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TEST REPORT

Report No.: 14010177HKG-002R1

Satarii Inc

Application
For
Certification
(Original Grant)
(FCC ID: AMX-2782MA)
(IC: 10134A-2782MA)
Transceiver

This report supersedes previous report with report number 14010177HKG-002 dated March 19, 2014

Prepared and Checked by:

Approved by:

Signed On File
Allen Wong
Assistant Engineer

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Lead Engineer
Date: March 26, 2014

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INTERTEK TESTING SERVICES

GENERAL INFORMATION

Satarii Inc
BRAND NAME: Swivl, MODEL: SW2782(MA)

FCC ID: AMX-2782MA
IC: 10134A-2782MA

Grantee:	Satarii Inc
Grantee Address:	1354 El Camino Real, San Carlos, California 94070, United States.
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Manufacturer:	Satarii Inc
Manufacturer Address:	1354 El Camino Real, San Carlos, California 94070, United States.
Brand Name:	Swivl
Model:	SW2782(MA)
Type of EUT:	Transceiver
Description of EUT:	Swivl Marker
Serial Number:	N/A
FCC ID / IC:	AMX-2782MA / 10134A-2782MA
Date of Sample Submitted:	January 06, 2014
Date of Test:	January 06, 2014 to January 30, 2014
Report No.:	14010177HKG-002R1
Report Date:	March 26, 2014
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

Satarii Inc

BRAND NAME: Swivl, MODEL: SW2782(MA)

FCC ID: AMX-2782MA

IC: 10134A-2782MA

TEST SPECIFICATION	REFERENCE	RESULTS
Bandwidth Requirement	15.249 /	Pass
Radiated Emission	210 A2.9 (a) A2.9 (b)	
Radiated Emission on the Bandedge		

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

FCC Part 15, October 1, 2012 Edition

RSS-210 Issue 8, December 2010

RSS-Gen Issue 3, December 2010

- 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.

Report No.: 14010177HKG-002R1

FCC ID: AMX-2782MA

IC: 10134A-2782MA

INTERTEK TESTING SERVICES

Table of Contents

1.0	<u>General Description</u>	1
1.1	Product Description	1
1.2	Related Submittal(s) Grants	1
1.3	Test Methodology	1
1.4	Test Facility	1
2.0	<u>System Test Configuration</u>	2
2.1	Justification	2
2.2	EUT Exercising Software	2
2.3	Special Accessories	2
2.4	Equipment Modification	2
2.5	Measurement Uncertainty	2
2.6	Support Equipment List and Description	2
3.0	<u>Emission Results</u>	3
3.1	Field Strength Calculation	3
3.2	Radiated Emission Configuration Photograph	4
3.3	Radiated Emission Data	4
4.0	<u>Equipment Photographs</u>	8
5.0	<u>Product Labelling</u>	8
6.0	<u>Technical Specifications</u>	8
7.0	<u>Instruction Manual</u>	8
8.0	<u>Miscellaneous Information</u>	9
8.1	Measured Bandwidth	9
8.2	Discussion of Pulse Desensitization	12
8.3	Calculation of Average Factor	12
8.4	Emissions Test Procedures	15
9.0	<u>Confidentiality Request</u>	16
10.0	<u>Equipment List</u>	17

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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 1 X 3.7V 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 Certification procedure of transceiver (Swivl Base) (with FCC ID: AMX-2782BA and IC: 10134A-2782BA) for this transceiver (Swivl Marker) (with FCC ID: AMX-2782MA and IC: 10134A-2782MA) is being processed as the same time of this application.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2009). All radiated measurements were performed in an Open Area Test Site. Preliminary scans were performed in the Open Area Test Site 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 open area test site and conducted measurement facility used to collect the radiated data is located at Garment Centre, 576 Castle Peak Road, Kowloon, 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 C63.4 (2009).

The device was powered by 1 x 3.7V Lithium rechargeable battery pack.

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 Equipment Modification

Any modifications installed previous to testing by Satarii Inc will be incorporated in each production model sold/leased in the United States and Canada.

No modifications were installed by Intertek Testing Services Hong Kong Ltd.

