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**CERTIFICATE OF COMPLIANCE
 FCC Part 2, 15 & 90 Certification**

Dates of Tests: August 13 ~ 21, 2004
 Test Report S/N:DR50110408AI
 Test Site : DIGITAL EMC CO., LTD.

FCC ID:

SGLWLS-2002

APPLICANT

ENCOMM CO., Ltd

| | | |
|-----------------------------|---|----------------------------------|
| Device name | : | Wireless Lighting Warning System |
| Manufacturer | : | ENCOMM CO., Ltd |
| Model name | : | WLS-2002 |
| Serial number | : | Identical prototype |
| FCC Rule Part(s) | : | §2, §15, §90 |
| Frequency Range | : | 447.2625MHz |
| RF Output Power | : | 10mW |
| Emission Designators | : | 18K6F1D |
| Data of issue | : | August 23, 2004 |

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.



NVLAP LAB CODE 200559-0

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1. General information's

This report contains the result of tests performed by:

DIGITAL EMC CO., LTD.

Address : 683-3, Yubang-Dong, Yongin-Si, Kyunggi-Do, Korea. 449-080

<http://www.digitalemc.com> E-mail : demc@unitel.co.kr

Tel: +82-31-321-2664 Fax: +82-31-321-1664

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the
“General requirements for the competents of calibration and testing laboratory”.

This laboratory is accredited by NVLAP for NVLAP Lab. Code : 200559-0.

Test operator: engineer



August 23, 2004

Kyung-Taek LEE

Data

Name

Signature

Report Reviewed By: manager



August 23, 2004

Dong-Min JUNG

Data

Name

Signature

Ordering party:

| | | |
|---------------|---|---|
| Company name | : | ENCOMM CO., Ltd |
| Address | : | #312, Ulsan University Techno Complex Bldg., San 29, Mugeo-dong, Nam-gu |
| Zipcode | : | 680-749 |
| City/town | : | Ulsan City |
| Country | : | KOREA |
| Date of order | : | August 10, 2004 |

2. Information's about test item

WLS-2002

2.1 Equipment information

| | |
|-----------------------|-------------------------|
| Equipment model no. | WLS-2002 |
| Equipment serial no. | Identical prototype |
| Type of equipment | Fixed |
| Type of modulation | NRZ-FSK |
| Frequency Range | 447.2625 MHz |
| Rated RF output power | 10mW |
| Type of antenna | Helical Antenna |
| Battery type | 3.6V DC NITHIUM Battery |

2.2 Tested environment

| | |
|---------------------------|----------------|
| Temperature | : 15 ~ 35 (°C) |
| Relative humidity content | : 20 ~ 75 % |
| Air pressure | : 86 ~ 103 kPa |
| Tested Voltage | : DC 3.6V |

2.3 Test conditions

| Test Conditions | Temperature(°C) |
|-----------------|-----------------|
| Low | -30 |
| High | +50 |

2.4 EMI Suppression Device(s)/Modifications

-> none

3. Test Report

3.1 Summary of tests

| Rule Reference | Parameter | Status (note 1) |
|-----------------|---|--------------------|
| 2.1046 | Carrier Output Power | C |
| 2.1049 | Emission Masks (Occupied Bandwidth) | C |
| 2.1051 | Unwanted Emissions (Transmitter Conducted) | C |
| 2.1053 / 15.209 | Field Strength of Spurious Radiation | C |
| 2.1055 | Frequency Stability (Temperature Variation) | C |
| 2.1055 | Frequency Stability (Voltage Variation) | C |
| 2.202 | Necessary Bandwidth and Emission Bandwidth | C |

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The device is only operated by battery.

Note 3: The device is governed by FCC rule Part 2, 15 and 90.

3.2 Requirements

3.2.1 Carrier Output Power

Definition:

- The carrier power output for a transmitter for this service is the power available at the output terminals of the transmitter when the output terminals are connected to the standard transmitter load.

| | |
|---------------|--|
| FCC ID | : SGLWLS-2002 |
| Specification | : 47 CFR 2.1046 (a) |
| Test method | : ANSI/TIA/EIA-603-2001, Paragraph 2.2.1 |

Measurement Procedure:

- For Conducted measurement, The EUT was connected to a resistive coaxial attenuator of normal load impedance, and the unmodulated output power was measured by means of an R.F. Power Meter.
- For Radiated measurement, Effective Radiated Power Output Measurements by Substitution Method according to ANSI/TIA/EIA-603-A-2001. The EUT was placed on a wooden turn-table 3-meters from the receive antenna. The receive antenna height and turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminals of the dipole is measured. The ERP is recorded.

