HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: FCC CFR 47 Part 90, subpart I

FOR:

HiRiseTech Ltd.
Radio Repeater System
Model: Hawkll
Part number: HRT2000SYS0020
FCC ID:2ASFAHRT2000SYS0020

Table of contents

1 Applicant information

Client name:	HiRiseTech Ltd.
Address:	20 Hamgshimim street, Petach Tikva 4934829, Israel
Telephone:	+972 58 565 8371
E-mail:	gadi@hirisetechnology.com
Contact name:	Mr. Gadi Shirazi

2 Equipment under test attributes

Product name:	Radio Repeater System
Product type:	Transceiver
Model(s):	HawkII
Part number:	HRT2000SYS0020
Serial number:	0001
Hardware version:	HRT2000SYS0020
Software release:	V2.12.0
Receipt date	28-Oct-18

3 Manufacturer information

Manufacturer name:	HiRiseTech Ltd.
Address:	20 Hamgshimim street, Petach Tikva 4934829, Israel
Telephone:	+972 58 565 8371
E-Mail:	gadi@hirisetechnology.com
Contact name:	Mr. Gadi Shirazi

4 Test details

Project ID:	31262
Location:	Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started:	28-Oct-18
Test completed:	13-Jan-19
Test specification(s):	FCC part 90, subpart I

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.210, Emission mask	Pass
Section 90.210, Radiated spurious emissions	Pass
Section 90.210, Conducted spurious emissions	Pass
Section 90.213, Frequency stability	Pass
Section 90.214, Transient frequency behaviour	Pass
Section 90.207, Modulation limiting	Pass
Section 90.214, Audio frequency response	Pass
Section 2.1091, RF radiation exposure evaluation	Pass

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

	Name and Title	Date	Signature
Tested by:	Mr. S. Samokha, test engineer	January 13, 2019	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	January 23, 2019	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	May 6, 2019	

6 EUT description

6.1 General information

The EUT is First-Responders Emergency Radio Repeater System for High-Rise buildings.It comprises Command Console, Central Control Unit (CCU) and Smart Splitters. The CCU comprises 4 iCOM (UHF) units approved by FCC under FCC ID:AFJ318002. The CCU is connected via main coax to the Smart Splitters.

6.2 Ports and lines

Port type	Port description	Conected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC	mains	EUT	1	Unshielded	2
RF	Signal	CCU	SMSP	1	Coax	3
Signal	Ethernet	CCU	Console	3	Shielded CAT6	2

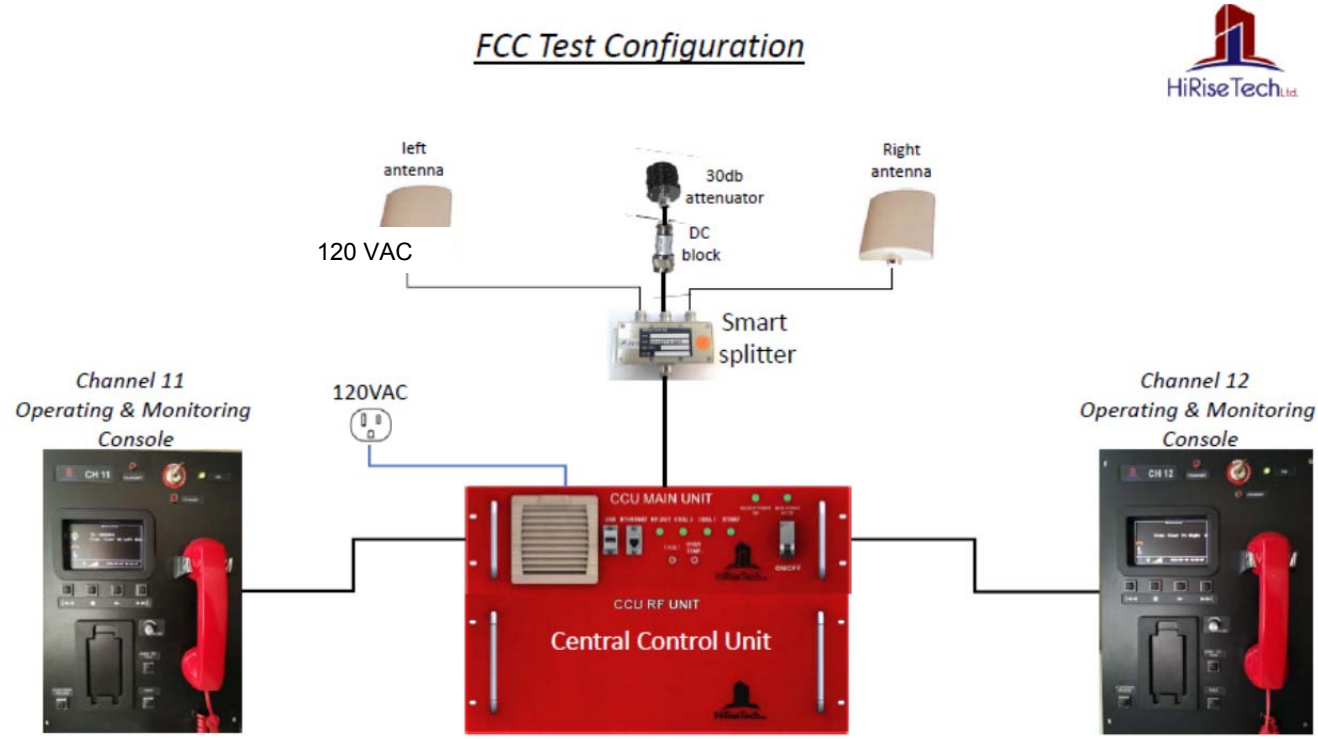
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Operational & Monitoring console	HiRiseTech	HRT2002LRU0010	NA
SMSP	HiRiseTech	HRT2003LRU0010	NA
Antenna	Decipro Technologies Ltd.	U4WM6B	NA

6.4 Changes made in EUT

No changes were implemented in the EUT during testing.

6.5 Test configuration



1

6.6 Transmitter characteristics

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

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

Assigned frequency range	450- 512 MHz

Maximum rated output power	At transmitter 50 Ω RF output (splitter) connector	13. dBm
	Output power declared by FCC ID:AFJ318002 grant	46.5 dBm

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

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

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
External	Decipro Technologies Ltd.	U4WM6B	6 dBi

Transmitter 99% power bandwidth	16.4 kHz
Transmitter aggregate data rate/s	Voice+telemetry (9600bps)
Type of modulation	FM+C4FM over FM
Modulating test signal (baseband)	PRBS

Maximum transmitter duty cycle in normal use		**Tx ON time**		**Period**	
Transmitter duty cycle supplied for test		**Tx ON time**		**Period**	

Transmitter power source						
	Battery	**Nominal rated voltage**		Battery type		
	DC	**Nominal rated voltage**	VDC			
X	AC mains	**Nominal rated voltage**	120 VAC	Frequency	60 Hz	

Common power source for transmitter and receiver	X yes	no

Test specification:	Section 90.205, Maximum output power		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 24 ºC	Relative Humidity: 44 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

7 Transmitter tests according to 47CFR part 90

7.1 Peak output power test

7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Conducted output power limits

Assigned frequency range, MHz	Maximum declared output power	
	W	dBm
470 – 512	45	46.5

7.1.2 Test procedure

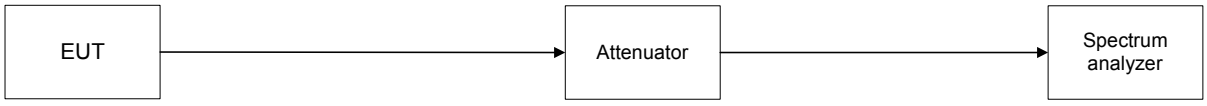
7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

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

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and the associated plots.

7.1.2.4 The EIRP results provided in Table 7.1.4.

Figure 7.1.1 Peak output power test setup



Test specification:	**Section 90.205, Maximum output power**		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	28-Oct-18		
Temperature: 24 ºC	**Relative Humidity:** 44 %	**Air Pressure:** 1011 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE: 470 – 512 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 30 kHz
VIDEO BANDWIDTH: 91 kHz
MODULATION: FM
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Modulation	SA reading, dBm	Duty Cycle, %	Output correction factor, dB	Maximum output power, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
483.0125	FM	13.37	100	32.7	46.07	46.5	-0.43	Pass
High carrier frequency								
484.7625	FM	13.31	100	32.7	46.01	46.5	-0.49	Pass

*****- Margin = RF power – Limit
******- Maximum output power was calculated as follows: *Maximum Output Power = SA Reading + Output correction Factor* where *Output correction Factor* = Diplexer loss + Cable loss + Splitter loss + Splitter attenuation =
= 4 + 0.1 + 0.1 +28.5 dB. = 32.7
.

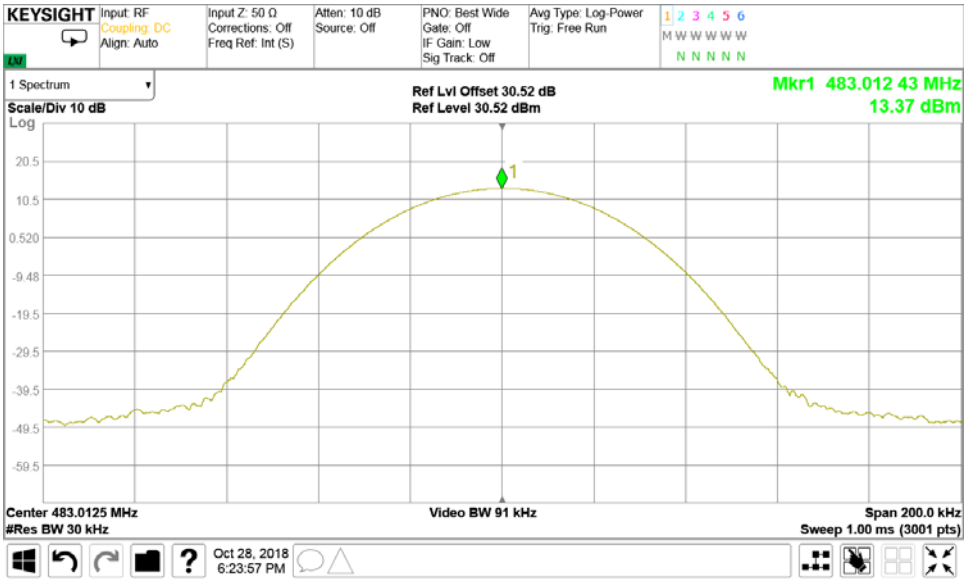
Reference numbers of test equipment used

HL 4068	HL 4938	HL 5376					

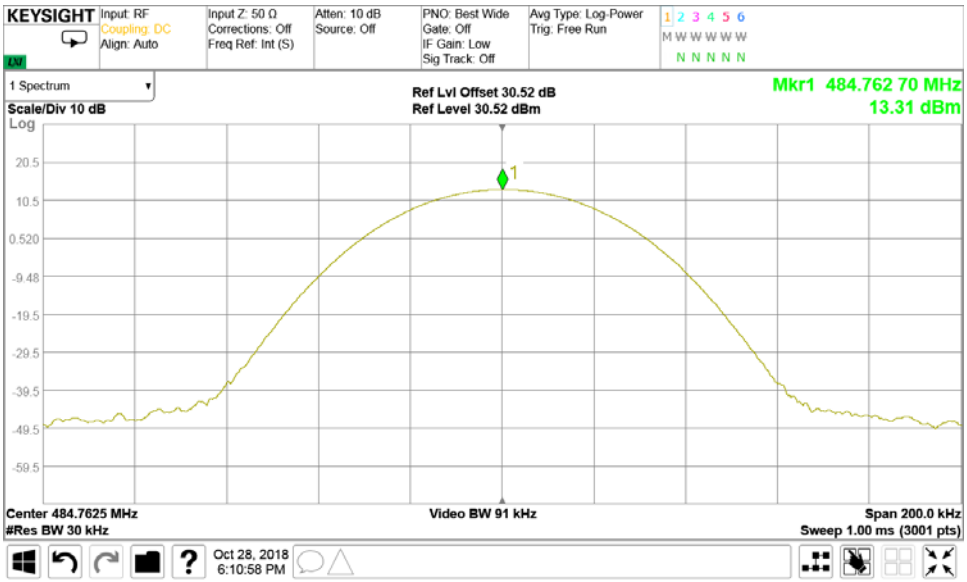
Full description is given in Appendix A.

Test specification:	Section 90.205, Maximum output power		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 24 ºC	Relative Humidity: 44 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.1.1 Peak output power test results at 483.0125 MHz



Plot 7.1.2 Peak output power test results at 484.7625 MHz



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	ANSI C63.26, Section 5.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Oct-18		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
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
483.0125	26	25
484.7625		25

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

7.2.2 Test procedure

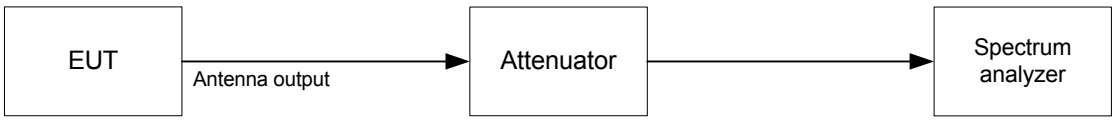
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

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, Table 7.2.3 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup



Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	ANSI C63.26, Section 5.4.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	29-Oct-18		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1011 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 300 Hz
VIDEO BANDWIDTH: 1 kHz
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
MODULATION: FM
MODULATING SIGNAL: 2.5 kHz tone

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
483.0125	14.061	25	-9.835	Pass
484.7625	13.048	25	-9.325	Pass

Table 7.2.3 Occupied bandwidth test results with Private Line

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 300 Hz
VIDEO BANDWIDTH: 1 kHz
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
MODULATION: FM
MODULATING SIGNAL: 2.5kHz tone

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
483.0125	15.192	25	-9.808	Pass
484.7625	16.391	25	-8.609	Pass

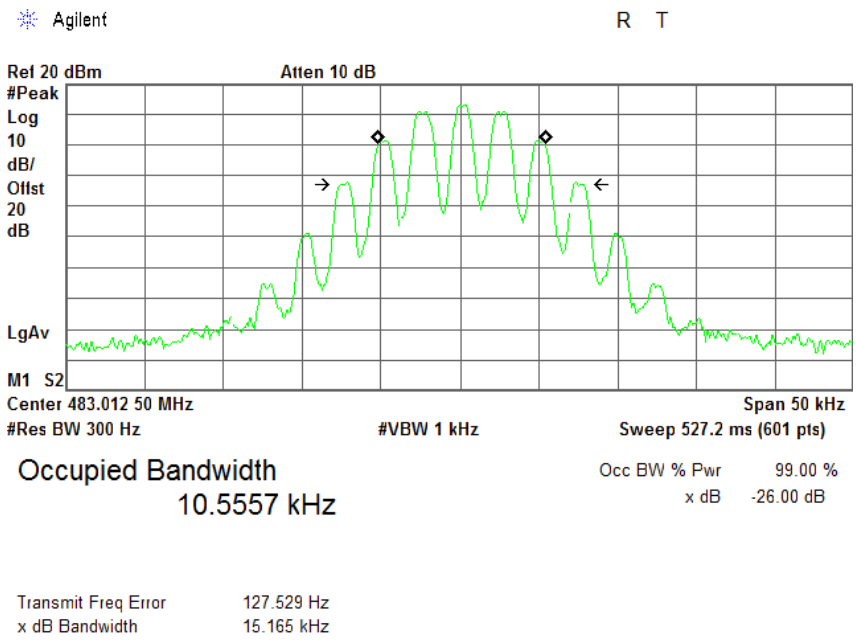
Reference numbers of test equipment used

HL 3433	HL 3440	HL 3818					

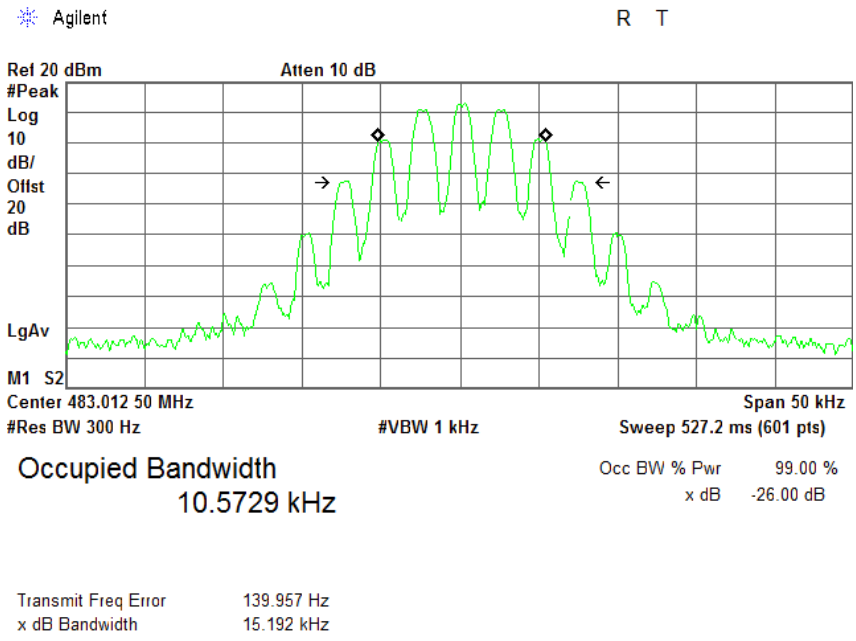
Full description is given in Appendix A.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	ANSI C63.26, Section 5.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Oct-18		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.2.1 Occupied bandwidth test result at 483.0125 MHz

