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Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Report number: 160433-1TRFWL

Apparatus: RFID Reader

Applicant: Information Mediary Corp.
2259 Gladwin Crescent
Ottawa, Ontario, Canada
K1B 4K9

FCC ID: TTTDTR11

Test specification:

Title 47 - Telecommunication
Chapter I - Federal Communications Commission
Subchapter A - General
Part 15 - Radio Frequency Devices
Subpart C - Intentional Radiators

- **§15.225 – Operation within the band 13.110–14.010 MHz**

Reviewed by: _____ March 17, 2011
Signature Date
Andrey Adelberg, Senior Wireless/EMC Specialist

Tested by: Shawn He, Wireless/EMC Specialist

SCC Accredited LAB
LAB Accrédité CCN

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.

Table of contents

Section 1: Report summary

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc.

Test specification:
FCC Part 15 Subpart C, 15.225
Operation within the band 13.110–14.010 MHz.

Compliance status:	Complies
Exclusions:	None
Non-compliances:	None
Report release history:	Original release
Test location:	Nemko Canada Inc. 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2
Registration number:	176392 (3 m Semi anechoic chamber)

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.

Section 2: Equipment under test

2.1 Identification of equipment under test (EUT)

The following information identifies the EUT under test:

Type of equipment:	RFID Reader
Product marketing name:	DTR
Model number:	11
Serial number:	200138
Nemko sample number:	Item # 1
FCC ID:	TTTDTR11
Date of receipt:	November 9, 2010

2.2 Accessories and support equipment

The following information identifies accessories used to exercise the EUT during testing:

Item # 1	
Brand name:	Emerson Network Power
Model name or number:	DCH3-050US-004
Serial number:	None
Nemko sample number:	Item # 2
Connection port:	AC input, USB port
Cable length and type:	1.6 m USB cable

Section 2: Equipment under test, continued

2.3 EUT description

The reader is consisted of digital and analog circuits. Digital circuit has LED indicators, a buzzer, a debug module, USB port, a RTC and flash memory. Analog circuit has a RFID transceiver, a matching circuit and an antenna and RF power management.

Input and output interface
LEDs and buzzer are the output interface of the reader. They received signal from the MCU and than generate images, sound or light to interface with the user.

Peripherals
Flash memory is used to save the reader configuration and the bootloader data. RTC is used to keep the real time and date.

Communication interface
USB is used to obtain power from PC and to communicate with LOG-IC application with PC.
Debug is used for firmware development and programming in house only.

Power
Power management manages the USB power. It converts the input voltage to 3.3 voltages and provides voltage to digital and analog circuits.

RF
It consists of 4 sub-modules. They are the transceiver, the matching circuit, the antenna and the RF power control.

Transceiver
Transceiver is configured every time while the reader is start-up. It obtains the signal from transceiver control signal to set-up the transceiver to demodulate the signal from the antenna. It also provide IF signal input/output to the MCU so that MCU can send data to the tag though the antenna.

Matching circuit
Matching circuit is used to provide the impedance matched between the antenna and the transceiver in 50 Ohm. It is also used as a low pass filter to suppress the harmonics generated by the transceiver.

Antenna
Antenna is designed to have 50-Ohm impedance. The copper loop has inductance around 380 nH. However, the process of the components and PCB has tolerance of 20 %. Therefore, variable components are needed to obtain the optimal performance.
They two variable capacitors are used to obtain the optimal performance. One of them is C43 and is in the antenna module. By trimming C43, the impedance of the antenna and the resonant frequency will be changed. The other one is C52 and is in the matching circuit. By trimming C52, impedance of source will be changed. Both capacitors must be trimmed until maximum rate of communication is obtained

RF power
RF power control is used to control the radiate power from the antenna.

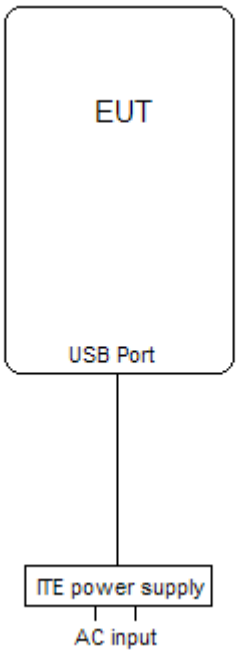
Section 2: Equipment under test, continued

2.4 Technical specifications of the EUT

Operating frequency:	13.56 MHz
Modulation type:	AM
Occupied bandwidth:	141.82 kHz
Antenna type:	Integral (Equipment does not have an external 50 Ω RF connector)
Power source	5 VDC or 120 VAC for ITE power supply

Section 2: Equipment under test, continued

2.5 EUT setup diagram



2.6 Operation of the EUT during testing

EUT transmits constantly when powered.

