

# PCTEST Engineering Laboratory, Inc.

6660-B Dobbin Road • Columbia, MD 21045 • U.S.A.

TEL (410) 290-6652 • FAX (410) 290-6654

<http://www.pctestlab.com>



## CERTIFICATE OF COMPLIANCE FCC Part 95 Certification

Ngai Lik Electronics Co., Ltd.  
Rm 29-32, 8/F., Block B, Focal Industrial Centre  
21 Man Lok Street, Hung Hom  
Kowloon, Hong Kong  
Attention: Mr. Anthony Tang, Marketing Manager

Dates of Tests: April 10-11, 2000  
Test Report S/N: 95.200316105.CEI  
Test Site: PCTEST Lab, MD U.S.A.

FCC ID

**CEITRA001**

APPLICANT

**NGAI LIK ELECTRONICS CO., LTD.**

Classification: Family Radio Face Held Transmitter (FRF)  
FCC Rule Part(s): §§§ 95(B), 2(J)  
EUT Type: 2-Way Portable Face Held Radio Transceiver (FRS)  
Model(s): TRA001  
Tx/Rx Frequency Range: 467.5625 – 467.6625 MHz  
Max. RF Output Power: 0.2 W  
Frequency Tolerance: 0.0025% (2.5 ppm)  
Emission Designator: 8K0F3E  
Channel Capacity: 2

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947 with the following remarks (Note Codes):

- (BC) The output power is continuously variable from the value listed in this entry to 5%-10% of the value listed.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

  
Randy Ortanez  
President & Chief Engineer



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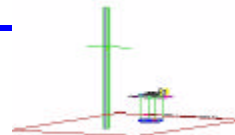
**NVLAP**<sup>®</sup>  
LAB CODE 100431-0

## TABLE OF CONTENTS

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|               |                          |     |
|---------------|--------------------------|-----|
| ATTACHMENT A: | COVER LETTER(S)          |     |
| ATTACHMENT B: | ATTESTATION STATEMENT(S) |     |
| ATTACHMENT C: | TEST REPORT              |     |
|               | SCOPE                    | 1   |
|               | INTRODUCTION             | 2   |
|               | TECHNICAL INFORMATION    | 3   |
|               | DESCRIPTION OF TESTS     | 4-6 |
|               | RADIATED MEASUREMENTS    | 7   |
|               | FREQUENCY STABILITY      | 8-9 |
|               | PLOTS OF EMISSIONS       | 10  |
|               | LIST OF TEST EQUIPMENT   | 11  |
|               | SAMPLE CALCULATIONS      | 12  |
|               | CONCLUSION               | 13  |
| ATTACHMENT D: | TEST PLOTS               |     |
| ATTACHMENT E: | FCC ID LABEL & LOCATION  |     |
| ATTACHMENT F: | TEST SETUP PHOTOGRAPHS   |     |
| ATTACHMENT G: | EXTERNAL PHOTOGRAPHS     |     |
| ATTACHMENT H: | INTERNAL PHOTOGRAPHS     |     |
| ATTACHMENT I: | BLOCK DIAGRAM(S)         |     |
| ATTACHMENT J: | SCHEMATIC DIAGRAM(S)     |     |
| ATTACHMENT K: | OPERATIONAL DESCRIPTION  |     |
| ATTACHMENT L: | USER'S MANUAL            |     |

# MEASUREMENT REPORT



## 1.1 Scope

*Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.*

## 1.2 General Information

|                        |                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Applicant Name:</b> | <b>Ngai Lik Electronics Co., Ltd.</b>                                                                          |
| <b>Address:</b>        | <b>Rm 29-32, 8/F., Block B, Focal Industrial Centre<br/>21 Man Lok Street, Hung Hom<br/>Kowloon, Hong Kong</b> |
| <b>Attention:</b>      | <b>Mr. Anthony Tang, Marketing Manager</b>                                                                     |

