ONE WORLD ○ OUR APPROVAL

Test report

233458-1TRFWL

Date of issue: July 8, 2013

Applicant:

Digital Security Controls, a division of Tyco Safety Products Canada Ltd.

Product:

Wireless Alarm Transceiver

Model:

HSM2HOST9

FCC ID: 13HS2HOST9

IC Registration number: 160A-HS2HOST9

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247

  Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz.

- RSS-210, Issue 8, December 2010, Annex 8

  Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

Test location

Nemko Canada Inc.
303 River Road
Ottawa, ON, K1V 1H2
Canada
FCC test site registration number: 176392 and IC registered site number: 2040A-4 (3 m semi anechoic chamber)

Telephone +1 613 737 9680
Facsimile +1 613 737 9691
Toll free +1 800 563 6336
Website www.nemko.com

Tested by David Duchesne, Senior EMC/Wireless Specialist

Reviewed by July 8, 2013
Andrey Adelberg, Senior Wireless/EMC Specialist **Date**

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.
Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
© Nemko Canada Inc.

Table of Contents

Section 1 Report summary

1.1 Applicant

Digital Security Controls, a division of Tyco Safety Products Canada Ltd.
3301 Langstaff Rd.
Concord, ON, Canada
L4K 4L2

1.2 Manufacturer

Digital Security Controls, a division of Tyco Safety Products Canada Ltd.
95 Bridgeland Ave
Toronto, ON, Canada
M6A 1Y7

1.3 Test specifications

Table 1.3-1: Test specification

Standard	Description
FCC 47 CFR Part 15, Subpart C, Chapter 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
RSS-210, Issue 8, December 2010, Annex 8	Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands
ANSI C64.3 v 2003	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

1.4 Test guidance

DA 00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

1.5 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.6 Exclusions

None

1.7 Test report revision history

Table 1.7-1: Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C – Test results

Table 2.1-1: FCC Part 15 Subpart C – General requirements results

Part	Test description	Verdict
§15.31(e)	Variation of power source	See Notes [1]
§15.31(m)	Number of operating frequencies	See Notes [2]
§15.203	Antenna requirement	See Notes [3]
§15.207(a)	Conducted limits	Pass [4]

Notes:
[1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed
[2] The frequency range over which the device operates is greater than 10 MHz. Tests were performed on three operating channels. (low, mid and high)
[3] The antenna used for this product is an internal built in wire antenna that no antenna other than that furnished by the responsible party shall be used with the device, The maximum peak gain of this antenna is 2 dBi.
[4] Conducted emissions performed on host alarm panel.

Table 2.1-2: FCC Part 15 Subpart C – Intentional Radiators results

Part	Test description	Verdict
§15.247(a)(1)	Frequency hopping systems	
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable
§15.247(b)	Maximum conducted peak output power and EIRP	
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Not applicable
§15.247(b)(4)	Conducted peak output power limitations	
§15.247(b)(4)(i)	Maximum peak output power for systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations.	Not applicable
§15.247(b)(4)(ii)	Maximum peak output power for systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations.	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Not applicable
§15.247(f)	Time of occupancy and power spectral density for hybrid systems	Not applicable

Notes: None

2.2 RSS, Issue 3, test results

Table 2.2-1: RSS-GEN – General requirements results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
6.1	Receiver spurious emissions limits (radiated)	See Notes [1]
6.2	Receiver spurious emissions limits (antenna conducted)	See Notes [1]
7.2.4	AC power lines conducted emission limits	Pass [2]

Notes: [1] According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.
[2] Conducted emissions performed on host alarm panel.

Table 2.2-2: RSS-210 – Intentional Radiators results

Part	Test description	Verdict
A8.1	Frequency hopping systems	
A8.1 (a)	Bandwidth of a frequency hopping channel	Pass
A8.1 (b)	Minimum channel spacing for frequency hopping systems	Pass
A8.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Pass
A8.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
A8.2	Digital modulation systems	
A8.2 (a)	Minimum 6 dB bandwidth	Not applicable
A8.2 (b)	Maximum power spectral density	Not applicable
A8.3	Hybrid systems	
A8.3 (1)	Digital modulation turned off	Not applicable
A8.3 (2)	Frequency hopping turned off	Not applicable
A8.4	Transmitter output power and e.i.r.p. requirements	
A8.4 (1)	Frequency hopping systems operating in the 902–928 MHz band	Pass
A8.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.4 (3)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
A8.4 (4)	Systems employing digital modulation techniques	Not applicable
A8.4 (5)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
A8.4 (6)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
A8.5	Out-of-band emissions	Pass

Notes: None

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	June 24, 2013
Nemko sample ID number	Item # 1 (TX data continuous lowest channel 912.750 MHz) Item # 2 (TX data continuous middle channel 915.863 MHz) Item # 3: (TX data continuous highest channel 919.106 MHz) Item # 4 (Normal operation)

3.2 EUT information

Product name	Wireless Alarm Transceiver
Model	HSM2HOST9
Serial number	2313161663 (TX data continuous lowest channel 912.750 MHz) 2313161664 (TX data continuous middle channel 915.863 MHz) 2313161660 (TX data continuous highest channel 919.106 MHz) 2313161662 (Normal operation)
Hardware version	UA651 Rev. 03 (main board)/RFK PG2 Rev. 01 (RF module)
Software version	1.0 /4.6 (RF)

3.3 Technical information

Operating band	902–928 MHz
Operating frequency	912.75–919.106 MHz
Modulation type	GFSK
Number of channels	50
Channel spacing	130 kHz
Occupied bandwidth (99%)	88.5 kHz
Emission designator	88K5F7D
Power requirements	12 V_{DC} (Power provided via a compatible control panel to which the transceiver is connected – 120 V_{AC} 60 Hz)
Antenna information	Integral (2 dBi)

3.4 Product description and theory of operation

128 Zones Wireless Alarm transceiver for use with DSC Control panels HS2128 series.

Alarm transceiver monitors the status of the enrolled wireless initiating devices. Receives RF signals from security and fire detection devices and transmits RF commands to wireless keypads, initiating devices or sirens (using 2-way RF protocol PG2)

3.5 EUT exercise details

Separate samples were provided with continuous carrier and continuous modulation transmission at Low, Mid and High channels.

3.6 EUT setup details

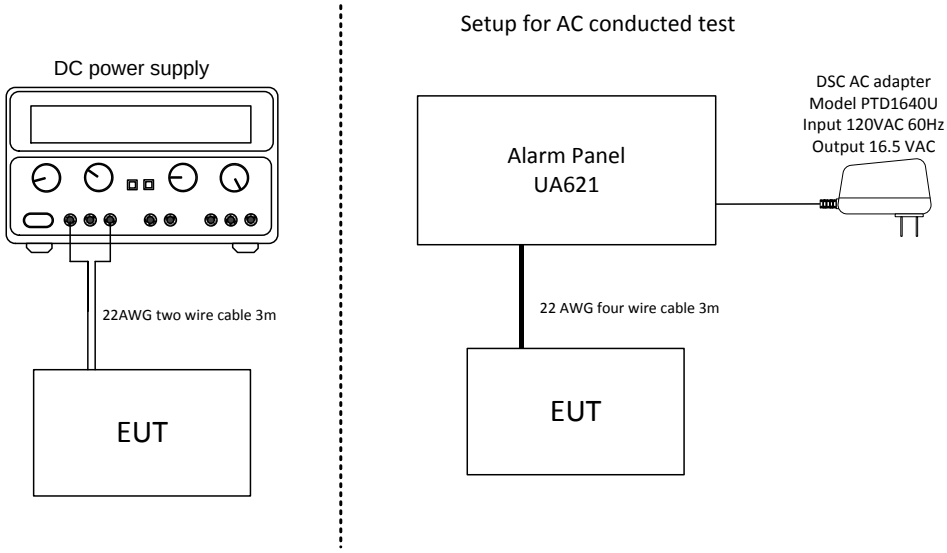


Figure 3.6-1: Setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

www.nemko.com

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature: 15–30 °C
Relative humidity: 20–75 %
Air pressure: 86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/14
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	May 30/14
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Feb. 28/14
Bilog antenna	Sunol	JB3	FA002108	1 year	Feb. 21/14
Horn antenna #2	EMCO	3115	FA000825	1 year	Feb. 21/14
1–18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	June 21/14
LISN	Rohde & Schwarz	ENV216	FA002023	1 year	Nov. 26/13

