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Compliance test report ID **206550-2TRFWL**

Date of issue
July 13, 2012

FCC 47 CFR Part 15 Subpart C, §15.247

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

RSS-210, Issue 8 Annex 8

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

Applicant	**Energate Inc.**
Product	**Foundation Smart Thermostat and Home Energy Gateway**
Model	**Foundation FZ100C**
FCC ID	**WUR-FZ100C**
IC Reg #	**8022A-FZ100**

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

SCC Accredited LAB
LAB Accrédité CCN

Test location

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

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Tested by Kevin Rose, Wireless/EMC Specialist

Reviewed by Andrey Adelberg, Senior Wireless/EMC Specialist

July 13, 2012
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

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Section 1 Report summary

1.1 Applicant and manufacturer

Energate Inc.
2415 Holly Lane, Suite 210
Ottawa, ON
K1V 7P1, Canada

1.2 Test specifications

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 Annex 8	Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

1.3 Test guidance

Note: As per 558074 D01DTS Meas Guidelines V01

1.4 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.

The Foundation FZ100 Smart Thermostat and Home Energy Gateway has two variants: FCC ID: WUR-FZ100 and FCC ID: WUR-FZ100C. The only difference between these two variants is that FCC ID: WUR-FZ100C variant includes the Consumption Data Receiver and associated components, which are not populated in FCC ID: WUR-FZ100. The item tested is FCC ID: WUR-FZ100C and is representative of the worst case configuration of this equipment for emissions testing.

See “Summary of test results” for full details.

1.5 Exclusions

None

1.6 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 – general requirements, test results

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

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] Since the frequency band was wider than 10 MHz, three channels (1 near top, 1 near middle and 1 near bottom) were selected for the testing.

2.2 FCC Part 15 Subpart C – Intentional Radiators, test results

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§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	Pass
§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	Not applicable
§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	Pass
§15.247(b)(4)	Maximum peak output power	Pass
§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	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 IC RSS-GEN, Issue 3, test results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
6.1	Receiver spurious emissions limits (radiated)	Not applicable
6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable
7.2.4	AC power lines conducted emission limits	Pass
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.		

2.4 IC RSS-210, Issue 8, test results

Part	Test description	Verdict
A8.1	Frequency hopping systems	
A8.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
A8.1 (b)	Minimum channel spacing for frequency hopping systems	Not applicable
A8.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
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	Pass
A8.2 (b)	Maximum power spectral density	Pass
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	Not applicable
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	Pass
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	April 23, 2012
Nemko sample ID number	1

3.2 EUT information

Product name	Foundation Smart Thermostat and Home Energy Gateway
Model	Foundation FZ100C
Serial number	E06AT00016

3.3 Technical information

Operating band	2400–2483.5 MHz
Operating frequency	2405–2480 MHz
Modulation type	Offset-QPSK
Occupied bandwidth (99 %)	2.44 MHz
Emission designator	2M44G1D
Power requirements	24 V_{AC}, 60 Hz, provided through a 120 V_{AC} / 24 V_{AC} transformer connected to AC mains
Antenna information	Integral, 1.5 dBi chip antenna Permanent fixed antenna The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The Foundation ™ Smart Thermostat and Home Energy Gateway is a Programmable Communicating Thermostat which controls the Heating, Ventilating and Air Conditioning (HVAC) equipment, receives and applies Demand Response commands sent by the Electric Utility through the ZigBee communication interface, and also displays Energy Price and Home Energy Consumption information.

3.5 EUT exercise details

EUT was controlled by PC using Tera Term Pro terminal application to force continuous transmission on low mid and high channels.

3.6 EUT setup diagram

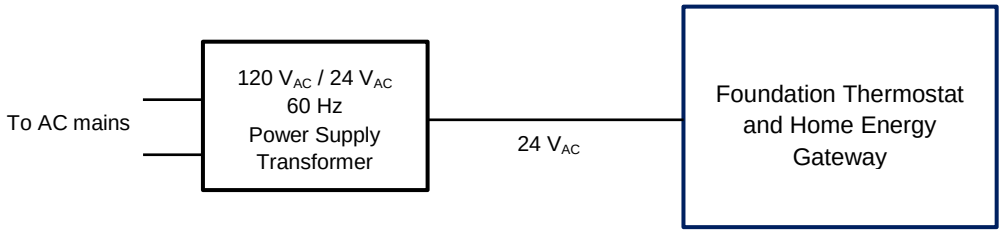


Diagram 3.6-1: *Setup diagram*

3.7 EUT sub assemblies

Description	Brand name	Model/Part number	Serial number	Rev.
Foundation Smart Thermostat and Home Energy Gateway	Energate	FZ100C / 0001390251	E06AT00016	N/A
Class 2 power supply transformer (120 VAC/24 VAC, 60 Hz)	Triad	WAU24-450	N/A	N/A

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.

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

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/13
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Apr. 27/12
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	May 18/12
Bilog antenna	Sunol	JB3	FA002108	1 year	Feb. 07/13
Horn antenna #2	EMCO	3115	FA000825	1 year	Feb. 24/13
1–18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	Aug. 15/12
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Feb. 09/13
Horn antenna 18–40 GHz	EMCO	3116	FA001847	1 year	May 20/12
18–26 GHz pre-amplifier	Narda	BBS-1826N612	FA001550	—	VOU
Note: NCR - no calibration required, VOU - verify on use					

Section 8 Testing data

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

8.1.1 Definitions and 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: *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
* - Decreases with the logarithm of the frequency.		

8.1.2 Test summary

Test date	April 24, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1002 mbar	**Relative humidity**	32 %