- |                               |                                                  |
|-------------------------------|--------------------------------------------------|
| • <b>FCC ID:</b>              | <b>CEITRA001</b>                                 |
| • <b>Model(s):</b>            | <b>TRA001</b>                                    |
| • <b>Quantity:</b>            | Quantity production is planned                   |
| • <b>Emission Designator:</b> | 8K0F3E                                           |
| • <b>Tx/Rx Freq. Range:</b>   | 467.5625 – 467.6625 MHz                          |
| • <b>Equipment Class:</b>     | Family Radio Face Held Transmitter (FRF)         |
| • <b>Equipment Type:</b>      | 2-Way Portable Face Held Radio Transceiver (FRS) |
| • <b>Modulation:</b>          | FM                                               |
| • <b>Frequency Tolerance:</b> | ± 0.0025% (2.5 ppm)                              |
| • <b>Max. Power:</b>          | 0.2W                                             |
| • <b>FCC Rule Part(s):</b>    | §§§§ 95(B), 2(J)                                 |
| • <b>Power Supply:</b>        | (3) AA batteries                                 |
| • <b>Dates of Tests:</b>      | April 10-11, 2000                                |
| • <b>Place of Tests:</b>      | PCTEST Lab, Columbia, MD U.S.A.                  |
| • <b>Test Report S/N:</b>     | 95.200316105.CEI                                 |



## 2.1 INTRODUCTION

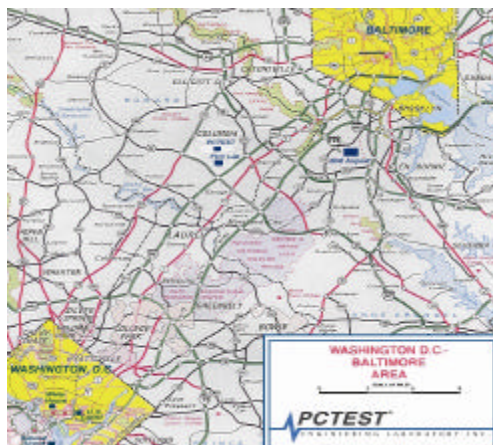


Figure 1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area.

These measurement tests were conducted at **PCTEST Engineering Laboratory, Inc.** facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49'38" W longitude. The facility is 1.5 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on October 19, 1992.

### Measurement Procedure

The radiated and spurious measurements were made outdoors at 3-meter test range (see Figure 2). The equipment under test is placed on the turntable connected to a RF wattmeter and a dummy RF load, and then its power is adjusted to its rated output. A receiving antenna located 2 meters from the turntable picks up any signal radiated from the transmitter. The turntable containing the system was rotated; the receiving antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. The testing procedure is repeated for both horizontal and vertical polarization of the receiving antenna. The actual radiated signal strength is obtained by substitution method with a signal generator with a calibrated output. The signal generator is adjusted in output until its reading is identical to that obtained when the receiving antenna is connected to the receiver. Signal strength is then read directly from the signal generator.

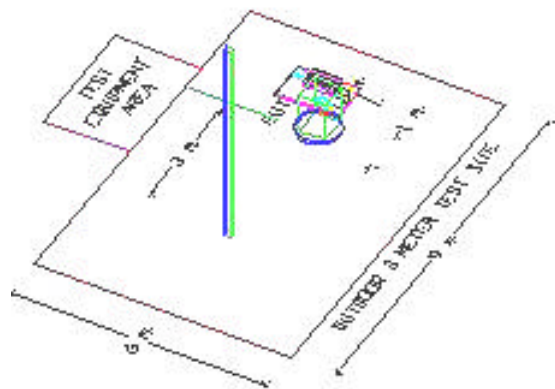


Figure 2. 3-meter out door test site

## **3.1 TECHNICAL INFORMATION**

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### **3.2 Block Diagram(s)**

The block diagram is shown in Attachment I.

### **3.3 Circuit Diagram(s)**

The circuit diagram is shown in Attachment J.

### **3.4 Operational Description**

The operational description is shown in Attachment K.

### **3.5 Operating Instructions**

The instruction manual is shown in Attachment L.

## 4.1 DESCRIPTION OF TESTS

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### 4.2 Transmitter Audio Frequency Response

The frequency response of the audio modulating circuit over the frequency range 100 – 5000 Hz is measured. The audio signal generator is connected to the audio input circuit/microphone of the EUT. The audio signal input is adjusted to obtain 50% modulation at 1kHz and this point is taken as the 0dB reference. With the input held constant and below the limit at all frequencies, the audio signal generator is varied from 100 to 50 kHz. The response in dB relative to 1kHz is measured using the HP8901 a Modulation Analyzer. For the frequency response of the audio low-pass filter, the audio input is connected at the input to the modulation limiter and the modulated stage. The audio output is connected at the output of the modulated stage. The corresponding plots are shown herein.