2.5 Measurement Uncertainty

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

2.6 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.

$$RA = 52.0 \text{ dB}\mu\text{V/m}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$AV = 5.0 \text{ dB}$$

$$FS = RR + LF$$

$$FS = 18 + 9 = 27 \text{ dB}\mu\text{V/m}$$

$$RR = 18.0 \text{ dB}\mu\text{V}$$

$$LF = 9.0 \text{ dB}$$

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

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3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 2406.000 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 13.2 dB

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Applicant: Satarii Inc
Model: SW2782(MA)
Worst-Case Operating Mode: Transmitting

Date of Test: January 30, 2014

Table 1

Radiated Emissions Pursuant to FCC Part 15 Section 15.249 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)
V	2406.000	104.4	33	29.4	100.8	29.5	71.3	94.0	-22.7
V	4812.000	42.3	33	34.9	44.2	29.5	14.7	54.0	-39.3
V	7218.000	41.9	33	37.9	46.8	29.5	17.3	54.0	-36.7
V	9624.000	41.1	33	40.4	48.5	29.5	19.0	54.0	-35.0
V	12030.000	42.8	33	40.5	50.3	29.5	20.8	54.0	-33.2
V	14436.000	45.4	33	40.0	52.4	29.5	22.9	54.0	-31.1

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)
V	2406.000	104.4	33	29.4	100.8	114.0	-13.2
V	4812.000	42.3	33	34.9	44.2	74.0	-29.8
V	7218.000	41.9	33	37.9	46.8	74.0	-27.2
V	9624.000	41.1	33	40.4	48.5	74.0	-25.5
V	12030.000	42.8	33	40.5	50.3	74.0	-23.7
V	14436.000	45.4	33	40.0	52.4	74.0	-21.6

- 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. For the measurement of radiated emission, summation method was used which numerical integrating (in terms of linear power) over the transmitter occupied bandwidth.
6. For the linear power measurement, data in 1MHz spacing was collected by spectrum analyzer with 1MHz resolution bandwidth.

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Applicant: Satarii Inc
Model: SW2782(MA)
Worst-Case Operating Mode: Transmitting

Date of Test: January 30, 2014

Table 2

Radiated Emissions Pursuant to FCC Part 15 Section 15.249 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)
V	2438.000	104.1	33	29.4	100.5	29.5	71.0	94.0	-23.0
V	4876.000	42.7	33	34.9	44.6	29.5	15.1	54.0	-38.9
V	7314.000	41.8	33	37.9	46.7	29.5	17.2	54.0	-36.8
V	9752.000	41.5	33	40.4	48.9	29.5	19.4	54.0	-34.6
V	12190.000	43.2	33	40.5	50.7	29.5	21.2	54.0	-32.8
V	14628.000	47.2	33	38.4	52.6	29.5	23.1	54.0	-30.9

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)
V	2438.000	104.1	33	29.4	100.5	114.0	-13.5
V	4876.000	42.7	33	34.9	44.6	74.0	-29.4
V	7314.000	41.8	33	37.9	46.7	74.0	-27.3
V	9752.000	41.5	33	40.4	48.9	74.0	-25.1
V	12190.000	43.2	33	40.5	50.7	74.0	-23.3
V	14628.000	47.2	33	38.4	52.6	74.0	-21.4

- 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. For the measurement of radiated emission, summation method was used which numerical integrating (in terms of linear power) over the transmitter occupied bandwidth.
6. For the linear power measurement, data in 1MHz spacing was collected by spectrum analyzer with 1MHz resolution bandwidth.

