HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: EN 300 220-2 V2.4.1: 2012, EN 300 220-1 V2.4.1: 2012

FOR:

Essence Security International Ltd.
Key Fob
Model: ES700KF3

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1 Applicant information

Client name:	Essence Security International Ltd.
Address:	12 Abba Even Avenue, Ackerstein Towers Bldg. D, P.O.B. 2073, Herzliya 46120, Israel
Telephone:	+972 73 244 7735
Fax:	+972 9772 9962
E-mail:	israelgo@essence-grp.com
Contact name:	Mr. Israel Gottesman

2 Equipment under test attributes

Product name:	Key Fob
Product type:	Transceiver
Model(s):	ES700KF3
Serial number:	00000B13
Hardware version:	2.J
Software release:	001.005.005
Receipt date	12/16/2012

3 Manufacturer information

Manufacturer name:	Essence Security International Ltd.
Address:	12 Abba Even Avenue, Ackerstein Towers Bldg. D, P.O.B. 2073, Herzliya 46120, Israel
Telephone:	+972 73 244 7735
Fax:	+972 9772 9962
E-Mail:	israelgo@essence-grp.com
Contact name:	Mr. Israel Gottesman

4 Test details

Project ID:	23787
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	12/16/2012
Test completed:	12/31/2012
Test specification(s):	EN 300 220-2 V2.4.1: 2012 EN 300 220-1 V2.4.1: 2012

5 Tests summary

Test	Status
Transmitter parameters	
Frequency error (narrow band transmitter)	Not required
Frequency error (wide band transmitter)	Pass
Average power	Not required
Effective radiated power	Pass
Transient power	Pass
Response of the transmitter to modulation frequency	
Adjacent channel power	Not required
Range of modulation bandwidth	Pass
Spurious emission	
Conducted	Not required
Radiated	Pass
Frequency stability under low voltage (narrow band transmitter)	Not required
Frequency stability under low voltage (wide band transmitter)	Pass
Duty cycle	Pass*
Receiver parameters	
Receiver sensitivity	Not required
Receiver LBT threshold and maximum Tx on-time	Not required
Adjacent channel selectivity	Not required
Blocking	Pass
Spurious response rejection	Not required
Spurious radiation	
Receiver spurious emissions (radiated)	Pass

* Declared by manufacturer (refer to Appendix G of the test report).

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

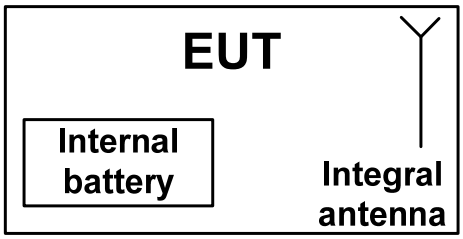
	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer Mr. A. Chaplik, test engineer	December 31, 2012	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	January 7, 2013	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	January 29, 2013	

6 EUT description

6.1 General information

The EUT is a wireless device (hand-held, in-pocket or on a key-ring), enabling remote control of the Essence Security International (E.S.I.) Ltd. security system as well as verifying the system status. The EUT operates at 868.3 MHz. The EUT is equipped with integral antenna and has receiver class 2. The EUT is powered by 3 V CR2450 Lithium battery.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

6.4 Transmitter characteristics

Type of equipment							
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)						

Assigned frequency range	868.0 – 868.6 MHz
Operating frequency	868.3 MHz
Maximum rated output power	Effective radiated power (for equipment with no RF connector) 9.25 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		with temporary RF connector
				X	without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
Integral	Essence Security International	NA	11.2 dB

Transmitter aggregate data rate/s	38.4 kbps
Type of modulation	2FSK
Modulating signal	ID code

Transmitter power source						
X	Battery	**Nominal rated voltage**	3.0 VDC	Battery type	Lithium
	DC	**Nominal rated voltage**	VDC		
	AC mains	**Nominal rated voltage**	VAC	Frequency	

Common power source for transmitter and receiver	X yes	no

Test specification:	Frequency error (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.1.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

7 Transmitter parameters

7.1 Frequency error

7.1.1 General

This test was performed to measure frequency error of transmitter RF carrier. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Frequency error limits

Assigned frequency	Transmitter type	Channel spacing, kHz	Maximum allowed frequency error	
			kHz	ppm*
500 to 1000 MHz	All types	10 / 12.5	± 5/6.25	NA
	All types	20 / 25	± 12.5	
	All types	Wideband	NA	± 100

* - Relative to the maximum frequency of the assigned band.

7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1 under normal conditions, energized and its proper operation was checked. The reference point frequency was measured at the power slope.

7.1.2.2 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.

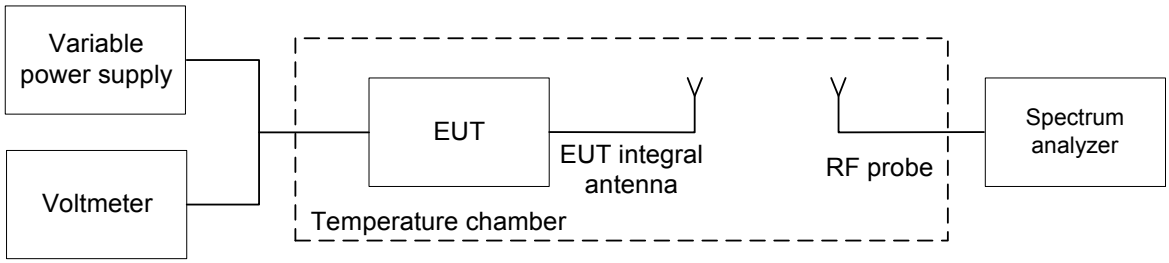
7.1.2.3 The EUT was powered on, frequency at the reference point was measured and then the EUT was powered off.

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

7.1.2.5 Frequency drift was calculated and compared with the limit as provided in Table 7.1.2.

Test specification:	Frequency error (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.1.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

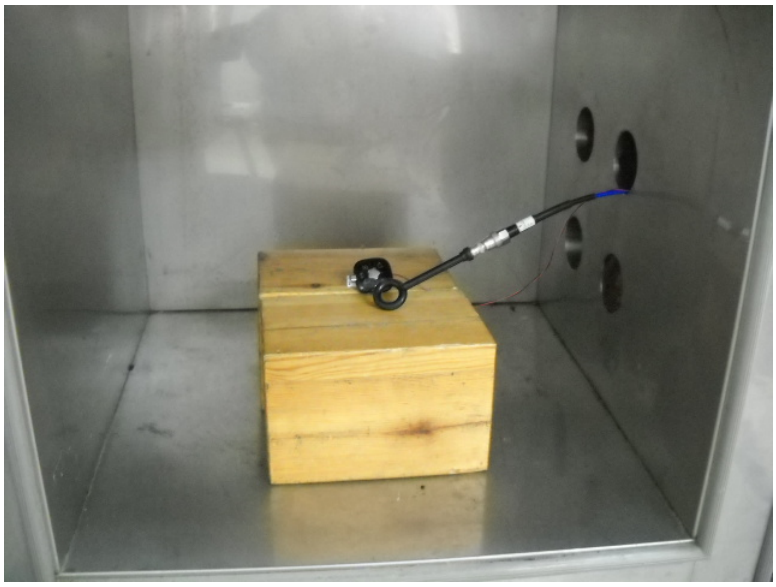
Figure 7.1.1 Frequency error test setup



Photograph 7.1.1 Frequency error test setup

Test specification:	Frequency error (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.1.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

Photograph 7.1.2 Frequency error test setup



Test specification:	**Frequency error (wide band transmitter)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.1.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

Table 7.1.2 Frequency error test results

OPERATING FREQUENCY: 868.3 MHz
NOMINAL POWER VOLTAGE: 3 V
REFERENCE POINT AT THE POWER SLOPE: Peak
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 1 kHz
VIDEO BANDWIDTH: 1 kHz
MODULATION: Unmodulated

Temperature, ºC	Voltage, V	Measured frequency*, MHz	Frequency drift**, Hz	Limit, Hz	Margin, Hz	Verdict
Operating frequency 868.3 MHz						
-10	3.0	868.29917	-830	±86830	86000	Pass
	2.5	868.29917	-830		86000	
+ 23	3.0	868.29933	-670		86160	
+55	3.0	868.29675	-3250		83580	
	2.5	868.29675	-3250		83580	

Margin= |Limit| - |drift|

*- Reference frequency.
**- Frequency drift was calculated as a difference between frequencies measured under normal and extreme conditions and the nominal frequency stated by the manufacturer.

Reference numbers of test equipment used

HL 1424	HL 2358	HL 3286	HL 3310				

Full description is given in Appendix A.

Test specification:	Effective radiated power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	Air Pressure: 1019 hPa	Relative Humidity: 45 %	Power Supply: 3V battery
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

Assigned frequency band, MHz	ERP*		Equivalent field strength limit @ 3m, dB(μV/m)**
	mW	dBm	
868.0 – 868.6	25	14	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(30×1.64×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 360^0, 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 Figure 7.2.2 and energized.

7.2.3.2 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.

7.2.3.3 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.

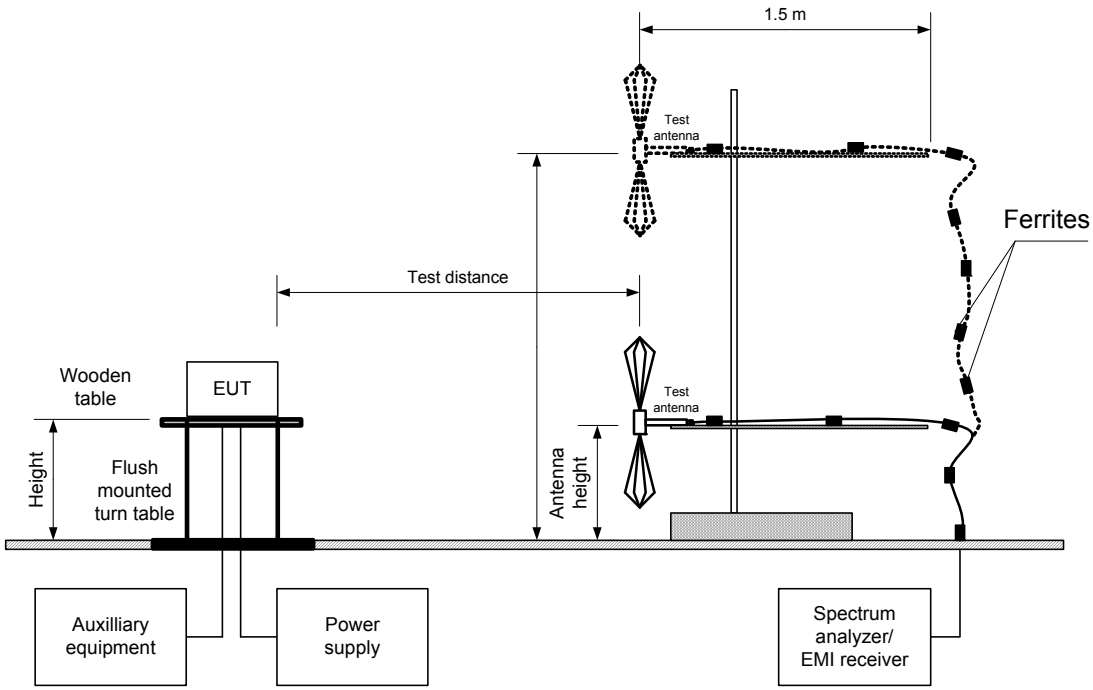
7.2.3.4 The ERP was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

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

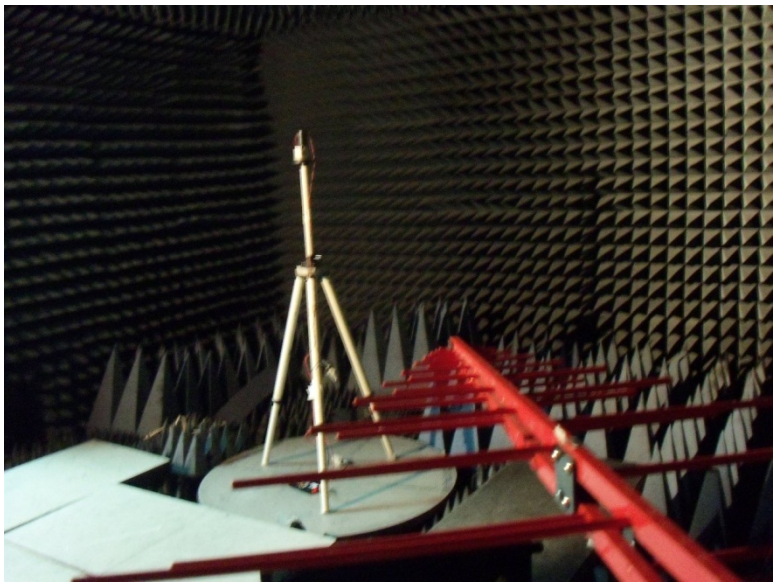
7.2.3.6 The worst test results (the lowest margins) were recorded in Table 7.2.3 and shown in the associated plots.

Test specification:	Effective radiated power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	Air Pressure: 1019 hPa	Relative Humidity: 45 %	Power Supply: 3V battery
Remarks:			

Figure 7.2.1 Setup for carrier field strength measurements

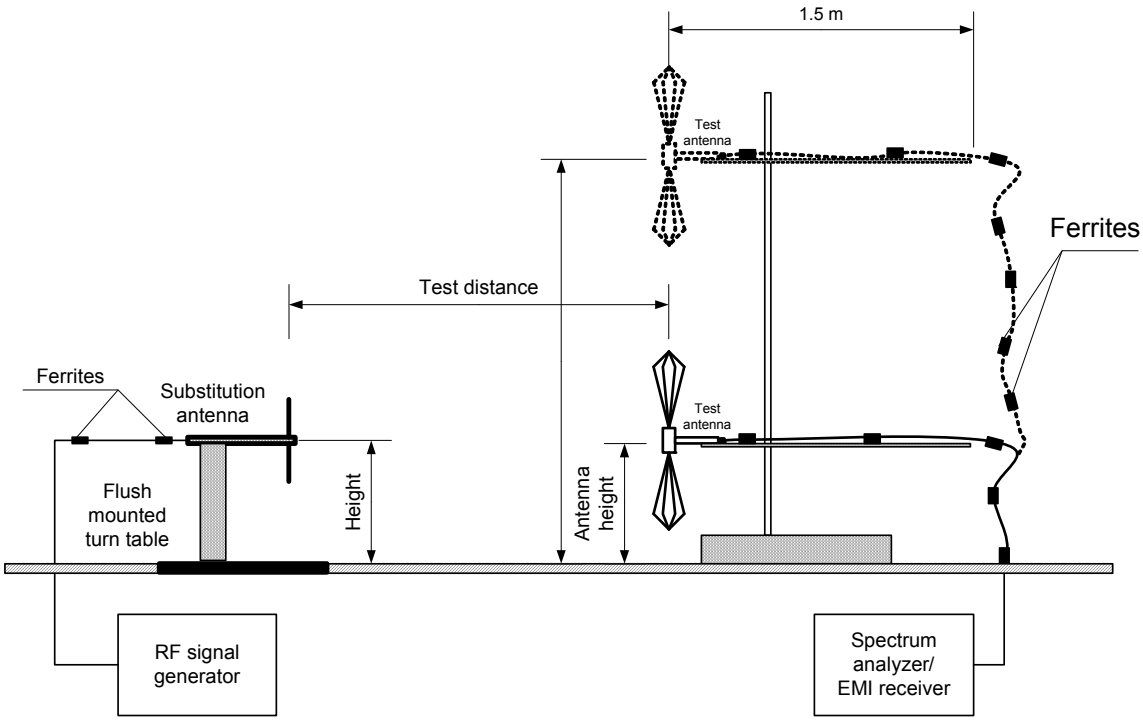


Photograph 7.2.1 Setup for carrier field strength measurements

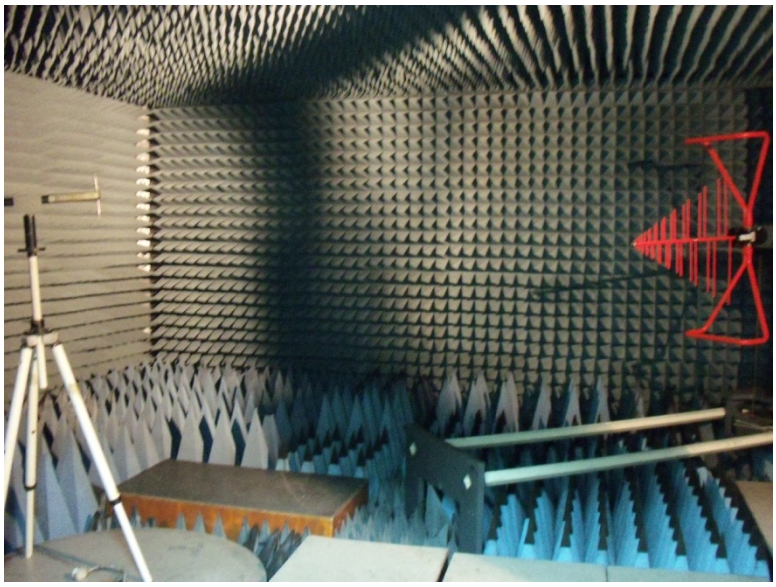


Test specification:	Effective radiated power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	Air Pressure: 1019 hPa	Relative Humidity: 45 %	Power Supply: 3V battery
Remarks:			

Figure 7.2.2 Setup for substitution ERP measurements



Photograph 7.2.2 Setup for substitution ERP measurements



Test specification:	**Effective radiated power**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	**Air Pressure:** 1019 hPa	**Relative Humidity:** 45 %	**Power Supply:** 3V battery
Remarks:			

Table 7.2.2 Transmitter carrier field strength

ASSIGNED FREQUENCY RANGE: 868.0 – 868.6 MHz
TEST SITE: Fully anechoic chamber
TEST DISTANCE: 3 m
EUT HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 1.8 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: 300 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
868.30000	102.6	111.4	-8.8	120	Vertical	1.65	240
868.29875	108.0	111.4	-3.4		Horizontal	1.75	325

*- 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 – 1.8 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: 300 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
868.30000	102.6	120	Vertical	7.1	-0.63	1.22	5.25	14	-8.75	Pass
868.29875	108.0		Horizontal	11.1	-0.63	1.22	9.25	14	-4.75	Pass

*- Margin = ERP – specification limit.