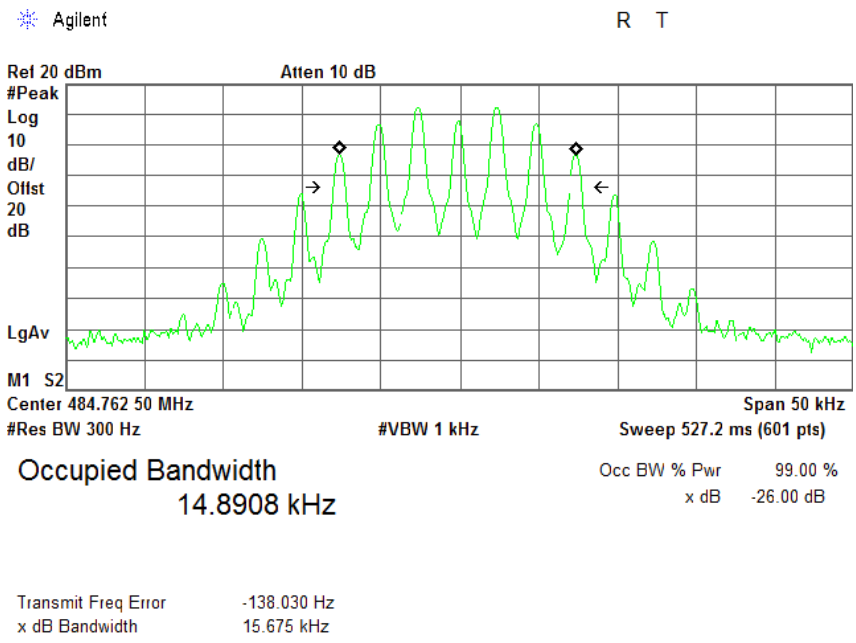


Plot 7.2.2 Occupied bandwidth test result at 483.0125 MHz with Private Line

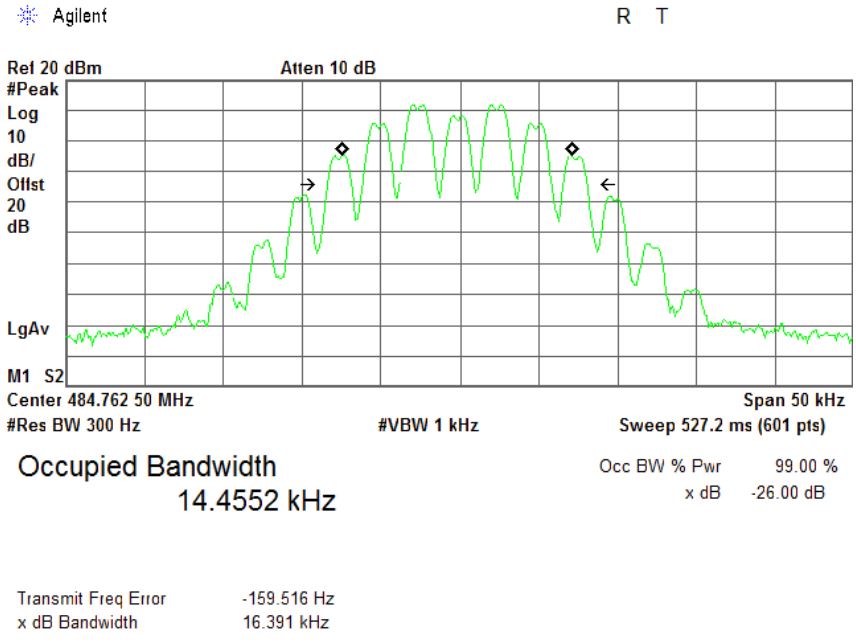


Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	ANSI C63.26, Section 5.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	29-Oct-18		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.2.3 Occupied bandwidth test result at 484.7625 MHz



Plot 7.2.4 Occupied bandwidth test result at 484.7625 MHz with Private Line



Test specification:	Section 90.210, Emission mask		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 25 ºC	Relative Humidity: 46 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
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 B (Channel bandwidth 25 kHz, authorized bandwidth 20 kHz) with audio low pass filter	
0 – 12.5 kHz	0
12.5 – 25.0 kHz	25.0
25.0 – 62.5 kHz	35.0
More than 62.5 kHz	43+10logP(W)

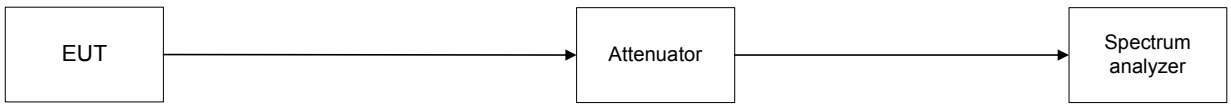
* - linearly increase with frequency
** - emission mask includes carrier modulation envelope within ± 250 % of the authorized bandwidth; the frequency range removed beyond ± 250 % of the authorized bandwidth from carrier was investigated as spurious emission

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 Table 7.3.2 and the associated plots.

Figure 7.3.1 Emission mask test setup



Test specification:	**Section 90.210, Emission mask**		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	28-Oct-18		
Temperature: 25 ºC	**Relative Humidity:** 46 %	**Air Pressure:** 1011 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
483.0125	Emission mask B	Pass
484.7625		

Reference numbers of test equipment used

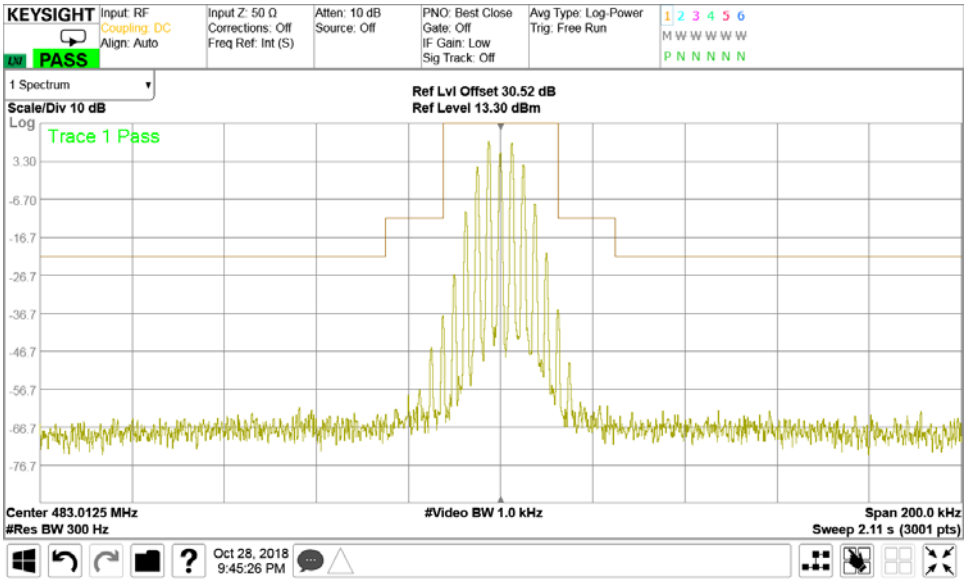
HL 4068	HL 4938	HL 5376					

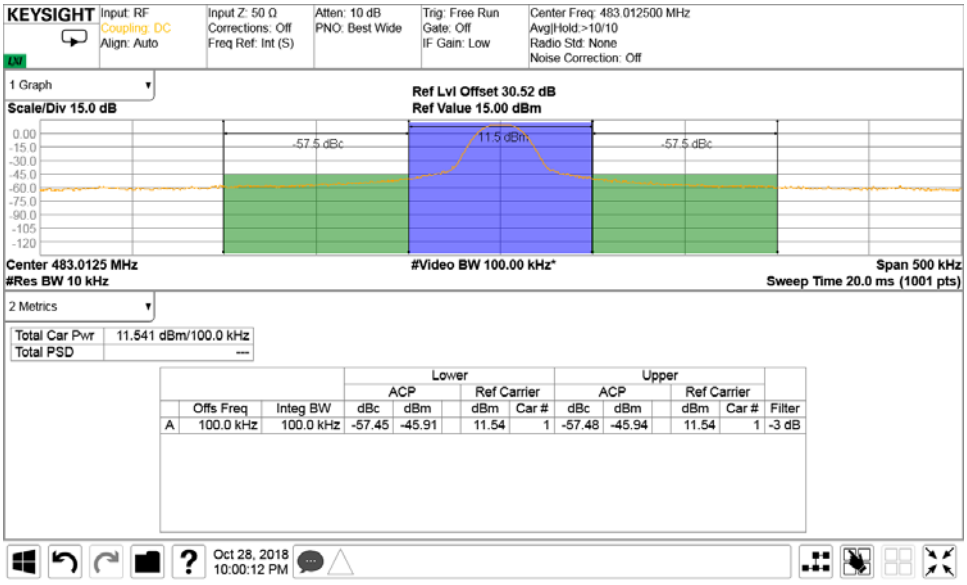
Full description is given in Appendix A.

Test specification:	Section 90.210, Emission mask		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 25 ºC	Relative Humidity: 46 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.1 Emission mask test results at 483.0125 MHz

DETECTOR USED: Peak
MODULATION: FM
MODULATING SIGNAL: 2.5 kHz tone
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

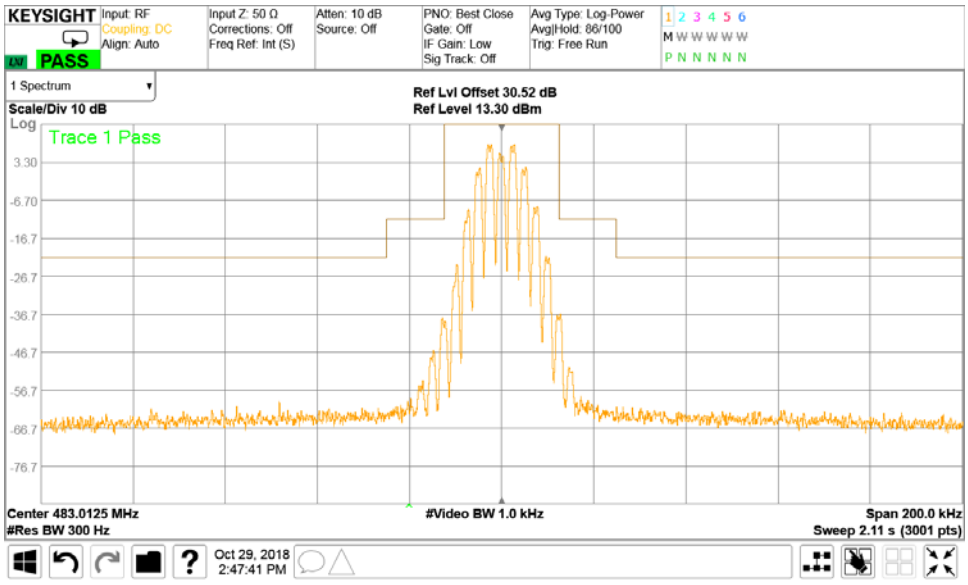


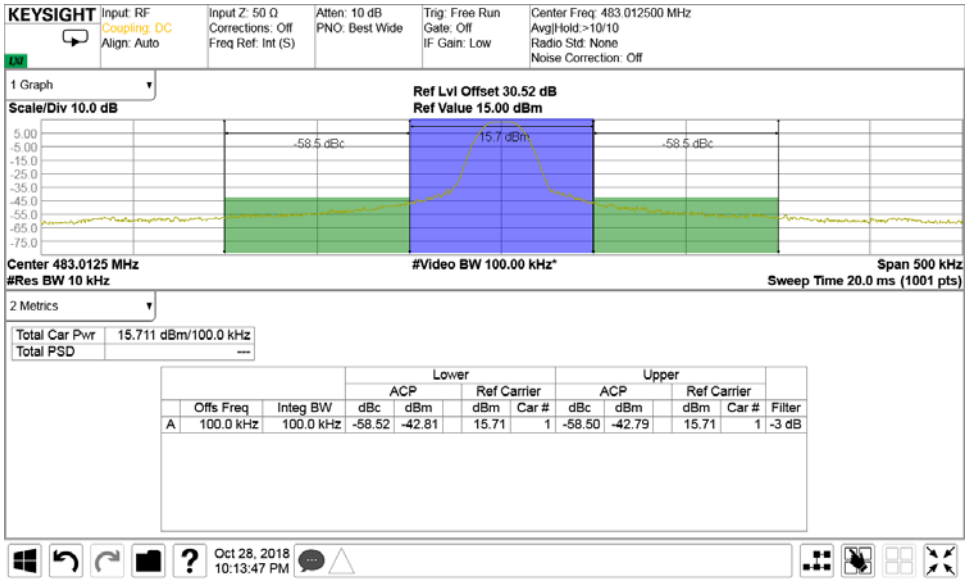


Test specification:	Section 90.210, Emission mask		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 25 ºC	Relative Humidity: 46 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.2 Emission mask test results at 483.0125 MHz with Private Line

DETECTOR USED:	Peak
MODULATION:	FM
MODULATING SIGNAL:	2.5 kHz tone
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum

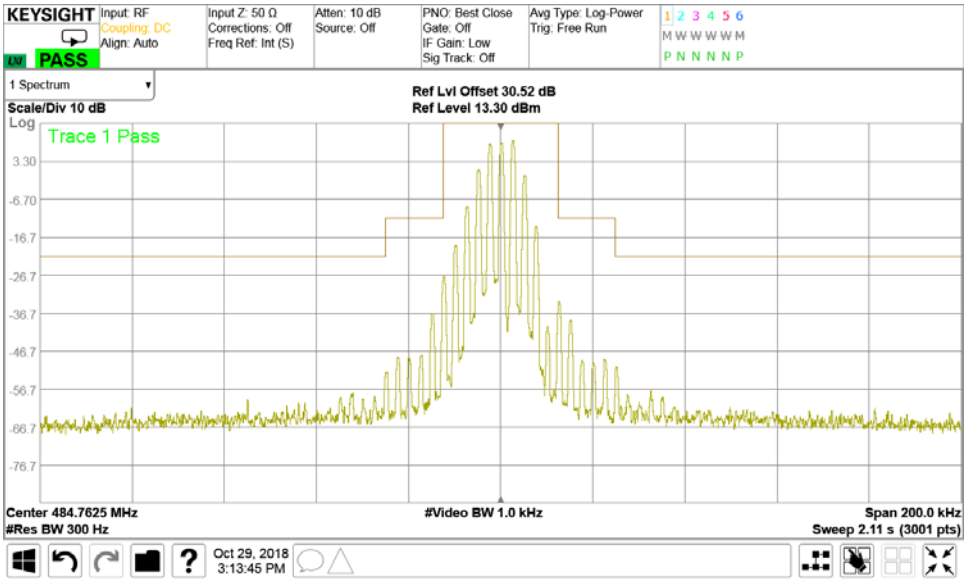


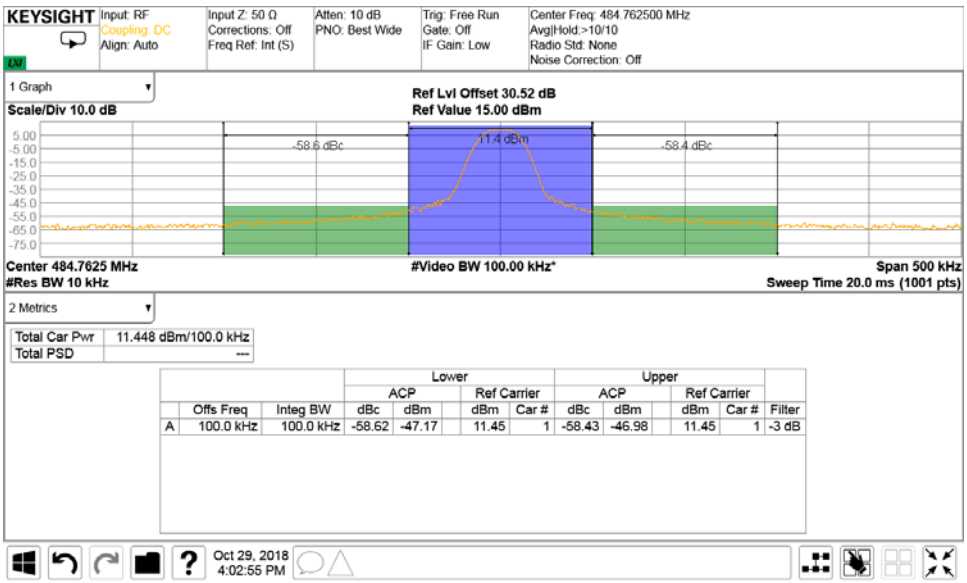


Test specification:	Section 90.210, Emission mask		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 25 ºC	Relative Humidity: 46 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.3 Emission mask test results at 484.7625 MHz