Notes: None

Table 7.1-2: Test software details

Test description	Manufacturer of Software	Details
Radiated emissions	Rhode & Schwarz	EMC32, Software for EMC Measurements, Version 8.53.0
Conducted emissions	Rhode & Schwarz	EMC32, Software for EMC Measurements, Version 8.53.0

Notes: None

Section 8 Testing data

8.1 AC power line conducted emissions

8.1.1 Definitions and limits

FCC Clause 15.207(a): Conducted limits
RSS-Gen Clause 7.2.4: AC power line conducted emissions limits

FCC:
Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

IC:
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 2. The tighter limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 Ω/50 µH line impedance stabilization network (LISN).

Table 8.1-1: AC power line conducted emissions limit

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Notes: * - Decreases with the logarithm of the frequency.

8.1.2 Test summary

Verdict Pass

8.1.3 Observations/special notes

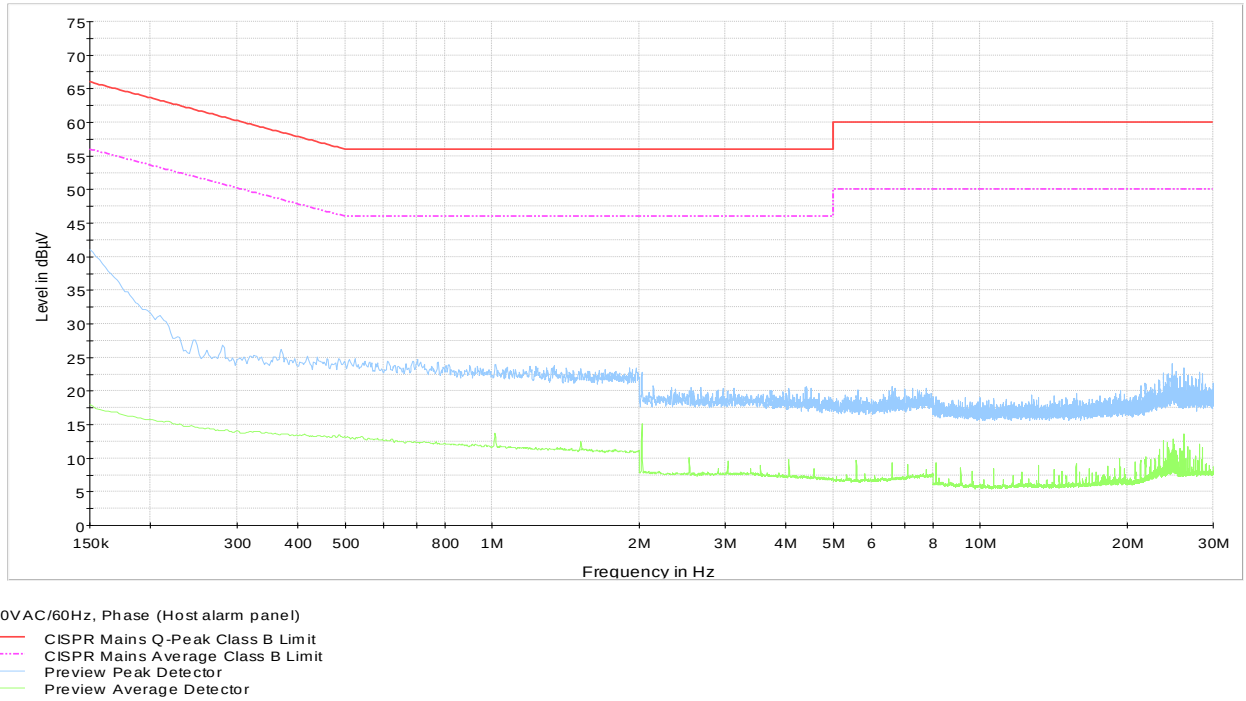
Test performed with host alarm panel. The UT was in a normal operating state.

8.1.4 Setup details

Test date	July 3, 2013	**Test engineer**	David Duchesne		
Temperature	24.7 °C	**Air pressure**	1009 mbar	**Relative humidity**	55.4 %

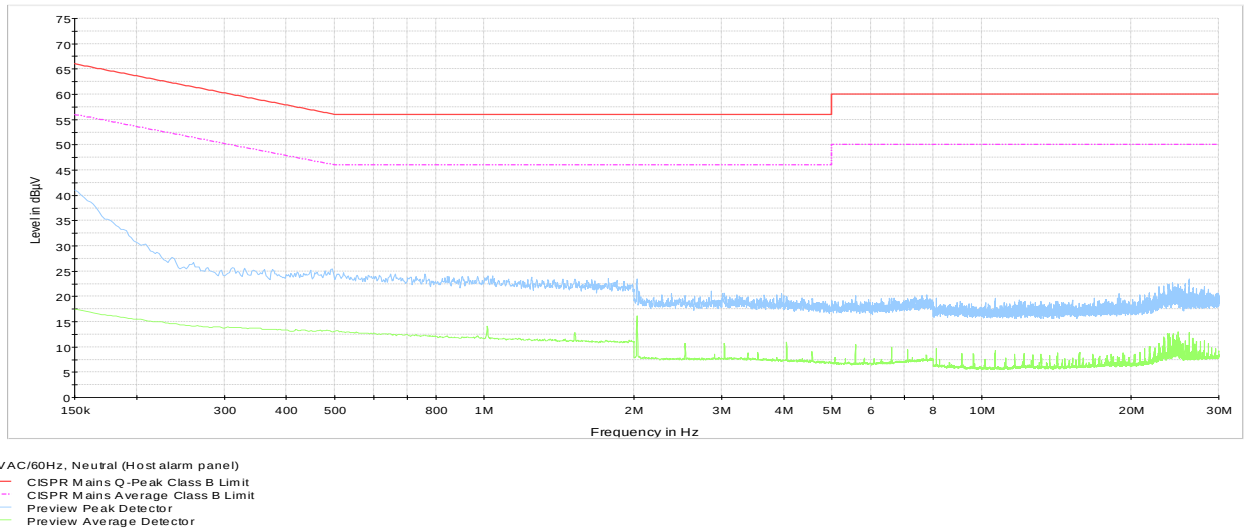
Port under test: AC input of host alarm panel
Receiver/spectrum analyzer settings: Peak and average detector (Max hold), RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms

8.1.5 Test data



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.1-1: AC power line conducted emissions on phase line



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.1-2: AC power line conducted emissions on phase on neutral line

