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TEST REPORT

Report No.: 15050640HKG-001R1

Satarii Inc

Application
For
Certification
(Original Grant)
(FCC ID: AMX-2783MA)
(IC: 10134A-2783MA)

Transceiver

This report supersedes previous report with report number 15050640HKG-001 dated November 11, 2015

Prepared and Checked by:

Approved by:

Signed On File
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Date: December 09, 2015

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GENERAL INFORMATION

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Manufacturer Address:	Unit 12, 8F, Trans Asia Center, 18 Kin Hwong Street, Kwai Chung, N.T., Hong Kong.
Brand Name:	Swivl Marker
Model:	SW2783(MA)
Type of EUT:	Transceiver
Description of EUT:	Swivl Marker Tracking
Serial Number:	N/A
FCC ID / IC:	AMX-2783MA / 10134A-2783MA
Date of Sample Submitted:	May 12, 2015
Date of Test:	May 12, 2015 to June 07, 2015
Report No.:	15050640HKG-001R1
Report Date:	December 09, 2015
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

TEST SPECIFICATION	REFERENCE	RESULTS
Radiated Emission Radiated Emission on the Bandedge	15.249, 15.209 / RSS-210 A2.9, RSS-210 2.5	Pass
Radiated Emission in Restricted Bands	15.205 / RSS-210 2.2	Pass

The equipment under test is found to be complying with the following standards:

FCC Part 15, October 1, 2014 Edition

RSS-210 Issue 8, December 2010

RSS-Gen Issue 4, November 2014

- Note: 1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.
2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

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1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is the marker portion of the 2.4GHz remote control system. The EUT contains an audio interface and a Purepath Wireless transceiver. The Purepath Wireless transceiver in the EUT is operating in the frequency range from 2406MHz to 2474MHz (18 channels with 4MHz channel spacing). The EUT can be powered by 1x3.7V rechargeable battery (Li-Poly). The EUT can accept audio signal from the audio interface. It can be transferred together with the control signal via Purepath Wireless to the base. To charge the EUT, place it into the dock of the base to start the charging process.

Antenna Type: Internal, Integral

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transceiver.

The transceiver (Base) for this Remote unit (with FCC ID: AMX-2782BA) has been authorized by Certification procedure.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). All radiated measurements were performed in an 3m Chamber. Preliminary scans were performed in the 3m Chamber only to determine worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the “**Justification Section**” of this Application.

1.4 Test Facility

The 3m Chamber used to collect the radiated data is located at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong. This test facility and site measurement data have been placed on file with the FCC and IC.

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2.0 **System Test Configuration**

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The device was powered by 1 x 3.7VDC Ni-MH rechargeable battery.

For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The unit was operated standalone and placed in the center of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the wooden turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

There was no special software to exercise the device. Once the unit is powered up, it transmits the RF signal continuously.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

2.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

2.5 Support Equipment List and Description

N/A

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3.0 Emission Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any), Average Factor (optional) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG - AV$$

where FS = Field Strength in dB μ V/m
 RA = Receiver Amplitude (including preamplifier) in dB μ V
 CF = Cable Attenuation Factor in dB
 AF = Antenna Factor in dB
 AG = Amplifier Gain in dB
 AV = Average Factor in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

$$FS = RR + LF$$

where FS = Field Strength in dB μ V/m
 RR = RA - AG - AV in dB μ V
 LF = CF + AF in dB

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB are added. The amplifier gain of 29 dB and average factor of 5 dB are subtracted, giving a field strength of 27 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V/m	
AF = 7.4 dB	RR = 18.0 dB μ V
CF = 1.6 dB	LF = 9.0 dB
AG = 29.0 dB	
AV = 5.0 dB	
FS = RR + LF	
FS = 18 + 9 = 27 dB μ V/m	

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(27 \text{ dB}\mu\text{V/m})/20] = 22.4 \mu\text{V/m}$$

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 2474.000 MHz

For electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgment: Passed by 3.7 dB

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Applicant: Satarii Inc
Model: SW2783MA
Worst-Case Operating Mode: Transmitting

Date of Test: June 07, 2015

Table 1
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 / RSS-210 A2.9 Requirement

