

**TEST REPORT****Report No.: 14050180HKG-002****LF Products Pte Ltd**

Application  
For  
Certification  
(Original Grant)  
**(FCC ID: 2ACIG-9751USRX)**

Superregenerative Receiver

Prepared and Checked by:

Signed On File  
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Date: June 25, 2014

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## GENERAL INFORMATION

|                           |  |
|---------------------------|--|
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| Manufacturer:             | Max-Plus Co., Ltd  |
| Manufacturer Address:     | 4/F, A Building, No. 3 Jin Ye Street,<br>Ping Nan Village, San Xiang Town,<br>China. |
| Brand Name:               | The Elf Light  |
| Model:                    | 9751-US  |
| Type of EUT:              | Superregenerative Receiver   |
| Description of EUT:       | Elf Light Green/Red with Remote  |
| Serial Number:            | N/A  |
| FCC ID:                   | 2ACIG-9751USRX   |
| Date of Sample Submitted: | May 05, 2014   |
| Date of Test:             | May 05, 2014 to June 10, 2014  |
| Report No.:               | 14050180HKG-002  |
| Report Date:              | June 25, 2014  |
| Environmental Conditions: | Temperature: +10 to 40°C<br>Humidity: 10 to 90%                                      |

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### SUMMARY OF TEST RESULT

| TEST SPECIFICATION                           | REFERENCE | RESULTS |
|--|-----------|---------|
| Receiver / Digital Device Radiated Emissions | 15.109    | Pass    |
| Digital Device Conducted Emissions           | 15.107    | Pass    |

The equipment under test is found to be complying with the following standards:  
FCC Part 15, October 1, 2012 Edition

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## 1.0 General Description

### 1.1 Product Description

The Equipment Under Test (EUT) is an ELF Light Green/Red with Remote Control. It operates at frequency of 433.920 MHz. The EUT is powered by an adaptor 120VAC to 12VAC 1000mA. It is a laser light projector with built-in superregenerative receiver. It can emit green/red laser color, flashing and timer preset to turn OFF/ON light via the portable wireless remote controller.

Antenna Type: External, 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 receiver.

The Certification procedure of transmitter (with FCC ID: 2ACIG-9751USTX) for this receiver (with FCC ID: 2ACIG-9751USRX) 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.

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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 AC/AC Adaptor (Model: XY-12100AUO, Input: 120VAC 60Hz, Output: 12VAC 1000mA 12W).

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 rear of unit shall be flushed with the rear of the table.

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 receives 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

An AC adaptor (Input:120VAC 60Hz; Output: 12VAC 1000mA, 12W Model: XY-12100AUO, Brand: Xing Yuan) (Supplied by Applicant)

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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  $\text{dB}\mu\text{V}/\text{m}$

$RA$  = Receiver Amplitude (including preamplifier) in  $\text{dB}\mu\text{V}$

$CF$  = 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  $\text{dB}\mu\text{V}/\text{m}$

$RR$  =  $RA - AG - AV$  in  $\text{dB}\mu\text{V}$

$LF$  =  $CF + AF$  in dB

Assume a receiver reading of 52.0  $\text{dB}\mu\text{V}$  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  $\text{dB}\mu\text{V}/\text{m}$ . This value in  $\text{dB}\mu\text{V}/\text{m}$  was converted to its corresponding level in  $\mu\text{V}/\text{m}$ .

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

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

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

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

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

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

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

$$FS = RR + LF$$

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

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

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### 3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 434.200 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 3.1 dB

### 3.4 Conducted Emission Configuration Photograph

For electronic filing, the worst case line-conducted configuration photographs are saved with filename: conducted photo.pdf.