8.1.5 Setup photos

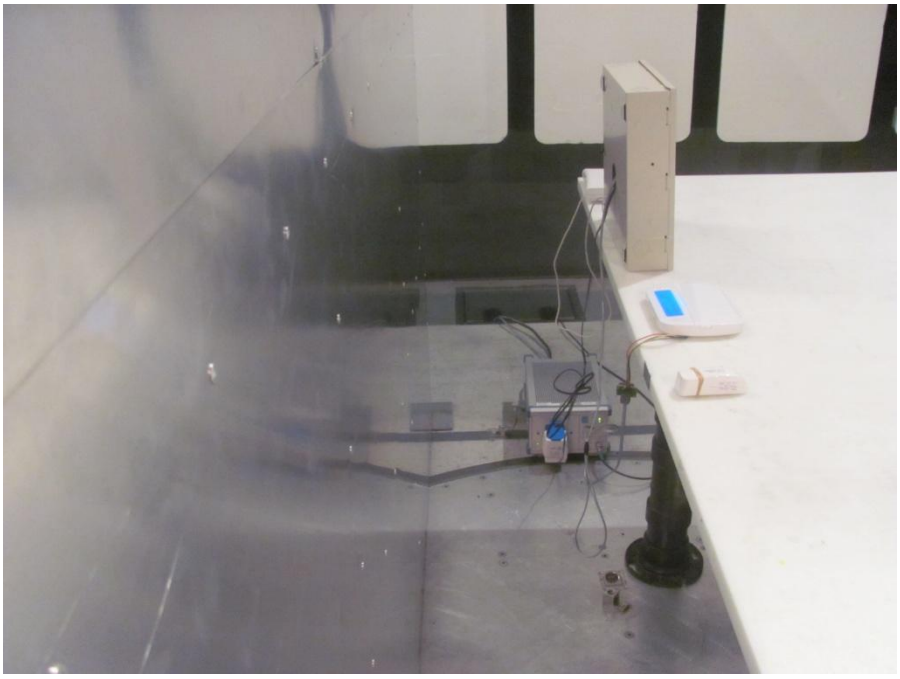


Figure 8.1-3: AC power line conducted emissions on phase setup photo

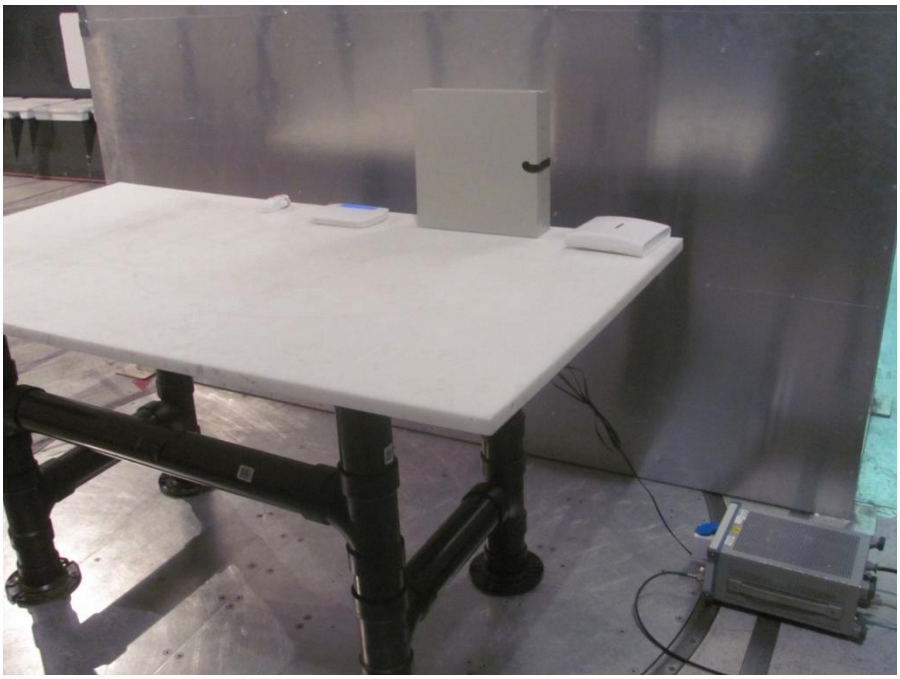


Figure 8.1-4: AC power line conducted emissions on phase setup photo

8.2 Frequency hopping requirements

8.2.1 Definitions and limits

FCC Clause 15.247(a)(1) and (i)
RSS-210 Clause A8.1 (a) and (c)

FCC: (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

IC:

A8.1 (a) Bandwidth of a frequency hopping channel

The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system RF bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset while the long term distribution appears evenly distributed.

A8.1 (c) Frequency hopping systems operating in the 902–928 MHz band

For frequency hopping systems in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20 second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

8.2.2 Test summary

Verdict Pass

8.2.3 Observations/special notes

- Test performed with modulation enabled.
- Tests were performed with hopping disabled at low, mid and high channel. Tests were additionally performed with hopping enabled.

8.2.4 Setup Details

Test date	July 3, 2013	**Test engineer**	David Duchesne		
Temperature	24.7 °C	**Air pressure**	1009 mbar	**Relative humidity**	55.4 %

8.2.5 Test data

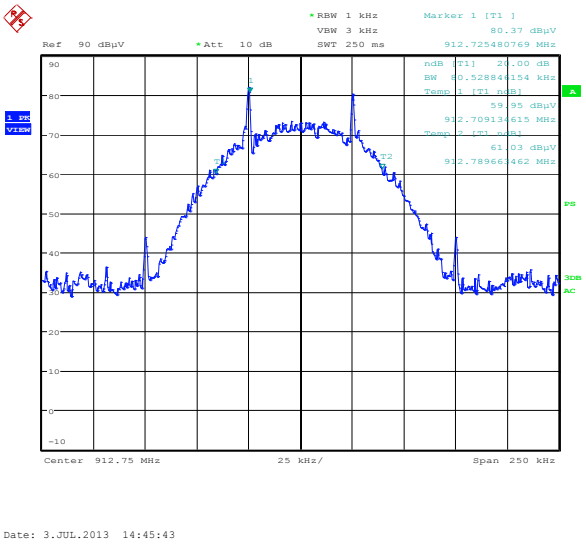


Figure 8.2-1: 20 dB bandwidth – Low channel

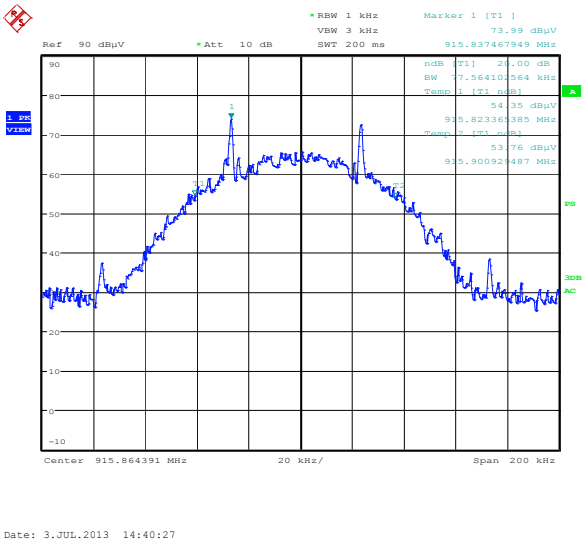


Figure 8.2-2: 20 dB bandwidth – Mid channel

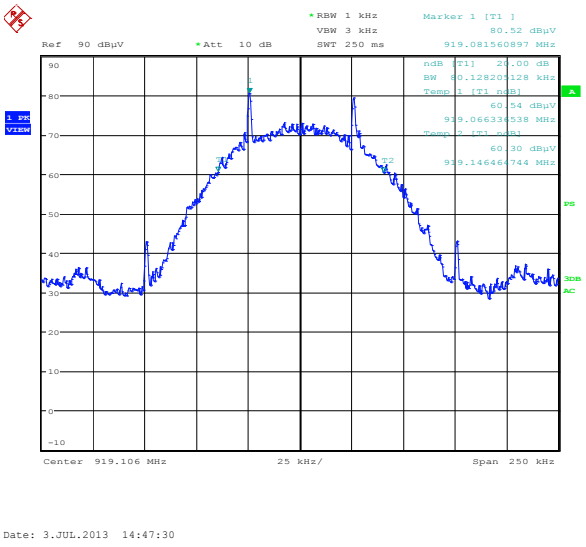


Figure 8.2-3: 20 dB bandwidth – High channel

Table 8.2-1: 20 dB bandwidth results

Frequency (MHz)	20 dB bandwidth (kHz)	Limit (kHz)	Margin (kHz)[1]
912.750 (Low channel)	80.52	500.00	419.48
915.863 (Mid channel)	77.56	500.00	422.44
919.106 (High channel)	80.13	500.00	419.87