8.1.3 Observations/special notes

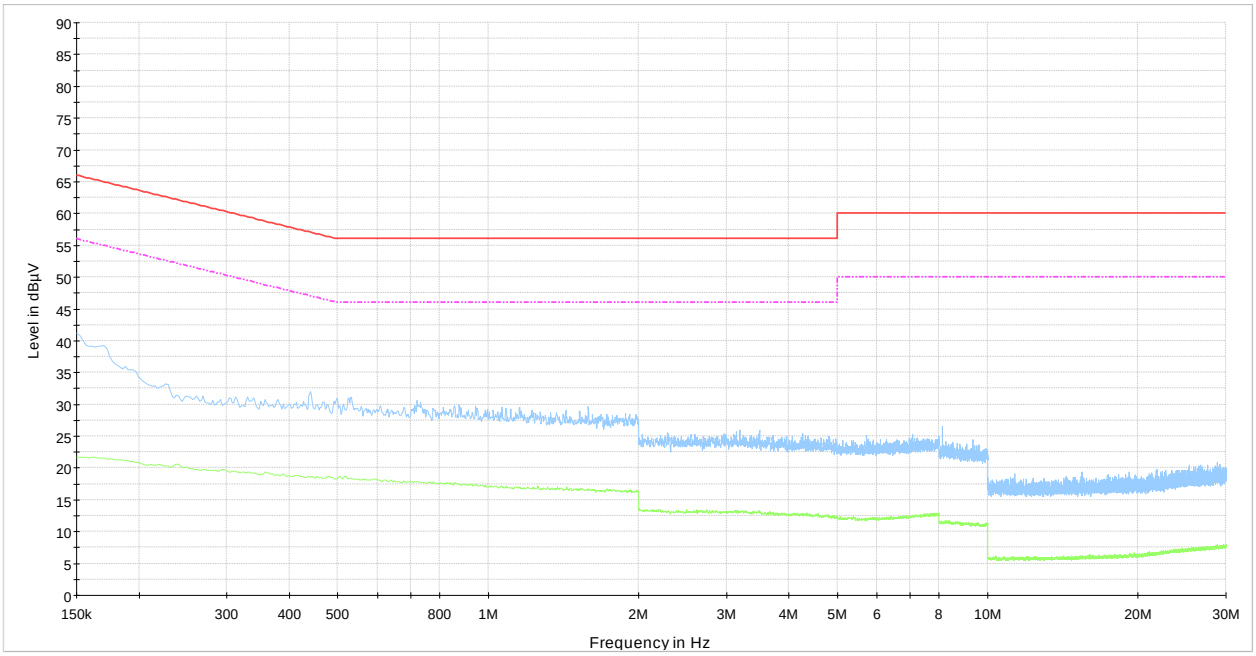
The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

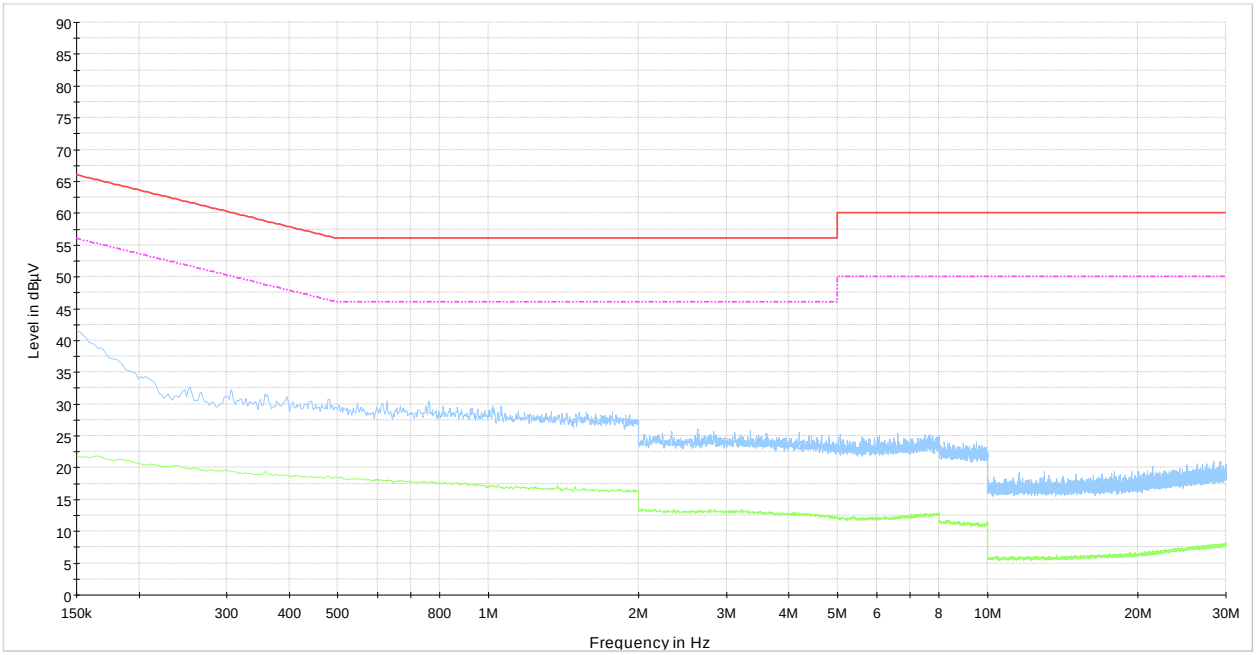
Receiver/spectrum analyzer settings
Preview measurements – Receiver:
Peak and Average detector (Max hold), RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms
Final measurements – Receiver:
Q-Peak and Average detector, RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms

Measurement details
A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement. The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

8.1.4 Test data



Plot 8.1-1: *Conducted emissions on phase line (green trace is made with average detector, blue trace is made with peak detector, red line is a quasi-peak limit line and pink line is an average limit line)*



Plot 8.1-2: *Conducted emissions on neutral line (green trace is made with average detector, blue trace is made with peak detector, red line is a quasi-peak limit line and pink line is an average limit line)*

8.2 FCC Clause 15.247(a)(2) and RSS-210 Clause A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.2.1 Definitions and limits

FCC and IC:

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

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

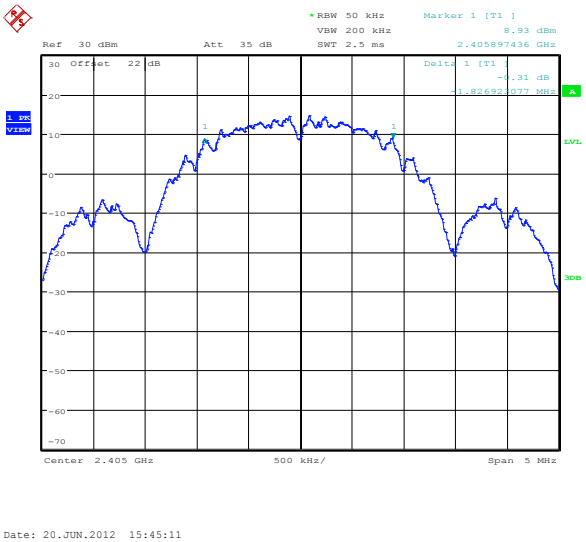
8.2.2 Test summary

Test date	June 20, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	55 %

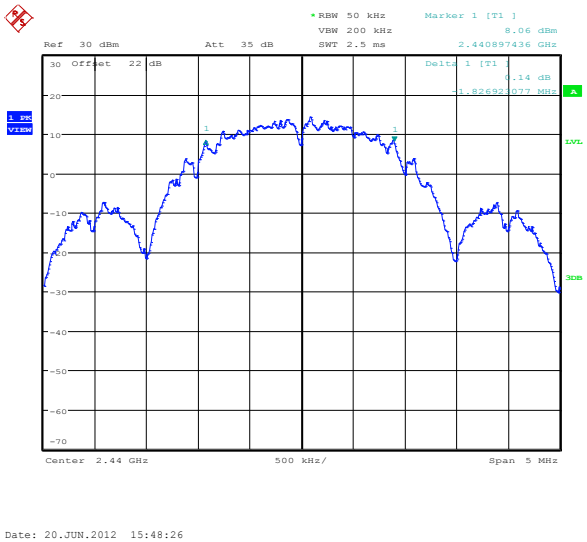
8.2.3 Observations/special notes

1. Set resolution bandwidth (RBW) = 1–5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) ≥ 3 × RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1–5 %.