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Applicant: Satarii Inc
Model: SW2782(MA)
Worst-Case Operating Mode: Transmitting

Date of Test: January 30, 2014

Table 3

Radiated Emissions Pursuant to FCC Part 15 Section 15.249 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)
V	2474.000	103.6	33	29.4	100.0	29.5	70.5	94.0	-23.5
V	4948.000	42.3	33	34.9	44.2	29.5	14.7	54.0	-39.3
V	7422.000	41.6	33	37.9	46.5	29.5	17.0	54.0	-37.0
V	9896.000	40.8	33	40.4	48.2	29.5	18.7	54.0	-35.3
V	12370.000	43.3	33	40.5	50.8	29.5	21.3	54.0	-32.7
V	14844.000	46.8	33	38.4	52.2	29.5	22.7	54.0	-31.3

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)
V	2474.000	103.6	33	29.4	100.0	114.0	-14.0
V	4948.000	42.3	33	34.9	44.2	74.0	-29.8
V	7422.000	41.6	33	37.9	46.5	74.0	-27.5
V	9896.000	40.8	33	40.4	48.2	74.0	-25.8
V	12370.000	43.3	33	40.5	50.8	74.0	-23.2
V	14844.000	46.8	33	38.4	52.2	74.0	-21.8

- 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. For the measurement of radiated emission, summation method was used which numerical integrating (in terms of linear power) over the transmitter occupied bandwidth.
6. For the linear power measurement, data in 1MHz spacing was collected by spectrum analyzer with 1MHz resolution bandwidth.

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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

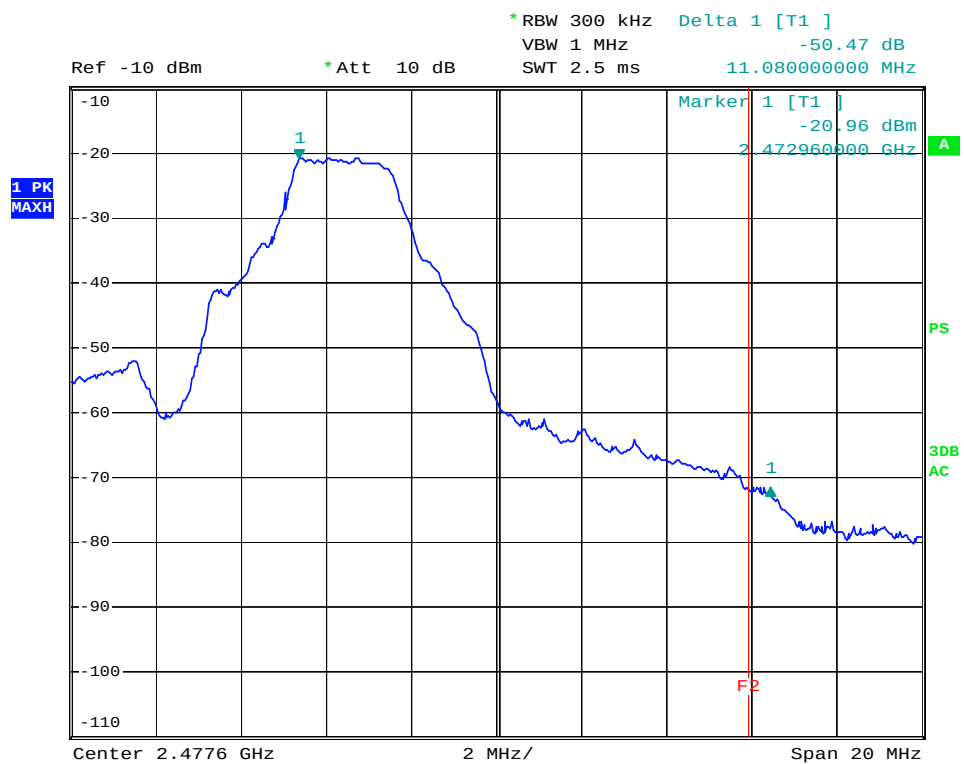
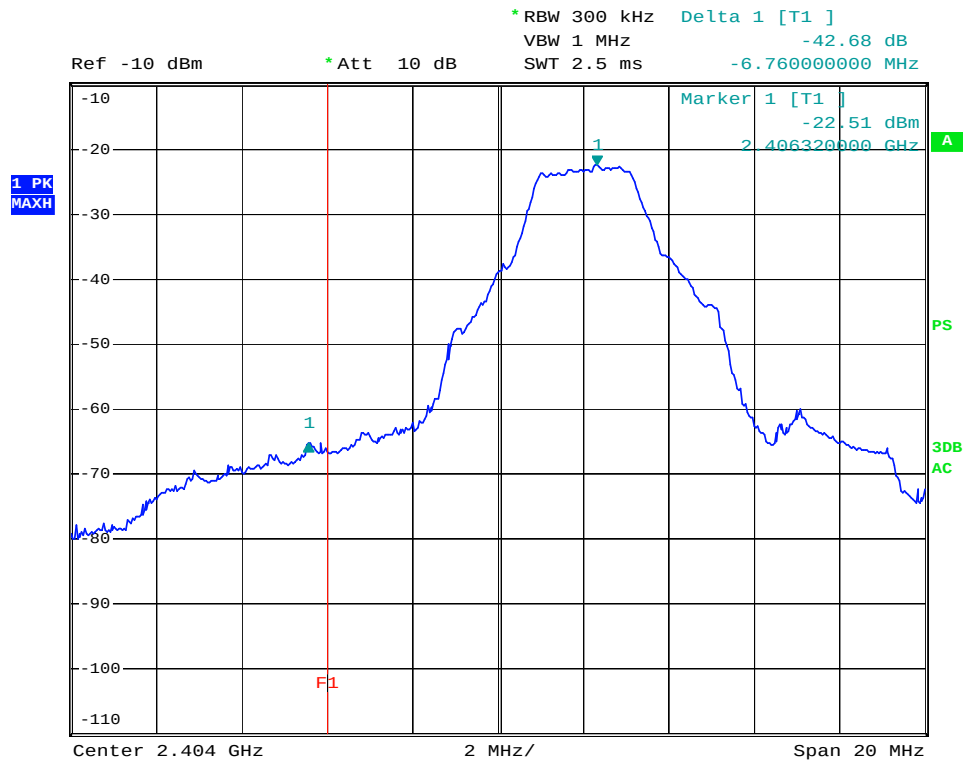
The miscellaneous information includes details of the test procedure and measured bandwidth / calculation of factor such as pulse desensitization and averaging factor (calculation and timing diagram).