Lowest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2406.000	111.3	33	29.4	107.7	32.6	75.1	94.0	-18.9
V	2400.000	62.4	33	29.4	58.8	32.6	26.2	54.0	-27.8
V	4812.000	59.6	33	34.9	61.5	32.6	28.9	54.0	-25.1
H	7218.000	57.6	33	37.9	62.5	32.6	29.9	54.0	-24.1
H	9624.000	49.0	33	40.4	56.4	32.6	23.8	54.0	-30.2
H	12030.000	51.6	33	40.5	59.1	32.6	26.5	54.0	-27.5
H	14436.000	53.6	33	40.0	60.6	32.6	28.0	54.0	-26.0

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2406.000	111.3	33	29.4	107.7	114.0	-6.3
V	2400.000	62.4	33	29.4	58.8	74.0	-15.2
V	4812.000	59.6	33	34.9	61.5	74.0	-12.5
H	7218.000	57.6	33	37.9	62.5	74.0	-11.5
H	9624.000	49.0	33	40.4	56.4	74.0	-17.6
H	12030.000	51.6	33	40.5	59.1	74.0	-14.9
H	14436.000	53.6	33	40.0	60.6	74.0	-13.4

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative sign in the column shows value below limit.

4. Horn antenna is used for the emission over 1000MHz.

5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 Section 2.2.

6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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Applicant: Satarii Inc
Model: SW2783MA
Worst-Case Operating Mode: Transmitting

Date of Test: June 07, 2015

Table 2
Radiated Emissions
Pursuant to FCC Part 15 Section 15.249 / RSS-210 A2.9 Requirement

Middle Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2438.000	111.5	33	29.4	107.9	32.6	75.3	94.0	-18.7
V	4876.000	60.4	33	34.9	62.3	32.6	29.7	54.0	-24.3
H	7314.000	58.5	33	37.9	63.4	32.6	30.8	54.0	-23.2
H	9752.000	49.3	33	40.4	56.7	32.6	24.1	54.0	-29.9
H	12190.000	52.1	33	40.5	59.6	32.6	27.0	54.0	-27.0
H	14628.000	55.4	33	38.4	60.8	32.6	28.2	54.0	-25.8

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2438.000	111.5	33	29.4	107.9	114.0	-6.1
V	4876.000	60.4	33	34.9	62.3	74.0	-11.7
H	7314.000	58.5	33	37.9	63.4	74.0	-10.6
H	9752.000	49.3	33	40.4	56.7	74.0	-17.3
H	12190.000	52.1	33	40.5	59.6	74.0	-14.4
H	14628.000	55.4	33	38.4	60.8	74.0	-13.2

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 Section 2.2.
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Applicant: Satarii Inc
 Model: SW2783MA
 Worst-Case Operating Mode: Transmitting

Date of Test: June 07, 2015

Table 3
Radiated Emissions
 Pursuant to FCC Part 15 Section 15.249 / RSS-210 A2.9 Requirement

Highest Channel

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2474.000	113.9	33	29.4	110.3	32.6	77.7	94.0	-16.3
V	2483.500	65.8	33	29.4	62.2	32.6	29.6	54.0	-24.4
V	4948.000	59.3	33	34.9	61.2	32.6	28.6	54.0	-25.4
H	7422.000	58.6	33	37.9	63.5	32.6	30.9	54.0	-23.1
H	9896.000	49.8	33	40.4	57.2	32.6	24.6	54.0	-29.4
H	12370.000	52.3	33	40.5	59.8	32.6	27.2	54.0	-26.8
H	14844.000	55.6	33	38.4	61.0	32.6	28.4	54.0	-25.6

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
H	2474.000	113.9	33	29.4	110.3	114.0	-3.7
V	2483.500	65.8	33	29.4	62.2	74.0	-11.8
V	4948.000	59.3	33	34.9	61.2	74.0	-12.8
H	7422.000	58.6	33	37.9	63.5	74.0	-10.5
H	9896.000	49.8	33	40.4	57.2	74.0	-16.8
H	12370.000	52.3	33	40.5	59.8	74.0	-14.2
H	14844.000	55.6	33	38.4	61.0	74.0	-13.0

- NOTES: 1. Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 Section 2.2.
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

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Applicant: Satarii Inc
Model: SW2783MA
Worst-Case Operating Mode: Transmitting

Date of Test: June 07, 2015

Table 4
Radiated Emissions
Pursuant to FCC Part 15 Section 15.209 / RSS-210 2.5 Requirement

