

**Nemko Test Report:** 117361-1TRFWL

**Applicant:** SMART Technologies ULC  
3636 Research Road NW  
Calgary, AB  
T2L 1Y1 Canada

**Apparatus:** Classroom Response System (Remote Unit)

**FCC ID:** QCISRP01

**In Accordance With:** FCC Part 15 Subpart C, 15.247  
FHSS System and Digitally Modulated Radiators  
902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

**Authorized By:**

A handwritten signature in blue ink, appearing to read 'Simon John', is written over a white rectangular background.

Production Manager

**Date:** May 19, 2009

**Total Number of Pages:** 19

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## Section 1 : Report Summary

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.

The assessment summary is as follows:

<b>Apparatus Assessed:</b>	Classroom Response System (Remote Unit)
<b>Specification:</b>	FCC Part 15 Subpart C, 15.247
<b>Compliance Status:</b>	Complies
<b>Exclusions:</b>	None
<b>Non-compliances:</b>	None
<b>Report Release History:</b>	Original Release
<b>Test Location:</b>	Nemko Canada Inc. 303 River Road Ottawa, Ontario K1V 1H2
<b>Registration Number:</b>	176392 (3 m Semi-Anechoic Chamber)
<b>Tests Performed By:</b>	Andrey Adelberg, EMC/Wireless Specialist
<b>Test Dates:</b>	November 13, 2008 to May 5, 2009

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 : Equipment Under Test

### 2.1 Identification of Equipment Under Test (EUT)

The following information identifies the EUT under test:

Type of Equipment:	Classroom Response System (Remote Unit)
Brand Name:	SMART Response
Model Name or Number:	03-00098-20
Serial Number:	None
Nemko Sample Number:	1
FCC ID:	QCISRP01
Date of Receipt:	November 13, 2008, December 19, 2008

### 2.2 Accessories

No additional accessories were used to exercise the EUT during testing.

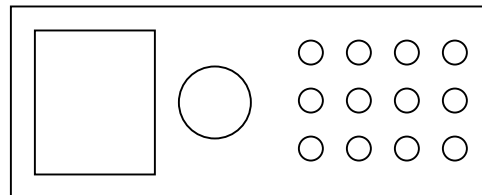
### 2.3 EUT Description

Handheld transmitter operates at 2.4–2.4835 GHz ISM band

## 2.4 Technical Specifications of the EUT

<b>Operating Band:</b>	2400–2483.5 MHz
<b>Operating Frequency:</b>	$F = 2405 + 5(k-11)$ MHz, $k=11, 12, \dots, 26$
<b>Modulation:</b>	DSSS
<b>Occupied Bandwidth:</b>	1.635 MHz
<b>Channel Number:</b>	16
<b>Emission Designator:</b>	1M63G1D
<b>Antenna Data:</b>	Integral 3 dBi
<b>Power Supply Requirements:</b>	3 VDC (2x1.5 Type “AA” batteries)

## 2.5 EUT Setup diagram



## 2.6 Operation of the EUT during testing

The EUT has been modified to transmit constantly at the low, mid and high channel.

## 2.7 Modifications incorporated in the EUT

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

## **Section 3 : Test Conditions**

### **3.1 Specifications**

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.247

FHSS System and Digitally Modulated Radiators

902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

### **3.2 Deviations From Laboratory Test Procedures**

No deviations were made from laboratory test procedures.

### **3.3 Test Environment**

All tests were performed under the following environmental conditions:

Temperature range	:	15–30 °C
Humidity range	:	20–75 %
Pressure range	:	86–106 kPa
Power supply range	:	±5 % of rated voltages

### **3.4 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.

### 3.5 Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Cal. Date	Next Cal.
3 m EMI chamber	TDK	SAC-3	FA002047	May 06/08	May 06/09
Bilog	Sunol	JB3	FA002108	Jan. 21/09	Jan. 21/10
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR	NCR
Controller	Sunol	SC104V	FA002060	NCR	NCR
Mast	Sunol	TLT2	FA002061	NCR	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/08	Dec. 16/09
50Ω Coax cable	HUBER + SUHNER	None	FA002015	Aug. 05/08	Aug. 05/09
50Ω Coax cable	HUBER + SUHNER	None	FA002022	July 07/08	July 07/09
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/09	Jan. 21/10
1-18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 2/08	Oct 2/09
Horn 18-26.5 GHz	Electro-Metrics	SH-50/60-1	FA000479	COU	COU
18.0 – 26.0 GHz Amplifier	NARDA	BBS-1826N612	FA001550	COU	COU