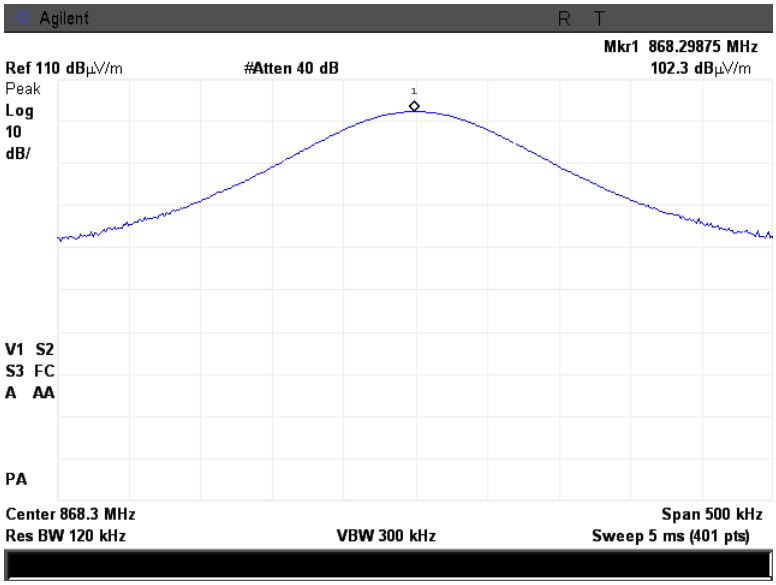
Reference numbers of test equipment used

HL 0567	HL 2667	HL 2697	HL 2780	HL 3634	HL 4347	HL 4349	

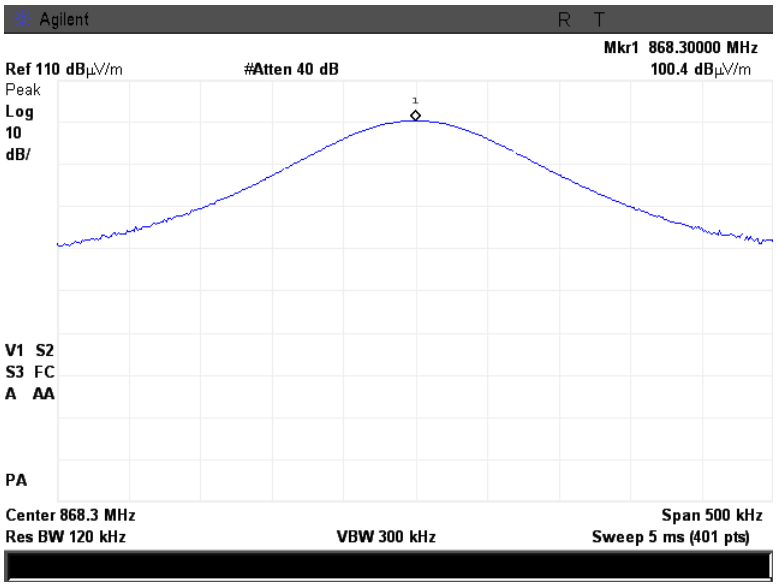
Full description is given in Appendix A.

Test specification:	Effective radiated power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	Air Pressure: 1019 hPa	Relative Humidity: 45 %	Power Supply: 3V battery
Remarks:			

Plot 7.2.1 Transmitter carrier field strength in vertical antenna polarization, EUT X-axis position

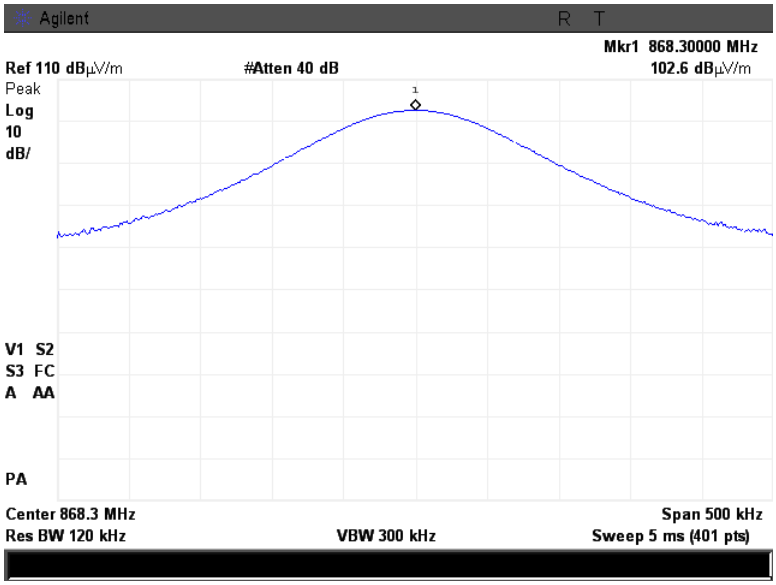


Plot 7.2.2 Transmitter carrier field strength in horizontal antenna polarization, EUT X-axis position

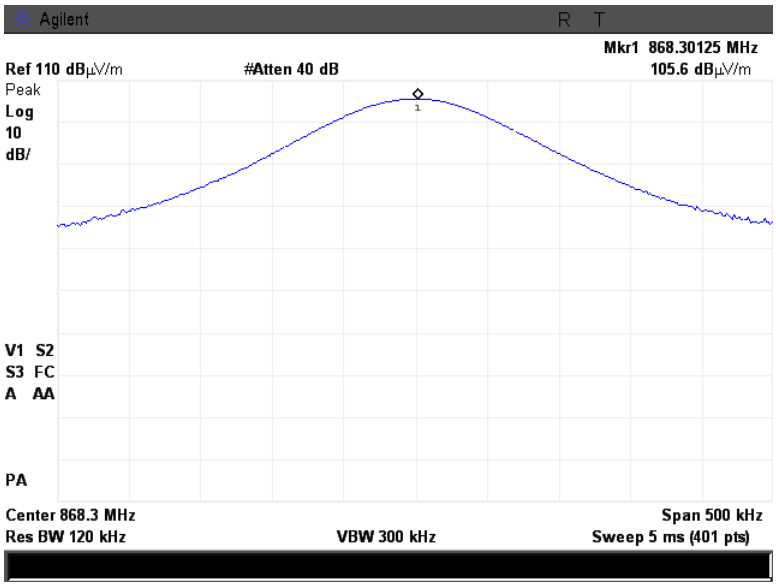


Test specification:	Effective radiated power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	Air Pressure: 1019 hPa	Relative Humidity: 45 %	Power Supply: 3V battery
Remarks:			

Plot 7.2.3 Transmitter carrier field strength in vertical antenna polarization, EUT Y-axis position

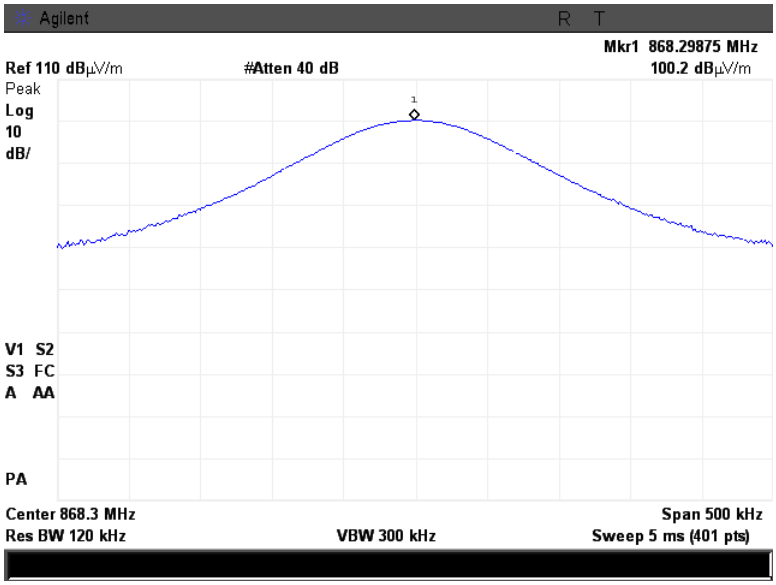


Plot 7.2.4 Transmitter carrier field strength in horizontal antenna polarization, EUT Y-axis position

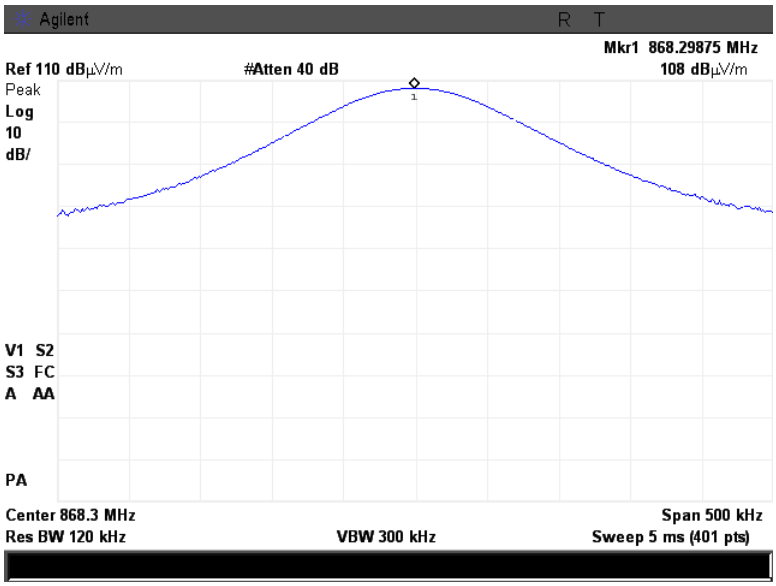


Test specification:	Effective radiated power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.3.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/16/2012		
Temperature: 22.3 ºC	Air Pressure: 1019 hPa	Relative Humidity: 45 %	Power Supply: 3V battery
Remarks:			

Plot 7.2.5 Transmitter carrier field strength in vertical antenna polarization, EUT Z-axis position



Plot 7.2.6 Transmitter carrier field strength in horizontal antenna polarization, EUT Z-axis position



Test specification:	Transient power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.5.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.6 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 3V battery
Remarks:			

7.3 Transient power

7.3.1 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 7.3.1.

Table 7.3.1 Transient power limit

Channel separation	Absolute transient power limit		Exceeding of permissible frequency power versus continuous power level, dB
	µW	dBm	
±100kHz from the edge of the modulation bandwidth	0.25	-36.0	3
±offset up to 2 MHz from the edge of the modulation bandwidth	0.25	-36.0	3

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 **Step 1.** The EUT was adjusted to produce modulated RF signal of maximum available to the end user RF power.

7.3.2.3 The spectrum analyzer center frequency was adjusted to the transmitter carrier frequency, searched for maximum power within the band and was recorded as a reference channel RF power.

7.3.2.4 The spectrum analyzer center frequency was adjusted to the f_a / f_b ± 100 kHz with resolution bandwidth of 120 kHz zero span, quasi-peak detector. The sweep time was set sufficiently long to record five switching operations.

7.3.2.5 The RF transmitter was triggered five times ON and OFF and the transient power was recorded.

7.3.2.6 The test was repeated at the rest of the test frequencies, transient power was measured and provided in Table 7.3.2 and associated plots.

7.3.2.7 As the resulting maximum power level in step 1 was above the spurious domain limit, the second measurement step was performed.

7.3.2.8 **Step 2.** The EUT was set on continuous transmission. The above procedure was repeated with the same settings of the measuring receiver.

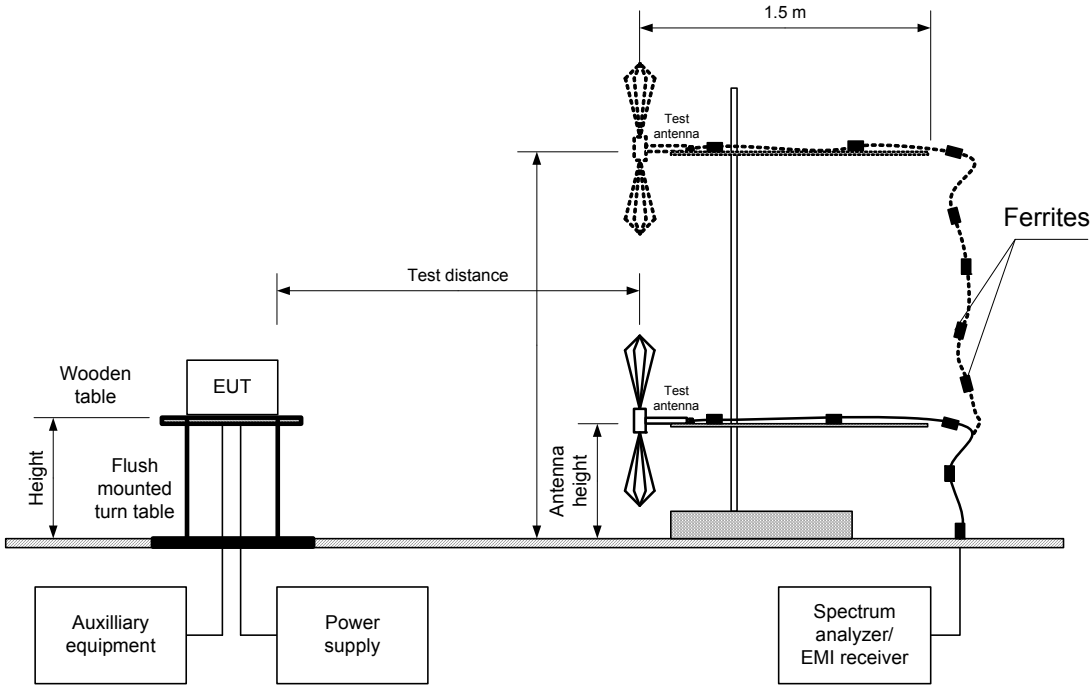
7.3.2.9 The measured power level was recorded for the measurement period identical to the one in Step 1 for the measurement receiver setting above and below the wanted channel.

7.3.2.10 The above procedure was repeated within the spectrum mask every 120 kHz from the primarily adjusted point to both sides of the wanted frequencies, until either it was clearly ascertained that no power increases or limit exceeding appeared, or until the frequency offset to the wanted frequency exceeded 2 MHz.

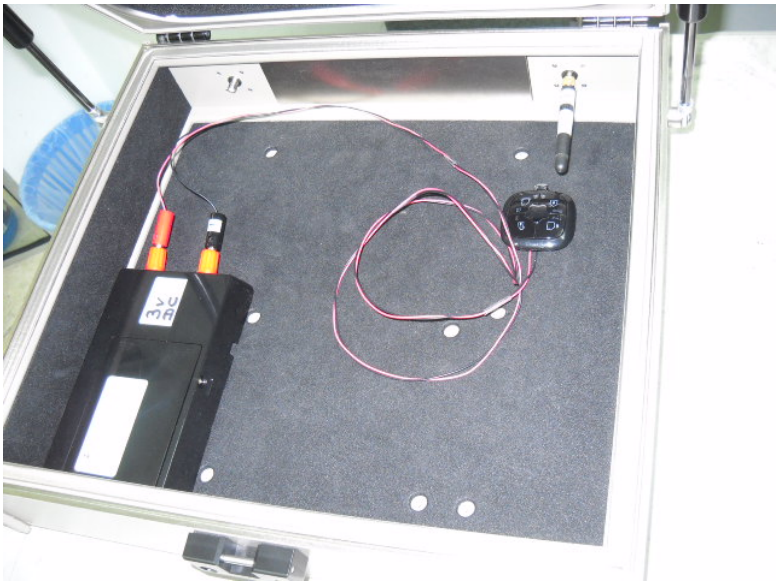
7.3.2.11 The test was repeated at the rest of the test frequencies, transient power was measured and provided in Table 7.3.2 and associated plots.

Test specification:	Transient power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.5.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.6 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 3V battery
Remarks:			

Figure 7.3.1 Setup for transient power measurements



Photograph 7.3.1 Setup for transient power measurements



Test specification:	**Transient power**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.5.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/20/2012		
Temperature: 22.6 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 42 %	**Power Supply:** 3V battery
Remarks:			

Table 7.3.2 Transient power test results

ASSIGNED FREQUENCY RANGE: 868.0 – 868.6 MHz
OPERATING FREQUENCY: 868.3 MHz
RESOLUTION BANDWIDTH: 120 kHz
MODULATION: 2FSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
NOMINAL POWER VOLTAGE: 3V

Measured frequency, MHz		**Transient power, dBm*** **	**Limit, dBm**	**Margin, dB**** **	**Continuous power, dBm**	**Exceeding of permissible frequency power versus continuous power level, dB***** **	**Limit, dB**	**Verdict**
f_a* - 100 kHz	868.0438	-27.63	-36	NA	-27.12	-0.51	3	Pass
f_b** + 100 kHz	868.5563	-28.47	-36	NA	-27.98	-0.49	3	Pass
f_a* - offset up to 2MHz	867.0238	-52.22	-36	NA	-51.71	-0.51	3	Pass
f_b** + offset up to 2MHz	868.6763	-33.45	-36	NA	-32.90	-0.55	3	Pass
f_a* - offset up to 2 MHz		Transient power less then continuous power					3	Pass
f_b** + offset up to 2 MHz		Transient power less then continuous power					3	Pass

* f_a – low point of modulation bandwidth
** f_b – upper point of modulation bandwidth
*** - Absolute level of transient power.
**** - Margin = Specification limit – measurement result.
***** - Transient power – continuous power.

