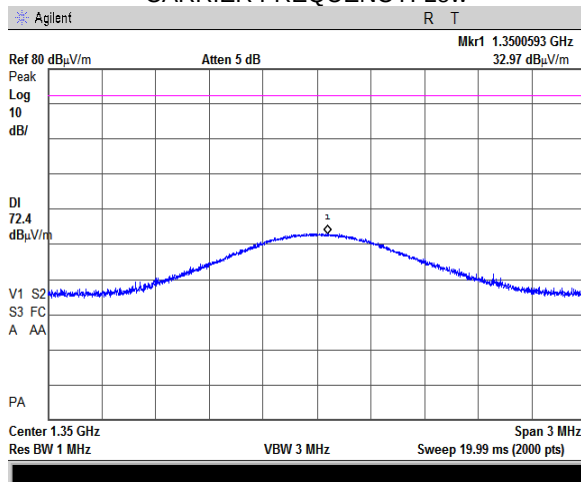
Vertical and Horizontal

TEST DISTANCE:

3 m

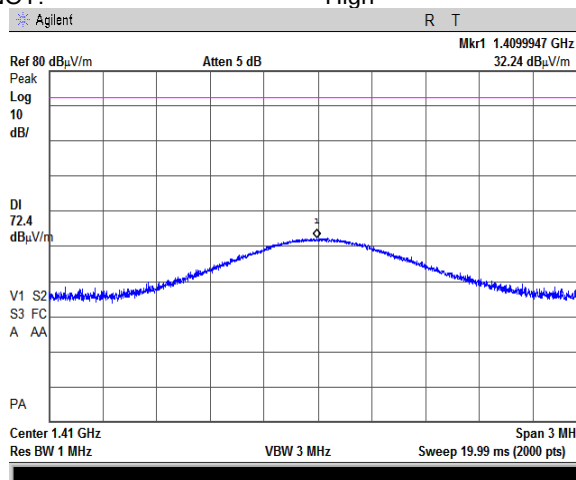
CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY:

High





HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Section 2.1053; TIA/EIA-603-E, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.4.7 Radiated spurious emission measurements at the 4th harmonic

TEST SITE:

Semi anechoic chamber

ANTENNA POLARIZATION:

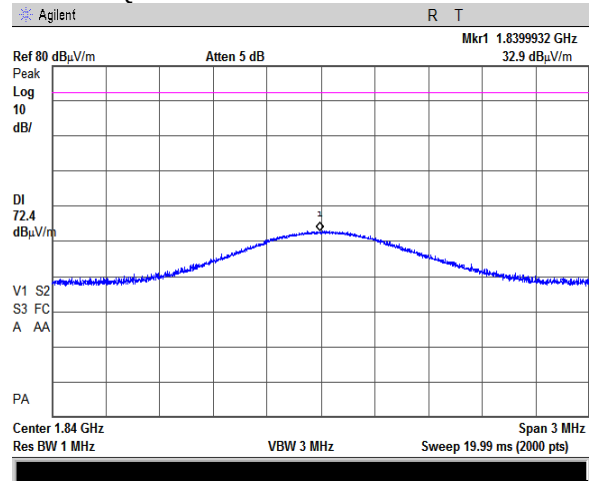
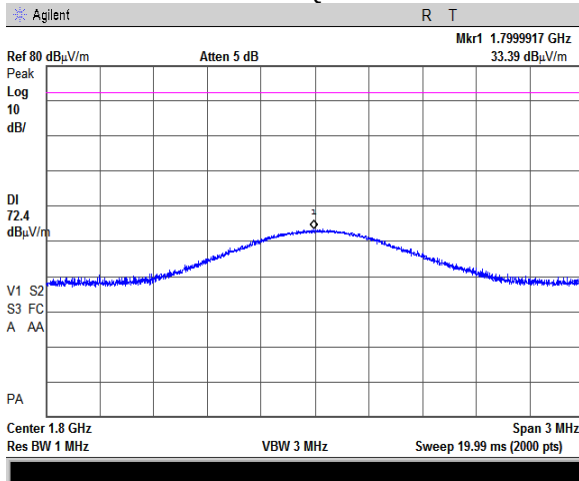
Vertical and Horizontal