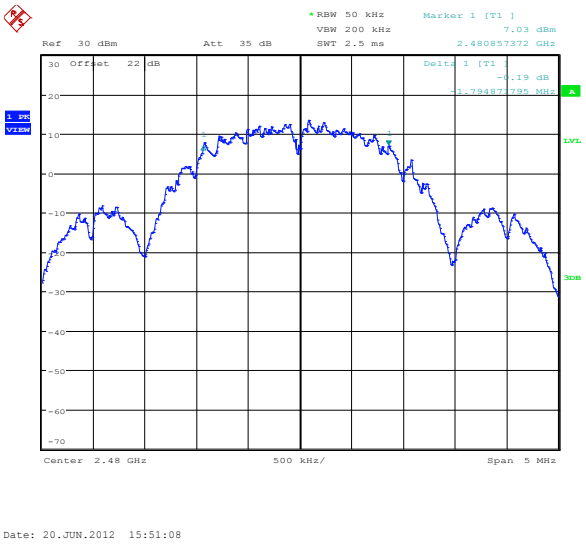
8.2.4 Test data



Plot 8.2-1: *6 dB bandwidth – Low channel*



Plot 8.2-2: *6 dB bandwidth – Mid channel*



Plot 8.2-3: *6 dB bandwidth – High channel*

Table 8.2-1: *6 dB bandwidth results*

Frequency (MHz)	6 dB bandwidth (MHz)	Minimum Limit (MHz)	Margin (MHz)
2405	1.826	0.5	1.326
2440	1.826	0.5	1.326
2480	1.794	0.5	1.294

8.3 RSS-Gen Clause 4.6.1 Occupied bandwidth

8.3.1 Definitions and limits

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.

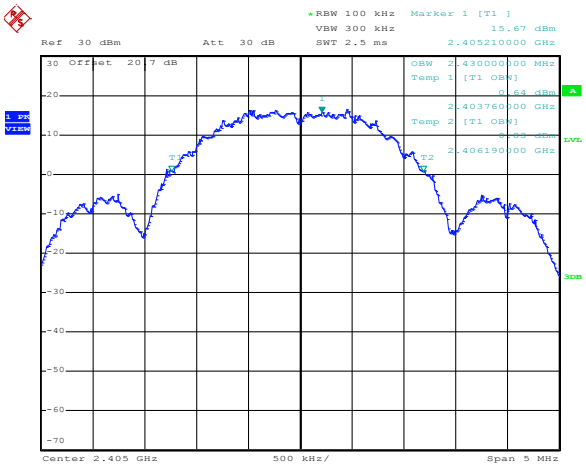
8.3.2 Test summary

Test date	April 24, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1002 mbar	**Relative humidity**	32 %

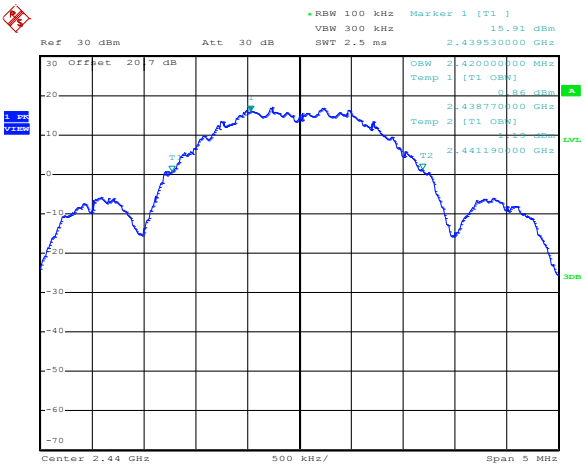
8.3.3 Observations/special notes

Measurements were performed with peak detector using RBW = 1–5 % of EBW. VBW was set wider than RBW.

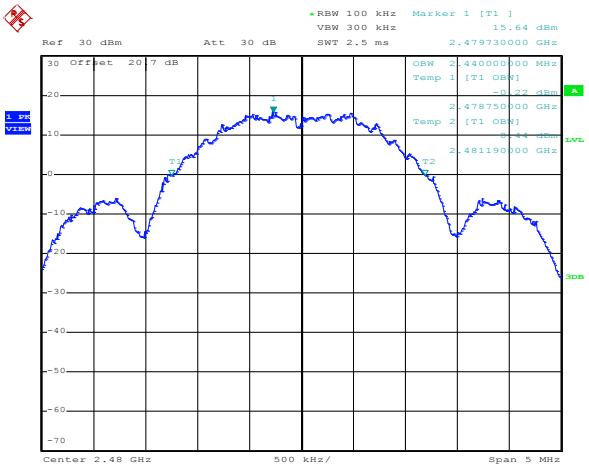
8.3.4 Test data



Plot 8.3-1: *99 % bandwidth – Low channel*



Plot 8.3-2: *99 % bandwidth – Mid channel*



Plot 8.3-3: *99 % bandwidth – High channel*

Table 8.3-1: *99 % bandwidth results*

Frequency (MHz)	99 % bandwidth (MHz)
2405	2.43
2440	2.42
2480	2.44

8.4 FCC Clause 15.247(b) and RSS-210 Clause A8.4 (2) Transmitter output power and e.i.r.p. requirements

8.4.1 Definitions and limits

FCC:

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

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Fixed, point-to-point operation, as used in paragraphs (b)(4)(i) and (b)(4)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

IC:

With the digital modulation operation of the hybrid system turned off, the frequency hopping operation shall have an average time of occupancy on any frequency not exceeding 0.4 seconds within a duration in seconds equal to the number of hopping frequencies multiplied by 0.4.

8.4.2 Test summary

Test date	April 24, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1002 mbar	**Relative humidity**	32 %

8.4.3 Observations/special notes

Measurement Procedure PK1:

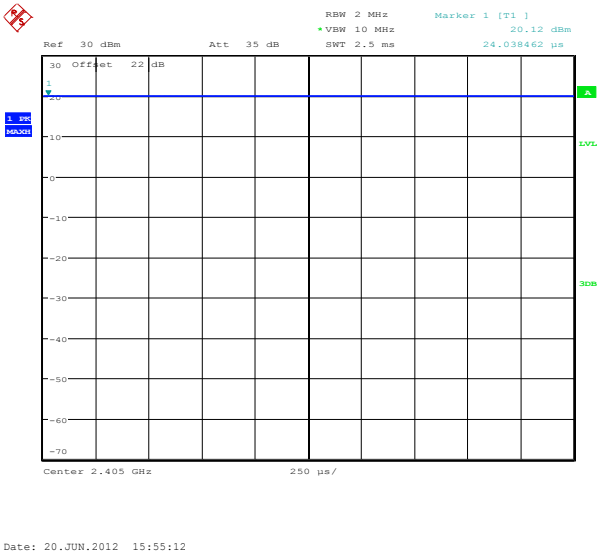
1. This procedure requires availability of a spectrum analyzer resolution bandwidth that is ≥ EBW.
2. Set the RBW ≥ EBW.
3. Set VBW ≥ 3 × RBW.
4. Set span = zero.
5. Sweep time = auto couple.
6. Detector = peak.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use peak marker function to determine the peak amplitude level within the fundamental emission.

