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TEST REPORT

Report No.: 14050180HKG-006

LF Products Pte Ltd

Application
For
Certification
(Original Grant)
(FCC ID: 2ACIG-9751USTX)
(IC: 12051A-9751CATX)

Transmitter

Prepared and Checked by:

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Signed On File
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Date: June 25, 2014

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GENERAL INFORMATION

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Contact Person:	Philip Chiu
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Manufacturer:	Max-Plus Co., Ltd
Manufacturer Address:	4/F, A Building, No. 3 Jin Ye Street, Ping Nan Village, San Xiang Town, China.
Brand Name:	The Elf Light
FCC Model:	9751-US
IC Model:	9751-CATX
Type of EUT:	Transmitter
Description of EUT:	RF Remote Controller for Elf Light
Serial Number:	N/A
FCC ID / IC:	2ACIG-9751USTX / 12051A-9751CATX
Date of Sample Submitted:	May 05, 2014
Date of Test:	May 05, 2014 to June 14, 2014
Report No.:	14050180HKG-006
Report Date:	June 25, 2014
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

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SUMMARY OF TEST RESULT

TEST SPECIFICATION	REFERENCE	RESULTS
Transmitter Field Strength, Bandwidth and Timing Requirement	15.231(a), (b), (c) / RSS-210 A1.1	Pass
Radiation 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, 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.

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1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is a portable RF Remote Controller for an Elf Light Green/Red version. It operates at frequency of 433.920 MHz. The EUT is powered by 1 x 23A size 12V Alkaline Battery. It transmits RF signal when key is pressed. It can change the light color (green or red), flash speed and have timer preset function.

Antenna Type: External / Telescope-type antenna

IC Model: 9751-CATX is the same as the FCC Model: 9751-US in electrical designs, including software & firmware, PCB layout and construction design/physical design /enclosure. The only differences between these models are color and model number to be sold for marketing purpose.

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 transmitter.

The Certification procedure of receiver (with FCC ID: 2ACIG-9751USRX) for this transmitter (with FCC ID: 2ACIG-9751USTX) is being processed as the same time of this application.

1.3 Test Methodology

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 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 new 1 x 23A size 12V alkaline 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.

All the relevant operation modes have been tested, and the worst case data is included in this report.

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 until key released.

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.

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 32 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 433.974 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 5.8 dB

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Applicant: LF Products Pte Ltd
Model: 9751-US
Worst-Case Operating Mode: Transmission

Date of Test: June 11, 2014

Table 1

Radiated Emissions Pursuant to FCC Part 15 Section 15.231(a) Requirement

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp (dB)	Antenna factor (dB)	Average Factor (dB)	Net at 3m Average (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	433.920	73.5	16	25.0	7.5	75.0	80.8	-5.8
V	867.840	41.3	16	31.0	7.5	48.8	60.8	-12.0
H	1301.760	56.4	33	26.1	7.5	42.0	54.0	-12.0
H	1735.680	56.4	33	27.2	7.5	43.1	60.8	-17.7
H	2169.600	52.2	33	29.4	7.5	41.1	60.8	-19.7
H	2603.520	50.8	33	30.4	7.5	40.7	60.8	-20.1
H	3037.440	49.1	33	31.9	7.5	40.5	60.8	-20.3
H	3471.360	48.7	33	31.9	7.5	40.1	60.8	-20.7
H	3905.280	47.1	33	33.3	7.5	39.9	54.0	-14.1
H	4339.200	45.5	33	34.8	7.5	39.8	54.0	-14.2

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
- 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.

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Applicant: LF Products Pte Ltd
Model: 9751-US
Worst-Case Operating Mode: Transmission

Date of Test: June 11, 2014

Table 2

Radiated Emissions
Pursuant to FCC Part 15 Section 15.231(a) Requirement

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp (dB)	Antenna factor (dB)	Net at 3m Peak (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
V	433.920	73.5	16	25.0	82.5	100.8	-18.3
V	867.840	41.3	16	31.0	56.3	80.8	-24.5
H	1301.760	56.4	33	26.1	49.5	74.0	-24.5
H	1735.680	56.4	33	27.2	50.6	80.8	-30.2
H	2169.600	52.2	33	29.4	48.6	80.8	-32.2
H	2603.520	50.8	33	30.4	48.2	80.8	-32.6
H	3037.440	49.1	33	31.9	48.0	80.8	-32.8
H	3471.360	48.7	33	31.9	47.6	80.8	-33.2
H	3905.280	47.1	33	33.3	47.4	74.0	-26.6
H	4339.200	45.5	33	34.8	47.3	74.0	-26.7

NOTES: 1. Peak Detector Data unless otherwise stated.