Conducted Measurement Data:

| Frequency (MHz) | Conducted Carrier power (mW) |
|--------------------|---------------------------------|
| 447.2625 | 9.3 |

ERP Measurement Data:

| Frequency (MHz) | TEST CONDITIONS | | | | |
|--------------------|---------------------|------------|--------------|-------------|----------|
| | Ref. level (dBm) | Pol. (H/V) | ERP (dBm) | ERP (mW) | Battery |
| 447.2625 | -28.14 | H | 10.22 | 10.52 | Standard |

3.2.2 Unwanted Emissions (Transmitter Conducted)

Definition:

- Conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies which are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired.

| | | |
|---------------|---|---|
| FCC ID | : | SGLWLS-2002 |
| Specification | : | 47 CFR 2.1051 |
| Test method | : | ANSI/TIA/EIA-603-2001, Paragraph 2.2.13 |

Measurement Procedure:

- The emissions were measured for the worst case as follows:
 - (1) Within a band of frequencies defined by the carrier frequency plus and minus one channel.
 - (2) From the lowest frequency generated in the EUT and to at least the 10th harmonic of the carrier frequency, or 40GHz, whichever is lower.
- The magnitude of spurious emissions that are attenuated more than 20dB below the permissible value need not be specified.

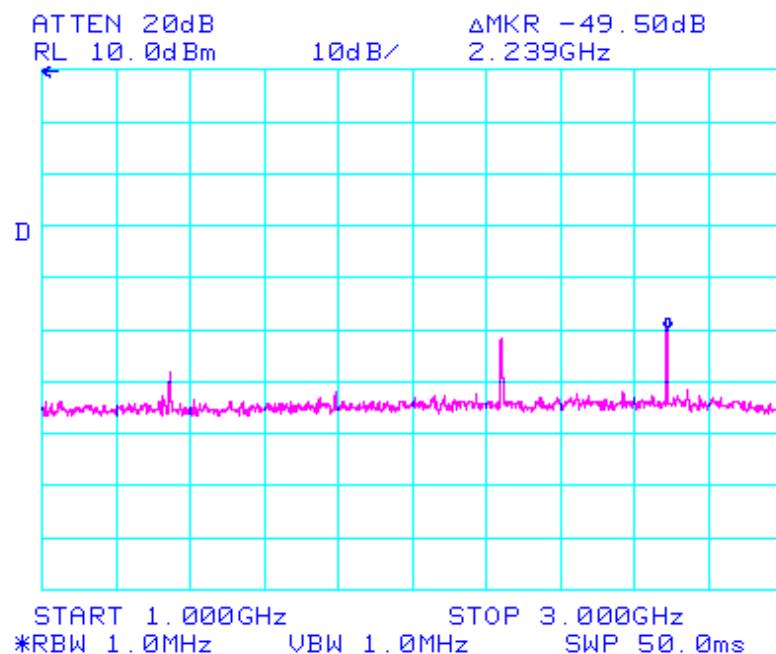
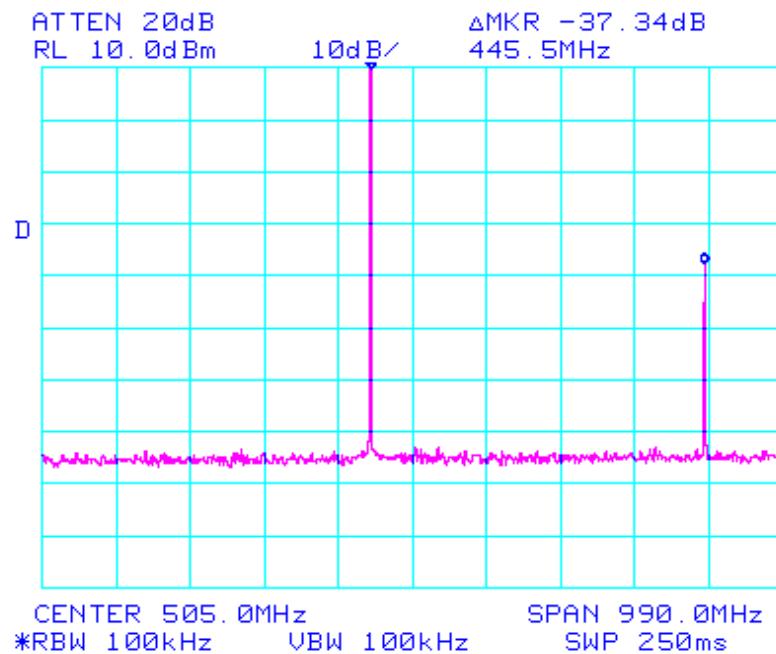
Measurement Data:

Refer to the Next page

LIMIT

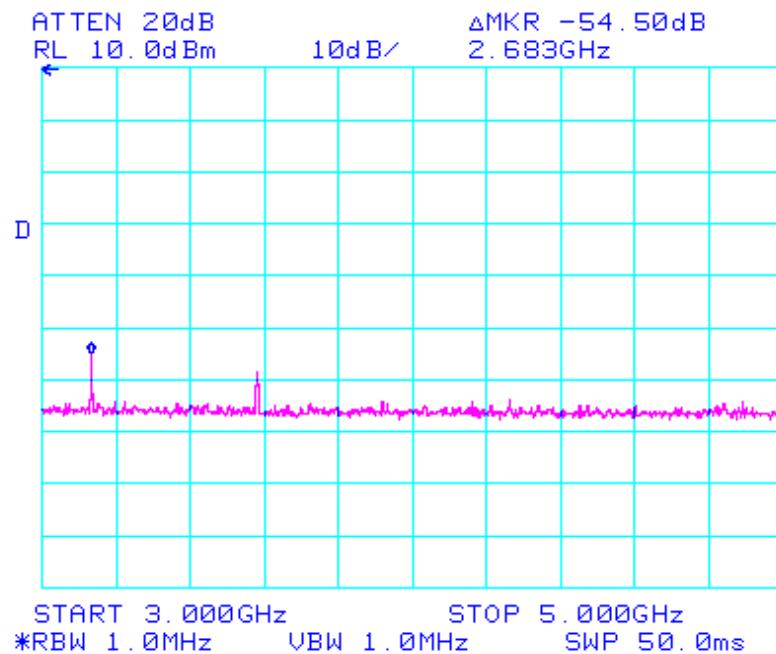
$$= 43 + 10 \log_{10} (P) \text{ dBc (or -13 dBm)}$$

TEST EQUIPMENT USED: 2, 19, 20, 35, 37

Unwanted Emissions (Transmitter Conducted)

Unwanted Emissions (Transmitter Conducted)

– Continuous



3.2.3 Field Strength of Spurious Radiation

Definition:

- Radiated spurious emissions are emissions from the equipment when transmitting into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desire.

| | |
|---------------|---|
| FCC ID | : SGLWLS-2002 |
| Specification | : 47 CFR 2.1053(a) / 15.209 |
| Test method | : ANSI/TIA/EIA-603-2001, Paragraph 2.2.12 |

Measurement Procedure:

- The test sample was set up at a distance of three meters from the test instrument. Valid spurious signals were determined by switching the power on and off.
- In the field, the test sample was placed on a wooden turntable above ground at three meters away from the search antenna.
- The cables were oriented in order to obtain the maximum response. At each emission frequency, the turntable was rotated and the search antennas were raised and lowered vertically.
- The emission was observed with both a vertically polarized and a horizontally polarized search antenna and the worst case was used.
- The field strength of each emission within 20dB of the limit was recorded and corrected with the appropriate cable and transducer factors.
- From the lowest frequency generated in the EUT and to at least the 10th harmonic of the carrier frequency, or 40GHz, whichever is lower.