The Power was reduced on the High channel (2480 MHz) to Pass the band edge measurements.
2475 MHz was tested at full power.

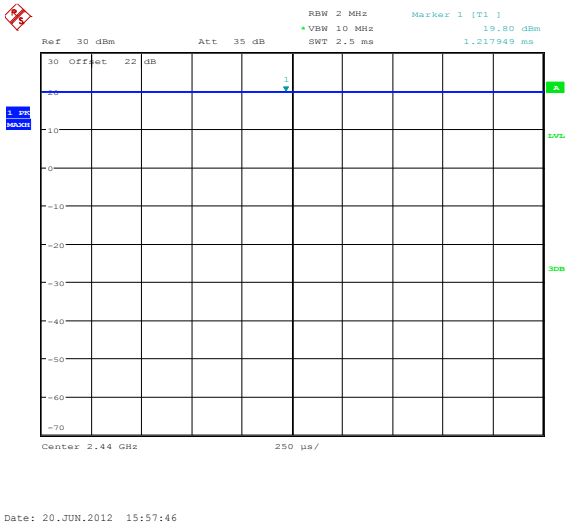
8.4.4 Test data

Table 8.4-1: *Conducted output power and EIRP results*

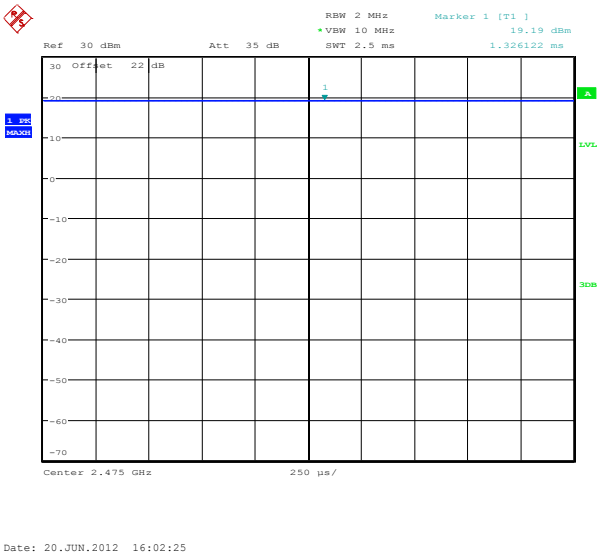
Frequency (MHz)	Conducted output power (dBm)	Output power limit (dBm)	Margin (dB)	Antenna gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
2405	20.12	30.0	9.88	1.5	21.62	36.0	14.38
2440	19.80	30.0	10.20	1.5	21.30	36.0	14.70
2475	19.19	30.0	10.81	1.5	20.69	36.0	15.31
2480	1.57	30.0	28.43	1.5	3.07	36.0	32.93



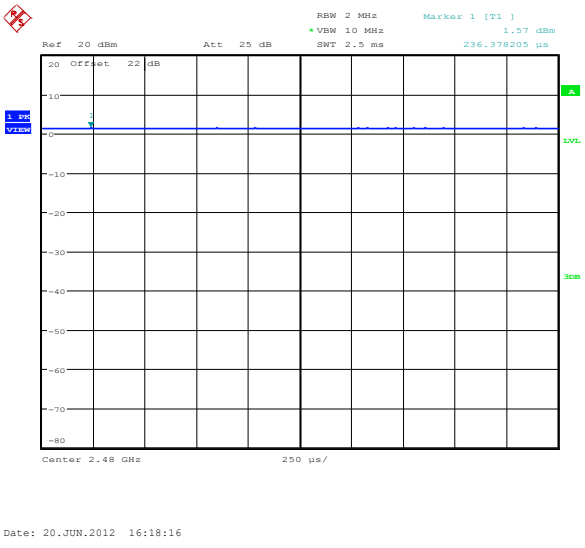
Plot 8.4-1: *Peak output power on low channel*



Plot 8.4-2: *Peak output power on mid channel*



Plot 8.4-3: *Peak output power on high channel*



Plot 8.4-4: *Peak output power on high channel*

8.5 FCC Clause 15.247(d) and RSS-210 Clause A8.5 Spurious (out-of-band) emissions

8.5.1 Definitions and limits

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 Tables 2 and 3 is not required.

8.5.2 Test summary

Test date	April 24, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1002 mbar	**Relative humidity**	32 %

8.5.3 Observations/special notes

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
*– applicable only to FCC requirements			

8.5.4 Test data

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			

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

Note: Certain frequency bands listed in table above 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

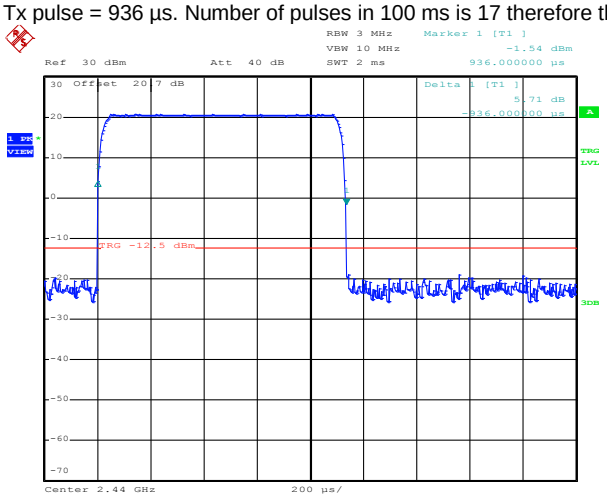
8.5.4 Test data

Duty cycle/average factor calculations

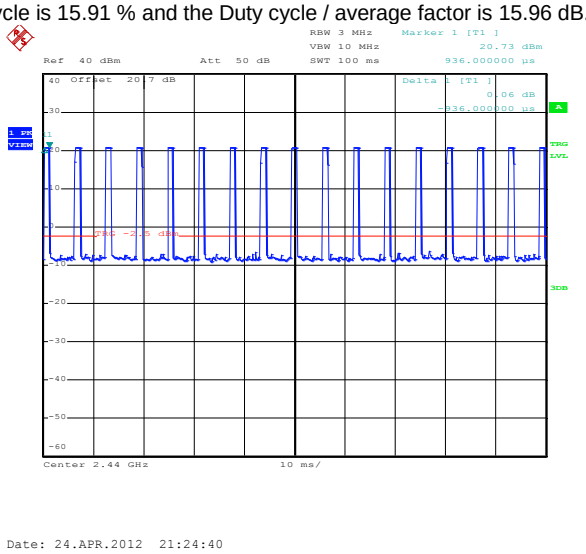
When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed; the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

$$Duty\,cycle\,/\,average\,factor = 20 \times \log_{10}\left(\frac{Tx_{100\,ms}}{100\,ms}\right)$$

Tx pulse = 936 µs. Number of pulses in 100 ms is 17 therefore the Duty Cycle is 15.91 % and the Duty cycle / average factor is 15.96 dB.