Reference numbers of test equipment used

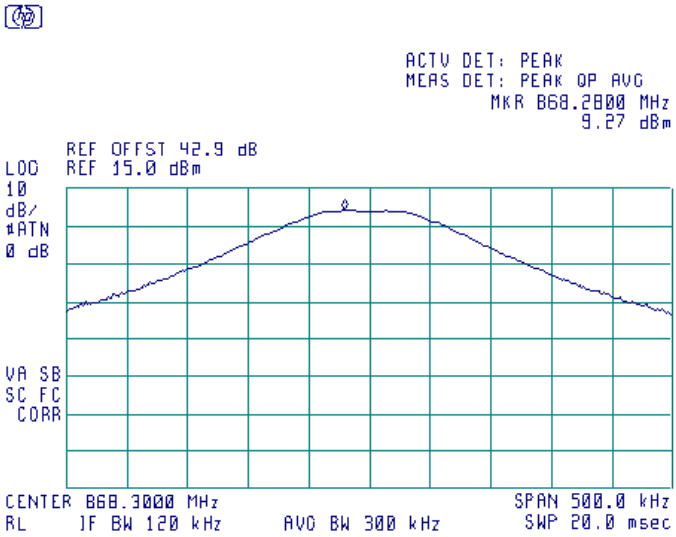
HL 1425	HL 4135						

Full description is given in Appendix A.

Test specification:	**Transient power**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.5.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/20/2012		
Temperature: 22.6 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 42 %	**Power Supply:** 3V battery
Remarks:			

Plot 7.3.1 Equivalent power at low frequency
(reference level measurement)

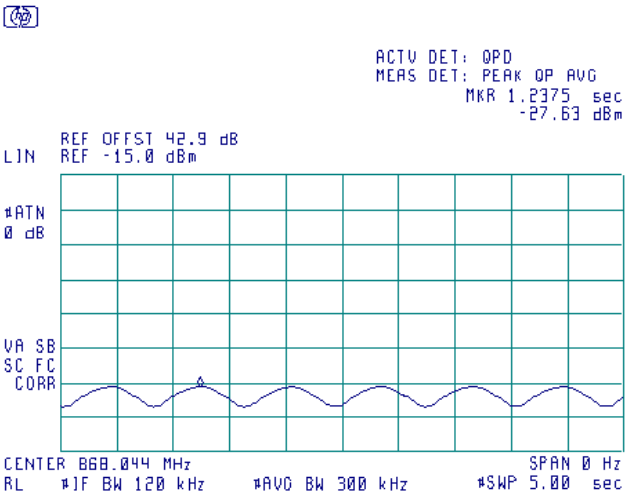
OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm

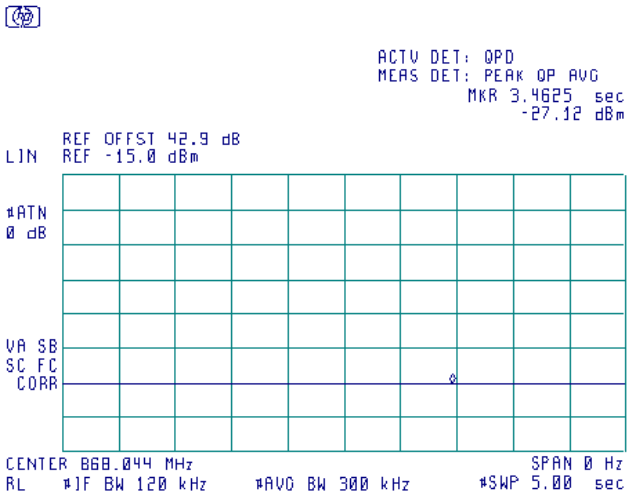


An offset represents jig coupling factor and converts spectrum analyzer to an actual power reading

Plot 7.3.2 Transient power at frequency shift 100 kHz from the low edge of the modulation bandwidth

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm





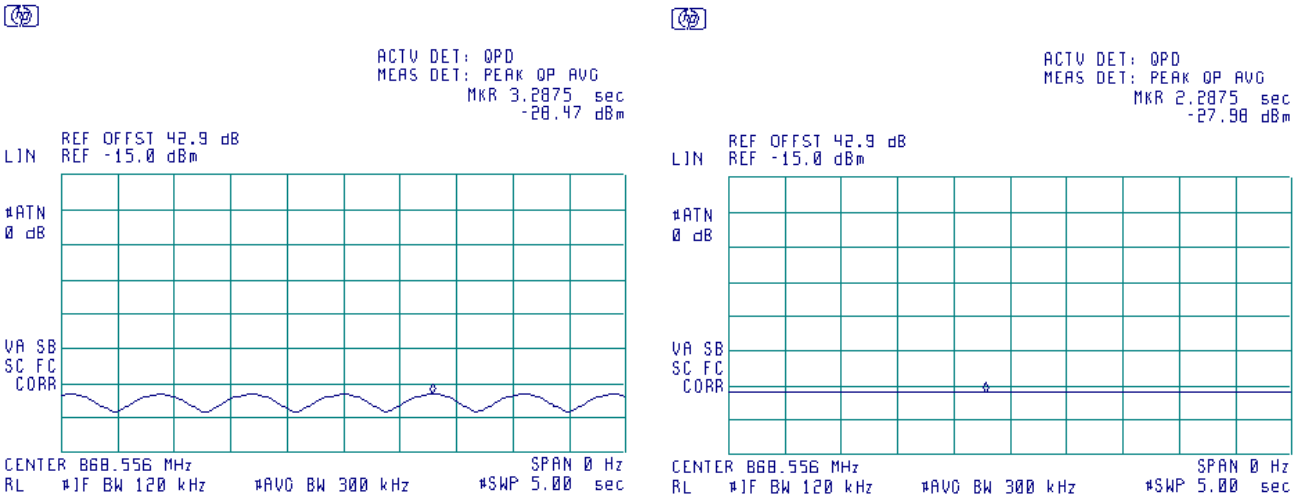
Transient power Continuous power

F=868.1438-0.1=868.0438 MHz

Test specification:	**Transient power**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.5.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/20/2012		
Temperature: 22.6 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 42 %	**Power Supply:** 3V battery
Remarks:			

Plot 7.3.3 Transient power at frequency shift 100 kHz from the high edge of the modulation bandwidth

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm

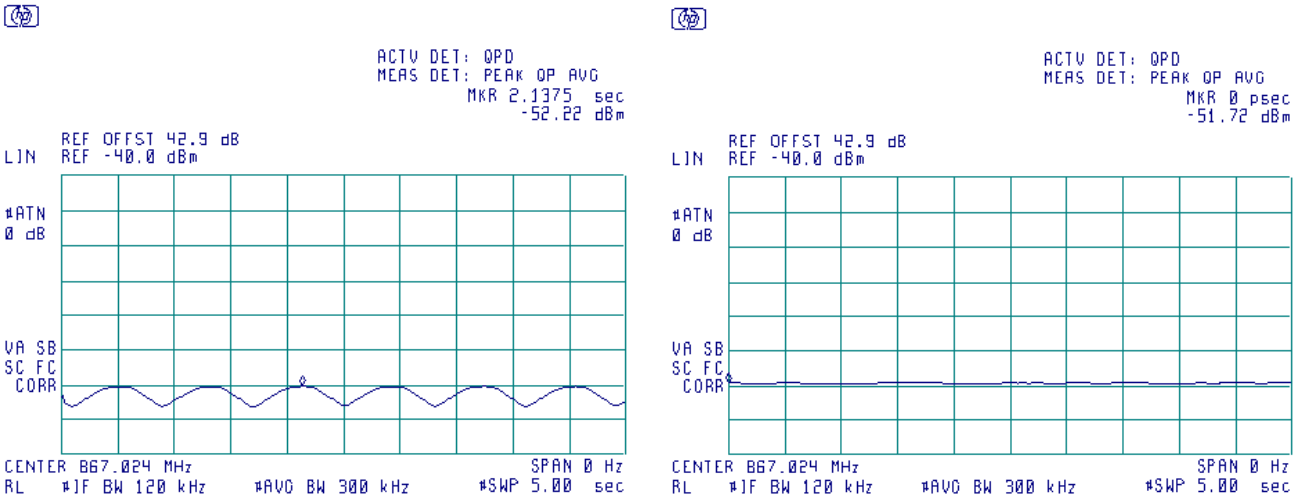


Transient power Continuous power

F=868.4563+0.1=868.5563 MHz

Plot 7.3.4 Transient power at frequency shift 220 kHz from the low edge of the modulation bandwidth

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



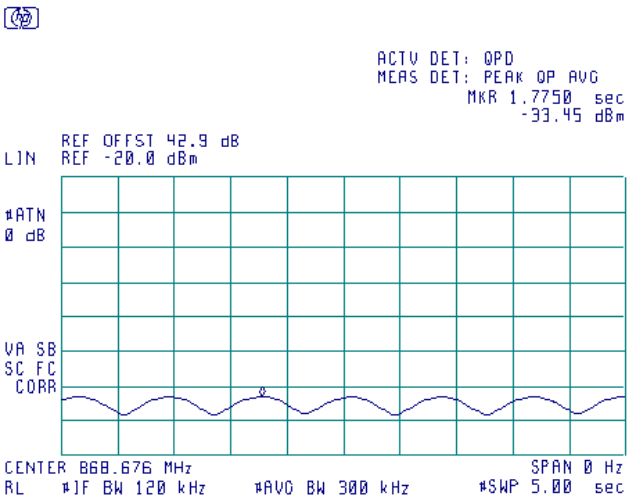
Transient power Continuous power

F=868.1438-0.2=867.0238 MHz

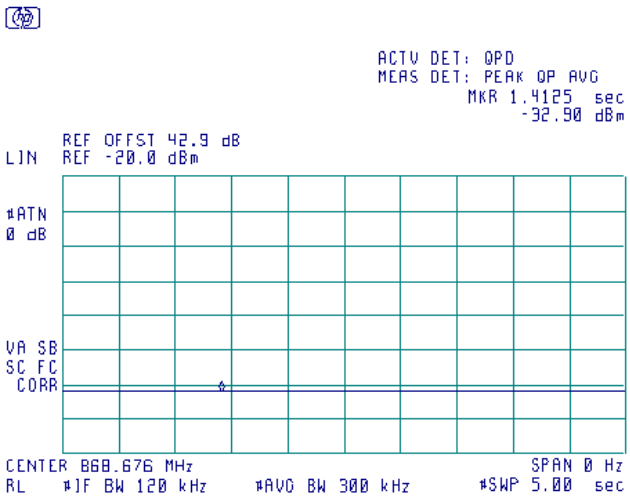
Test specification:	Transient power		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.5.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.6 ºC	Air Pressure: 1006 hPa	Relative Humidity: 42 %	Power Supply: 3V battery
Remarks:			

Plot 7.3.5 Transient power at frequency shift 220 kHz from the high edge of the modulation bandwidth

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



Transient power



Continuous power

F=868.4563+0.22=868.6763 MHz

Test specification:	Range of modulation bandwidth		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.4 ºC	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3V battery
Remarks:			

7.4 Range of modulation bandwidth

7.4.1 General

This test was performed to measure the range of modulation bandwidth of the EUT including all associated side bands above the appropriate spurious limit and frequency drift under extreme test conditions. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Modulation bandwidth limits

Reference bandwidth (RBW), kHz	Limit	Lower envelope point minimum frequency	Upper envelope point maximum frequency
1	1 uW	f_e, lower	f_e, upper
1	250 nW	(f_e, lower – 200 kHz)	(f_e, upper + 200 kHz)
10	250 nW	(f_e, lower – 400 kHz)	(f_e, upper + 400 kHz)
100	250 nW	(f_e, lower – 1000 kHz)	(f_e, upper + 1000 kHz)

f_e, lower – lower edge of the band in which the EUT operates.
f_e, upper – upper edge of the band in which the EUT operates.

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 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. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

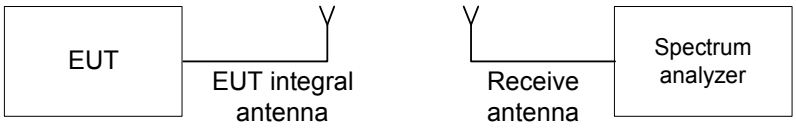
7.4.2.3 The peak of emission related to the ERP was measured. The reference bandwidth of 1 kHz according to Table 7.4.1 was set. The frequency of modulation envelope points f_a and f_b at which power level drops below 30 dBm limit was measured.

7.4.2.4 Modulation bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained modulation bandwidth was verified to be within the allowed frequency range.

7.4.2.5 The above procedure was repeated at the rest reference bandwidths and limits according to Table 7.4.1.

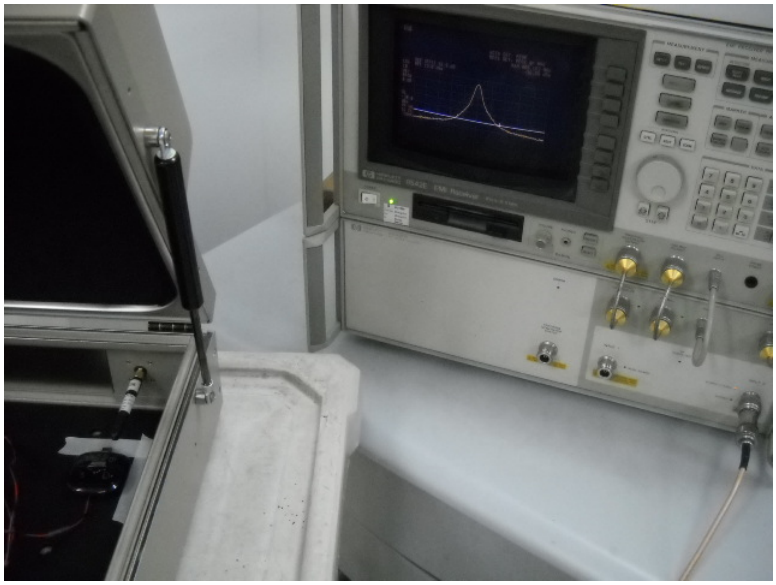
7.4.2.6 The test results were recorded in Table 7.4.2 and shown in the associated plots.

Figure 7.4.1 Range of modulation bandwidth measurements



Test specification:	Range of modulation bandwidth		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.7		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/20/2012		
Temperature: 22.4 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 43 %	**Power Supply:** 3V battery
Remarks:			

Photograph 7.4.1 Range of modulation bandwidth measurements



Test specification:	Range of modulation bandwidth		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.4 ºC	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3V battery
Remarks:			

Table 7.4.2 Range of modulation bandwidth test results

DETECTOR USED: Peak hold
VIDEO BANDWIDTH: 3 x resolution bandwidth
MODULATION: 2 FSK
BIT RATE: 38.4 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
ASSIGNED FREQUENCY RANGE 868.0 – 868.6 MHz

Test sequence	RBW, kHz	Limit, dBm	Cross point frequency, MHz	Frequency drift, kHz		Cross point frequency including frequency drift, MHz	Limit of modulated signal, MHz	Verdict
				Negative	Positive			
1	1	-30	868.1438	2.58	NA	868.14122	868.0	Pass
			868.4563	NA	0	868.45630	868.6	Pass
2	1	-36	868.0300	2.58	NA	868.02742	867.8	Pass
			868.5750	NA	0	868.57500	868.8	Pass
3	10	-36	867.8350	2.58	NA	867.83242	867.6	Pass
			868.8050	NA	0	868.80500	869.0	Pass
4	100	-36	867.4500	2.58	NA	867.44742	867.0	Pass
			869.1630	NA	0	869.16300	869.6	Pass

Reference numbers of test equipment used

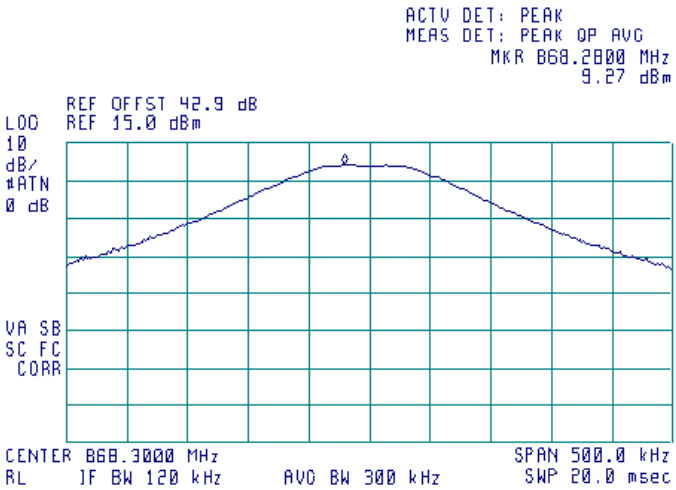
HL 1425	HL 4135						

Full description is given in Appendix A.

