

TEST REPORT

ACCORDING TO:

EN 300 220-2 V3.1.1: 2017

EN 300 220-1 V3.1.1: 2017

FOR:

**Essence Security
International Ltd.**

Smoke Detector

Model: ES700SK2-ES-M03

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1 Applicant information

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Telephone: +972 7324 47735
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E-mail: israelgo@essence-grp.com
Contact name: Mr. Israel Gottesman

2 Equipment under test attributes

Product name: Smoke Detector
Product type: Transceiver
Model: ES700SK2-ES-M03
Hardware version: 4.H
Software release: 2.09
Receipt date: 10-Apr-18

3 Manufacturer information

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

4 Test details

Project ID: 30366
Location: Hermon Laboratories Ltd. Hefetz-Haim 10, Tel Aviv 6744124, Israel
Test started: 10-Apr-18
Test completed: 06-Jun-18
Test specifications: EN 300 220-2 V3.1.1: 2017
EN 300 220-1 V3.1.1: 2017

5 Tests summary

Test	Status
EN 300 220-2 V3.1.1 / EN 300 220-1 V3.1.1	
Transmitter parameters	
Operating frequency	Pass ^{Note 1}
Effective radiated power	Pass
Maximum effective radiated power spectral density	Not required ^{Note 2}
Duty cycle	Pass
Occupied bandwidth	Pass
Frequency error	Pass
Tx out of band emissions	
Conducted	Pass
Radiated	Not required ^{Note 3}
Unwanted emissions in the spurious domain	
Conducted	Not required ^{Note 4}
Spectrum mask for unwanted emissions in the spurious domain (Radiated)	Pass
Spurious domain emissions (Radiated)	Pass
Transient power	Pass
Adjacent channel power	
Conducted	Not required ^{Note 5}
Radiated	Not required ^{Note 5}
Tx behaviour under low voltage conditions	Pass
Adaptive power control	Not required ^{Note 6}
Tx FHSS	Not required ^{Note 7}
Tx short term behaviour	Not required ^{Note 8}
Receiver parameters	
Receiver sensitivity level	Not required ^{Note 9}
Clear channel assessment threshold	Not required ^{Note 9}
Polite spectrum access timing parameters	Not required ^{Note 9}
Blocking	Pass
Adaptive frequency agility	Not required ^{Note 10}

Note 1: Declared by manufacturer.

Note 2: The EUT does not belong to radio equipment using bands I, L of EN 300 220-2 V3.1.1, Annex B or using DSSS or wideband techniques other than FHSS modulation or using band X of EN 300 220-2 V3.1.1, Annex C.

Note 3: Conducted measurement method was used.

Note 4: Radiated measurement method was used.

Note 5: The EUT operating channel bandwidth is 500 kHz (> 25 kHz).

Note 6: The EUT does not belong to radio equipment with adaptive power control using band AA of EN 300 220-2 V3.1.1, Annex C.

Note 7: The EUT does not belong to FHSS radio equipment.




Note 8: The EUT does not belong to radio equipment using band Y, Z, AA, AB, AC, AD of EN 300 220-2 V3.1.1, Annex C.

Note 9: The EUT does not belong to radio equipment with polite spectrum access.

Note 10: The EUT does not belong to radio equipment with adaptive frequency agility.

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	June 6, 2018	
Reviewed by:	Ms. N. Averin, certification engineer	June 18, 2018	
Approved by:	Mr. K. Zushchuk, Projects & Customer Manager, EMC & Radio	July 9, 2018	

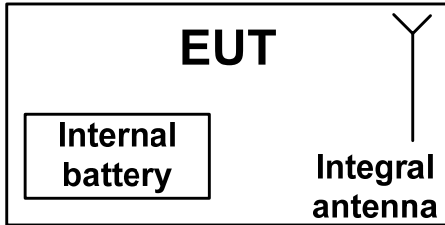


6 EUT description

6.1 General information

The EUT is a smoke detector ES700SK2-ES-M03, ceiling mounted. The EUT comprises RF module operating at 868.3 MHz, 2FSK modulation. The EUT is powered by 3VDC from 2 batteries of 1.5V. The EUT has a receiver class 2.

6.2 Test configuration





Test specification:	Section 4.2.1: Operating frequency		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.1; manufacturer declaration		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.7 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7 Parameters and tests

7.1 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		
Operational frequency bands		868.0 – 868.6 MHz		
Operating frequencies		868.3 MHz		
Maximum rated output power		At transmitter 50 Ω RF output connector	dBm	
		Effective radiated power (for equipment with no RF connector)	3.72 dBm	
Is transmitter output power variable?	X	No		
		Yes	continuous variable	
			stepped variable with stepsize	dB
			minimum RF power	dBm
		maximum RF power	dBm	
Antenna connection				
unique coupling	standard connector	X	integral	
		X	with temporary RF connector without temporary RF connector	
Antenna gain		-3 dBi		
Operating channel bandwidth		500 kHz		
Type of modulation		2FSK		
Bit rate		38.4 kbps		
Maximum transmitter duty cycle		0.0006 (≤ 0.1 %)		
Transmitter power source				
X	Battery	Nominal rated voltage	3 VDC	
	DC	Nominal rated voltage	VDC	
	AC mains	Nominal rated voltage	VAC	
		Frequency	Hz	
Common power source for transmitter and receiver		X	yes	
			No	
Receiver class		2		



Test specification:	Section 4.3.1: Effective radiated power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.2 Effective radiated power of carrier

7.2.1 General

This test was performed to measure effective radiated power emanated by transmitter at carrier frequency. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Effective radiated power limit

Operational frequency band, MHz	ERP*		Equivalent field strength limit @ 3m, dB(μV/m)**
	mW	dBm	
868.0 – 868.6	25	14.0	111.4

* - ERP limits for the assigned frequency band referred to CEPT ERC Recommendation 70-03.

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

7.2.2 Test procedure for field strength measurements

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was swept throughout the range, specified in Table 7.2.2, in both vertical and horizontal polarizations.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.2.2 and shown in the associated plots.

7.2.3 Test procedure for substitution ERP measurements

7.2.3.1 The test equipment was set up as shown in

7.2.3.2 Figure 7.2.2 and energized.

7.2.3.3 RF signal generator was set to the EUT carrier frequency and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.2.3.4 The test antenna height was swept throughout the specified in Table 7.2.2 range to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.2.3.5 The ERP was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.2.3.6 The above procedure was performed in both horizontal and vertical polarizations of the test antenna.

7.2.3.7 The worst test results (the lowest margins) were recorded in Table 7.2.3.

7.2.4 Test procedure for ERP measurements in extreme temperature conditions

7.2.4.1 The EUT was set up as shown in Figure 7.2.3 under normal conditions, energized and its proper operation was checked. The EUT output power at temporary antenna connector was measured at the lowest EUT operating frequency.

7.2.4.2 The EUT power was turned off. The temperature within test chamber and power voltage were set to the higher extreme condition and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

7.2.4.3 The EUT was powered on, the EUT output power at temporary antenna connector was measured.

7.2.4.4 The above procedure was repeated under the rest of extreme temperatures and voltages.

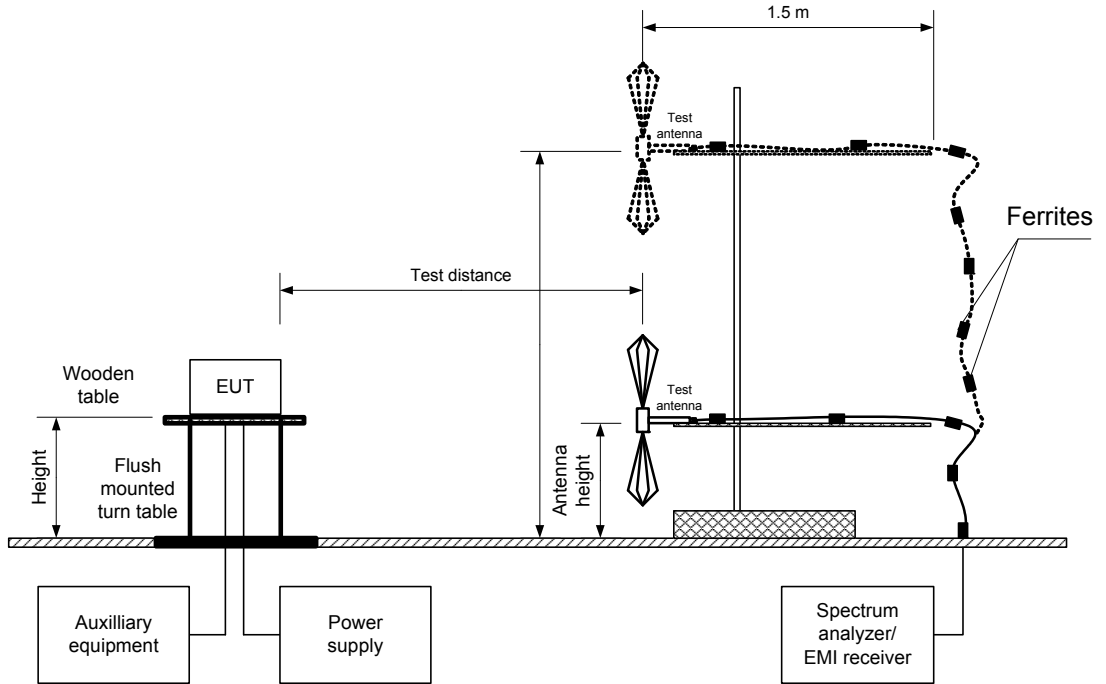
7.2.4.5 The above procedure was repeated at the highest EUT operating frequency.

7.2.4.6 ERP was calculated and compared with the limit as provided in Table 7.2.4.



Test specification:	Section 4.3.1: Effective radiated power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.2.1 Setup for carrier field strength measurements



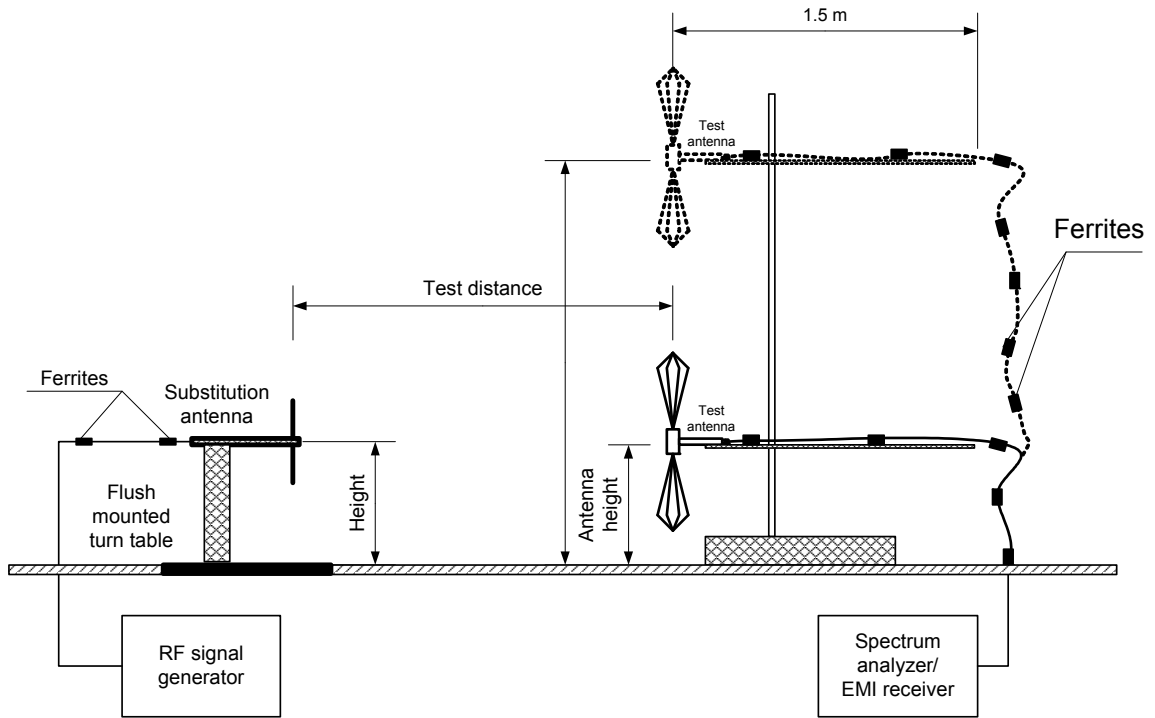
Photograph 7.2.1 Setup for carrier field strength measurements



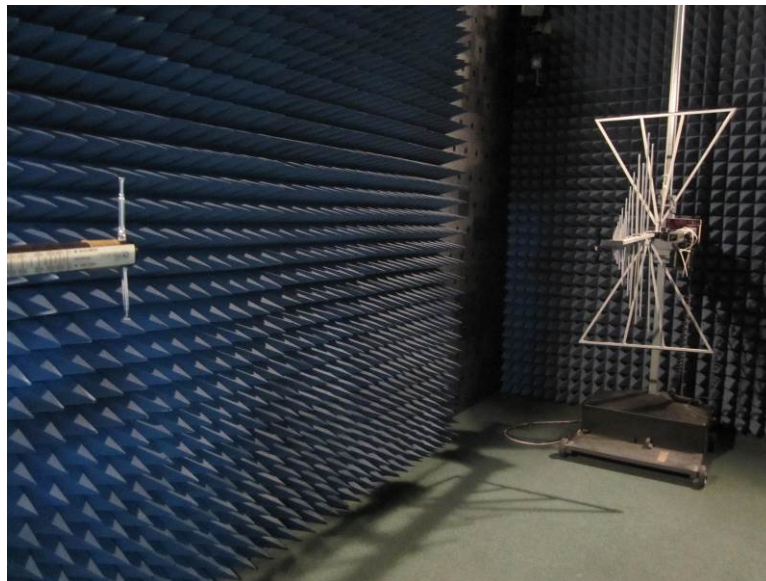


Test specification:	Section 4.3.1: Effective radiated power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.2.2 Setup for substitution ERP measurements



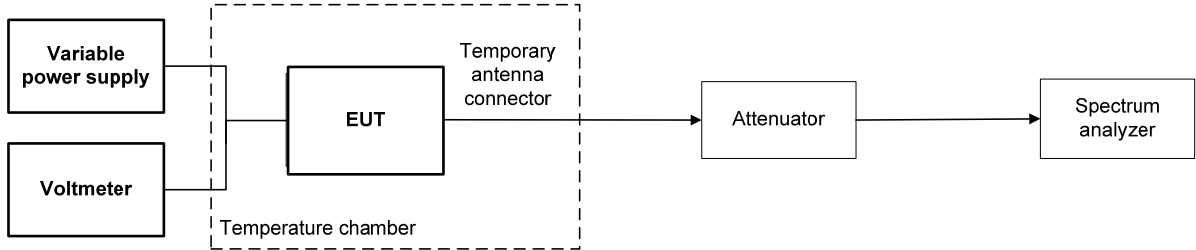
Photograph 7.2.2 Setup for substitution ERP measurements





Test specification:	Section 4.3.1: Effective radiated power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.2.3 ERP measurements in extreme test conditions test setup



Photograph 7.2.3 ERP measurements in extreme test conditions test setup





Test specification:	Section 4.3.1: Effective radiated power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.2.2 Transmitter carrier field strength

OPERATIONAL FREQUENCY BAND: 868.0-868.6 MHz
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
EUT HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 2.5 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: 3000 kHz
TEST ANTENNA TYPE: Biconilog (25 MHz – 1000 MHz)
MODULATION: Unmodulated
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
Operating frequency 868.30 MHz							
868.300	91.55	111.4	-19.85	1000	Vertical	1.89	333
868.290	102.90	111.4	-8.50		Horizontal	1.26	31

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

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

Table 7.2.3 Transmitter carrier ERP

TEST DISTANCE: 3 m
SUBSTITUTION ANTENNA HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 2.5 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: 3000 kHz
SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
Operating frequency 868.30 MHz										
868.300	91.55	1000	Vertical	-4.4	-0.34	2.78	-7.55	14	-21.55	Pass
868.290	102.90		Horizontal	6.54	-0.34	2.48	3.72	14	-10.28	Pass

*- Margin = ERP – specification limit.

Reference numbers of test equipment used

HL 4535	HL 4541	HL 4542	HL 4549	HL 4575	HL 4604	HL 4665	HL 4958
HL 0493	HL 4550	HL 3771	HL 4649	HL 3233			

Full description is given in Appendix A.

Table 7.2.4 Transmitter carrier ERP under extreme test conditions

Frequency MHz	Temperature, °C	Voltage, V	ERP dBm	Limit dBm	Margin dB	Verdict
Operating frequency 868.30 MHz						
868.30	+55	3.0	3.60	14	-10.40	Pass
		2.55	3.59		-10.41	Pass
	+25	3.0	3.72		-10.28	Pass
		3.0	4.15		-9.85	Pass
		2.55	4.16		-9.84	Pass
-10	3.0	3.60	-10.40	Pass		
	2.55	3.59	-10.41	Pass		

*- ERP = Pout + antenna gain.