DETECTOR USED: Peak
MODULATION: FM
MODULATING SIGNAL: 2.5 kHz tone
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

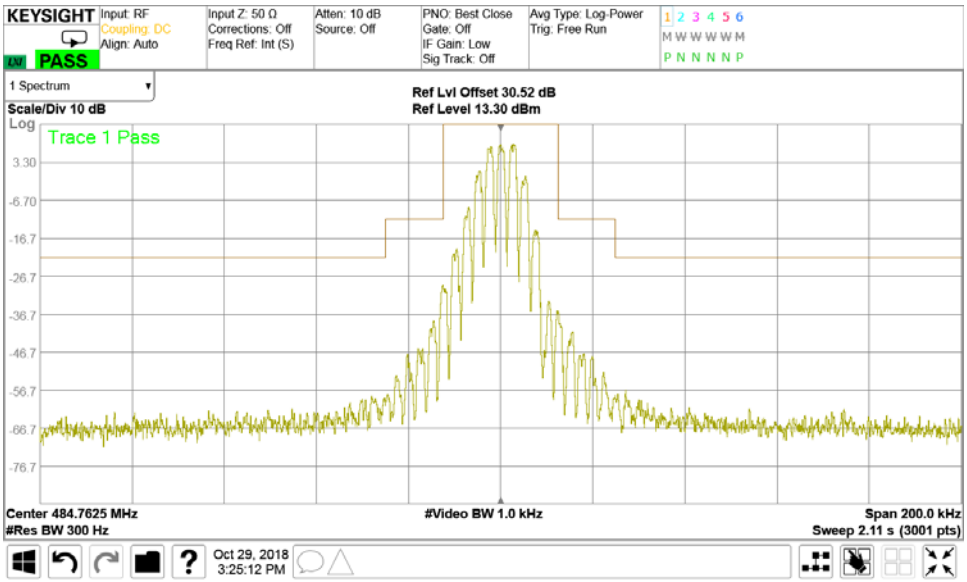




Test specification:	Section 90.210, Emission mask		
Test procedure:	ANSI C63.26, Section 5.2.4.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	28-Oct-18		
Temperature: 25 ºC	Relative Humidity: 46 %	Air Pressure: 1011 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.3.4 Emission mask test results at 484.7625 MHz with Private Line

DETECTOR USED: Peak
MODULATION: FM
MODULATING SIGNAL: 2.5 kHz tone
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



Test specification:	**Section 90.210, Radiated spurious emissions**		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	20-Nov-18		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1019 hPa	**Power:** 120 VAC, 60 Hz
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*	43+10logP**	-13	84.4

* - 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×P×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 spurious emission field strength 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 360^0 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 spurious emission field strength 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 360^0 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, Radiated spurious emissions**		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	20-Nov-18		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1019 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

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

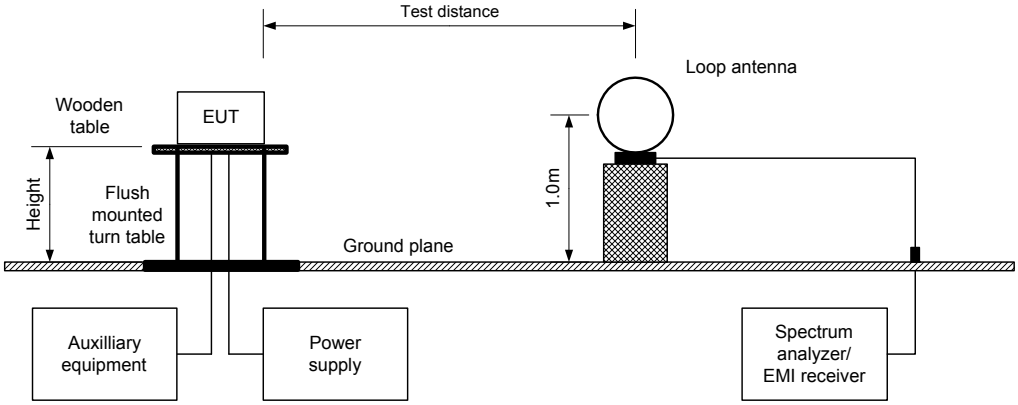
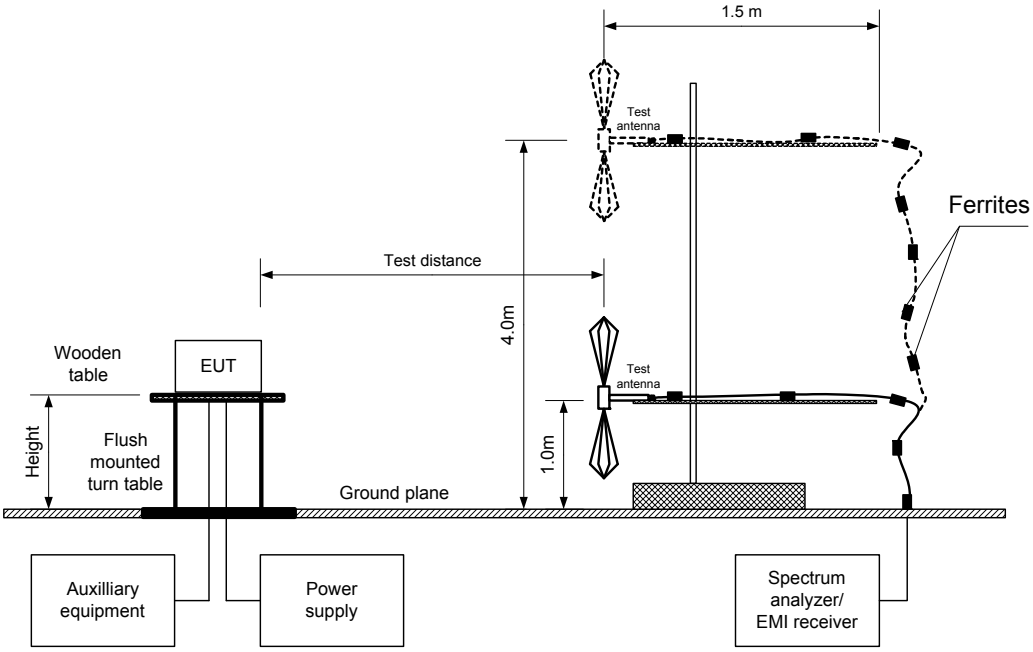


Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 90.210, Radiated spurious emissions**		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	20-Nov-18		
Temperature: 24 ºC	**Relative Humidity:** 45 %	**Air Pressure:** 1019 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.4.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 470-512 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)
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
All emissions are more than 20 dB below the limit							

Verdict: 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

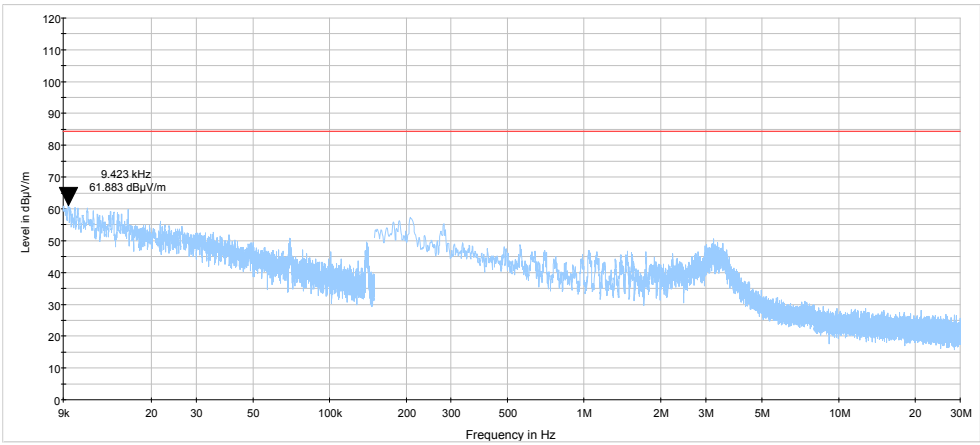
HL 3903	HL 4360	HL 4933	HL 5405	HL 5288			

Full description is given in Appendix A.

Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Nov-18		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1019 hPa	Power: 120 VAC, 60 Hz
Remarks:			

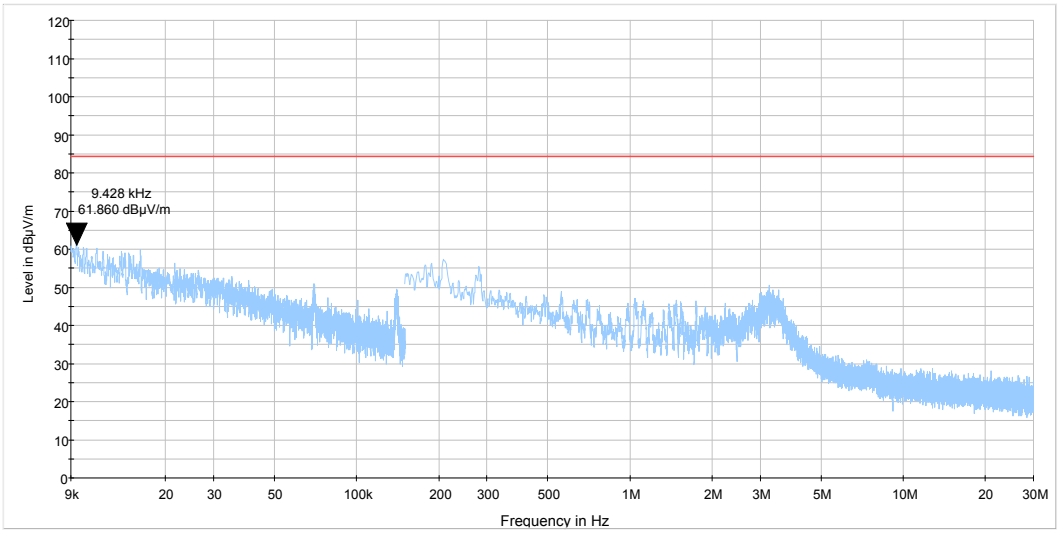
Plot 7.4.1 Radiated emission measurements in 9 kHz – 30 MHz range at frequency 483.0125 MHz

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



Plot 7.4.2 Radiated emission measurements in 9 kHz – 30 MHz range at high frequency 484.7625 MHz

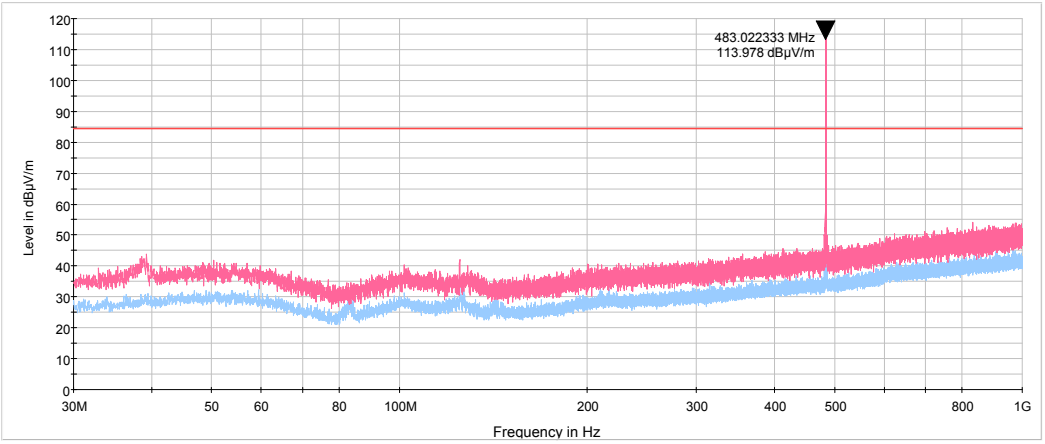
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Nov-18		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1019 hPa	Power: 120 VAC, 60 Hz
Remarks:			

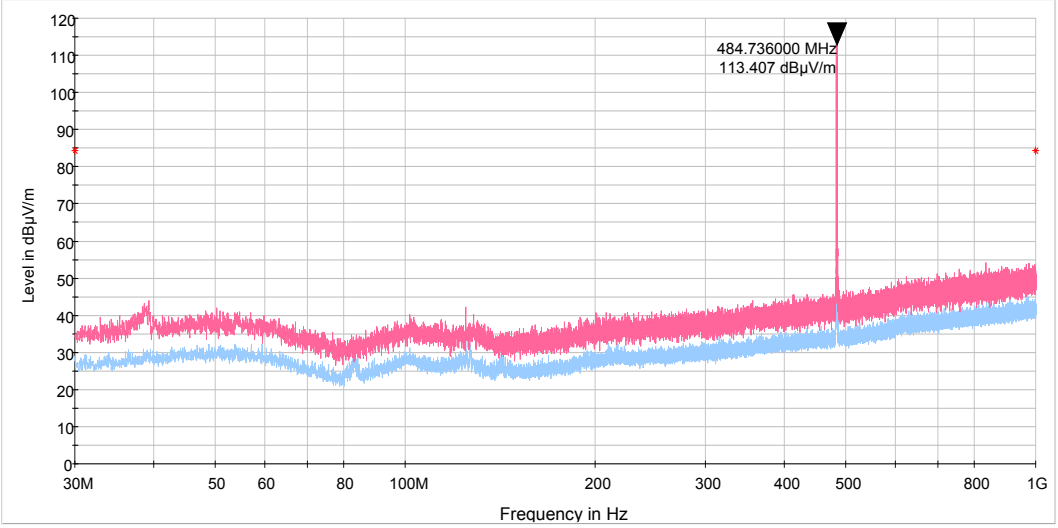
Plot 7.4.3 Radiated emission measurements in 30 - 1000 MHz range at frequency 483.0125 MHz

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



Plot 7.4.4 Radiated emission measurements in 30 - 1000 MHz range at frequency 484.7625 MHz

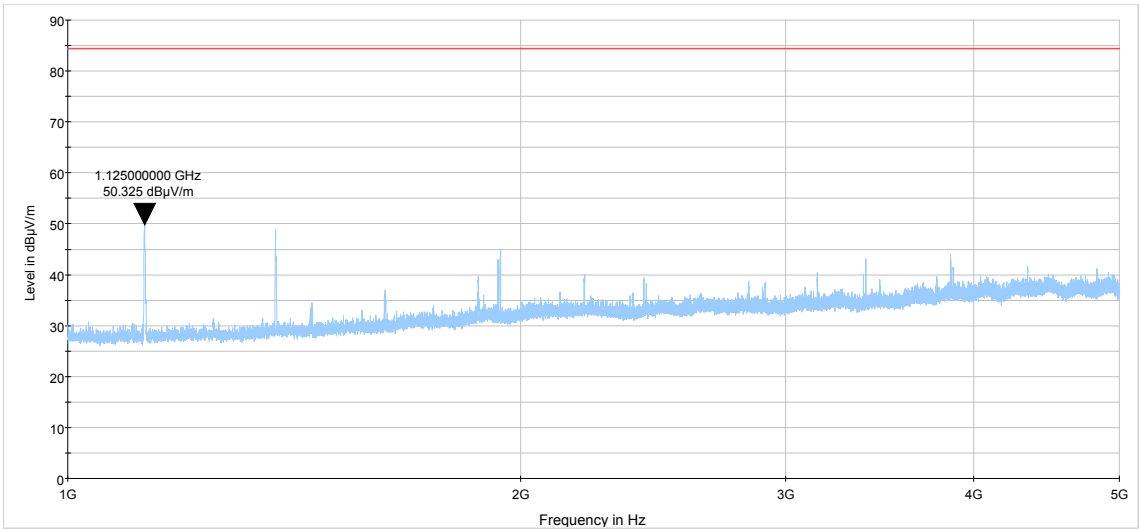
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 90.210, Radiated spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	20-Nov-18		
Temperature: 24 ºC	Relative Humidity: 45 %	Air Pressure: 1019 hPa	Power: 120 VAC, 60 Hz
Remarks:			

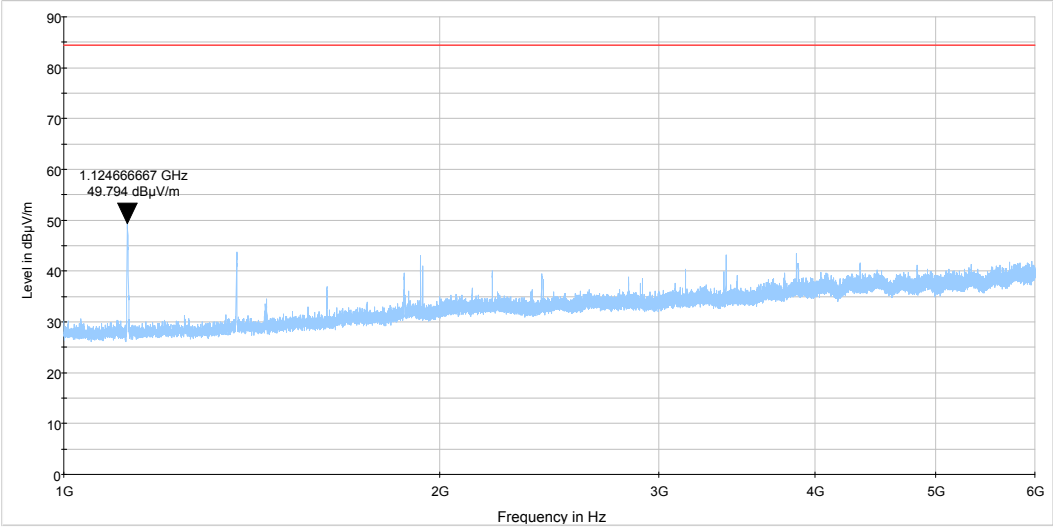
Plot 7.4.5 Radiated emission measurements in 1000 – 5000 MHz range at frequency 483.0125 MHz

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



Plot 7.4.6 Radiated emission measurements in 1000 – 5000 MHz range at frequency 484.7625 MHz

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



Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

7.5 Spurious emissions at RF antenna connector test

7.5.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.5.1. .