Test specification:	Range of modulation bandwidth		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.4 ºC	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3V battery
Remarks:			

Plot 7.4.1 Reference output power

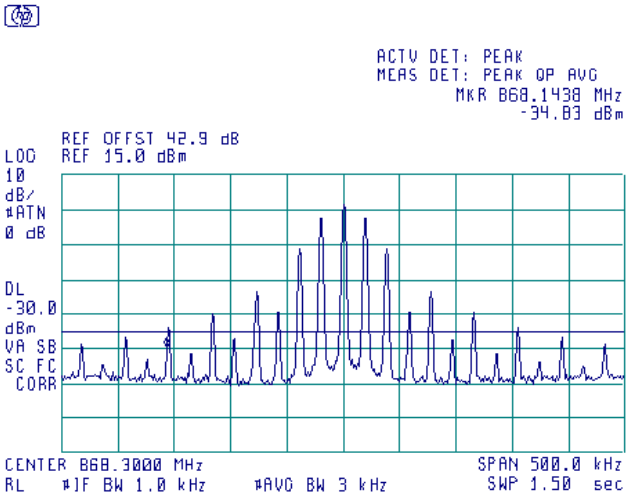
OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



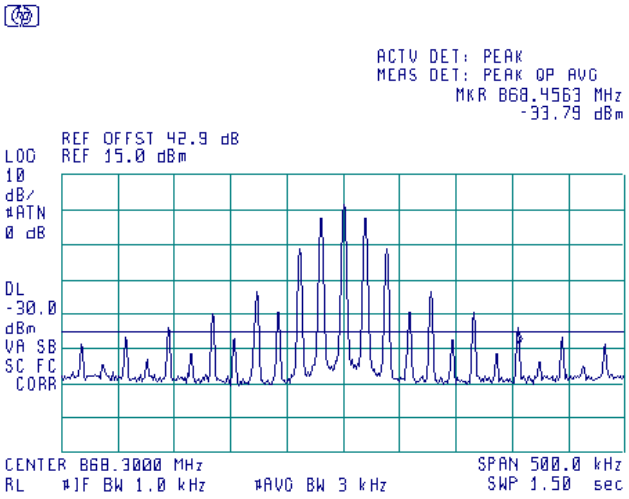
An offset represents jig coupling factor and converts spectrum analyzer to an actual power reading.

Plot 7.4.2 Modulation bandwidth, test sequence 1

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



f_a=868.1438 MHz

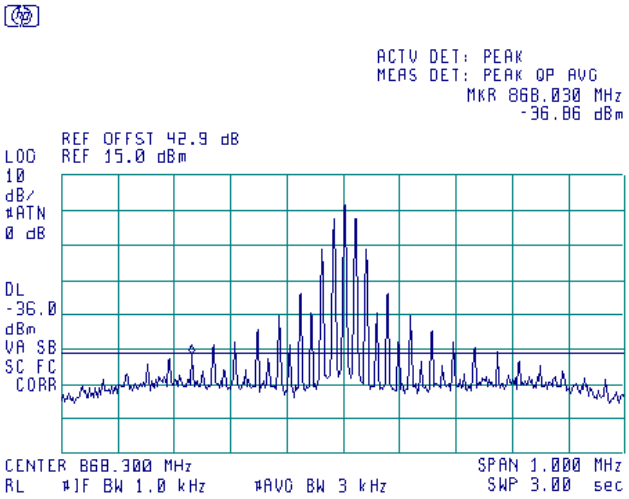


f_b=868.4563 MHz

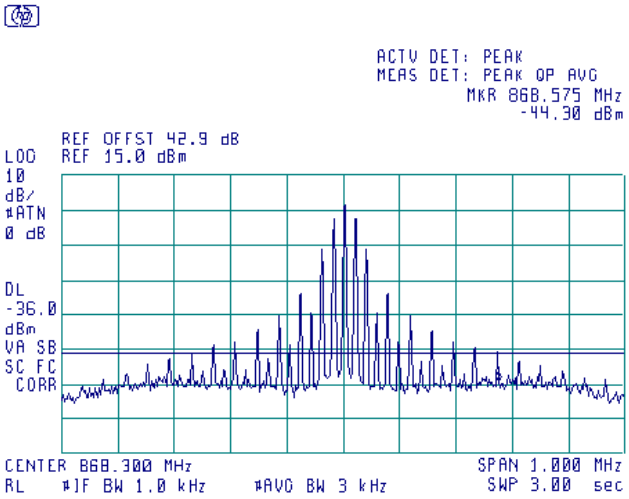
Test specification:	Range of modulation bandwidth		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.7		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/20/2012		
Temperature: 22.4 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 3V battery
Remarks:			

Plot 7.4.3 Modulation bandwidth, test sequence 2

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



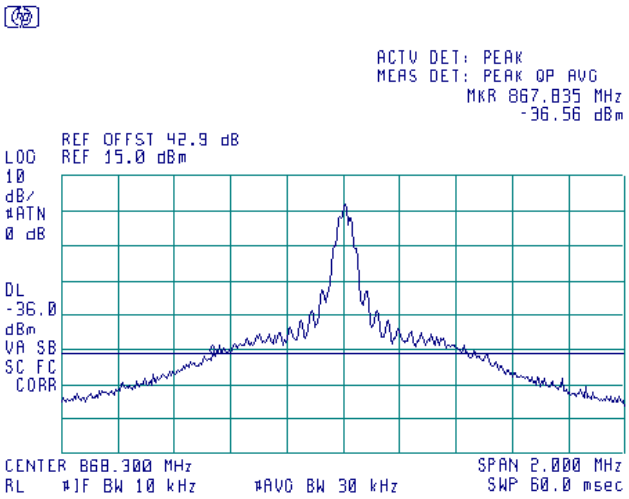
f_a=868.030 MHz



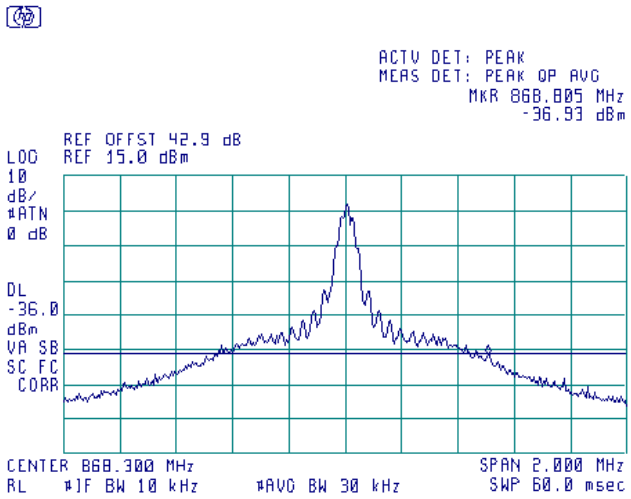
f_b=868.575 MHz

Plot 7.4.4 Modulation bandwidth, test sequence 3

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



f_a=867.835 MHz

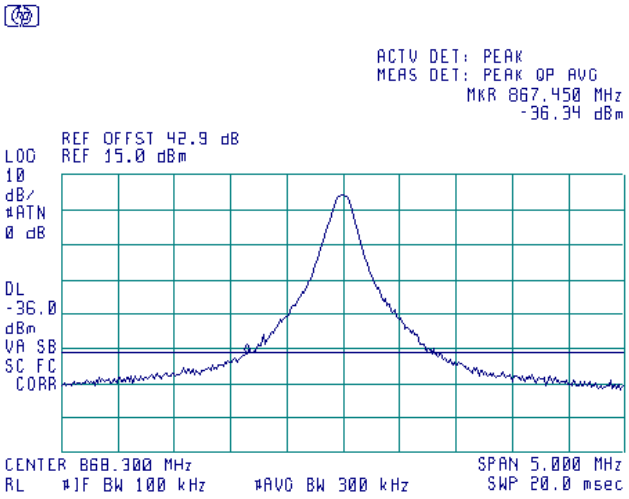


f_b=868.805 MHz

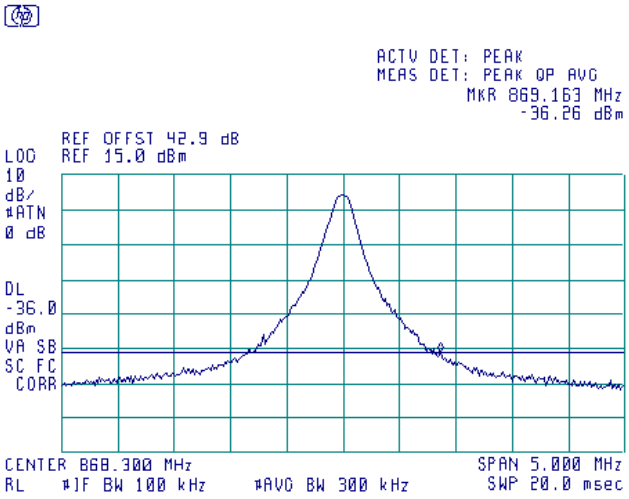
Test specification:	**Range of modulation bandwidth**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.7		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/20/2012		
Temperature: 22.4 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 43 %	**Power Supply:** 3V battery
Remarks:			

Plot 7.4.5 Modulation bandwidth, test sequence 4

OPERATING FREQUENCY 868.3 MHz ERP = 9.25dBm



f_a=867.450 MHz



f_b=869.163 MHz

Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

7.5 Effective radiated power of transmitter spurious emission

7.5.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Radiated spurious emission test limits

Frequency, MHz	Operating mode		Standby mode	
	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 - 862	- 54.0 (4 nW)	43.35	- 57.0 (2 nW)	40.35
862 - 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(30×1.64×P)/r, where P is ERP in Watts and r is antenna to EUT distance in meters.

Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

7.5.2 Test procedure for spurious emission field strength measurements in transmit mode

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

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

7.5.2.3 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was swept throughout the specified in Table 7.5.2 range in both, vertical and horizontal, polarizations.

7.5.2.4 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

7.5.3 Test procedure for spurious emission field strength measurements in standby mode

7.5.3.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

7.5.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was swept throughout the specified in Table 7.5.4 range in both, vertical and horizontal, polarizations.

7.5.3.3 The worst test results (the lowest margins) were recorded in Table 7.5.4 and shown in the associated plots.

7.5.4 Test procedure for substitution ERP measurements of spurious emission

7.5.4.1 The test equipment was set up as shown in Figure 7.5.2 and energized.

7.5.4.2 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.

7.5.4.3 The test antenna height was swept throughout the specified in Table 7.5.2 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.

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

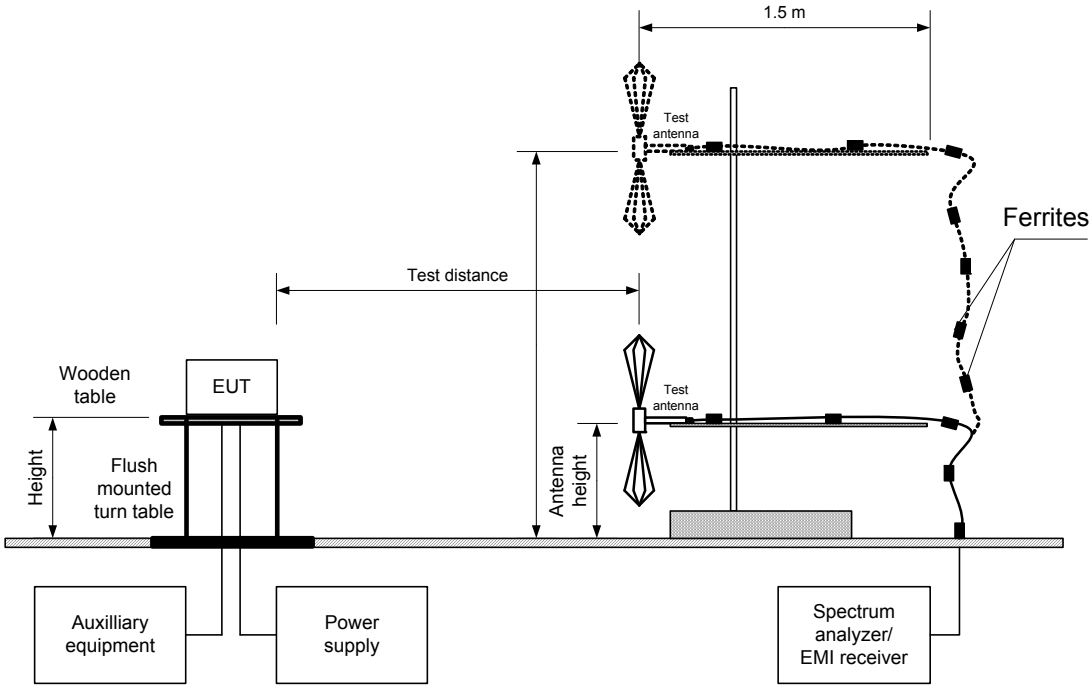
7.5.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

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

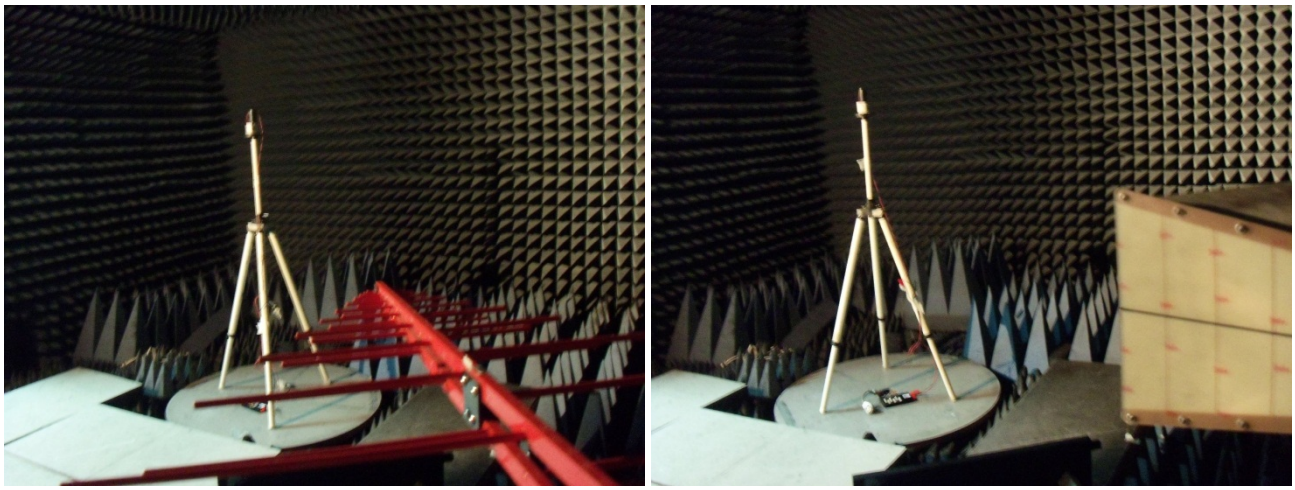
7.5.4.7 The worst test results (the lowest margins) were recorded in Table 7.5.3.

Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

Figure 7.5.1 Setup for spurious emission field strength measurements

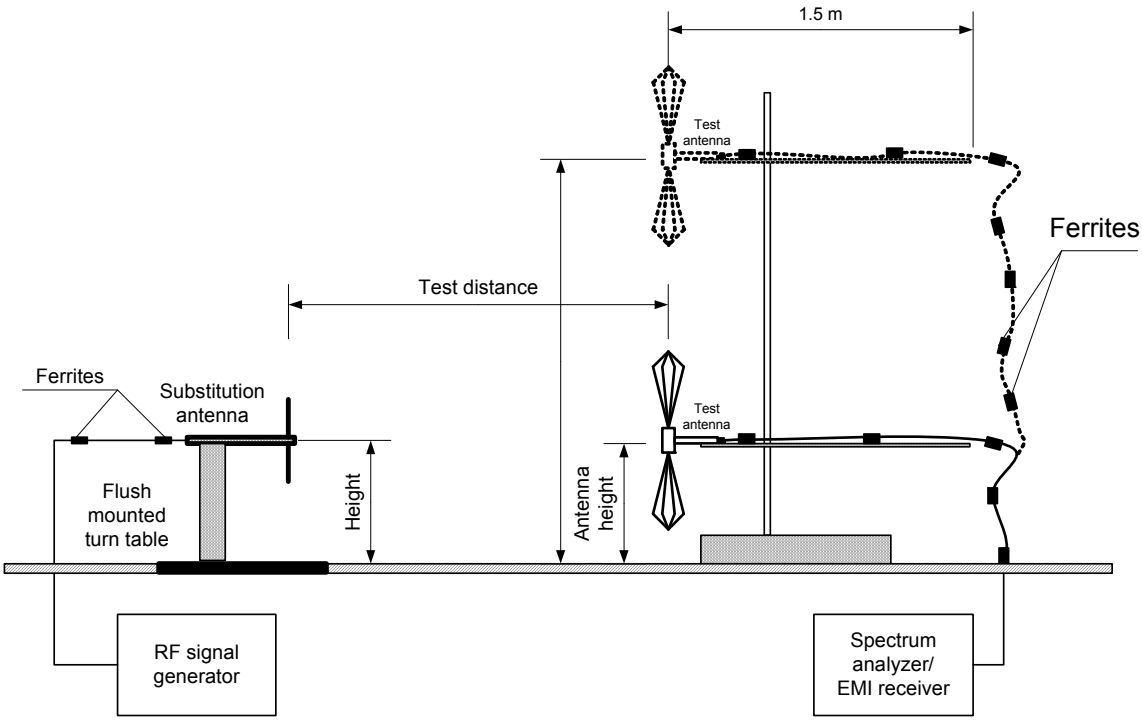


Photograph 7.5.1 Setup for spurious emission field strength measurements

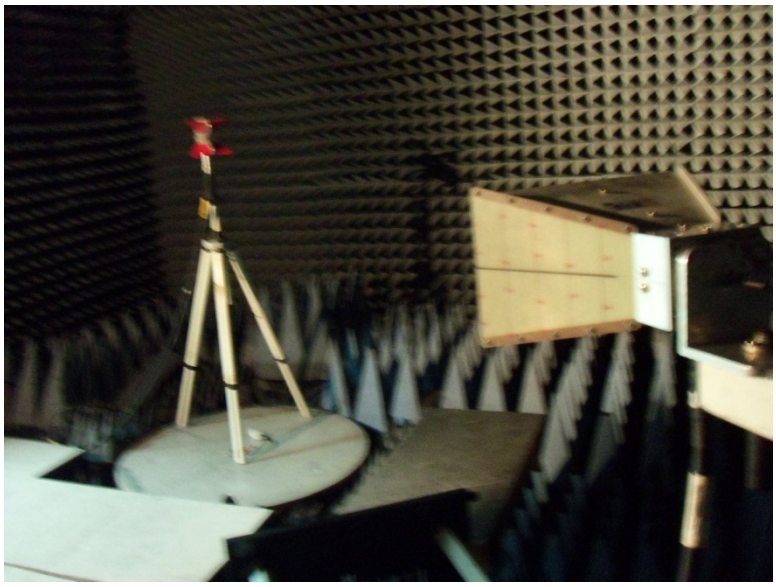


Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

Figure 7.5.2 Setup for substitution ERP measurements of spurious



Photograph 7.5.2 Setup for substitution ERP measurements of spurious



Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

Table 7.5.2 Spurious emission field strength test results in transmit mode

OPERATING FREQUENCY: 868.3 MHz
EUT ANTENNA: Integral
TEST DISTANCE: 3 m
EUT HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 1.8 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: 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
1736.615	60.93	67.35	-6.42	1000	Vertical	1.7	300
2604.830	56.70	67.35	-10.65	1000	Vertical	1.5	360
3473.165	63.51	67.35	-3.84	1000	Horizontal	1.1	80
5209.738	50.45	67.35	-16.90	1000	Horizontal	1.3	360

*- Margin = Field strength of spurious – calculated field strength limit.
**- EUT front panel refer to 0 degrees position of turntable.