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
H	161.720	22.9	16	16.0	22.9	43.5	-20.6
H	208.660	23.0	16	17.0	24.0	43.5	-19.5
H	299.130	21.1	16	22.0	27.1	46.0	-18.9
H	346.260	21.3	16	24.0	29.3	46.0	-16.7
H	357.750	20.7	16	24.0	28.7	46.0	-17.3
H	535.100	14.6	16	28.0	26.6	46.0	-19.4
H	684.360	14.4	16	29.0	27.4	46.0	-18.6

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative sign in the column shows value below limit.
4. Horn antenna is used for the emission over 1000MHz.
5. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.
6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

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4.0 **Equipment Photographs**

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

5.0 **Product Labelling**

For electronics filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

6.0 **Technical Specifications**

For electronic filing, the block diagram and schematic of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

7.0 **Instruction Manual**

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States and Canada.

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8.0 **Miscellaneous Information**

The miscellaneous information includes details of the test procedure and measured bandwidth / calculation of factor such as pulse desensitization and averaging factor.

8.1 Radiated Emission on the Bandedge

Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50dB below the level of the fundamental or to the general radiated emissions limits in Section 15.209 / RSS-210 2.5, whichever is the lesser attenuation, which meet the requirement of part 15.249(d) / RSS-210 A2.9.

The bandedge data have been placed on this report on page 5 and 7.

The resultant field strength meets the general radiated emission limit in Section 15.209 / RSS-210 2.5, which does not exceed 74 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

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8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (Teff) is approximately 0.8ms for a digital "1" bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 3MHz, so the pulse desensitivity factor is 0dB.

8.3 Calculation of Average Factor

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 100ms

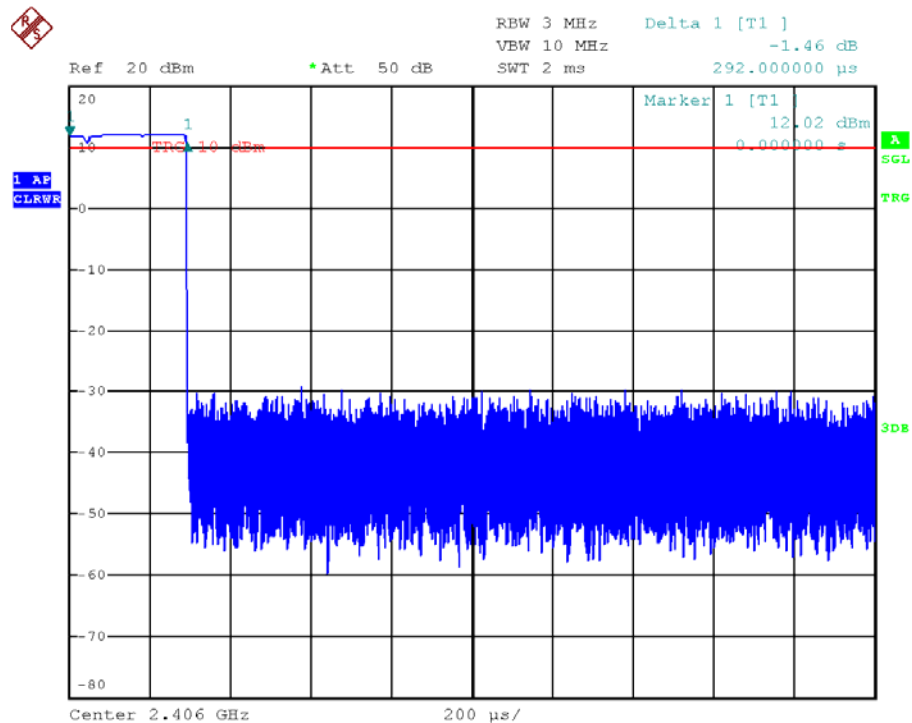
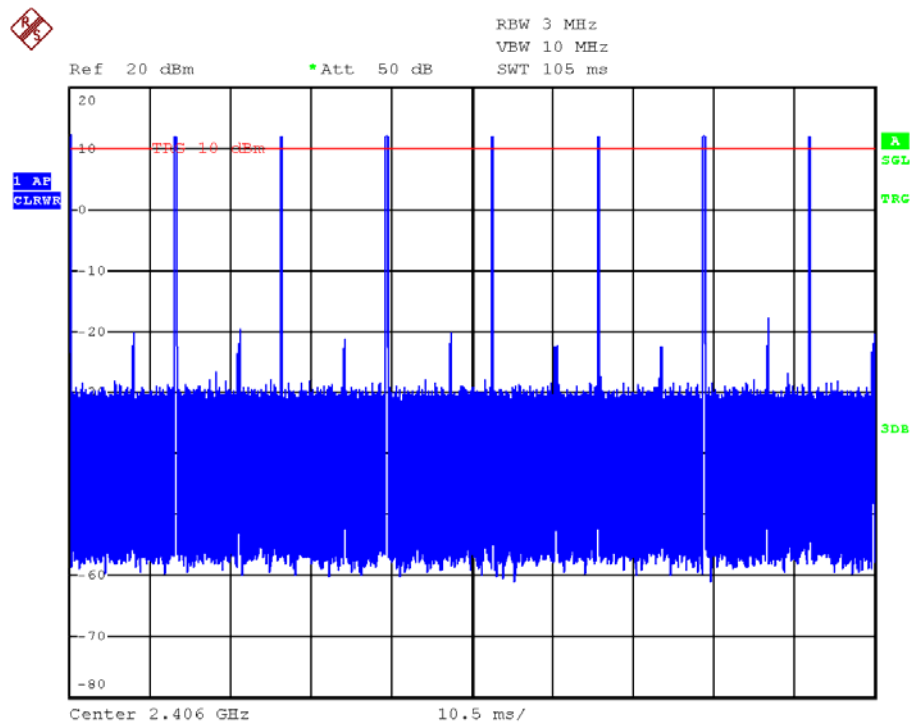
Effective period of the cycle = $0.292 \times 8 = 2.336\text{ms}$