TEST DISTANCE:

3 m

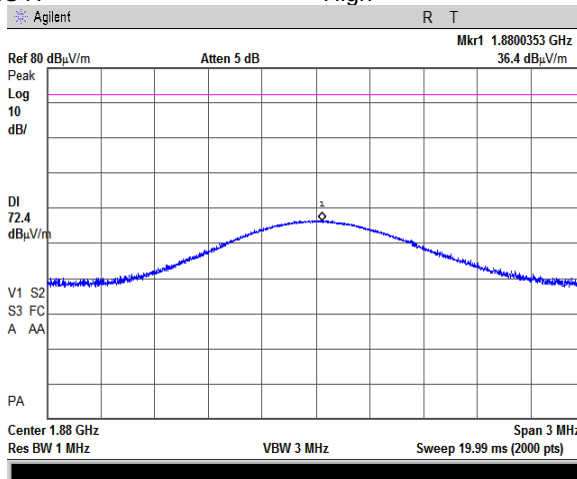
CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY:

High





Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-E, Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

7.5 Frequency stability test

7.5.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.5.1. The test results are provided in Table 7.5.2.

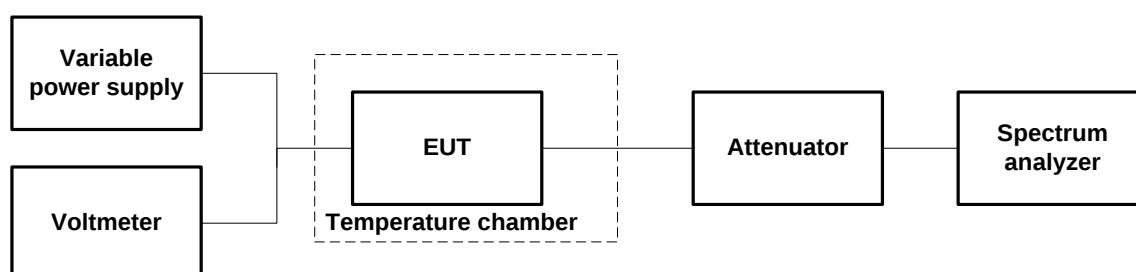
Table 7.5.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450.0031	1	450
460.0000		460
469.9969		470

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 power was turned off. Temperature within test chamber was set to +30°C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.5.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.
- 7.5.2.4 The above procedure was repeated at 0°C and at the lowest test temperature.
- 7.5.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.
- 7.5.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.5.2.

Figure 7.5.1 Frequency stability test setup





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Report ID: TELRAD_FCC.40685_Rev1

Date of Issue: 11-Jan-21

Test specification: Section 90.213 / RSS-119 Section 5.3, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-E, Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 01-Nov-20			
Temperature: 23 °C	Relative Humidity: 46 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Table 7.5.2 Frequency stability test results

OPERATING FREQUENCY: 450.0 – 470.0 MHz
 NOMINAL POWER VOLTAGE: 3.6 V
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 10 Hz
 VIDEO BANDWIDTH: 30 Hz
 MODULATION: Unmodulated