COU – Calibrate on Use

NCR – No Calibration Required

## Section 4 : Results Summary

This section contains the following:

### 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)

### 4.1 FCC Part 15 Subpart C : Test Results

Part 15	Test Description	Required	Result
15.31(e)	Variation of power supply	YES	PASS
15.207(a)	Powerline Conducted Emissions	N/A	
15.209(a)	Radiated Emissions within Restricted Bands	YES	PASS
15.247(a)(1)	Frequency hopping systems	N/A	
15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	N/A	
15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	N/A	
15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	N/A	
15.247(a)(2)	Systems using digital modulation techniques	YES	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	N/A	
15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	N/A	
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	YES	PASS
15.247(b)(4)	Maximum peak output power	YES	PASS
15.247(c)(1)	Fixed point-to-point Operation with directional antenna gains greater than 6 dBi	N/A	
15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	N/A	
15.247(d)	Radiated Emissions Not in Restricted Bands	YES	PASS
15.247(e)	Power Spectral Density for Digitally Modulated Devices	YES	PASS
15.247(f)	Time of Occupancy for Hybrid Systems	N/A	



## Appendix A : Test Results

### Clause 15.209(a) Radiated Emissions within Restricted Bands

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength		Measurement Distance (m)
	( $\mu$ V/m)	(dB $\mu$ V/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

Note: F = fundamental frequency in kHz

**Test Results:** Pass

#### Additional Observations:

The Spectrum was searched from 30 MHz to the 10<sup>th</sup> Harmonic.

These results apply to emissions found in the Restricted bands defined in FCC Part 15 Subpart C, 15.205.

The EUT was measured on three orthogonal axis.

New battery was used during the test.

Peak Detector with 100 kHz RBW/300 kHz VBW was used below 1 GHz and 1 MHz RBW/3 MHz VBW above 1 GHz.

All measurements were performed at 3 m distance.

Channel	Frequency, MHz	Polarization	Max-Peak, dBμV/m	Peak Limit, dBμV/m	Peak margin, dB
Low	4809.976	H	66.80	74.00	7.20
Low	7215.000	H	64.86	74.00	9.14
Low	9619.906	H	50.59	74.00	23.41
Mid	4889.980	H	64.84	74.00	9.16
Mid	7335.024	H	62.33	74.00	11.67
Mid	9779.970	H	48.88	74.00	25.12
High	4960.010	H	63.69	74.00	10.31
High	7439.989	H	61.99	74.00	12.01
High	9919.990	H	47.72	74.00	26.28

Channel	Frequency, MHz	Max-Peak, dBμV/m	Duty cycle factor, dB	Average, dBμV/m	Peak Limit, dBμV/m	Average margin, dB
Low	4809.976	66.80	45.76	21.04	54.00	32.96
Low	7215.000	64.86	45.76	19.10	54.00	34.90
Low	9619.906	50.59	45.76	4.83	54.00	49.17
Mid	4889.980	64.84	45.76	19.08	54.00	34.92
Mid	7335.024	62.33	45.76	16.57	54.00	37.43
Mid	9779.970	48.88	45.76	3.12	54.00	50.88
High	4960.010	63.69	45.76	17.93	54.00	36.07
High	7439.989	61.99	45.76	16.23	54.00	37.77
High	9919.990	47.72	45.76	1.96	54.00	52.04

**Delta Marker Measurement for 2.4835 GHz Band Edge**

Measured Field Strength for High Channel with Peak Detector using 1 MHz RBW/3 MHz VBW = 91.77 dBμV/m