DC = $2.336\text{ms} / 100\text{ms} = 0.02336$

Therefore, the averaging factor is found by $20\log 0.02336 = -32.6\text{dB}$.

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Worse case average factor occurred at normal operation



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8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services Hong Kong Ltd. in the measurements of transmitter operating under the Part 15, Subpart C rules.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately 0.8m in height above the ground plane for emission measurement at or below 1GHz and 1.5m in height above the ground plane for emission measurement above 1GHz. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axis to obtain maximum emission levels. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

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8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements were made as described in ANSI C63.10 (2013).

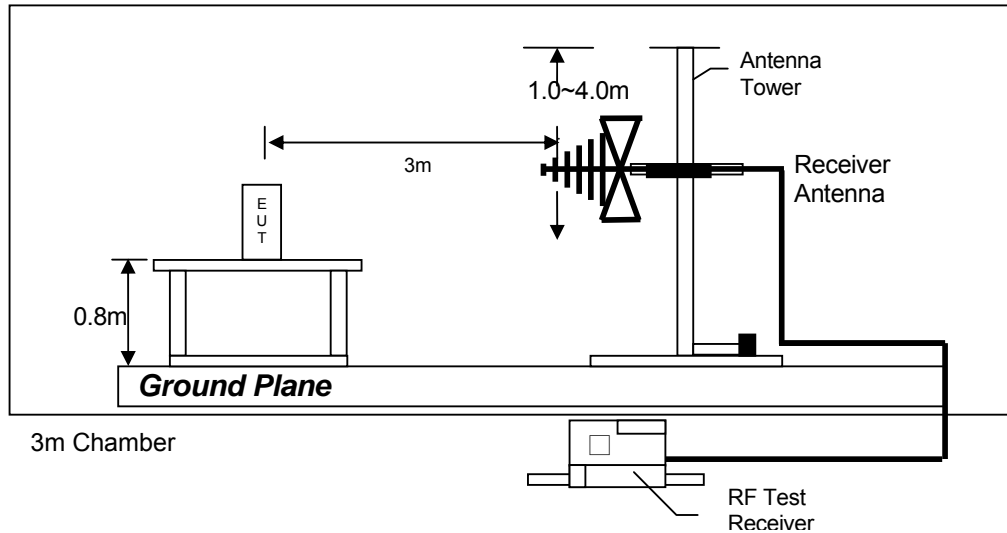
The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 10 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, unless otherwise reported. Measurements taken at a closer distance are so marked.