- 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.
- Negative sign in the column shows value below limit.
- Horn antenna is used for the emission over 1000MHz.
- 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.

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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.

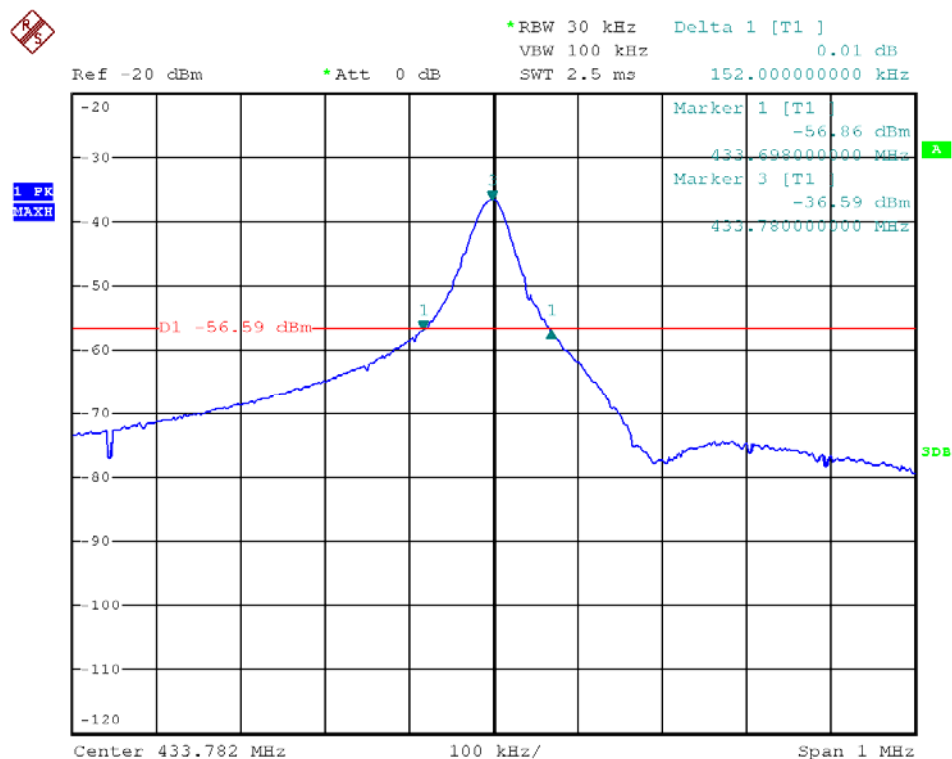
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8.0 Miscellaneous Information

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

This plot shows the fundamental emission when modulated. From the plot, the bandwidth is observed to be 152kHz, at 20dBc where the bandwidth limit is 1084.8kHz. It fulfils the requirement of 15.231(C).



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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 320 μ s for a digital “1” bit which illustrated on technical specification, with a resolution bandwidth (3dB) of 100kHz, 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