Delta Marker = 37.2 dB

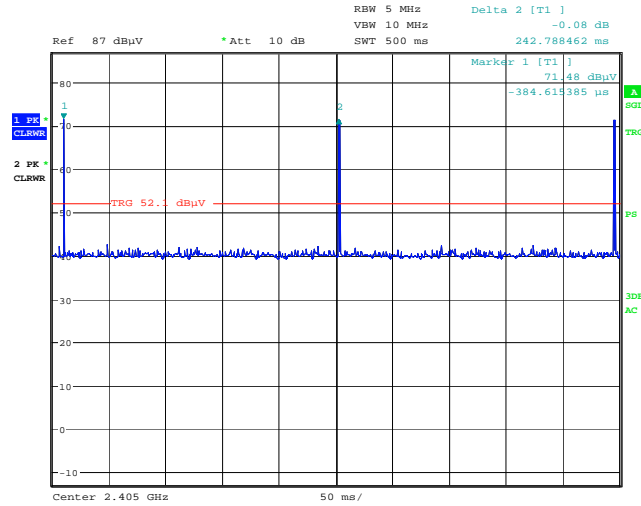
Therefore, Peak Field Strength = 91.77 dBμV/m – 37.2 dB = 54.57 dBμV/m

Limit = 74 dBμV/m

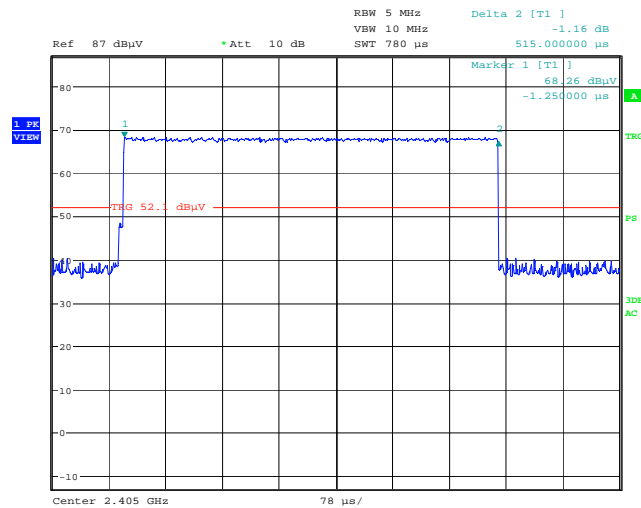
Average Field Strength = 54.57 dBμV/m – 45.76 dB (Duty Cycle) = 8.8 dBμV/m

Limit = 54 dBμV/m

Duty cycle correction factor:



Date: 8.JAN.2009 22:18:07



Date: 8.JAN.2009 22:21:11

Duty cycle correction factor calculation:

$$20 \times \log\left(\frac{100}{0.515}\right) = 45.76 \text{ dB}$$



**Nemko Canada Inc.**

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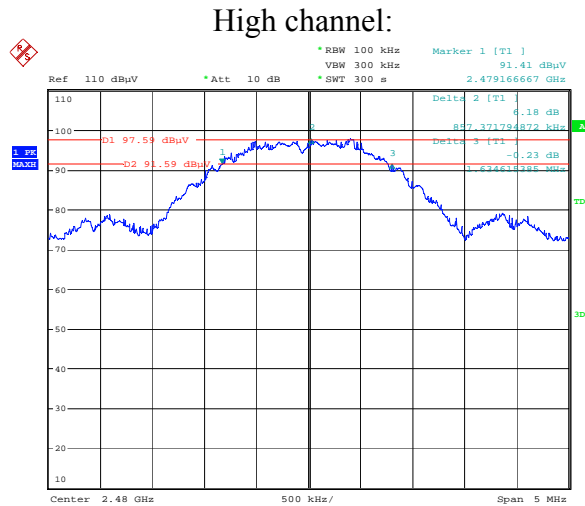
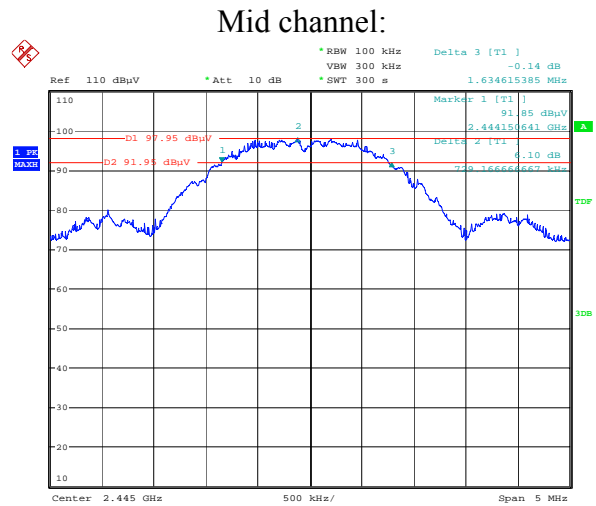
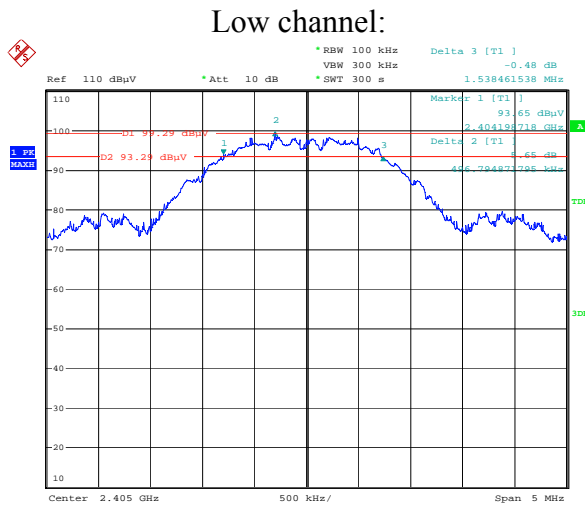
Specification: FCC Part 15 Subpart C, 15.247

