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Report Reference ID	167484-1TRFWL
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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
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Applicant	Computerized Security Systems, Inc. dba Saflok 31750 Sherman Avenue Madison Heights, MI, USA 48071
Product name	Quantum 2 MT
Model	QPL3 / QP3
FCC ID	SAPQUANTUMRF2R

Testing laboratory	Nemko Canada Inc. 303 River Road Ottawa, ON, Canada K1V 1H2 Telephone: (613) 737-9680 Facsimile: (613) 737-9691
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	Name and title	Date
Tested by:	David Duchesne, Senior Wireless/EMC Specialist	March 14, 2011
Reviewed by:	 Sim Jagpal, General Manager	March 14, 2011



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The tests included in this report are within the scope of this accreditation.

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Section 1: Report summary

1.1 Test specification

FCC Part 15 Subpart C, 15.225

Operation within the band 13.110-14.010 MHz

1.2 Statement of compliance

In the configuration tested the EUT was found compliant

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003.

See "Summary of test results" for full details.

1.3 Exclusions

None

1.4 Registration number

Test site FCC ID number: 176392 (3 m Semi anechoic chamber)

1.5 Test report revision history

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

1.6 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.

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Section 2: Summary of test results

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

General requirements for FCC Part 15

Part	Test description	Verdict
§15.31(e)	Variation of power source	See note 1
§15.31(m)	Number of operating frequencies	See note 2
§15.203	Antenna requirement	See note 3
§15.207(a)	Conducted limits	Not applicable (See note 4)
§15.215(c)	20 dB bandwidth	Pass

Specific requirements for FCC Part 15 Subpart C, 15.231

Part	Test description	Verdict
15.225(a)	Field strength in the 13.553-13.567 MHz band	Pass
15.225(b)	Field strength in the 13.410-13.553 MHz and 13.567-13.710 MHz bands	Pass
15.225(c)	Field strength in the 13.110-13.410 MHz and 13.710-14.010 MHz bands	Pass
15.225(d)	Field strength of any emissions appearing outside of the 13.110-14.010 MHz band	Pass
15.225(e)	Frequency tolerance of the carrier signal	Pass
15.225(f)	Radio frequency powered tags	Not applicable

Notes:

1. The EUT is battery operated, tests were performed with a new battery.
2. The frequency range over which the device operates is less than 1 MHz. Tests were performed at a single frequencies in the middle of band.
3. Antenna is an integral.
4. EUT is battery powered only.

Section 3: Equipment under test (EUT) and application details

3.1 Product details

Product name	Quantum 2 MT
Model	QPL3 / QP3
Serial number	Non production sample

3.2 Sample information

Receipt date	February 2, 2011
Nemko sample ID number	Item # 1

3.3 EUT technical specifications

Operating band	13.553 – 13.567 MHz
Operating frequency	13.56 MHz
Modulation type	ASK
Occupied bandwidth	2.72 kHz
Antenna data	Integral
Power source	6 VDC Battery

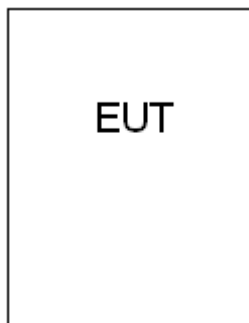
3.4 EUT description

The EUT is a 13.56 MHz RFID reader, which is attached to a secure lock. Whenever a known card is brought in proximity to the reader it will grant access through the door.

3.5 Operation of the EUT during testing

EUT was set for continuous transmission

3.6 EUT 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 test procedures.

Section 5: Test conditions

5.1 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 $\pm 5\%$, for which the equipment was designed.

Section 6: 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.