2.7 Modifications incorporated in the EUT

The following modifications were Performed by client
In order to comply with radiated emissions requirements, A Wurth Elektronik ferrite clamp (PN# 742 712 21 or PN# 742 712 21S) was installed on the USB cable with 2 loops

Section 3: Test conditions

3.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

3.2 Test conditions, power source and ambient temperatures

Normal temperature, humidity and air pressure test 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.
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 3: Test conditions, continued

3.3 Measurement uncertainty

Nemko Canada measurement uncertainty has been calculated using guidance of UKAS LAB 34:2003 and TIA-603-B Nov 7, 2002. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko Canada document MU-003.

3.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	Mar. 09/11
Flush mount turntable	Sunol	FM2022	FA002082	NCR
Controller	Sunol	SC104V	FA002060	NCR
Antenna mast	Sunol	TLT2	FA002061	NCR
International Power Supply	California Inst.	3001i	FA001021	COU
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Jan. 14/11
Bilog Antenna	Sunol	JB3	FA002108	Jan. 18/11
50 Coax cable	HUBER + SUHNER	None	FA002013	Sept. 01/11
50 Coax cable	HUBER + SUHNER	None	FA002074	July 13/11
50 Coax cable	HUBER + SUHNER	None	FA002015	Sept. 1/11
LISN	Tegam	95300-50	FA000986	Jan. 22/11
LISN	Tegam	95300-50	FA000987	Jan. 22/11
Temperature chamber	Thermotron	SM-16C	FA001030	NCR
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	May 17/11
Multimeter	Fluke	16	FA001831	Jan. 12/11
Active loop antenna	Emco	6502	FA001686	July 27/11

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

Section 4: Result summary

4.1 FCC Part 15 Subpart C: Test results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N	No : not applicable / not relevant.
Y	Yes : Mandatory i.e. the apparatus shall conform to these tests.
N/T	Not Tested, mandatory but not assessed. (See report summary)

Part	Test description	Required	Result
§15.207(a)	Conducted limits	Y	Pass
§15.215(c)	20 dB bandwidth	Y	Pass
§15.225(a)	Field strength in the 13.553–13.567 MHz band	Y	Pass
§15.225(b)	Field strength in the 13.410–13.553 MHz and 13.567–13.710 MHz band	Y	Pass
§15.225(c)	Field strength in the 13.110–13.410 MHz and 13.710–14.010 MHz band	Y	Pass
§15.225(d)	Field strength of any emissions appearing outside of the 13.110–14.010 MHz band	Y	Pass
§15.225(e)	Frequency tolerance of the carrier signal	Y	Pass
§15.225(f)	Radio frequency powered tags	N	N

Notes: None

Appendix A: Test results

Clause 15.207(a) Conducted limits

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.

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.		

Special notes

Port under test: AC input of ITE power supply

Preview measurements:
0.15 MHz to 30 MHz
Receiver settings:
– Peak and average detector
– 9 kHz RBW

Final measurement:
0.15 MHz to 30 MHz
Receiver settings:
– Q-Peak and average detector
– 9 kHz RBW

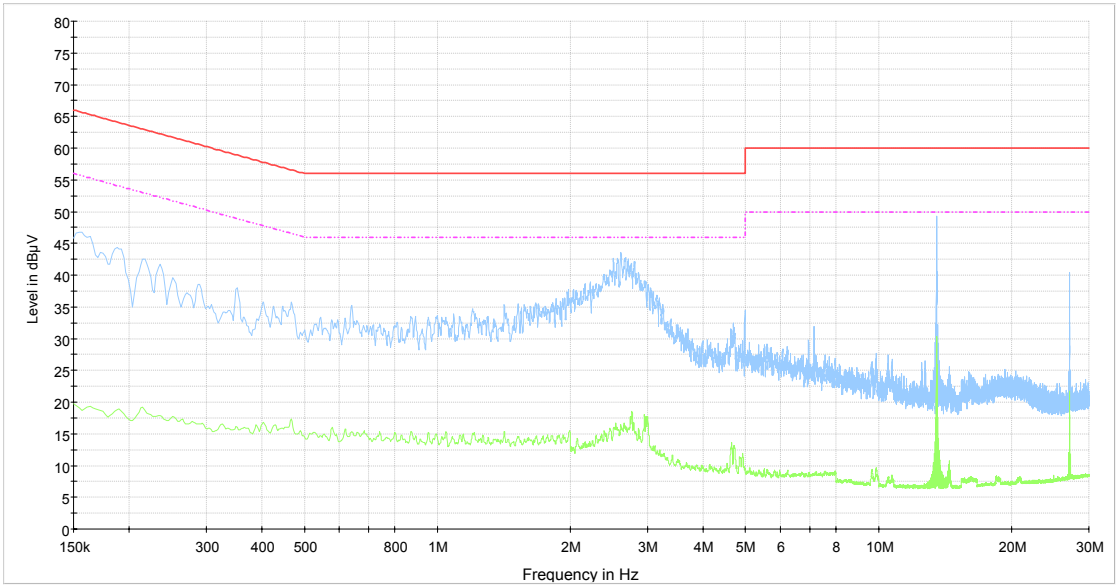
- Spectral plots have been corrected for transducer factors; cable loss, LISN, and attenuators.
- Emissions detected within 6 dB of limit were re-measured with a quasi peak or average detector for a final measurement.