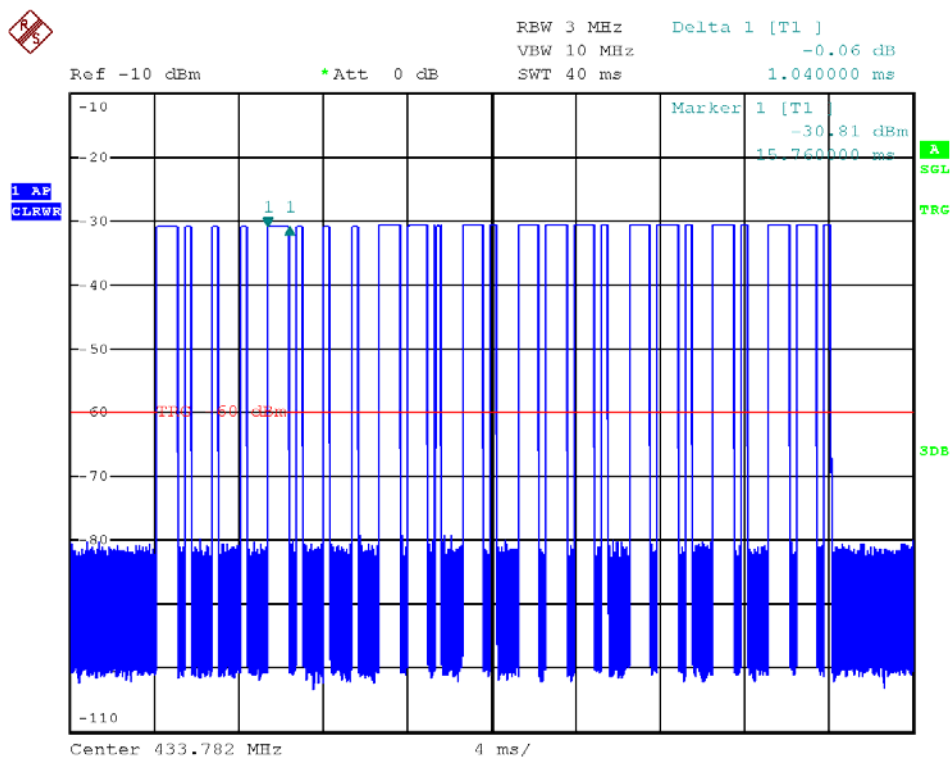
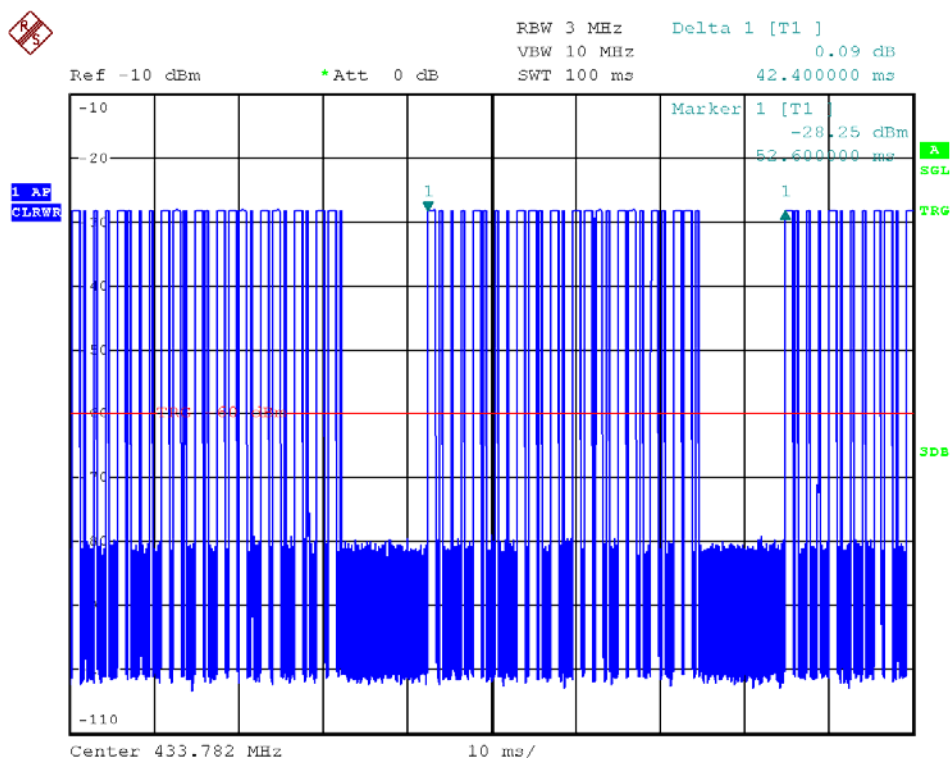
Effective period of the cycle =

$13 \times 1.04\text{ms} + 12 \times 0.32\text{ms} + 13 \times 1.04\text{ms} + 12 \times 0.32\text{ms} + 5 \times 1.04\text{ms} + 7 \times 0.32\text{ms}$