Notes: [1] Margin = Limit– 20 dB bandwidth

8.2.6 Test data, continued

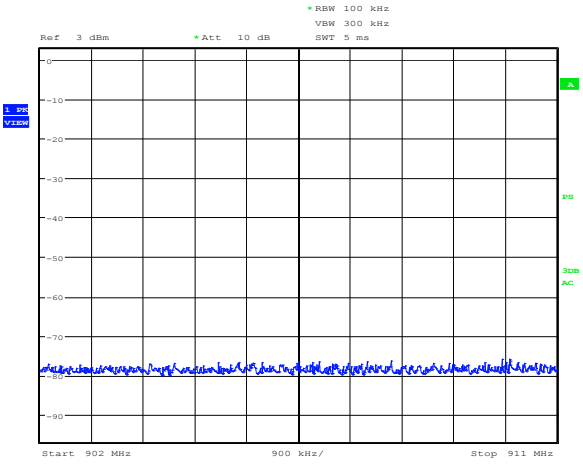


Figure 8.2-4: Number of hopping frequencies in the frequency range 902 to 911 MHz (None)

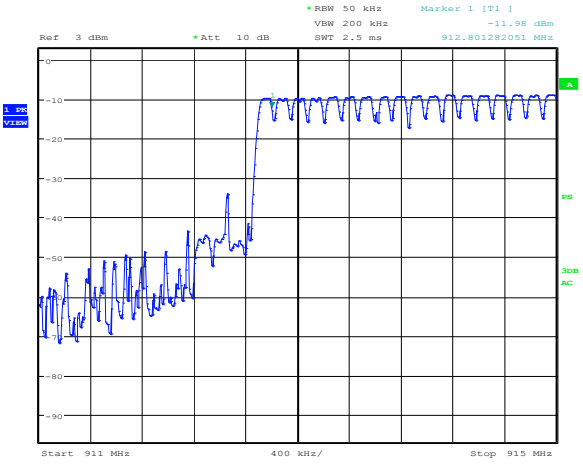


Figure 8.2-5: Number of hopping frequencies in the frequency range 911 to 915 MHz (Eighteen)

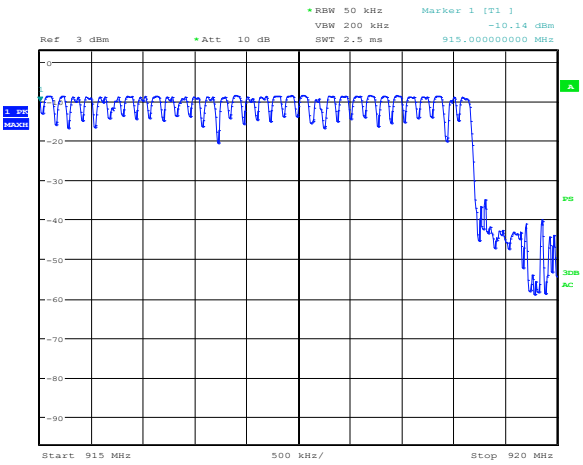


Figure 8.2-6: Number of hopping frequencies in the frequency range 915 to 920 MHz (Thirty two)

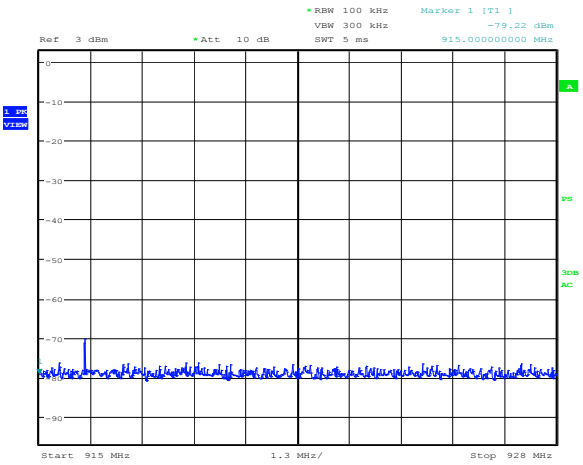


Figure 8.2-7: Number of hopping frequencies in the frequency range 915 to 928 MHz (None)

Table 8.2-2: Number of hopping frequencies

Number of hopping frequencies	Minimum number of hopping frequencies	Margin[1]
50	50	0

Notes: [1] Margin = Number of hopping frequencies – Minimum number of hopping frequencies.

8.2.7 Test data, continued

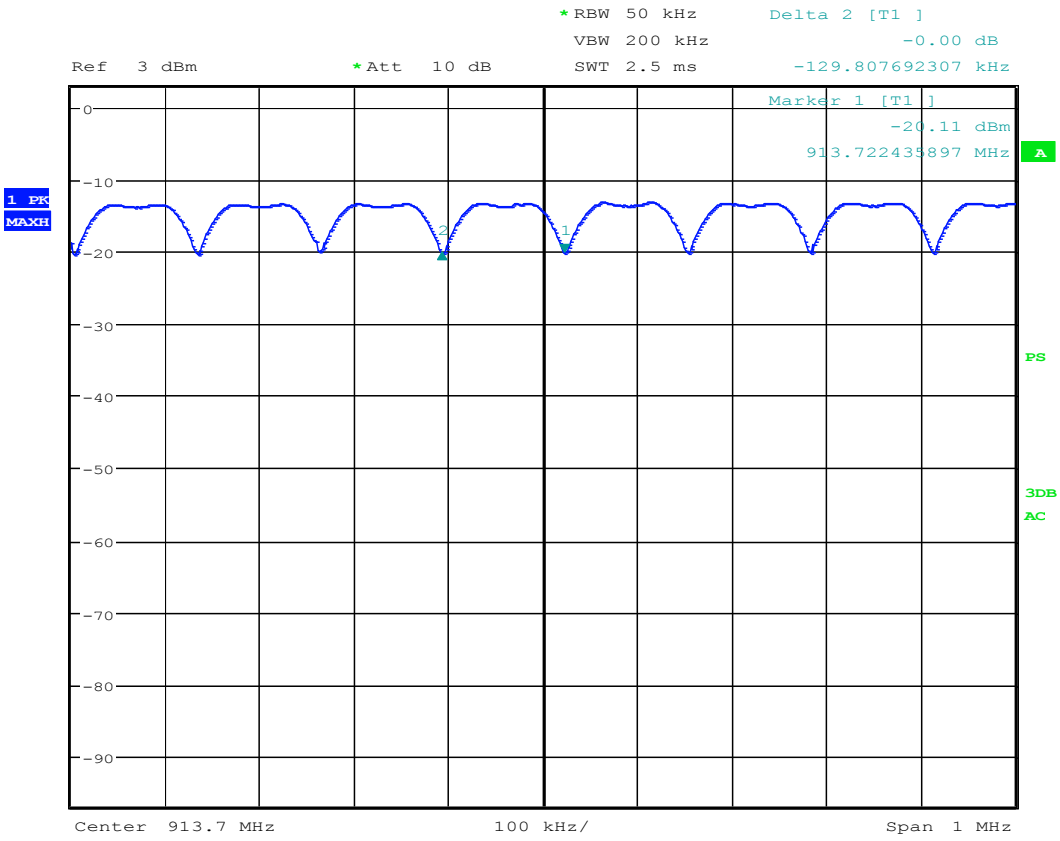


Figure 8.2-8: Carrier frequency separation

Table 8.2-3: Carrier frequency separation

Carrier frequency separation (kHz)	Minimum limit (kHz)[1]	Margin (kHz)[2]
129.81	80.52	49.29