### 4.3 Modulation Limiting

The audio signal generator is connected to the audio input circuit/microphone of the EUT. The modulation response is measured for each of the three modulating frequencies (300Hz, 1000 Hz, and 2990Hz), and the input voltage is varied from 30% modulation ( $\pm 3.6$ kHz deviation) to at least 20dB higher than the saturation point. Measurements of modulation and the plots are attached herein.

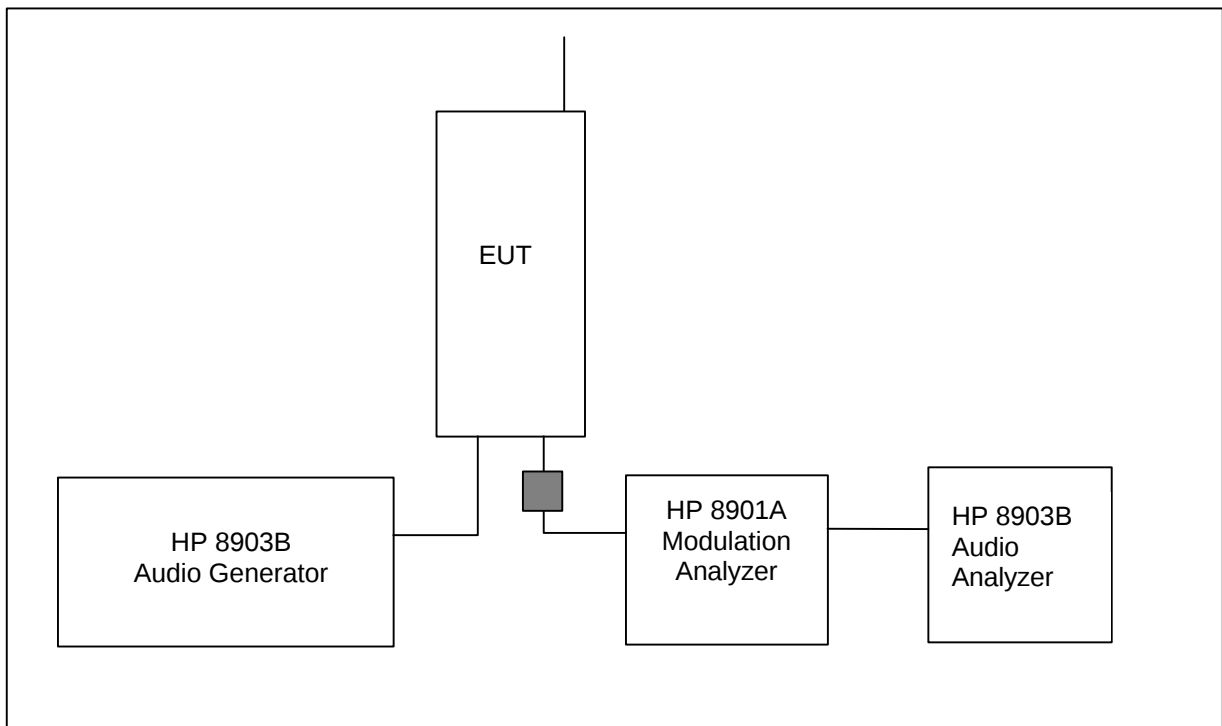


Fig. 3. Transmitter Audio Freq. Test Setup

## **4.1 DESCRIPTION OF TESTS (CONTINUED)**

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### **4.4 Occupied Bandwidth**

The audio signal generator is adjusted to 1kHz. The output level is set to +/- 6kHz deviation. With the level constant, the freq. is set to 2,500Hz. Then the audio signal level is increased by 16dB.

The limits are specified in Section 2.1049.

#### **Bandwidth Calculations (2M + 2D):**

$$2(3) + 2 (2.20) \\ 6 + 4.4 = 10.4 \text{ kHz}$$

**Emission Designator = 10K4F3E**

M = maximum modulation frequency

D = maximum deviation from modulating limiting plot

### **4.5 Spurious and Harmonic Emissions at Antenna Terminal**

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to the tenth harmonic.