Section 7: Test equipment

7.1 Test equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	April 14/11
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Jan. 04/12
50 coax cable	Huber + Suhner	NONE	FA002013	1 year	Sept. 01/11
50 coax cable	Huber + Suhner	NONE	FA002074	1 year	July 13/11
Active loop antenna	EMCO	6502	FA001686	1 year	July 27/11
Biconical antenna	Sunol	BC2	FA002078	1 year	Dec. 08/11
Log periodic antenna	Sunol	LP5	FA002077	1 year	Dec. 10/11
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Multimeter	Fluke	16	FA001831	1 year	Jan. 26/12
Air probe	Fluke	NONE	FA001561	—	NCR

Note: N/A = Not applicable, NCR = No cal required, COU = Cal on use

Section 8: Testing data	Product: Quantum 2 MT	
Test name: Clause 15.215 (c) 20 dB bandwidth		
Test date: February 4, 2011	Test engineer: David Duchesne	Verdict: Pass
Specification: FCC Part 15 Subpart C		

Section 8: Testing data

8.1 Clause 15.215 (c) 20 dB Bandwidth

(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.

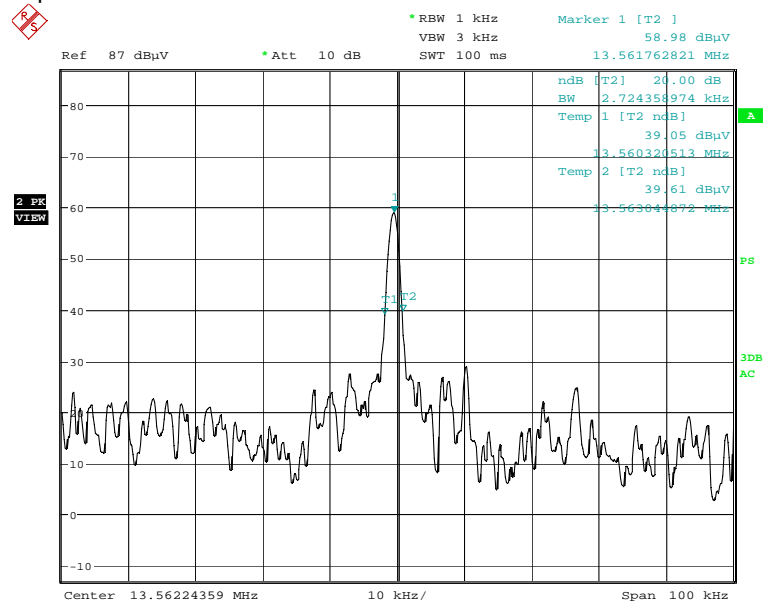
Special notes

None

Test data

Test results

20 dB bandwidth spectral plot



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Section 8: Testing data		Product: Quantum 2 MT	
Test name: Clause 15.225 (a) (b) (c) Field strength			
Test date: February 2, 2010		Test engineer: David Duchesne	Verdict: Pass
Specification: FCC Part 15 Subpart C			

8.2 Clause 15.225 (a) (b) (c) Field strength

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

Special notes

None

Test Data

Test result

Frequency (MHz)	Receiver reading (dBuV)	Antenna factor (dB)	Cable loss (dB)	Field strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
13.553 - 13.567 MHz Band						
13.56	38.86	10.6	0.1	49.56	124	74.44
13.41 - 13.553 MHz Band						
13.482	12.5	10.6	0.1	23.2	90.5	67.3
13.567 - 13.71 MHz Band						
13.639	11.3	10.6	0.1	22	90.5	68.5
13.11 - 13.41 MHz Band						
13.26	10.3	10.6	0.1	21	80.5	59.5
13.710 - 14.01 MHz Band						
13.26	12.3	10.6	0.1	23	80.5	57.5

Notes:

Only the worst case for each band has been recorded.

Sample calculation for peak field strength (dBμV/m):

Correction factor (dB) = antenna factor ACF (dB) + cable loss (dB)

Peak field strength (dBμV/m) = **XX** dBμV (reading from receiver/spectrum analyzer) + **XX** dB (Correction factor)

Measurement details

- Measurement performed at 3m.
- Limit was corrected from 30 to 3 m using $40\log(30/3) = +40$ dB
- All test were performed with transmitter set to maximum power. Transmitter power is not adjustable.
- Spectrum analyzer settings:
 - Peak detector RBW = 10 kHz, VBW = 30 kHz
 - Measurement time 100 ms



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Section 8: Testing data	Product: Quantum 2 MT	
Test name: Clause 15.225 (a) (b) (c) Field strength		
Test date: February 2, 2010	Test engineer: David Duchesne	Verdict: Pass
Specification: FCC Part 15 Subpart C		

Test data, continued

Setup photos





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Section 8: Testing data

Product: Quantum 2 MT

Test name: Clause 15.225 (d) Field strength of any emissions appearing outside of the 13.110-14.010 MHz band

Test date: February 2, 2011

Test engineer: David Duchesne

Verdict: Pass

Specification: FCC Part 15 Subpart C

8.3 Clause 15.225 (d) Field strength of any emissions appearing outside of the 13.110-14.010 MHz band

(d) 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

§15.209 – Radiated emission limits; general requirements.