** - Margin = ERP – specification limit.

Reference numbers of test equipment used

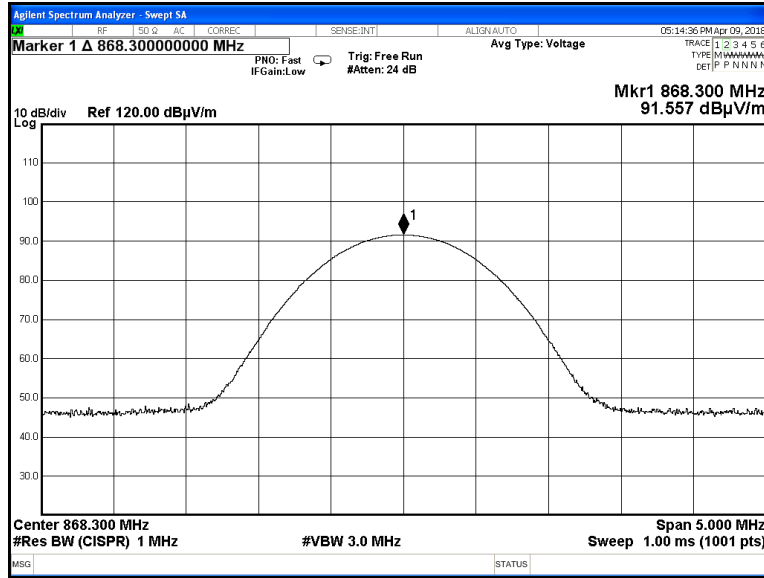
HL 0493	HL 4575	HL 4550	HL 4649	HL 3233		
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Full description is given in Appendix A.

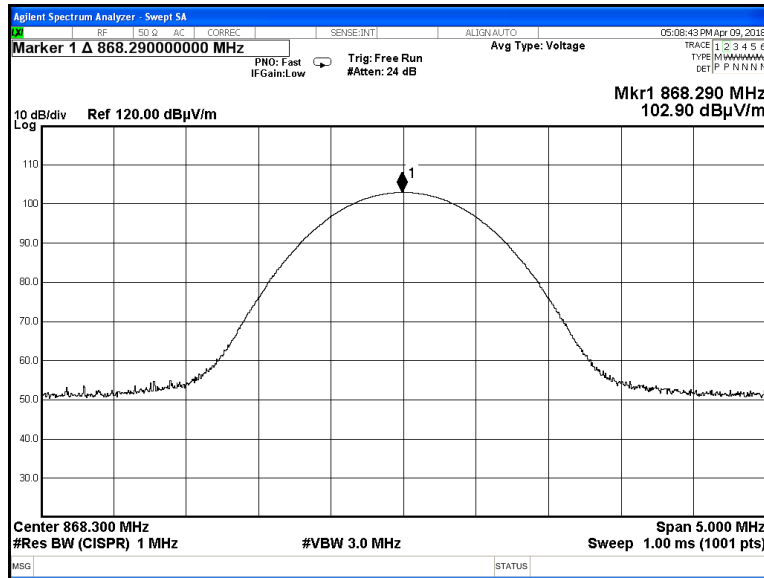


Test specification:	Section 4.3.1: Effective radiated power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Plot 7.2.1 Transmitter carrier field strength in vertical antenna polarization



Plot 7.2.2 Transmitter carrier field strength in horizontal antenna polarization





Test specification:	Section 4.3.3: Duty cycle		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.4.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.7 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.3 Duty cycle

7.3.1 General

This test was performed to measure RF transmission duration, repetition rate and to calculate duty cycle. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Duty cycle limit

Assigned frequency band, MHz	Duty cycle*, %	Observation period, hours
868.0 – 868.6	1	1

* - Duty cycle limit for the assigned frequency band referred to CEPT ERC Recommendation 70-03.

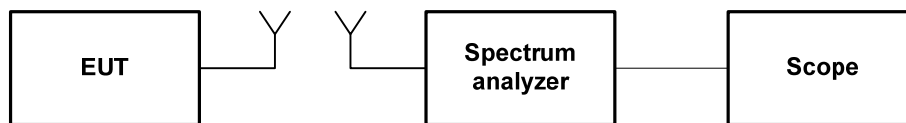
7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT was adjusted to produce maximum available to end user duty cycle.

7.3.2.3 The time characteristics of RF transmission were measured as provided in Table 7.3.2 and associated plots.

Figure 7.3.1 Setup for duty cycle measurements



Photograph 7.3.1 Setup for duty cycle measurements





Test specification:	Section 4.3.3: Duty cycle		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.4.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.7 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.3.2 Duty cycle measurement results

OPERATIONAL FREQUENCY BAND: 868.0 – 868.6 MHz
 MODULATION: 2FSK
 MODULATING SIGNAL: PRBS
 OBSERVATION PERIOD: 1 hour

RF pulse duration, ms	Number of RF pulses within one observation period	Total duty cycle*, %	Limit, %	Margin**, %	Verdict
7.750	3	0.00064583	1.0	-0.99935	Pass

*- The total duty cycle was calculated as follows:

$$Duty\ cycle = \frac{RF\ pulse\ duration \times Number\ of\ RF\ pulses\ within\ one\ observation\ period}{Observation\ period} \times 100\%$$

**- Margin = Total duty cycle – specification limit.

Reference numbers of test equipment used

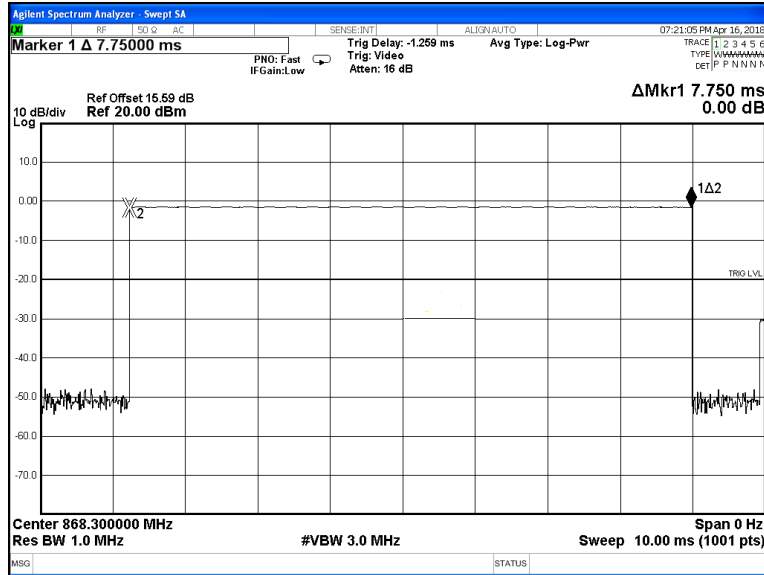
HL 4575	HL 0493	HL 4550				
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Full description is given in Appendix A.

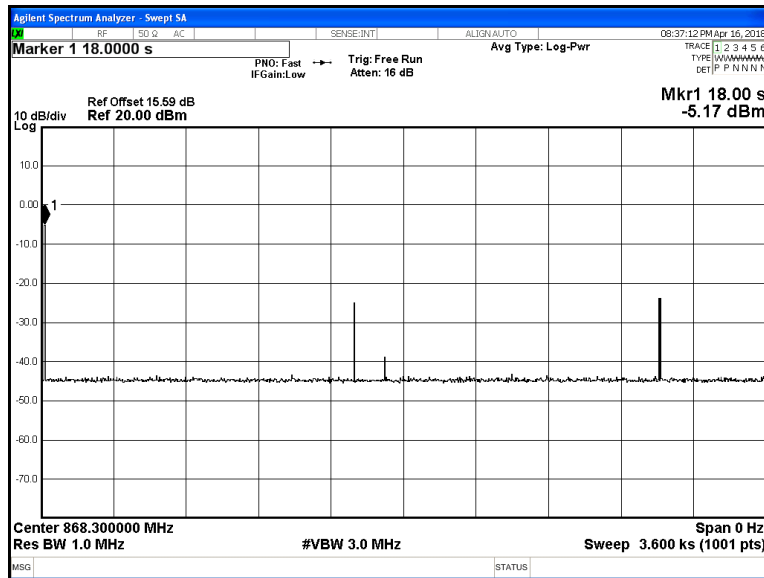


Test specification:	Section 4.3.3: Duty cycle		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.4.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.7 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Plot 7.3.1 RF transmission duration



Plot 7.3.2 RF transmission period



Test specification:	Section 4.3.4: Occupied bandwidth		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.6.3.3/5.6.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.3 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.4 Occupied bandwidth

7.4.1 General

This test was performed to measure occupied bandwidth at the EUT RF antenna connector. Maximum occupied bandwidth at 99% shall reside entirely within the operating channel defined in Table 7.4.1.

Table 7.4.1 Operating channel

Operational frequency band, MHz	Modulation envelope reference points
868.0 – 868.6 MHz	99%

7.4.2 Test procedure

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

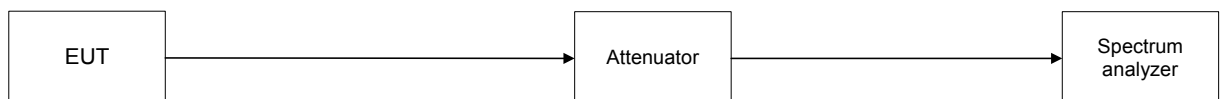
7.4.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.4.2.3 The occupied bandwidth was measured with spectrum analyzer (the 99% occupied bandwidth function of the spectrum analyzer was used).

7.4.2.4 Maximum occupied bandwidth was calculated as OBW under normal conditions by adding the worst frequency error under extreme conditions result.

7.4.2.5 The test results were recorded in Table 7.4.2 and shown in the associated plot.

Figure 7.4.1 Setup for occupied bandwidth measurements



Photograph 7.4.1 Setup for occupied bandwidth measurements





Test specification:	Section 4.3.4: Occupied bandwidth		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.6.3.3/5.6.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.3 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.4.2 Occupied bandwidth test results

RESOLUTION BANDWIDTH: 10 kHz
VIDEO BANDWIDTH: 30 kHz
TRACE: Max hold

Frequency, MHz	OBW under normal conditions, kHz	Maximum OBW, kHz*	OBW limit, kHz**	Verdict
868.3	148.84	154.511	500.00	Pass

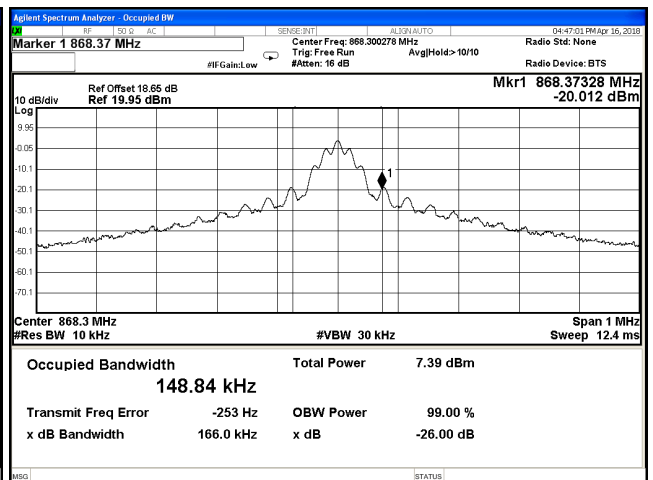
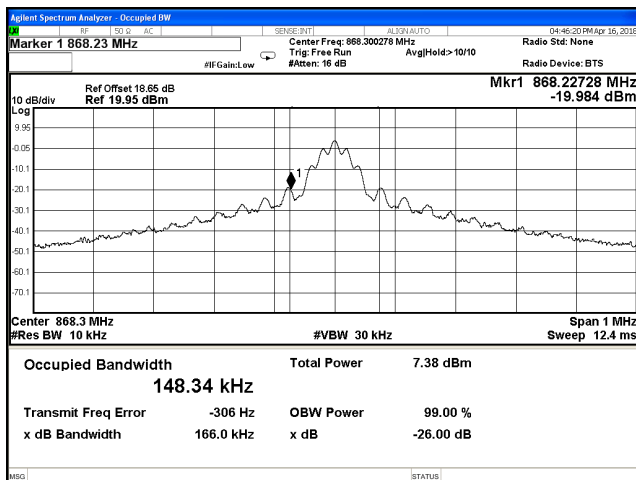
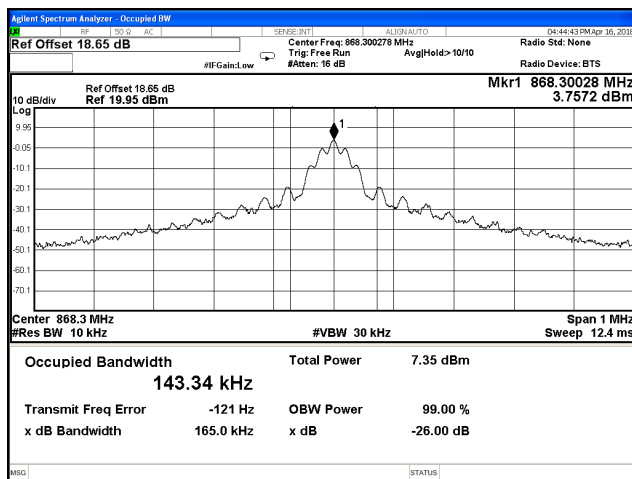
* OBW under normal conditions by adding the worst frequency error under extreme conditions result
** Channel bandwidth declared by manufacturer

Reference numbers of test equipment used

HL 4575	HL 4274					
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Full description is given in Appendix A.

Plot 7.4.1 Occupied bandwidth measurements





Test specification:	Section 5.7: Frequency error		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.7.2.2/5.7.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.5 Frequency error

7.5.1 General

This test was performed to measure frequency error of transmitter RF carrier. The test results are provided in Table 7.5.1.

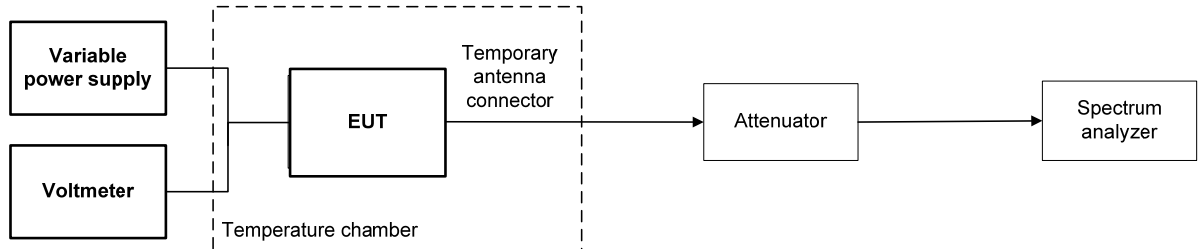
7.5.2 Test procedure

- 7.5.2.1 The EUT was set up as shown in Figure 7.5.1 under normal conditions, energized and its proper operation was checked. The reference point frequency was measured at the power slope.
- 7.5.2.2 The EUT power was turned off. The temperature within test chamber and power voltage were set to the higher extreme condition 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, frequency at the reference point was measured and then the EUT was powered off.
- 7.5.2.4 The above procedure was repeated under the rest of extreme temperatures and voltages.
- 7.5.2.5 Frequency error was calculated and recorded in Table 7.5.1.



Test specification:	Section 5.7: Frequency error		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.7.2.2/5.7.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.5.1 Frequency error test setup



Photograph 7.5.1 Frequency error test setup





Test specification:	Section 5.7: Frequency error		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.7.2.2/5.7.2.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.2 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.5.1 Frequency error test results

NOMINAL POWER VOLTAGE: 3 V
 TEMPERATURE STABILIZATION PERIOD: 30 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Peak hold
 RESOLUTION BANDWIDTH: 100 Hz
 VIDEO BANDWIDTH: 300 Hz
 MODULATION: Unmodulated
 OPERATIONAL FREQUENCY BAND: 868.0 – 868.6 MHz

Temperature, °C	Voltage, V	Measured frequency, MHz	Frequency error*, kHz
Frequency 868.30 MHz			
+55	3.0	868.297038	-2.9620
	2.55	868.296962	-3.0380
+ 23	3.0	868.300200	0.2000
	3.0	868.302633	2.6330
-10	3.0	868.302551	2.5510
	2.55		

*-Frequency error was calculated as a maximum difference between frequencies measured under extreme test conditions and the nominal frequency stated by the manufacturer.

Reference numbers of test equipment used

HL 0493	HL 4575	HL 4550	HL 4649	HL 3233			
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Full description is given in Appendix A.



Test specification:	Section 4.3.5: Tx out of band emissions		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.8.3.3/5.8.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.6 Tx out of band emissions

7.6.1 General

This test was performed to measure two out of band domains (one for operating channel and one for operational frequency band) at the EUT RF antenna connector. Specification test limits are given in Table 7.6.1 and shown in Figure 7.6.1, Figure 7.6.2.

Table 7.6.1 Emission limits in the out of band domains

Domain	Frequency range, MHz	RBW _{REF}	Max power limit
OOB limits applicable to Operational Frequency Band (See Figure 1.1.2)	$f \leq f_{low_OFB} - 400 \text{ kHz}$	10 kHz	-36 dBm
	$f \leq f_{low_OFB} - 400 \text{ kHz} \leq f \leq f_{low_OFB} - 200 \text{ kHz}$	1 kHz	-36 dBm
	$f_{low_OFB} - 200 \text{ kHz} \leq f < f_{low_OFB}$	1 kHz	See Figure 7.6.2
	$f = f_{low_OFB}$	1 kHz	0 dBm
	$f = f_{high_OFB}$	1 kHz	0 dBm
	$f_{high_OFB} < f \leq f_{high_OFB} + 200 \text{ kHz}$	1 kHz	See Figure 7.6.2
	$f_{high_OFB} + 200 \text{ kHz} \leq f \leq f_{high_OFB} + 400 \text{ kHz}$	1 kHz	-36 dBm
OOB limits applicable to Operating Channel (See Figure 1.1.1)	$f_{high_OFB} + 400 \text{ kHz} \leq f$	10 kHz	-36 dBm
	$f = f_c - 2.5 \times \text{OCW}$	1 kHz	-36 dBm
	$f_c - 2.5 \times \text{OCW} \leq f \leq f_c - 0.5 \times \text{OCW}$	1 kHz	See Figure 7.6.1
	$f = f_c - 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f = f_c + 0.5 \times \text{OCW}$	1 kHz	0 dBm
	$f = f_c + 0.5 \times \text{OCW} \leq f \leq f_c + 2.5 \times \text{OCW}$	1 kHz	See Figure 7.6.1
	$f = f_c + 2.5 \times \text{OCW}$	1 kHz	-36 dBm

Note:

f is the measurement frequency.

f_c is the Operating Frequency.

f_{low_OFB} is the lower edge of the Operational Frequency Band.

f_{high_OFB} is the upper edge of the Operational Frequency Band.