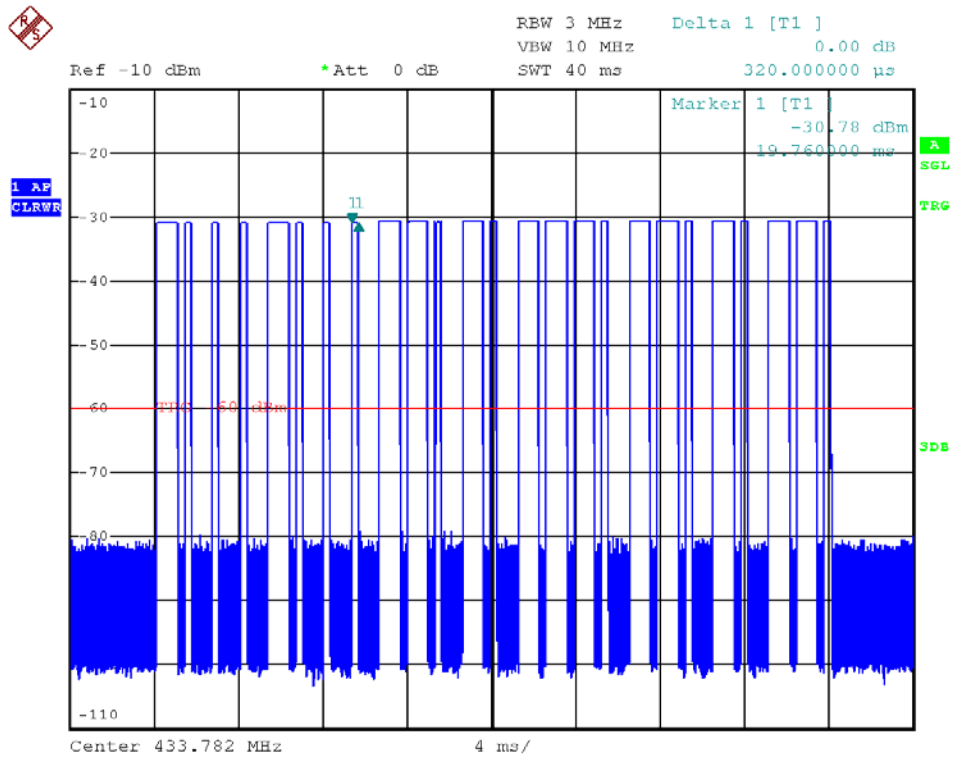
$DC = 42.16 / 100\text{ms} = 0.4216$

Therefore, the averaging factor is found by $20\log 0.4216 = -7.5\text{dB}$.

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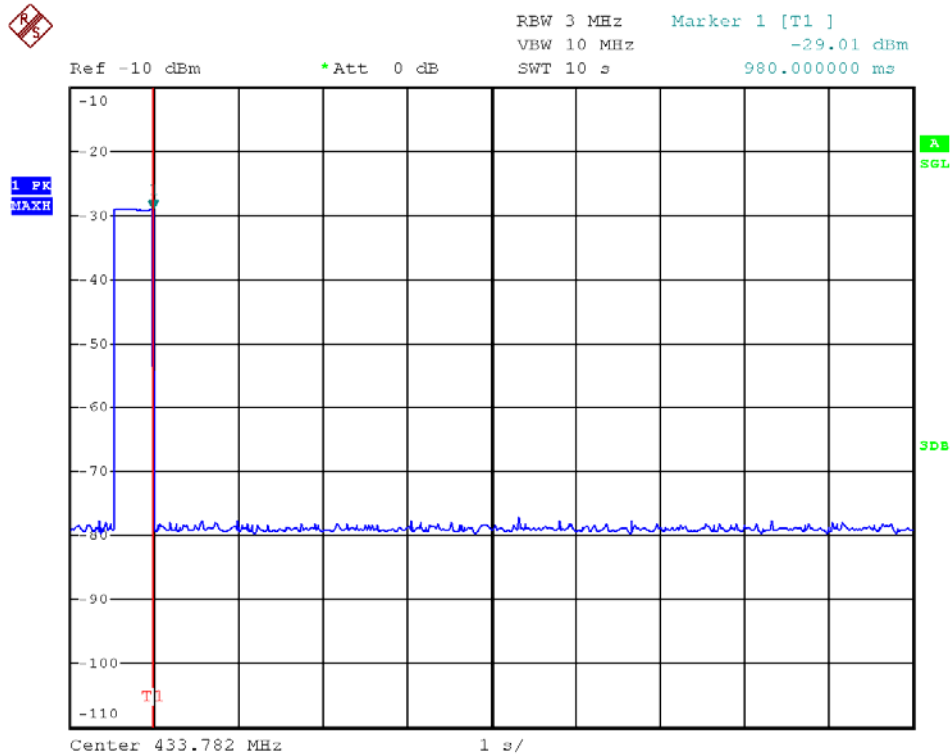


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Timing Plot – Pursuant to FCC Part 15 Section 15.231(a)



Result: The emission was found to cease within 5 seconds after key release.

Comment: Pass.

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.

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.

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9.0 Equipment List

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Biconical Antenna	Log Periodic Antenna
Registration No.	EW-2666	EW-2512	EW-0446
Manufacturer	R&S	EMCO	EMCO
Model No.	ESCI7	3104C	3146
Calibration Date	Jun. 20, 2013	Jun. 25, 2013	Apr. 30, 2013
Calibration Due Date	Jun. 20, 2014	Dec. 25, 2014	Oct. 30, 2014

Equipment	Spectrum Analyzer	Double Ridged Guide Antenna
Registration No.	EW-2188	EW-1015
Manufacturer	AGILENTTECH	EMCO
Model No.	E4407B	3115
Calibration Date	Apr. 16, 2014	Mar. 05, 2013
Calibration Due Date	Apr. 16, 2015	Sep. 05, 2014

2) Bandwidth Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-2249
Manufacturer	R&S
Model No.	FSP30
Calibration Date	Oct. 28, 2013
Calibration Due Date	Oct. 28, 2014

END OF TEST REPORT