Test date: November 9, 2010

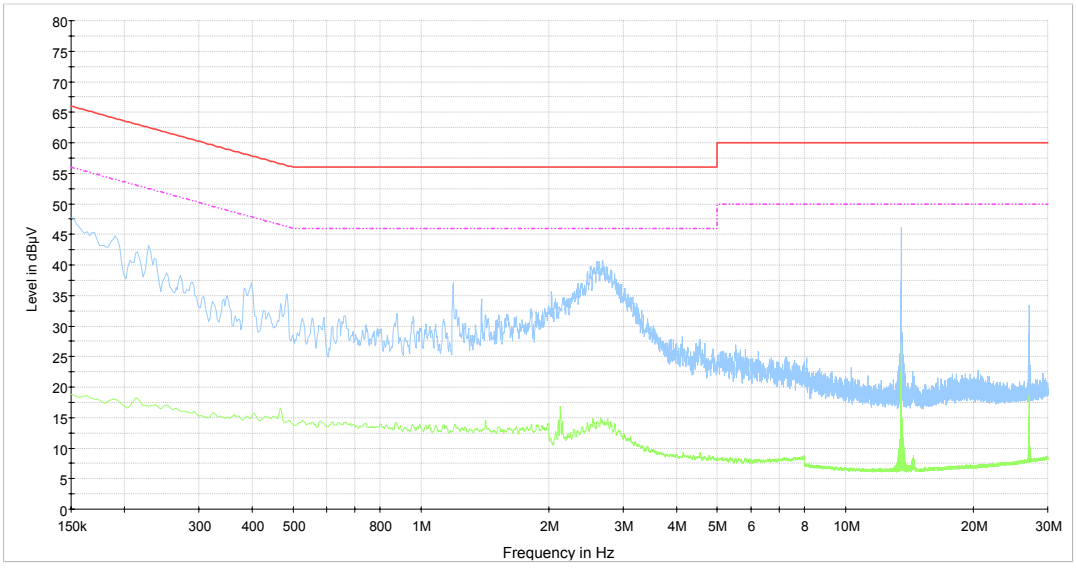
Test results: Pass

Clause 15.207(a) Conducted limits, continued

Test plots



120VAC 60Hz Phase Line
CISPR 22 Mains QP Class B Limit
CISPR 22 Mains AV Class B Limit
Preview Peak Detector
Preview Average Detector