MODULATION.													
T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1 st min	2 nd min	3 rd min	4 th min	5 th min	10 th min	Positive	Negative			
Low frequency													
-30	nominal	450.003368	450.003370	450.003371	450.003370	450.003369	450.003370	450.003369	23	0	450	-427	Pass
-20	nominal	450.003295	NA	NA	NA	NA	NA	450.003292	0	-56		-394	Pass
-10	nominal	450.003270	NA	NA	NA	NA	NA	450.003277	0	-78		-372	Pass
0	nominal	450.003306	450.003307	450.003306	450.003307	450.003307	450.003306	450.003308	0	-42		-408	Pass
10	nominal	450.003327	NA	NA	NA	NA	NA	450.003340	0	-21		-429	Pass
20	+15%	450.003354	NA	NA	NA	NA	NA	450.003350	6	0		-444	Pass
20	nominal	450.003353	NA	NA	NA	NA	NA	450.003348*	5	0		-445	Pass
20	-15%	450.003327	NA	NA	NA	NA	NA	450.003341	0	-21		-429	Pass
30	nominal	450.003323	450.003337	450.003341	450.003340	450.003341	450.003341	450.003341	0	-25		-425	Pass
40	nominal	450.003352	NA	NA	NA	NA	NA	450.003355	7	0		-443	Pass
50	nominal	450.003363	NA	NA	NA	NA	NA	450.003365	17	0		-433	Pass
Mid frequency													
-30	nominal	460.000325	460.000327	460.000328	460.000328	460.000327	460.000327	460.000328	26	0	460	-434	Pass
-20	nominal	460.000255	NA	NA	NA	NA	NA	460.000246	0	-56		-404	Pass
-10	nominal	460.000221	NA	NA	NA	NA	NA	460.000228	0	-81		-379	Pass
0	nominal	460.000251	460.000256	460.000257	460.000258	460.000260	460.000260	460.000260	0	-51		-409	Pass
10	nominal	460.000295	NA	NA	NA	NA	NA	460.000298	0	-7		-453	Pass
20	+15%	460.000305	NA	NA	NA	NA	NA	460.000305	3	0		-457	Pass
20	nominal	460.000303	NA	NA	NA	NA	NA	460.000302*	1	0		-459	Pass
20	-15%	460.000296	NA	NA	NA	NA	NA	460.000295	0	-7		-453	Pass
30	nominal	460.000282	460.000296	460.000297	460.000297	460.000296	460.000297	460.000293	0	-20		-440	Pass
40	nominal	460.000306	NA	NA	NA	NA	NA	460.000311	9	0		-451	Pass
50	nominal	460.000320	NA	NA	NA	NA	NA	460.000321	19	0		-441	Pass
High frequency													
-30	nominal	469.997205	469.997210	469.997211	469.997211	469.997210	469.997210	469.997211	31	0	470	-439	Pass
-20	nominal	469.997137	NA	NA	NA	NA	NA	469.997126	0	-54		-416	Pass
-10	nominal	469.997096	NA	NA	NA	NA	NA	469.997103	0	-84		-386	Pass
0	nominal	469.997132	469.997136	469.997135	469.997136	469.997137	469.997136	469.997135	0	-48		-422	Pass
10	nominal	469.997167	NA	NA	NA	NA	NA	469.997176	0	-13		-457	Pass
20	+15%	469.997172	NA	NA	NA	NA	NA	469.997182	2	-8		-462	Pass
20	nominal	469.997181	NA	NA	NA	NA	NA	469.997180*	1	0		-469	Pass
20	-15%	469.997175	NA	NA	NA	NA	NA	469.997176	0	-5		-465	Pass
30	nominal	469.997176	469.997177	469.997177	469.997176	469.997177	469.997176	469.997176	0	-4		-466	Pass
40	nominal	469.997186	NA	NA	NA	NA	NA	469.997187	7	0		-463	Pass
50	nominal	469.997205	NA	NA	NA	NA	NA	469.997206	26	0		-444	Pass

* - Reference frequency

Reference numbers of test equipment used

HL 3286	HL 4355	HL 5608	HL 3521	HL 3901			
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Full description is given in Appendix A.



Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-E, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Oct-20			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

7.6 Transient frequency behaviour test

7.6.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.6.1. The test results are provided in the associated plots.

Table 7.6.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
421.0 – 512.0 MHz band			
6.25	± 6.25	10.0	t_1
	± 3.125	25.0	t_2
	± 6.25	10.0	t_3

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;

t_1 is the time period immediately following t_{on} ;

t_2 is the time period immediately following t_1 ;

t_3 is the time period from the instant when the transmitter is turned off until t_{off} ;

t_{off} is the instant when the 1 kHz test signal starts to rise.