OCW is the operating channel bandwidth.

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.3, energized and the performance check was conducted.

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

7.6.2.3 The out of band emissions were measured with spectrum analyzer as provided in Table 7.6.2 and shown in the associated plots.

7.6.2.4 Out of band domain for operating channel and out of band domain for operational frequency band masks under normal conditions was corrected taking into account the worst frequency error under extreme conditions result.



Test specification:	Section 4.3.5: Tx out of band emissions		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.8.3.3/5.8.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.6.1 Out Of Band Domain for Operating Channel with reference BW

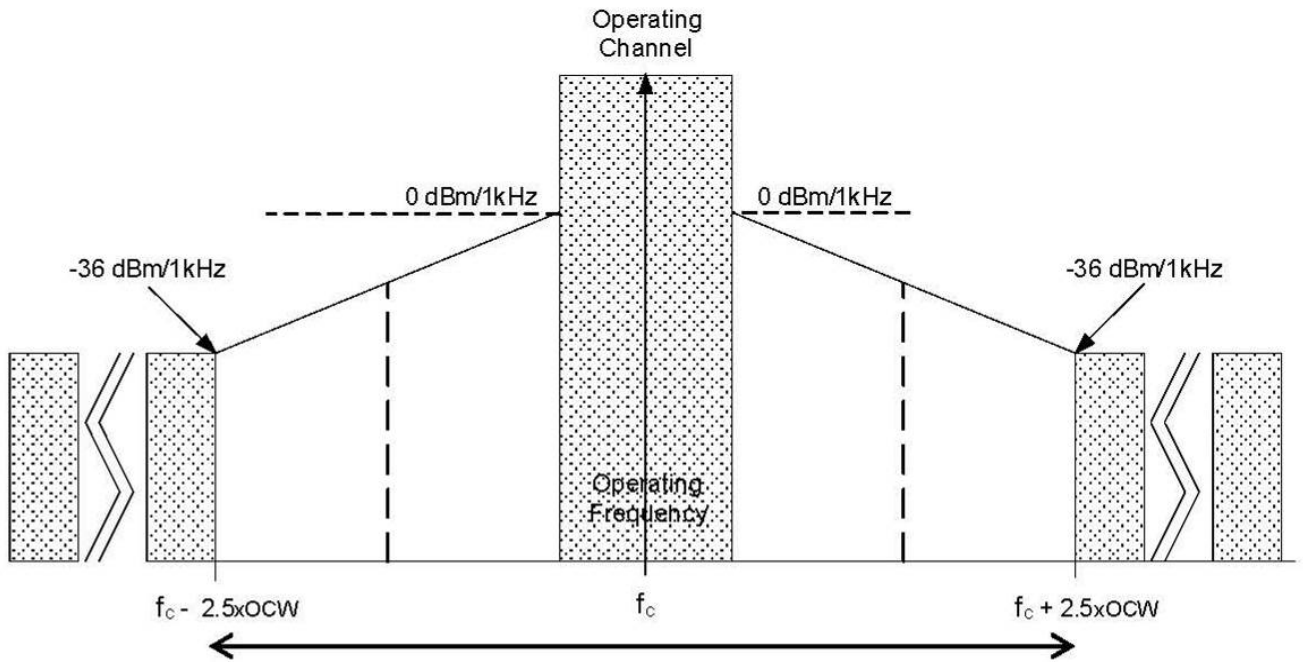
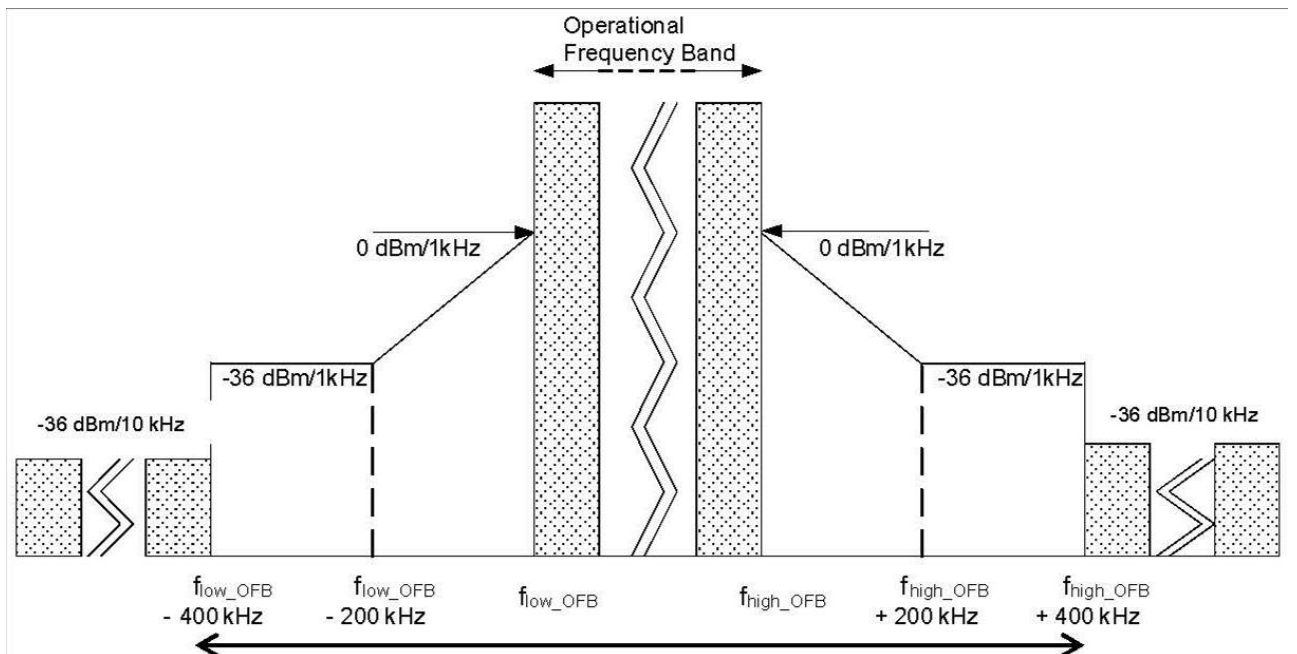


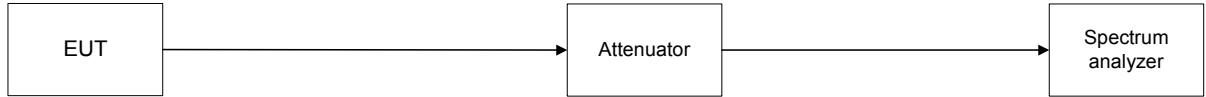
Figure 7.6.2 Out Of Band Domain for Operational Frequency Band with reference BW





Test specification:	Section 4.3.5: Tx out of band emissions		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.8.3.3/5.8.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.6.3 Setup for Tx out of band emissions measurements



Photograph 7.6.1 Setup for Tx out of band emissions measurements





Test specification:	Section 4.3.5: Tx out of band emissions		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.8.3.3/5.8.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.6.2 Tx out of band emissions test results

OPERATIONAL FREQUENCY BAND: 868.0-868.6 MHz
 OPERATING FREQUENCY: 868.3 MHz

Out of band domain for operating channel mask	Verdict
All emissions were found below spectrum mask limits.	Pass
Out of band domain for operational frequency band mask	Verdict
All emissions were found below spectrum mask limits.	Pass

Reference numbers of test equipment used

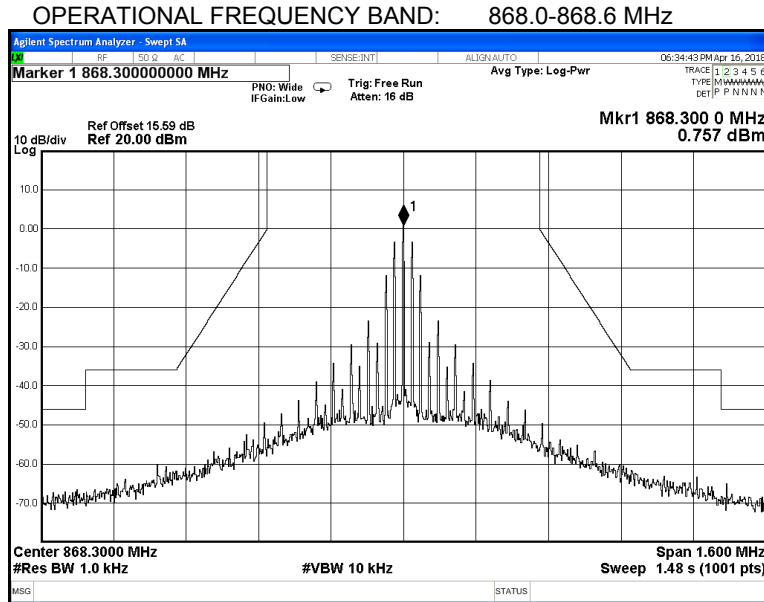
HL 4575	HL 4274	HL 3210	HL 4594				
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Full description is given in Appendix A.

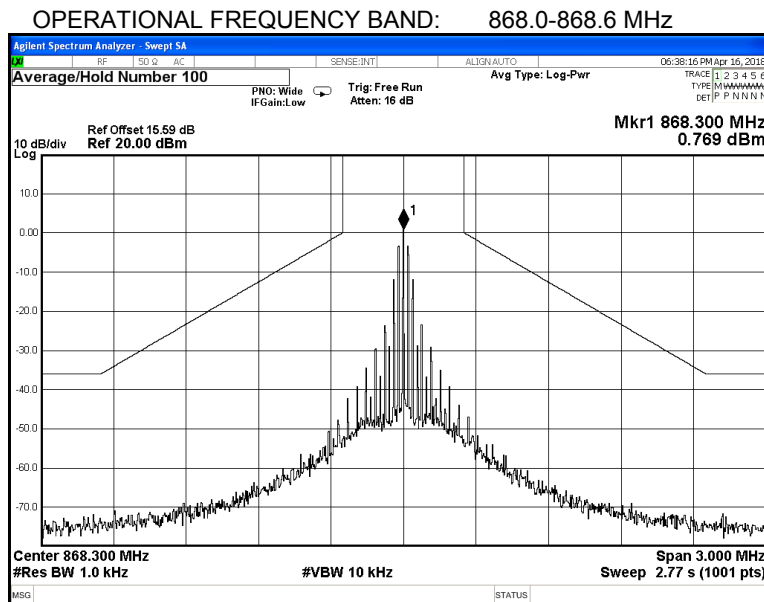


Test specification:	Section 4.3.5: Tx out of band emissions		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.8.3.3/5.8.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Plot 7.6.1 Out Of Band Domain for Operational Frequency Band with reference BW, normal conditions



Plot 7.6.2 Out Of Band Domain for Operating Channel with reference BW, normal conditions

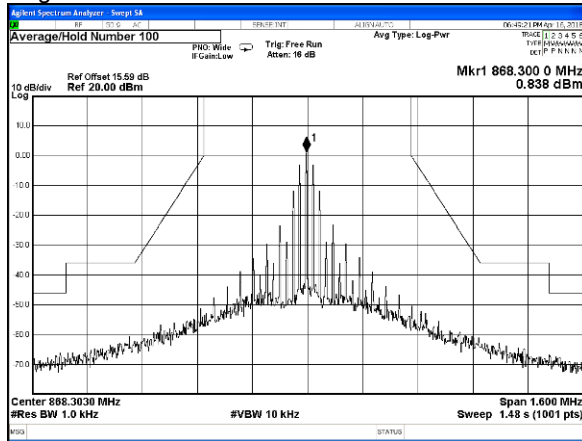




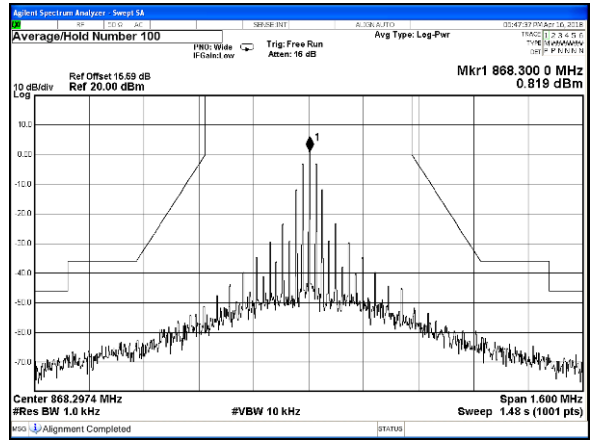
Test specification:	Section 4.3.5: Tx out of band emissions		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.8.3.3/5.8.3.4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18	Air Pressure: 1014 hPa	Power: 3 VDC
Temperature: 25.6 °C	Relative Humidity: 54 %		
Remarks:			

Plot 7.6.3 Out Of Band Domain for Operational Frequency Band MHz with reference BW

OPERATIONAL FREQUENCY BAND
Negative Drift: -3.038kHz

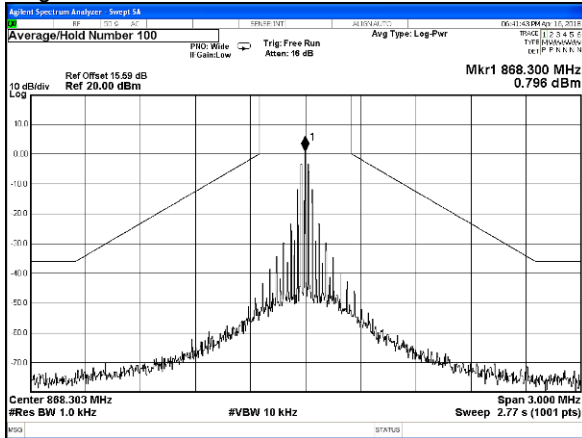


868.0-868.6 MHz
Positive Drift: +2.633 kHz

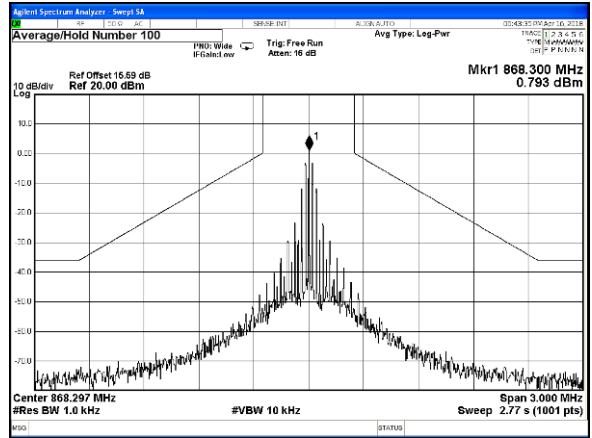


Plot 7.6.4 Out Of Band Domain for Operating Channel with reference BW

OPERATIONAL FREQUENCY BAND
Negative Drift: -3.038kHz



868.0-868.6 MHz
Positive Drift: +2.633 kHz





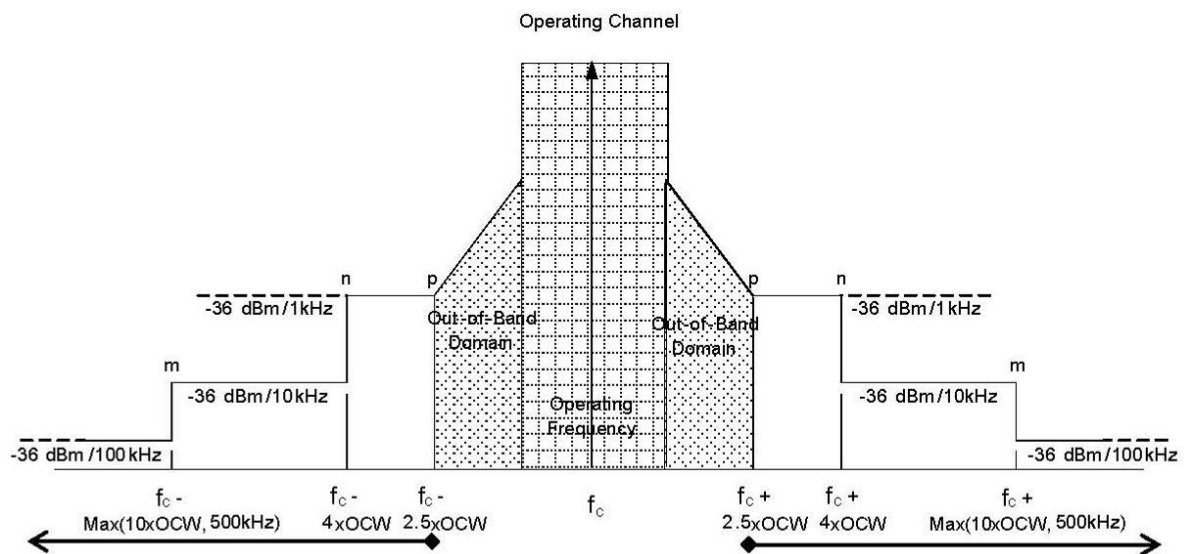
Test specification:	Section 4.2.2: Spectrum mask		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.1/5.9.3.1/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Apr-18		
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

7.7 Spectrum mask for unwanted emissions in the spurious domain

7.7.1 General

This test was performed to measure unwanted emissions in the spurious domain under spectrum mask in transmit mode. Specification test limits are given in Figure 7.7.1.