Frequency (MHz)	Field strength		Measurement distance (m)
	($\mu\text{V}/\text{m}$)	($\text{dB}\mu\text{V}/\text{m}$)	
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:

- 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.

Special notes

None

Test data

Tests results

No emissions detected within 10 dB of limit, see spectral plots of this section.

Measurement details

- EUT was scanned from 10 kHz to 1 GHz
- Measurements performed at 3m.
- Limit was corrected from 0.009 to 0.49 MHz using $40\log(300/3) = + 80 \text{ dB}$
- Limit was corrected from 0.49 to 30 MHz using $40\log(30/3) = + 40 \text{ dB}$
- All test were performed with transmitter set to maximum power. Transmitter power is not adjustable.
- Spectrum analyzer settings from 10 kHz to 150 kHz
 - Peak detector RBW = 200 Hz, VBW = 1 kHz
 - Measurement time 100 ms
- Spectrum analyzer settings from 150 kHz to 30 MHz
 - Peak detector RBW = 10 kHz, VBW = 30 kHz
 - Measurement time 100 ms
- Spectrum analyzer settings from 30 MHz to 1 GHz
 - Peak detector RBW = 100 kHz, VBW = 300 kHz
 - Measurement time 100 ms

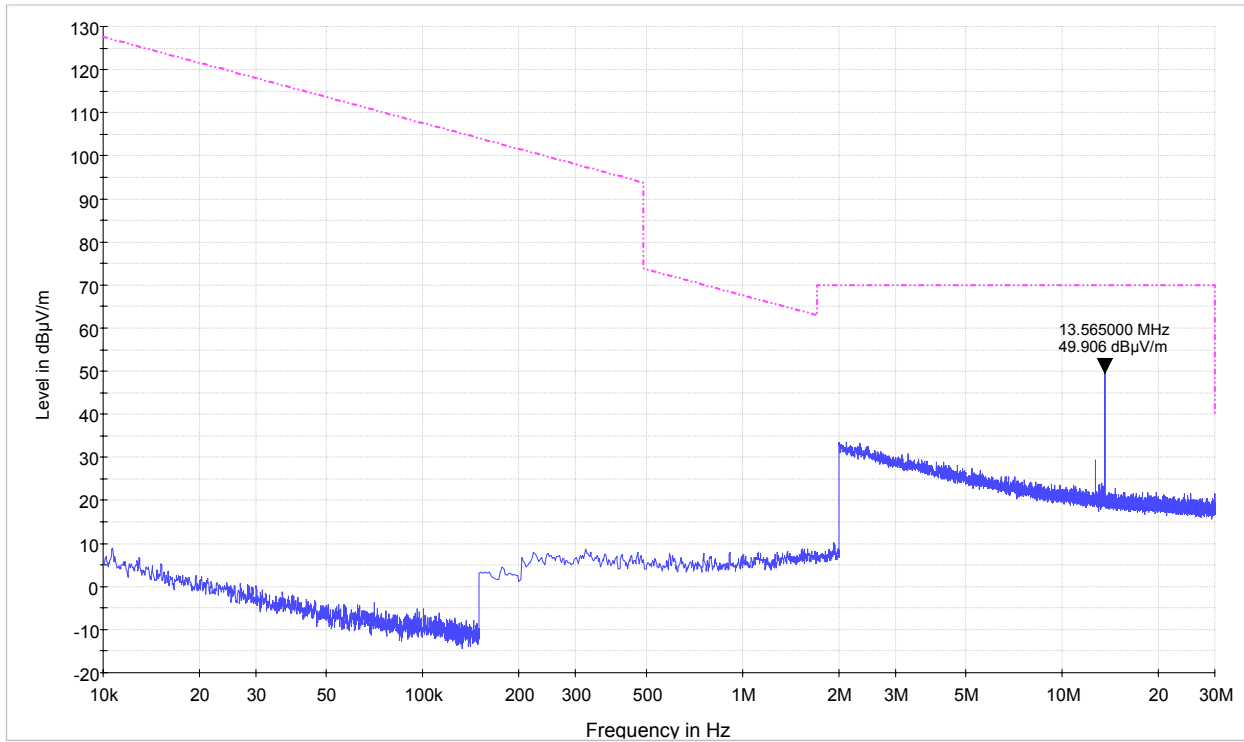


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Section 8: Testing data	Product: Quantum 2 MT	
Test name: Clause 15.225 (d) Field strength of any emissions appearing outside of the 13.110-14.010 MHz band		
Test date: February 2, 2011	Test engineer: David Duchesne	Verdict: Pass
Specification: FCC Part 15 Subpart C		

Test data

Spectral plot



— Preview Peak Detector - - - - - FCC 15.209 and RSS-210 limit line

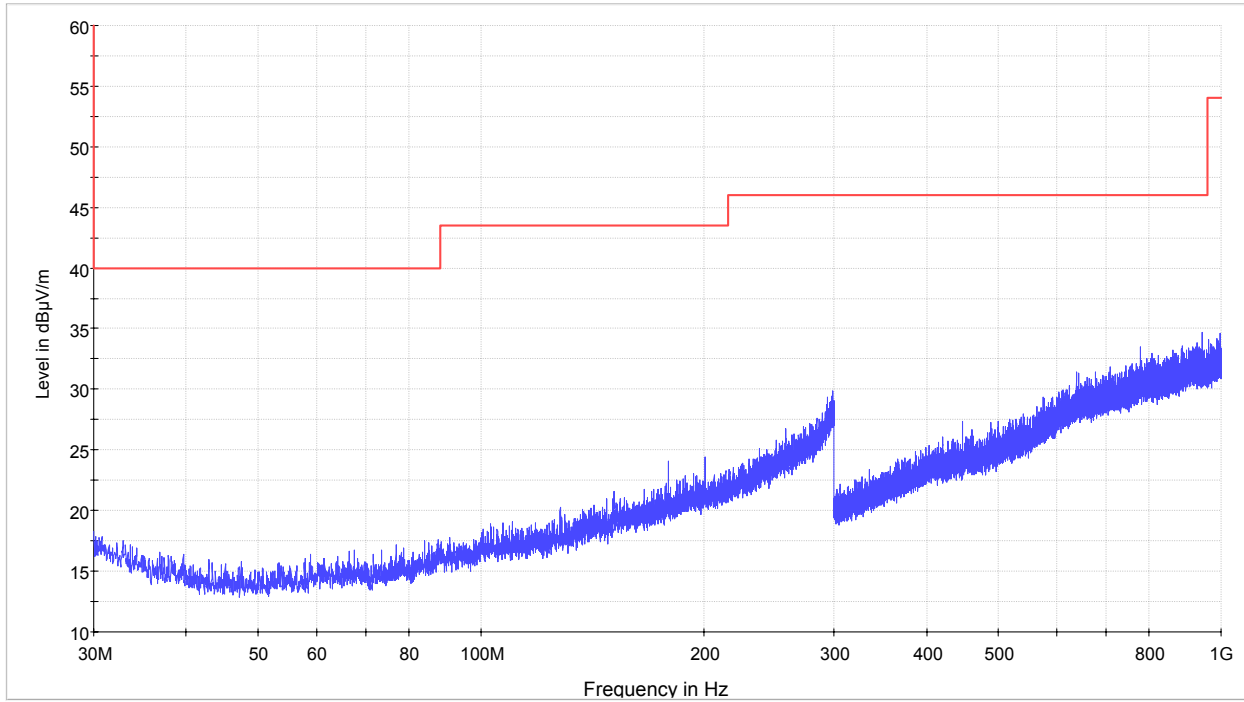


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Section 8: Testing data		Product: Quantum 2 MT	
Test name: Clause 15.225 (d) Field strength of any emissions appearing outside of the 13.110-14.010 MHz band			
Test date: February 2, 2011		Test engineer: David Duchesne	Verdict: Pass
Specification: FCC Part 15 Subpart C			

