

**FCC Part 95(B) Test Report**  
for  
**Telson Information and Communication Co., Ltd.**  
on the  
**Family Radio**  
**Model: RANGER-Plus**

Test Report: J99017682  
Date of Report: July 29, 1999

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|            |              |  |
|------------|--------------|--|
| Tested by: | Xi-Ming Yang |  |
| Reviewer:  | C. K. Li     |  |

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## 1 JOB DESCRIPTION

### 1.1 Client Information

The EUT has been tested at the request of

**Company:** Telson Information and Communications Co., Ltd.  
356\_5GA, San-Dong, Kum Cheun-Ku  
Seoul, Korea

**Name of contact:** Y. Won  
**Telephone:** (02) 851-2780  
**Fax:** (02) 857-9583

### 1.2 Equipment under test (EUT)

**Equipment type:** Family Radio Face-Held Transceiver

**Model number(s):** RANGER-Plus

**Part or serial number:** FCC ID: OBARANGER-Plus

**Manufacturer:** SAME as above.

**Use of Product :** Voice communications

**Production is planned:** [X] Yes, [ ] No

**Technical Specifications:**

|                                                                                                   |                                                                     |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Type of Emission                                                                                  | 11KOF3E                                                             |
| Max. Allowed modulation (M)                                                                       | 3.0 kHz                                                             |
| Max. Allowed deviation (D)                                                                        | 2.5 kHz                                                             |
| Range of RF Output                                                                                | 0.5 W (ERP)                                                         |
| Means for variation of operating power                                                            | None                                                                |
| The dc voltage applied to and current into the several elements of the final RF amplifying device | <i>Collector Voltage:</i> 6 Vdc<br><i>Collector Current:</i> 150 mA |
| Frequency Range                                                                                   | 462 to 468 MHz                                                      |
| Max. number of Channels                                                                           | 14                                                                  |
| Antenna                                                                                           | Monopole                                                            |
| Detachable antenna ?                                                                              | No                                                                  |
| External input                                                                                    | Audio                                                               |

**EUT receive date:** 06/23/1999  
**EUT received condition:** Good condition prototype  
**Test start date:** 06/30/1999  
**Test end date:** 07/16/1999

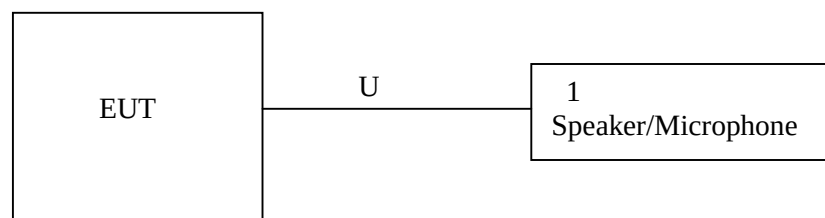
### 1.3 Test plan reference

FCC Part 2.1033, FCC Part 95 (B)

### 1.4 System test configuration

#### 1.4.1 System block diagram & Support equipment

The diagram shown below details the placement of the equipment under test on the turntable. Please note that the equipment on the rear of the table was centered along the back edge. Equipment on the front of the turntable was centered along the front edge. All peripherals were separated by 10 cm.



|           |          |           |          |           |                   |
|-----------|----------|-----------|----------|-----------|-------------------|
| <b>S:</b> | Shielded | <b>U:</b> | Unshield | <b>F:</b> | With Ferrite Core |
|-----------|----------|-----------|----------|-----------|-------------------|

| Support equipment |                    |              |         |              |        |
|-------------------|--------------------|--------------|---------|--------------|--------|
| Equip. #          | Equipment          | Manufacturer | Model # | S/N #        | FCC ID |
| 1                 | Speaker/Microphone | Radio Shack  | 19-315  | Not labelled | N/A    |
| --                | --                 | --           | --      | --           | --     |

**1.4.2 Justification**

The system was configured for testing in a typical manner in accordance with ANSI C63.4 standard. During testing, the peripheral locations were varied with respect to the EUT.