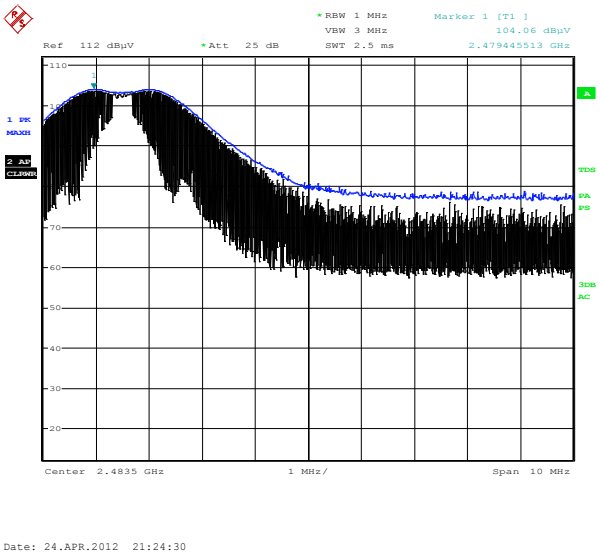
Plot 8.5-1: *Duty Cycle (pulse width)*

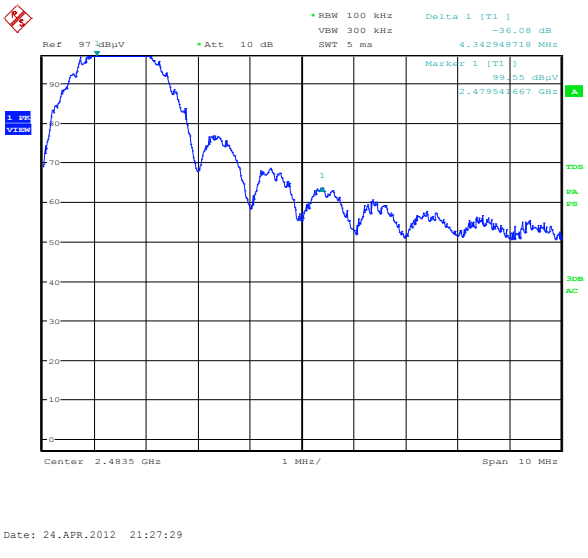


Plot 8.5-2: *Duty Cycle (Number of pulses)*

8.5.4 Test data, continued

Marker-delta measurement for 2.4835 GHz Band Edge



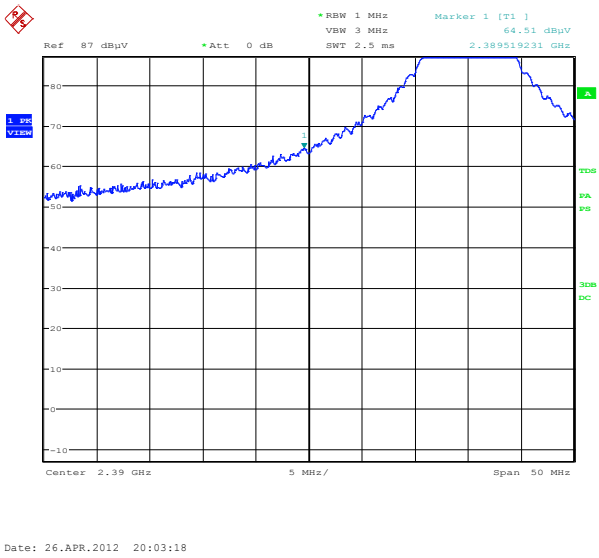


Plot 8.5-3: *Upper band edge 1 MHz RBW, 3 MHz VBW*

Plot 8.5-4: *Upper band edge 100 kHz RBW, 300 kHz VBW*

Measured field strength for high channel in 1 MHz/3 MHz RBW/VBW = 104.06 dBµV/m
Delta marker = 36.08 dB

Therefore, Peak Field Strength = 104.06 dBµV/m − 36.08 dB (Delta marker) = 67.98 dBµV/m
Limit = 74 dBµV/m
Average Field Strength = 67.98 dBµV/m − 15.96 dB (Duty cycle correction factor) = 52.02 dBµV/m
Limit = 54 dBµV/m

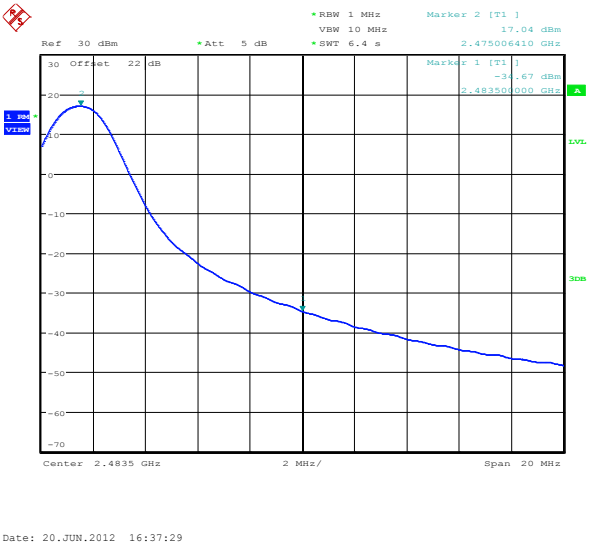


Plot 8.5-5: *Lower band edge 1 MHz RBW, 3 MHz VBW*

Note: Lower band edge Average compliance is: Peak + duty cycle correction factor.