8.1 Measured Bandwidth

From the following plots, they show that the fundamental emissions are confined in the specified band (2400MHz to 2483.5MHz). In case of the fundamental emissions are within two standard bandwidths from the bandedge, the delta measurement technique is used for determining bandedge compliance. Standard bandwidth is the bandwidth specified by ANSI C63.4 (2009) for frequency being measured.

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, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

INTERTEK TESTING SERVICES



Report No.: 14010177HKG-002R1

FCC ID: AMX-2782MA

IC: 10134A-2782MA

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Peak Measurement

Bandedge compliance is determined by applying marker-delta method, i.e. (Bandedge Plot).

Lower bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=100.8 dB μ V/m - 42.7 dB
=58.1 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=71.0 dB μ V/m - 42.7 dB
=28.3 dB μ V/m

Upper bandedge

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the plot

=100.0 dB μ V/m - 50.5 dB
=49.5 dB μ V/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the plot

=70.5 dB μ V/m - 50.5 dB
=20.0 dB μ V/m

The resultant field strength meets the general radiated emission limit in section 15.209, 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 (T_{eff}) is approximately 0.42ms for a digital "1" bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 1MHz, 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:

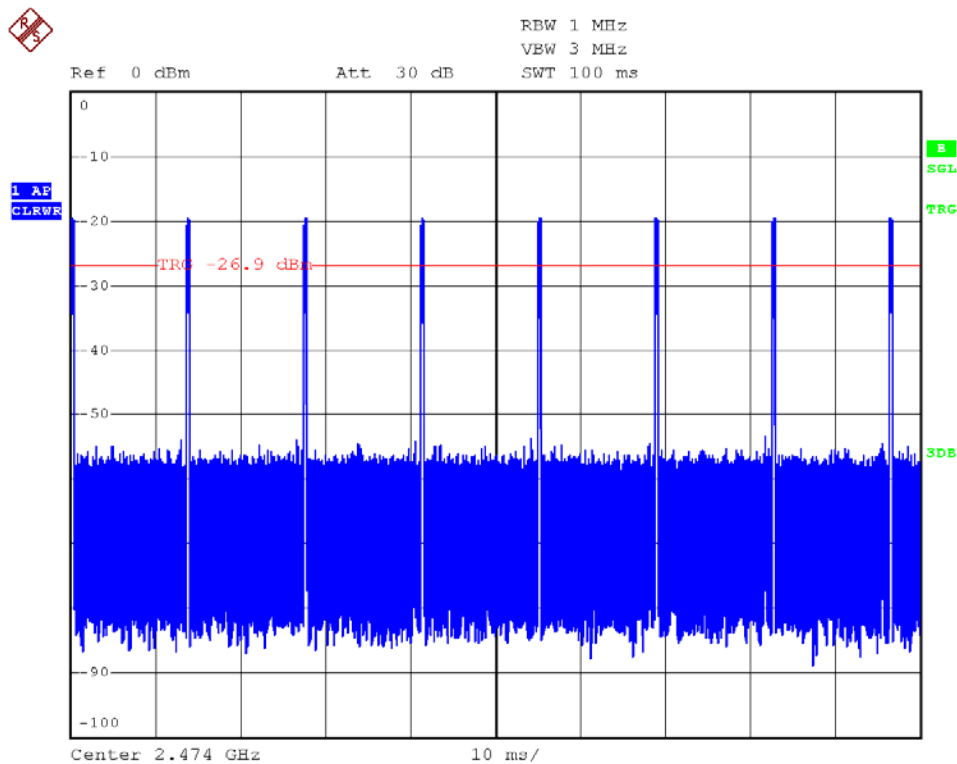
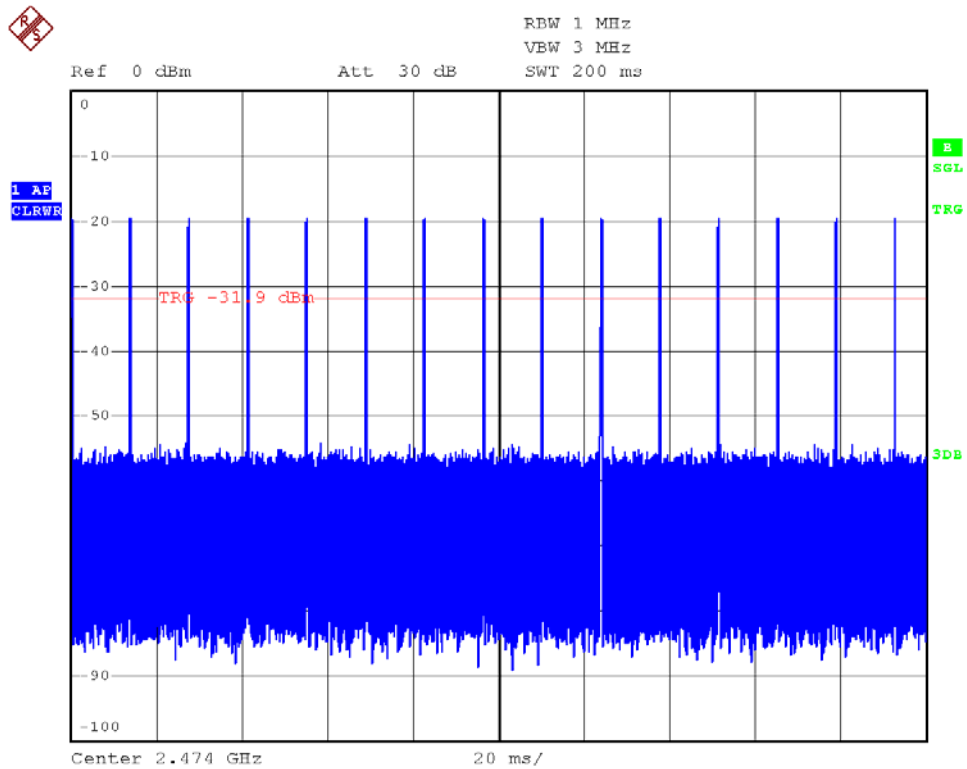
The duration of one cycle = 100 ms

Effective period of the cycle = $8 \times 0.420 = 3.360$ ms

DC = $3.360 / 100 = 0.0336$

Therefore, the averaging factor is found by $20\log 0.0336 = -29.5\text{dB}$.