**1.4.3 Mode(s) of operation**

The EUT was powered and fully operational with option speaker/microphone connected. The unit was powered from 4 fully charged AAA batteries.

**1.5 Modifications required for compliance**

No modifications were implemented by Intertek Testing Services.

**2 TEST SUMMARY**

| <b>FCC RULE</b>                  | <b>DESCRIPTION OF TEST</b>                                                                              | <b>RESULT</b>                                 | <b>PAGE</b> |
|----------------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------|
| <b>Transmitter Section</b>       |                                                                                                         |                                               |             |
| 2.1046<br>95.639(d)              | Effective Radiated Power                                                                                | 0.49 W                                        | 8           |
| 2.1047<br>95.631(d)<br>95.637(a) | Modulation Characteristics<br>F3E analogy voice<br>Peak frequency deviation<br>Audio frequency response | 2.5 kHz<br>3.0 kHz                            | 9           |
| 2.1049<br>95.633(c)              | Occupied Bandwidth                                                                                      | 11 kHz                                        | 12          |
| 2.1053<br>15.109(a)              | Field Strength of Spurious<br>Radiation                                                                 | Worst case Freq.: 3237.9MHz<br>Margin: -5.0dB | 14          |
| 15.107                           | Line Conducted Emissions                                                                                | N/A                                           | N/A         |
| 2.1055                           | Frequency Stability<br>Vs. Temperature<br>Vs. Voltage                                                   | 1.75 ppm<br>-1.44ppm                          | 20          |
| <b>Receiver Section</b>          |                                                                                                         |                                               |             |
| 15.109(a)                        | Radiated Emissions                                                                                      | Worst case Freq.: 441.2 MHz<br>Margin: -3.2dB | 16          |

### 3 EFFECTIVE RADIATED POWER

#### 3.1 Test Description

|                                 |              |
|---------------------------------|--------------|
| Parameter:                      | FCC § 2.1046 |
| Requirement:                    | FCC § 95.639 |
| Effective Radiated Power (ERP): | < 0.5 watts  |

#### 3.2 Test Procedure

The EUT was positioned on a non-conductive turntable, 0.8m above the ground plane on an open test site.

The radiated emission at the fundamental frequency was measured at 3m distance with a test antenna and spectrum analyzer. During the measurement, the resolution and video bandwidth of the spectrum analyzer were set to 100 kHz. To maximize emissions, the system was rotated through 360°, the antenna height was varied from 1m to 4m, and the antenna polarization was changed.

The ERP was calculated using equation:

$$E = \frac{\sqrt{30 \cdot P \cdot G}}{D}$$

Where E = Field Strength (V/m),

G = Antenna Gain (1.64 for a half-wave dipole),

P = ERP (W)

D = Distance (m)

#### 3.3 Test Results

|                  |         |                   |                   |            |                |       |
|------------------|---------|-------------------|-------------------|------------|----------------|-------|
| Test Conditions: |         | Antenna Gain ,G = |                   | 1.64       | Distance, D =  | 3     |
| Frequency        | Reading | Antenna Factor    | Preamplifier Gain | Cable Loss | Field Strength | ERP   |
| MHz              | dB(μV)  | dB(1/m)           | dB                | DB         | dB(μV/m)       | W     |
| 462.56           | 105.5   | 17.3              | 0                 | 1.5        | 124.3          | 0.489 |
| 467.72           | 105.2   | 17.6              | 0                 | 1.5        | 124.3          | 0.489 |

Note: Field Strength = Reading + Antenna Factor – preamp + Cable loss

#### 3.4 Modifications made during testing

None

#### 3.5 Test Instrumentation

[x] Hewlett Packard HP8566B Spectrum Analyzer (S.A.)