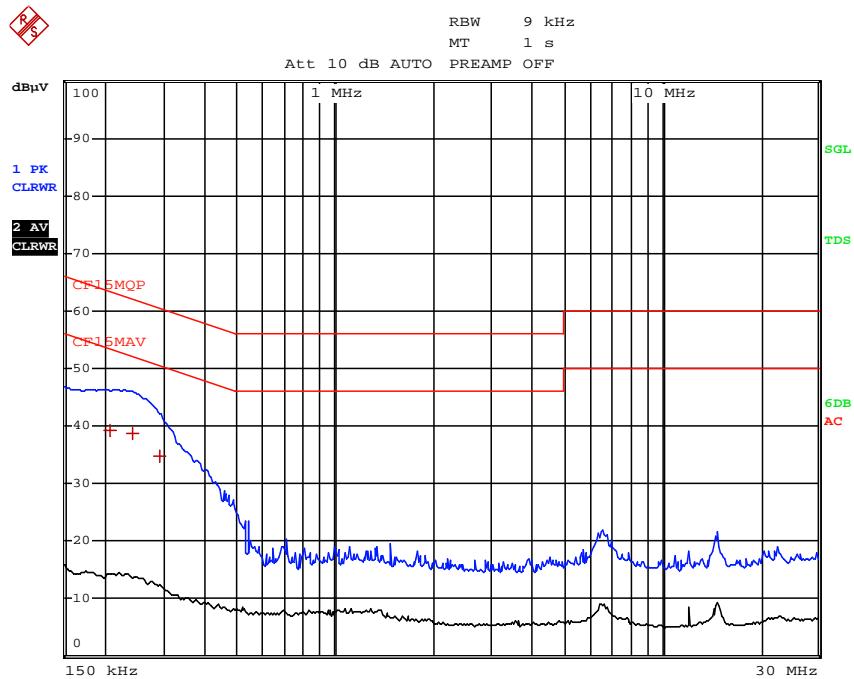
### 3.5 Conducted Emission Data

The graph and data table of conducted emission is shown in the following pages.

Judgment: Pass by more than 20dB margin compared with limit

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## Worst-Case Operating Mode: Receive (Light On)



| EDIT PEAK LIST (Final Measurement Results) |           |            |       |          |
|--|-----------|------------|-------|----------|
| Trace1:                                    | CF15MQP   |            |       |          |
| Trace2:                                    | CF15MAV   |            |       |          |
| Trace3:                                    | ---       |            |       |          |
| TRACE                                      | FREQUENCY | LEVEL dBµV | DELTA | LIMIT dB |
| 1 Quasi Peak                               | 208.5 kHz | 39.15      | N     | -24.11   |
| 1 Quasi Peak                               | 240 kHz   | 38.74      | N     | -23.35   |
| 1 Quasi Peak                               | 294 kHz   | 34.73      | N     | -25.67   |

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Applicant: LF Products Pte Ltd

Date of Test: May 27, 2014

Model: 9751-US

Worst-Case Operating Mode: Receive (Light On)

Table 1

### Radiated Emissions Pursuant to FCC Part 15 Section 15.109 Requirement

| Polarization | Frequency (MHz) | Reading (dB $\mu$ V) | Pre-amp (dB) | Antenna Factor (dB) | Net at 3m (dB $\mu$ V/m) | Limit at 3m (dB $\mu$ V/m) | Margin (dB) |
|--------------|-----------------|----------------------|--------------|---------------------|--------------------------|----------------------------|-------------|
| V            | 425.800         | 30.3                 | 16           | 25.0                | 39.3                     | 46.0                       | -6.7        |
| V            | 432.200         | 31.2                 | 16           | 25.0                | 40.2                     | 46.0                       | -5.8        |
| V            | 434.200         | 33.9                 | 16           | 25.0                | 42.9                     | 46.0                       | -3.1        |
| V            | 438.000         | 31.3                 | 16           | 26.0                | 41.3                     | 46.0                       | -4.7        |
| V            | 442.200         | 27.7                 | 16           | 26.0                | 37.7                     | 46.0                       | -8.3        |
| H            | 864.757         | 21.7                 | 16           | 31.0                | 36.7                     | 46.0                       | -9.3        |
| H            | 866.886         | 22.2                 | 16           | 31.0                | 37.2                     | 46.0                       | -8.8        |
| H            | 869.300         | 19.4                 | 16           | 31.0                | 34.4                     | 46.0                       | -11.6       |
| H            | 1302.200        | 42.6                 | 33           | 26.1                | 35.7                     | 54.0                       | -18.3       |
| H            | 1305.700        | 41.7                 | 33           | 26.1                | 34.8                     | 54.0                       | -19.2       |

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.

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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.