Figure 7.7.1 Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW



7.7.2 Test procedure

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

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

7.7.2.3 The turntable position, the measuring antenna height and polarization, EUT orientation were installed according to the maximal signal at the EUT carrier frequency defined during ERP test.

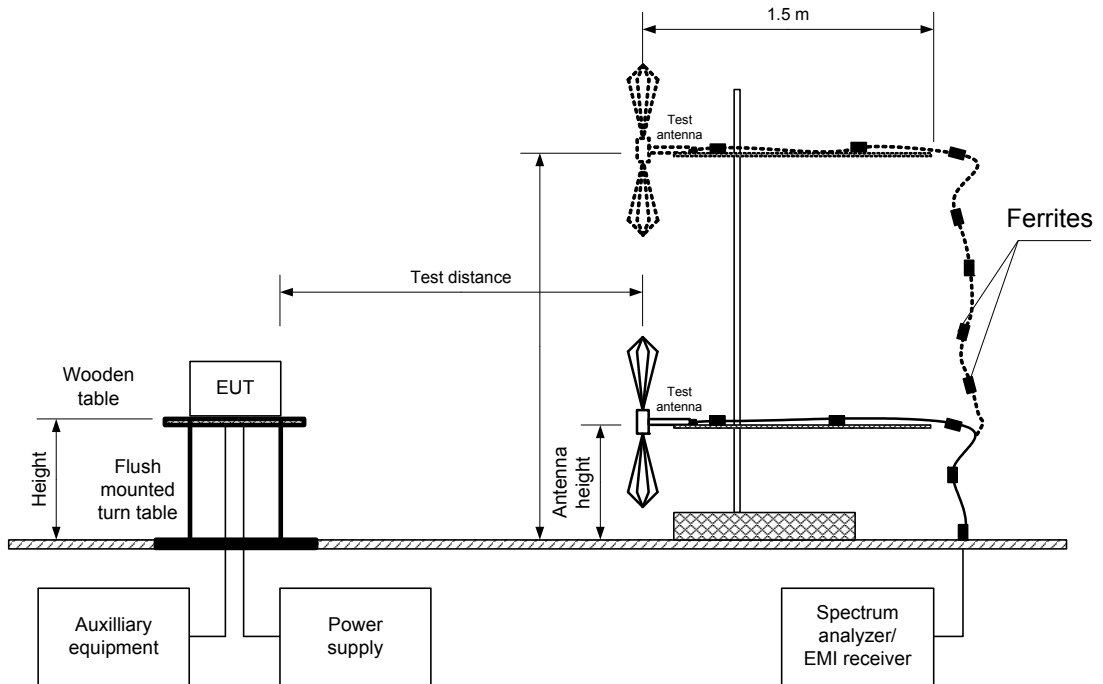
7.7.2.4 The spectrum mask for unwanted emissions in the spurious domain was constructed according to Figure 7.7.1.

7.7.2.5 The test results were recorded in Table 7.7.1 and shown in the associated plot.



Test specification:	Section 4.2.2: Spectrum mask		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.1/5.9.3.1/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Apr-18		
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

Figure 7.7.2 Setup for unwanted emissions in the spurious domain under spectrum mask measurements



Photograph 7.7.1 Setup for unwanted emissions in the spurious domain under spectrum mask measurements





Test specification:	Section 4.2.2: Spectrum mask		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.1/5.9.3.1/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	10-Apr-18		
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

Table 7.7.1 Unwanted emissions in the spurious domain under spectrum mask test results in transmit mode

OPERATIONAL FREQUENCY BANDS: 868.0 – 868.6 MHz

Frequency, MHz	RBW, kHz	Field strength, dB(μV/m)	Unwanted emission, dBm	Limit, dBm	Margin, dB*	Verdict
Operating frequency 868.30 MHz						Pass
No emissions were found.						

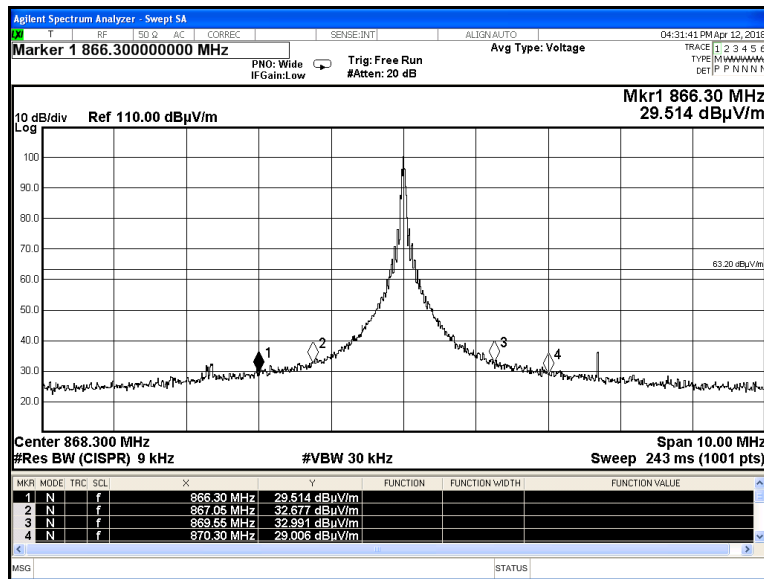
*- Margin = Unwanted emissions –limit.

Reference numbers of test equipment used

HL 5102	HL 4541	HL 4542	HL 4575	HL 4604	HL 4665		
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Full description is given in Appendix A.

Plot 7.7.1 Spectrum mask for unwanted emissions in the spurious domain



Note: Display line 63.2 dBuV/m corresponds with -36 dBm



Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

7.8 Spurious domain emissions (radiated)

7.8.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.8.1.

Table 7.8.1 Radiated spurious emission test limits

Frequency, MHz	TX mode		RX and other modes	
	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)*	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)*
25 - 47	- 36.0 (250 nW)	61.35	- 57.0 (2 nW)	40.35
47 - 74	- 54.0 (4 nW)	43.35	- 57.0 (2 nW)	40.35
74 - 87.5	- 36.0 (250 nW)	61.35	- 57.0 (2 nW)	40.35
87.5 - 118	- 54.0 (4 nW)	43.35	- 57.0 (2 nW)	40.35
118 - 174	- 36.0 (250 nW)	61.35	- 57.0 (2 nW)	40.35
174 - 230	- 54.0 (4 nW)	43.35	- 57.0 (2 nW)	40.35
230 - 470	- 36.0 (250 nW)	61.35	- 57.0 (2 nW)	40.35
470 - 790	- 54.0 (4 nW)	43.35	- 57.0 (2 nW)	40.35
790 - 1000	- 36.0 (250 nW)	61.35	- 57.0 (2 nW)	40.35
1000 - 6000	- 30.0 (1 μW)	67.35	- 47.0 (20 nW)	50.35

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

7.8.2 Test procedure for spurious emission field strength measurements in TX mode

7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized and the performance check was conducted.

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

7.8.2.3 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was swept throughout the specified in Table 7.8.2 range in both, vertical and horizontal, polarizations.

7.8.2.4 The worst test results (the lowest margins) were recorded in Table 7.8.2 and shown in the associated plots.

7.8.3 Test procedure for spurious emission field strength measurements in RX and standby modes

7.8.3.1 The EUT was set up as shown in Figure 7.8.1, energized and the performance check was conducted.

7.8.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was swept throughout the specified in Table 7.8.4 range in both, vertical and horizontal, polarizations.

7.8.3.3 The worst test results (the lowest margins) were recorded in Table 7.8.4 and shown in the associated plots.

7.8.4 Test procedure for substitution ERP measurements of spurious emission

7.8.4.1 The test equipment was set up as shown in Figure 7.8.2 and energized.

7.8.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from EUT.

7.8.4.3 The test antenna height was swept throughout the specified in Table 7.8.2 range to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from EUT.

7.8.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test antenna.

7.8.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

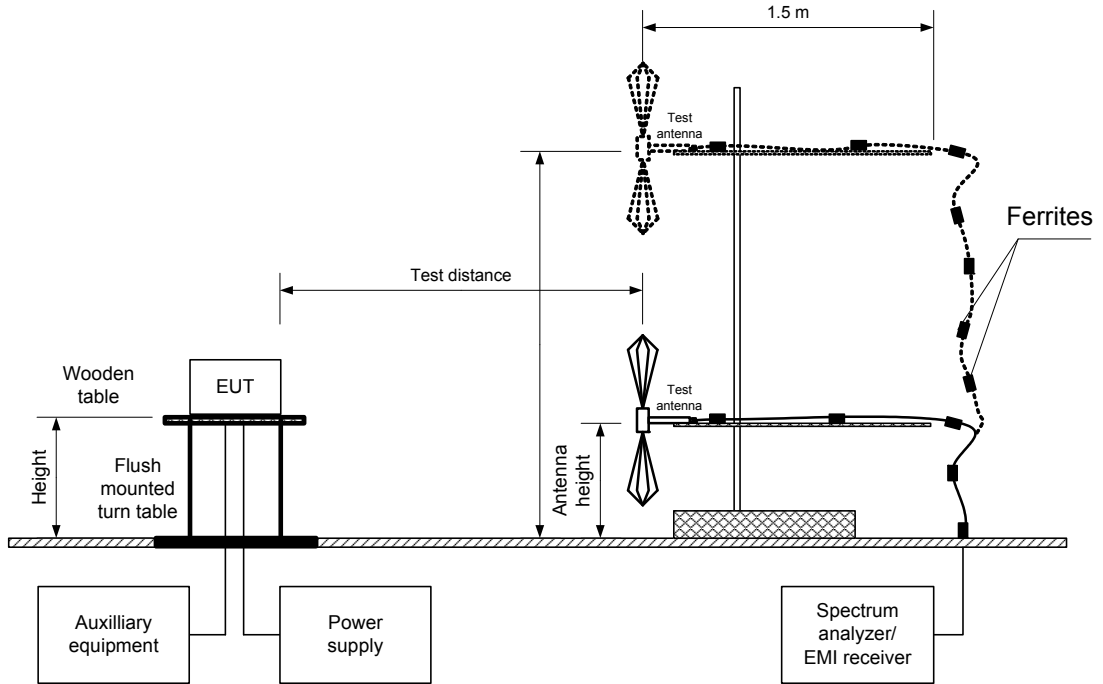
7.8.4.6 The above procedure was repeated at the rest of investigated frequencies.

7.8.4.7 The worst test results (the lowest margins) were recorded in Table 7.8.3 and Table 7.8.5.

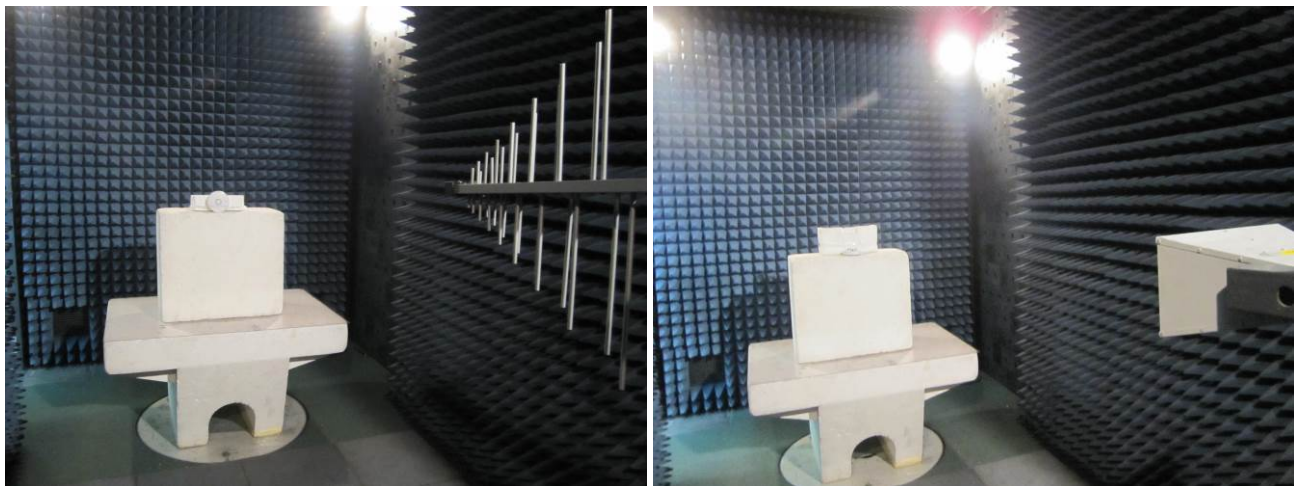


Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

Figure 7.8.1 Setup for spurious emission field strength measurements



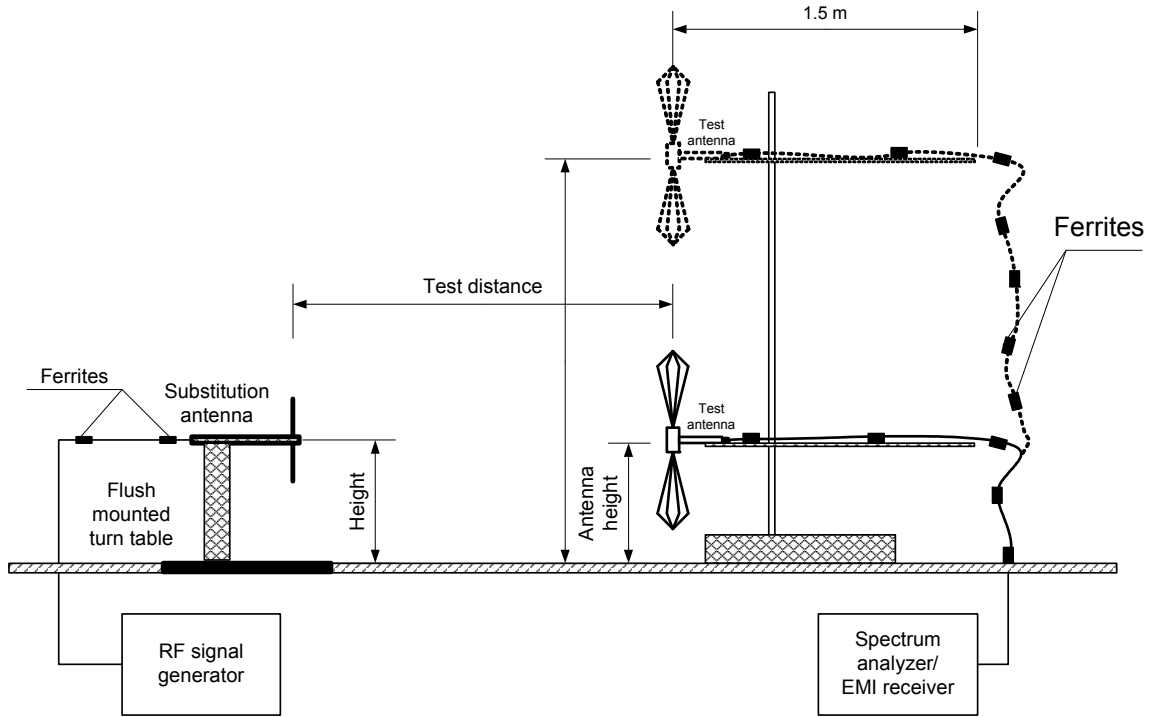
Photograph 7.8.1 Setup for spurious emission field strength measurements



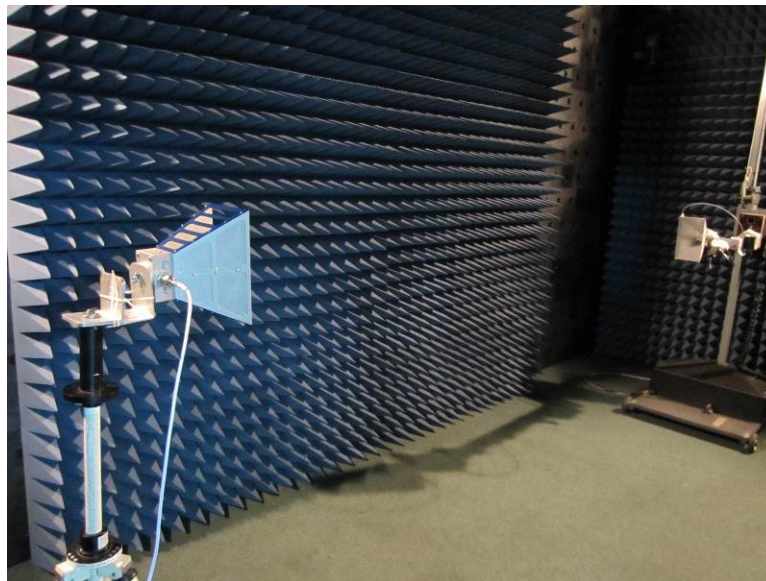


Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

Figure 7.8.2 Setup for substitution ERP measurements of spurious



Photograph 7.8.2 Setup for substitution ERP measurements of spurious





Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

Table 7.8.2 Spurious emission field strength test results in TX mode

OPERATIONAL FREQUENCY BAND: 868.0-868.6 MHz
EUT ANTENNA: Integral
TEST DISTANCE: 3 m
EUT HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 2.5 m
INVESTIGATED FREQUENCY RANGE: 25 - 6000 MHz
DETECTOR USED: Quasi-peak (25 – 1000 MHz)
Peak (above 1000 MHz)
RESOLUTION BANDWIDTH: 25 MHz – 1000 MHz: 120 kHz (6 dB RBW)
above 1000 MHz: 1.0 MHz (3 dB RBW)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Biconilog (25 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
MODULATION: modulated