[x] EMCO Bi-Log Antenna

[ ] HP Pre-amp



## 4 MODULATION CHARACTERISTICS

### 4.1 Test Description

|                           |                         |
|---------------------------|-------------------------|
| Parameter:                | FCC § 2.1047            |
| Requirement:              | FCC § 95.637            |
| Peak Frequency Deviation: | Less than $\pm 2.5$ kHz |
| Audio Frequency Response: | $\leq 3.125$ kHz        |

### 4.2 Test Procedure

#### 4.2.1 Audio Frequency Response

The RF output of the transceiver was connected to the input of a FM deviation meter through sufficient attenuation so as not to overload the meter or distort the readings. An audio signal generator was coupled into the external microphone jack of the transceiver, or alternatively, the microphone element was removed and the generator output was connected to the microphone connectors.

The audio signal input level was adjusted to obtain 20% of the maximum rated system deviation at 1 kHz, and recorded as  $DEV_{REF}$ . With the audio signal generator level unchanged, set the generator frequency between 300 Hz to 5000 Hz. The transmitter deviations ( $DEV_{FREQ}$ ) were measured and the audio frequency response was calculated as

$$20 \log_{10} \left[ \frac{DEV_{FREQ}}{DEV_{REF}} \right]$$

#### 4.2.2 Audio Low-Pass Filter Response

An audio signal generator and an audio spectrum analyzer were connected to the input and output of the post limiter low pass filter respectively. The audio signal generator frequency was set between 1000 Hz and the upper low pass filter limit. The audio frequency response at test frequency was calculated as

$$LEV_{FREQ} - LEV_{REF}$$

#### 4.2.3 Modulation Limiting

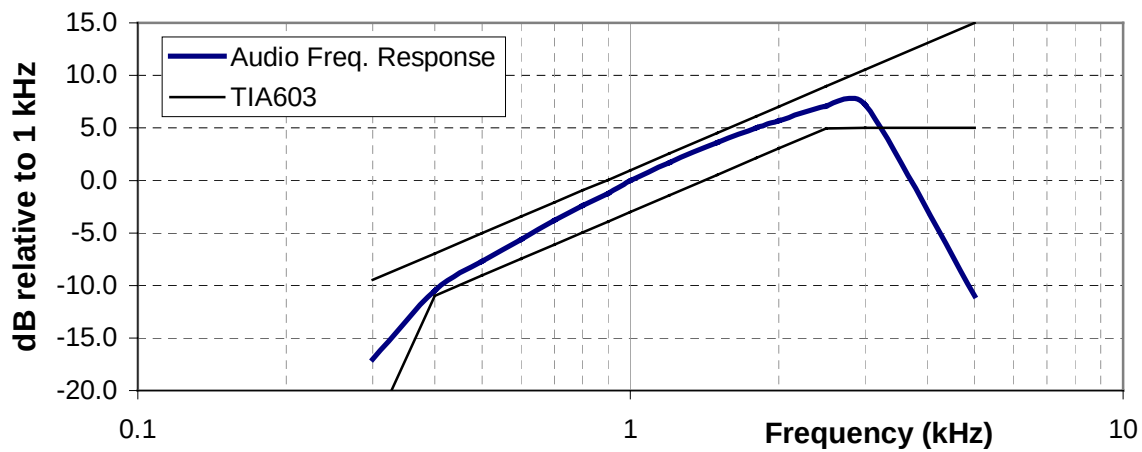
With the same setup as section 4.2.1 above, at three different modulating frequencies, the output level of the audio generator was varied and the FM deviation level was recorded.