Table 7.5.3 ERP of spurious emission test results in transmit mode

OPERATING FREQUENCY: 868.3 MHz
TEST DISTANCE: 3 m
SUBSTITUTION ANTENNA HEIGHT: 1.5 m
TEST ANTENNA HEIGHTS RANGE: 1.0 – 1.8 m
DETECTOR USED: Peak / 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: 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
1736.615	60.93	1000	Vertical	-39.5	3.2	1.8	-38.1	-30	-8.1	Pass
2604.830	56.70	1000	Vertical	-44.5	3.8	3.0	-43.7	-30	-13.7	Pass
3473.165	63.51	1000	Horizontal	-39.0	5.9	3.4	-36.5	-30	-6.5	Pass
5209.738	50.45	1000	Horizontal	-53.0	8.3	4.3	-49.0	-30	-19.0	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

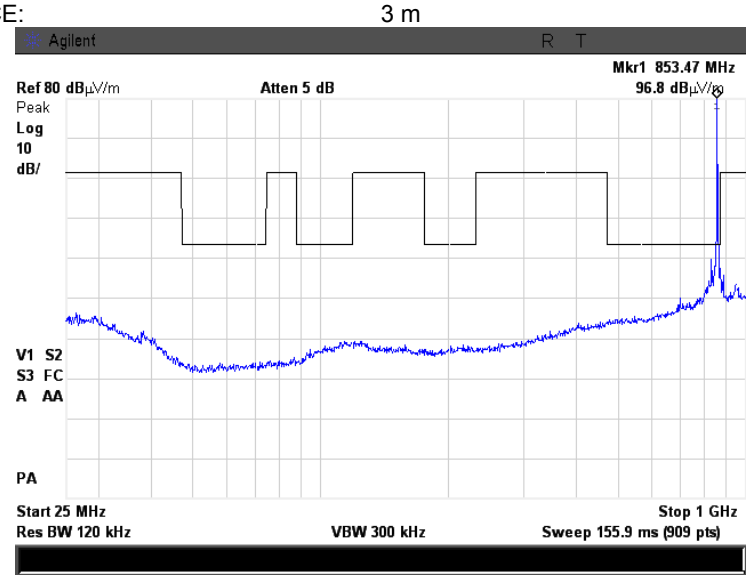
HL 0661	HL 2432	HL 2667	HL 2697	HL 2780	HL 3634	HL 4114	HL 4160
HL 4278	HL 4347	HL 4349					

Full description is given in Appendix A.

Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

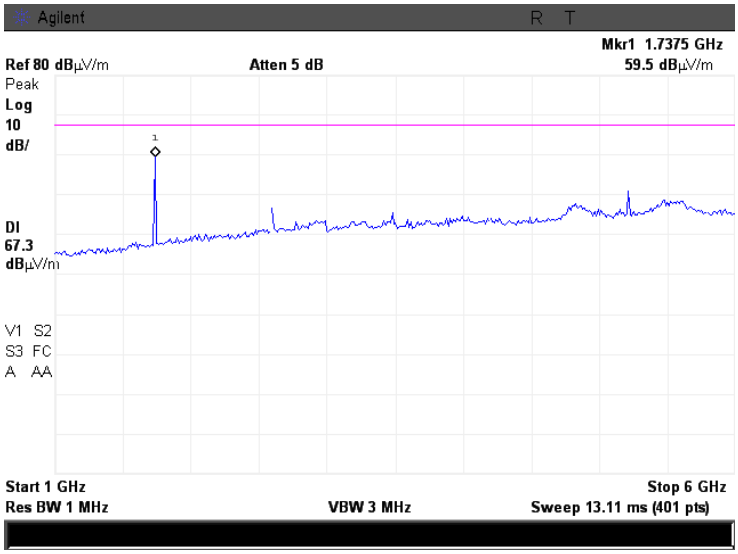
Plot 7.5.1 Radiated emission measurements in 25 - 1000 MHz range

TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 7.5.2 Radiated emission measurements in 1 – 6 GHz range

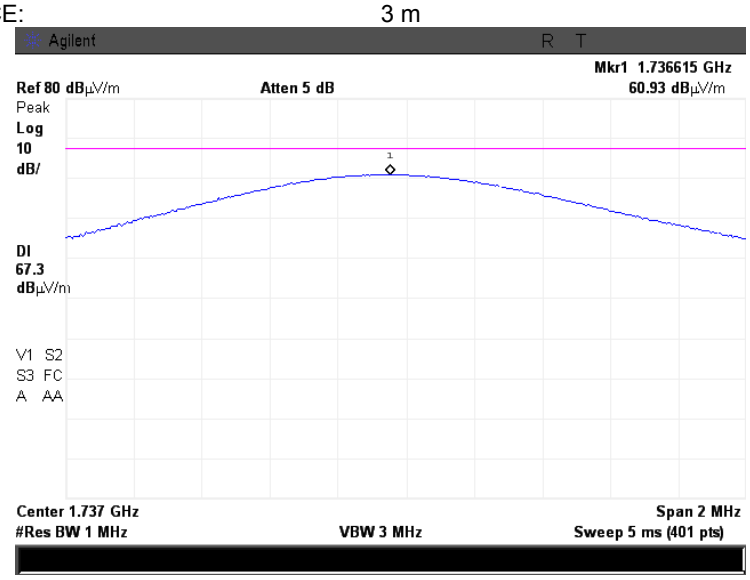
TEST SITE: Fully anechoic
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

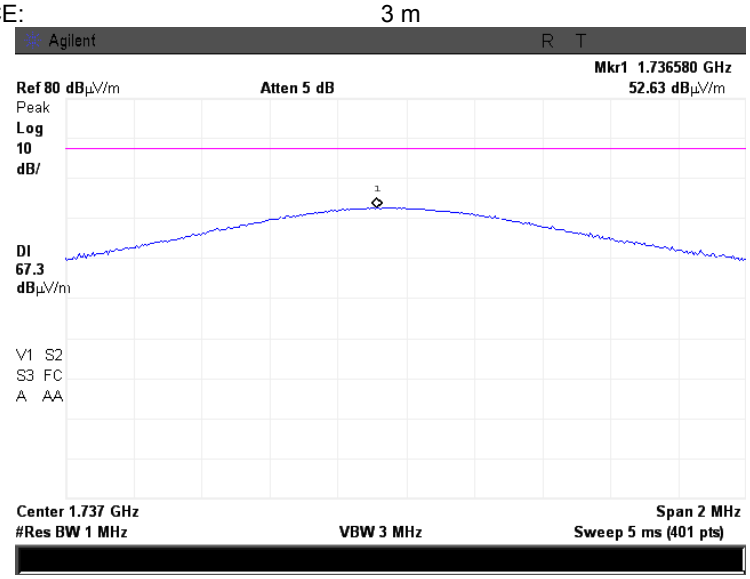
Plot 7.5.3 Radiated emission measurements at the 2nd harmonic

TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Plot 7.5.4 Radiated emission measurements at the 2nd harmonic

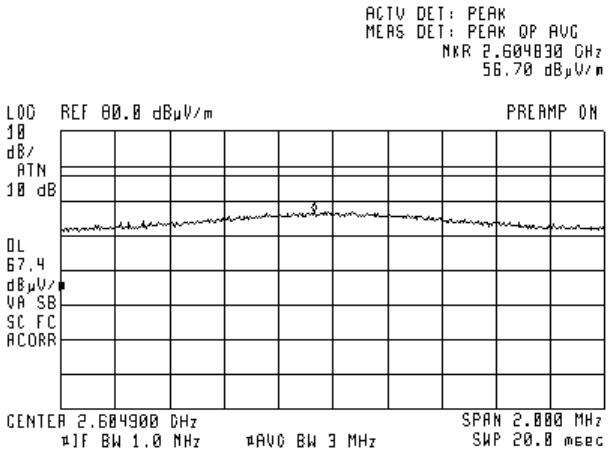
TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	**Frequency stability under low voltage (wide band transmitter)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

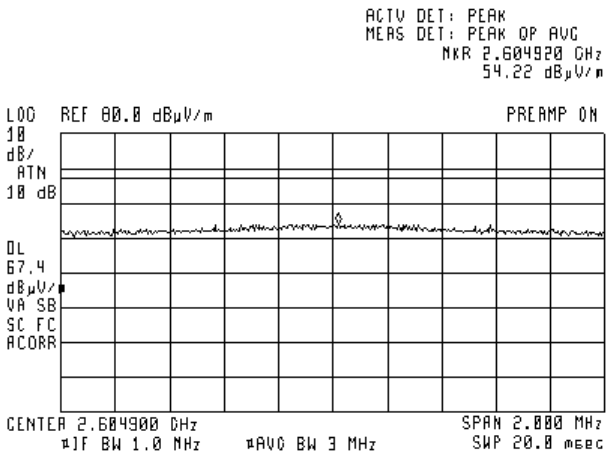
Plot 7.5.5 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Plot 7.5.6 Radiated emission measurements at the 3rd harmonic

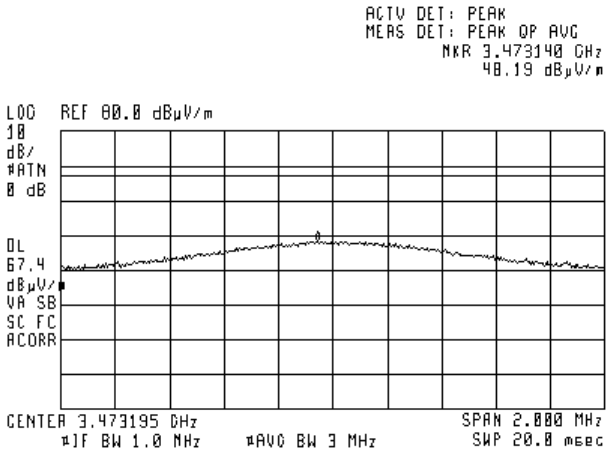
TEST SITE: Semi anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	**Frequency stability under low voltage (wide band transmitter)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

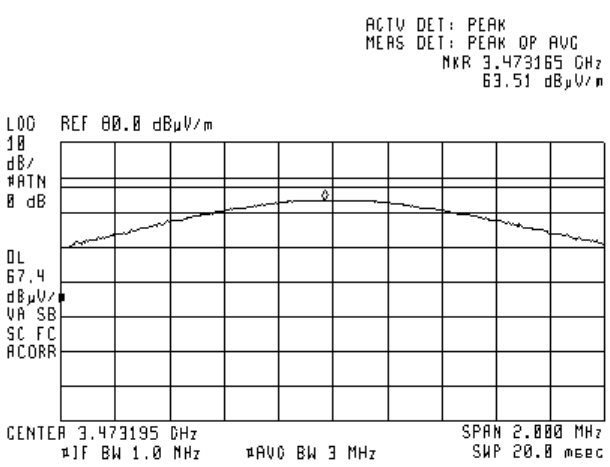
Plot 7.5.7 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Plot 7.5.8 Radiated emission measurements at the 4th harmonic

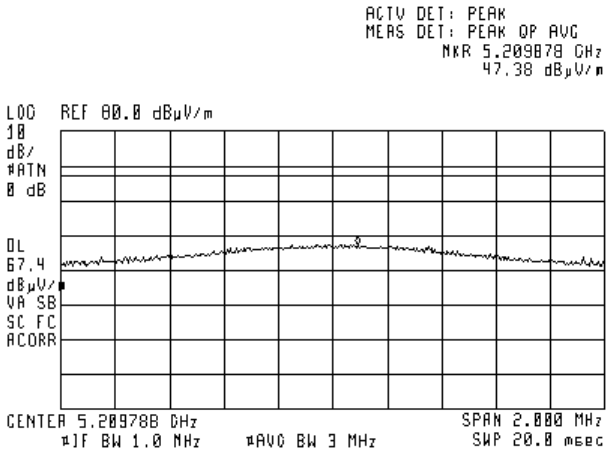
TEST SITE: Semi anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	**Frequency stability under low voltage (wide band transmitter)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

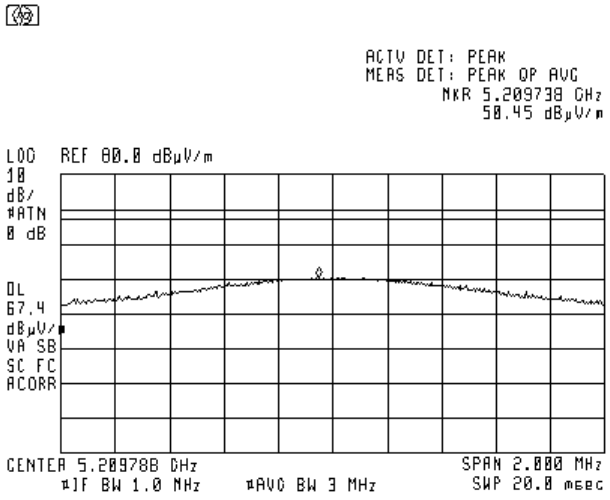
Plot 7.5.9 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Vertical
TEST DISTANCE: 3 m



Plot 7.5.10 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
OPERATIONAL MODE: Transmit
ANTENNA POLARIZATION: Horizontal
TEST DISTANCE: 3 m



Test specification:	**Frequency stability under low voltage (wide band transmitter)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

Table 7.5.4 Spurious emission field strength test results in standby mode

ASSIGNED FREQUENCY RANGE: 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 – 1.8 m
DETECTOR USED: Peak / Quasi-peak (25 – 1000 MHz)
Peak (above 1000 MHz)
RESOLUTION BANDWIDTH: 25 MHz – 1000 MHz: 120 kHz (6 dB RBW)/ 100 kHz (3 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
No signals were founded							

Verdict: Pass

*- Margin = Field strength of spurious – calculated field strength limit.
**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

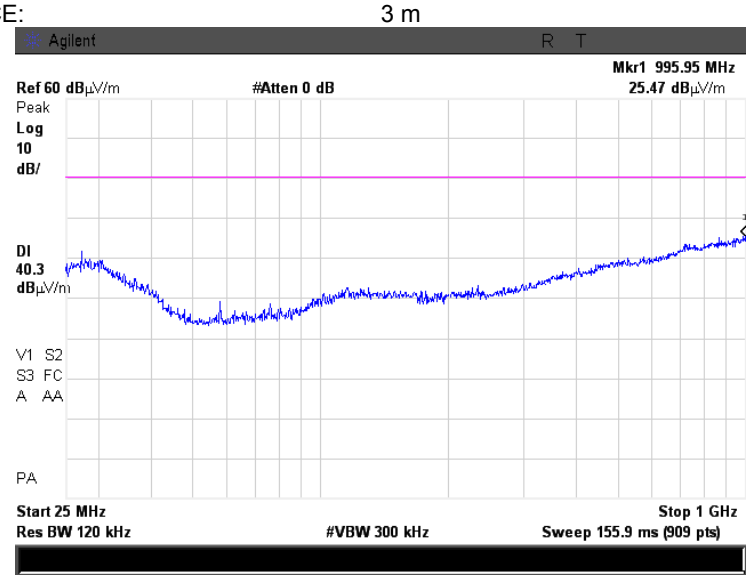
HL 0521	HL 1984	HL 2432	HL 2697	HL 2780	HL 3531	HL 4160	HL 4347
HL 4349	HL 4352	HL 4353					

Full description is given in Appendix A.

Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

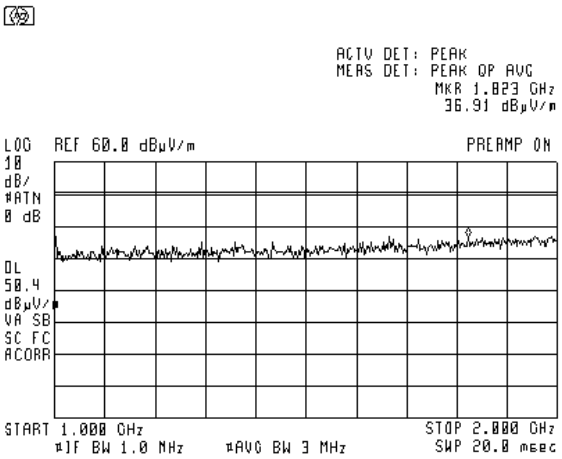
Plot 7.5.11 Radiated emission measurements in 25 - 1000 MHz range

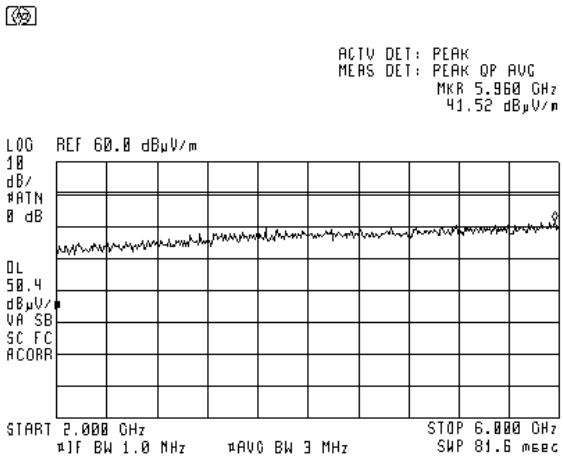
TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Standby
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 7.5.12 Radiated emission measurements in 1 – 6 GHz range

TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Standby
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m





Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

7.6 Frequency stability under low voltage conditions

7.6.1 General

This test was performed to verify the transmitter modulation envelope including all associated side bands above the appropriate spurious limit given in Table 7.6.1 remained within the assigned band or the transmitter ceased to function under low voltage conditions.