INTERTEK TESTING SERVICES

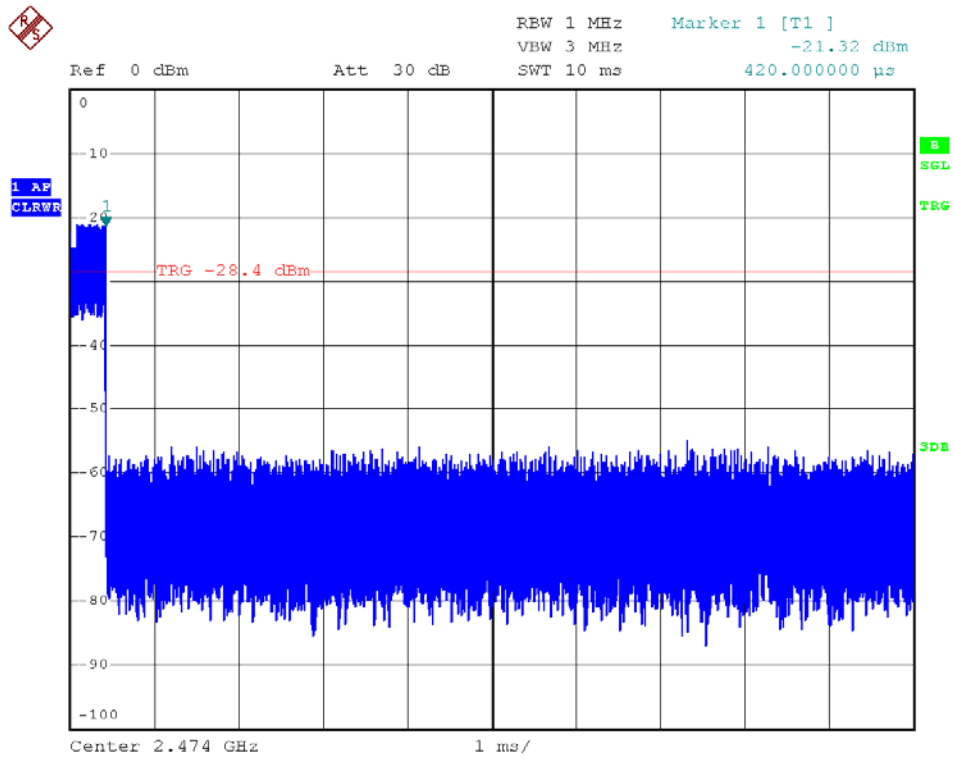


Report No.: 14010177HKG-002R1

FCC ID: AMX-2782MA

IC: 10134A-2782MA

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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 one meter in height above the ground plane. 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.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

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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 C63.4 (2009).

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 1 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.

9.0 **Confidentiality Request**

For electronic filing, a preliminary copy of the confidentiality request is saved with filename: request.pdf.

INTERTEK TESTING SERVICES

10.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Biconical Antenna	Log Periodic Antenna
Registration No.	EW-2500	EW-0954	EW-0446
Manufacturer	R&S	EMCO	EMCO
Model No.	ESCI	3104C	3146
Calibration Date	Mar. 22, 2013	Apr. 30, 2013	Apr. 30, 2013
Calibration Due Date	Feb. 28, 2014	Oct. 30, 2014	Oct. 30, 2014

Equipment	Spectrum Analyzer	Double Ridged Guide Antenna
Registration No.	EW-2188	EW-1133
Manufacturer	AGILENTTECH	EMCO
Model No.	E4407B	3115
Calibration Date	Nov. 05, 2012	Oct. 05, 2012
Calibration Due Date	Feb. 05, 2014	Apr. 05, 2014

2) Bandedge Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2329
Manufacturer	R&S
Model No.	FSP3
Calibration Date	Jan. 30, 2013
Calibration Due Date	Apr. 30, 2014