Notes: [1] Minimum limit = 20 dB bandwidth
[2]. Margin = Minimum limit – Carrier frequency separation

8.2.5 Test data, continued

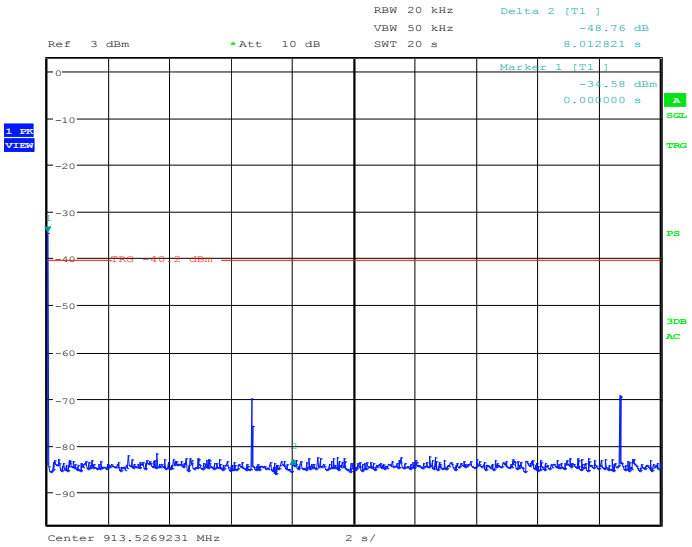


Figure 8.2-9: Average time of occupancy (hop interval)

Table 8.2-4: Average time of occupancy

Assigned frequency range (MHz)	Average time of occupancy limit over 20 seconds (ms)	Measured average time of occupancy[1] (ms)	Margin (ms)
902–928	400	41.92	395.75

Notes: Dwell time = 4.25 ms
Hop interval > 20 s
Number of hopping Channels= 50
Period = 0.4 (seconds/channel) × 50 (channels) = 20 s

[1] Information as provided by manufacturer:

Disarming the wireless alarm system sets the detectors to disarm mode, similarly arming the alarm system sets the detectors to armed mode. Setting the detectors to armed/disarmed mode is done by the HSM2HOST9 transmitting a long message "multi unicast massage". The length of the message is defined by the number of detectors in the system.

The message construction and duration is:

- 20 bytes overhead
- 30 bytes transmission to devices, a byte for each device (for a system with 30 devices)
- 8 bits for each byte
- 50Kbps – data rate

For 30 devices (20 +30)x8/50K = **8msec** –message transmission duration.
For 64 devices (20 + 64)x8/50K =**13.44msec**
For 128 devices (20+128)x8/50K = **23.68msec**
For 242 devices (20+242)x8/50K = **41.92msec**

8.3 Occupied bandwidth

8.3.1 Definitions and limits

RSS-Gen Clause 4.6.1 Occupied bandwidth

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

8.3.2 Test summary

Verdict Pass

8.3.3 Observations/special notes

- Test performed with modulation enabled.
- Tests were performed with hopping disabled at low, mid and high channel.

8.3.4 Setup details

Test date	July 3, 2013	**Test engineer**	David Duchesne		
Temperature	24.7 °C	**Air pressure**	1009 mbar	**Relative humidity**	55.4 %

8.3.5 Test data

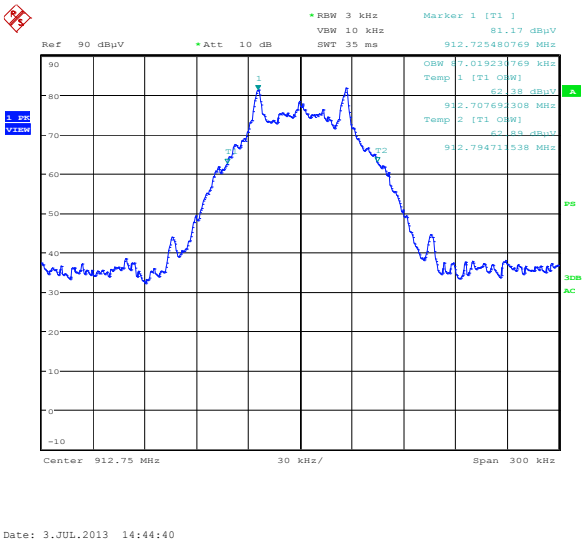


Figure 8.3-1: 99 % bandwidth – Low channel

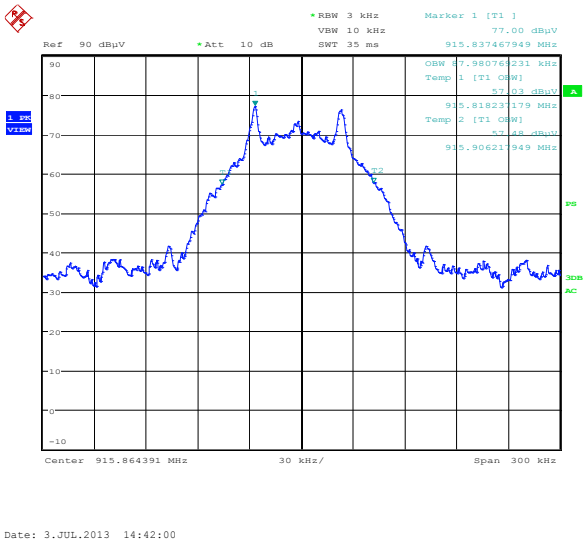


Figure 8.3-2: 99 % bandwidth – Mid channel

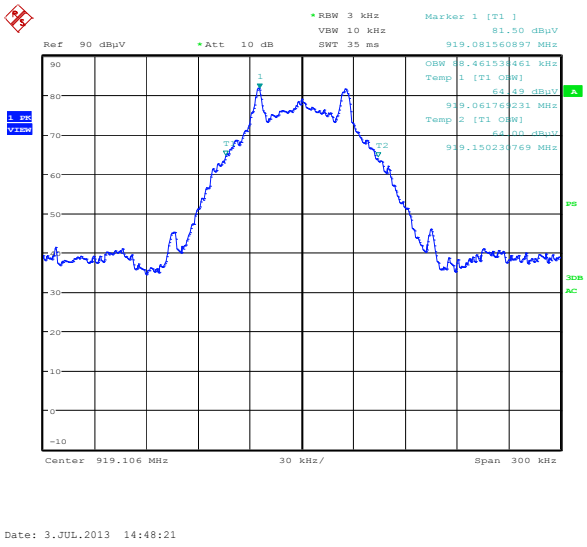


Figure 8.3-3: 99 % bandwidth – High channel

Table 8.3-1: 99 % bandwidth results

Frequency (MHz)	99% bandwidth (kHz)
912.750 (Low channel)	87.02
915.863 (Mid channel)	87.98
919.106 (High channel)	88.46

Notes: None

8.4 Transmitter output power and EIRP requirements for frequency hopping systems

8.4.1 Definitions and limits

FCC Clause 15.247(b) (2)
RSS-210 Clause A8.4 (1)

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 W (30 dBm) for systems employing at least 50 hopping channels; and, 0.25 W (24 dBm) for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

IC:

A8.4 (1) Transmitter Output Power and e.i.r.p. Requirements for Frequency hopping systems operating in the 902–928 MHz band

For frequency hopping systems operating in the band 902–928 MHz, the maximum peak conducted output power shall not exceed 1 W (30 dBm), and the e.i.r.p. shall not exceed 4 W (36 dBm), if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W (24 dBm), and the e.i.r.p. shall not exceed 1 W (30 dBm), if the hopset uses less than 50 hopping channels.