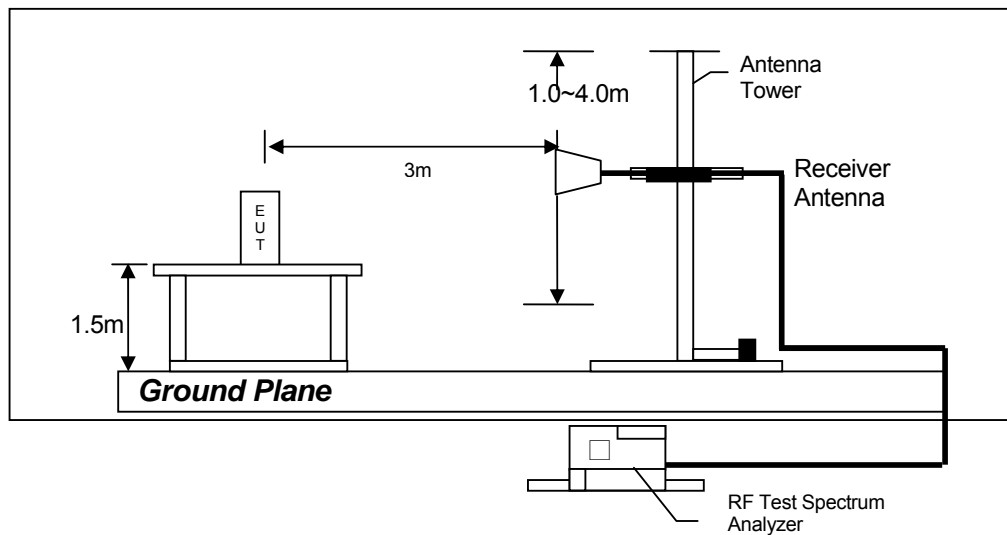
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8.4.1 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

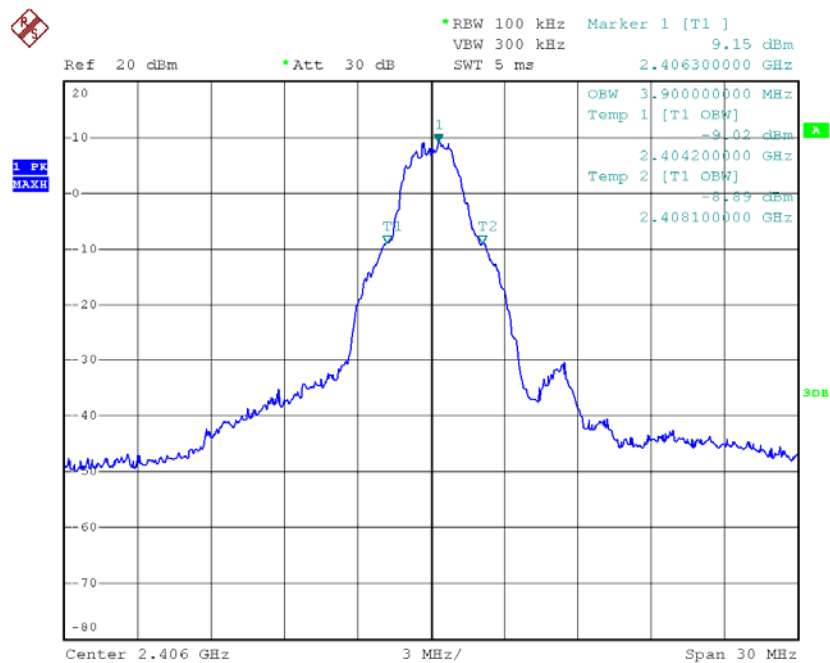
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8.5 Occupied Bandwidth

Occupied Bandwidth Results:

	Occupied Bandwidth (MHz)
Low Channel: 2406	3.90
Middle Channel: 2438	3.90
High Channel: 2474	3.84

The worst case is shown as below



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9.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer
Registration No.	EW-3095	EW-2466
Manufacturer	R&S	R&S
Model No.	ESCI	FSP30
Calibration Date	Oct. 16, 2014	Sep. 02, 2014
Calibration Due Date	Oct. 16, 2015	Sep. 02, 2015

Equipment	BiConiLog Antenna	Pyramidal Horn Antenna	Double Ridged Guide Antenna
Registration No.	EW-3061	EW-0905	EW-1133
Manufacturer	EMCO	EMCO	EMCO
Model No.	3412E	3160-09	3115
Calibration Date	Jul. 17, 2014	Jan. 28, 2014	Apr. 30, 2014
Calibration Due Date	Jul. 17, 2015	Jul. 28, 2015	Oct. 30, 2015

2) Average factor Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2249
Manufacturer	R&S
Model No.	FSP30
Calibration Date	Nov. 19, 2014
Calibration Due Date	Nov. 19, 2015

END OF TEST REPORT