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Compliance test report ID **218524-1TRFWL**

Date of issue
January 9, 2013

FCC 47 CFR Part 15 Subpart C, §15.249

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz and 24.0–24.25 GHz

RSS-210, Issue 8 Annex 2.9

Devices Operating in bands 902–928, 2400–2483.5 and 5725–5875 MHz for any application

Applicant	Novyc International Inc.
Product	RF radio Module
Model	RFD21735
FCC ID	RG5 NOVYC1
IC Reg#	10781A-NOVYC1

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
Canada
Test site FCC ID: 176392 (3 m semi anechoic chamber)

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Tested by Kevin Rose, Wireless/EMC Specialist

Reviewed by 

Andrey Adelberg, Senior Wireless/EMC Specialist

January 9, 2013

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

Table of Contents

Section 1 Report summary

1.1 Applicant

Novyc International Inc.
2298, Chemin St-Francois
Dorval Quebec
Canada H9P 1K2

1.2 Manufacturer

RF Digital Corporation
13715 Alton Pkwy
Irvine, CA 92618

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C, Chapter 15.249

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz and 24.0–24.25 GHz

RSS-210, Issue 8 Annex 2.9

Bands 902–928, 2400–2483.5 and 5725–5875 MHz

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.

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
§15.215(c)	20 dB bandwidth	Pass
Notes: None		

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

Part	Test description	Verdict
§15.249(a)	Radiated emissions not in restricted bands	Pass
§15.249(d)	Spurious emissions (except harmonics)	Pass
Notes: None		

2.3 IC RSS-GEN, Issue 3, test results

Part	Test description	Verdict
§4.6.1	Occupied bandwidth	Pass
§7.2.4	AC power lines conducted emission limits	Pass
Notes: None		

2.4 RSS-210, Issue 8, test results

Part	Test description	Verdict
§A2.9a	Radiated emissions not in restricted bands	Pass
§A2.9b	Spurious emissions (except harmonics)	Pass
Notes: None		

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	October 15, 2012
Nemko sample ID number	1

3.2 EUT information

Product name	RF radio module
Model	RFD21735
Part number	RFD21735

3.3 Technical information

Operating band	2400–2483.5 MHz
Operating frequency	2402–2481 MHz
Modulation type	GFSK
Occupied bandwidth	573 kHz
Emission designator	573KF1D
Power requirements	1.9–3.6 Vdc, 17 mA (AC/DC power cube 120 Vac 60 Hz)
Antenna information	TRF1002 5 dBi, Microchip Technology The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

Remote controller to change the price on signs.

3.5 EUT exercise details

Test software was used to control the channels

3.6 EUT setup diagram

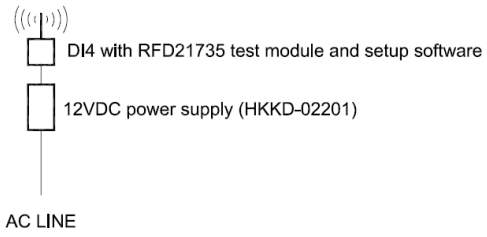


Diagram 3.6-1: Setup diagram

3.7 EUT sub assemblies

Description	Brand name	Model/Part number	Serial number	Rev.
Battery charger	Hon Kwang	HKKD-02201	-	-

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
50 coax cable	Huber + Suhner	NONE	FA002392	1 year	June. 27/13
50 coax cable	Huber + Suhner	NONE	FA002074	1 year	Aug. 23/13
1–18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	July 03/13
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	May 16/13
Bilog antenna	Sunol	JB3	FA002108	1 year	Feb. 07/13
Horn antenna #2	EMCO	3115	FA000825	1 year	Feb. 24/13
Horn antenna 18–26.5 GHz	Electro-metrics	SH-50/60-1	FA000479	—	VOU
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 15.207(a) and RSS-Gen 7.2.4 Conducted limits

8.1.1 Definitions and limits

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.

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	October 15, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1001 mbar	**Relative humidity**	26 %

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.