Table 7.5.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	43+10logP** (mask B, C)	-13.0

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing
** - P is transmitter output power in Watts

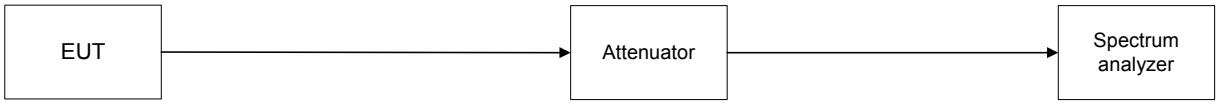
7.5.2 Test procedure

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

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

7.5.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.5.2 and associated plots.

Figure 7.5.1 Spurious emission test setup



Test specification:	**Section 90.210, Conducted spurious emissions**		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	**Relative Humidity:** 41 %	**Air Pressure:** 1012 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.5.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 470 - 512 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥3* Resolution bandwidth
MODULATION: FM
MODULATING SIGNAL: 2.5 kHz tone
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
483.0125 MHz carrier frequency									
No emissions were found									Pass
484.7625 MHz carrier frequency									
No emissions were found									Pass

*****- Margin = Spurious emission – specification limit.

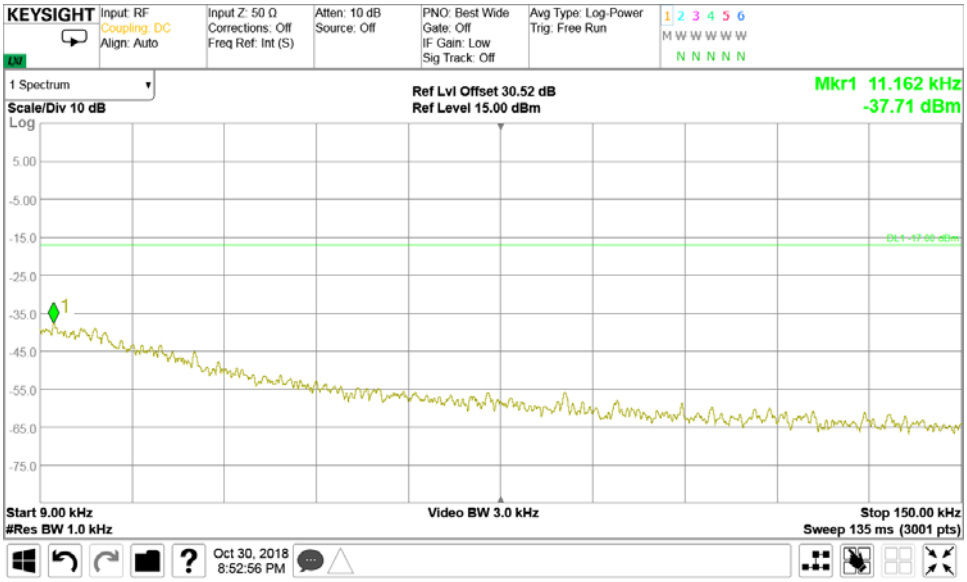
Reference numbers of test equipment used

HL 3637	HL 4778				

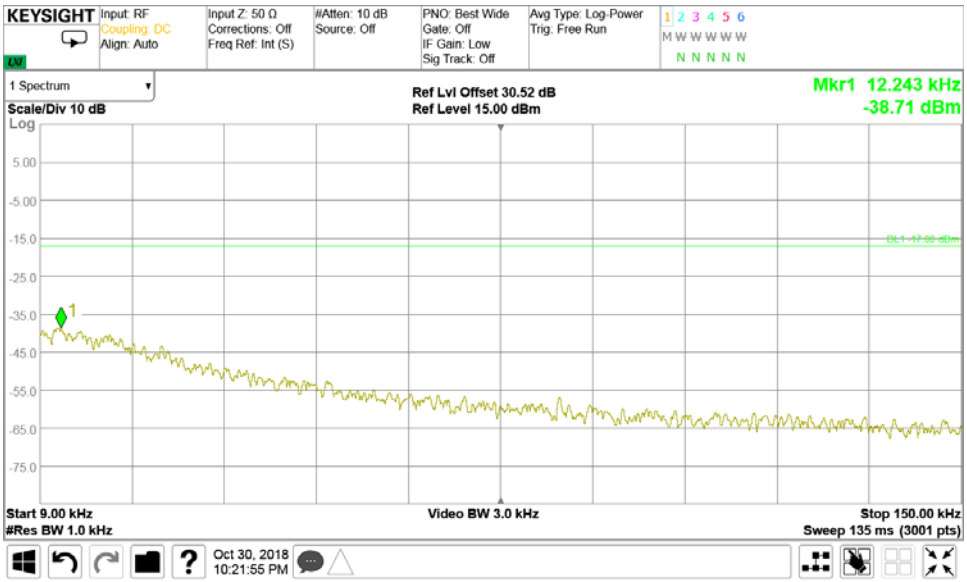
Full description is given in Appendix A.

Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.1 Spurious emission measurements in 9 - 150 kHz range at 483.0125 MHz

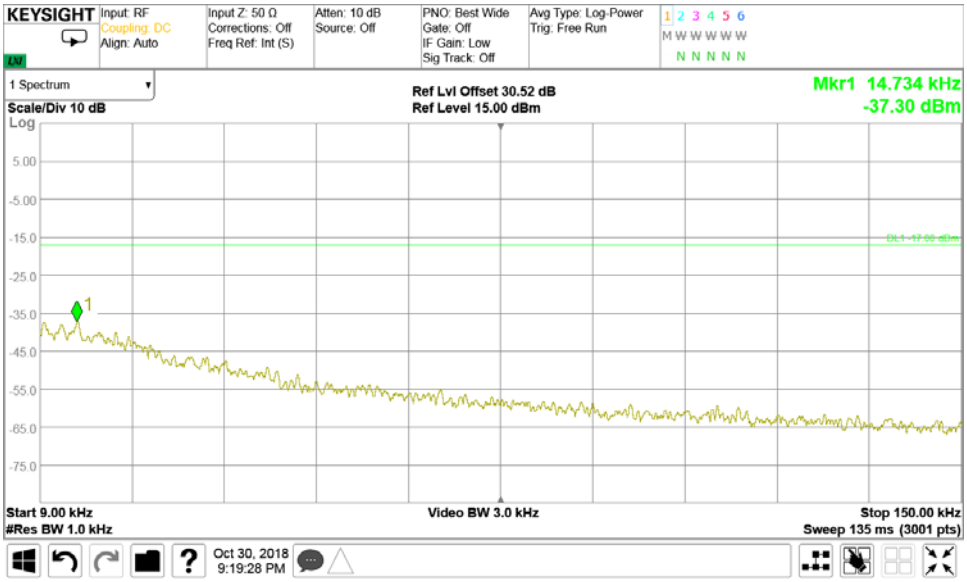


Plot 7.5.2 Spurious emission measurements in 9 - 150 kHz range at 483.0125 MHz with Private Line

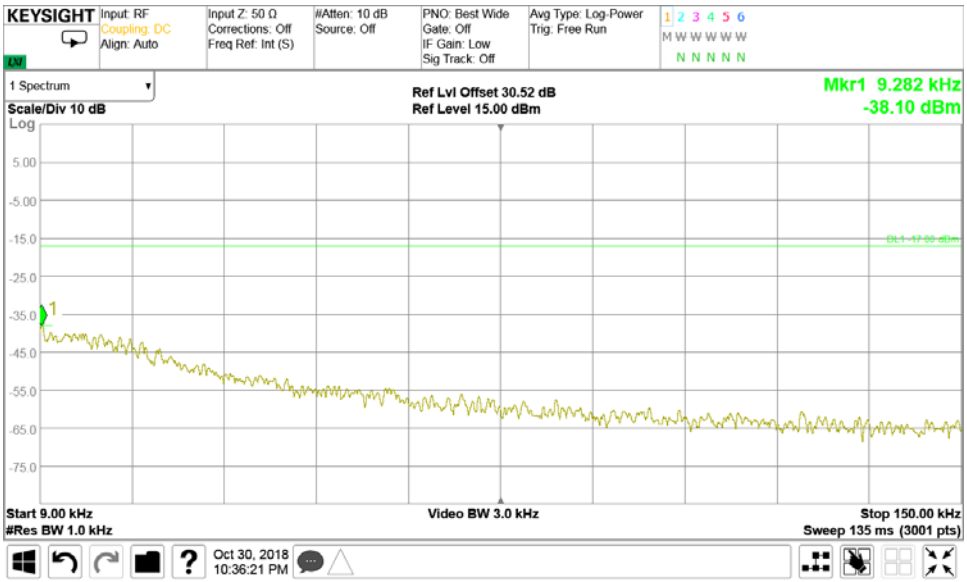


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.3 Spurious emission measurements in 9 - 150 kHz range at 484.7625 MHz

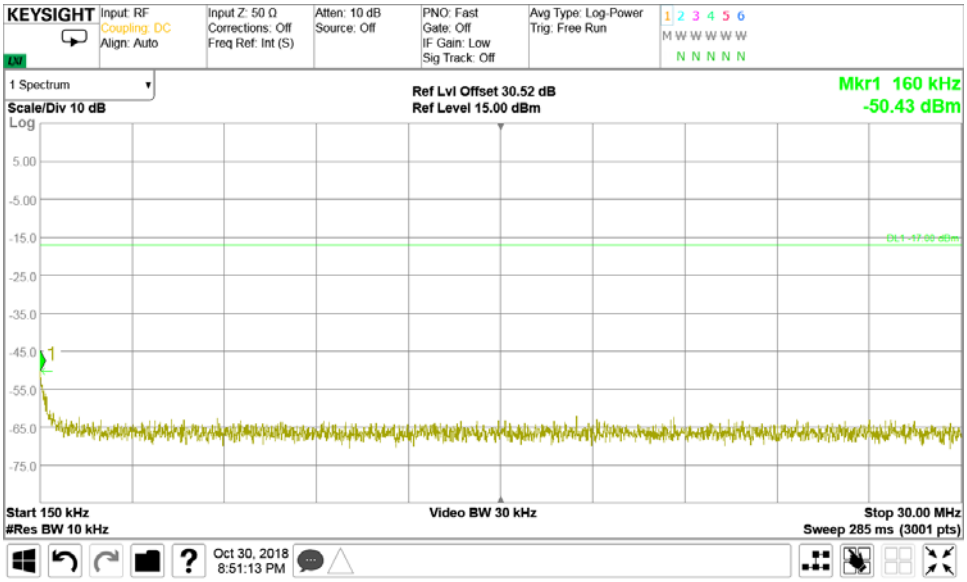


Plot 7.5.4 Spurious emission measurements in 9 - 150 kHz range at 484.7625 MHz with Private Line

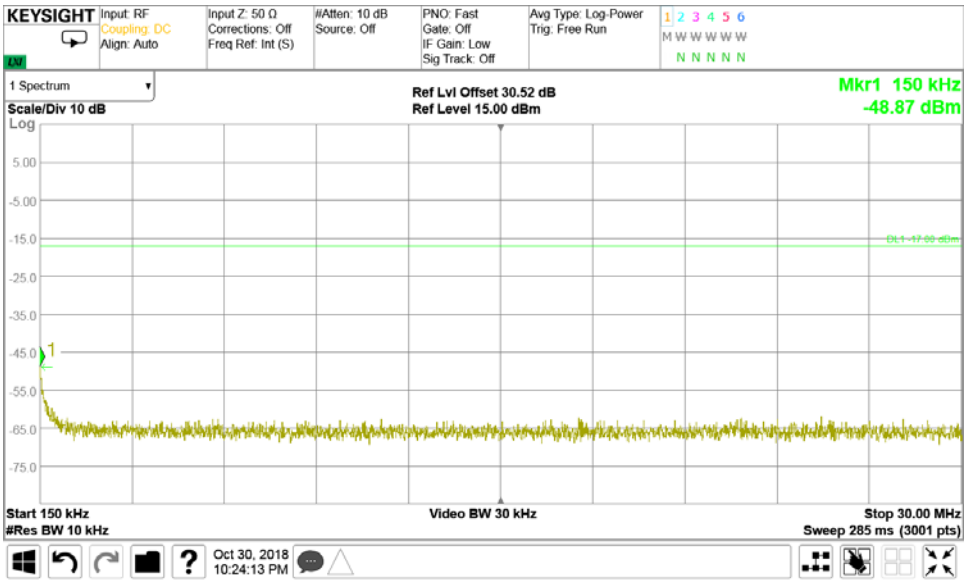


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.5 Spurious emission measurements in 0.15 - 30 MHz range at 483.0125 MHz

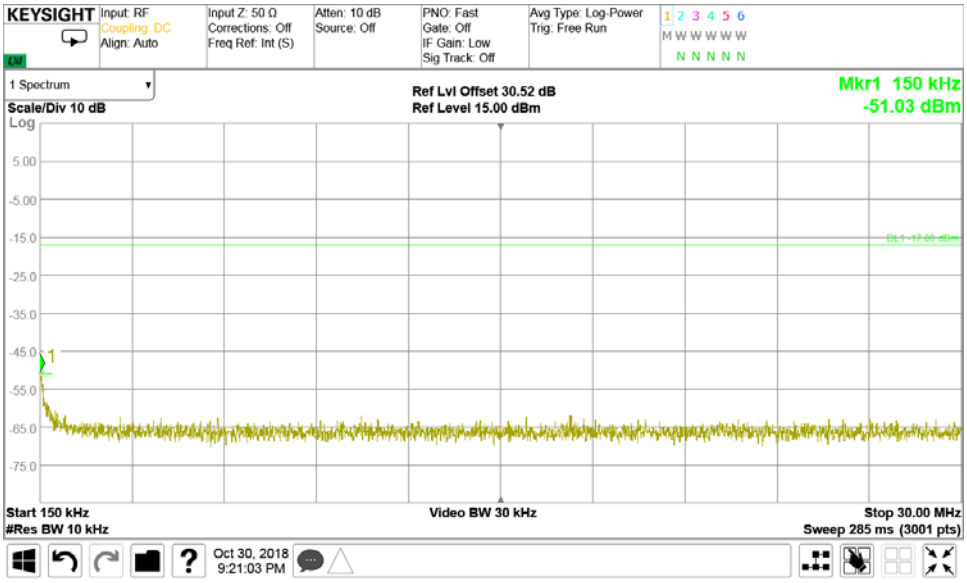


Plot 7.5.6 Spurious emission measurements in 0.15 - 30 MHz range at 483.0125 MHz with Private Line