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

7.6.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

7.6.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

7.6.2.4 The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.



Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-E, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Oct-20			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Figure 7.6.1 Transient frequency test setup

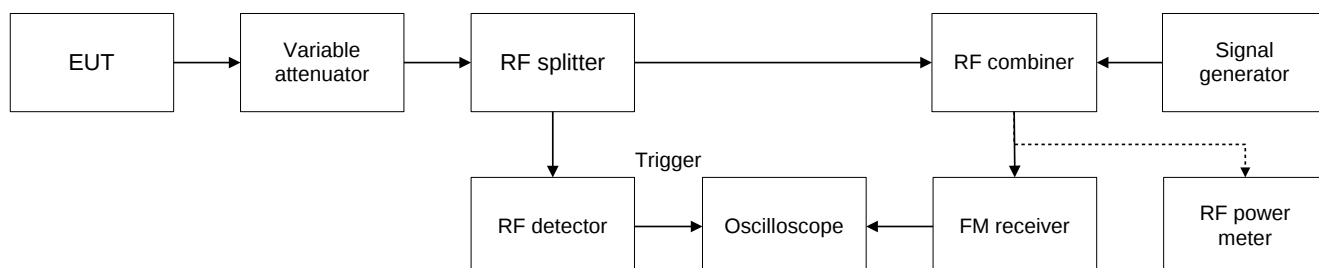


Table 7.6.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 6.25 kHz						
450.0031	t ₁	10.0	2.644	± 6.25	-3.606	Pass
	t ₂	25.0	1.323	± 3.125	-1.802	
	t ₃	10.0	1.373	± 6.25	-4.877	
460.0000	t ₁	10.0	2.765	± 6.25	-3.485	Pass
	t ₂	25.0	1.202	± 3.125	-1.923	
	t ₃	10.0	1.373	± 6.25	-4.877	
469.9969	t ₁	10.0	2.524	± 6.25	-3.726	Pass
	t ₂	25.0	1.082	± 3.125	-2.043	
	t ₃	10.0	1.176	± 6.25	-5.074	

Reference numbers of test equipment used

HL 5372	HL 0539	HL2227	HL 2017	HL 3433	HL 3434	HL 5714	HL 2015
HL 2016	HL 3370	HL 4068					

Full description is given in Appendix A.