Test data, continued

Spectral plot, continued



Vertical and Horizontal
Preview Peak Detector
FCC 15.209 and RSS-210 limit line



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Section 8: Testing data

Product: Quantum 2 MT

Test name: Clause 15.225 (d) Field strength of any emissions appearing outside of the 13.110-14.010 MHz band

Test date: February 2, 2011

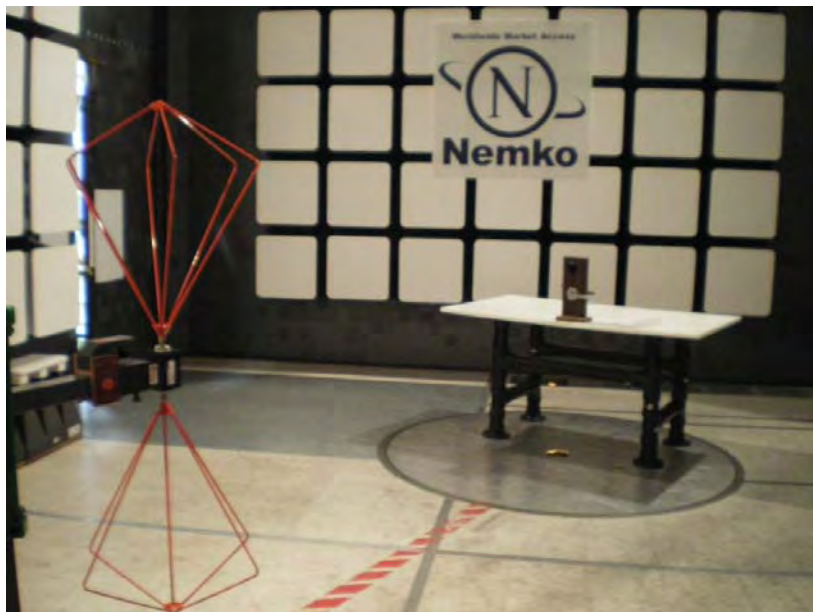
Test engineer: David Duchesne

Verdict: Pass

Specification: FCC Part 15 Subpart C

Test data, continued

Setup photos





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Section 8: Testing data		Product: Quantum 2 MT	
Test name: Clause 15.225 (e) Frequency tolerance of the carrier signal			
Test date: February 3, 2011		Test engineer: David Duchesne	Verdict: Pass
Specification: FCC Part 15 Subpart C			

8.4 Clause 15.225 (e) Frequency tolerance of the carrier signal

(e) The frequency tolerance of the carrier signal shall be maintained within +/-0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees 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 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Special notes

The apparatus is battery powered therefore no supply voltage variation is required.

Test data

Test result

Conditions	Frequency (Hz)	Offset (ppm)
+50°C	13561923	0
+40°C	13561923	0
+30°C	13561923	0
+20°C	13561923	—
+10°C	13561923	0
0°C	13561998	5.53
-10°C	13561998	5.53
-20°C	13561998	5.53