8.4.2 Test summary

Verdict Pass

8.4.3 Observations/special notes

None

8.4.4 Setup details

Test date	July 3, 2013	**Test engineer**	David Duchesne		
Temperature	24.7 °C	**Air pressure**	1009 mbar	**Relative humidity**	55.4 %

Test facility: 3 m Semi anechoic chamber
Measuring distance (m): 3
Antenna height variation (m): 1–4
Turn table position (°): 0–360

Spectrum analyzer settings:
RBW = 1 MHz (RBW > the 20 dB bandwidth of the emission being measured)
VBW = 3 MHz
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
Sweep = auto
Detector function = peak
Trace = max hold

8.4.5 Test data

Table 8.4-1: Output power results

Frequency (MHz)	Antenna Pol.	Field strength (dBµV/m)[1]	Theoretical conversion factor (dB)[2]	Antenna gain (dBi)	Output power (dBm)	Limit (dBm)	Margin (dB)
912.750	V	115.57	95.23	2.00	18.34	30.00	11.66
	H	110.46	95.23	2.00	13.23	30.00	16.77
915.853	V	115.82	95.23	2.00	18.59	30.00	11.41
	H	109.36	95.23	2.00	12.13	30.00	17.87
919.105	V	115.01	95.23	2.00	17.78	30.00	12.22
	H	109.82	95.23	2.00	12.59	30.00	17.41

Notes: [1] Field strength (dBµV/m) = spectrum analyzer value (dBµV) + correction factor (dB)
Correction factor = antenna factor ACF (dB) + cable loss (dB)
Sample calculation: 107.41 dBµV/m (field strength) = 81.41 dBµV (receiver reading) + 26 dB (Correction factor)

[2] Theoretical conversion from field strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$\frac{P \times G}{4\pi \times d^2} = \frac{E^2}{120\pi}$$

$$P = \frac{E^2 \times 4\pi \times d^2}{120\pi \times G} = \frac{E^2 \times d^2}{30 \times G}$$

P = Output power (W)
E = Measured field strength value (V/m)
d = Measurement distance (m)
G = Antenna gain (numeric)

Therefore for *d* = 3 m,

$$P[dBW] = E[dBV/m] + 20 \cdot Log_{10}(3)[dB] - 10 \cdot Log_{10}(30)[dB] - 10 \cdot Log_{10}(G)[dBi]$$

$$P[dBW] = E[dBV/m] + 9.54\ [dB] - 14.77\ [dB] - 10 \cdot Log_{10}(G)[dBi] = E[dBV/m] - 5.23\ [dB] - 10 \cdot Log_{10}(G)[dBi]$$

where

$$P[W] = P[mW] \div 1{,}000 \rightarrow\ P[dBW] = P[dBmW] - 10 \times Log_{10}(1{,}000)[dB] \rightarrow P[dBW] = P[dBmW] - 30\ [dB]$$

$$E[V/m] = E[\mu V/m] \div 1{,}000{,}000 \rightarrow\ E[dBV/m] = E[dB\mu V/m] - 20 \times Log_{10}(1{,}000{,}000)[dB] \rightarrow E[dBV/m] = E[dB\mu V/m] - 120\ [dB]$$

from which we obtain

$$P[dBmW] = P[dBm] = E[dB\mu V/m] - 120\ [dB] - 5.23\ [dB] - 10 \cdot Log_{10}(G)[dBi] + 30\ [dB]$$

$$P[dBm] = E[dB\mu V/m] - 95.23\ [dB] - 10 \cdot Log_{10}(G)[dBi]$$
$$Output\ power\ [dBm] = Field\ strength\ [dB\mu V/m] - 95.23\ [dB] - Antenna\ gain\ [dBi]$$

Table 8.4-2: EIRP calculation results

Frequency (MHz)	Output power (dBm)	Antenna gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
912.750	18.34	2.00	20.34	36.00	15.66
915.853	18.59	2.00	20.59	36.00	15.41
919.105	17.78	2.00	19.78	36.00	16.22

Notes: EIRP [dBm] = Output power [dBm] + Antenna gain [dBi]; Margin = Limit − EIRP

8.4.6 Setup photos

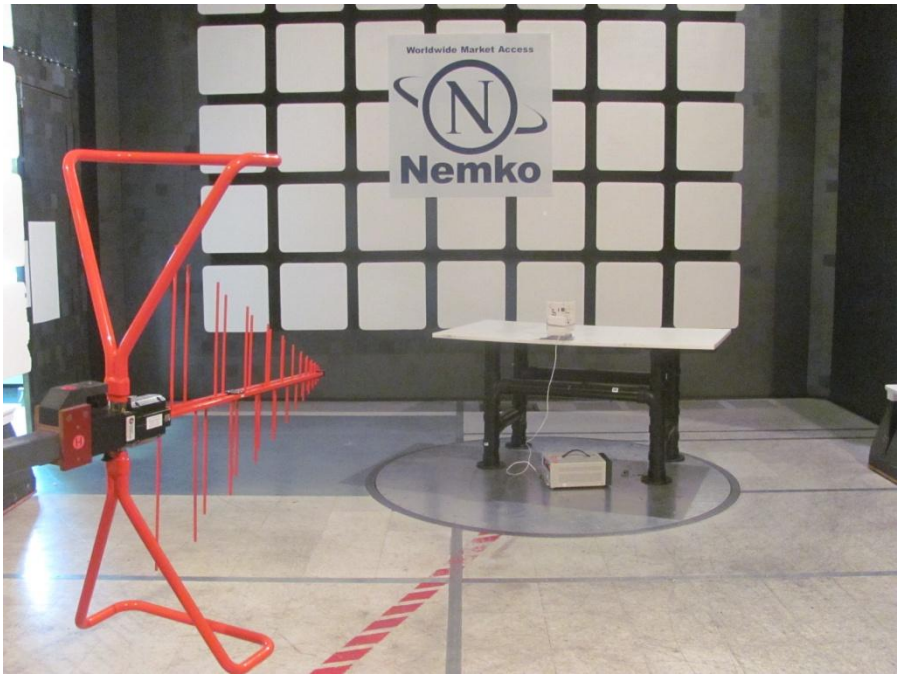


Figure 8.4-1: Transmitter output power and e.i.r.p. setup photo

Figure 8.4-2: Transmitter output power and e.i.r.p. setup photo

8.5 Spurious (out-of-band) emissions

8.5.1 Definitions and limits

FCC Clause 15.247(d): Spurious emissions
RSS-210 Clause A8.5 Out-of-band emissions

FCC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Error! Reference source not found. is not required.

Table 8.5-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency (MHz)	Field strength		Measurement distance (m)
	(µV/m)	(dBµV/m)	
0.009–0.490	2400/F	$67.6-20\times\log_{10}(F)$	300
0.490–1.705	24000/F	$87.6-20\times\log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: None

8.5.1 Definitions and limits, continued

Table 8.5-2: FCC Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

Notes: *– applicable only to FCC requirements

Table 8.5-3: IC Restricted bands of operation

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Notes: Certain frequency bands listed in
Table 8.5-3 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

8.5.2 Test summary

Verdict Pass

8.5.3 Observations/special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- Test performed with modulation enabled.
- Tests were performed with hopping disabled at low, mid and high channel. Tests were additionally performed with hopping enabled.