#### 4.3 Test Results

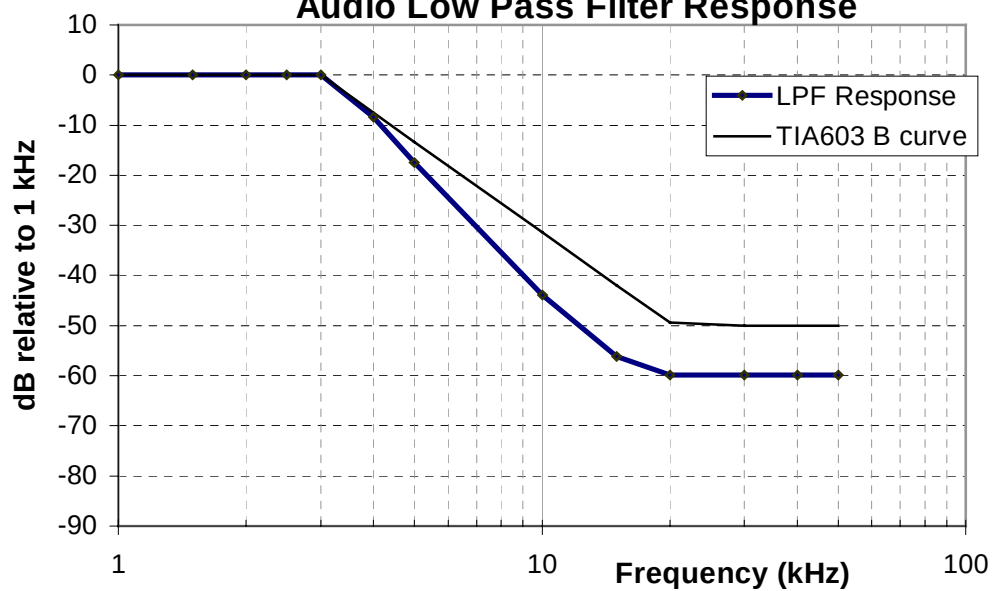
|   |                                                                                     |
|---|-------------------------------------------------------------------------------------|
| X | See below.                                                                          |
|   | There were no changes in the schematics and PCB layout of the already granted unit. |

| Test Condition  |             |
|-----------------|-------------|
| Frequency (MHz) | mid channel |