**Clause 15.247(a)(2) 6 dB Bandwidth for systems using digital modulation techniques**

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.

**Test Results:** Pass

**6 dB Bandwidth:**



Frequency, MHz	6 dB Bandwidth, kHz	Limit, kHz	Delta, kHz
2405	1538.4	500	-1038.4
2445	1634.6	500	-1134.6
2480	1634.6	500	-1134.6

**Clause 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**

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W. As an alternative to a peak power measurement, compliance with the 1 W limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

**Clause 15.247(b)(4) Maximum peak output power**

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.

**Test Results:** Pass

**Conducted Output Power:**

Measured output power = 6.07 dBm  
 Maximum output power = 6.07 dBm + 3 dBi = 9.07 dBm EIRP  
 Limit = 36 dBm EIRP

All tests were performed using new batteries.

The EUT was measured on three orthogonal axis, only worst case presented in the report.

Channel Range	Measured Field Strength, dBμV/m	Calculated Output Power (W)
Low	104.31	0.00405
Mid	102.35	0.00258
High	101.20	0.00198

**Radiated Output Power:**

Channel	EUT Axis	Freq. MHz	Pol V/H	ANT.	F.S. dBμV/m	Cable loss dB	Ant Factor dB/m
Low	Flat	2405	V	Horn	100.64	4.5	28.8
Low	Flat	2405	H	Horn	104.31	4.5	28.8
Mid	Flat	2445	V	Horn	98.11	4.5	28.8
Mid	Flat	2445	H	Horn	102.35	4.5	28.8
High	Flat	2480	V	Horn	97.77	4.5	28.8
High	Flat	2480	H	Horn	101.20	4.5	28.8

$$E \text{ (V/m)} = \frac{10^{(FS/20)}}{1 \times 10^6} = \left( 10^{\left( \frac{104.31}{20} \right)} \right) \times 10^{-6} = 0.164 \text{ V/m}$$

$$G \text{ (numeric)} = 10^{(Ag/10)} = 10^{\left( \frac{3}{10} \right)} = 2$$

$$P \text{ (W)} = \frac{E^2 R^2}{30G} = 0.004047 \text{ W} = 4.05 \text{ mW}$$

FS = Field Strength (dBμV/m)

Ag = Antenna gain (dBi)

E = Measured Value (V/m)

R = Measurement distance (m)

G = Antenna Gain (numeric)

P = Output power (W)

$$\text{Output Power (dBm)} = 10 \times \log(\text{Output Power(mW)}) = 10 \times \log(4.05) = 6.07 \text{ dBm}$$

Conducted Output Power Limit = 30 dBm

**Additional Observations:**

All Measurements were performed at 3 m with Peak Detector using 2 MHz RBW and 3 MHz VBW.

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**Clause 15.247(d) Radiated Emissions Not in Restricted Bands**

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)).

**Test Results:** Pass

The Spectrum was searched from 30 MHz to the 10<sup>th</sup> Harmonic.

New battery was used during the test.

Peak Detector with 100 kHz RBW/300 kHz VBW was used below 1 GHz and Peak Detector with 1 MHz BRW/3 MHz VBW was used for measurements above 1 GHz.

All measurements were performed at 3 m distance.