8.5.4 Setup Details

Test date	July 3, 2013	**Test engineer**	David Duchesne		
Temperature	24.7 °C	**Air pressure**	1009 mbar	**Relative humidity**	55.4 %

Test facility: 3 m Semi anechoic chamber
Measuring distance (m): 3
Antenna height variation (m): 1–4

Spurious (Out of band) emissions

- All spurious peak emissions outside of the authorized frequency band with a 100 kHz bandwidth were greater than 40 dB below the transmitter output power.
- Radiated spurious emissions that fell within restricted bands that were within 20 dB of the limit have been recorded. See **Table 8.5–4**

8.5.5 Test data

Table 8.5-4: Radiated spurious emissions within restricted bands.

Freq. (MHz)	Ant. Pol. (V/H)	Meas. peak field strength[1] (dBµV/m)	Peak field strength limit (dBµV/m)	Peak field strength margin[3] (dB)	Duty cycle cor. factor [4](dB)	Calculated average field strength[2] (dBµV/m)	Average field strength limit (dBµV/m)	Average field strength margin (dB)
912.75 MHz (Low-Channel)								
2738.5	V	54.00	74.00	20.00	-7.55	46.45	54.00	7.55
4564	V	58.30	74.00	15.70	-7.55	50.75	54.00	3.25
8214.8	H	58.14	74.00	15.86	-7.55	50.59	54.00	3.41
915.863 MHz (Mid-Channel)								
4579.5	V	56.80	74.00	17.20	-7.55	49.25	54.00	4.75
919.105 MHz (High Channel)								
4595.5	V	57.00	74.00	17.00	-7.55	49.45	54.00	4.55

Notes:
- Frequency hopping disabled.
- Spectrum analyzer setting:
  Peak measurement: Peak detector, RBW = 1 MHz, VBW= 3 MHz

[1] Field strength (dBµV/m) = spectrum analyzer value (dBµV) + correction factor (dB)
Correction factor = antenna factor ACF (dB) + cable loss (dB) − amplifier gain (dB)
Sample calculation: 58.3 dBµV/m (field strength) = 68.4 dBµV (receiver reading) + (-10.1) dB (Correction factor)

[2] Calculated average field strength (dBµV/m) = Peak field strength (dBµV/m) + Duty cycle correction factor (dB). Duty cycle correction factor as calculated from §15.35 (c)

[3] Margin (dB) = field strength limit - field strength measurement

[4] Duty cycle correction
Disarming the wireless alarm system sets the detectors to disarm mode, similarly arming the alarm system sets the detectors to armed mode. Setting the detectors to armed/disarmed mode is done by the HSM2HOST9 transmitting a long message "multi unicast massage". The length of the message is defined by the number of detectors in the system.

The message construction and duration is:

- 20 bytes overhead
- 30 bytes transmission to devices, a byte for each device (for a system with 30 devices)
- 8 bits for each byte
- 50Kbps – data rate

For 30 devices (20 +30)x8/50K = **8msec** –message transmission duration.
For 64 devices (20 + 64)x8/50K =**13.44msec**
For 128 devices (20+128)x8/50K = **23.68msec**
For 242 devices (20+242)x8/50K = **41.92msec**

The worst case scenario for duty cycle correction factor would be:

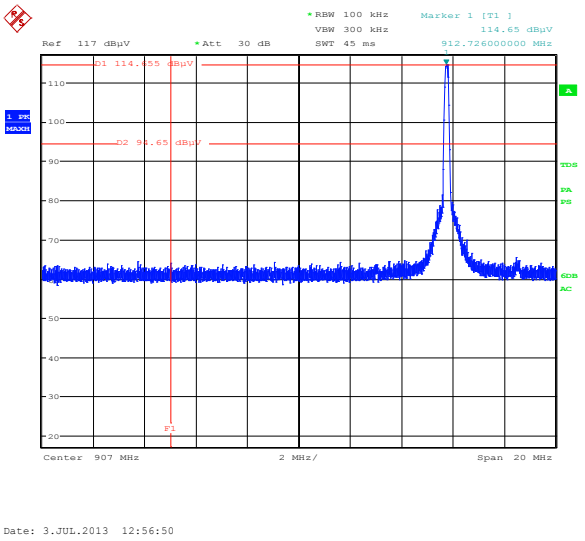
Duty cycle correction factor = −7.55 dB $Tx_{100\,ms}$ = 41.92 ms

$$Dutycycle/averagefactor = 20\times\log_{10}\left(\frac{Tx_{100ms}}{100ms}\right)$$

$$Dutycycle/averagefactor = 20\times\log_{10}\left(\frac{41.92ms}{100ms}\right) = -7.55[dB]$$

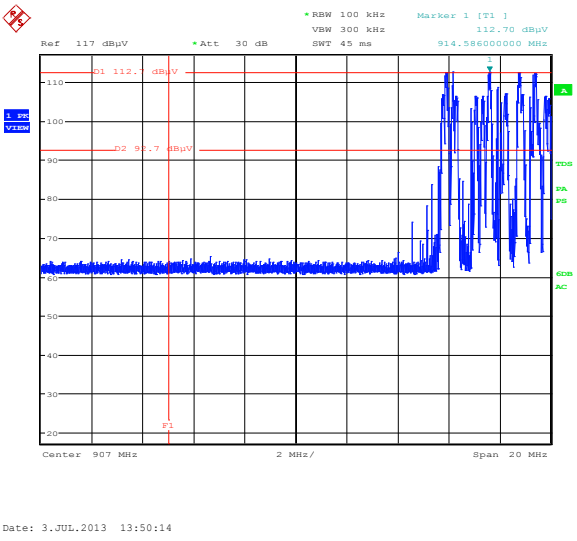
8.5.5 Test data

Spurious (Out of band) emissions at band edges



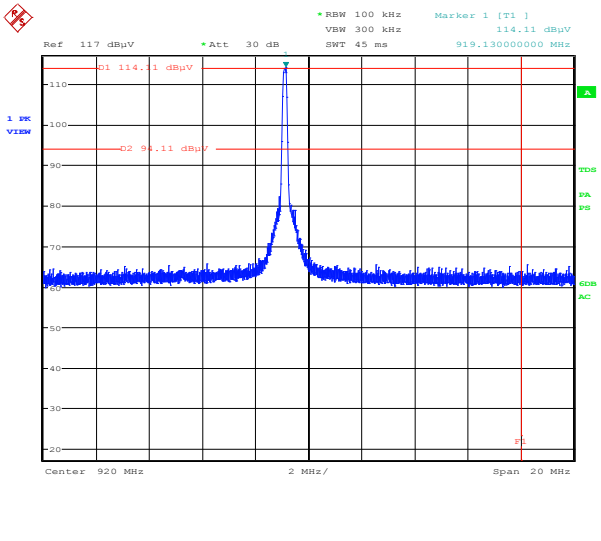
F1 = 902 MHz (Low Band Edge)

Figure 8.5-1: Radiated spurious emissions Low band edge (Tx at lowest channel)



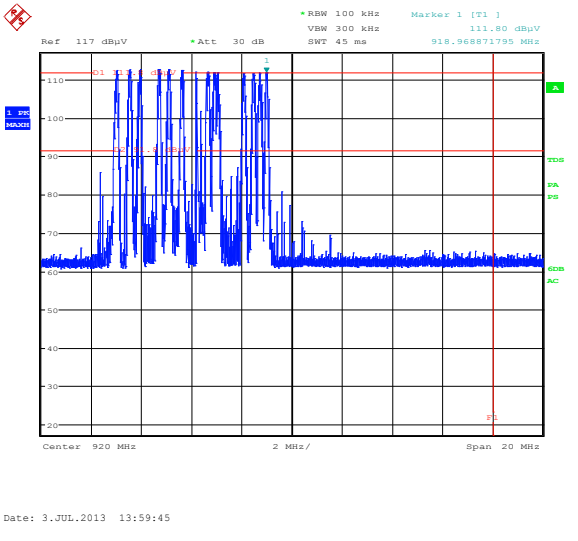
F1 = 902 MHz (Low Band Edge)