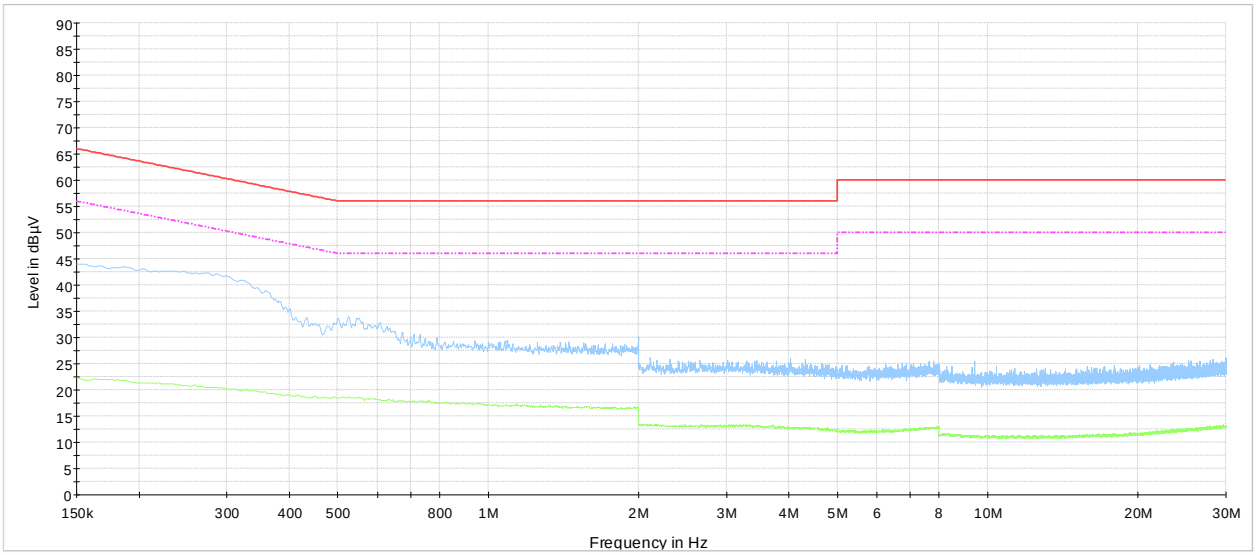
Receiver/spectrum analyzer settings

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

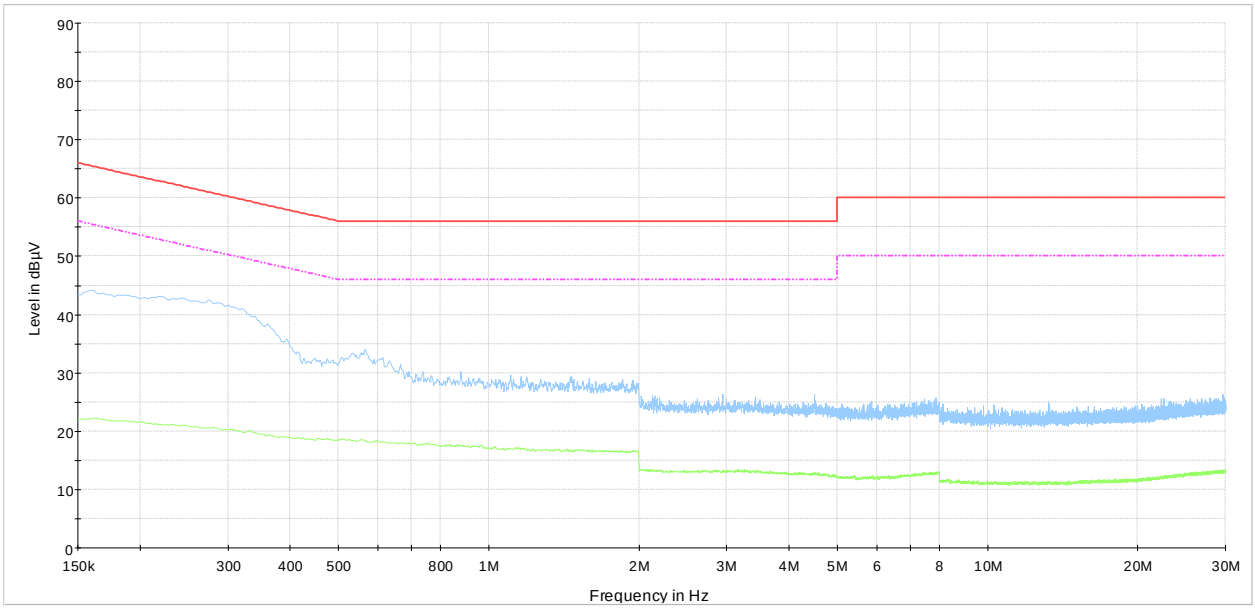
Measurement details

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



Plot 8.1-2: Conducted emissions on neutral line

8.2 FCC 15.215(c) Emission bandwidth and RSS-Gen 4.6.1 Occupied bandwidth

8.2.1 Definitions and limits

FCC Part 15.215(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

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.