**No emissions within 20 dB below the limit were observed.**

**Clause 15.247(e) Power Spectral Density for Digitally Modulated Devices**

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.

**Test Results:** Pass

Frequency, MHz	PSD, dBμV/m/3 kHz	PSD, dBm/3 kHz	Limit, dBm/3 kHz	Delta, dB
2405	88.72	-9.51	8.00	17.51
2445	87.02	-11.21	8.00	19.21
2480	87.33	-10.90	8.00	18.90

Theoretical conversion between Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P(W) = E^2 R^2 / (30G)$$

$$\text{Therefore dBW} = \text{dBV} + 20\text{Log}(3) - 10\text{Log}(30) - 10\text{Log}(G)$$

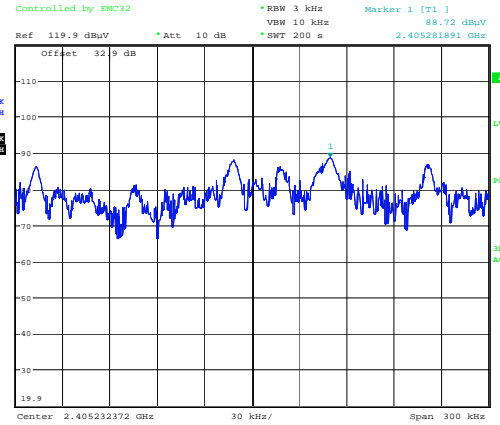
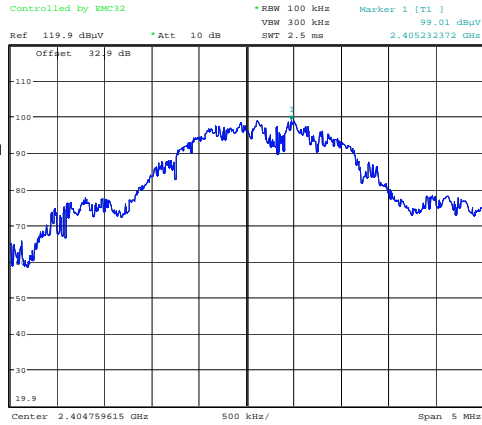
From which we obtain

$$\begin{aligned} \text{DBmW} &= \text{dB}\mu\text{V} - 120 + 20\text{Log}(3) - 10\text{Log}(30) - 10\text{Log}(G) + 30 \\ &= \text{dB}\mu\text{V} - 95.23 - 10\text{Log}(G) \end{aligned}$$

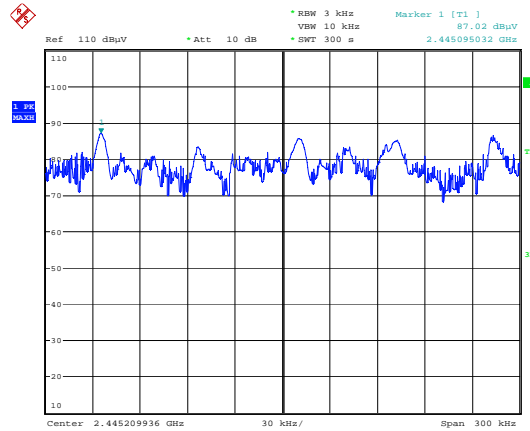
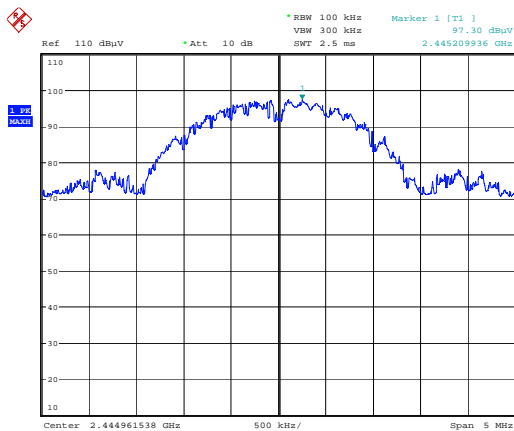
$$\text{Field Strength [dB}\mu\text{V/m]} - 95.23 \text{ [dB]} - 3 \text{ [dBi]}$$