Figure 8.5-2: Radiated spurious emissions Low band edge (Tx Hopping)



F1 = 928 MHz (High Band Edge)

Figure 8.5-3: Radiated spurious emissions High band edge (Tx at highest channel)



F1 = 928 MHz (High Band Edge)

Figure 8.5-4: Radiated spurious emissions High band edge (Tx Hopping**)**

8.5.5 Setup photos

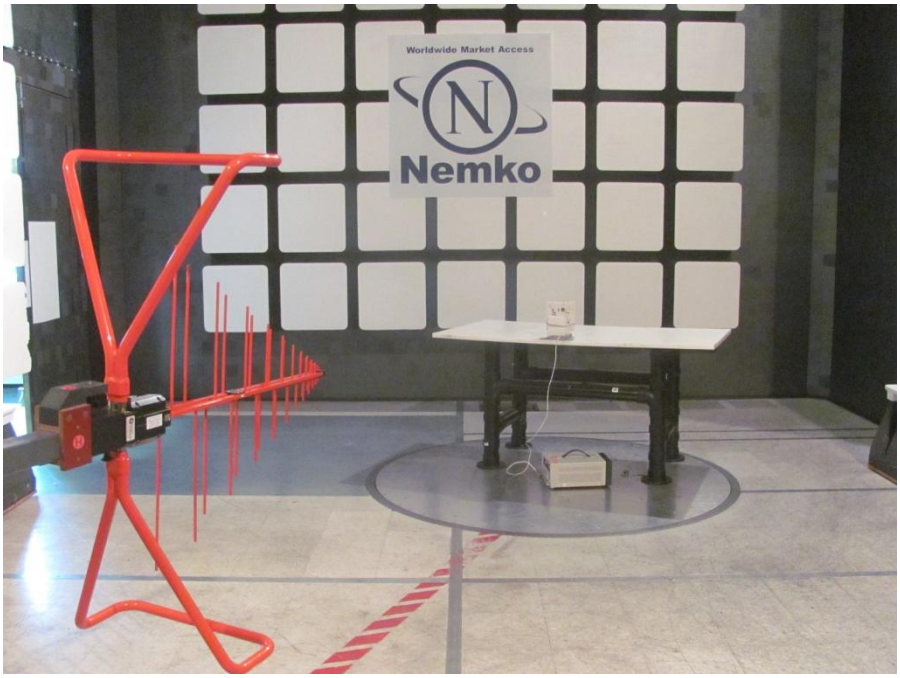
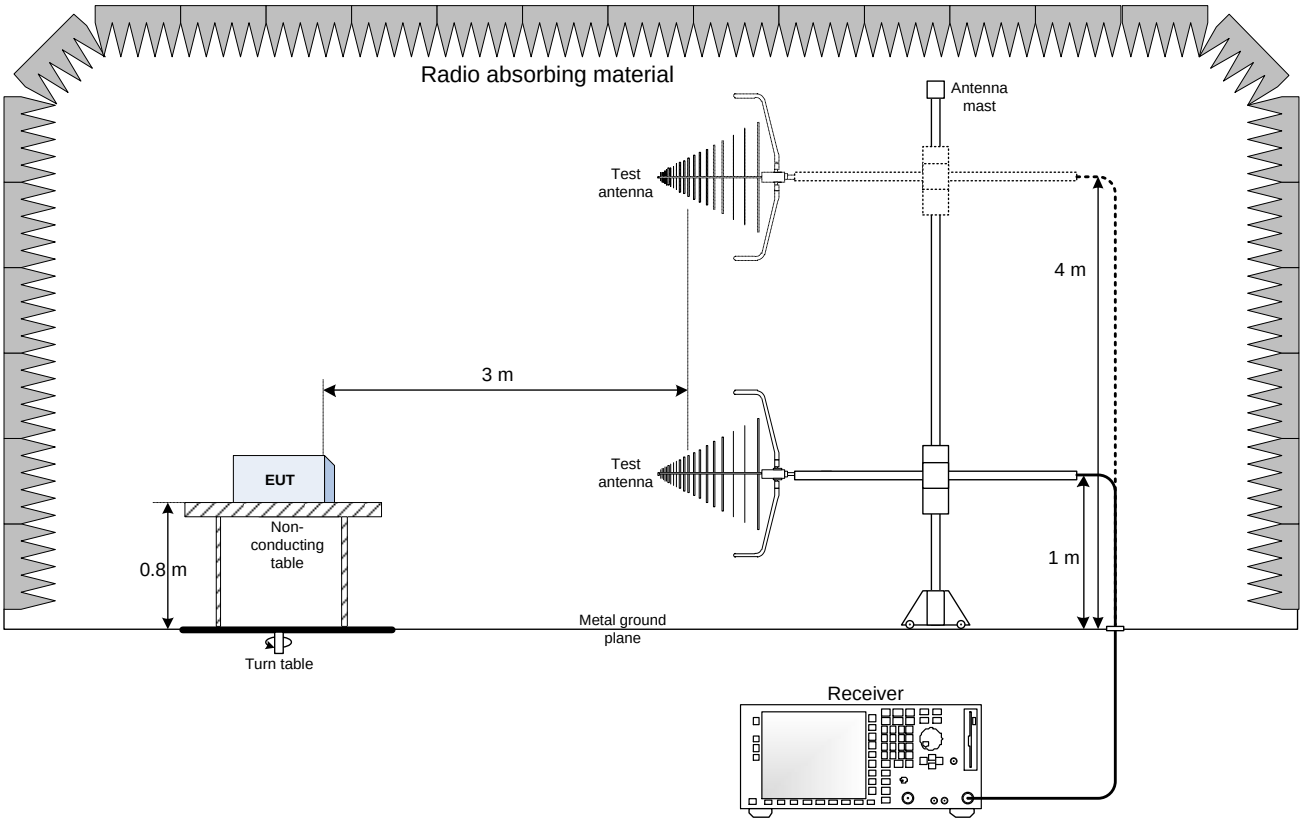


Figure 8.5-5: Spurious (out-of-band) emissions setup photo

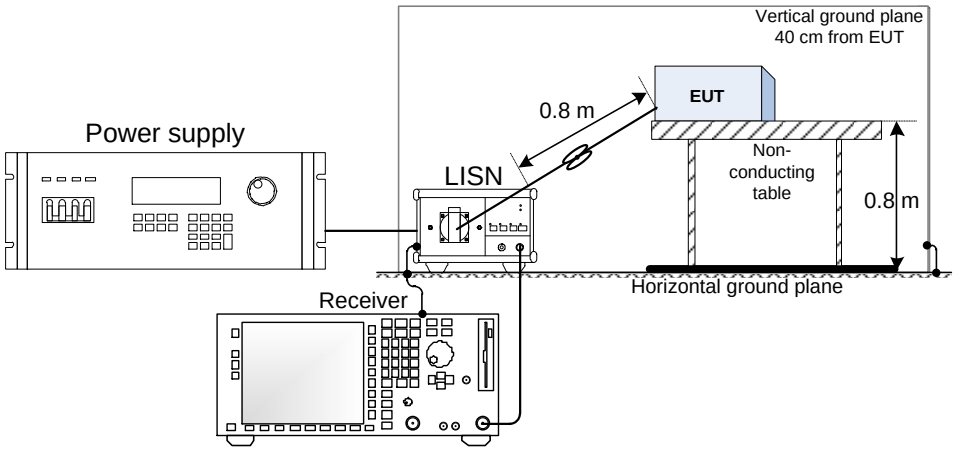
Figure 8.5-6: Spurious (out-of-band) emissions setup photo

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up



Section 10 EUT photos

10.1 External photos