Average field strength calculation: 64.5 + (−15.96) = 48.55 dBµV/m

8.5.4 Test data, continued



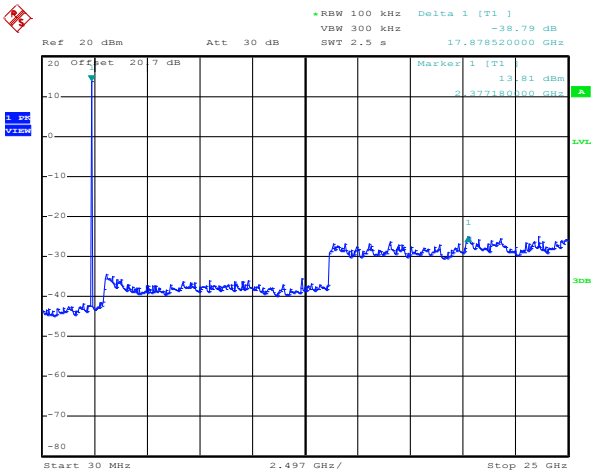
Plot 8.5-6: *Conducted upper bad edge for 2475 MHz channel, 1 MHz RBW, 10 MHz VBW*

Table 8.5-4: *Band edge measurement*

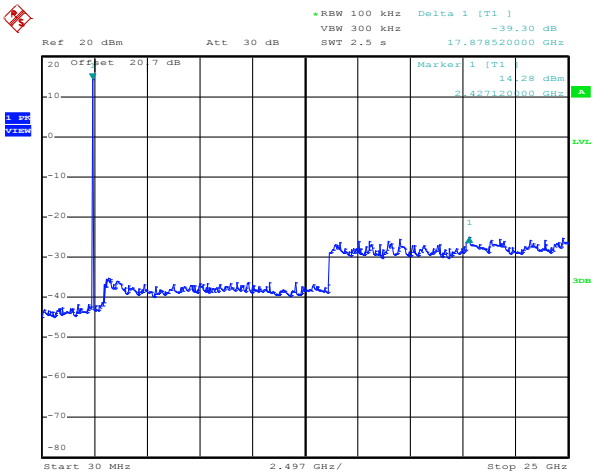
Frequency, MHz	Conducted Peak, dBm	Antenna gain*, dBi	Peak EIRP, dBm	Peak EIRP limit, dBm	Margin, dB	Average factor, dB	Average EIRP, dBm	Average EIRP limit, dBm	Margin, dB
2475	-34.67	2.00	-32.67	-21.23	11.44	-15.96	-48.63	-41.23	7.40

Note: As per 558074 D01DTS Meas Guidelines V01, minimum antenna gain for conducted measurements is 2 dBi.

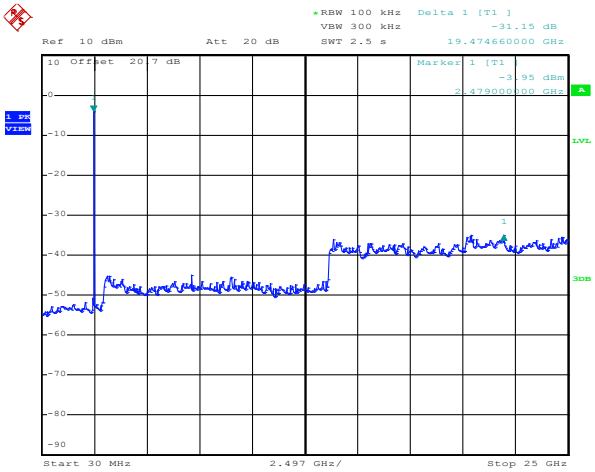
8.5.4 Test data, continued



Plot 8.5-7: *Conducted spurious emissions on low channel*



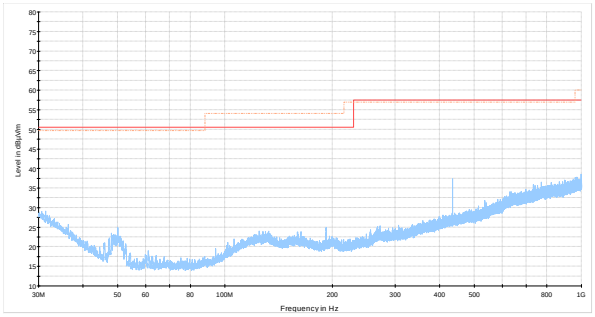
Plot 8.5-8: *Conducted spurious emissions on mid channel*



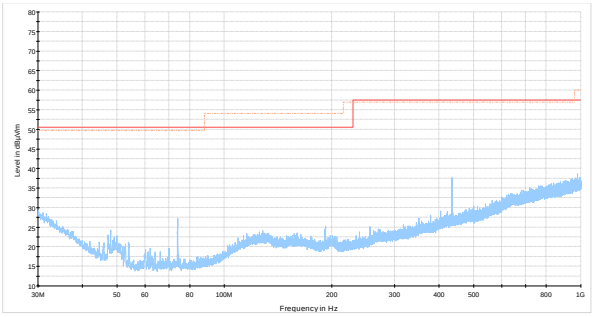
Plot 8.5-9: *Conducted spurious emissions on high channel*