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Operating frequency 868.30 MHz							
699.31	40.84	43.35	-2.51	120	Vertical	1.47	358
712.30	44.87	43.35	1.52	120	Vertical	1.48	360
1736.610	58.05	67.35	-9.30	1000	Horizontal	1.6	3334
2604.920	58.18	67.35	-9.17	1000	Horizontal	1.58	193
3473.255	53.63	67.35	-13.72	1000	Horizontal	1.59	336
4341.600	60.29	67.35	-7.06	1000	Horizontal	1.35	197
5209.890	55.66	67.35	-11.69	1000	Vertical	1.46	0

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

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

Table 7.8.3 ERP of spurious emission test results in TX mode

OPERATIONAL FREQUENCY BAND: 868.0-868.6 MHz
TEST DISTANCE: 3 m
SUBSTITUTION ANTENNA HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 2.5 m
DETECTOR USED: Quasi-peak (25 – 1000 MHz)
Peak (above 1000 MHz)
RESOLUTION BANDWIDTH: 25 MHz – 1000 MHz: 120 kHz (6 dB RBW)
above 1000 MHz: 1.0 MHz (3 dB RBW)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
699.31	40.84	120	Vertical	-54.5	-0.52	2.74	-57.82	-54	-3.82	Pass
712.30	44.87	120	Vertical	-50.8	-0.46	2.74	-54.02	-54	-0.02	Pass
1736.610	58.05	1000	Horizontal	-40.6	6.28	3.77	-38.17	-30	-8.17	Pass
2604.920	58.18	1000	Horizontal	-39.4	7.31	4.90	-37.02	-30	-7.02	Pass
3473.255	53.63	1000	Horizontal	-45.0	6.70	5.50	-43.81	-30	-13.81	Pass
4341.600	60.29	1000	Horizontal	-37.2	8.14	6.22	-35.33	-30	-5.33	Pass
5209.890	55.66	1000	Vertical	-41.6	7.93	6.91	-40.65	-30	-10.65	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 4295	HL 4535	HL 4541	HL 4542	HL 4543	HL 4549	HL 4663	HL 4575
HL 4603	HL 4604	HL 4665	HL 4676	HL 4958	HL 3042		

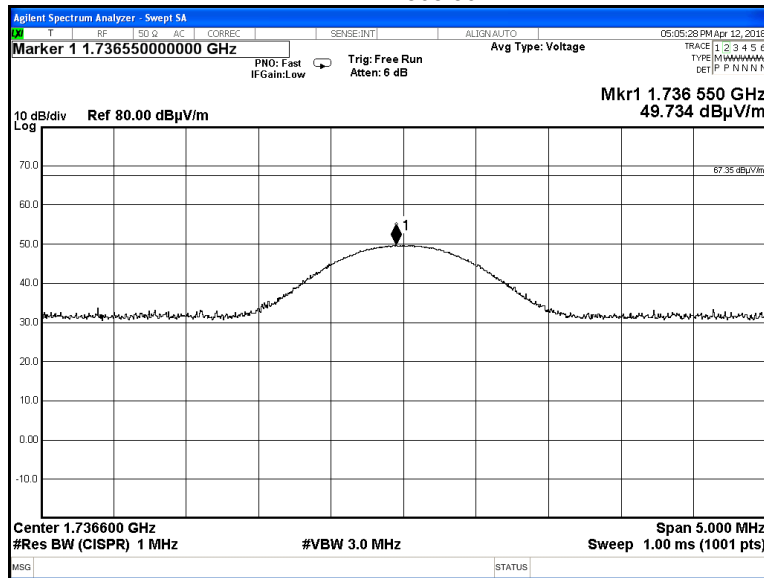
Full description is given in Appendix A.



Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

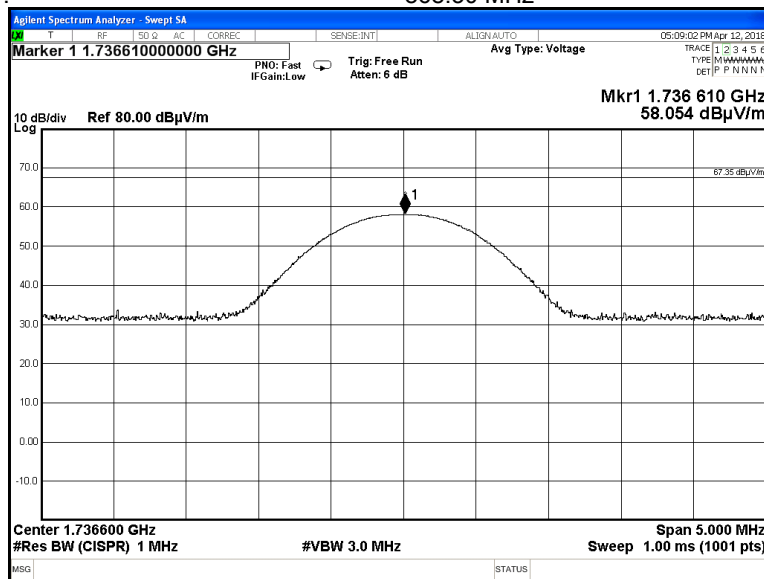
Plot 7.8.1 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz



Plot 7.8.2 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz

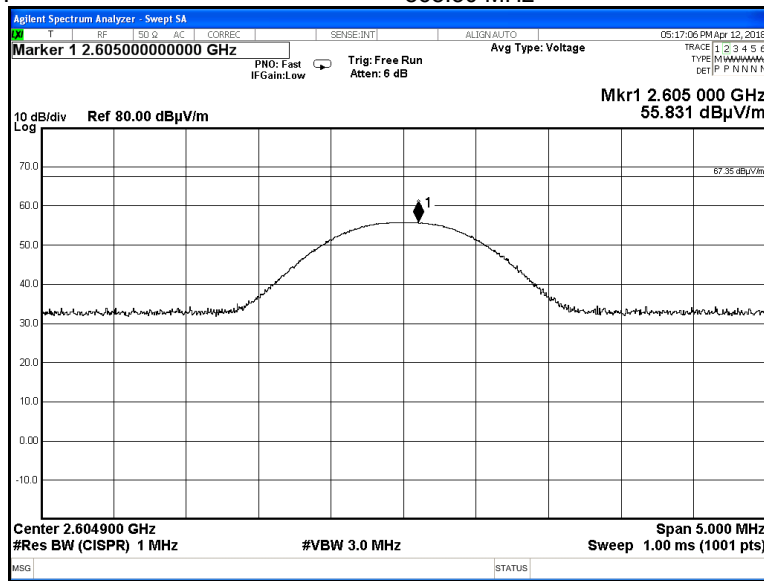




Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

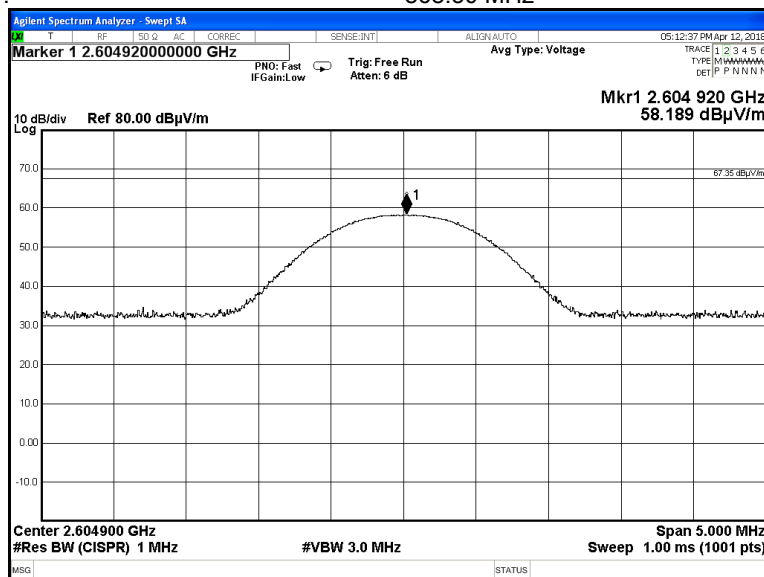
Plot 7.8.3 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz



Plot 7.8.4 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz

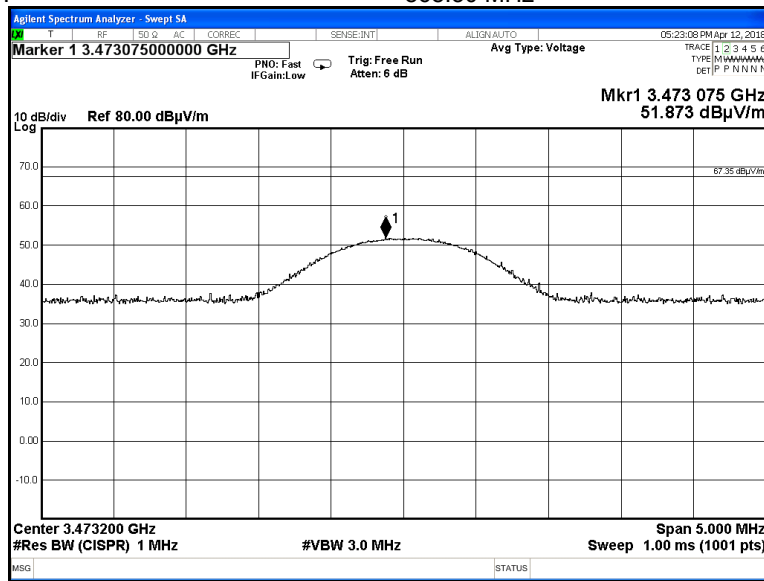




Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

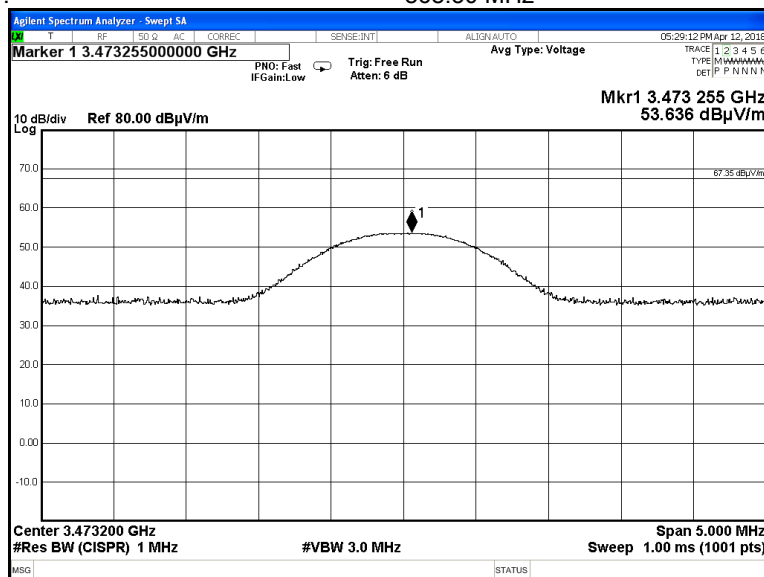
Plot 7.8.5 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz



Plot 7.8.6 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz

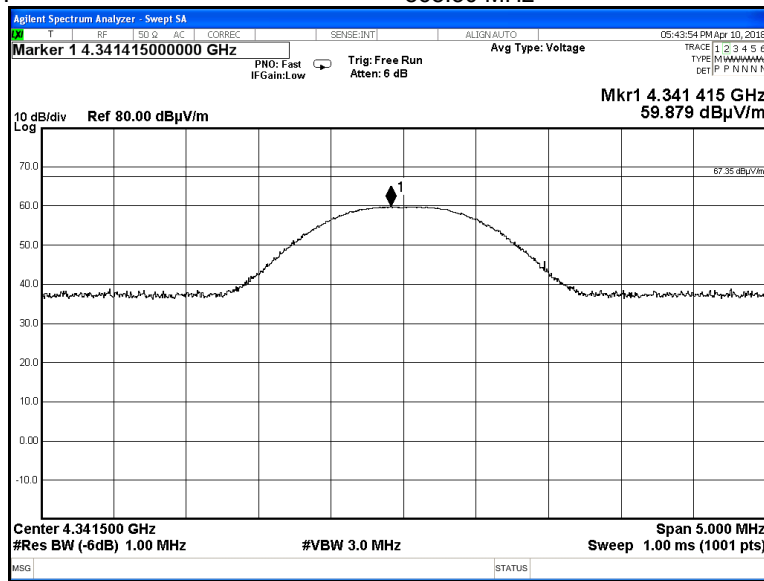




Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

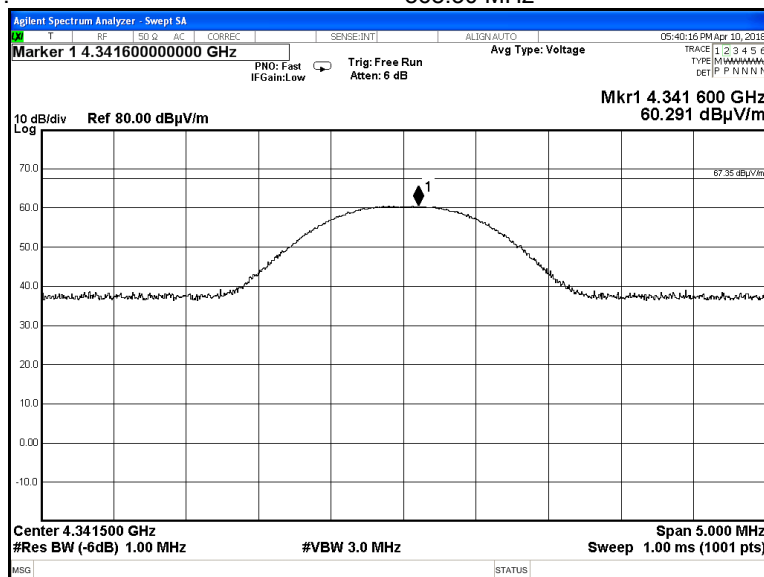
Plot 7.8.7 Radiated emission measurements at the 5^{ed} harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz



Plot 7.8.8 Radiated emission measurements at the 5^{ed} harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz

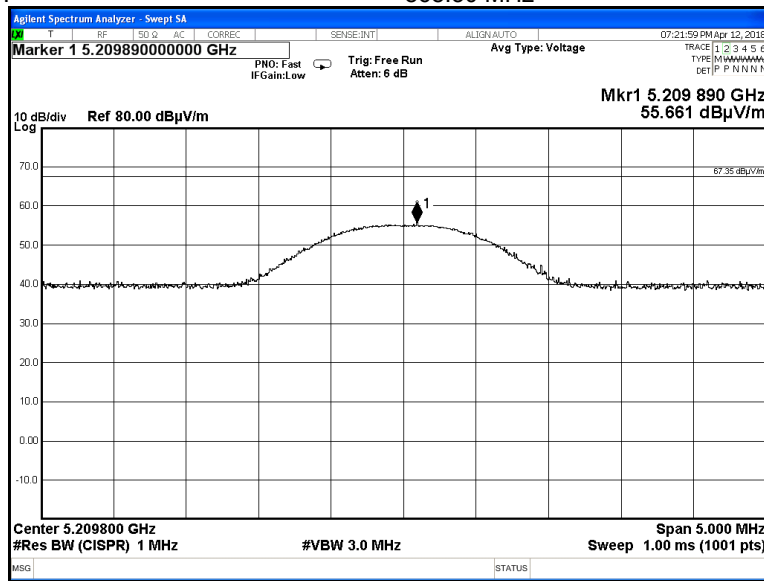




Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

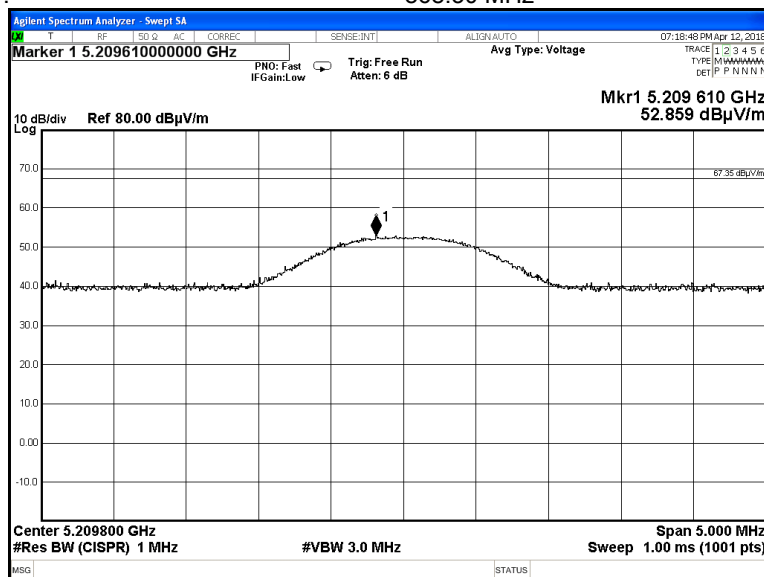
Plot 7.8.9 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz



Plot 7.8.10 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz

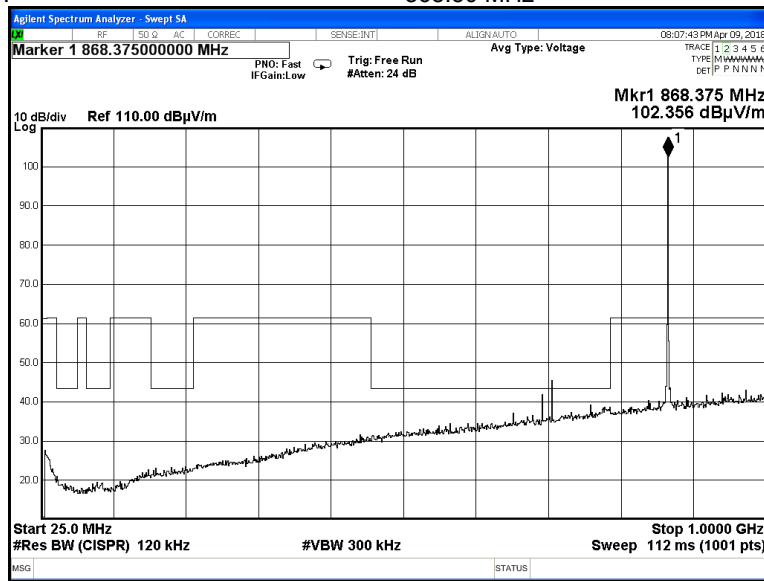




Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

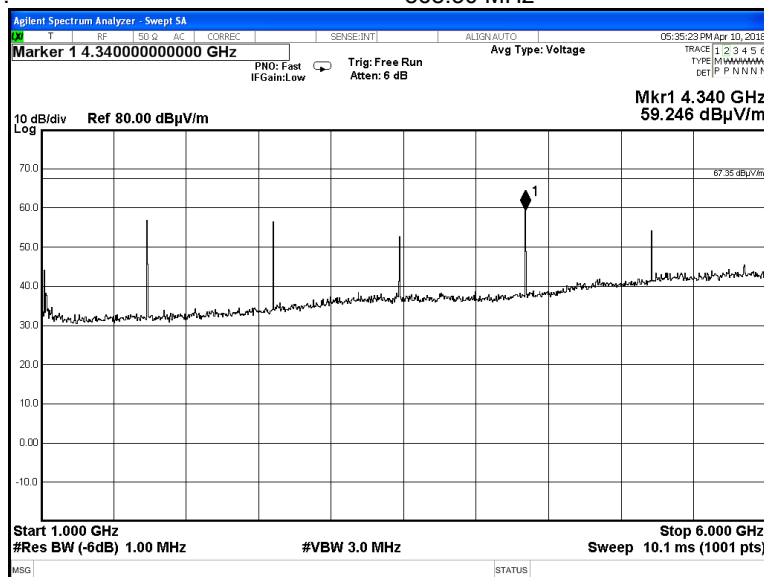
Plot 7.8.11 Radiated emission measurements in 25 - 1000 MHz range

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz



Plot 7.8.12 Radiated emission measurements in 1 – 6 GHz range

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: TX
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m
 FREQUENCY: 868.30 MHz





Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

Table 7.8.4 Spurious emission field strength test results in RX and standby modes

OPERATIONAL FREQUENCY BAND: 868.0-868.6 MHz
 EUT ANTENNA: Integral
 INVESTIGATED FREQUENCY RANGE: 25 - 6000 MHz
 TEST DISTANCE: 3 m
 EUT HEIGHT: 1.5 m
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 2.5 m
 DETECTOR USED: Quasi-peak (25 – 1000 MHz)
 Peak (above 1000 MHz)
 RESOLUTION BANDWIDTH: 25 MHz – 1000 MHz: 120 kHz (6 dB RBW)
 above 1000 MHz: 1.0 MHz (3 dB RBW)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Biconilog (25 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
5208.935	48.54	50.35	-1.81	1000	Horizontal	1.58	0

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

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

Table 7.8.5 ERP of spurious emission test results in RX and standby modes

SUBSTITUTION ANTENNA HEIGHT: 1.5 m
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 2.5 m
 DETECTOR USED: Peak (above 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 SUBSTITUTION ANTENNA TYPE: Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(µV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
5208.935	48.54	1000	Horizontal	-48.79	7.92	6.91	-47.78	-47.0	-0.78	Pass

*- Margin = Spurious emission - specification limit.

Reference numbers of test equipment used

HL 4295	HL 4535	HL 4541	HL 4542	HL 4543	HL 4549	HL 3042	HL 4575
HL 4603	HL 4604	HL 4665	HL 4676	HL 4958			

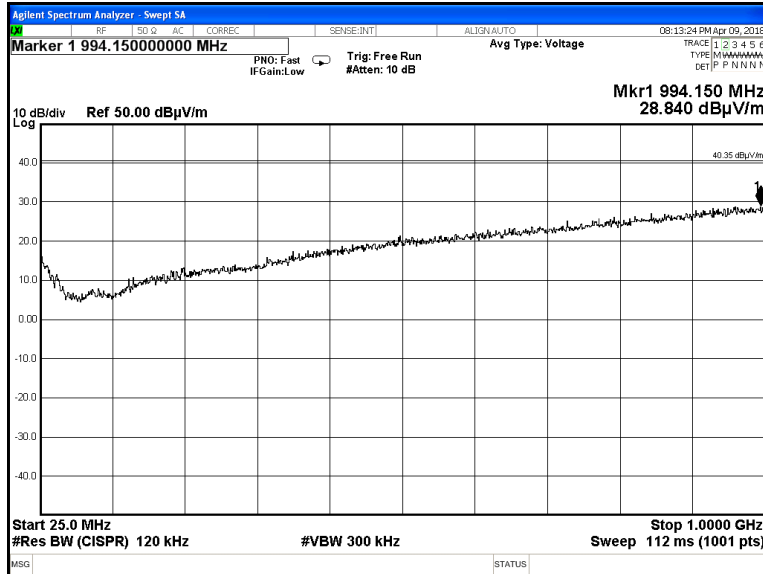
Full description is given in Appendix A.



Test specification:	Section 4.2.2: Spurious domain emissions (radiated)		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.9.1.2/5.9.2/5.9.3.2/5.9.3.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12-Apr-18		
Temperature: 24 °C	Relative Humidity: 47 %	Air Pressure: 1012 hPa	Power: 3 VDC
Remarks:			

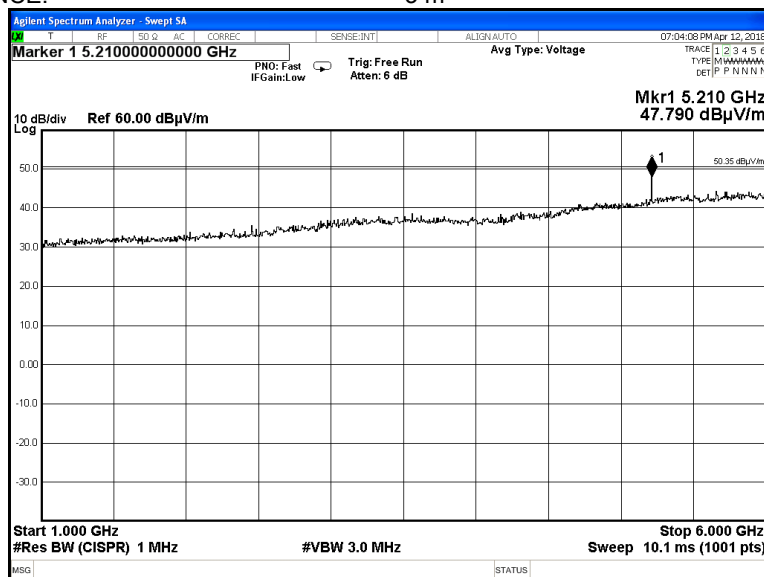
Plot 7.8.13 Radiated emission measurements in 25 - 1000 MHz range

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: RX and standby
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m



Plot 7.8.14 Radiated emission measurements in 1 – 6 GHz range

TEST SITE: Semi anechoic chamber
 OPERATIONAL MODE: RX and standby
 ANTENNA POLARIZATION: Vertical and Horizontal
 TEST DISTANCE: 3 m





Test specification:	Section 4.3.6: Transient power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.10.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.9 Transient power

7.9.1 General

This test was performed to measure the part of the total transmission output power that fell into adjacent spectrum due to switching the transmitter on and off during normal operation. Specification test limits are given in Table 7.9.1. Measurement points and resolution bandwidths are given in Table 7.9.2.

Table 7.9.1 Transient power limit

Absolute offset from centre frequency	RBW _{REF}	Peak power limit applicable at measurement point
≤400 kHz	1 kHz	0 dBm
>400 kHz	1 kHz	-27 dBm

Table 7.9.2 RBW and measurement points for transient power measurement

Measurement points: offset from centre frequency	Analyser RBW	RBW _{REF}
-0,5 x OCW - 3 kHz 0,5 x OCW + 3 kHz Not applicable for OCW < 25 kHz	1 kHz	1 kHz
±12,5 kHz or ±OCW whichever is the greater	Max (RBW pattern 1, 3, 10 kHz) ≤ Offset frequency/6 (see note)	1 kHz
-0,5 x OCW - 400 kHz 0,5 x OCW + 400 kHz	100 kHz	1 kHz
-0,5 x OCW - 1200 kHz 0,5 x OCW + 1200 kHz	300 kHz	1 kHz

Note:

Max (RBW pattern 1, 3, 10 kHz) means the maximum bandwidth that falls into the commonly implemented 1, 3, 10 kHz RBW filter bandwidth incremental pattern of spectrum analyzer's.

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 EUT was adjusted to produce modulated RF signal of maximum available to the end user RF power.
- 7.9.2.3 The spectrum analyzer center frequency was adjusted to the transmitter carrier frequency.
- 7.9.2.4 The measurements were performed in zero span mode.
- 7.9.2.5 The spectrum analyzer center frequency was set to an offset of operating center frequency provided in Table 7.9.3 and shown in the associated plots.
- 7.9.2.6 The recorded power values were converted to power values measured in RBW_{REF} by the below formula

$$B = A + 10 \log \frac{RBW_{ref}}{RBW_{MEASURED}}, \text{ where}$$

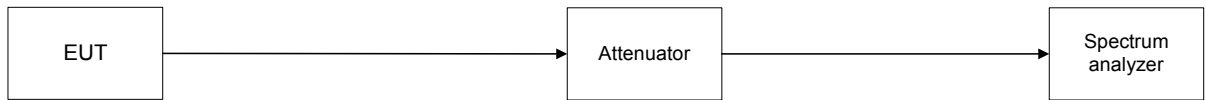
"A" is the measured value at the wider measurement bandwidth RBW_{measured};

"B" is the corresponding value at RBW_{REF}.



Test specification:	Section 4.3.6: Transient power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.10.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.9.1 Setup for transient power measurements



Photograph 7.9.1 Setup for transient power measurements





Test specification:	Section 4.3.6: Transient power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.10.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.9.3 Transient power test results

OPERATIONAL FREQUENCY BAND: 868.0-868.6 MHz
 MODULATION: 2FSK
 NOMINAL POWER VOLTAGE: 3 V
 OPERATING CHANNEL WIDTH (OCW): 500 kHz

Center frequency, MHz	Offset from center frequency	Measured frequency, MHz	RBW, kHz	Transient power, dBm/RBW	Transient power, dBm/1kHz*	Limit, dBm	Margin, dB**	Verdict
868.3	-0.5 x OCW - 3	868.047	1	-49.89	-49.89	0	-49.89	Pass
	0.5 x OCW + 3	868.553	1	-49.43	-49.43	0	-49.43	Pass
	- OCW	867.800	10	-41.78	-51.78	0	-51.78	Pass
	+ OCW	868.800	10	-38.47	-48.47	0	-48.47	Pass
	-0.5 x OCW - 400	867.650	100	-24.43	-44.43	-27.0	-17.43	Pass
	+0.5 x OCW + 400	868.950	100	-20.74	-40.74	-27.0	-13.74	Pass
	-0.5 x OCW - 1200	866.850	300	-22.11	-46.88	-27.0	-19.88	Pass
+0.5 x OCW + 1200	869.750	300	-19.26	-44.03	-27.0	-17.03	Pass	

* Transient power (dBm /1kHz) = Transient power (dBm /1kHz) + 10xlog(1kHz/RBW)

** Margin (dB) = Transient power (dBm /1kHz) – Limit (dBm)

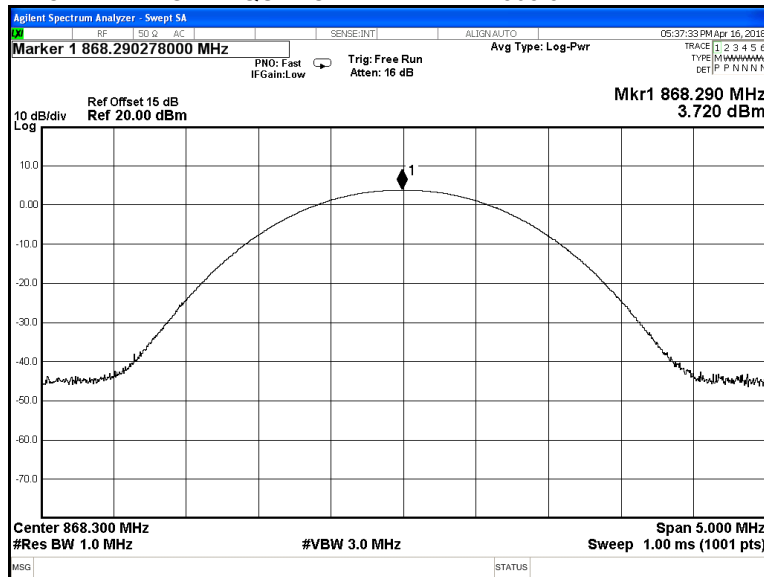
Reference numbers of test equipment used

HL 4575	HL 0493	HL 4550				
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Full description is given in Appendix A.

Plot 7.9.1 Transient power, reference level

OPERATIONAL FREQUENCY BAND 868.0-868.6 MHz
 OPERATING FREQUENCY 868.3 MHz



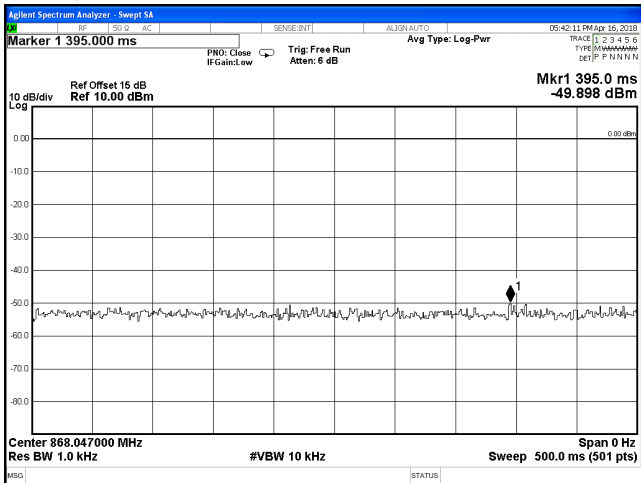
ERP 3.72 dBm



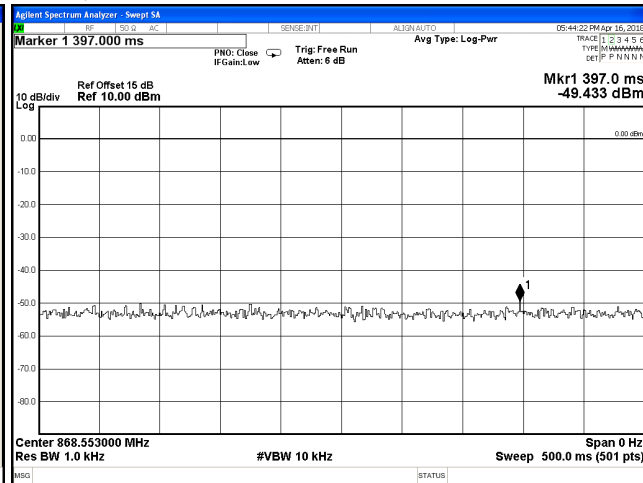
Test specification:	Section 4.3.6: Transient power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.10.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Plot 7.9.2 Transient power at frequency shift 253 kHz from center frequency