Table 7.6.1 Spurious emission limits at the assigned 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.

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and the performance check was conducted.

7.6.2.2 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.

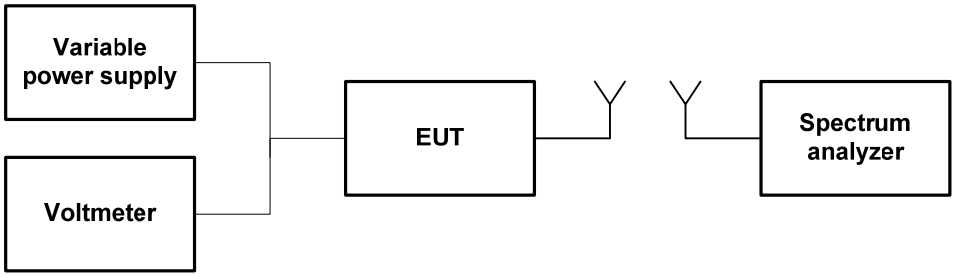
7.6.2.3 The peak of emission related to the ERP was measured.

7.6.2.4 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.

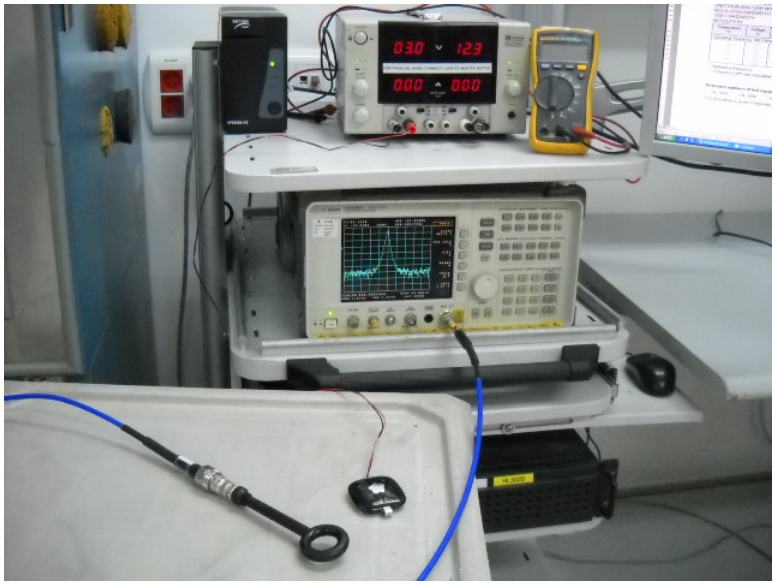
7.6.2.5 The test results were recorded in Table 7.6.2 and shown in the associated plots.

Test specification:	Frequency stability under low voltage (wide band transmitter)		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

Figure 7.6.1 Frequency stability test set up



Photograph 7.6.1 Frequency stability test set up



Test specification:	**Frequency stability under low voltage (wide band transmitter)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 7.9.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

Table 7.6.2 Frequency stability test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 1 kHz
VIDEO BANDWIDTH: 1 kHz
MODULATION: 2FSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Voltage, V	**Measured frequency, MHz**	**Assigned band edge, MHz**	**Verdict**
3.0	868.29933	868.0-868.6	Pass
2.5	868.29933		Pass
1.9	868.29933		Pass
Below 1.9	Transmitter ceased to function.		Pass

Reference numbers of test equipment used

HL 1424	HL 2358	HL 3310					

Full description is given in Appendix A.

Test specification:	Blocking		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.4.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/31/2012		
Temperature: 21 ºC	Air Pressure: 1018 hPa	Relative Humidity: 46 %	Power Supply: 3V battery
Remarks:			

8 Receiver parameters

8.1 Blocking

8.1.1 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 8.1.1.

Table 8.1.1 Blocking limit

Receiver class	Frequency offset from band edge	Lmit, dB
1	± 2.0 MHz	≥84.0 – A (Note 2)
1	± 10.0 MHz	≥84.0 – A (Note 2)
2	**± 2.0 MHz**	**≥35.0 – A (Note 2)**
2	**± 10.0 MHz**	**≥60.0 – A (Note 2)**
3	± 2.0 MHz	≥24.0 – A (Note 2)
3	± 10.0 MHz	≥44.0 – A (Note 2)

Note 1: The limits apply also for the repeated tests in case of equipment using LBT or category 1 receivers, reduced by 13 dB or 40 dB, respectively, to account for the increased wanted signal level.
Note 2: A = 10log (BW_{kHz} / 16 kHz, where BW is the receiver bandwidth.

8.1.2 Test procedure

8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and its proper operation was checked.

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

8.1.2.3 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.

8.1.2.4 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 Table 8.1.2.

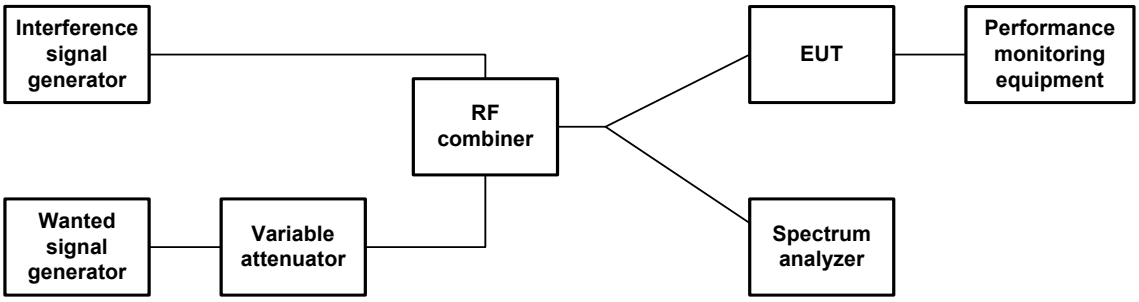
8.1.2.5 The output power of the wanted signal generator was increased by 3 dB above the receiver sensitivity limit.

8.1.2.6 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.

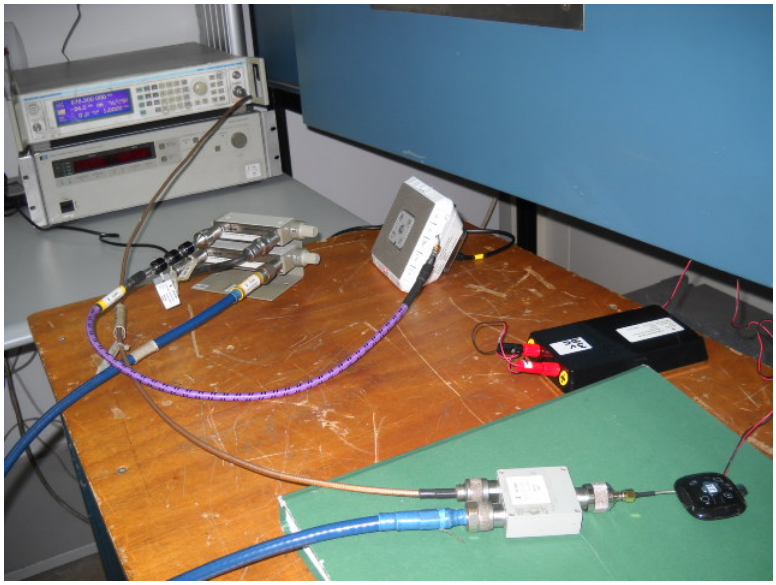
8.1.2.7 The blocking (difference between the interference signal generator and the wanted signal generator levels) was recorded in Table 8.1.2.

Test specification:	Blocking		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.4.2		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/31/2012		
Temperature: 21 ºC	Air Pressure: 1018 hPa	Relative Humidity: 46 %	Power Supply: 3V battery
Remarks:			

Figure 8.1.1 Setup for blocking test



Photograph 8.1.1 Setup for blocking test



Test specification:	**Blocking**		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.4.2		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/31/2012		
Temperature: 21 ºC	**Air Pressure:** 1018 hPa	**Relative Humidity:** 46 %	**Power Supply:** 3V battery
Remarks:			

Table 8.1.2 Blocking test results

ASSIGNED FREQUENCY RANGE: 868.0-868.6 MHz
RECEIVER BANDWIDTH: 102 kHz
WANTED SIGNAL MODULATION: 2 FSK
BIT RATE: 38.4 kbps
PERFOMANCE DEGRADATION THRESHOLD: Message acceptance ratio < 80 %
INTERFERENCE SIGNAL MODULATION: Unmodulated

Wanted frequency, MHz	Interference frequency, MHz	Sensitivity limit, dBm	Wanted signal level, dBm*	Interference level, dBm	Blocking, dB**	Limit, dB***	Margin, dB****	Verdict
868.3	858.3	-99	-96	-29	67	52	-15	Pass
	866.3			-40	56	27	-29	Pass
	870.3			-38	58	27	-31	Pass
	878.3			-27	69	52	-17	Pass

* - Wanted signal level was calculated as sensitivity limit increased by 3 dB
** - Blocking = Interference level – Wanted signal level.
***- The limit was calculated as described in Note 2 of Table 8.1.1.
**** - Margin = Calculated limit - Blocking.

Reference numbers of test equipment used

HL 0557	HL 1424	HL 1456	HL 1908	HL 3300	HL 3389	HL 3437	HL 3442
HL 3472	HL 3781						

Full description is given in Appendix A.

Test specification:	Receiver spurious emissions (radiated)		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.6.3/4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

8.2 Effective radiated power of receiver spurious emission

8.2.1 General

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

Table 8.2.1 Radiated spurious emission test limits

Frequency, MHz	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)*
25 - 1000	- 57.0 (2 nW)	40.35
1000 - 6000	- 47.0 (20 nW)	50.35

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

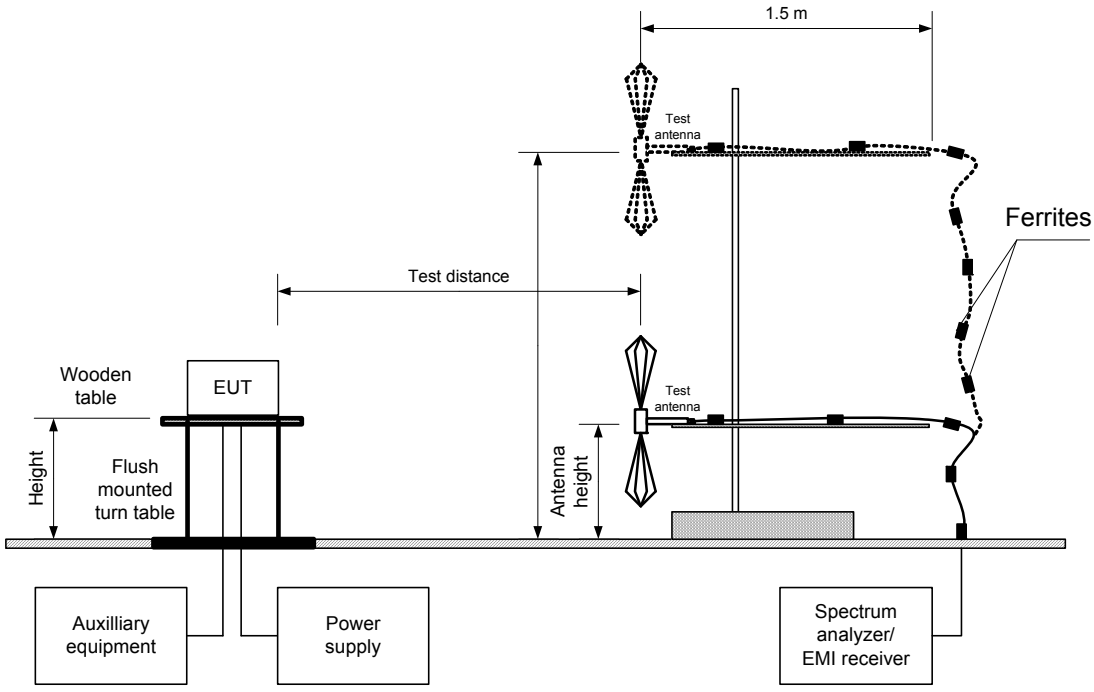
8.2.2 Test procedure for spurious emission field strength measurements

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

8.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 3600, the measuring antenna height was swept throughout the specified in Table 8.2.2 range in both, vertical and horizontal, polarizations.

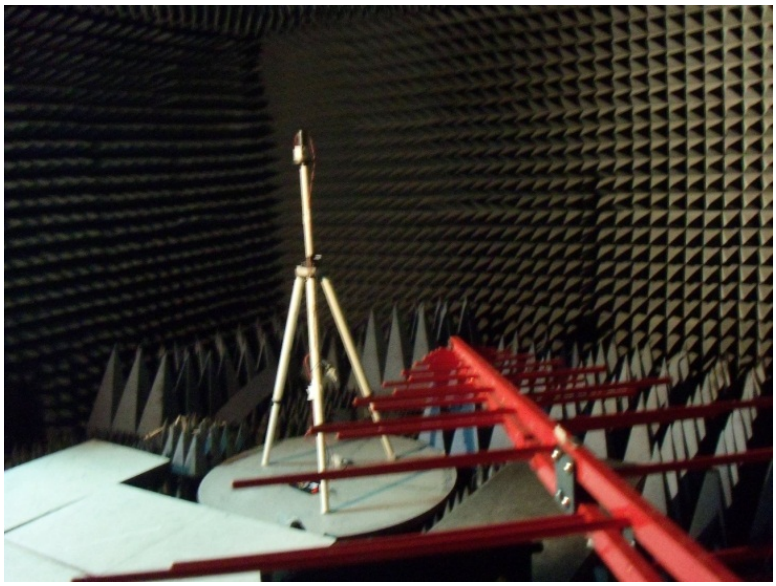
8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Figure 8.2.1 Setup for spurious emission field strength measurements

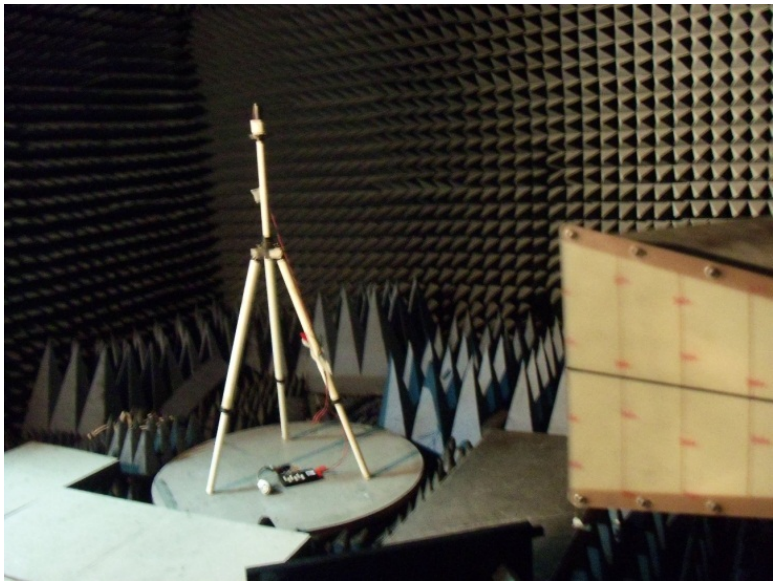


Test specification:	Receiver spurious emissions (radiated)		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.6.3/4		
Test mode:	Compliance	Verdict:	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	Air Pressure: 1016 hPa	Relative Humidity: 47 %	Power Supply: 3V battery
Remarks:			

Photograph 8.2.1 Setup for spurious emission field strength measurements



Photograph 8.2.2 Setup for spurious emission field strength measurements



Test specification:	**Receiver spurious emissions (radiated)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.6.3/4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

Table 8.2.2 Spurious emission field strength test results in receive mode

ASSIGNED FREQUENCY RANGE: 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 – 1.8 m
DETECTOR USED: Peak / 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
No signals were found							

Verdict: Pass

*- Margin = Field strength of spurious – calculated field strength limit.
**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

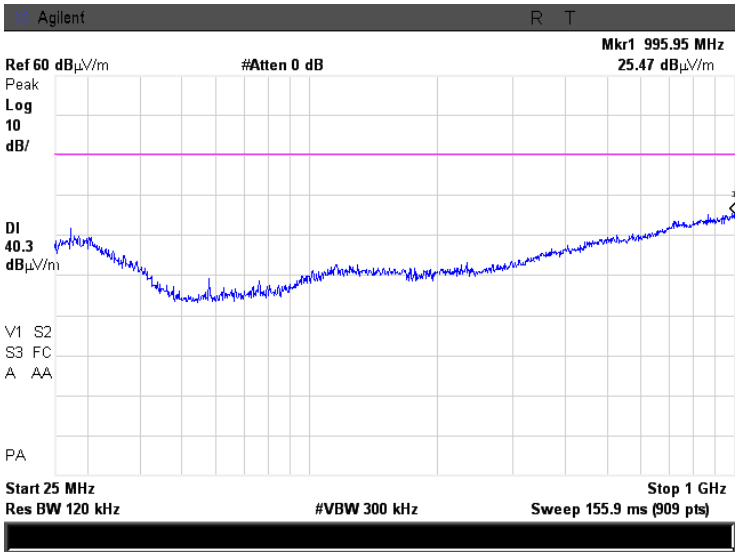
HL 0521	HL 1984	HL 2432	HL 2697	HL 2780	HL 3531	HL 4160	HL 4347
HL 4349	HL 4352	HL 4353					

Full description is given in Appendix A.