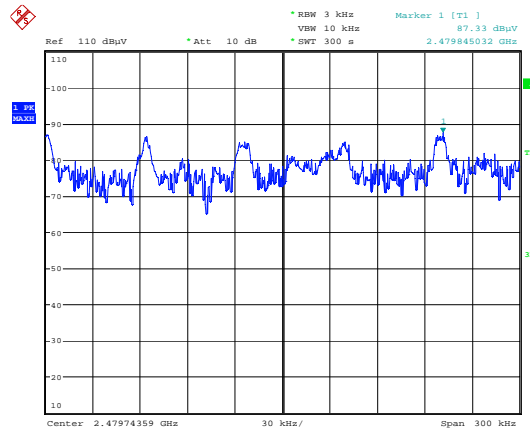
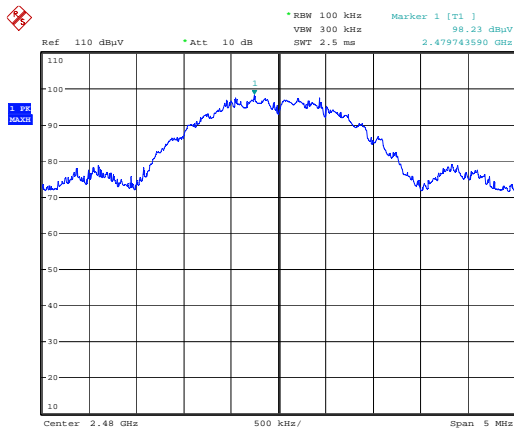
Low channel



Mid channel



High channel



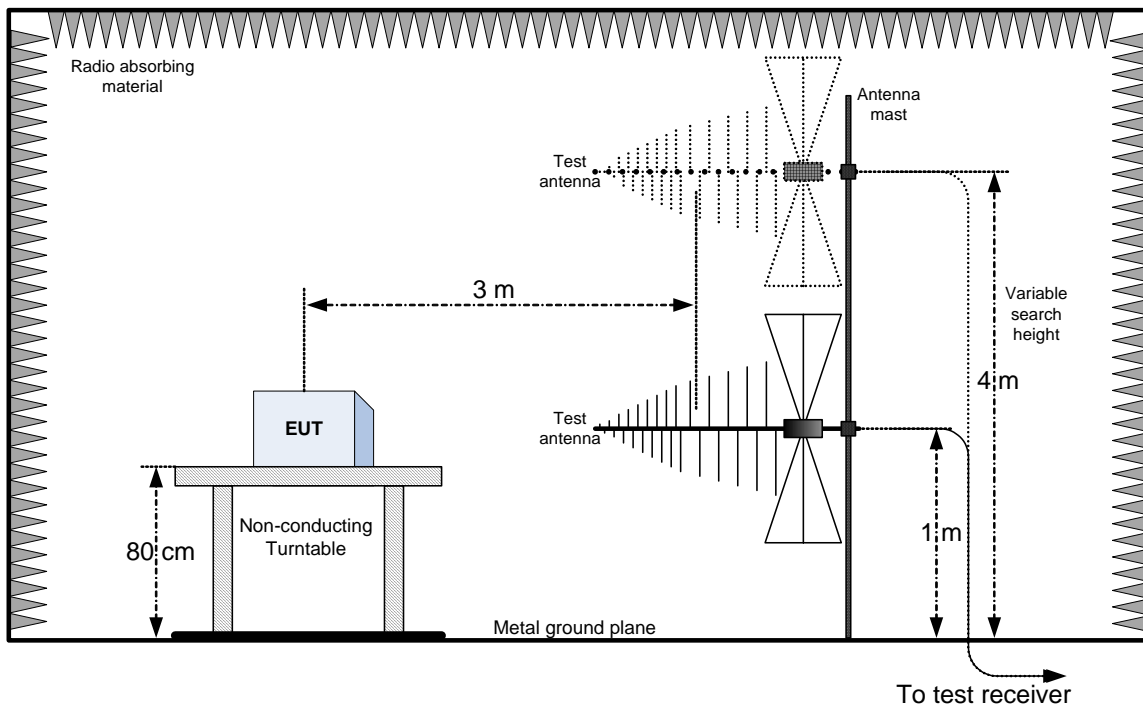
## Appendix B : Setup Photographs

### Spurious Emissions Setup:



## Appendix C : Block Diagram of Test Setups

### Radiated Emissions in 30–1000 MHz range Test Site



### Radiated Emissions above 1000 MHz Test Site