Note: The trace was on Max Hold and then placed in View to take to image

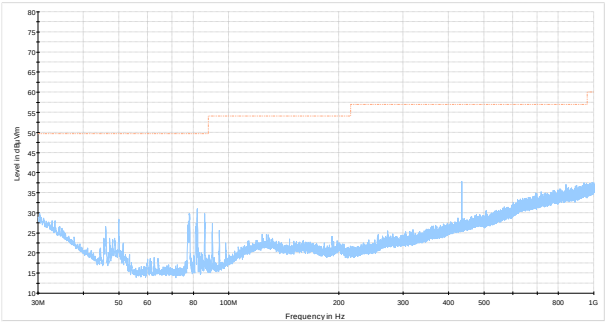
8.5.5 Test data, continued



Plot 8.5-10: *Radiated spurious emissions on low channel*

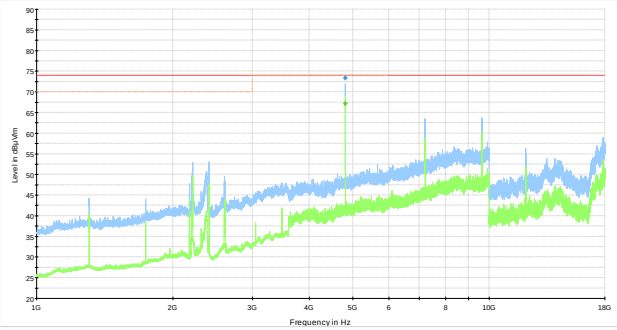


Plot 8.5-11: *Radiated spurious emissions on mid channel*

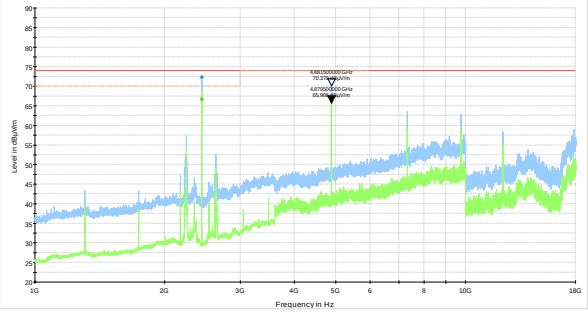


Plot 8.5-12: *Radiated spurious emissions on high channel*

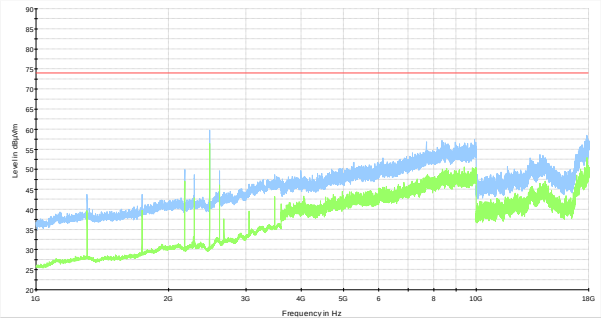
8.5.4 Test data, continued



Plot 8.5-13: *Radiated spurious emissions on low channel*



Plot 8.5-14: *Radiated spurious emissions on mid channel*



Plot 8.5-15: *Radiated spurious emissions on high channel*

- All measurements were performed at a distance of 3 m.
- All measurements performed:
  - within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
  - and using peak detector with 1 MHz/ 10 Hz RBW/VBW for average results as per ANSI C63.10, section 4.2.3.2.3
  - Transmit output power was measured while supply voltage was varied from 102 V_{AC} to 138 V_{AC} (85 % to 115 % of the nominal rated supply voltage). No change in transmit output power was observed.

Note: The EUT was Transmitting at 100%.

Table 8.5-5: *Radiated spurious emissions results*

Frequency (MHz)	Peak/Average	Reading (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Reading (dBµV/m)	Limit (dBm)	Margin (dB)
4808	Peak	71.30	N/A	71.30	74.00	2.70
	Average	65.00	−15.96	49.04	54.00	4.96
4888	Peak	70.37	N/A	70.37	74.00	3.63
	Average	65.97	−15.96	50.01	54.00	3.99

8.6 FCC Clause 15.247(e) and RSS-210 Clause A8.2(b) Power spectral density for digitally modulated devices

8.6.1 Definitions and limits

FCC Clause 15.247(e) and RSS-210 Clause A8.2(b) Power spectral density for digitally modulated devices

FCC:
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

IC:
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration. This power spectral density shall be determined in accordance with the provisions of Section A8.4(4); (i.e. the power spectral density shall be determined using the same method for determining the conducted output power).

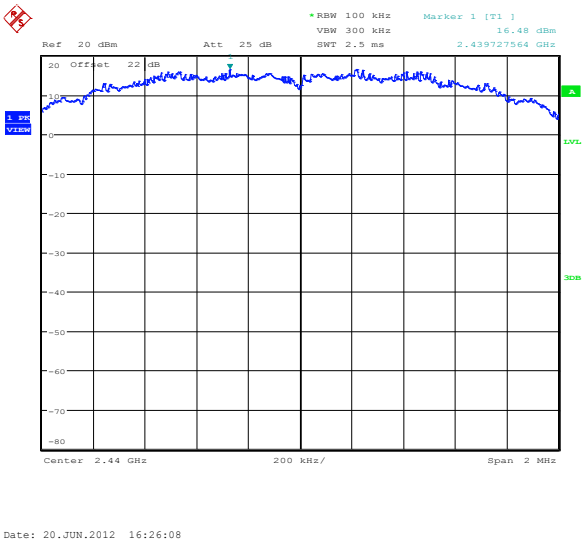
8.6.2 Test summary

Test date	April 24, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1002 mbar	**Relative humidity**	32 %

8.6.3 Observations/special notes

The test was performed using Peak detector with 100 kHz RBW.