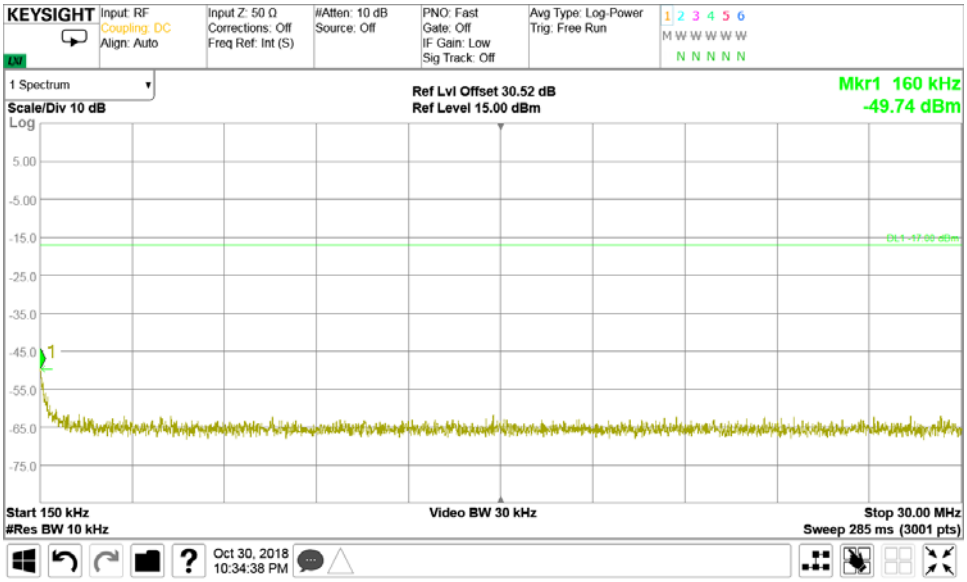


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.7 Spurious emission measurements in 0.15 – 30 MHz range at 484.7625 MHz

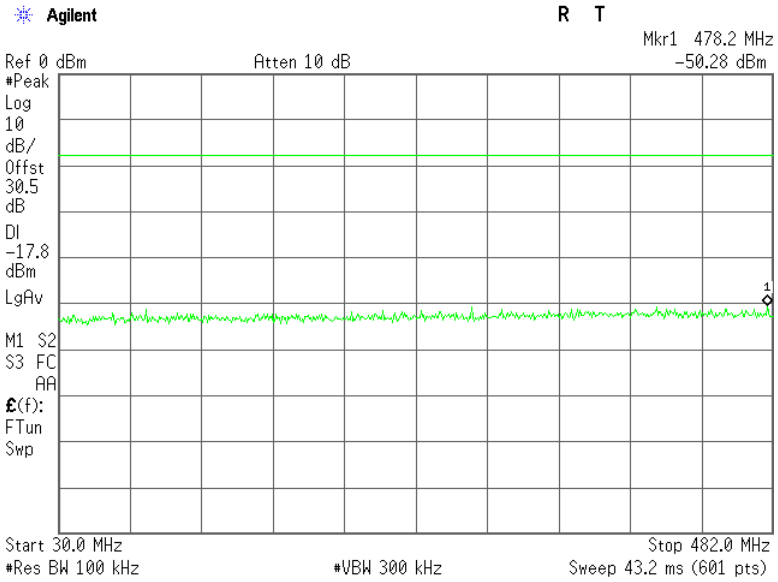


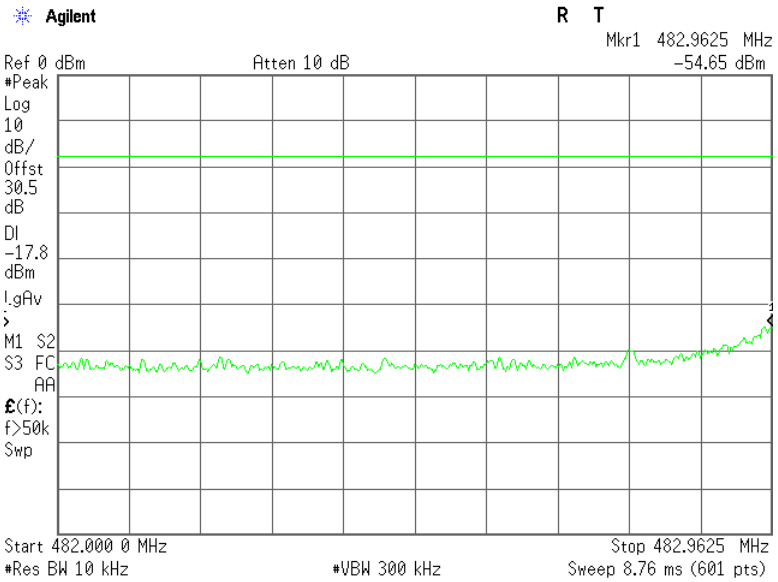
Plot 7.5.8 Spurious emission measurements in 0.15 – 30 MHz range at 484.7625 MHz with Private Line



Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.9 Spurious emission measurements in 30 – 482.9625 MHz range at 483.0125 MHz

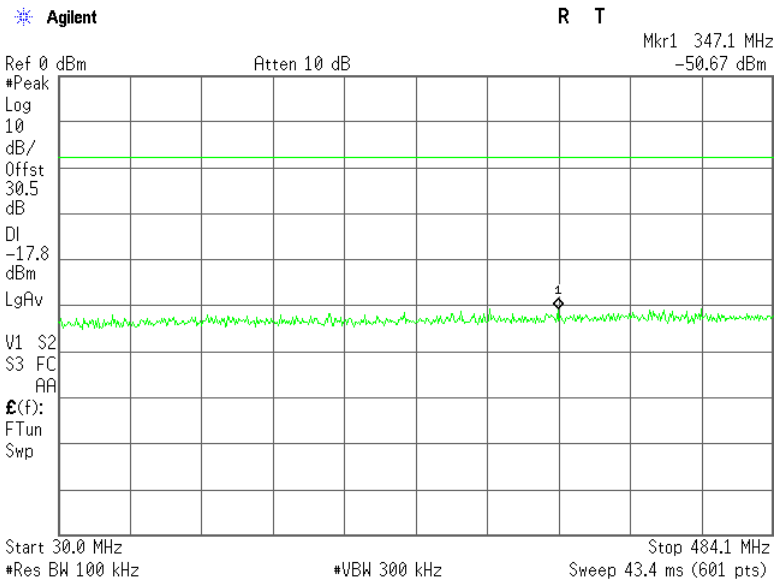


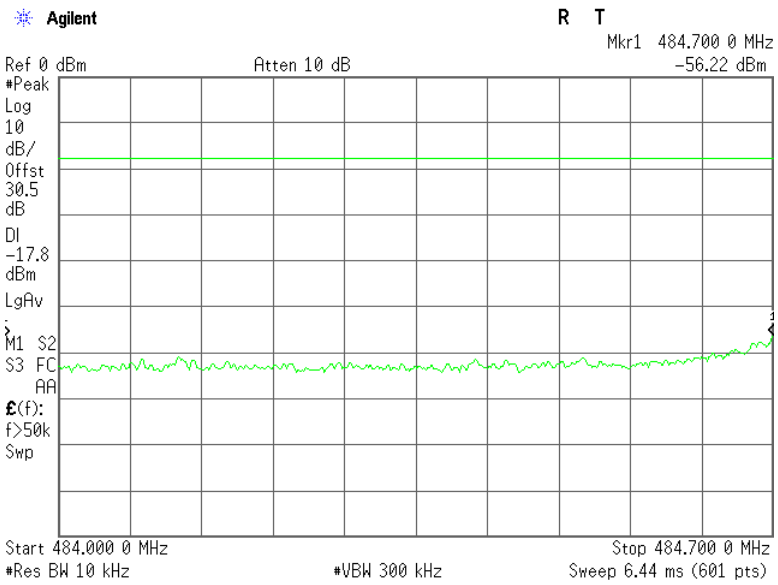


Note: RBW factor = 10 Log(100/10) will be added

Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.10 Spurious emission measurements in 30 – 484.7 MHz range at 484.7625 MHz

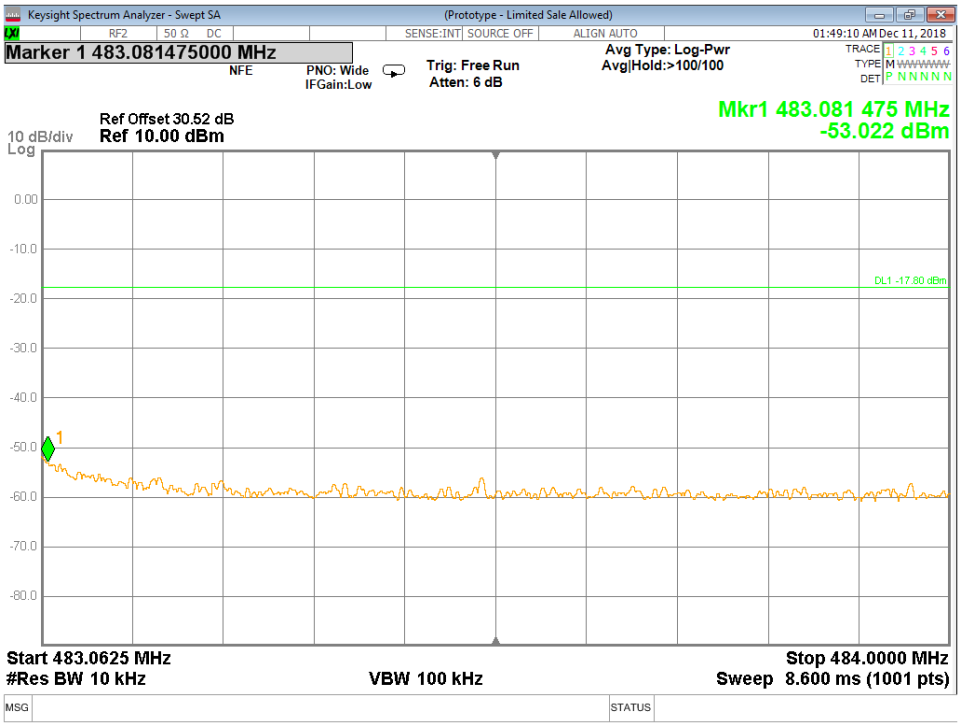




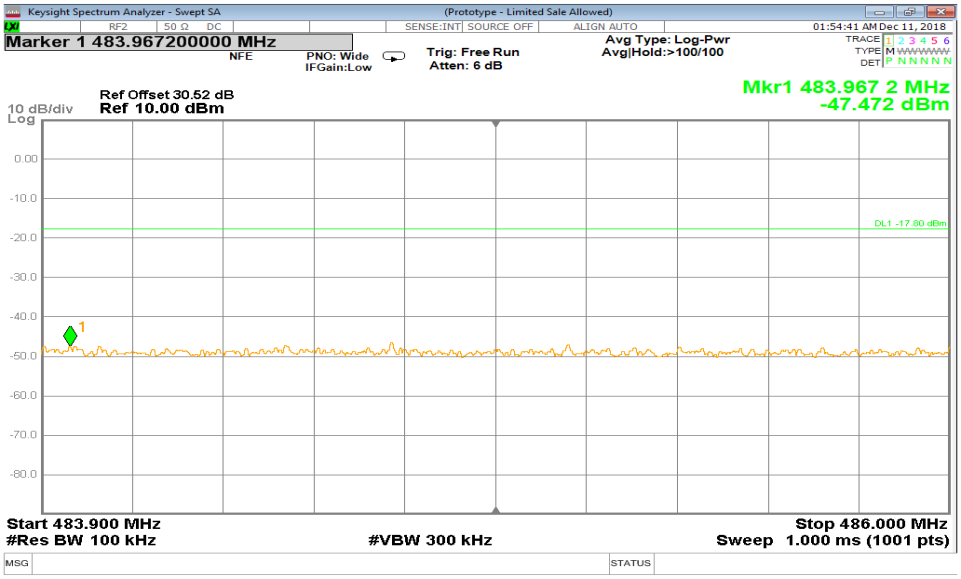
Note: RBW factor = 10 Log(100/10) will be added

Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.11 Spurious emission measurements in 483.0625 –486.0 MHz range at 483.0125 MHz

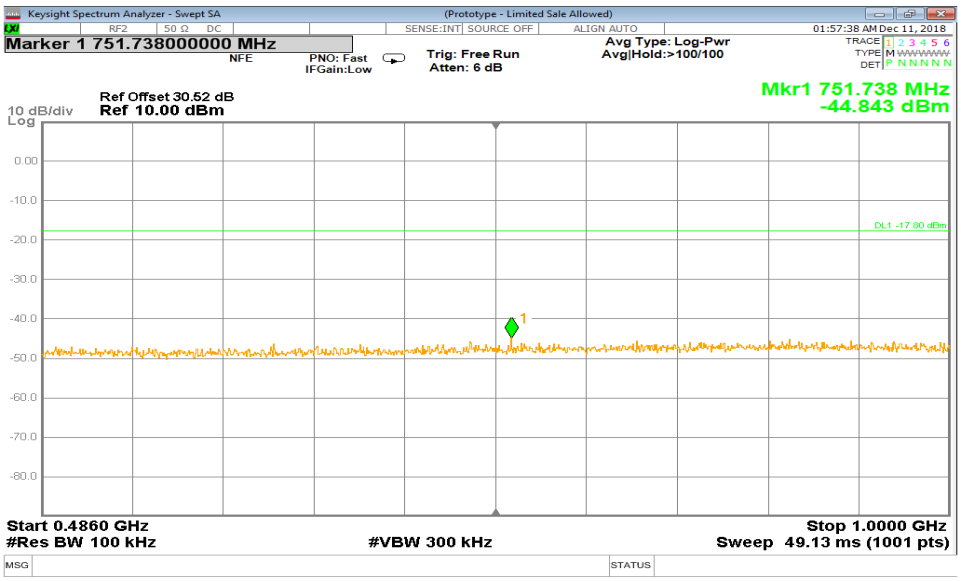


Note: RBW factor = 10 Log(100/10) will be added



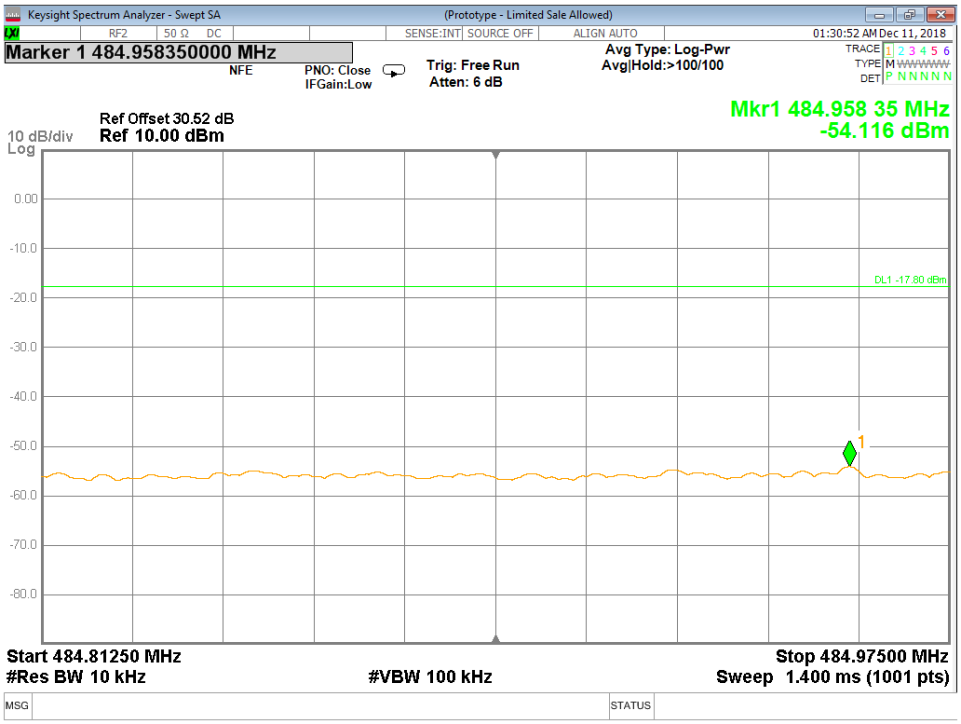
Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.12 Spurious emission measurements in 486.0 – 1000 MHz range at 483.0125 MHz