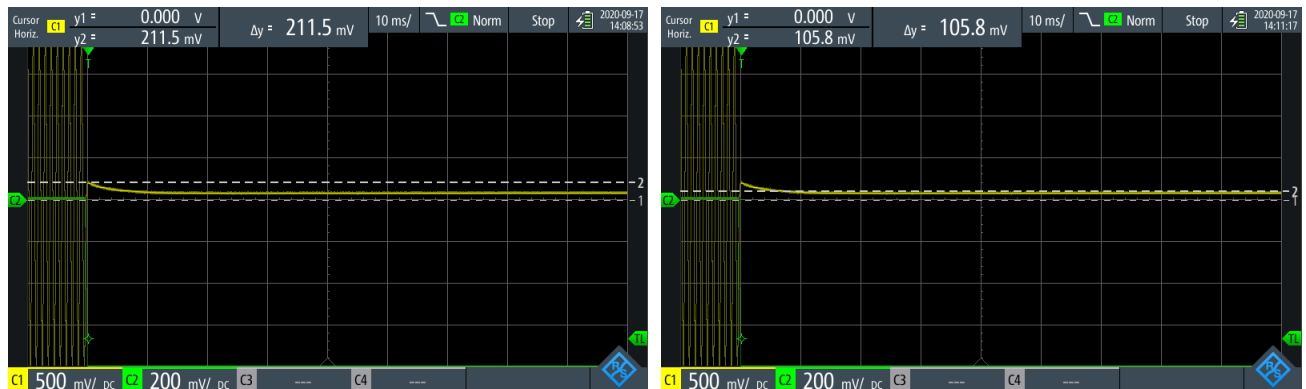
HERMON LABORATORIES

Report ID: TELRAD_FCC.40685_Rev1

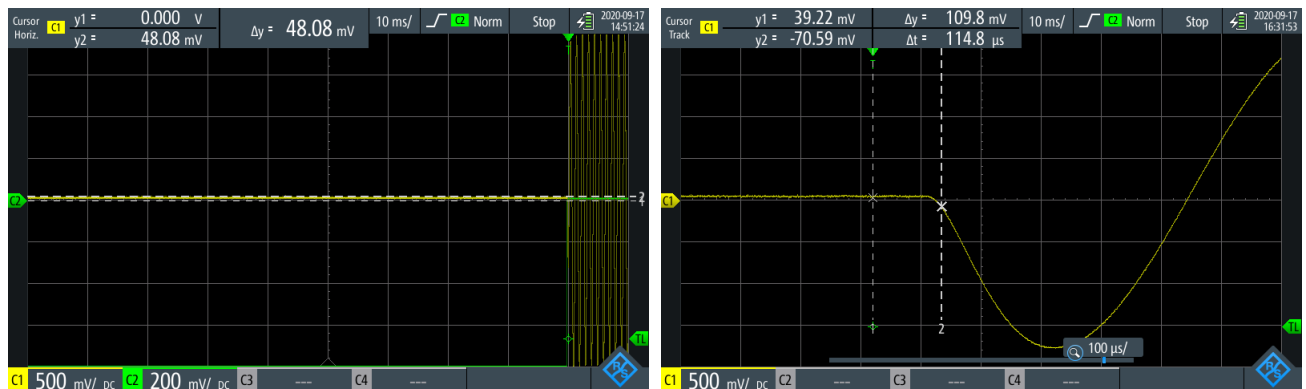
Date of Issue: 11-Jan-21

Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-E, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Oct-20			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.6.1 Transient frequency during power ON test results at low carrier frequency



Plot 7.6.2 Transient frequency during power OFF test results at low carrier frequency



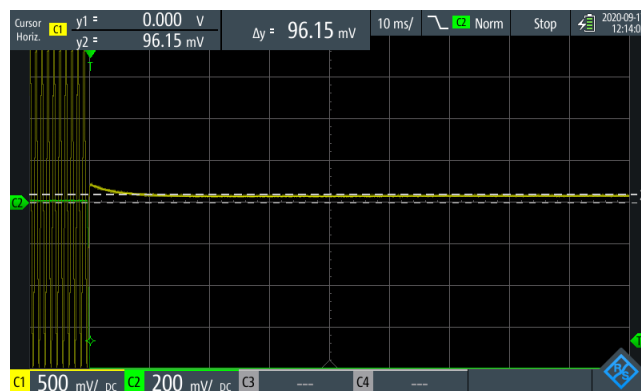
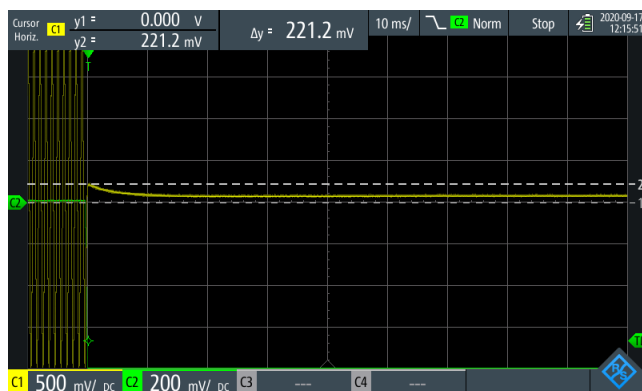


HERMON LABORATORIES

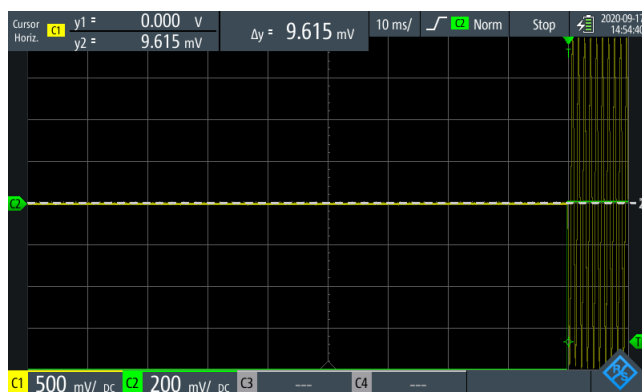
Report ID: TELRAD_FCC.40685_Rev1
Date of Issue: 11-Jan-21

Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-E, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Oct-20			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.6.3 Transient frequency during power ON test results at mid carrier frequency



Plot 7.6.4 Transient frequency during power OFF test results at mid carrier frequency