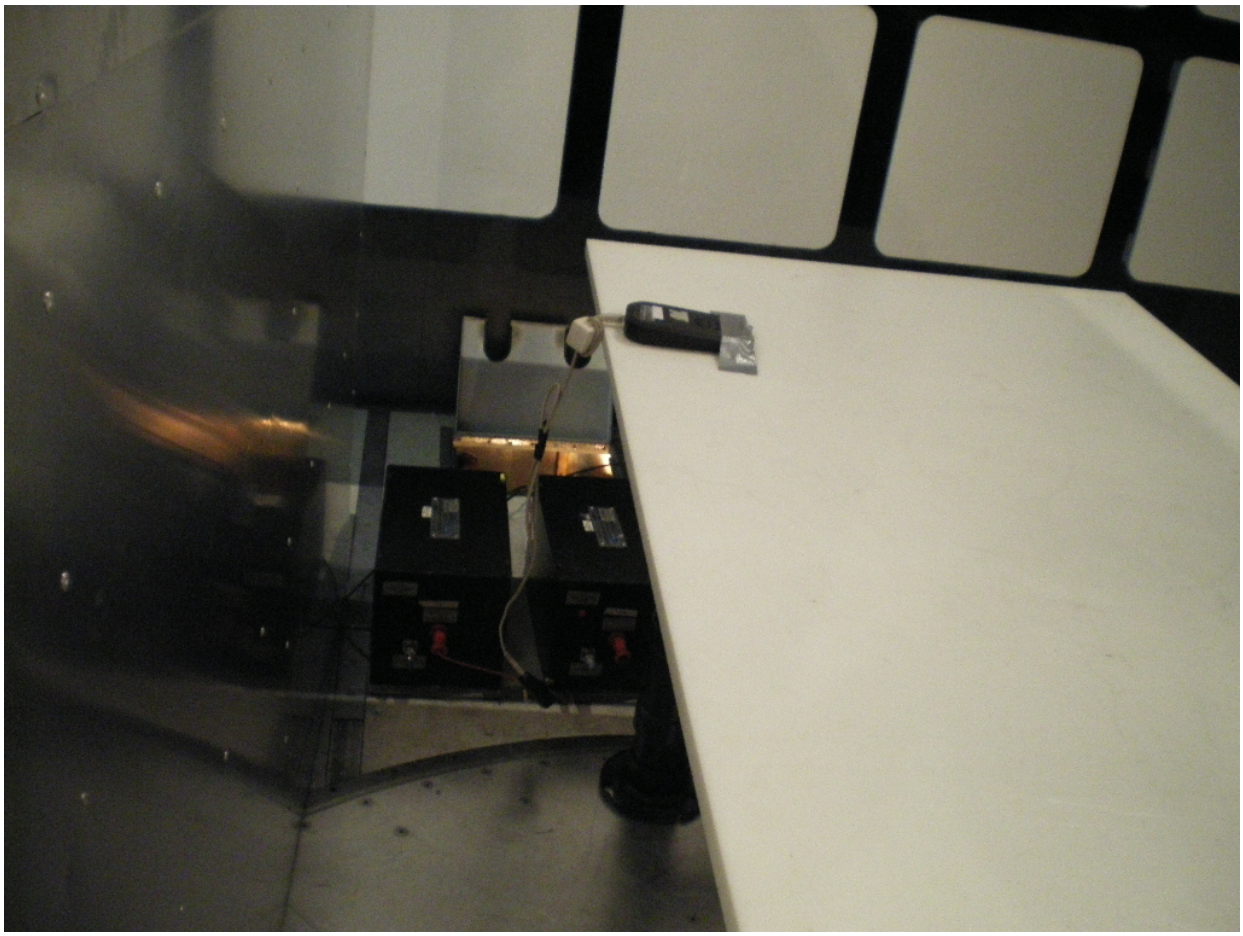


120VAC 60Hz Neutral Line
CISPR 22 Mains QP Class B Limit
CISPR 22 Mains AV Class B Limit
Preview Peak Detector
Preview Average Detector

No emissions could be found within 6 dB below the limits.

Clause 15.207(a) Conducted limits, continued

Set up photo



Clause 15.215(c) 20 dB bandwidth

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.