OPERATING FREQUENCY
FREQUENCY OFFSET: - 253kHz

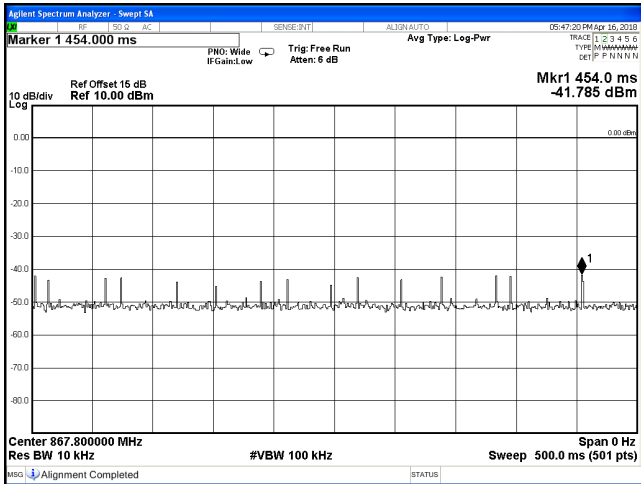


868.30 MHz
FREQUENCY OFFSET: + 253 kHz

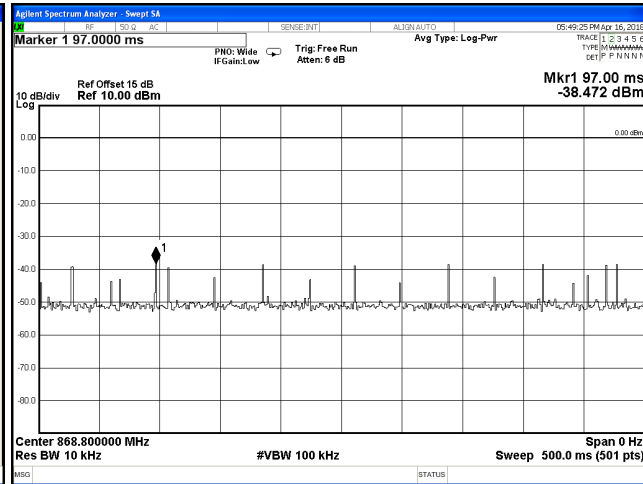


Plot 7.9.3 Transient power at frequency shift 500 kHz from center frequency

OPERATING FREQUENCY
FREQUENCY OFFSET: - 500 kHz



868.30 MHz
FREQUENCY OFFSET: + 500 kHz



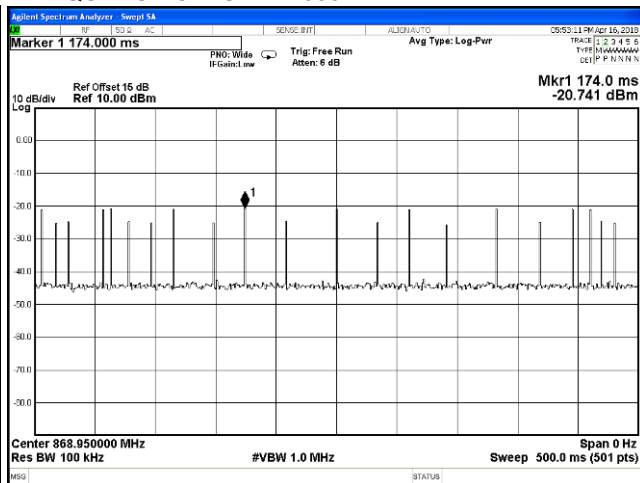
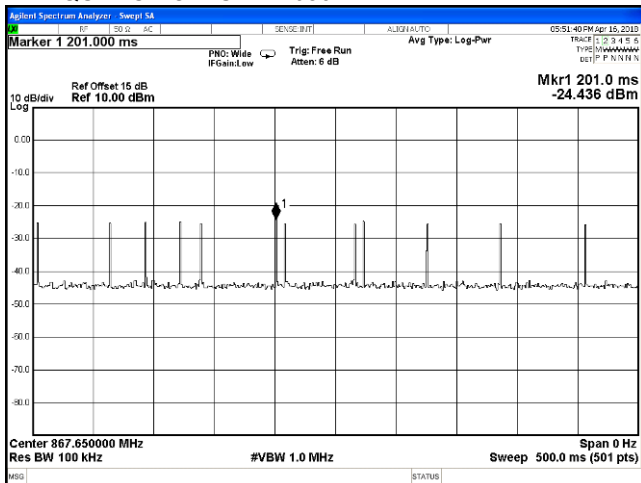


Test specification:	Section 4.3.6: Transient power		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.10.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.6 °C	Relative Humidity: 54 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Plot 7.9.4 Transient power at frequency shift 650 kHz from center frequency

OPERATING FREQUENCY
FREQUENCY OFFSET: - 650 kHz

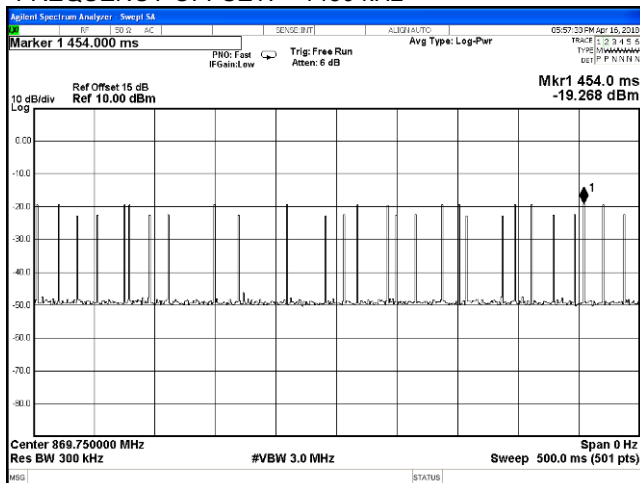
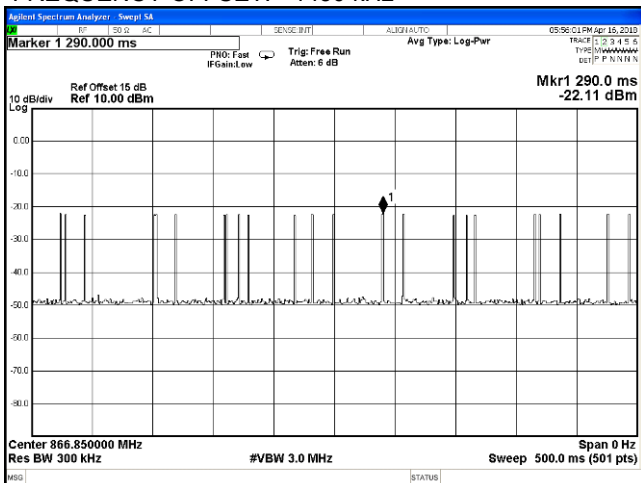
868.30 MHz
FREQUENCY OFFSET: + 650 kHz



Plot 7.9.5 Transient power at frequency shift 1450 kHz from center frequency

OPERATING FREQUENCY
FREQUENCY OFFSET: - 1450 kHz

868.30 MHz
FREQUENCY OFFSET: + 1450 kHz



Test specification:	Section 4.3.8: Tx behaviour under low voltage		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.12.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.1 °C	Relative Humidity: 55 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

7.10 TX behaviour under low voltage conditions

7.10.1 General

This test was performed to verify the transmitter modulation envelope including all associated side bands above the appropriate spurious limit given in Table 7.10.1 remained within the assigned band or the transmitter ceased to function under low voltage conditions.

Table 7.10.1 Spurious emission limits at the operational band edges

Assigned frequency band*, MHz	Spurious emission limit, dBm
433.05 – 434.79	- 36.0 (250 nW)
868.00 – 868.60	- 36.0 (250 nW)
868.60 – 868.70	- 36.0 (250 nW)
868.70 – 869.20	- 36.0 (250 nW)
869.20 – 869.25	- 36.0 (250 nW)
869.25 – 869.30	- 36.0 (250 nW)
869.30 – 869.40	- 36.0 (250 nW)
869.40 – 869.65	- 36.0 (250 nW)
869.65 – 869.70	- 36.0 (250 nW)
869.70 – 870.00	- 36.0 (250 nW)
2400.00 – 2483.50	- 30.0 (1 µW)

* - Frequency bands referred to CEPT ERC Recommendation 70-03.

7.10.2 Test procedure

7.10.2.1 The EUT was set up as shown in Figure 7.10.1, energized and the performance check was conducted.

7.10.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements.

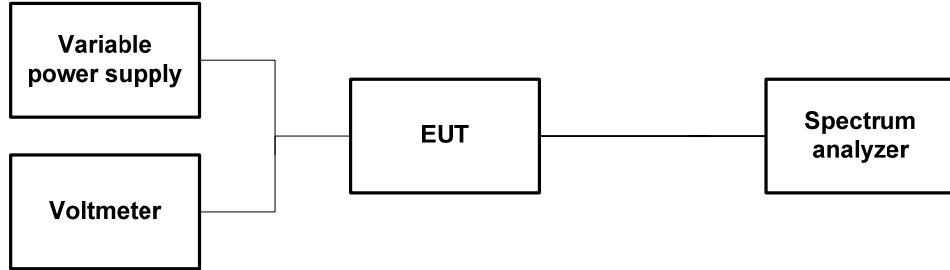
7.10.2.3 The peak of emission related to the carrier RF power was measured.

7.10.2.4 The EUT power voltage was gradually reduced and the frequency of modulation envelope points at which power level drops below the spurious emission limit was measured until the EUT ceased to operate.

7.10.2.5 The test results were recorded in Table 7.10.1.

Test specification:	Section 4.3.8: Tx behaviour under low voltage		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.12.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.1 °C	Relative Humidity: 55 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Figure 7.10.1 TX behaviour under low voltage conditions test setup



Photograph 7.10.1 TX behaviour under low voltage conditions test setup





Test specification:	Section 4.3.8: Tx behaviour under low voltage		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.12.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	16-Apr-18		
Temperature: 25.1 °C	Relative Humidity: 55 %	Air Pressure: 1014 hPa	Power: 3 VDC
Remarks:			

Table 7.10.2 Frequency stability test results

DETECTOR USED: Peak hold
 MODULATION: 2FSK
 BIT RATE: 38.4 kbps
 OPERATING FREQUENCY: 868.30 MHz

Voltage, V	Measured frequency, MHz	Operational band edge, MHz	Verdict
Nominal 3.0	868.301131	868.0-868.6	Pass
Low extreme 2.55	868.301067		Pass
1.55	868.300879		Pass
Below 1.55	Transmitter ceased to function.		Pass

Reference numbers of test equipment used

HL 4575	HL 4550	HL 4649	HL 3233				
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Full description is given in Appendix A.



Test specification:	Section 4.4.2: Blocking		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.18.2/3/4/5 / 5.18.6.3/4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	06-Jun-18		
Temperature: 25 °C	Relative Humidity: 51 %	Air Pressure: 1007 hPa	Power: 3.0 VDC
Remarks:			

7.11 Blocking

7.11.1 General

This test was performed to verify capability of the receiver to operate satisfactorily in the presence of unwanted signal (interference) at the frequencies other than adjacent channels or bands. Specification test limits are given in Table 7.11.1.

Table 7.11.1 Blocking limit

Receiver category	Frequency offset from band edge	Lmit, dB
1	± 2.0 MHz from OC edge f high and f low	≥ -20 dBm
	± 10.0 MHz from OC edge f high and f low	≥ -20 dBm
	± 5% of Centre Frequency or 15.0 MHz whichever is the greater	≥ -20 dBm
1.5	± 2.0 MHz from OC edge f high and f low	≥ -43 dBm
	± 10.0 MHz from OC edge f high and f low	≥ -33 dBm
	± 5% of Centre Frequency or 15.0 MHz whichever is the greater	≥ -33 dBm
2	± 2.0 MHz from OC edge f high and f low	≥ -69 dBm
	± 10.0 MHz from OC edge f high and f low	≥ -44 dBm
	± 5% of Centre Frequency or 15.0 MHz whichever is the greater	≥ -44 dBm
3	± 2.0 MHz from OC edge f high and f low	≥ -80 dBm
	± 10.0 MHz from OC edge f high and f low	≥ -60 dBm
	± 5% of Centre Frequency or 15.0 MHz whichever is the greater	≥ -60 dBm

7.11.2 Test procedure

7.11.2.1 The EUT was set up as shown in Figure 7.11.1, energized and its proper operation was checked.

7.11.2.2 The interference signal generator RF output power was turned off.

7.11.2.3 The wanted signal generator was adjusted to produce RF signal of normal modulation the receiver under test is intended to receive and the output level was slowly decreased until communication link lost.

7.11.2.4 The output power of the wanted signal generator was slowly increased to establish a signal level just sufficient to provide proper response of the receiver under test; however the level at the receiver input was not adjusted below the sensitivity limit recorded in Tale 7.11.2.

7.11.2.5 The output power of the wanted signal generator was increased by 3 dB above the receiver input level obtained in the item above.

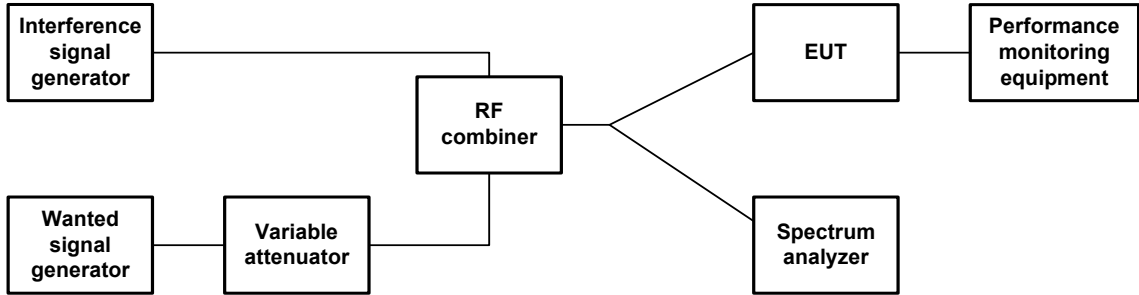
7.11.2.6 The interference signal generator was adjusted to the upper frequency of the assigned band and output power was slowly increased until the performance degradation beyond the acceptable level was noticed.

7.11.2.7 The blocking (the conducted power received from the interference signal generator at the EUT antenna connector) was recorded in Table 7.11.2.

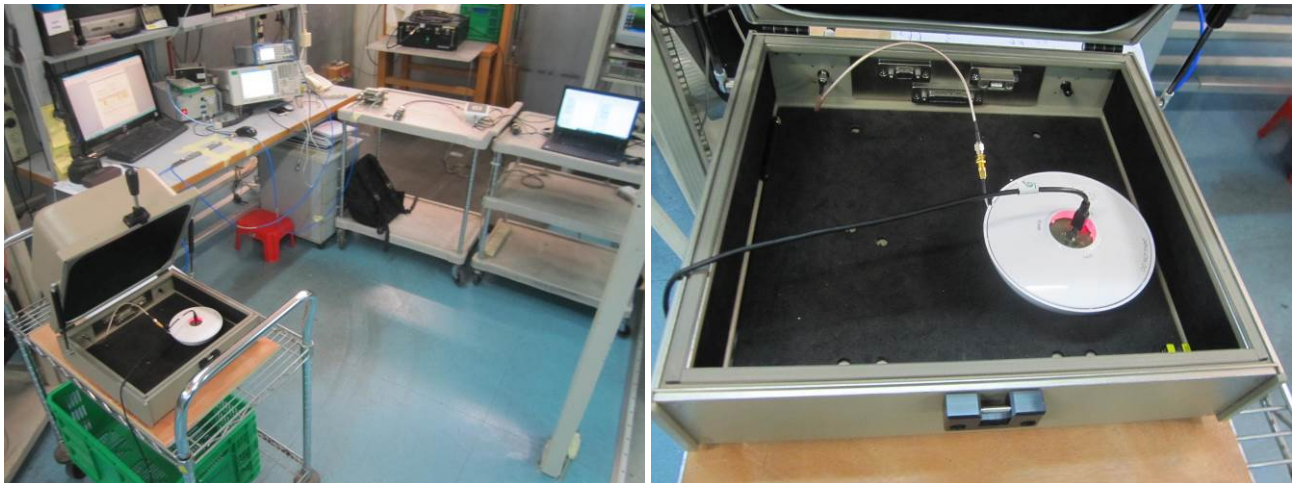


Test specification:	Section 4.4.2: Blocking		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.18.2/3/4/5 / 5.18.6.3/4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	06-Jun-18		
Temperature: 25 °C	Relative Humidity: 51 %	Air Pressure: 1007 hPa	Power: 3.0 VDC
Remarks:			

Figure 7.11.1 Setup for blocking test



Photograph 7.11.1 Setup for blocking test





Test specification:	Section 4.4.2: Blocking		
Test procedure:	EN 300 220-1 V3.1.1, Section 5.18.2/3/4/5 / 5.18.6.3/4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	06-Jun-18		
Temperature: 25 °C	Relative Humidity: 51 %	Air Pressure: 1007 hPa	Power: 3.0 VDC
Remarks:			

Table 7.11.2 Blocking test results

OPERATIONAL FREQUENCY BAND: 868.0 – 868.6 MHz
RECEIVER BANDWIDTH: 101 kHz
OPERATING CHANNEL BANDWIDTH: 500 kHz
WANTED SIGNAL MODULATION: 2FSK
BIT RATE: 38.4 kbps
PERFORMANCE DEGRADATION THRESHOLD: Message acceptance ratio < 80 %
INTERFERENCE SIGNAL MODULATION: Unmodulated

Wanted frequency, MHz	Interference frequency, MHz	Sensitivity level, dBm	Sensitivity limit, dBm	Wanted signal level, dBm*	Blocking (Interference level), dBm	Limit, dBm	Margin, dB**	Verdict
868.3	866.2495	-99.66	-96.95	-93.95	-39.82	-69	-29.18	Pass
	870.3505				-39.88	-69	-29.12	Pass
	858.2495				-33.74	-44	-10.26	Pass
	878.3505				-33.50	-44	-10.50	Pass
	911.715				-24.96	-44	-19.04	Pass
	824.885				-24.78	-44	-19.22	Pass

* - Wanted signal level was calculated as sensitivity limit increased by 3 dB

** - Margin = Specification limit – Blocking

Reference numbers of test equipment used

HL 4575	HL 2013	HL 1906	HL 4274	HL 4097	HL 2017	HL 3903	HL 4685
HL 4273	HL 4275						

Full description is given in Appendix A.