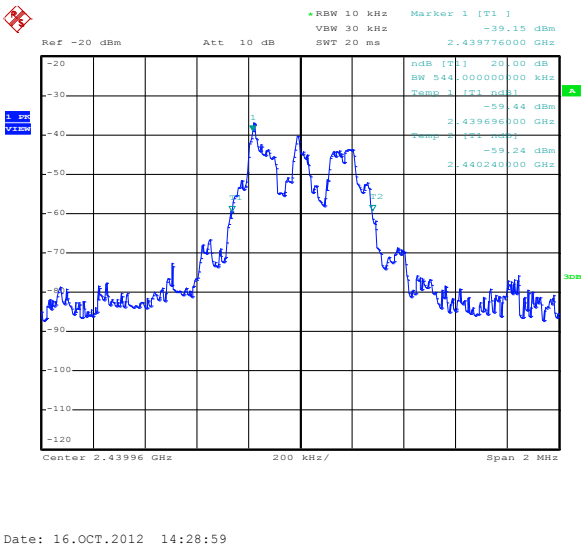
8.2.2 Test summary

Test date	October 16, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1002 mbar	**Relative humidity**	24 %

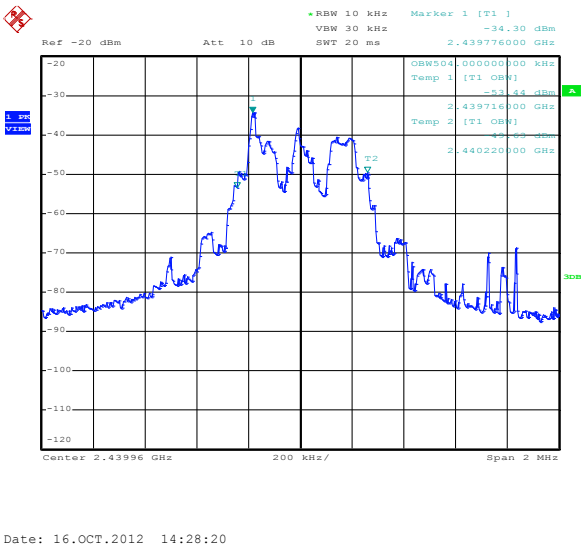
8.2.3 Observations/special notes

None

8.2.4 Test data



Plot 8.2-1: 20 dB bandwidth Example



Plot 8.2-2: 99 % bandwidth Example

Table 8.2-1: 20 dB BW results

Frequency (MHz)	20 dB bandwidth (kHz)
2401	573
2440	544
2481	548

Table 8.2-2: 99 % occupied BW results

Frequency (MHz)	99 % bandwidth (kHz)
2401	513
2440	504
2481	636

8.3 FCC 15.249(a) and RSS 210 A2.9(a) Field strength of emissions not in restricted bands

8.3.1 Definitions and limits

In addition to the provisions of §15.205 and RSS Gen the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Table 8.3-1: Field strength limits

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	(dBµV/m)	Field strength of spurious emissions (µV/m)	(dBµV/m)
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24.0–24.25	250	108	2500	68

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter (128 dBµV/m) at 3 meters along the antenna azimuth.

8.3.2 Test summary

Test date	October 15, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1001 mbar	**Relative humidity**	26 %

8.3.3 Observations/special notes

Table 8.3-2: §15.209 RSS Gen 7.2.5 – Radiated emission limits

Frequency (MHz)	Field strength (µV/m)	(dBµV/m)	Measurement distance (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

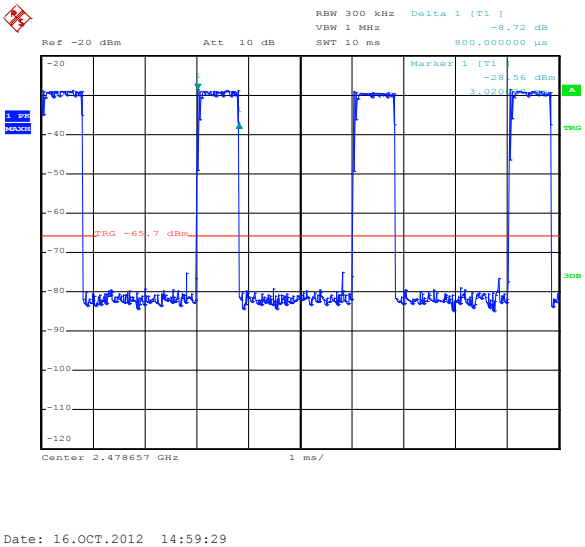
- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
- within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
- above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
- and using a duty cycle/average factor for average results calculations.
- Transmit output power was measured while supply voltage was varied from 102 VAC to 138 VAC (85 % to 115 % of the nominal rated supply voltage). No change in transmit output power was observed.