Special notes

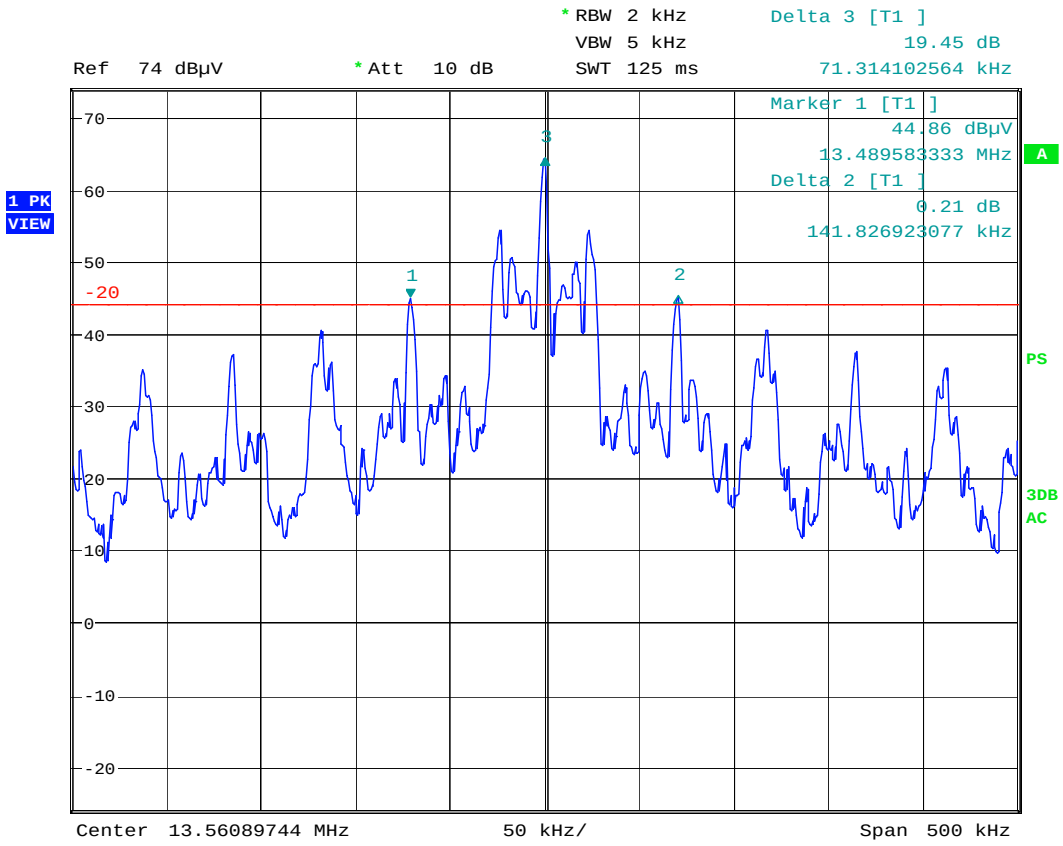
None

Test date: November 9, 2010

Test results: Pass

Clause 15.215(c) 20 dB bandwidth, continued

Test data



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20 dB Bandwidth: 141.82 kHz

Clause 15.225(a) Field Strength in the 13.553–13.567 MHz band

The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 µV/m (84 dBµV/m) at 30 meters.

Special notes

The measurements were performed using peak detector with 200 kHz RBW at the distance of 3 m. Distance correction* was applied to the measurement result in order to comply with 30 m limits. The EUT was measured on three orthogonal axis and was rotated 360°

30 m to 3 m correction factor calculation (for 13.56 MHz band):

40 × Log (30 m/3 m) = 40 dB

Test data

Frequency (MHz)	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Margin (dB)
13.560	58.4	11.3	124.0	65.6

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Test date: November 9, 2010

Test results: Pass

Clause 15.225(b) Field Strength in the 13.410–13.553 MHz and 13.567–13.710 MHz bands

Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 µV/m (50.5 dBµV/m) at 30 meters.

Special notes

The measurements were performed using peak detector with 10 kHz RBW at the distance of 3 m. Distance correction* was applied to the measurement result in order to comply with 30 m limits. The EUT was measured on three orthogonal axis and was rotated 360°

30 m to 3 m correction factor calculation (for 13 MHz band):

40 × Log (30 m/3 m) = 40 dB

Test data

Frequency (MHz)	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)
13.441	35.2	11.3	90.5	55.3
13.491	39.1	11.3	90.5	51.4
13.538	48.1	11.3	90.5	42.4
13.552	52.6	11.3	90.5	37.9
13.568	53.1	11.3	90.5	37.4
13.584	48.1	11.2	90.5	42.4
13.630	39.6	11.2	90.5	50.9
13.678	36.2	11.2	90.5	54.3

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Test date: November 9, 2010

Test results: Pass

Clause 15.225(c) Field Strength in the 13.110–13.410 MHz and 13.710–14.010 MHz bands

Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 µV/m (40.5 dBµV/m) at 30 meters.

Special notes

The measurements were performed using peak detector with 10 kHz RBW at the distance of 3 m. Distance correction* was applied to the measurement result in order to comply with 30 m limits. The EUT was measured on three orthogonal axis and was rotated 360°

30 m to 3 m correction factor calculation (for 13 MHz band):

$$40 \times \text{Log}\ (30\ \text{m}/3\ \text{m}) = 40\ \text{dB}$$

Test data

Frequency (MHz)	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Peak margin (dB)
13.112	27.2	11.3	80.5	53.3
13.163	27.9	11.3	80.5	52.6
13.210	29.6	11.3	80.5	50.9
13.255	29.5	11.3	80.5	51.0
13.300	30.3	11.3	80.5	50.2
13.378	31.1	11.3	80.5	49.4
13.397	32.8	11.3	80.5	47.7

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Test date: November 9, 2010

Test results: Pass

Clause 15.225(d) Field Strength of any emissions appearing outside of the 13.110–14.010 MHz band

The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209

Frequency (MHz)	Field strength		Measurement distance (m)
	(µV/m)	(dBµV/m)	
0.009–0.490	2400/F	67.6−20log(F)	300
0.490–1.705	24000/F	87.6−20log(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:
1. F = fundamental frequency in kHz
2. In the emission table above, the tighter limit applies at the band edges.
3. 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.

Special notes

1. The spectrum was searched from 9 kHz to the 10th harmonic.
2. The EUT was measured on three orthogonal axis.
3. All measurements were performed at a distance of 3 m.
4. All measurements were performed:
5. Below 30 MHz: using a peak detector with 10 kHz/30 kHz RBW/VBW,
6. Within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
7. Only the worst data presented in the test report.
8. The Spectrum was searched from 30 MHz to the 10th Harmonic.