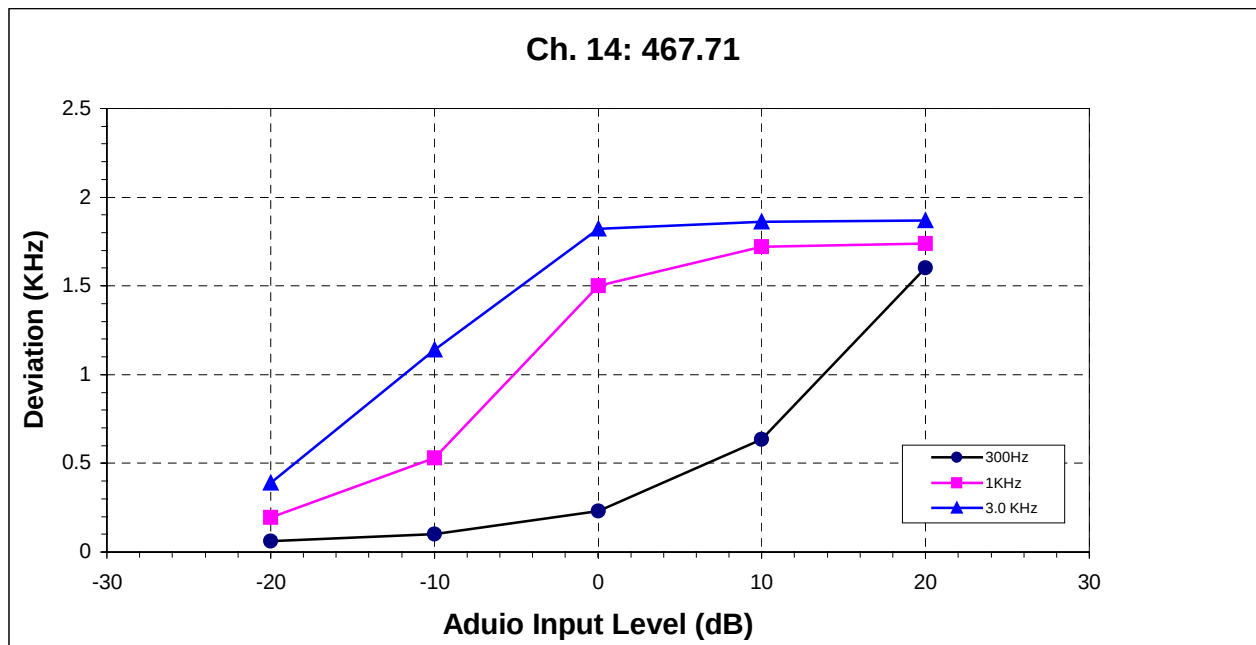
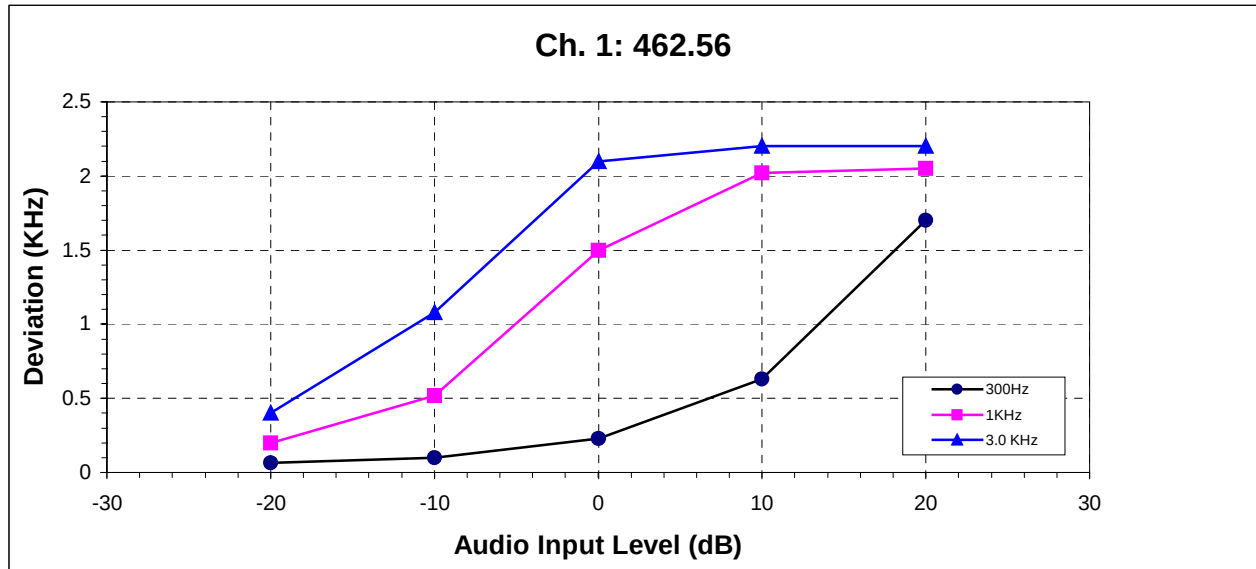
**Transmitter Audio Frequency Response**



**Audio Low Pass Filter Response**



| Modulation Limiting Test Condition |                                       |
|------------------------------------|---------------------------------------|
| Frequency (MHz)                    | 462.56 and 467.7125                   |
| V <sub>inp</sub> (mV)              | 15 mV                                 |
| Reference Deviation                | 1.5 kHz at 1 kHz modulating frequency |



#### 4.4 Modifications made during testing

None

#### 4.5 Test instrumentation

[X] Marconi 2955A Radio Communication Test Set

[X] Leader LFG-1300S Function Generator

[X] LMV-182 AC Millivoltmeter

### 5 OCCUPIED BANDWIDTH

#### 5.1 Test description

|                     |                 |
|---------------------|-----------------|
| Parameter:          | FCC §2.1049     |
| Requirement:        | FCC § 95.633(c) |
| Emission Bandwidth: | 12.5 kHz        |

#### 5.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set up at least 10 times higher than the authorized bandwidth of the transmitter. With the transmitter keyed, the level of the unmodulated carrier was set to the full scale reference line of the spectrum analyzer. This is used as a 0dB reference for emission mask measurements.