8.3.4 Test data

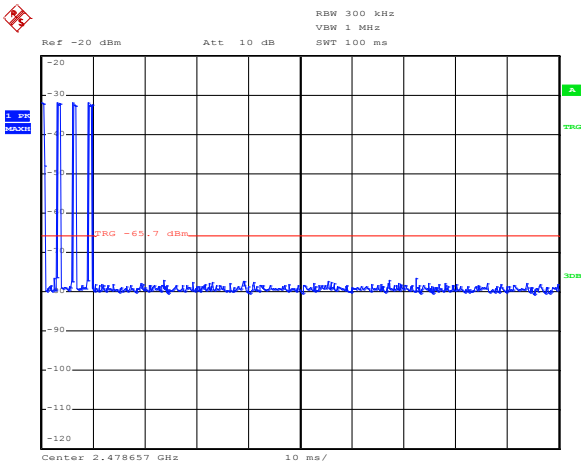
Duty cycle/average factor calculations

§15.35(c) 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.

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



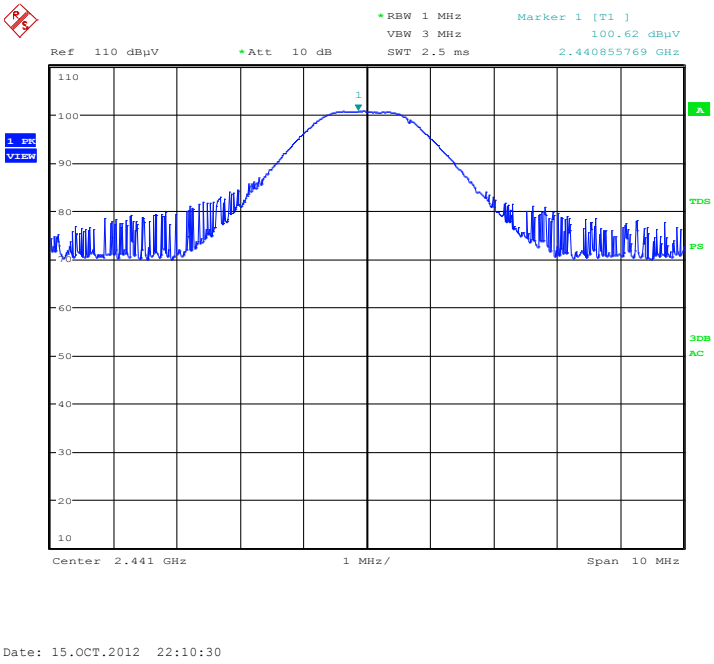
Plot 8.3-1: Pulse width 800 µs



Plot 8.3-2: Number of pulses in 100 ms

Note: 800 µs pulse width × 4 pulses within 100 ms = 20 × Log_{10} (3.2 ÷ 100) = 29.9 dB duty cycle correction.

8.3.4 Test data, continued



Plot 8.3-3: Peak power plot example

The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators) for determination of compliance. Limits have been adjusted to reflect 3 m requirements.

A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and antenna adjusted to maximize radiated emission. 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.

Table 8.3-3: Field strength measurement results

Frequency (MHz)	Polarization V/H	Peak Field strength (dBµV/m)	Peak limit (dBµV/m)	Margin (dB)	Duty cycle factor (dB)	Avg Field strength (dBµV/m)	Avg. limit (dBµV/m)	Margin (dB)
Fundamental								
2401	V	99.61	114	14.39	29.9	69.71	94	24.29
2440	V	100.62	114	13.38	29.9	70.72	94	23.28
2481	V	101.13	114	12.87	29.9	71.23	94	22.77
Harmonics								
4802	V	56.78	74	17.22	29.9	26.88	54	27.12
4880	V	51.75	74	22.25	29.9	21.85	54	32.15
4962	V	53.38	74	20.62	29.9	23.48	54	30.52

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Avg Field strength = Peak Field strength - Duty cycle factor