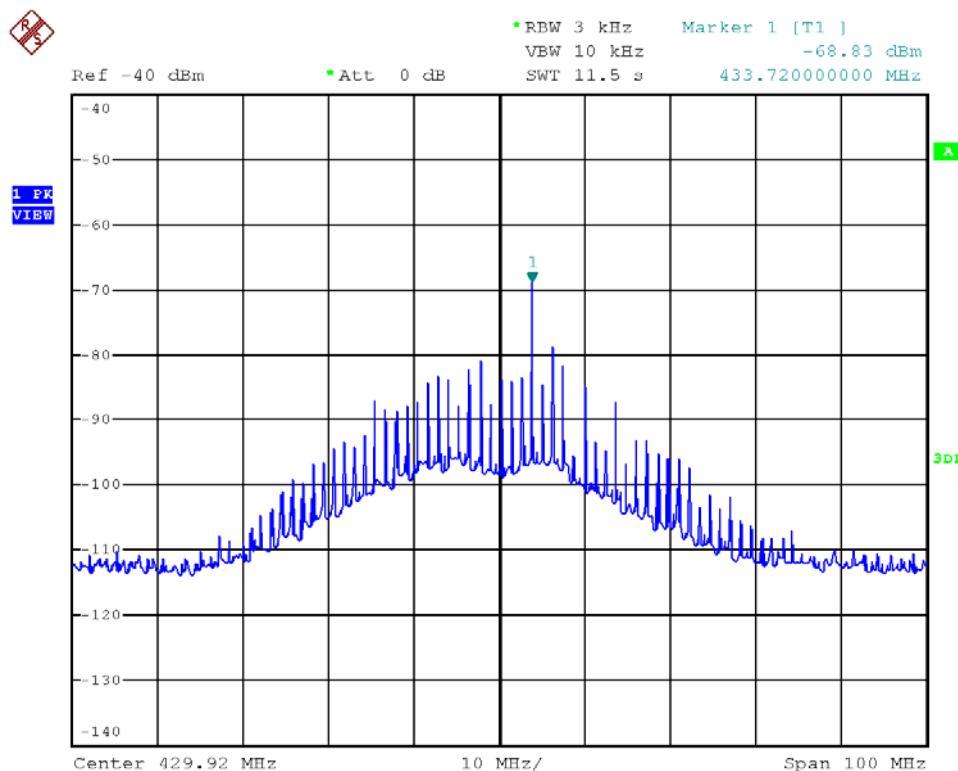
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## 8.0 Miscellaneous Information

This miscellaneous information includes details of the stabilizing process (including a plot of the stabilized waveform), the test procedure and calculation of the factors such as pulse desensitization and averaging factor.

### 8.1 Stabilization Waveform

Previous to the testing, the superregenerative receiver was stabilized as outlined in the test procedure. The plot shows the fundamental emission when a signal generator was used to stabilize the receiver. Please note that the antenna was placed as close as possible to the EUT for clear demonstration of the waveform and that accurate readings are not possible from this plot.



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### 8.2 Discussion of Pulse Desensitization

This device is a Superregenerative receiver. No desensitization of the measurement equipment is required as the received signals are continuously.

### 8.3 Calculation of Average Factor

This device is a Superregenerative receiver. It is not necessary to apply average factor to the measurement result.

### 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 Superregenerative receivers operating under the Part 15, Subpart B rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (2009). A typical or an unmodulated CW signal at the operating frequency of the EUT has been supplied to the EUT for all measurements. Such a signal is supplied by a signal generator and an antenna in close proximity to the EUT. The signal level is sufficient to stabilize the local oscillator of the EUT.

The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the groundplane. 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 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.

The frequency range scanned is from 30 MHz to 2000 MHz.

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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 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Measurements are normally conducted at a measurement distance of three meters. 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-0571           | EW-0446              |
| Manufacturer         | R&S               | EMCO              | EMCO                 |
| Model No.            | ESCI7             | 3104C             | 3146                 |
| Calibration Date     | Jun. 20, 2013     | Nov. 01, 2013     | Apr. 30, 2013        |
| Calibration Due Date | Jun. 20, 2014     | May 01, 2015      | Oct. 30, 2014        |

| Equipment            | Spectrum Analyzer | Double Ridged Guide Antenna | Spectrum Analyzer |
|----------------------|-------------------|-----------------------------|-------------------|
| Registration No.     | EW-2188           | EW-1015                     | EW-2249           |
| Manufacturer         | AGILENTTECH       | EMCO                        | R&S               |
| Model No.            | E4407B            | 3115                        | FSP30             |
| Calibration Date     | Apr. 16, 2014     | Mar. 05, 2013               | Oct. 28, 2013     |
| Calibration Due Date | Apr. 16, 2015     | Sep. 05, 2014               | Oct. 28, 2014     |

#### 2) Conducted Emissions Test

| Equipment            | EMI Test Receiver | LISN          |
|----------------------|-------------------|---------------|
| Registration No.     | EW-2251           | EW-2501       |
| Manufacturer         | R&S               | R&S           |
| Model No.            | ESCI              | ENV-216       |
| Calibration Date     | Nov. 20, 2013     | Dec. 25, 2013 |
| Calibration Due Date | Nov. 20, 2014     | Nov. 30, 2014 |

END OF TEST REPORT