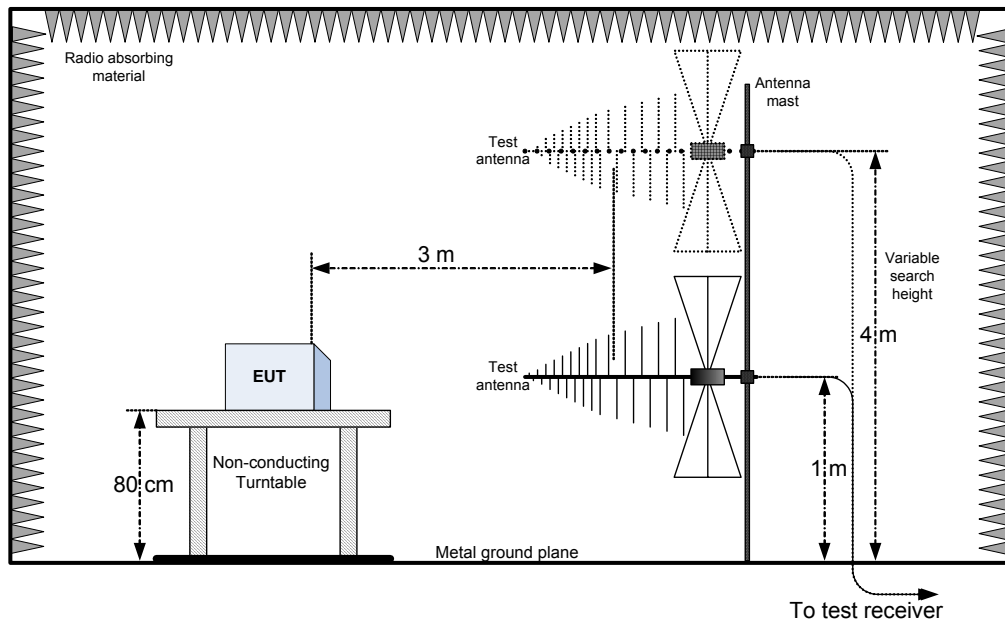
Notes:
Limit: +/-0.01% = +/-100ppm

Offset calculation:
$$\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^6$$

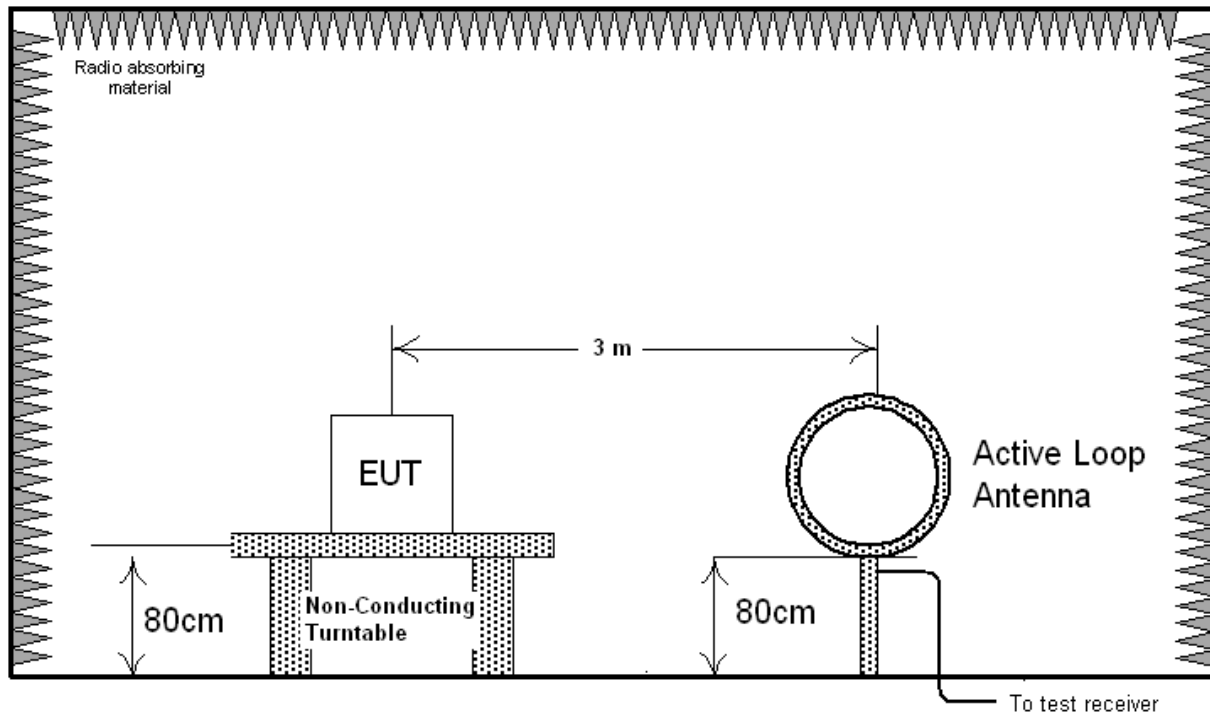
Measurement details
Frequency measured with spectrum analyzer.

Section 8: Block diagrams of test set-ups

Radiated Emissions above 30MHz



Radiated Emissions below 30MHz



Frequency stability