8.4 FCC 15.249(d) and RSS-210 A2.9(b) Spurious emissions (except for harmonics)

8.4.1 Definitions and limits

FCC 15.249(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

RSS 210 A2.9 (b).Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

Table 8.4-1: Field strength limits

Frequency (MHz)	Field strength (μV/m)	(dBμV/m)	Measurement distance (m)
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:
- F = fundamental frequency in kHz
- In the emission table above, the tighter limit applies at the band edges.
- For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

8.4.2 Test summary

Test date	October 15, 2012	**Test engineer**	Kevin Rose	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1001 mbar	**Relative humidity**	26 %

8.4.3 Observations/special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were 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 a duty cycle/average factor for average results calculations.
- Transmit output power was measured while supply voltage was varied from 102 VAC to 138 VAC (85 % to 115 % of the nominal rated supply voltage). No change in transmit output power was observed.
- Marker delta was used to perform the upper band edge measurement

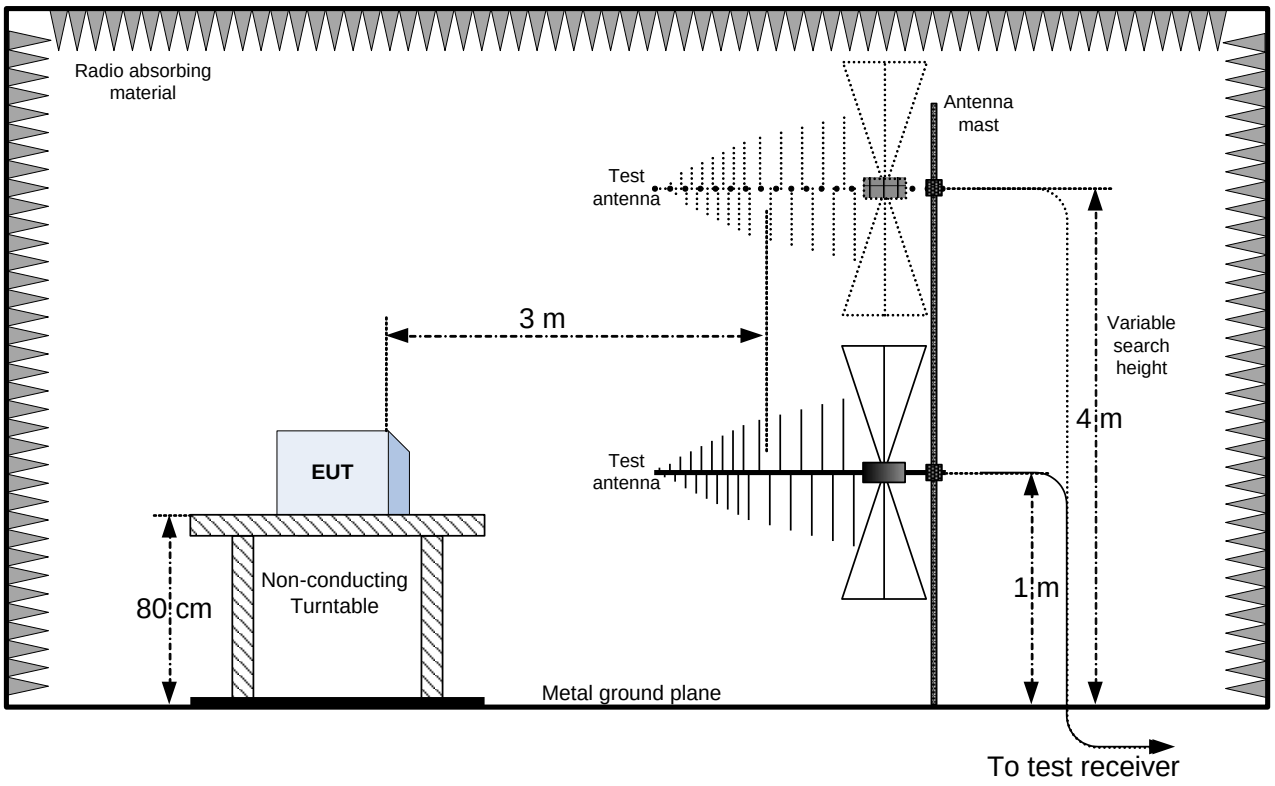
8.4.4 Test data

Table 8.4-2: Band edge results

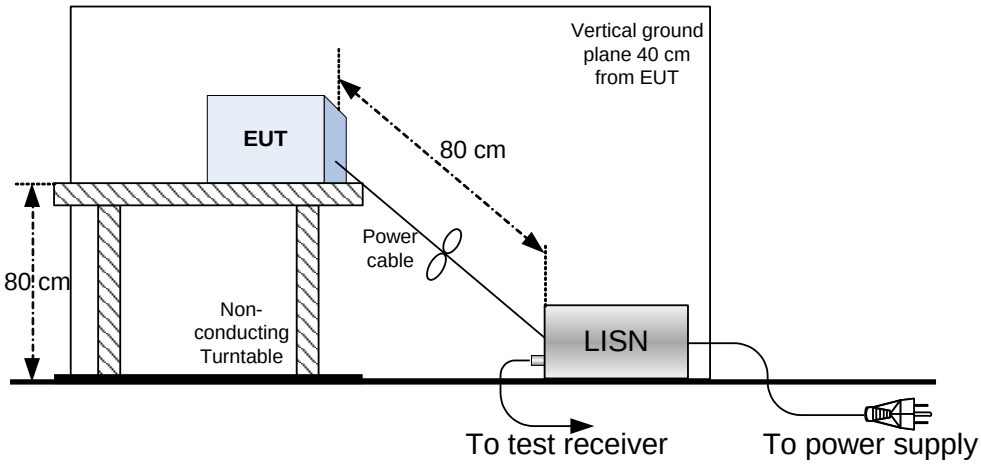
Frequency (MHz)	Polarization V/H	Peak Field strength (dBμV/m)	Peak limit (dBμV/m)	Margin (dB)	Duty cycle factor (dB)	Avg Field strength (dBμV/m)	Avg. limit (dBμV/m)	Margin (dB)
2390.0	V	42.56	74	31.44	29.9	12.66	54	41.34
2483.5	V	67.95	74	6.05	29.9	38.05	54	15.95
Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable. Average Field strength = Peak Field strength − Duty cycle factor								