Test date: November 9, 2010

Test results: Pass

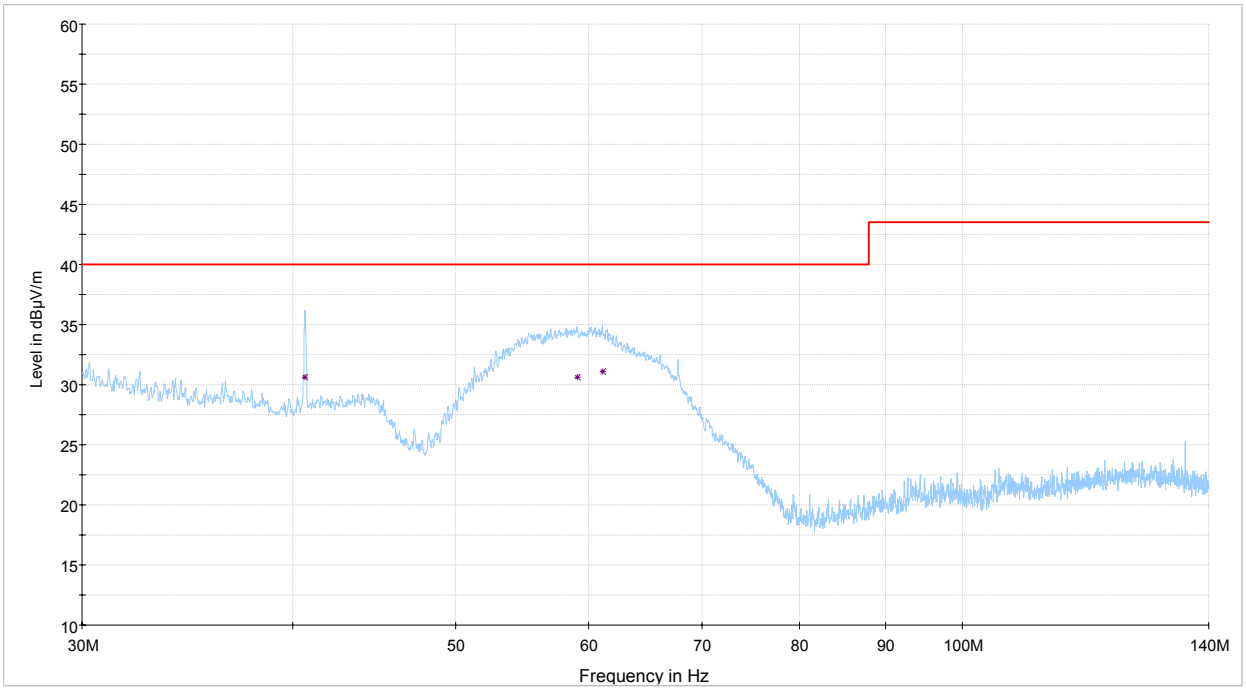
Clause 15. 225(d) Field Strength of any emissions appearing outside of the 13.110–14.010 MHz band, continued

Test data

Freq.(MHz)	Peak field strength (dBµV/m)	Correction (dB)	Peak limit (dBµV/m)	Margin (dB)
0.395	51.43	20.5	95.67	44.24
15.629	25.59	11.2	69.54	43.95
27.164	31.99	9.5	69.54	37.55
Freq.(MHz)	**Quasi-Peak field strength (dBµV/m)**	**Correction (dB)**	**Quasi-Peak limit (dBµV/m)**	**Margin (dB)**
40.680	30.7	13.4	40.0	9.3
59.040	30.6	8.3	40.0	9.4
61.110	31.1	8.4	40.0	8.9

Note: Correction factor includes antenna, cable loss, amplifier, and attenuators.

Test plot



Clause 15. 225(e) Frequency tolerance of the carrier signal

The frequency tolerance of the carrier signal shall be maintained within ±0.01 % of the operating frequency over a temperature variation of –20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 °C. For battery-operated equipment, the equipment tests shall be performed using a new battery.

Special notes

The test was performed using peak detector of the spectrum analyzer with RBW no narrower than 1 % of the emission bandwidth.