The transmitter was then modulated with a 2500 Hz tone at an input level 16 dB greater than the necessary to produce 50% of rated system deviation. The resolution bandwidth of the spectrum analyzer was set up to 100 Hz and the spectrum of the transmitting signal was recorded. This spectrum was compared to the required emission mask.

**5.3 Test Results**

Please see Exhibit 10 for the occupied bandwidth plots:

| <b>Plot Number</b> | <b>Description</b>                |
|--------------------|-----------------------------------|
| 10-1               | Full Power, reference level       |
| 10-2               | Occupied bandwidth, scan 62.5 kHz |

**5.4 Modifications made during testing**

None

**5.5 Test instrumentation**

[X] Leader LFG-1300S Function Generator

[X] HP 8566B Spectrum Analyzer

[X] HP 7470A Plotter

## 6 RADIATED SPURIOUS EMISSIONS

### 6.1 Test description

|              |              |
|--------------|--------------|
| Parameter:   | FCC §2.1053  |
| Requirement: | FCC § 15.109 |
| --           | --           |

### 6.2 Test Procedure

The transmitter was placed on a wooden turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

The spurious harmonic attenuation was calculated as the difference between E in dB(uV/m) at the fundamental frequency and at the spurious emission frequency.

Spurious attenuation in dB =  $43 + 10\text{Log}_{10}(\text{power out in Watts})$

### 6.3 Test Results

Please see the following pages for

[X] Spurious harmonic attenuation

[X] FCC Part 15.109 Radiated Emission

**SPURIOUS HARMONIC ATTENUATION**

**Company:** Telson Information & Communication  
**Project #:** J99017682  
**Model:** RANGER-Plus  
**Engineer:** Xi-Ming Y  
**Date of test:** July 14, 1999

**Test Condition:** Continue Transmitting

| Frequency<br>Pol<br>MHz  | Antenna<br>Factor<br>H/V | Reading<br>dB(uV) | Antenna<br>dB(1/m) | Pre-amp<br>dB | Cable<br>Loss<br>dB | Field<br>Strength<br>dB(uV/m) | Spurious<br>Attenuation<br>dB | Margin<br>dB |
|--------------------------|--------------------------|-------------------|--------------------|---------------|---------------------|-------------------------------|-------------------------------|--------------|
| <b><u>Channel 1</u></b>  |                          |                   |                    |               |                     |                               |                               |              |
| 925.15                   | V                        | 48.2              | 22.8               | 0.0           | 2.2                 | 73.2                          | 51.1                          | -11.1        |
| 1387.69                  | V                        | 49.0              | 24.7               | 0.0           | 2.7                 | 76.4                          | 47.9                          | -7.9         |
| 1850.25                  | V                        | 41.1              | 27.2               | 0.0           | 3.2                 | 71.5                          | 52.8                          | -12.8        |
| 2312.81                  | V                        | 32.2              | 29.6               | 0.0           | 2.3                 | 64.1                          | 60.2                          | -20.2        |
| 2775.38                  | V                        | 45.2              | 30.6               | 0.0           | 2.3                 | 78.1                          | 46.2                          | -6.2         |
| 3237.94                  | V                        | 45.0              | 31.8               | 0.0           | 2.5                 | 79.3                          | 45.0                          | -5.0         |
| 3700.50                  | V                        | 41.7              | 33.1               | 0.0           | 2.7                 | 77.5                          | 46.8                          | -6.8         |
| 4163.06                  | V                        | 38.9              | 34.2               | 0.0           | 2.9                 | 76.0                          | 48.3                          | -8.3         |
| 4625.63                  | V                        | 31.9              | 33.5               | 0.0           | 3.2                 | 68.2                          | 55.7                          | -15.7        |
| <b><u>Channel 14</u></b> |                          |                   |                    |               |                     |                               |                               |              |
| 935.43                   | V                        | 52.9              | 22.6               | 0.0           | 2.2                 | 77.7                          | 46.6                          | -6.6         |
| 1403.14                  | V                        | 47.1              | 24.7               | 0.0           | 2.7                 | 74.5                          | 49.8                          | -9.8         |
| 1870.25                  | V                        | 37.5              | 27.2               | 0.0           | 3.2                 | 67.9                          | 56.4                          | -16.4        |
| 2338.56                  | V                        | 32.0              | 29.6               | 0.0           | 2.3                 | 63.9                          | 60.4                          | -20.4        |
| 2806.28                  | V                        | 44.3              | 30.6               | 0.0           | 2.3                 | 77.2                          | 47.1                          | -7.1         |
| 3273.99                  | V                        | 41.3              | 31.8               | 0.0           | 2.5                 | 75.6                          | 48.7                          | -8.7         |
| 3741.70                  | V                        | 39.6              | 33.1               | 0.0           | 2.7                 | 75.4                          | 48.9                          | -8.9         |
| 4209.42                  | V                        | 36.2              | 34.2               | 0.0           | 2.9                 | 73.2                          | 51.1                          | -11.1        |
| 4677.12                  | v                        | 34.7              | 33.5               | 0.0           | 3.2                 | 71.4                          | 52.9                          | -12.9        |