### **4.6 Radiation Spurious and Harmonic Emissions**

Radiation and harmonic emissions above 1 GHz is measured at our 3-meter indoor site. The EUT is placed on the turntable connected to a dummy load in normal operation using the intended power source. A receiving antenna located 3 meters from the turntable receives any signal radiated from the transmitter and its operating accessories. The antenna is varied from 1 to 4 meters and the polarization is varied (horizontal and vertical) to determine the worst-case emission level. To obtain actual radiated signal strength, a signal generator is adjusted in output until a reading identical to that obtained with the actual transmitter is obtained at the receiver. Signal strength is read directly from the generator and recorded on the attached table.

## 4.1 DESCRIPTION OF TESTS (CONTINUED)

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### **4.7 Frequency Stability/Temperature Variation**

The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +60°C using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

*Specification – The minimum frequency stability shall be +/- 0.0010% at any time during normal operation.*

#### **Time Period and Procedure:**

1. The carrier frequency of the transmitter and the individual oscillators is measured at room temperature (25°C to 27°C to provide a reference).
2. The equipment is subjected to an overnight “soak” at -30°C without any power applied.
3. After the overnight “soak” at 30°C (usually 14-16 hours), the equipment is turned on in a “standby” condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter and the individual oscillators is made within a three minute interval after applying power to the transmitter.
4. Frequency measurements are made at 10°C interval up to room temperature. At least a period of one and one half-hour is provided to allow stabilization of the equipment at each temperature level.
5. Again the transmitter carrier frequency and the individual oscillators is measured at room temperature to begin measurement of the upper temperature levels.
6. Frequency were made at 10 intervals starting at 30°C up to +50°C allowing at least two hours at each temperature for stabilization. In all measurements the frequency is measured within three minutes after applying power to the transmitter.
7. The artificial load is mounted external to the temperature chamber.

**NOTE: The EUT is tested down to the battery endpoint.**

## 5.1 Test Data

### 5.2 Radiated Measurements

#### Field Strength of SPURIOUS Radiation

OPERATING FREQUENCY: 467.5625 MHz  
 CHANNEL: 8 (Low)  
 MEASURED OUTPUT POWER: 23.09 dBm = 0.2 W  
 MODULATION SIGNAL: FM  
 DISTANCE: 3 meters  
 LIMIT:  $43 + 10 \log_{10} (W) =$  36.10 dBc

| FREQ.<br>(MHz) | LEVEL<br>(dBm) | AFCL<br>(dB) | POL<br>(H/V) | F/S<br>( $\mu$ V/m) | ERP<br>(dBm) | (dBc) |
|----------------|----------------|--------------|--------------|---------------------|--------------|-------|
| 935.1250       | -70.0          | 33.0         | V            | 3162.3              | -25.23       | 48.3  |
| 1402.6875      | -73.0          | 32.6         | V            | 2138.0              | -28.63       | 51.7  |
| 1870.2500      | -76.0          | 35.3         | V            | 2065.4              | -28.93       | 52.0  |
| 2337.8125      | -83.0          | 37.9         | V            | 1244.5              | -33.33       | 56.4  |
| 2805.3750      | -96.0          | 39.0         | V            | 316.2               | -45.23       | 68.3  |
| 3272.9375      | < -130         |              |              |                     |              |       |

#### NOTES:

- The spectrum was checked from 25 MHz up to the 10th harmonic.
- All emissions not listed were found to be more than 20dB below the limit.
- < -130dBm is below the floor of the spectrum analyzer.
- The EUT is manipulated through 3 orthogonal axis and the worst-case are reported.
- The EUT is placed 3m. away from the receiving antenna and the ERP is calculated using the formula:  

$$\text{ERP (dBm)} = 10 \log_{10} (((r(\text{mV/m})/1 \times 10^6)^2 / 49.2/1 \times 10^{-3})$$

$$\text{ERP (dBm)} = 10 \log_{10} [ (3 \times \text{FS}/1 \times 10^6)^2 / (49.2) \times 1000]$$

$$\text{ERP (Watts)} = \{(3 \times \text{FS})/1 \times 10^6\}^2 / 49.2$$

## 5.1 Test Data (continued)

### 5.2 Radiated Measurements

#### Field Strength of SPURIOUS Radiation

OPERATING FREQUENCY: 467.6625 MHz  
 CHANNEL: 12 (High)  
 MEASURED OUTPUT POWER: 23.09 dBm = 0.2 W  
 MODULATION SIGNAL: FM  
 DISTANCE: 3 meters  
 LIMIT:  $43 + 10 \log_{10} (W) =$  36.10 dBc