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



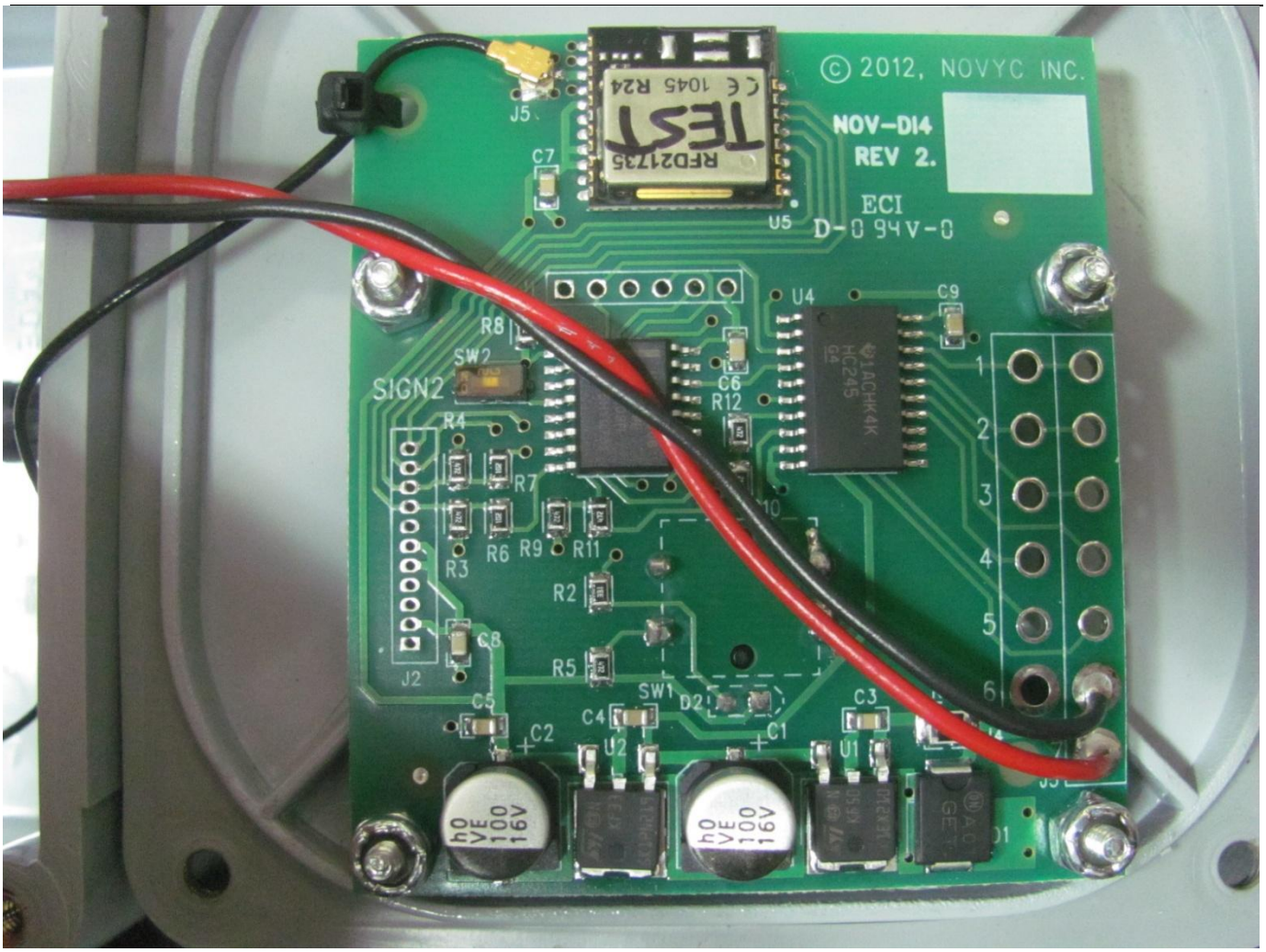
9.2 Conducted emissions set-up