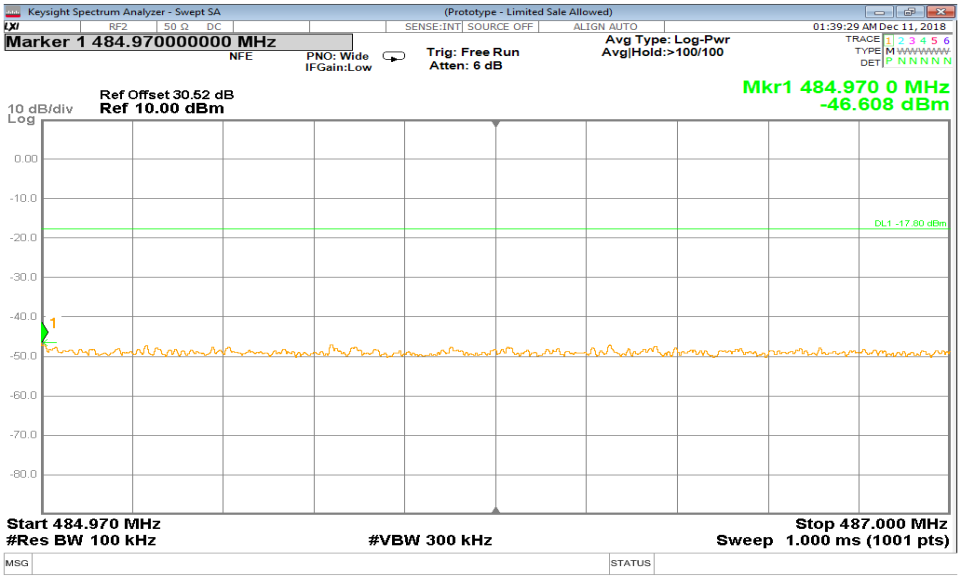


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.13 Spurious emission measurements in 484.8125 – 487.0 MHz range at 484.7625 MHz

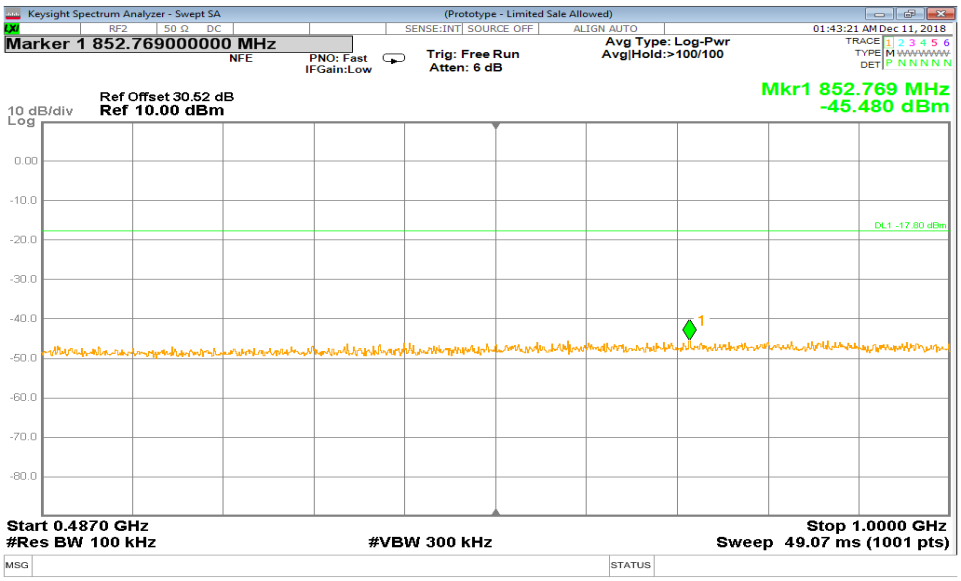


Note: RBW factor = 10 Log(100/10) will be added



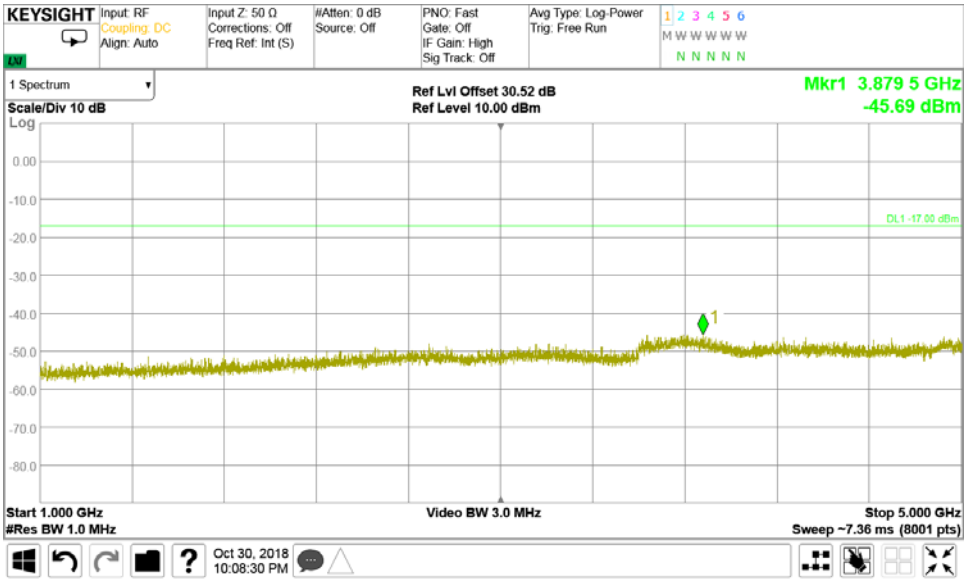
Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.14 Spurious emission measurements in 487.0 – 1000 MHz range at 484.7625 MHz

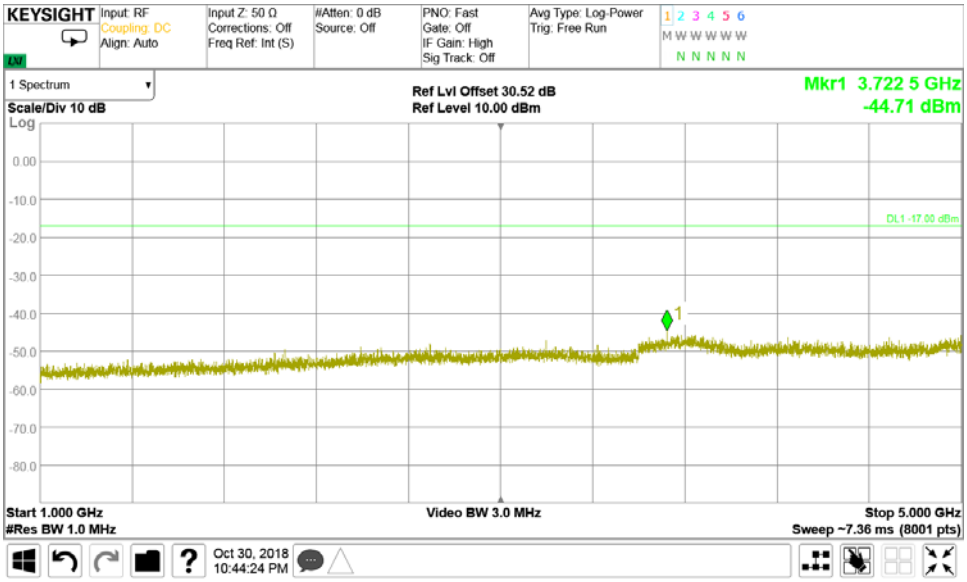


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.15 Spurious emission measurements in 1000 - 5000 MHz range at 483.0125 MHz

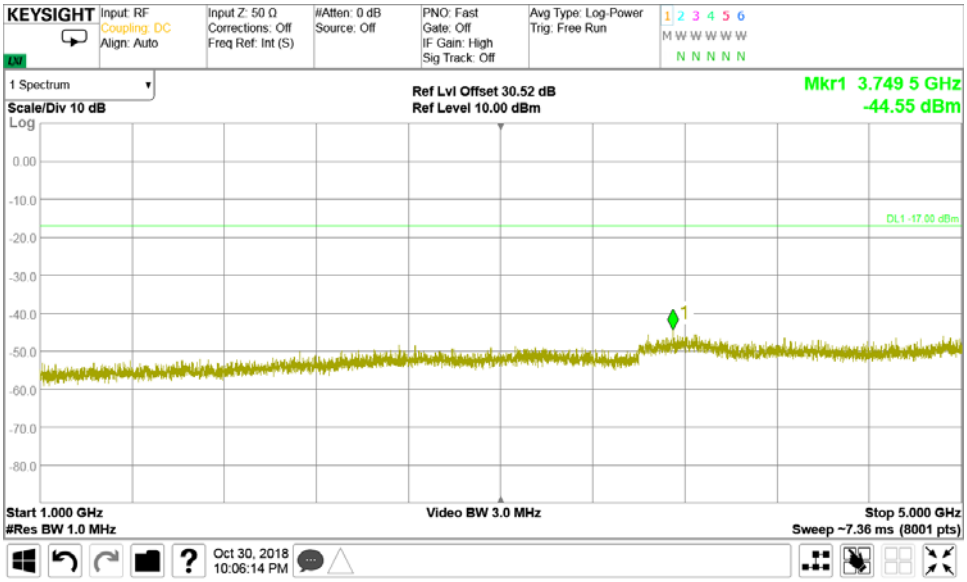


Plot 7.5.16 Spurious emission measurements in 1000 - 5000 MHz at 483.0125 MHz Private Line

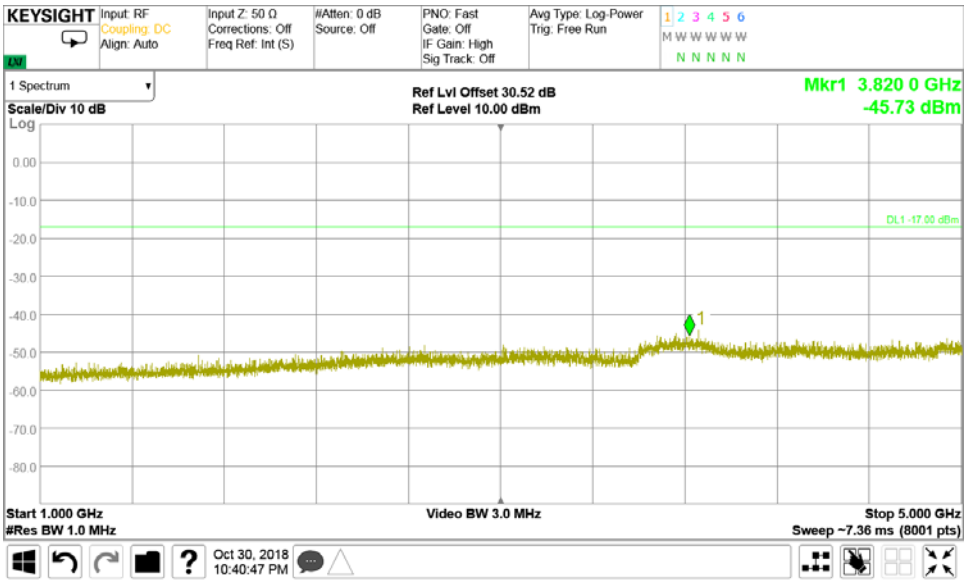


Test specification:	Section 90.210, Conducted spurious emissions		
Test procedure:	ANSI C63.26, Section 5.7.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	30-Oct-18		
Temperature: 24 ºC	Relative Humidity: 41 %	Air Pressure: 1012 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.5.17 Spurious emission measurements in 1000 - 5000 MHz at 484.7625 MHz



Plot 7.5.18 Spurious emission measurements in 1000 - 5000 MHz at 484.7625 MHz Private Line



Test specification:	Section 90.213, Frequency stability		
Test procedure:	ANSI C63.26, Section 5.6.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	13-Jan-19		
Temperature: 24.3 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

7.6 Frequency stability test

7.6.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
483.0125	2.5	1208
484.7625		1212

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.

7.6.2.2 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.

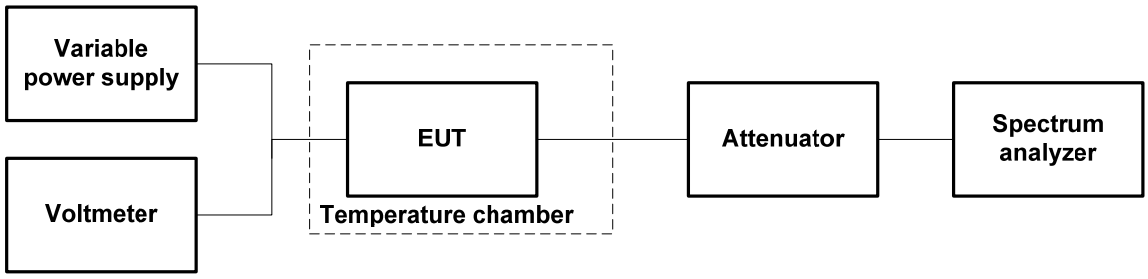
7.6.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

7.6.2.4 The above procedure was repeated at 0˚C and at the lowest test temperature.

7.6.2.5 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.

7.6.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.6.2.

Figure 7.6.1 Frequency stability test setup



Test specification:	**Section 90.213, Frequency stability**		
Test procedure:	ANSI C63.26, Section 5.6.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	13-Jan-19		
Temperature: 24.3 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY:	483.0125 MHz , 484.7625 MHz
NOMINAL POWER VOLTAGE:	120V
TEMPERATURE STABILIZATION PERIOD:	20 min
POWER DURING TEMPERATURE TRANSITION:	Off
SPECTRUM ANALYZER MODE:	Counter
RESOLUTION BANDWIDTH:	100Hz
VIDEO BANDWIDTH:	100Hz
MODULATION:	FM

T, ºC	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1st min	2nd min	3rd min	4th min	5th min	10th min	Positive	Negative			
Low frequency 483.0125 MHz													
-30	nominal	483.012478	483.012478	483.012480	483.012520	483.012574	483.012597	483.012560	54	-65	1208	-1143	Pass
-20	nominal	483.012507	NA	NA	NA	NA	NA	483.012568	25	-36		-1172	Pass
-10	nominal	483.012554	NA	NA	NA	NA	NA	483.012531	11	-12		-1196	Pass
0	nominal	483.012595	483.012557	483.012545	483.012536	483.012536	483.012543	483.012558	52	-7		-1156	Pass
10	nominal	483.012533	NA	NA	NA	NA	NA	483.012561	18	-10		-1190	Pass
20	15%	483.012522	NA	NA	NA	NA	NA	483.012554	11	-21		-1187	Pass
20	nominal	483.012528	NA	NA	NA	NA	NA	483.012543	0	-15		-1193	Pass
20	-15%	483.012529	NA	NA	NA	NA	NA	483.012503	0	-40		-1168	Pass
30	nominal	483.012526	483.012534	483.012537	483.012542	483.012548	483.012556	483.012549	13	-17		-1191	Pass
40	nominal	483.012547	NA	NA	NA	NA	NA	483.012537	4	-6		-1202	Pass
50	nominal	483.012543	NA	NA	NA	NA	NA	483.012466	0	-77		-1131	Pass
Mid frequency 484.7625 MHz													
-30	nominal	484.762524	484.762494	484.762526	484.762569	484.762618	484.762622	484.762648	282	0	1212	-930	Pass
-20	nominal	484.762499	NA	NA	NA	NA	NA	484.762715	349	0		-863	Pass
-10	nominal	484.762527	NA	NA	NA	NA	NA	484.762709	343	0		-869	Pass
0	nominal	484.762714	484.762707	484.762700	484.762693	484.762682	484.762674	484.762625	348	0		-864	Pass
10	nominal	484.762765	NA	NA	NA	NA	NA	484.762698	399	0		-813	Pass
20	15%	484.762702	NA	NA	NA	NA	NA	484.762313	336	-53		-876	Pass
20	nominal	484.762721	NA	NA	NA	NA	NA	484.762366	355	0		-857	Pass
20	-15%	484.762672	NA	NA	NA	NA	NA	484.762309	306	-57		-906	Pass
30	nominal	484.762716	484.762704	484.762664	484.762657	484.762610	484.762595	484.762361	350	-5		-862	Pass
40	nominal	484.762737	NA	NA	NA	NA	NA	484.762316	371	-50		-841	Pass
50	nominal	484.762711	NA	NA	NA	NA	NA	484.762373	345	0		-867	Pass

* - Reference frequency

Reference numbers of test equipment used

HL1205	HL1480	HL 1824	HL 2909	HL4068	HL 5391		

Full description is given in Appendix A.

Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 ºC	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

7.7 Transient frequency behavior test

7.7.1 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 7.7.1.

Table 7.7.1 Transient frequency behavior limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
421.0 – 512.0 MHz band			
25.0	± 25.0	10.0	t_1
	± 12.5	25.0	t_2
	± 25.0	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.

7.7.2 Test procedure

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, 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.

7.7.2.2 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.

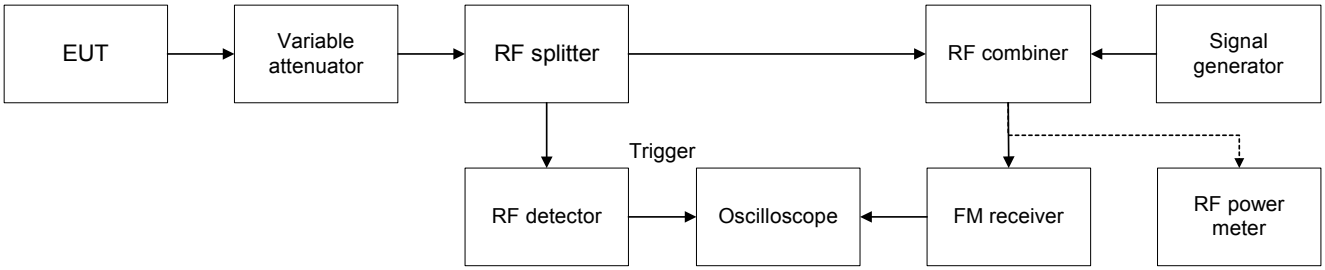
7.7.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

7.7.2.4 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.