Test data

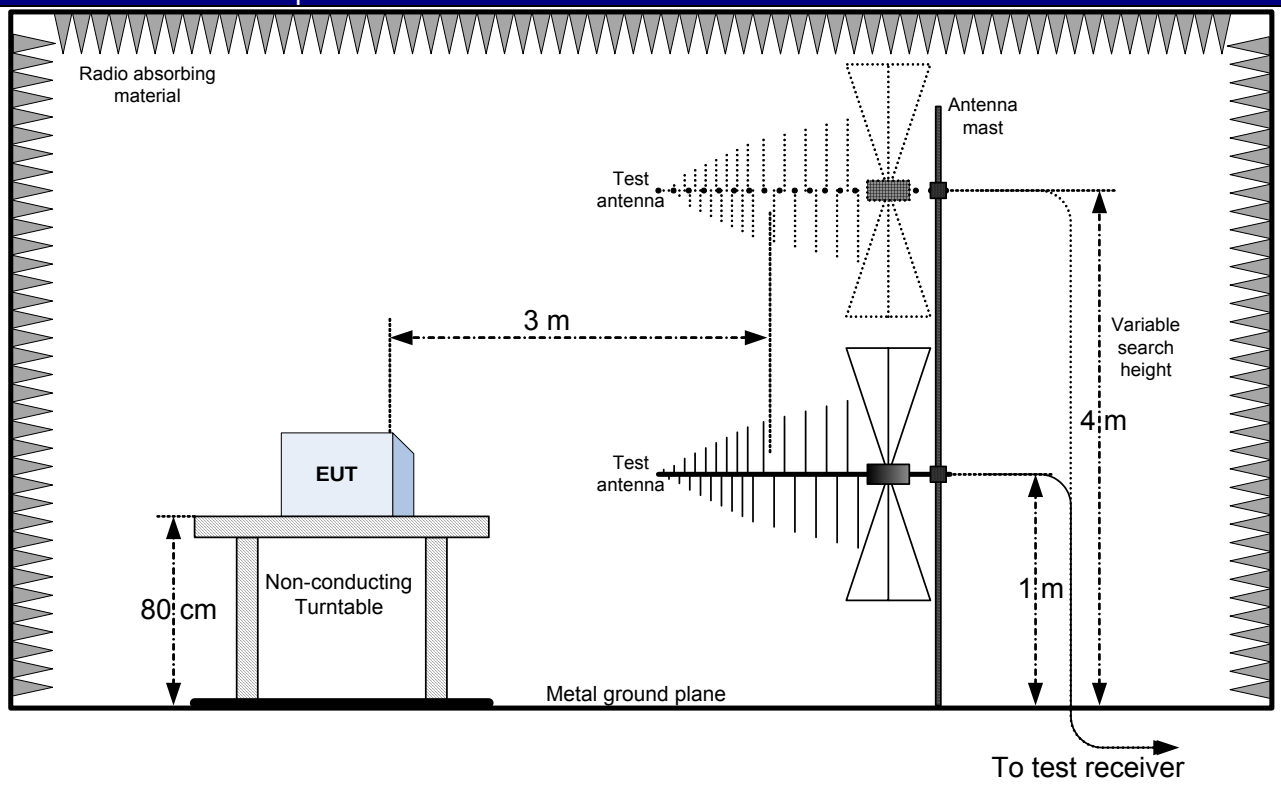
Conditions	Frequency (MHz)	Within ±0.01% operating frequency (MHz)
+50 °C, Nominal voltage	13.5619	13.5605 ~ 13.5633
+40 °C, Nominal voltage	13.5619	
+30 °C, Nominal voltage	13.5619	
+20 °C, 85 % Normal voltage	13.5619	
+20 °C, Nominal voltage	13.5619	
+20 °C, 115 % Normal voltage	13.5619	
+10 °C, Nominal voltage	13.5619	
0 °C, Nominal voltage	13.5619	
-10 °C, Nominal voltage	13.5619	
-20 °C, Nominal voltage	13.5619	