| FREQ.<br>(MHz) | LEVEL<br>(dBm) | AFCL<br>(dB) | POL<br>(H/V) | F/S<br>( $\mu$ V/m) | ERP<br>(dBm) | (dBc) |
|----------------|----------------|--------------|--------------|---------------------|--------------|-------|
| 935.33         | -70.2          | 33.1         | V            | 3126.1              | -25.33       | 48.4  |
| 1402.99        | -73.5          | 32.7         | V            | 2041.7              | -29.03       | 52.1  |
| 1870.65        | -76.2          | 35.4         | V            | 2041.7              | -29.03       | 52.1  |
| 2338.31        | -83.5          | 38.0         | V            | 1188.5              | -33.73       | 56.8  |
| 2805.98        | -95.0          | 39.0         | V            | 354.8               | -44.23       | 67.3  |
| 3273.64        | < -130         |              |              |                     |              |       |

#### NOTES:

- The spectrum was checked from 25 MHz up to the 10th harmonic.
- All emissions not listed were found to be more than 20dB below the limit.
- < -149.2dBm is below the floor of the spectrum analyzer.
- The EUT is manipulated through 3 orthogonal axis and the worst-case are reported.
- The EUT is placed 3m. away from the receiving antenna and the ERP is calculated using the formula:  

$$\text{ERP (dBm)} = 10 \log_{10} ((r(\text{mV/m})/1 \times 10^6)^2 / 49.2/1 \times 10^{-3})$$

$$\text{ERP (dBm)} = 10 \log_{10} [(3 \times \text{FS}/1 \times 10^6)^2 / (49.2) \times 1000]$$