7.7.2.5 The test results are provided in Table 7.7.2 and the associated plots.

Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 ºC	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Figure 7.7.1 Transient frequency behavior test setup



Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 °C	**Relative Humidity:** 47 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.7.2 Transient frequency behavior test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 25.0 kHz						
483.0125	t_1	10.0	6.68	25	-18.32	Pass
	t_2	25.0	1.73	12.5	-10.77	
	t_3	10.0	3.43	25	-21.57	
484.7625	t_1	10.0	6.68	25	-18.32	Pass
	t_2	25.0	1.73	12.5	-10.77	
	t_3	5.0	3.43	25	-21.57	

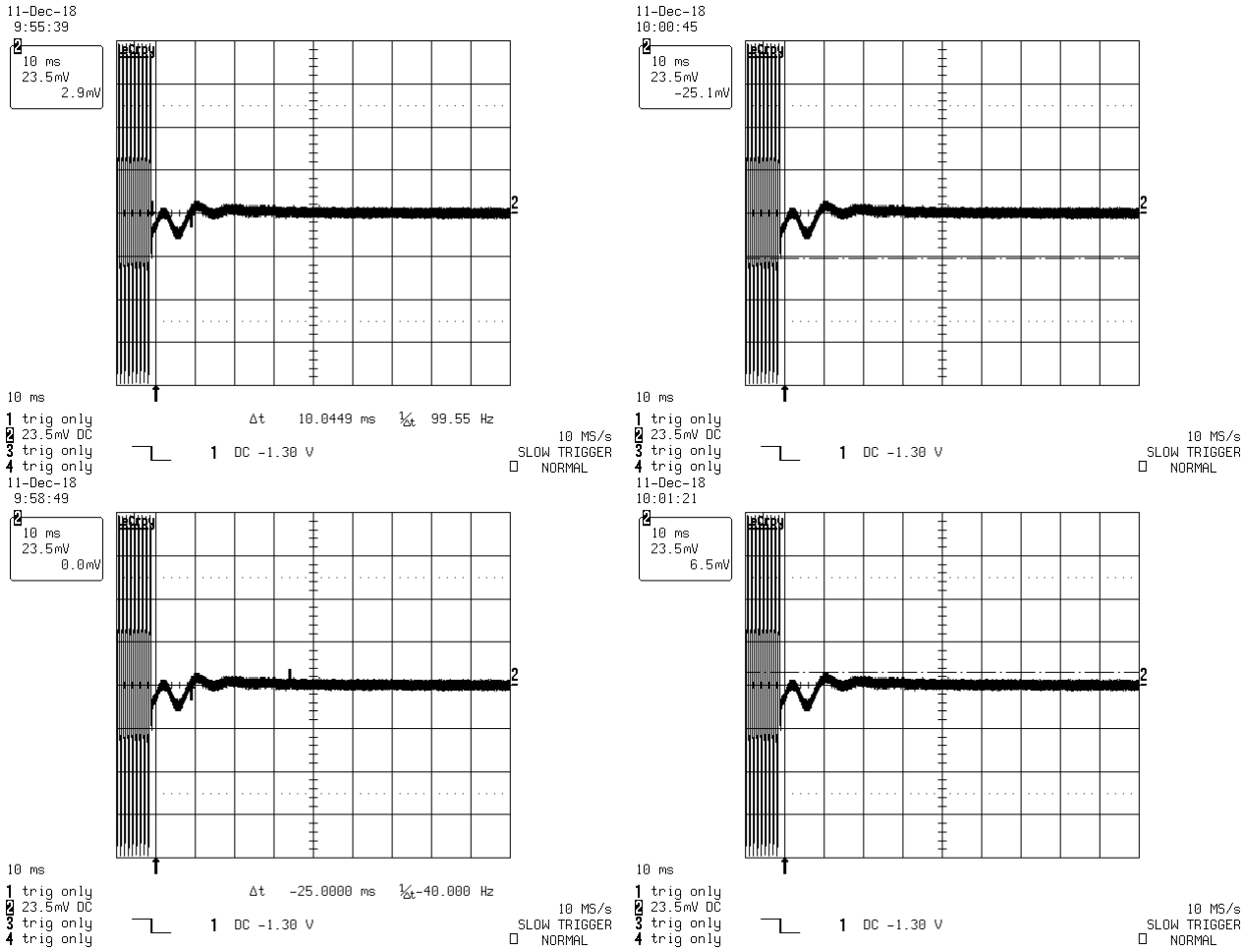
Reference numbers of test equipment used

HL 0911	HL 2016	HL 2017	HL 2227	HL 4413	HL 4938	HL 5369	HL 5372

Full description is given in Appendix A.

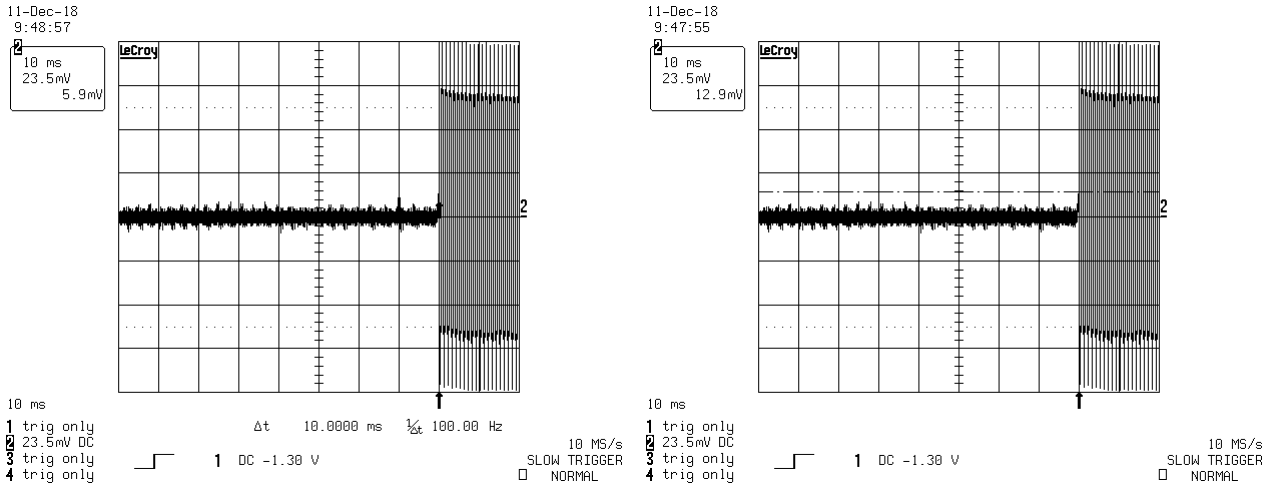
Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 ºC	**Relative Humidity:** 47 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 7.7.1 Transient frequency behavior during power ON test results at low carrier frequency



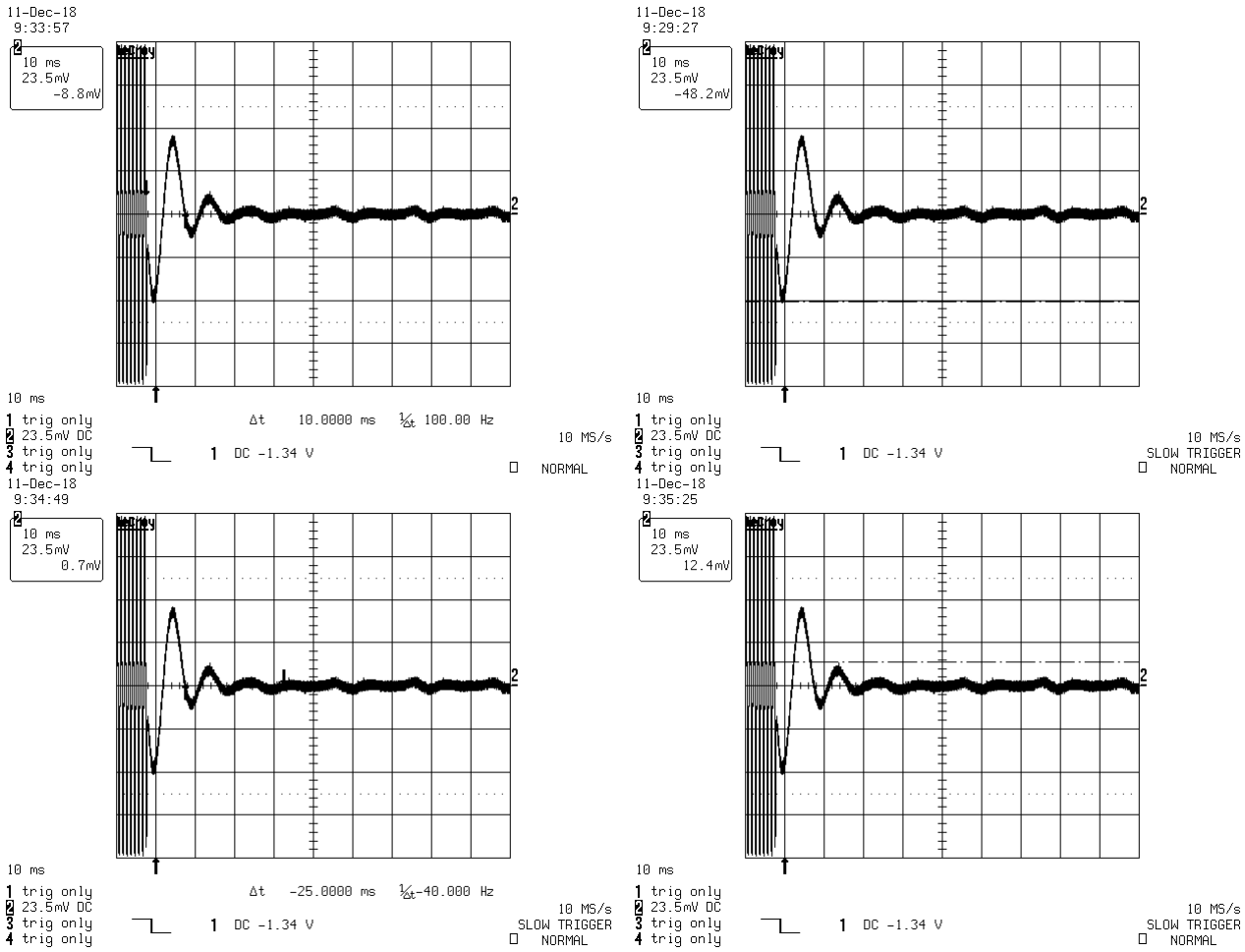
Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 °C	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.7.2 Transient frequency behavior during power OFF test results at low carrier frequency



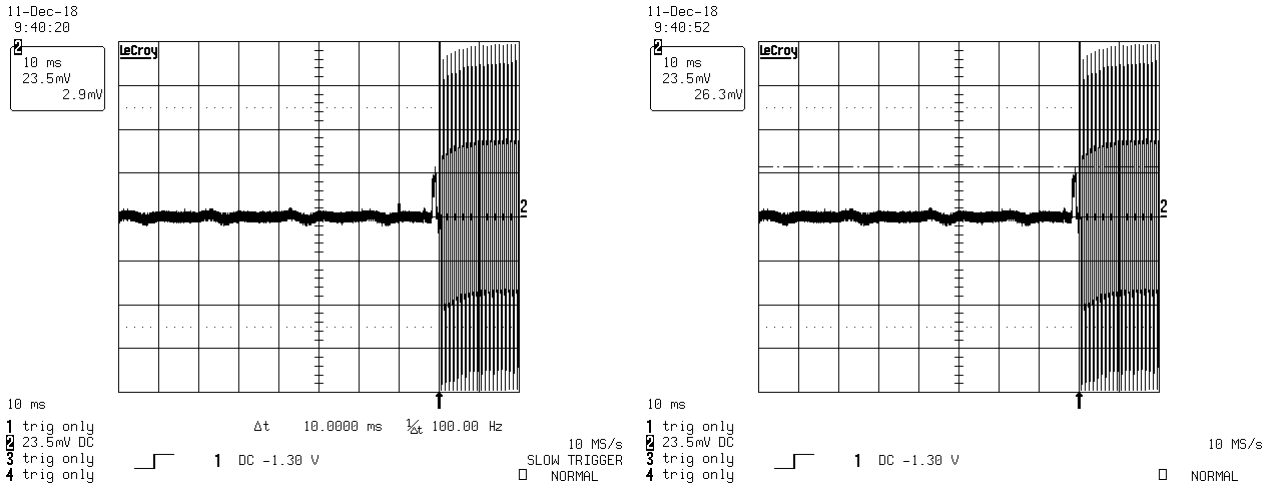
Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 °C	**Relative Humidity:** 47 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Plot 7.7.3 Transient frequency behavior during power ON test results at high carrier frequency



Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	ANSI C63.26, section 6.5.2.3		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Dec-18 - 11-Dec-18		
Temperature: 24.2 °C	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Plot 7.7.4 Transient frequency behavior during power OFF test results at high carrier frequency



Test specification:	Section 90.207, Modulation limiting		
Test procedure:	ANSI C63.26, section 5.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	06-Dec-18		
Temperature: 24.1 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

7.8 Modulation limiting

7.8.1 General

This test was performed to check the ability of a transmitter circuit to limit the transmitter from producing deviations in excess of a rated system deviation.

7.8.2 Test procedure

7.8.2.1 The EUT was set up as shown in Figure 7.7.1, energized and its proper operation was checked.

7.8.2.2 The EUT was adjusted to provide full rated system deviation.

7.8.2.3 The test receiver was set to measure peak positive deviations. The de-emphasis function was turned off.

7.8.2.4 A 1000 Hz modulating signal of audio generator was applied to the EUT and the output level was adjusted to obtain 60% of the full rated system deviation. This level was used as a reference level (0 dB).

7.8.2.5 The level from audio generator was increased by 20 dB in 5 increments and the deviation in each step was measured and recorded from the test receiver.

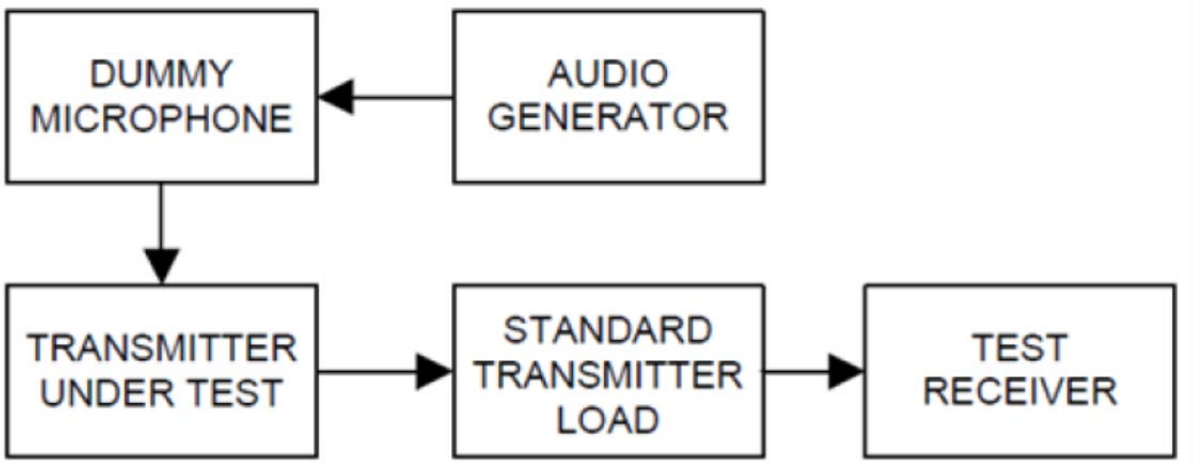
7.8.2.6 The test was repeated at frequencies 300, 2500 and 3000 Hz at a minimum using the 0 dB reference obtained above.

7.8.2.7 The test receiver was set to measure peak negative deviation and the test was repeated at all frequencies.

7.8.2.8 The values recorded above are the modulation limiting and the frequency deviation was obtained as a percentage of deviation relative to the 0 dB reference point versus voltage (function of the input level) and provided in Table 7.8.1, Table 7.8.2.