Test date: November 9, 2010

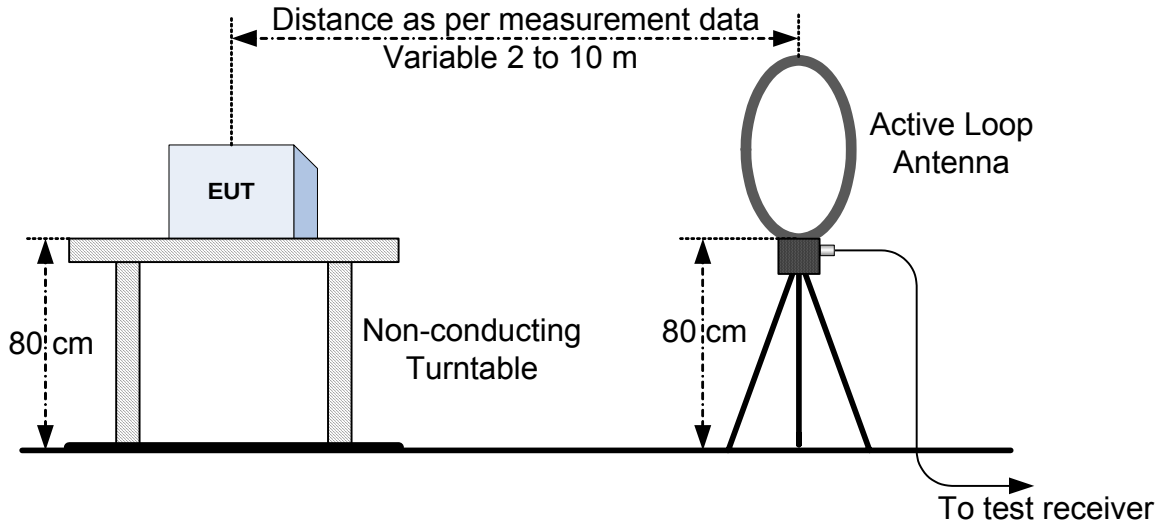
Test results: Pass

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up above 30 MHz

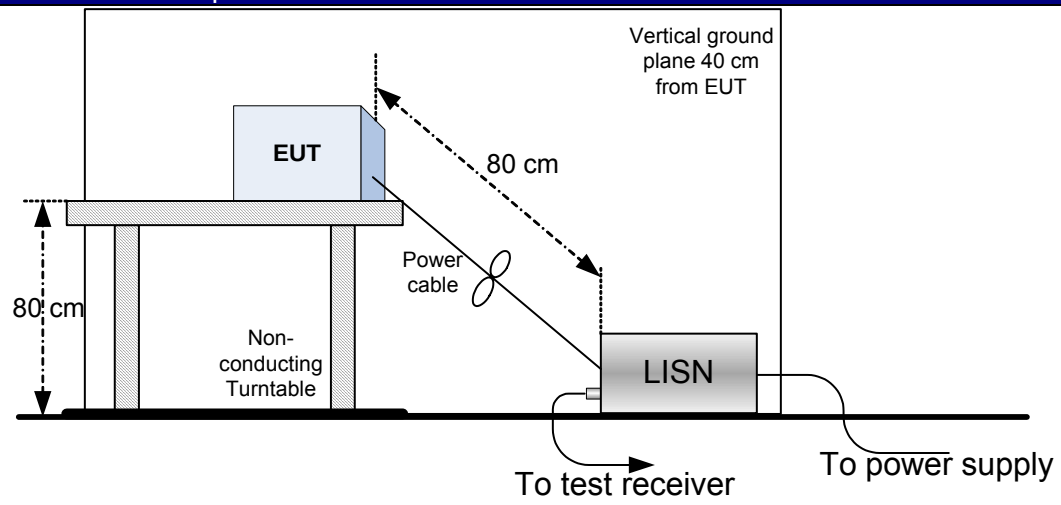


Radiated emissions set-up below 30 MHz

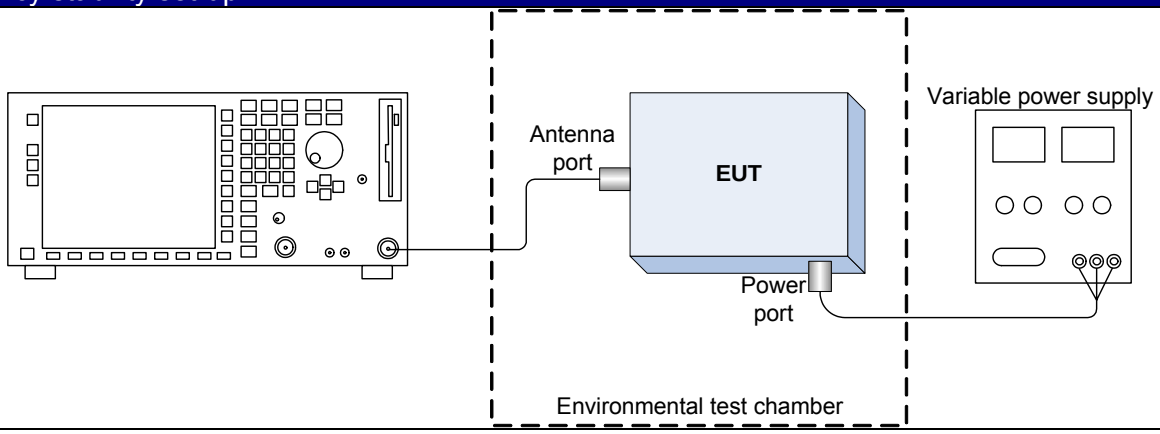


Block diagram, continued

Conducted emissions set-up



Frequency stability set-up



Appendix C: EUT photos

EUT photos

EUT photos, continued

EUT photos, continued