- Note: 1. All measurement were made at 3 meters
2. Field Strength at the fundamental frequency equals 124.3 dBuV/m (ch.1) and 124.3 dBuV/m (ch.14)
3. Negative signs (-) in the margin column signify levels below the limit.

**FCC PART 15.109 RADIATED EMISSION****Test Condition:** Receiving mode**Frequency range investigated:** 30 to 1000 MHz.

| Frequency | Reading | Det.  | Ant.<br>Pol. | Ant.<br>Factor | Pre-Amp | Cable Loss | Net      | Limit @3m | Margin |
|-----------|---------|-------|--------------|----------------|---------|------------|----------|-----------|--------|
| MHz       | dB(uV)  | P/A/Q | H/V          | dB(1/m)        | dB      | dB         | dB(uV/m) | dB(uV/m)  | dB     |
| 41.89     | 38.0    | Peak  | V            | 7.8            | 18.7    | 0.4        | 27.5     | 40.0      | -12.5  |
| 62.84     | 32.0    | Peak  | V            | 5.1            | 18.9    | 0.5        | 18.7     | 43.5      | -21.3  |
| 167.56    | 25.0    | Peak  | V            | 9.0            | 18.9    | 0.8        | 15.9     | 46.0      | -27.6  |
| 230.34    | 30.0    | Peak  | V            | 11.1           | 18.4    | 1.0        | 23.7     | 46.0      | -22.3  |
| 441.17    | 42.1    | Peak  | V            | 16.2           | 16.9    | 1.4        | 42.8     | 46.0      | -3.2   |
| 446.31    | 40.2    | Peak  | V            | 16.1           | 16.9    | 1.4        | 40.8     | 46.0      | -5.2   |
| 881.62    | 25.0    | Peak  | V            | 22.8           | 14.6    | 2.1        | 35.3     | 46.0      | -10.7  |
| 892.62    | 24.0    | Peak  | V            | 22.8           | 14.6    | 2.1        | 34.3     | 46.0      | -11.7  |

Note: 1. All measurement were made at 3 meters

2. Negative signs (-) in the margin column signify levels below the limit.



**6.4 Modifications made during testing**

None

**6.5 Test instrumentation**

[X] CDI B100/200/300 Biconical Antennas  
[X] EMCO Bi-logcon Antenna  
[X] EMCO 3115 Horn Antenna  
[X] HP 8566B Spectrum Analyzer  
[X] Preamplifiers

## 7 AC LINE CONDUCTED EMISSIONS

### 7.1 Test description

|              |              |
|--------------|--------------|
| Parameter:   | ANSI C63.4   |
| Requirement: | FCC § 15.107 |

### 7.2 Test Procedure

The EUT was connected to the DC power supply, that was connected to the AC line through the LISNs.