Test specification:	Section 90.207, Modulation limiting		
Test procedure:	ANSI C63.26, section 5.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	06-Dec-18		
Temperature: 24.1 ºC	Relative Humidity: 46 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Figure 7.8.1 Modulation limiting test setup



Test specification:	**Section 90.207, Modulation limiting**		
Test procedure:	ANSI C63.26, section 5.3.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	06-Dec-18		
Temperature: 24.1 ºC	**Relative Humidity:** 46 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.8.1 Modulation limiting test results at channel 11, 483.0125 MHz

Modulating signal	**1000 Hz**		**300 Hz**		**2500 Hz**		**3000 Hz**	
Level audio generator, dB	**Positive deviation, kHz**	**Negative deviation, kHz**	**Positive deviation, kHz**	**Negative deviation, kHz**	**Positive deviation, kHz**	**Negative deviation, kHz**	**Positive deviation, kHz**	**Negative deviation, kHz**
0 (210 mV)*	3.00	3.00	1.25	1.25	3.75	3.75	3.25	3.25
5 (373.4 mV)	4.50	4.50	2.00	2.00	4.00	4.00	3.25	3.25
10 (664 mV)	4.50	4.75	3.37	2.50	4.00	4.00	3.25	3.25
15 (1180 mV)	4.25	4.50	3.75	2.50	4.25	4.25	3.37	3.35
20 2100 mV)	4.25	4.50	3.75	2.50	4.00	3.75	3.37	3.40

*60% of full rate of system deviation is level audio generator 210mV. This is the 0 dB reference level

Table 7.8.2 Modulation limiting test results at channel 12, 484.76 25 MHz

Modulating signal	**1000 Hz**		**300 Hz**		**2500 Hz**		**3000 Hz**	
Level audio generator, dB	**Positive deviation, kHz**	**Negative deviation, kHz**	**Positive deviation, kHz**	**Negative deviation, kHz**	**Positive deviation, kHz**	**Negative deviation, kHz**	**Positive deviation, kHz**	**Negative deviation, kHz**
0 (210 mV)*	2.75	2.75	1.25	1.25	3.00	3.37	2.50	2.50
5 (373.4 mV)	4.24	4.00	1.50	1.50	3.00	3.25	2.50	2.50
10 (664 mV)	4.00	4.37	2.00	2.00	3.00	3.25	2.50	2.50
15 (1180 mV)	3.50	4.00	2.85	2.25	3.00	3.25	2.50	2.50
20 2100 mV)	3.00	4.00	3.12	2.25	3.00	3.25	2.50	2.50

*60% of full rate of system deviation is level audio generator 210mV This is the 0 dB reference level

Reference numbers of test equipment used

HL 0911	HL 2016	HL 2017	HL 2227	HL 4413	HL 4938	HL 5369	HL 5372

Full description is given in Appendix A.

Test specification:	**Section 90.214, Audio frequency response**		
Test procedure:	ANSI C63.26, section 5.3.3.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11-Dec-18		
Temperature: 23.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

7.9 Audio frequency response test

7.9.1 General

This test was performed to measure the frequency response of the audio modulation circuit over a range of 300 to 3000 Hz.

7.9.2 Test procedure

7.9.2.1 The EUT was set up as shown in Figure 7.9.1, energized and its proper operation was checked.

7.9.2.2 The receiver was set to measure peak positive deviations. The de-emphasis function was turned off.

7.9.2.3 The EUT was adjusted to provide full rated system deviation.

7.9.2.4 A 1000 Hz tone of audio generator was applied to the EUT and the level was adjusted to obtain 20% of full rated system deviation. .This level was used as a reference (0 dB).

7.9.2.5 The receiver was set to measure rms deviation and results were recorded as DEV_{ref} in Table 7.9.2.

7.9.2.6 The audio generator was set to the desired test frequencies between 300 Hz and 3000 Hz and the test receiver deviation reading was recorded as DEV_{freq} in Table 7.9.2.

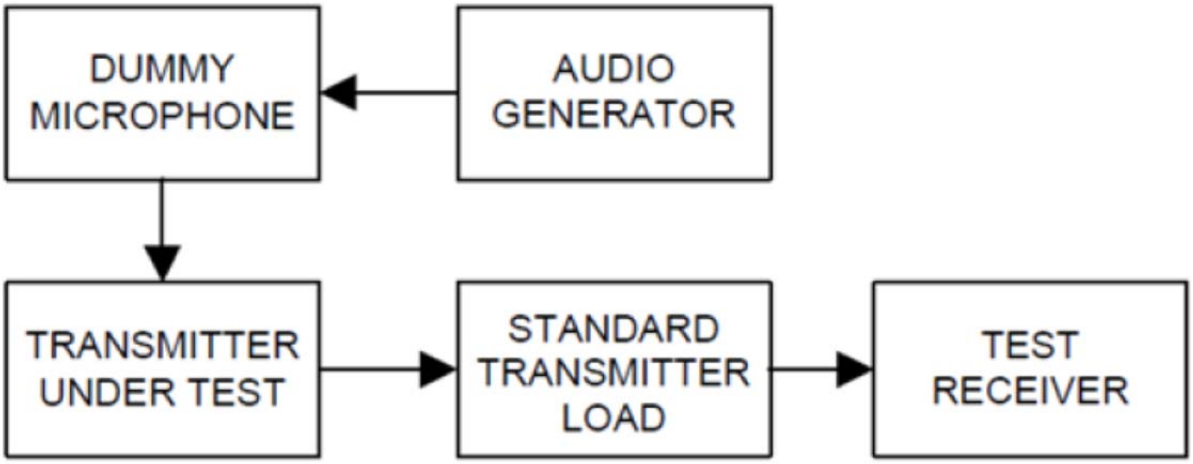
7.9.2.7 The audio frequency response at the present frequency was calculated according to the next equation:

$$\text{audio frequency response} = 20 \log_{10} (DEV_{FREQ} / DEV_{REF})$$

7.9.2.8 The test was repeated at 300 Hz, 2500 Hz and 3000 Hz and test results were recorded in Table 7.9.2.

Test specification:	Section 90.214, Audio frequency response		
Test procedure:	ANSI C63.26, section 5.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	11-Dec-18		
Temperature: 23.9 ºC	Relative Humidity: 48 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

Figure 7.9.1 Audio frequency response test test setup



Test specification:	**Section 90.214, Audio frequency response**		
Test procedure:	ANSI C63.26, section 5.3.3.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	11-Dec-18		
Temperature: 23.9 ºC	**Relative Humidity:** 48 %	**Air Pressure:** 1009 hPa	**Power:** 120 VAC, 60 Hz
Remarks:			

Table 7.9.1 Audio frequency response test test results

Carrier frequency, MHz	Frequency , Hz	Reference deviation DEV_{ref}, mV	Measured deviation, DEF_{freq}, mV	Audio frequency response, dB
483.0125	300	51.3	201.5	11.88
	400		126.8	7.86
	500		99.7	5.77
	700		72.4	2.99
	1000		51.3	0
	1500		37.0	-2.84
	2000		29.7	-4.75
	2500		26.7	-5.67
	3000		30.6	-4.49
484.7625	300	57.56	207.7	11.15
	400		133.2	7.29
	500		104.3	5.16
	700		75.1	2.31
	1000		57.56	0.00
	1500		41.2	-2.90
	2000		33.3	-4.75
	2500		28.7	-6.04
	3000		30.6	-5.49

Reference numbers of test equipment used

HL 0911	HL 2016	HL 2017	HL 2227	HL 4413	HL 4938	HL 5369	HL 5372

Full description is given in Appendix A.

8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0911	Coupler Dual Directional, 20 dB, 0.1 - 2.0 GHz	Hewlett Packard	778D	1144A07827	12-Mar-19	12-Mar-22
1205	One phase voltage regulator, 2kVA, 0-250V	Hermon Laboratories	TDGC-2	109	03-Apr-19	03-Apr-20
1480	Cable, 1 m	Harbour Industries	MIL 17/60-RG142	1480	02-Sep-18	02-Sep-19
1824	Attenuator Coaxial, 30 dB, 100 W, 50 Ohm	Bird Electronic Corp.	8323	1185	11-Feb-19	11-Feb-20
2016	Attenuator, Manual Step, 0-9/1 dB, 0-8 GHz, 2 W	Midwest Microwave	1072	1315	05-Mar-19	05-Mar-20
2017	Attenuator, Manual Step, 0-60/10 dB, 0-8.0 GHz	Midwest Microwave	1071	2017	05-Mar-19	05-Mar-20
2227	Crystal Detector 0.01-18 GHz, 100 mW	Hewlett Packard Co	8472A	NA	19-Sep-17	19-Sep-19
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY41444762	04-Apr-19	04-Apr-20
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	28-Mar-19	28-Mar-20
3440	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini-Circuits	BW-S20W5+	NA	10-Dec-18	10-Dec-19
3637	Cable RF, 3.5 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	26-Jun-18	26-Jun-19
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	28-May-18	28-May-19
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	07-Apr-19	07-Apr-20
4068	Attenuator, SMA, 30 dB, DC to 12.4 GHz	Midwest Microwave	ATT-0527-30-SMA-07	NA	09-Aug-18	09-Aug-19
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	31-Dec-18	31-Dec-19
4413	Resistive divider, DC to 1.5 GHz, 2 W	Microlab	DA-3FN	NA	20-Jul-17	20-Jul-19
4778	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1431, HL4777	Hewlett Packard	8542E	30807A00262, 3427A00123	28-Oct-18	28-Oct-19
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	06-Jan-19	06-Jan-20
4938	Test Cable, 50Ω, 1.8 m, DC to 18 GHz	Mini-Circuits	CBL-6FT-SMNM+	NA	28-Mar-18	28-Mar-19
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	08-Feb-19	08-Feb-22
5369	Digital storage oscilloscope, 350 MHz	Keysight Technologies	DSOX3034T	MY58032630	31-May-18	31-May-19
5372	MXE EMI receiver, 3 Hz to 44 GHz	Keysight Technologies	N9038A	MY57290155	21-May-18	21-May-19
5376	EXA Signal Analyzer, 10 Hz - 32 GHz	Keysight Technologies	N9010B	MY57470404	18-Mar-19	18-Mar-20
5391	Temperature/Humidity Cycle Chamber, -77 - +177 deg., Humidity Range 20% RH to 95% RH	Thermotron	SM-8C	27737	22-Jul-18	22-Jul-19
5405	RF cable, 18 GHz, N-N, 6 m	Huber-Suhner	SF118/11N(x2)	500023/118	01-Aug-18	01-Aug-19

9 APPENDIX B 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	±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 ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

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

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

10 APPENDIX C Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.
Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers are R-10808 for OATS, R-1082 for anechoic chamber, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 for conducted emissions at telecommunication ports).
The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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

11 APPENDIX D Specification references

FCC 47CFR part 90: 2018	Private land mobile radio services
FCC 47CFR part 1: 2018	Practice and procedure
FCC 47CFR part 2: 2018	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.26: 2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
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.

12 APPENDIX E Test equipment correction factors

Antenna factor
Trilog antenna
Model ALX-8000E, Frankonia, S/N 00809, HL 5288, 30-1000 MHz

Frequency, MHz	Antenna factor, dB/m		
	Vert Up	Vert Down	Delta
30	-51.19	-51.28	0.09
35	-44.03	-44.12	0.09
40	-43.07	-43.12	0.05
45	-39.61	-39.79	0.18
50	-37.84	-38.14	0.3
60	-34.93	-34.9	0.03
70	-29.76	-29.66	0.1
80	-27.69	-27.82	0.13
90	-29.05	-29.07	0.02
100	-31.19	-31.19	0
120	-31.61	-31.6	0.01
140	-28.13	-28.06	0.07
160	-27.71	-27.75	0.04
180	-26.19	-26.15	0.04
200	-28.2	-28.15	0.05
250	-27.45	-27.47	0.02
300	-29.61	-29.63	0.02
400	-31.77	-31.78	0.01
500	-32.81	-32.81	0
600	-33.64	-33.61	0.03
700	-34.21	-34.21	0
800	-35.66	-35.66	0
900	-36.99	-36.91	0.08
1000	-38	-37.91	0.09

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/m).

Antenna factor
Active Horn Antenna,
Com-Power Corporation, model: AHA-118, s/n 701046, HL 4933

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
1000	-16.1
1500	-15.1
2000	-10.9
2500	-11.9
3000	-11.1
3500	-10.6
4000	-8.6
4500	-8.3
5000	-5.9
5500	-5.7
6000	-3.3
6500	-4.0
7000	-2.2
7500	-1.7
8000	1.1
8500	-0.8
9000	-1.5
9500	-0.2

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
10000	1.8
10500	1.0
11000	0.3
11500	-0.5
12000	3.1
12500	1.4
13000	-0.3
13500	-0.4
14000	2.5
14500	2.2
15000	1.9
15500	0.5
16000	2.1
16500	1.2
17000	0.6
17500	3.1
18000	4.2

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

Cable loss
Cable coaxial, RG-214/U, N type-N type, 3.5 m
Alpha Wire, HL 3637

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.03	3300	2.02
50	0.16	3400	2.11
100	0.24	3500	2.12
200	0.36	3600	2.19
300	0.45	3700	2.24
400	0.54	3800	2.27
500	0.60	3900	2.35
600	0.67	4000	2.35
700	0.74	4100	2.44
800	0.80	4200	2.45
900	0.86	4300	2.51
1000	0.91	4400	2.56
1100	0.97	4500	2.59
1200	1.02	4600	2.65
1300	1.07	4700	2.68
1400	1.13	4800	2.76
1500	1.17	4900	2.78
1600	1.23	5000	2.86
1700	1.30	5100	2.91
1800	1.33	5200	2.95
1900	1.37	5300	3.05
2000	1.43	5400	3.05
2100	1.48	5500	3.14
2200	1.52	5600	3.16
2300	1.57	5700	3.23
2400	1.61	5800	3.31
2500	1.66	5900	3.34
2600	1.70	6000	3.45
2700	1.75	6100	3.46
2800	1.80	6200	3.56
2900	1.84	6300	3.61
3000	1.89	6400	3.68
3100	1.94	6500	3.77
3200	1.99		

Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A
HL 3903

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.02	9500	1.84	21000	2.98
100	0.15	10000	1.86	22000	3.07
500	0.38	10500	1.93	23000	3.13
1000	0.56	11000	1.99	24000	3.21
1500	0.69	11500	2.04	25000	3.26
2000	0.82	12000	2.10	26000	3.48
2500	0.90	12500	2.15	27000	3.44
3000	0.98	13000	2.21	28000	3.53
3500	1.06	13500	2.25	29000	3.59
4000	1.11	14000	2.29	30000	3.66
4500	1.17	14500	2.34	31000	3.70
5000	1.24	15000	2.36	32000	3.79
5500	1.32	15500	2.40	33000	3.88
6000	1.40	16000	2.45	34000	3.94
6500	1.50	16500	2.48	35000	3.91
7000	1.56	17000	2.56	36000	4.05
7500	1.62	17500	2.58	37000	4.22
8000	1.68	18000	2.60	38000	4.25
8500	1.74	19000	2.84	39000	4.27
9000	1.78	20000	2.88	40000	4.33

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m,
SF118/11N(x2), S/N 500023/118
HL 5405

5405

Specific Test Report

Frequency Range [GHz]	IL min S21 [dB]	IL min S12 [dB]	RL max S11 [dB]	RL max S22 [dB]
0.040 - 1.836	-1.431	-1.431	-37.037	-37.704
1.836 - 3.632	-2.062	-2.066	-33.573	-32.848
3.632 - 5.428	-2.576	-2.576	-28.548	-29.602
5.428 - 7.224	-3.013	-3.014	-30.738	-32.523
7.224 - 9.020	-3.415	-3.416	-33.728	-32.257
9.020 - 10.816	-3.772	-3.772	-29.302	-30.735
10.816 - 12.612	-4.138	-4.138	-28.768	-26.255
12.612 - 14.408	-4.456	-4.462	-27.109	-26.151
14.408 - 16.204	-4.786	-4.786	-26.056	-27.116
16.204 - 18.000	-5.113	-5.111	-27.762	-28.508

Type:	SF118/11N/11N/6000MM
Sales no.:	10497130
Serial no.:	500023 /118
PA no.:	1956306
Ring no.:	
Cable length:	6 m
Test length:	
Connector 1:	SF_11_N-656
Connector 2:	SF_11_N-656
Cable:	SUCOFLEX_118
Meas. System:	N5230C,MY49001834,A.09.42.22
Time:	7:04:21 AM
Date:	6/6/2018
Inspected by:	AZ /111
Start Freq.:	0.04000 GHz
Stop Freq.:	18.00000 GHz
Meas Points:	801
Source Power:	-5 dBm

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
dBΩ	decibel referred to one Ohm
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
ITE	information technology equipment
k	kilo
kHz	kilohertz
LISN	line impedance stabilization network
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
QP	quasi-peak
PM	pulse modulation
PS	power supply
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere

END OF DOCUMENT