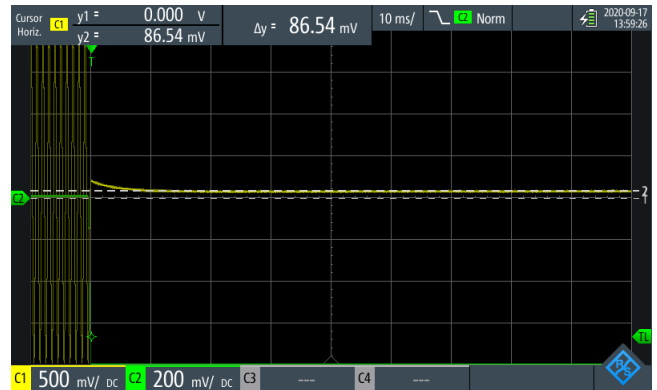
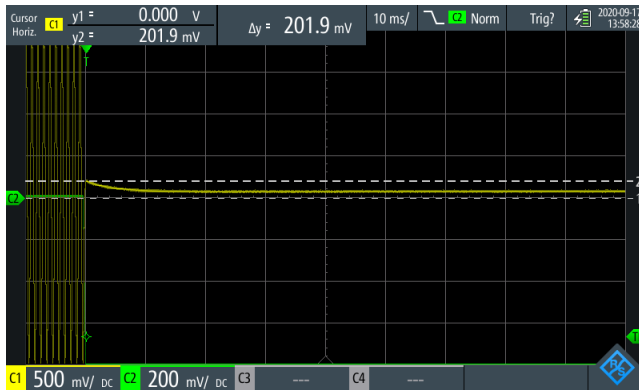


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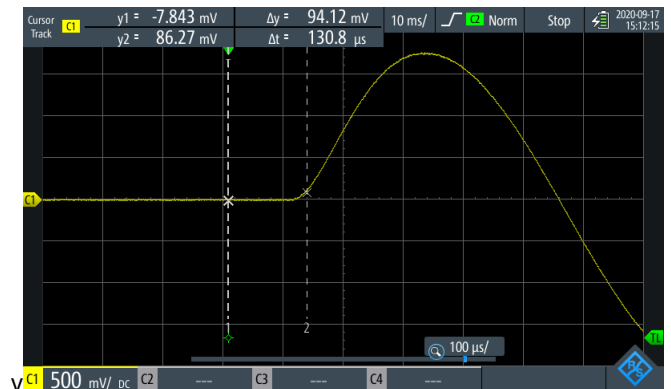
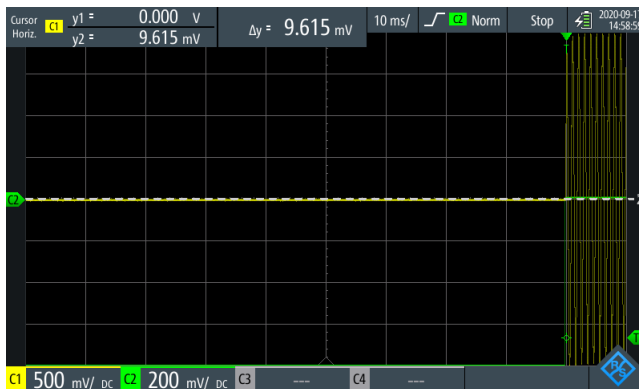
Report ID: TELRAD_FCC.40685_Rev1
Date of Issue: 11-Jan-21

Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-E, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 14-Oct-20			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1010 hPa	Power: 3.6 VDC
Remarks:			

Plot 7.6.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.6.6 Transient frequency during power OFF test results at high carrier frequency