8 EUT photographs

8.1 External

Photograph 8.1.1 Front view

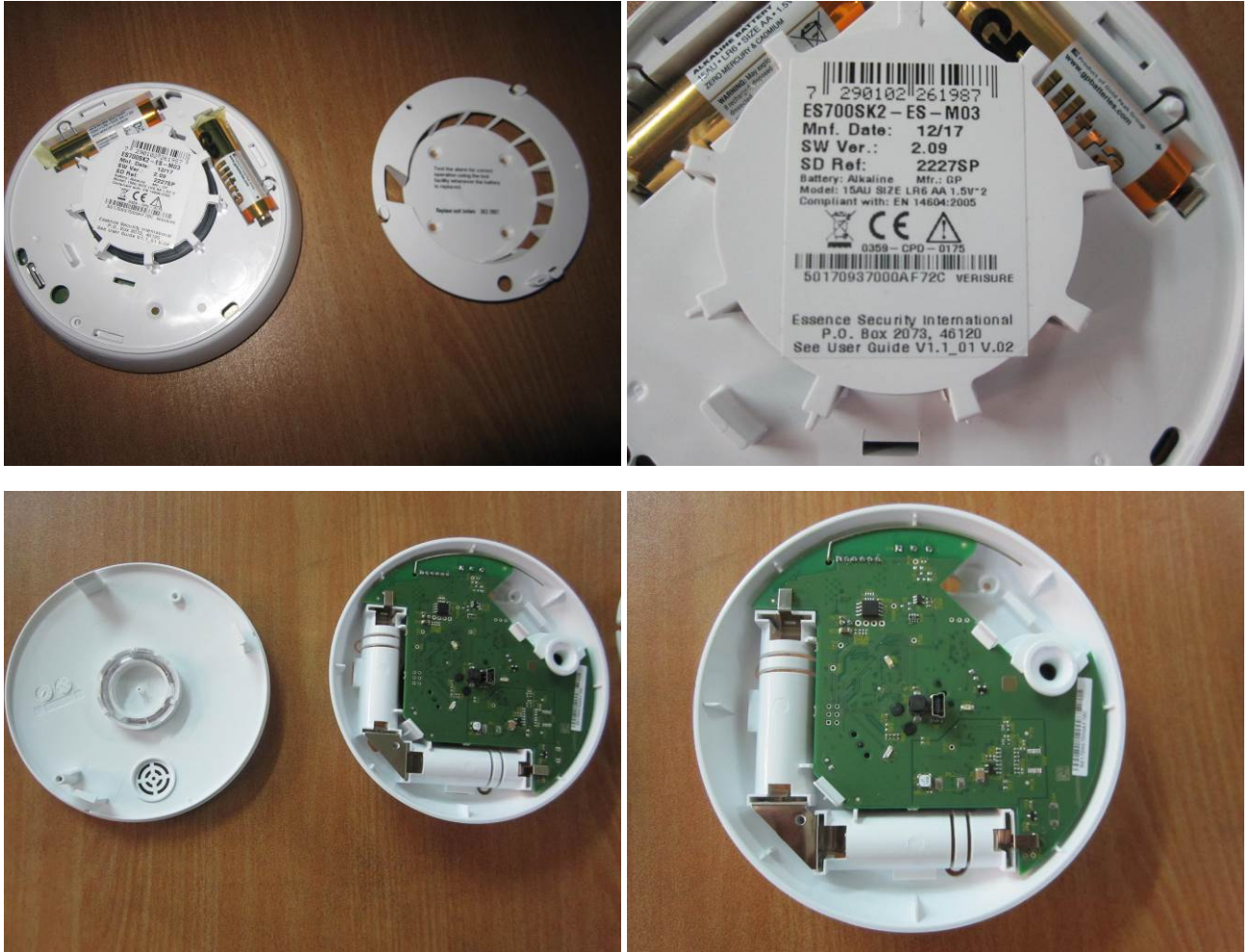


Photograph 8.1.2 Rear view



8.2 Internal

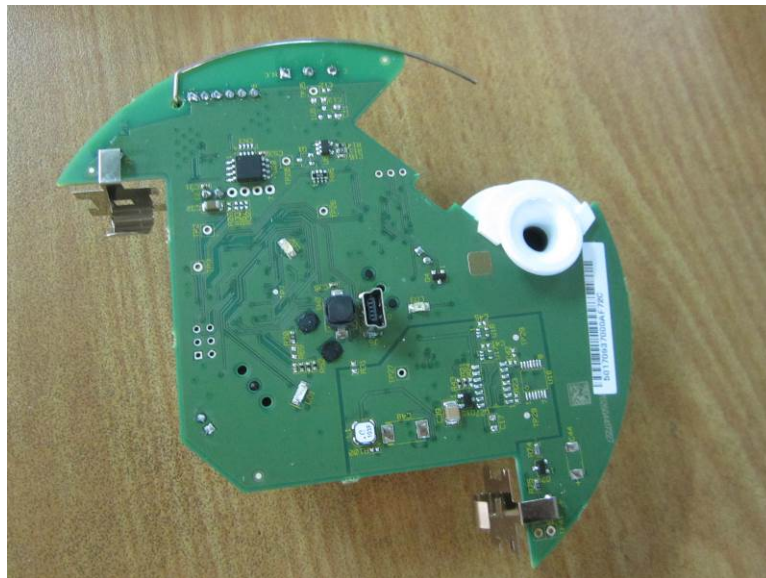
Photograph 8.2.1 Internal view



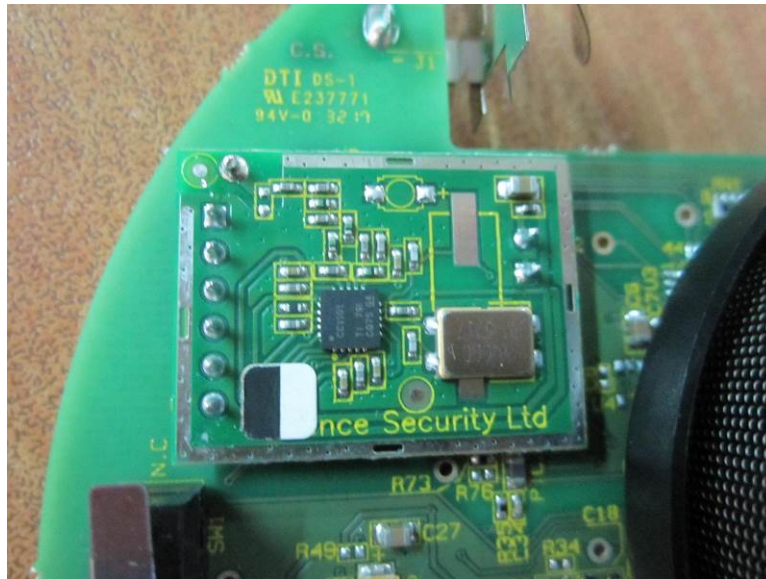
Photograph 8.2.2 Component side of the main PCB



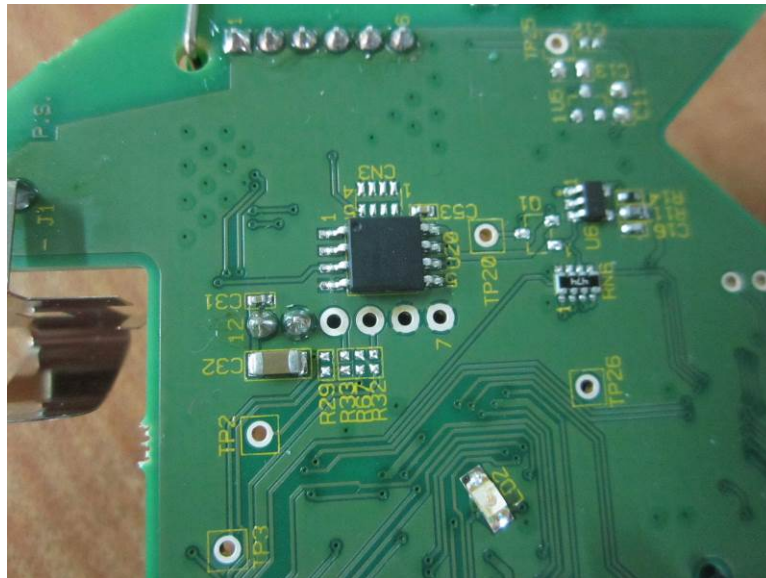
Photograph 8.2.3 Print side of the main PCB



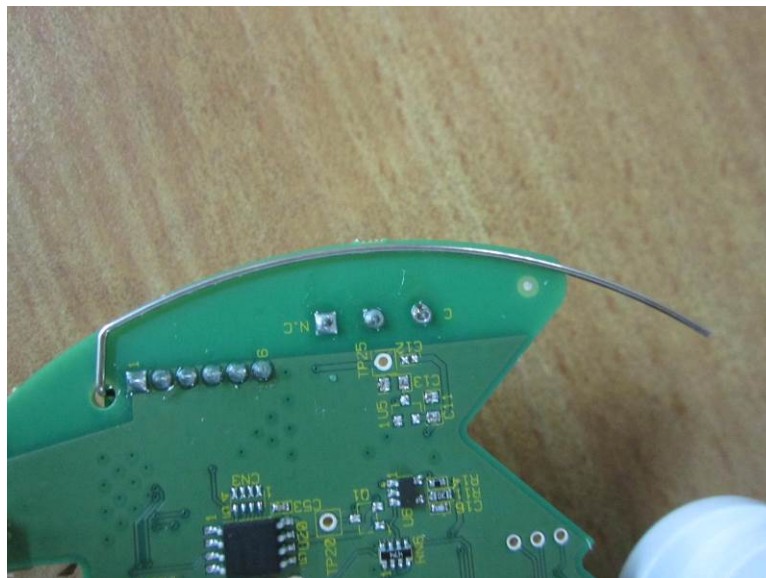
Photograph 8.2.4 Component side of the RF PCB



Photograph 8.2.5 Print side of the RF PCB



Photograph 8.2.6 Antenna assembly



**9 APPENDIX A Test equipment and ancillaries used for tests**

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./Check	Due Cal./Check
0493	Temperature Chamber -45...175 deg C	Thermotron	S-1.2 Mini-Max	14016	11-Jun-18	11-Jun-19
1906	Power Divider, 0.5-18.0 GHz, 80 W	Omni Spectra	2090-6204-00	NA	23-Jan-17	23-Jan-19
2013	Power Divider, 0.5-18.0 GHz, 80 W	Omni Spectra	2090-6204-00	NA	23-Jan-17	23-Jan-19
2017	Attenuator, Manual Step, 0-60/10 dB, 0-8.0 GHz	Midwest Microwave	1071	2017	01-Mar-18	01-Mar-19
3042	Antenna, Horn, 1-18 GHz	Hermon Laboratories	A1-18	3042	17-Jan-18	17-Jan-19
3210	Temperature Chamber, (-50...+100) °C	Associated Environmental Systems	NA	NA	03-Sep-17	03-Sep-18
3233	Multimeter	Fluke	115C	93771523	17-Jul-17	17-Jul-18
3771	Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N10W5+	NA	16-Aug-17	16-Aug-18
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	07-Feb-18	07-Feb-19
4051	Variac (Contact voltage regulator), 3kVA, 1phase, current rated 12A	Hermon Laboratories	TDGC20-3	NA	13-Mar-18	13-Mar-19
4097	Attenuator, Manual Step, 0-60/10 dB, 0-9/1 dB, 0-4.0 GHz	Weinschel	AC9003-69-11	17416	06-May-18	06-May-19
4274	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70047	04-Jun-18	04-Jun-19
4275	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70050	28-Mar-18	28-Mar-19
4295	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	04-Oct-17	04-Oct-18
4535	Microwave Cable Assembly, 6.5 GHz, 5.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	04-Jun-18	04-Jun-19
4541	Microwave Cable Assembly, 4.0 GHz, 1.0 m, N/M type-N/M type	Suhner Switzerland	214-U	NA	10-Sep-17	10-Sep-18
4542	Amplifier, 9 kHz to 1 GHz, 32 dB gain	Sonoma Instrument	310	0002A05639	22-Mar-18	22-Mar-19
4543	Broadband preamplifier, 0.5 to 18 GHz, 35 dB gain	Schwarzbeck mess-elektronik	BBV 9718	9718-134	22-Mar-18	22-Mar-19
4549	Cable RF, 6.8 m, N/N - type, up to 3 GHz	Suhner Switzerland	NA	07262	19-Mar-18	19-Mar-19
4550	Cable RF, 8.5 m, BNC/BNC, up to 1 GHz	Suhner Switzerland	RG-58	NA	04-Oct-17	04-Oct-18
4575	EXA Signal Analyzer, 9 kHz - 26.5 GHz	Agilent Technologies	N9010A	MY48030110	28-Dec-17	28-Dec-18
4594	Precision Fixed Attenuator, 50 Ohm, 2W, 20dB, DC to 18000 MHz	M/A-COM	3082-6144-20	NA	23-Jan-18	23-Jan-19
4603	Horn Antenna, 1 - 18 GHz	Schwarzbeck mess-elektronik	BBHA 9120 D	9120D-611	04-Jan-18	04-Jan-19
4604	Biconilog Antenna, 26 - 2000 MHz	EMCO	3142B	9909-1421	31-May-18	31-May-19
4649	DC Power Supply, 0-80 VDC, 0-42 A,	TDK-Lambda Ltd	GEN80-42	NA	13-Mar-18	13-Mar-19
4663	Spectrum Analyzer, 9 kHz - 1.5 GHz	Hewlett Packard	E7401A	US39150141	26-Mar-18	26-Mar-19
4665	Image Mainframe Controller	TESEQ	OVCMO2B	7432	13-Mar-18	13-Mar-19
4676	Multi Device Controller	EMCO ETS	2090	9908-1449	13-Mar-18	13-Mar-19
4685	Cable, 0.9 m, 18 GHz, SMA	Semflex	1-800-778-4401	NA	22-Mar-18	22-Mar-19
4958	Tuned dipole antenna	COM-POWER CORPORATION	AD-100	040191	22-May-18	22-May-19
5102	RF cable, 18 GHz, 6 m, N-type	Huber-Suhner	SF106A/11N/11N/6000M	500848/6A	27-Jul-17	27-Jul-18

10 APPENDIX B Test laboratory description

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

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered by Industry Canada for electromagnetic emissions, file number IC 2186A-1 for OATS, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-869 for RE measurements above 1 GHz, C-845 for conducted emissions site and T-1606 for conducted emissions at telecommunication ports).

The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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

11 APPENDIX C Abbreviations and acronyms

A	ampere
AC	alternating current
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
DC	direct current
EMC	electromagnetic compatibility
EMI	electromagnetic interference
EN	European Norm
EUT	equipment under test
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
kV	kilovolt
L	length
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
OBW	occupied bandwidth
OC	operating channel
OCW	operating channel bandwidth
OFB	operational frequency band
Ω	Ohm
QP	quasi-peak
PM	pulse modulation
PS	power supply
RBW	resolution bandwidth
RBW _{REF}	reference resolution bandwidth
RE	radiated emission
RF	radio frequency
rms	root mean square
s	second
V	volt
W	width

12 APPENDIX D Test equipment correction factors

Biconilog antenna factor
EMCO, model 3142B, serial number 9909-1421

Frequency, MHz	Measured
30	17.5
35	14.4
40	12.0
45	10.3
50	8.8
60	7.3
70	6.4
80	6.1
90	7.0
100	7.8
120	7.0
140	7.6
160	10.1
180	9.6
200	9.9
250	12.6
300	12.9
400	16.3
500	18.1
600	19.9
700	21.8
800	22.6
900	23.8
1000	24.6

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

**Tuned dipole antenna factor
COM-POWER CORPORATION, Model AD-100
Serial number 040191**

Table 3.1 Dipole element lengths, typical factors, typical balun loss

Balun Number	Frequency MHz	L/4 Length mm	Balun Loss dB	Antenna Factor dB
DB-1	30	2413	0.2	-1.8
	35	2080	0.2	-0.5
	40	1803	0.2	0.6
	45	1600	0.2	1.7
	50	1438	0.2	2.5
	60	1197	0.2	4.2
DB-2	70	1026	0.3	5.5
	80	889	0.3	6.7
	90	791	0.3	7.7
	100	714	0.3	8.8
	120	589	0.3	10.2
	125	565	0.3	10.3
	140	500	0.4	11.5
	150	467	0.4	11.7
	160	438	0.4	12.7
	175	400	0.4	12.9
	180	389	0.4	13.7
DB-3	180	389	0.4	13.7
	200	352	0.4	14.6
	250	283	0.4	16.6
	300	235	0.4	18.1
	400	175	0.5	20.8
DB-4	400	175	0.5	20.6
	500	143	0.5	22.6
	600	117	0.5	24.2
	700	102	0.5	25.5
	800	89	0.5	26.7
	900	79	0.5	27.7
	1000	76	0.5	28.6

Note: L/4 is the quarter wave length of the tunable dipole at the given frequency. This is the length measured from the notch at the center of the antenna to each tip of the two elements. Due to the finite diameter of the elements, the optimum or tuned length of the dipole is found to be slightly less (approx. 4%) than determined by calculations.

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

Horn antenna factor
Schwarzbeck mess-elektronik, Model BBHA 9120 D
Serial number: 9120D-611

Frequency, MHz	Measured antenna factor, dB/m
1000	24.6
1500	25.4
2000	26.1
2500	27.7
3000	28.3
3500	29.2
4000	30.0
4500	30.6
5000	31.8
5500	32.3
6000	32.8
6500	34.7
7000	35.7
7500	36.6
8000	37.1
8500	36.5
9000	36.8
9500	37.8
10000	38.3
10500	39.5
11000	40.1
11500	40.0
12000	38.9
12500	38.8
13000	39.5
13500	40.5
14000	41.2
14500	41.7
15000	41.2
15500	39.3
16000	38.5
16500	40.0
17000	41.1
17500	44.2
18000	53.4

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

13 APPENDIX E Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Frequency error 5 – 30 MHz 30 – 300 MHz 300 – 1000 MHz	± 6.1 Hz (1.22 ppm) ± 50.5 Hz (1.68 ppm) ± 168 Hz (0.56 ppm)
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (ERP), substitution method	± 4.5 dB
Frequency deviation	$\pm 7.0\%$
Adjacent channel power	± 1.3 dB
Occupied bandwidth	$\pm 2.0\%$
Spurious emissions conducted 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
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0\%$
Temperature	$\pm 2.3^{\circ}\text{C}$
Humidity	$\pm 6.4\%$

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.

14 APPENDIX F Specification references

EN 300 220-1 V3.1.1: 2017	Short Range Devices (SRD) operating in the frequency range 25 MHz to 1000 MHz; Part 1: Technical characteristics and methods of measurement
EN 300 220-2 V3.1.1: 2017	Short Range Devices (SRD) operating in the frequency range 25 MHz to 1000 MHz; Part 2: Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non specific radio equipment
ERC REC 70-03	ERC Recommendation 70-03: 2018

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