$$\text{ERP (Watts)} = \{(3 \times \text{FS})/1 \times 10^6\}^2 / 49.2$$

## 6.1 Test Data

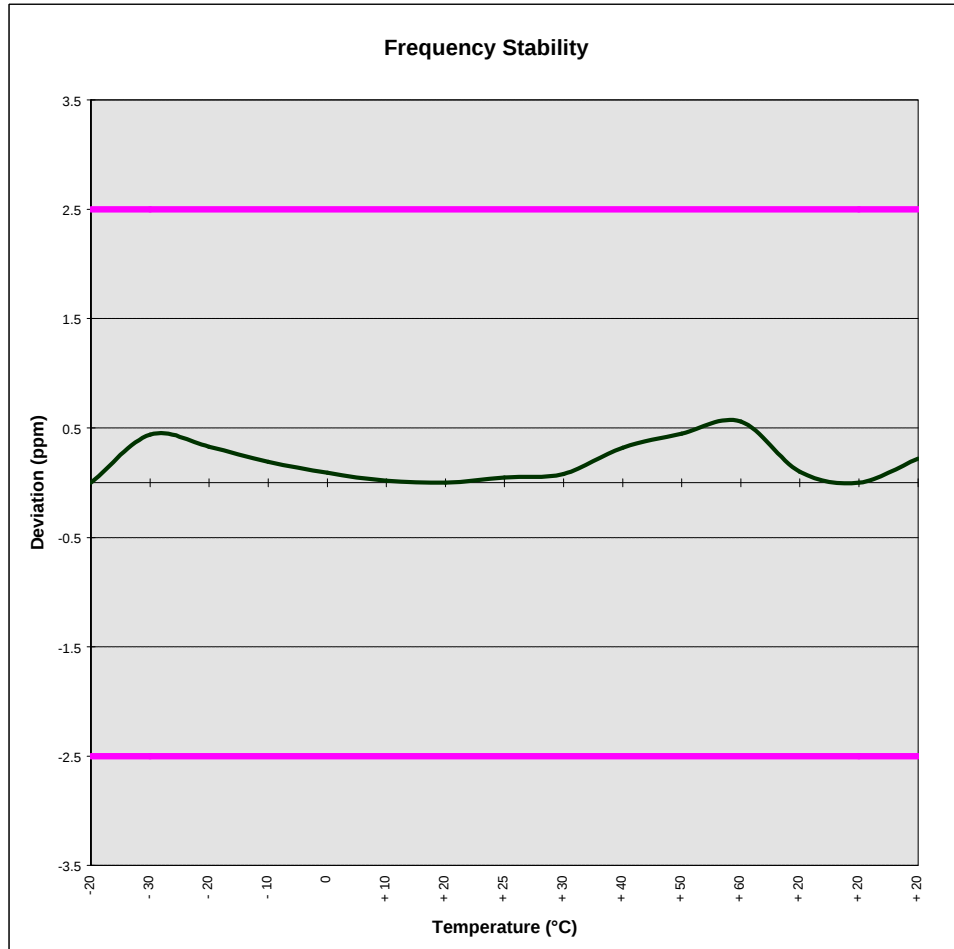
### 6.2 FREQUENCY STABILITY

OPERATING FREQUENCY: 467,562,512 Hz  
 CHANNEL: 8  
 REFERENCE VOLTAGE: 4.5 VDC  
 DEVIATION LIMIT: ± 0.00025 % or 2.5 ppm

| VOLTAGE<br>(%) | POWER<br>(VDC) | TEMP<br>(°C) | FREQ.<br>(Hz) | Deviation<br>(%) |
|----------------|----------------|--------------|---------------|------------------|
| 100 %          | 4.50           | + 20 (Ref)   | 467,562,512   | 0.000000         |
| 100 %          |                | - 30         | 467,562,306   | 0.000044         |
| 100 %          |                | - 20         | 467,562,358   | 0.000033         |
| 100 %          |                | - 10         | 467,562,423   | 0.000019         |
| 100 %          |                | 0            | 467,562,470   | 0.000009         |
| 100 %          |                | + 10         | 467,562,503   | 0.000002         |
| 100 %          |                | + 20         | 467,562,512   | 0.000000         |
| 100 %          |                | + 25         | 467,562,489   | 0.000005         |
| 100 %          |                | + 30         | 467,562,475   | 0.000008         |
| 100 %          |                | + 40         | 467,562,362   | 0.000032         |
| 100 %          |                | + 50         | 467,562,302   | 0.000045         |
| 100 %          |                | + 60         | 467,562,250   | 0.000056         |
| 85 %           | 3.83           | + 20         | 467,562,465   | 0.000010         |
| 115 %          | 5.18           | + 20         | 467,562,512   | 0.000000         |
| BATT. ENDPOINT | 2.54           | + 20         | 467,562,409   | 0.000022         |