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0539	Generator Signal, 10 kHz - 1.2 GHz	Marconi Instruments	2023	112121/041	12-Aug-20	12-Aug-21
2015	Power Divider, 0.5-18.0 GHz, 80 W	Omni Spectra	2090-6204-00	NA	21-Jan-19	21-Jan-21
2016	Attenuator, Manual Step, 0-9/1 dB, 0-8 GHz, 2 W	Midwest Microwave	1072	1315	08-Mar-20	08-Mar-21
2017	Attenuator, Manual Step, 0-60/10 dB, 0-8.0 GHz	Midwest Microwave	1071	2017	08-Mar-20	08-Mar-21
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	05-Apr-20	05-Apr-21
3286	Temperature Chamber, (-50 to +170) °C	Thermotron	EL-8-CH-1-1-CO2	21-9048	04-Dec-19	04-Dec-20
3370	Load Termination 50 Ohm, 0.5 W, DC-1GHz	RELM	LT-50	3370	31-Oct-19	31-Oct-20
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	13-Apr-20	13-Apr-21
3434	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25683	13-Apr-20	13-Apr-21
3521	Multimeter	Fluke	115	94771103	20-Jul-20	20-Jul-21
3787	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	23-Sep-20	23-Sep-21
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	27-Apr-20	27-Apr-21
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1225/2A	06-Apr-20	06-Apr-21
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1226/2A	06-Apr-20	06-Apr-21
4068	Attenuator, SMA, 30 dB, DC to 12.4 GHz	Midwest Microwave	ATT-0527-30-SMA-07	NA	06-Aug-20	06-Aug-21
4339	High pass Filter, 50 Ohm, 1000 to 18000 MHz, SMA-FM / SMA-M	Micro-Tronics	HPM50115-02	001	05-Jun-19	05-Jun-21
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	09-Sep-20	09-Sep-21
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	20-Jan-20	20-Jan-21
4413	Resistive divider, DC to 1.5 GHz, 2 W	Microlab	DA-3FN	NA	14-Nov-19	14-Nov-21
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	06-Jan-20	06-Jan-21
5112	RF cable, 40 GHz, 5.5 m, K-type	Huber-Suhner	SF102EA/11SK/11SK/5500MM	502494/2EA	19-Apr-20	19-Apr-21

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	08-Feb-19	08-Feb-22
5372	MXE EMI receiver, 3 Hz to 44 GHz	Keysight Technologies	N9038A	MY57290155	10-Aug-20	10-Aug-21
5397	H-field near field probe, 3 cm	ETS Lindgren	7405-902	NA	16-Aug-20	16-Aug-22
5608	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini Circuits	BW-S10W5+	NA	17-Sep-20	17-Sep-21
5637	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/SMA	Mini Circuits	CBL-6FT-SMSM+	NA	29-Oct-20	29-Oct-21
5714	Handheld Oscilloscope, 60 MHz, 4 channels	Rohde & Schwarz	RTH1004	104416	10-Dec-19	10-Dec-20

9 APPENDIX B Test equipment correction factors

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

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m	Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
1000	-16.1	10000	1.8
1500	-15.1	10500	1.0
2000	-10.9	11000	0.3
2500	-11.9	11500	-0.5
3000	-11.1	12000	3.1
3500	-10.6	12500	1.4
4000	-8.6	13000	-0.3
4500	-8.3	13500	-0.4
5000	-5.9	14000	2.5
5500	-5.7	14500	2.2
6000	-3.3	15000	1.9
6500	-4.0	15500	0.5
7000	-2.2	16000	2.1
7500	-1.7	16500	1.2
8000	1.1	17000	0.6
8500	-0.8	17500	3.1
9000	-1.5	18000	4.2
9500	-0.2		

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

HL 5112 RF cable, 40 GHz, 5.5 m, K-type
Huber-Suhner, SF102EA/11SK/11SK/5500MM, s/n 502494/2EA, HL 5112