Both HOT and NEUTRAL leads were tested.

### 7.3 Test Results

[X] Not applicable, the EUT is battery powered only.

### 7.4 Modifications made during testing

None

### 7.5 Test instrumentation

[ ] HP 8566B Spectrum Analyzer

[ ] LISN

## 8 FREQUENCY STABILITY

### 8.1 Test description

|                      |                         |
|----------------------|-------------------------|
| Parameter:           | FCC §2.1055             |
| Requirement:         | FCC § 95.627            |
| Frequency Tolerance: | Within 0.00025% (25ppm) |

### 8.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm\ error = \left( \frac{MCF}{ACF} - 1 \right) \cdot 10^6$$

Where MCF is the Measured Carrier Frequency in MHz  
ACF is the Assigned Carrier Frequency in MHz

#### 8.2.1 Frequency Stability vs. Temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

#### 9.2.2 Frequency Stability vs. Voltage

At room temperature ( $25 \pm 5$  °C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

**9.3 Test Results**

|                     |            |               |
|---------------------|------------|---------------|
| ACF (MHz): 462.5625 |            | Limit: 2.5ppm |
| Temperature, C      | MCF (MHz)  | PPM Error     |
| 50                  | 462.561519 | -2.120794487  |
| 40                  | 462.561649 | -1.839751385  |
| 30                  | 462.562186 | -0.678827186  |
| 20                  | 462.56275  | 0.540467504   |
| 10                  | 462.563235 | 1.588974463   |
| 0                   | 462.563341 | 1.818132685   |
| -10                 | 462.562953 | 0.979327118   |
| -20                 | 462.56348  | 2.118632617   |

|                     |         |            |                |
|---------------------|---------|------------|----------------|
| ACF (MHz): 462.5625 |         |            | Limit: 2.5 ppm |
| %                   | Voltage | MCF (MHz)  | PPM Error      |
| 115                 | 6.90    | 462.562796 | -1.22          |
| 100                 | 6.00    | 462.562796 | -0.64          |
| 85                  | 5.10    | 462.562796 | -0.64          |
| Battery Endpoint    | 4.00    | 462.562796 | -0.64          |

**9.4 Modifications made during testing**

None

**9.5 Test instrumentation**

☒ Temperature Chamber, -50C to +100C  
☒ Hewlett Packard 5383A Frequency Counter  
☒ Tektronix 2784 Spectrum Analyzer  
☒ Goldstar DC Power Supply, GR303

**10 LIST OF EXHIBITS**

The following exhibits are listed as reference only and are submitted as separate attachments:

*Exhibit 1*        **ID Label Format**

*Exhibit 2*        **ID Label Location**

*Exhibit 3*        **Equipment Photographs**

*Exhibit 4*        **Block Diagram**

*Exhibit 5*        **Circuit Diagram**

*Exhibit 6*        **Theory of Operation:**  
**Description of all circuitry and devices provided for determining and stabilizing**  
**Frequency, for suppression of spurious radiation, for limiting modulation, and for**  
**Limiting power.**

*Exhibit 7*        **Tune-Up Procedure over the power range**

*Exhibit 8*        **Test Setup Photos**

*Exhibit 9*        **Instruction Manual**

*Exhibit 10*       **Plots**

10-1: Full Power, reference level

10-2: Occupied bandwidth, scan 62.50kHz

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**Intertek Testing Services NA Inc.**

1365 Adams Court, Menlo Park, CA 94025  
Telephone 650-463-2900 Fax 650-463-2910 <http://www.worldlab.com>