## 6.1 Test Data (continued)

### 6.3 FREQUENCY STABILITY



## **7.1 PLOT(S) OF EMISSIONS**

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SEE ATTACHMENT D

## 8.1 TEST EQUIPMENT

| 8.2 Type                         | Model                                                                       | Cal. Due Date | S/N                    |
|----------------------------------|-----------------------------------------------------------------------------|---------------|------------------------|
| Microwave Spectrum Analyzer      | HP 8566B (100Hz-22GHz)                                                      | 08/15/00      | 3638A08713             |
| Microwave Spectrum Analyzer      | HP 8566B (100Hz-22GHz)                                                      | 04/17/00      | 2542A11898             |
| Spectrum Analyzer/Tracking Gen.  | HP 8591A (100Hz-1.8GHz)                                                     | 08/10/00      | 3144A02458             |
| Signal Generator*                | HP 8640B (500Hz-1GHz)                                                       | 06/03/00      | 2232A19558             |
| Signal Generator*                | HP 8640B (500Hz-1GHz)                                                       | 06/03/00      | 1851A09816             |
| Signal Generator*                | Rohde & Schwarz (0.1-1000MHz)                                               | 09/11/00      | 894215/012             |
| Ailtech/Eaton Receiver           | NM 37/57A-SL (30-1000MHz)                                                   | 04/12/00      | 0792-03271             |
| Ailtech/Eaton Receiver           | NM 37/57A (30-1000MHz)                                                      | 03/11/01      | 0805-03334             |
| Ailtech/Eaton Receiver           | NM 17/27A (0.1-32MHz)                                                       | 09/17/00      | 0608-03241             |
| Quasi-Peak Adapter               | HP 85650A                                                                   | 08/15/00      | 2043A00301             |
| Ailtech/Eaton Adapter            | CCA-7 CISPR/ANSI QP Adapter                                                 | 03/11/01      | 0194-04082             |
| RG58 Coax Test Cable             | No. 167                                                                     |               | n/a                    |
| Harmonic/Flicker Test System     | HP 6841A (IEC 555-2/3)                                                      |               | 3531A00115             |
| Broadband Amplifier (2)          | HP 8447D                                                                    |               | 1145A00470, 1937A03348 |
| Broadband Amplifier              | HP 8447F                                                                    |               | 2443A03784             |
| Transient Limiter                | HP 11947A (9kHz-200MHz)                                                     |               | 2820A00300             |
| Horn Antenna                     | EMCO Model 3115 (1-18GHz)                                                   |               | 9704-5182              |
| Horn Antenna                     | EMCO Model 3115 (1-18GHz)                                                   |               | 9205-3874              |
| Horn Antenna                     | EMCO Model 3116 (18-40GHz)                                                  |               | 9203-2178              |
| Biconical Antenna (4)            | Eaton 94455/Eaton 94455-1/Singer 94455-1/Compliance Design 1295, 1332, 0355 |               |                        |
| Log-Spiral Antenna (3)           | Ailtech/Eaton 93490-1                                                       |               | 0608, 1103, 1104       |
| Roberts Dipoles                  | Compliance Design (1 set)                                                   |               |                        |
| Ailtech Dipoles                  | DM-105A (1 set)                                                             |               | 33448-111              |
| EMCO LISN                        | 3816/2                                                                      |               | 1079                   |
| EMCO LISN                        | 3816/2                                                                      |               | 1077                   |
| EMCO LISN                        | 3725/2                                                                      |               | 2009                   |
| Microwave Preamplifier 40dB Gain | HP 83017A (0.5-26.5GHz)                                                     |               | 3123A00181             |
| Microwave Cables                 | MicroCoax (1.0-26.5GHz)                                                     |               |                        |
| Ailtech/Eaton Receiver           | NM37/57A-SL                                                                 |               | 0792-03271             |
| Spectrum Analyzer                | HP 8594A                                                                    |               | 3051A00187             |
| Spectrum Analyzer (2)            | HP 8591A                                                                    |               | 3034A01395, 3108A02053 |
| Modulation Analyzer              | HP 8901A                                                                    |               | 2432A03467             |
| NTSC Pattern Generator           | Leader 408                                                                  |               | 0377433                |
| Noise Figure Meter               | HP 8970B                                                                    |               | 3106A02189             |
| Noise Figure Meter               | Ailtech 7510                                                                |               | TE31700                |
| Noise Generator                  | Ailtech 7010                                                                |               | 1473                   |
| Microwave Survey Meter           | Holaday Model 1501 (2.450GHz)                                               |               | 80931                  |
| Digital Thermometer              | Extech Instruments 421305                                                   |               | 426966                 |
| Attenuator                       | HP 8495A (0-70dB) DC-4GHz                                                   |               |                        |
| Bi-Directional Coax Coupler      | Narda 3020A (50-1000MHz)                                                    |               |                        |
| Shielded Screen Room             | RF Lindgren Model 26-2/2-0                                                  |               | 6710 (PCT270)          |
| Shielded Semi-Anechoic Chamber   | Ray Proof Model S81                                                         |               | R2437 (PCT278)         |
| Environmental Chamber            | Associated Systems Model 1025 (Temperature/Humidity)                        |               | PCT285                 |

\* Calibration traceable to the National Institute of Standards and Technology (NIST).

## 9.1 SAMPLE CALCULATIONS

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Level  $\mu\text{V/m}$  @ 3 meters =  $\frac{\text{Log } 10^{-1} (\text{dBm} + 107 + \text{AFCL})}{20}$

20

$\frac{\text{Log } 10^{-1} (-14 + 107 + 31.7)}{20}$

20

1717908.4  $\mu\text{V/m}$  @ 3 meters

Sample Calculation (relative to a dipole)

$\text{ERP (dBm)} = 10 \text{ Log}_{10} (((r(\mu\text{V/m})1 \times 10^6)^2 / 49.2 / 1 \times 10^{-3})$

$\text{ERP (dBm)} = 10 \text{ Log}_{10} (((3(1717908.4)1 \times 10^6)^2 / 49.2 / 1 \times 10^{-3})$

**ERP (dBm) = 27.32**

## 10.1 CONCLUSION

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The data collected shows that the **NGAI LIK ELECTRONICS CO., LTD** 2-Way Portable Face Held Radio Transceiver (FRF) **FCC ID: CEITRA001** complies with all the requirements of Parts 2 and 95 of the FCC rules.