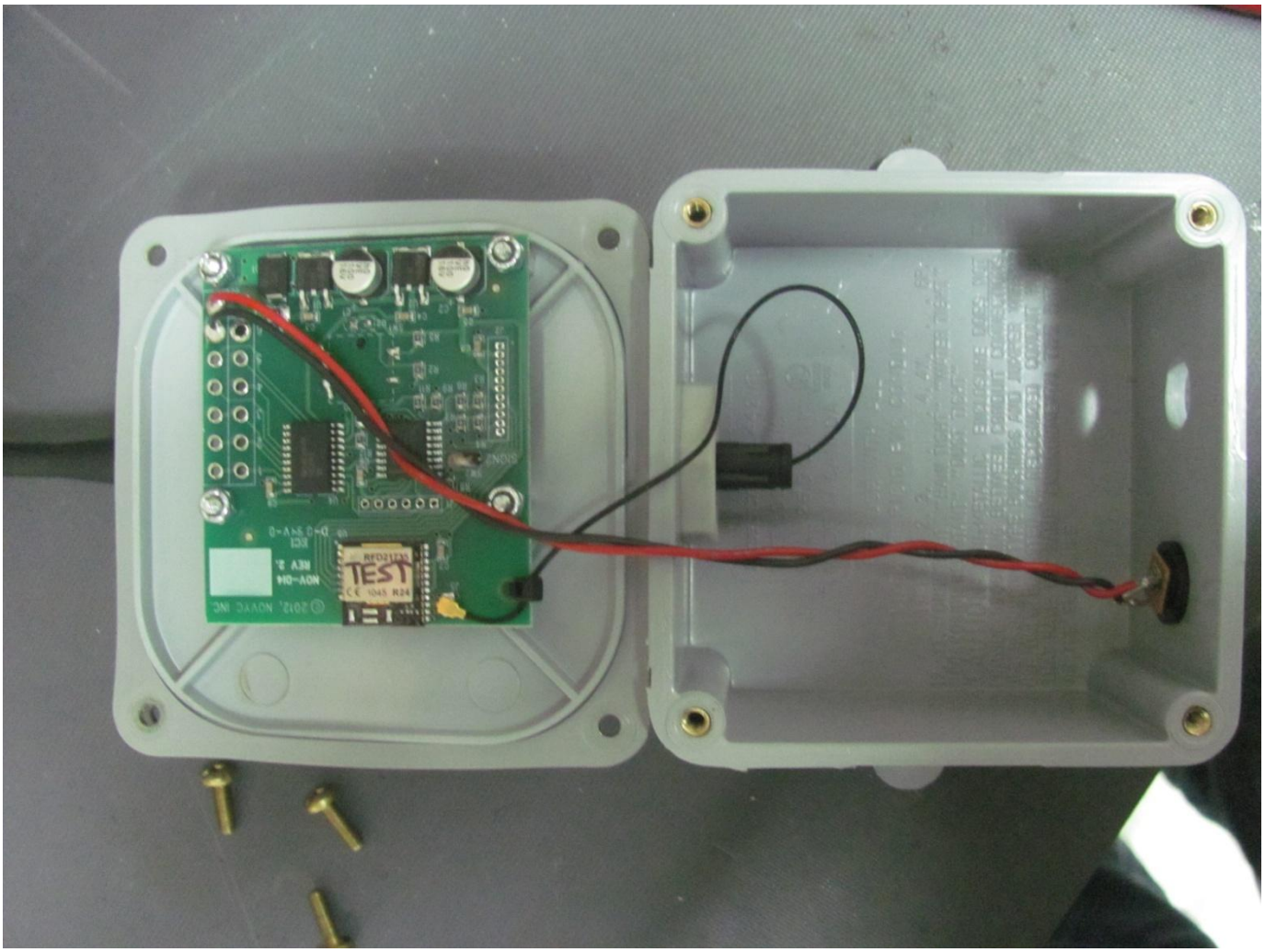
Section 10 EUT photos

10.1 External photos

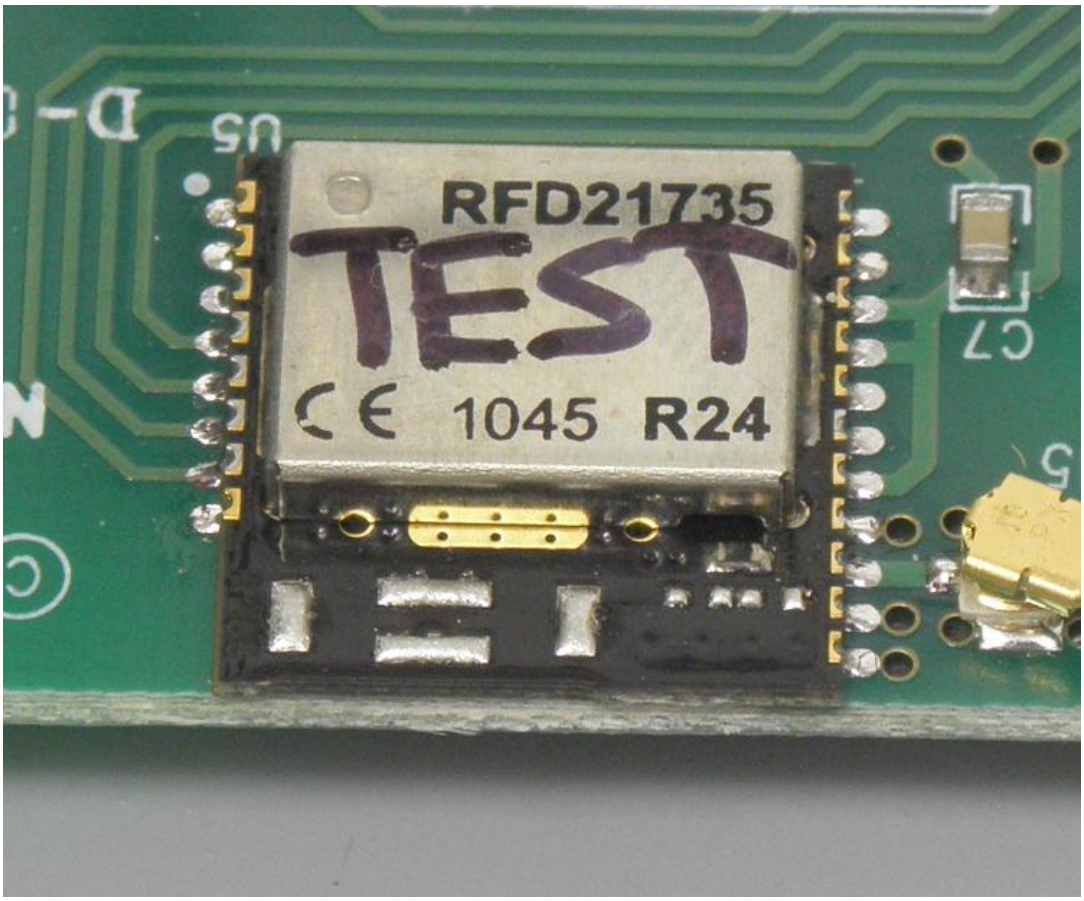
10.1.1 EUT front view



10.1.2 EUT rear view



10.1.3 EUT top view



10.1.4 EUT Host bottom view