Insertion loss

Set / Applied, MHz	Measured, dB	Uncertainty, dB
100	0.70	±0.07
200	0.99	±0.08
300	1.21	±0.08
500	1.55	±0.08
1000	2.18	±0.08
1500	2.67	±0.08
2000	3.09	±0.08
2500	3.46	±0.10
3000	3.80	±0.10
3500	4.12	±0.10
4000	4.41	±0.10
4500	4.69	±0.10
5000	4.95	±0.10
5500	5.20	±0.10
6000	5.45	±0.10
6500	5.68	±0.10
7000	5.91	±0.10
7500	6.13	±0.10
8000	6.34	±0.10
8500	6.56	±0.10
9000	6.76	±0.10
9500	6.95	±0.10
10000	7.16	±0.10
10500	7.33	±0.10
11000	7.51	±0.10
11500	7.68	±0.10
12000	7.85	±0.10
12500	8.02	±0.13
13000	8.17	±0.13
13500	8.31	±0.13
14000	8.46	±0.13
14500	8.61	±0.18
15000	8.76	±0.18
15500	8.91	±0.18
16000	9.07	±0.18
16500	9.22	±0.18
17000	9.36	±0.18
17500	9.51	±0.18
18000	9.66	±0.18
18500	9.81	±0.23
19000	9.95	±0.23
19500	10.10	±0.23

Set / Applied, MHz	Measured, dB	Uncertainty, dB
20000	10.25	±0.23
20500	10.38	±0.23
21000	10.52	±0.23
21500	10.67	±0.23
22000	10.84	±0.23
22500	11.00	±0.29
23000	11.10	±0.29
23500	11.20	±0.29
24000	11.32	±0.29
24500	11.42	±0.29
25000	11.59	±0.23
25500	11.70	±0.23
26000	11.85	±0.23
26500	11.97	±0.23
27000	12.07	±0.33
27500	12.17	±0.33
28000	12.26	±0.40
28500	12.38	±0.40
29000	12.50	±0.40
29500	12.63	±0.40
30000	12.75	±0.40
30500	12.82	±0.33
31000	12.93	±0.33
31500	13.09	±0.33
32000	13.22	±0.33
32500	13.35	±0.33
33000	13.48	±0.33
33500	13.60	±0.33
34000	13.72	±0.33
34500	13.80	±0.40
35000	13.92	±0.40
35500	14.01	±0.40
36000	14.12	±0.40
36500	14.23	±0.40
37000	14.34	±0.33
37500	14.44	±0.33
38000	14.57	±0.33
38500	14.72	±0.33
39000	14.82	±0.33
39500	14.94	±0.33
40000	15.08	±0.47

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

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

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

The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.
above 1000 MHz

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

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

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

10 APPENDIX C Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	$\pm 8\%$
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
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz $\pm 13.9\%$
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0\%$
Unintentional radiator tests	
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	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB
Vertical polarization	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.

11 APPENDIX D Test laboratory description

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

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers for OATS are R-10808 for RE measurements below 1 GHz, G-20112 for RE measurements above 1 GHz, R-11082 for anechoic chamber for RE measurements below 1 GHz, 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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Telephone: +972 4628 8001

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e-mail: mail@hermonlabs.com

website: www.hermonlabs.com

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

12 APPENDIX E

Specification references

FCC 47CFR part 90: 2019
FCC 47CFR part 2: 2019
ANSI/TIA/EIA-603-E:2016
RSS-119 Issue 12: 2015

Private land mobile radio services
Frequency allocations and radio treaty matters; general rules and regulations
Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz

13 APPENDIX F Manufacturer's declaration of Identity



Declaration of Identity

We, the undersigned,

Company: ST Engineering Telematics Wireless Ltd.
Address: 26 Hamelacha street, POB 1911, Holon 5811801
Country: Israel
Telephone number: +972 35575700
Fax number: +972 35575703

Declare under our sole responsibility that the following equipment:

Brand/Item	Type/Model	Short Product description
Allegro wall Mount	ALLWM	The item operates in Allegro system at 450-470MHz

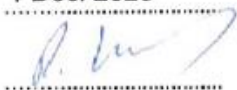
and

Brand/Item	Type/Model	Short Product description
Allegro wall Mount	ALLRCD	The item operates in Allegro system at 450-470MHz

are electronically/ mechanically identical – have the same hardware (PCB card and antenna) and the same radio operational software, except that

Model ALLWM has a data cable connected to a water meter and a battery size C.
Model ALLRCD (used as a technician tool for debugging) has no data cable and has a battery size D.

1 Dec. 2020



(date)

(signature)

Roman Sternberg

(printed name)

VP Marketing & Business Development

(position)

ST Engineering
Telematics Wireless Ltd.

(company stamp)

14 APPENDIX G Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt

END OF DOCUMENT