Test specification:	**Receiver spurious emissions (radiated)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.6.3/4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

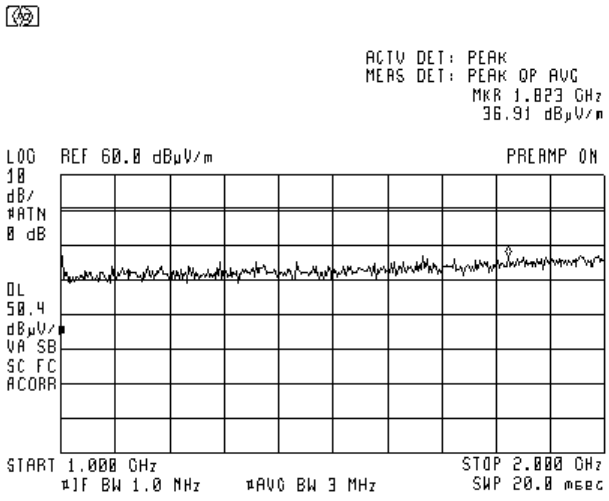
Plot 8.2.1 Radiated emission measurements in 25 - 1000 MHz range

TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Receive
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 8.2.2 Radiated emission measurements in 1 – 2.0 GHz range

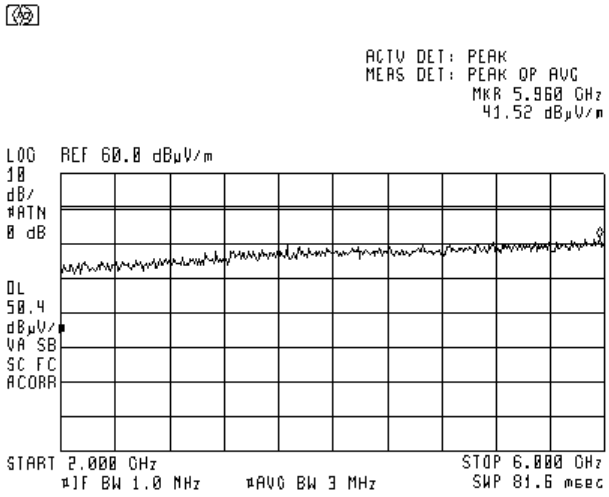
TEST SITE: Fully anechoic chamber
OPERATIONAL MODE: Receive
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	**Receiver spurious emissions (radiated)**		
Test procedure:	EN 300 220-1 V2.4.1, Section 8.6.3/4		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	12/24/2012		
Temperature: 22 ºC	**Air Pressure:** 1016 hPa	**Relative Humidity:** 47 %	**Power Supply:** 3V battery
Remarks:			

Plot 8.2.3 Radiated emission measurements in 2.0– 6.0 GHz range

TEST SITE:	Fully anechoic chamber
OPERATIONAL MODE:	Receive
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



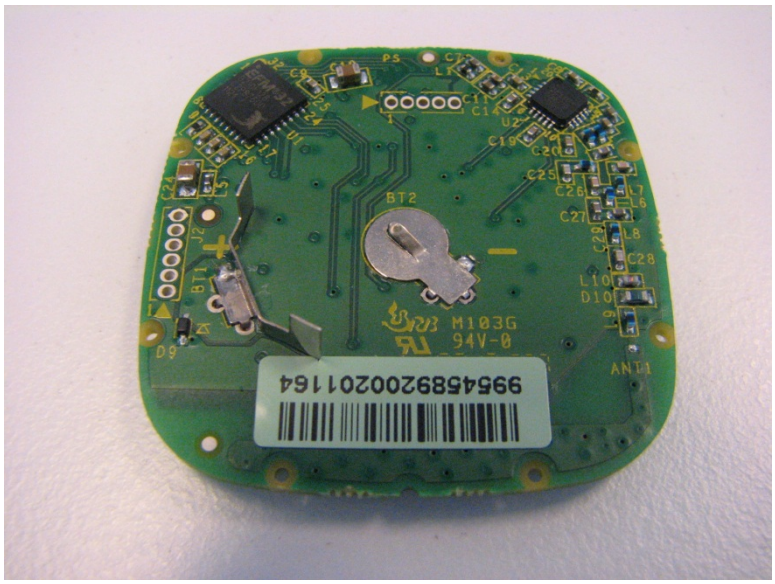
9 Transmitter photographs

9.1 External

Photograph 9.1.1 Front view

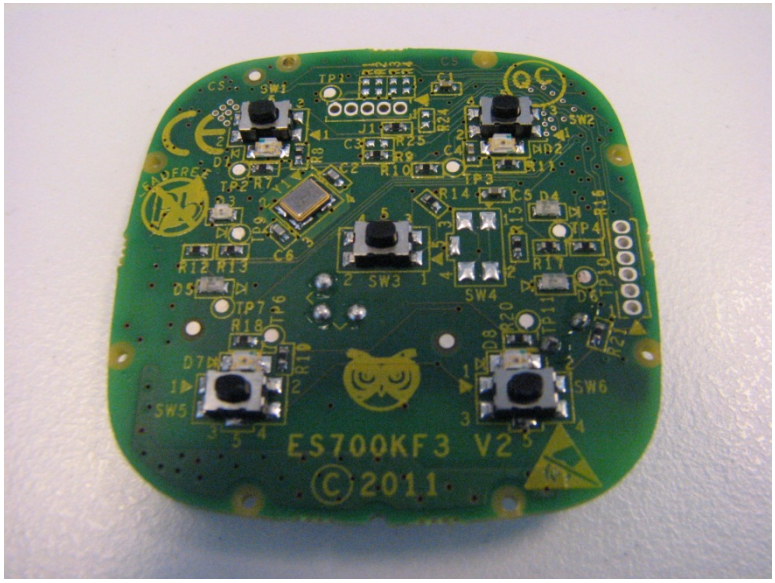
Photograph 9.1.2 Rear view

Photograph 9.1.3 Antenna assembly

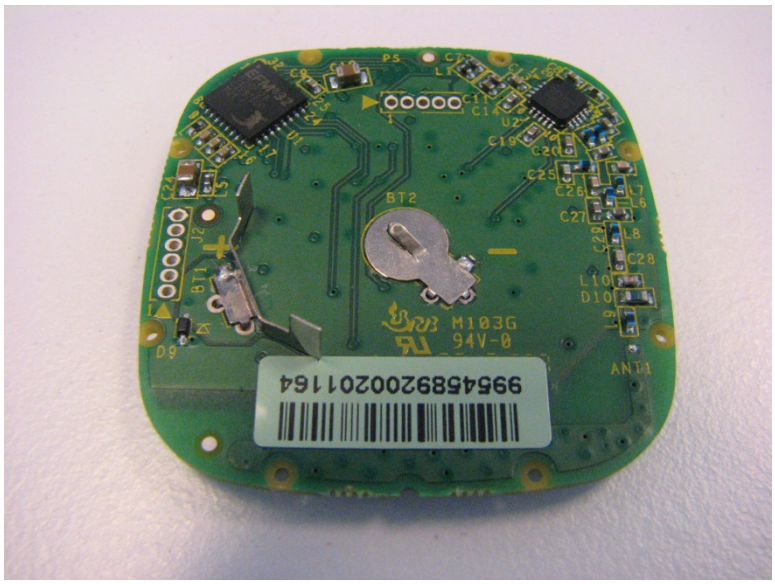


9.2 Internal

Photograph 9.2.1 Front side of the main PCB



Photograph 9.2.2 Second side of the main PCB



10 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	24-Sep-12	24-Sep-13
0557	Generator Signal, 9 KHz - 1.2 GHz	Marconi Instruments	2023	112225/08 0	22-Feb-12	22-Feb-13
0567	Antenna, Dipole, Tunable, 500 - 1000 MHz	Electro-Metrics	TDS-25/30-2	298	04-Feb-11	04-Feb-13
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A002 66	15-Dec-11	15-Jan-13
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A002 19	04-Oct-12	04-Oct-13
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	26-Aug-12	26-Aug-13
1456	Cable, 1 m	Harbour Industries	MIL 17/60-RG142	1456	02-Sep-12	02-Sep-13
1908	Power Splitter / Combiner 0.5-1 GHz	Mini-Circuits	ZAPD-1	1908	02-Jul-12	02-Jul-15
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	07-Dec-12	07-Dec-13
2358	Power Supply, 2 X 0-36VDC / 5A, 5VDC / 5A	Horizon Electronics	DHR3655 D	767469	08-Mar-12	08-Mar-13
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	07-Dec-12	07-Dec-13
2667	Signal generator, 9 kHz - 3.3 GHz	Rohde & Schwarz	SML03	101909	21-Aug-12	21-Aug-13
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	20-May-12	20-May-14
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 62	09-Jul-12	09-Jul-13
3286	Temperature Chamber, (-50 to +170) °C	Thermotron	EL-8-CH-1-1-CO2	21-9048	13-Sep-12	13-Sep-13
3300	Attenuator set, 0 to 81 dB, 1 dB step, DC-18 GHz	Agilent Technologies	8494B/84 95B	MY421469 11/MY421 43939	08-Aug-12	08-Aug-13
3310	Multimeter	Fluke	115C	94321810	09-Jul-12	09-Jul-13
3389	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3389	07-Feb-12	07-Feb-13
3437	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	07-Mar-12	07-Mar-13
3442	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini-Circuits	BW-S20W5+	NA	07-Mar-12	07-Mar-13
3472	Cable, Coax, Microwave, DC-18 GHz, SMA-SMA, 1.0 m	Gore	GORE 65474	1003478	09-May-12	09-May-13
3531	Amplifier, low noise, 2 to 8 GHz	Quinstar Technology	QLJ-02084040 -J0	111590020 02	25-Dec-12	25-Dec-13
3634	Cable RF, 5.5 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	09-May-12	09-May-13

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
3781	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	04-Dec-12	04-Dec-13
4114	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz	ETS Lindgren	3117	00123515	07-Dec-12	07-Dec-13
4135	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000136	11-Apr-12	11-Apr-13
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY47010594	08-Aug-12	08-Aug-13
4278	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0755A	26-Nov-12	26-Nov-13
4347	Low Loss Armored Test Cable, DC - 18 GHz, 2.0 m, N type-M/N type-M	MegaPhase	NC29-N1N1-79	12025103001	06-Jun-12	06-Mar-13
4349	Low Loss Armored Test Cable, DC - 18 GHz, 4.5 m, N type-M/N type-M	MegaPhase	NC29-N1N1-177	12025102001	06-Jun-12	06-Mar-13
4352	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101002	06-Jun-12	06-Mar-13
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	06-Jun-12	06-Mar-13

11 APPENDIX B 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	±7.0%
Range of modulation bandwidth	±8.0%
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

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.

12 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.
Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is US1003.

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13 APPENDIX D Specification references

EN 300 220-1 V2.4.1: 2012	Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods
EN 300 220-2 V2.4.1: 2012	Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW; Part 3: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive
ERC REC 70-03	ERC Recommendation 70-03: 2012

14 APPENDIX E Test equipment correction factors

Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

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
Double-ridged guide horn antenna
Model 3115, serial number: 00027177, HL 2432

Frequency, MHz	Antenna factor. dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.8
2500.0	28.9
3000.0	30.7
3500.0	31.8
4000.0	33.0
4500.0	32.8
5000.0	34.2
5500.0	34.9
6000.0	35.2
6500.0	35.4
7000.0	36.3
7500.0	37.3
8000.0	37.5
8500.0	38.0
9000.0	38.3
9500.0	38.3
10000.0	38.7
10500.0	38.7
11000.0	38.9
11500.0	39.5
12000.0	39.5
12500.0	39.4
13000.0	40.5
13500.0	40.8
14000.0	41.5
14500.0	41.3
15000.0	40.2
15500.0	38.7
16000.0	38.5
16500.0	39.8
17000.0	41.9
17500.0	45.8
18000.0	49.1

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 calibration
Sunol Sciences Inc., model JB3, serial number A022805, HL 2697

Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain
30	22.2	-22.5	0.01	620	19.7	6.3	4.27	1215	24.9	7.0	5.05	1810	28.3	7.1	5.08	2405	30.9	6.9	4.93
35	18.5	-17.4	0.02	625	19.7	6.5	4.42	1220	24.9	7.0	4.99	1815	28.5	6.9	4.91	2410	30.9	6.9	4.89
40	14.7	-12.5	0.06	630	19.6	6.6	4.57	1225	25.1	6.9	4.91	1820	28.6	6.8	4.74	2415	31.0	6.9	4.85
45	11.3	-8.1	0.16	635	19.7	6.5	4.48	1230	25.2	6.8	4.82	1825	28.7	6.8	4.75	2420	31.0	6.8	4.82
45	11.3	-8.1	0.16	640	19.9	6.4	4.40	1235	25.1	7.0	4.96	1830	28.7	6.8	4.76	2425	31.1	6.8	4.81
50	8.9	-4.7	0.34	645	19.9	6.5	4.45	1240	25.0	7.1	5.09	1835	28.7	6.7	4.72	2430	31.0	6.9	4.87
55	7.9	-2.8	0.52	650	19.9	6.5	4.51	1245	25.0	7.1	5.12	1840	28.8	6.7	4.69	2435	31.0	6.9	4.88
60	7.8	-2.1	0.62	655	19.9	6.6	4.60	1250	25.0	7.1	5.15	1845	28.6	6.9	4.90	2440	31.2	6.8	4.74
65	8.5	-2.0	0.63	660	19.9	6.7	4.69	1255	25.0	7.2	5.25	1850	28.4	7.1	5.12	2445	31.1	6.9	4.91
70	9.0	-1.9	0.64	665	19.9	6.7	4.70	1260	24.9	7.3	5.36	1855	28.5	7.0	5.07	2450	31.0	7.0	4.96
75	8.8	-1.1	0.78	670	20.0	6.7	4.71	1265	25.0	7.3	5.31	1860	28.6	7.0	5.01	2455	31.0	7.0	5.01
80	8.4	-0.2	0.97	675	20.1	6.7	4.71	1270	25.1	7.2	5.26	1865	28.5	7.1	5.17	2460	30.9	7.2	5.19
85	8.0	0.8	1.20	680	20.1	6.7	4.71	1275	25.3	7.0	5.05	1870	28.4	7.3	5.33	2465	31.1	6.9	4.95
90	8.2	1.1	1.29	685	20.1	6.8	4.79	1280	25.5	6.8	4.84	1875	28.4	7.2	5.28	2470	31.3	6.8	4.76
95	9.2	0.5	1.13	690	20.1	6.9	4.88	1285	25.4	7.0	4.97	1880	28.5	7.2	5.22	2475	31.4	6.7	4.69
100	10.6	-0.4	0.92	695	20.2	6.8	4.82	1290	25.3	7.1	5.10	1885	28.5	7.2	5.22	2480	31.3	6.8	4.79
110	12.6	-1.6	0.70	705	20.4	6.8	4.75	1300	25.2	7.3	5.33	1895	28.6	7.2	5.24	2490	31.1	7.0	4.99
120	13.9	-2.1	0.62	715	20.5	6.8	4.80	1310	25.5	7.1	5.09	1905	28.5	7.3	5.36	2500	30.9	7.2	5.27
125	14.2	-2.0	0.63	720	20.5	6.9	4.85	1315	25.4	7.2	5.23	1910	28.5	7.4	5.45	2505	31.1	7.1	5.15
130	14.2	-1.7	0.68	725	20.6	6.8	4.81	1320	25.3	7.3	5.36	1915	28.5	7.3	5.38	2510	31.0	7.2	5.22
140	13.4	-0.3	0.94	735	20.9	6.7	4.65	1330	25.6	7.0	5.06	1925	28.6	7.3	5.35	2520	31.2	7.0	5.05
150	12.9	0.8	1.21	745	21.0	6.6	4.59	1340	25.7	7.1	5.09	1935	28.5	7.4	5.54	2530	31.0	7.3	5.37
160	12.7	1.6	1.44	755	21.0	6.8	4.74	1350	25.7	7.1	5.17	1945	28.5	7.5	5.59	2540	31.2	7.1	5.09
165	12.5	2.0	1.59	760	21.0	6.8	4.83	1355	25.8	7.0	5.06	1950	28.6	7.4	5.48	2545	31.0	7.3	5.43
170	12.2	2.6	1.83	765	21.1	6.8	4.73	1360	25.9	6.9	4.95	1955	28.6	7.5	5.57	2550	31.0	7.3	5.39
175	11.8	3.3	2.13	770	21.3	6.7	4.64	1365	26.0	6.9	4.95	1960	28.6	7.5	5.65	2555	31.1	7.2	5.30
180	11.6	3.7	2.36	775	21.3	6.7	4.68	1370	26.0	7.0	4.96	1965	28.7	7.4	5.47	2560	31.0	7.4	5.47
185	11.5	4.0	2.54	780	21.3	6.7	4.72	1375	26.0	7.0	5.01	1970	28.9	7.2	5.29	2565	30.8	7.6	5.70
190	11.6	4.2	2.61	785	21.3	6.8	4.77	1380	26.0	7.0	5.06	1975	28.9	7.2	5.22	2570	31.1	7.3	5.37
200	13.1	3.2	2.07	795	21.4	6.8	4.79	1390	26.1	6.9	4.92	1985	29.1	7.1	5.11	2580	31.6	6.9	4.87
205	12.0	4.4	2.76	800	21.5	6.8	4.77	1395	26.2	6.9	4.94	1990	29.1	7.0	5.06	2585	31.6	6.8	4.79
210	11.0	5.6	3.66	805	21.6	6.7	4.71	1400	26.2	7.0	4.96	1995	29.1	7.1	5.09	2590	31.6	6.9	4.88
215	11.3	5.6	3.59	810	21.7	6.7	4.65	1405	26.1	7.0	5.02	2000	29.1	7.1	5.11	2595	31.5	7.0	4.97
220	11.6	5.5	3.52	815	21.7	6.7	4.72	1410	26.1	7.1	5.09	2005	29.1	7.1	5.16	2600	31.6	6.9	4.86
225	11.7	5.5	3.55	820	21.7	6.8	4.80	1415	26.2	7.0	5.02	2010	29.1	7.1	5.15	2605	31.3	7.2	5.30
230	11.9	5.5	3.57	825	21.7	6.8	4.82	1420	26.3	7.0	4.96	2015	29.2	7.1	5.13	2610	31.4	7.1	5.15
235	12.1	5.5	3.56	830	21.7	6.9	4.85	1425	26.2	7.1	5.10	2020	29.2	7.1	5.18	2615	31.7	6.9	4.88
240	12.3	5.5	3.54	835	21.8	6.8	4.82	1430	26.1	7.2	5.25	2025	29.3	7.1	5.08	2620	31.6	7.0	4.97
245	12.3	5.7	3.71	840	21.9	6.8	4.80	1435	26.1	7.2	5.24	2030	29.3	7.0	5.05	2625	31.4	7.1	5.17
250	12.3	5.9	3.88	845	21.9	6.8	4.83	1440	26.2	7.2	5.24	2035	29.3	7.1	5.07	2630	31.6	7.0	5.00
255	12.5	5.9	3.85	850	21.9	6.9	4.86	1445	26.3	1	5.11	2040	29.3	7.1	5.13	2635	31.8	6.8	4.82
260	12.7	5.8	3.83	855	22.0	6.8	4.80	1450	26.5	7.0	4.98	2045	29.2	7.2	5.23	2640	31.7	7.0	4.98
265	13.2	5.5	3.54	860	22.1	6.8	4.74	1455	26.4	7.1	5.07	2050	29.2	7.2	5.27	2645	31.7	6.9	4.93
270	13.7	5.2	3.27	865	22.0	6.9	4.92	1460	26.4	7.1	5.17	2055	29.3	7.2	5.21	2650	31.8	6.9	4.85
275	13.7	5.3	3.39	870	21.9	7.1	5.11	1465	26.4	7.2	5.19	2060	29.5	7.0	5.02	2655	31.8	6.9	4.85
280	13.7	5.4	3.50	875	22.0	7.1	5.08	1470	26.4	7.2	5.22	2065	29.4	7.1	5.08	2660	31.7	7.0	5.02
285	13.7	5.6	3.61	880	22.1	7.0	5.05	1475	26.4	7.1	5.17	2070	29.4	7.1	5.10	2665	32.0	6.7	4.71
290	13.7	5.7	3.72	885	22.1	7.0	5.06	1480	26.5	7.1	5.12	2075	29.5	7.0	5.01	2670	32.0	6.7	4.67
295	13.8	5.8	3.77	890	22.1	7.0	5.06	1485	26.5	7.1	5.14	2080	29.8	6.8	4.76	2675	31.9	6.8	4.81
300	13.9	5.8	3.81	895	22.2	7.1	5.09	1490	26.5	7.1	5.17	2085	29.7	6.9	4.89	2680	31.7	7.0	5.04
305	14.0	5.9	3.85	900	22.2	7.1	5.12	1495	26.5	7.2	5.24	2090	29.7	6.9	4.86	2685	31.9	6.8	4.83
310	14.1	5.9	3.88	905	22.3	7.1	5.09	1500	26.5	7.2	5.31	2095	29.8	6.8	4.78	2690	32.1	6.7	4.72
315	14.3	5.9	3.89	910	22.3	7.0	5.05	1505	26.5	7.2	5.27	2100	29.9	6.8	4.75	2695	32.1	6.7	4.71
320	14.4	5.9	3.90	915	22.4	7.0	4.99	1510	26.6	7.2	5.23	2105	29.8	6.8	4.81	2700	32.0	6.8	4.81
325	14.5	5.9	3.92	920	22.6	6.9	4.92	1515	26.6	7.2	5.30	2110	29.9	6.8	4.78	2705	32.0	6.8	4.80
330	14.6	5.9	3.93	925	22.7	6.9	4.85	1520	26.5	7.3	5.38	2115	29.9	6.8	4.76	2710	32.1	6.8	4.79
335	14.7	6.0	4.02	930	22.8	6.8	4.77	1525	26.6	7.3	5.37	2120	29.9	6.8	4.84	2715	32.1	6.7	4.71
340	14.7	6.2	4.12	935	22.8	6.8	4.83	1530	26.6	7.3	5.36	2125	29.9	6.9	4.89	2720	32.4	6.5	4.47
345	14.9	6.1	4.06	940	22.8	6.9	4.89	1535	26.6	7.4	5.44	2130	29.9	6.9	4.90	2725	32.2	6.7	4.63
350	15.1	6.0	3.99	945	22.8	6.9	4.87	1540	26.5	7.4	5.53	2135	29.8	6.9	4.94	2730	31.9	7.0	5.05
355	15.3	5.9	3.88	950	22.9	6.9	4.85	1545	26.5	7.5	5.58	2140	29.8	7.1	5.08	2735	31.6	7.4	5.44
360	15.6	5.8	3.78	955	23.0	6.8	4.81	1550	26.5	7.5	5.63	2145	29.9	6.9	4.92	2740	31.6	7.1	5.46
365	15.5	5.9	3.89	960	23.1	6.8	4.77	1555	26.7	7.3	5.39	2150	29.9	7.0	4.98	2745	31.9	7.0	5.06
370	15.5	6.0	4.01	965	23.1	6.7	4.73	1560	26.9	7.1	5.16	2155	29.8	7.1	5.10	2750	32.0	6.9	4.94
375	15.6	6.1	4.03	970	23.2	6.7	4.69	1565	26.9	7.2	5.23	2160	29.8	7.1	5.09	2755	32.0	7.0	4.98
380	15.7	6.1	4.05	975	23.3	6.6	4.62	1570	26.9	7.2	5.30	2165	29.9	7.0	5.00	2760	32.0	7.0	5.06
385	15.7	6.2	4.15	980	23.5	6.6	4.54	1575	27.0	7.2	5.23	2170	29.9	7.1	5.07	2765	32.2	6.8	4.80
390	15.7	6.3	4.25	985	23.5	6.6	4.52	1580	27.0	7.1	5.17	2175	29.8	7.2	5.20	2770	32.3	6.8	4.73
395	15.9	6.3	4.22	990	23.6	6.5	4.50	1585	27.0	7.2	5.20	2180	29.8	7.2	5.27	2775	32.3	6.8	4.77
400	16.0	6.2	4.18	995	23.6	6.5	4.48	1590	27.0	7.2	5.22	2185	29.8	7.2	5.27	2780	32.3	6.8	4.82
405	16.3	6.1	4.07	1000	23.7	6.5	4.46	1595	27.0	7.2	5.29	2190	29.8	7.2	5.28	2785	32.7	6.4	4.41
410	16.5	6.0	3.96	1005	23.7	6.5	4.51	1600	27.0	7.3	5.36	2195	29.8	7.2	5.30	2790	32.8	6.3	4.25
415	16.5	6.0	4.00	1010	23.7	6.6	4.57	1605	27.0	7.3	5.38	2200	29.7	7.3	5.38	2795	32.8	6.4	4.33
420	16.6	6.1	4.03	1015	23.7	6.6	4.55	1610	27.0	7.3	5.41	2205	29.7	7.3	5.41	2800	32.5	6.7	4.66
425	16.6	6.1	4.10	1020	23.8	6.6	4.54	1615	27.1	7.3	5.33	2210	29.7	7.4	5.47	2805	32.5	6.6	4.62
430	16.7	6.2	4.16	1025	23.8	6.6	4.62	1620	27.2	7.2	5.27	2215	29.7	7.4	5.54	2810	32.5	6.7	4.70
435	16.9	6.1	4.05	1030	23.7	6.7	4.70	1625	27.2	7.2	5.30	2220	29.7	7.5	5.57	2815	32.3	6.9	4.85
440	17.1	5.9	3.93	1035	23.7	6.8	4.81	1630	27.2	7.3	5.33	2225	29.8	7.3	5.43	2820	32.2	7.0	5.01
445	17.2	6.0	3.97	1040	23.6	6.9	4.92	1635	27.2	7.3	5.35	2230	29.8	7.4	5.45	2825	32.3	7.0	4.96
450	17.2	6.0	4.00	1045	23.7	6.9	4.91	1640	27.2	7.3	5.36	2235	29.7	7.5	5.61	2830	32.4	6.8	4.80
455	17.3	6.1	4.04	1050	23.7	6.9	4.91	1645	27.3	7.2	5.22	2240	29.5	7.7	5.86	2835	32.5	6.7	4.68
460	17.4	6.1	4.07	1055	23.7	7.0	5.01	1650	27.5	7.1	5.09	2245	29.8	7.4	5.53	2840	32.5	6.8	4.78
465	17.5	6.1	4.05	1060	23.6	7.1	5.11	1655	27.5	7.1	5.11	2250	30.0	7.3	5.35	2845	32.6	6.6	4.62
470	17.6	6.1	4.04	1065	23.7	7.0	5.06	1660	27.5	7.1	5.13	2255	30.0	7.2	5.28	2850	32.6	6.7	4.70
475	17.7	6.0	3.99	1070	23.8	7.0	5.01	1665	27.6	7.0	5.06	2260	30.1	7.2	5.24	2855	32.4	6.9	4.88
480	17.9	5.9	3.93	1075	23.8	7.0	5.01	1670	27.7	7.0	4.99	2265	30.1	7.2	5.20	2860	32.4	7.0	4.98
485	18.0	5.9	3.88	1080	23.9	7.0	5.01	1675	27.7	7.0	5.02	2270	30.2	7.1	5.12	2865	32.8	6.5	4.52
490	18.2	5.8	3.82	1085	24.0	7.0	4.96	1680	27.7	7.0	5.05	2275	30.3	7.0	5.05	2870	33.0	6.3	4.30
495	18.0	6.0	4.02	1090	24.0	6.9	4.91	1685	27.7	7.0	5.01	2280	30.0	7.0	5.06	2875	33.0	6.4	4.38
500	17.9	6.3	4.23	1095	24.1	6.9	4.86	1690	27.8	7.0	4.98	2285	30.3	7.0	5.05	2880	32.5	6.9	4.87
505	17.9	6.3	4.29	1100	24.2	6.8	4.82	1695	27.8	7.0	5.01	2290	30.3	7.1	5.07	2885	33.0	6.4	4.40
510	18.0	6.4	4.36	1105	24.3	6.8	4.80	1700	27.8	7.0	5.03	2295	30.3	7.1	5.13	2890	33.1	6.3	4.28
515	18.1	6.4	4.34	1110	24.3	6.8	4.78	1705	27.8	7.1	5.09	2300	30.2	7.2	5.23	2895	33.1	6.4	4.34
520	18.2	6.4	4.32	1115	24.3	6.8	4.79	1710	27.7	7.1	5.16	2305	30.3	7.2	5.20	2900	33.0	6.4	4.41
525	18.2	6.4	4.36	1120	24.4	6.8	4.80	1715	27.8	7.1	5.08	2310	30.2	7.3	5.35	2905	32.9	6.6	4.58
530	18.3	6.4	4.39	1125	24.3	6.9	4.90	1720	27.9	7.0	5.00	2315	30.1	7.4	5.45	2910	32.9	6.5	4.51
535	18.3	6.4	4.41	1130	24.3	7.0	5.00	1725	28.0	7.0	4.99	2320	30.3	7.2	5.27	2915	33.1	6.4	4.33
540	18.4	6.4	4.41	1135	24.4	6.9	4.90	1730	28.0	7.0	4.98	2325	304	7.2	5.22	2920	33.3	6.2	4.16
545	18.4	6.5	4.47	1140	24.5	6.8	4.81	1735	28.0	7.0	5.02	2330	30.4	7.1	5.13	2925	33.0	6.5	4.45
550	18.4	6.6	4.53	1145	24.6	6.8	4.76	1740	28.0	7.1	5.07	2335	30.5	7.0	5.07	2930	33.0	6.5	4.51
555	18.6	6.5	4.45	1150	24.7	6.7	4.71	1745	28.0	7.0	5.04	2340	30.5	7.1	5.11	2935	33.0	6.5	4.48
560	18.8	6.4	4.37	1155	24.7	6.8	4.76	1750	28.1	7.0	5.01	2345	30.6	7.0	5.07	2940	33.0	6.5	4.52
565	18.9	6.4	4.33	1160	24.7	6.8	4.80	1755	27.9	7.1	5.17	2350	30.5	7.1	5.12	2945	33.1	6.5	4.42
570	19.0	6.3	4.28	1165	24.7	6.8	4.81	1760	27.8	7.3	5.34	2355	30.6	7.1	5.08	2950	33.2	6.4	4.32
575	19.1	6.3	4.31	1170	24.7	6.8	4.81	1765	27.9	7.3	5.31	2360	30.9	6.8	4.79	2955	33.3	6.3	4.27
580	19.1	6.4	4.33	1175	24.8	6.8	4.84	1770	27.9	7.2	5.28	2365	31.0	6.7	4.66	2960	33.3	6.3	4.30
590	19.1	6.6	4.52	1185	24.8	6.9	4.92	1780	27.9	7.3	5.35	2375	31.1	6.6	4.60	2970	33.3	6.4	4.36
595	19.0	6.6	4.62	1190	24.7	7.0	4.99	1785	28.1	7.2	5.21	2380	31.1	6.6	4.61	2975	33.0	6.6	4.60
600	19.0	6.7	4.72	1195	24.7	7.0	5.02	1790	28.2	7.0	5.07	2385	31.1	6.7	4.62	2980	32.9	6.8	4.74
610	19.1	6.8	4.76	1205	24.08	7.1	5.08	1800	28.3	7.0	5.06	2395	31.2	6.6	4.60	2990	32.9	6.8	4.82
615	19.4	6.5	4.51	1210	24.8	7.1	5.11	1805	28.3	7.1	5.07	2400	30.9	6.9	4.93	3000	33.4	6.4	4.33

Antenna factor
Double-ridged waveguide horn antenna
ETS Lindgren, Model 3117, serial number: 00123515, HL 4114

Frequency, MHz	Antenna factor, dB/m		
	Measured	Manufacturer	Deviation
1000	28.0	28.4	-0.4
1500	28.0	27.4	0.6
2000	31.2	30.9	0.3
2500	32.5	33.4	-0.9
3000	32.9	32.6	0.3
3500	32.7	32.8	-0.1
4000	33.1	33.4	-0.3
4500	33.8	33.9	-0.1
5000	33.8	34.1	-0.3
5500	34.4	34.5	-0.1
6000	35.0	35.2	-0.2
6500	35.4	35.5	-0.1
7000	35.7	35.7	0.0
7500	35.9	35.7	0.2
8000	35.8	35.8	0.0
8500	35.9	35.8	0.1
9000	36.3	36.2	0.1
9500	36.6	36.6	0.0
10000	37.1	37.1	0.0
10500	37.6	37.5	0.1
11000	37.9	37.7	0.2
11500	38.5	38.1	0.4
12000	39.2	38.7	0.5
12500	39.0	38.9	0.1
13000	39.1	39.1	0.0
13500	38.9	38.8	0.1
14000	39.0	38.8	0.2
14500	39.6	39.9	-0.3
15000	39.9	39.7	0.2
15500	39.9	40.1	-0.2
16000	40.7	40.8	-0.1
16500	41.3	41.8	-0.5
17000	42.5	42.1	0.4
17500	41.3	41.2	0.1
18000	41.4	40.9	0.5

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field strength in dB(μV/meter)

15 APPENDIX F 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(μV)	decibel referred to one microvolt
dB(μV/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
μs	microsecond
NA	not applicable
NB	narrow band
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
s	second
V	volt
W	width

END OF TEST REPORT

16 APPENDIX G Manufacturer's declaration

Duty cycle results
For ES700KF3

ASSIGNED FREQUENCY RANGE: 868.0 – 868.6 MHz
MODULATION: 2FSK
MODULATING SIGNAL: ID code
OBSERVATION PERIOD: 1 hour

Supervision message			
Supervision transmission duration, ms	Number of supervision transmissions within one hour	Number of RF transmitters	Supervision transmission time, ms*
4.4	3	1	13.2

Alarm transmission		
Alarm transmission duration, ms	Number of alarm events within one hour**	Alarm transmission time, ms***
4.4	1	4.4

Other transmission		
Other transmission duration, ms	Number of other events within one hour**	Other transmission time****, ms
4.4	1	4.4

Total transmission						
Acknowledge transmission time, ms*****	Alarm transmission time, ms	Total transmission time, ms	Total duty cycle, %******	Limit, %	Margin, %*******	Verdict
17.6	4.4	22	0.000611	1.0	-0.999389	Pass

*- Supervision transmission time = Supervision transmission duration x Number of supervision transmissions within one hour x Number RF transmitters, [ms]
** - Declared by manufacturer as the typical usage pattern.
*** - Alarm transmission time = Alarm transmission duration x Number of alarm events within one hour, [ms]
****- Other transmission time = Other transmission duration x Number of other transmissions within one hour, [ms]
*****- Acknowledge transmission time = Supervision transmission time + Other transmission time [ms]
****** - The total duty cycle was calculated as follows: (Total transmission time / 3600) [s] x 100%, [%]
*******- Margin = Total duty cycle – specification limit

END OF DOCUMENT