8.6.4 Test data



Sample plot 8.6-1: *Power spectral density*

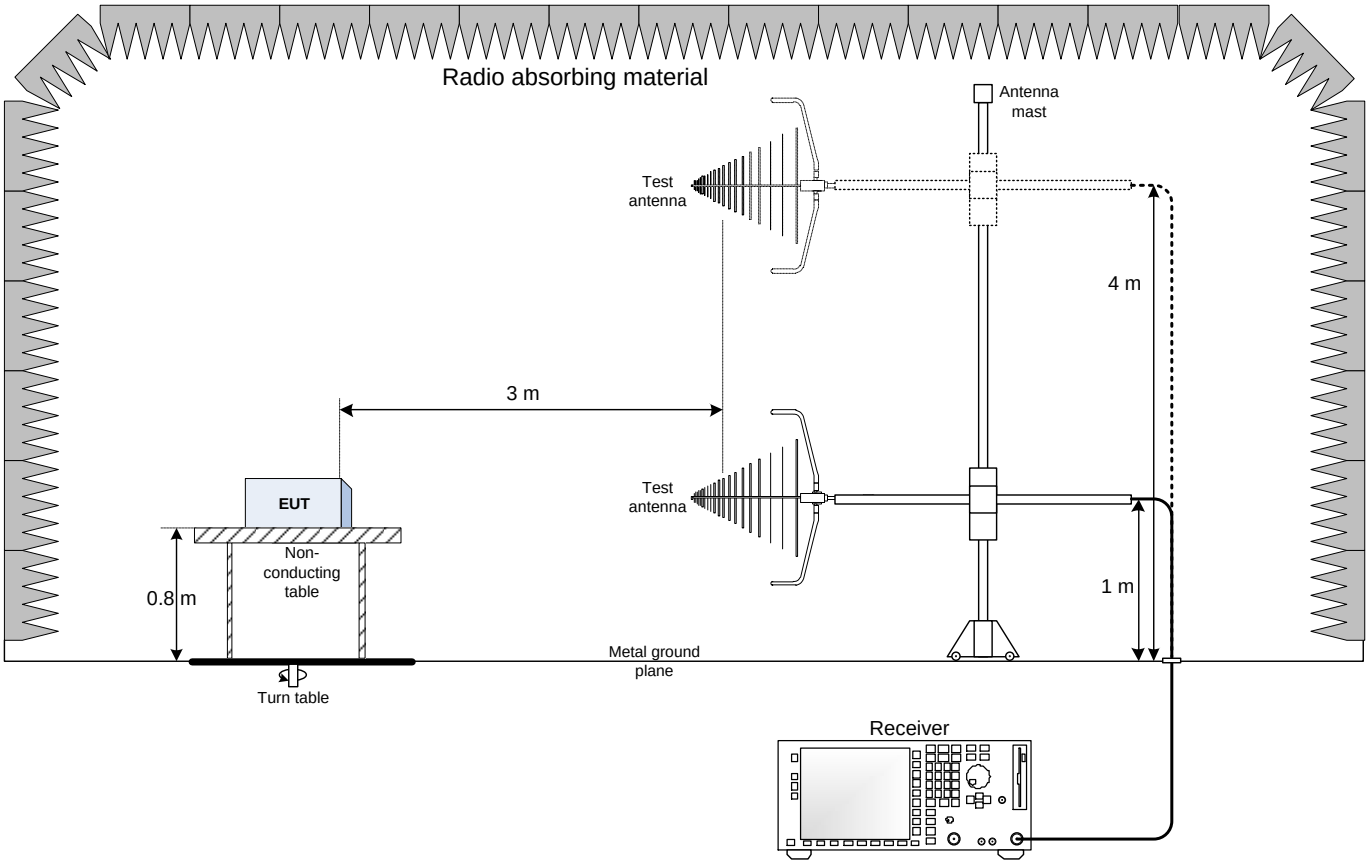
Table 8.6-1: *PSD results*

Frequency (MHz)	PSD (dBm/100 kHz)	BW correction factor	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
2405	16.20	-15.2	1.00	8.0	7.00
2440	16.48	-15.2	1.28	8.0	6.72
2480	-2.13	-15.2	-17.33	8.0	25.33
BW correction factor = $10 \times \log_{10}(3\ \text{kHz}/100\ \text{kHz}) = -15.2$ dB					

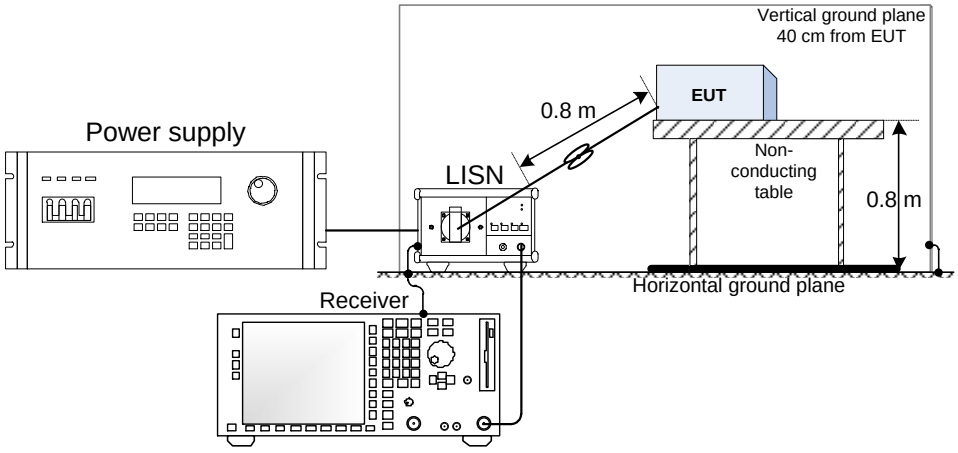
Note: The trace was on Max Hold and then placed in View to take to image

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up

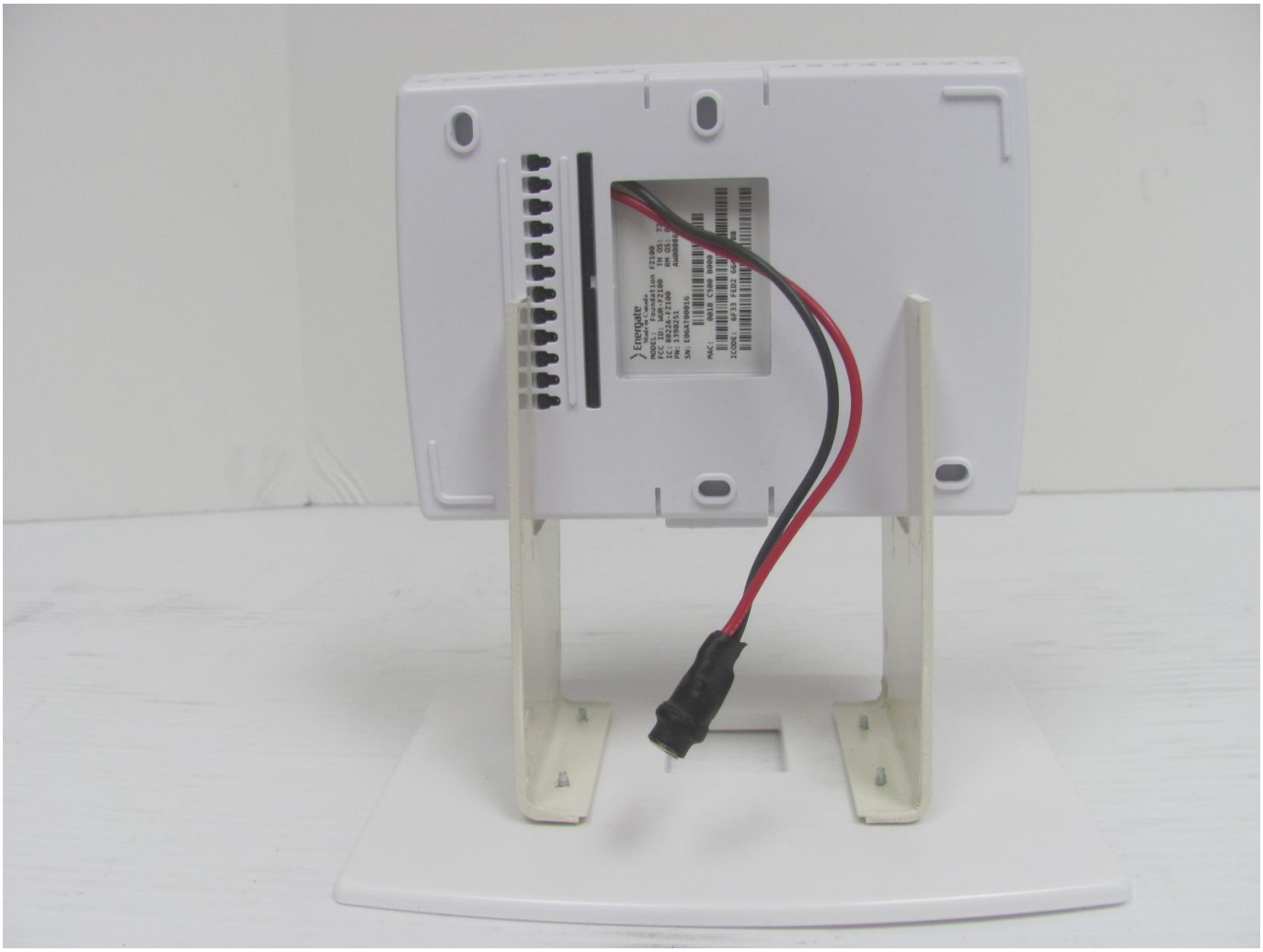


Section 10 EUT photos

10.1 External photos

10.1.1 EUT front view

10.1.2 EUT rear view



10.1.3 EUT top view

10.1.4 EUT bottom view