LIMIT

$$= 43 + 10 \log_{10} (P) \text{ dBc (or -13 dBm)}$$

TEST EQUIPMENT USED: 1, 8, 19, 22, 23, 33, 34, 35

1. Measurement Data: Harmonics of the 447.2625 MHz

OUTPUT POWER : 0.01052 W = 10.22 dBm
 LIMIT : $43 + 10 \log_{10} (W) = 23.22$ dBc

| Freq. (MHz) | LEVEL@ ANTENNA TERMINALS (dBm) | SUBSTITUTE ANTENNA GAIN (dBi) | CORRECT GENERATOR LEVEL (dBm) | POL (H/V) | (dBc) |
|----------------|---|--|--|--------------|-------|
| 894.5250 | -48.56 | 6.2 | -42.36 | H | 52.58 |
| 1341.7875 | -56.06 | 8.2 | -47.86 | H | 58.08 |
| 1789.0500 | -61.29 | 10.3 | -50.99 | H | 61.21 |
| 2236.3125 | -62.17 | 9.5 | -52.67 | H | 62.89 |
| - | - | - | - | - | - |

Remark :

Radiated Spurious Emission Measurements by Substitution Method
according to ANSI/TIA/EIA-603-A-2001, Aug. 15, 2001:

The EUT was placed on a wooden turn table 3-meters from the receive antenna. The receive antenna height and turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. This spurious level is recorded. For readings above 1GHz, the above procedure is repeated using horn antennas and the difference between the gain of the horn and an isotropic or dipole antenna are taken into consideration.

2. Measurement Data: other frequency

| Frequency [MHz] | ANT Pol. | Q.P Reading [dB μ V] | T.F [dB] | Q.P Results [dB μ V/m] | Limits [dB μ V/m] | Margin [dB] |
|--|-------------|-----------------------------|-------------|-------------------------------|--------------------------|----------------|
| | | | | | | |
| | | | | | | |
| No emissions were detected at a level greater than 10dB below limit. | | | | | | |
| | | | | | | |
| | | | | | | |

Remark

1. Measurements above 1GHz is performed using a minimum resolution bandwidth of 1MHz.
2. The EUT was tested up to the 5GHz and no significant emission was found.

3.2.4 Emission Masks (Occupied Bandwidth)

Definition:

- The term transmitter Sideband Spectrum denotes the sideband energy produced at a discrete frequency separation from the carrier up to the test bandwidth due to all sources of unwanted noise within the transmitter in a modulated condition.

| | | |
|---------------|---|---|
| FCC ID | : | SGLWLS-2002 |
| Specification | : | 47 CFR 2.1049 |
| Test method | : | ANSI/TIA/EIA-603-2001, Paragraph 2.2.11 |

Measurement Procedure:

- The EUT and test equipment were set up as shown on the following page, with the Spectrum Analyzer connected.
- For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for ± 1.25 kHz deviation (or 50% modulation). With level constant, the signal level was increased 16dB.
- For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.
- The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.

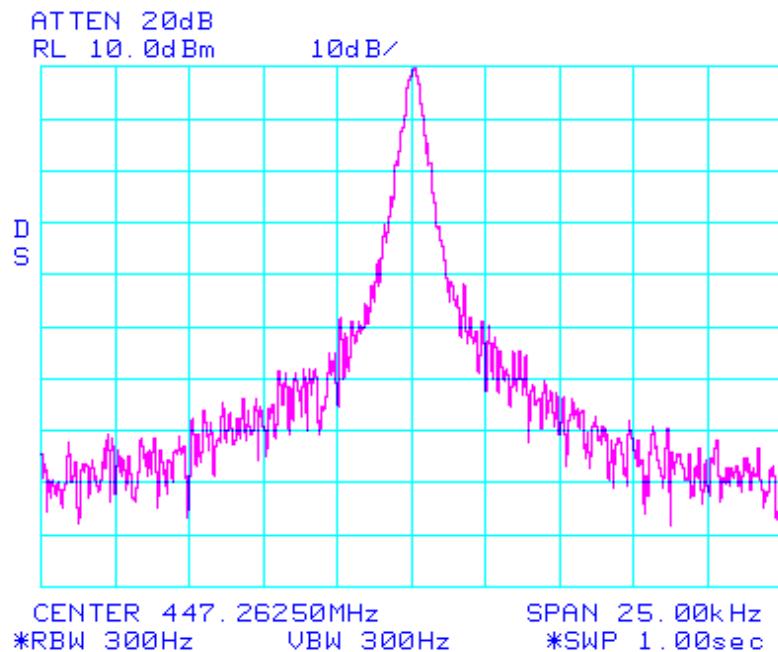
Measurement Data:

Refer to the next page

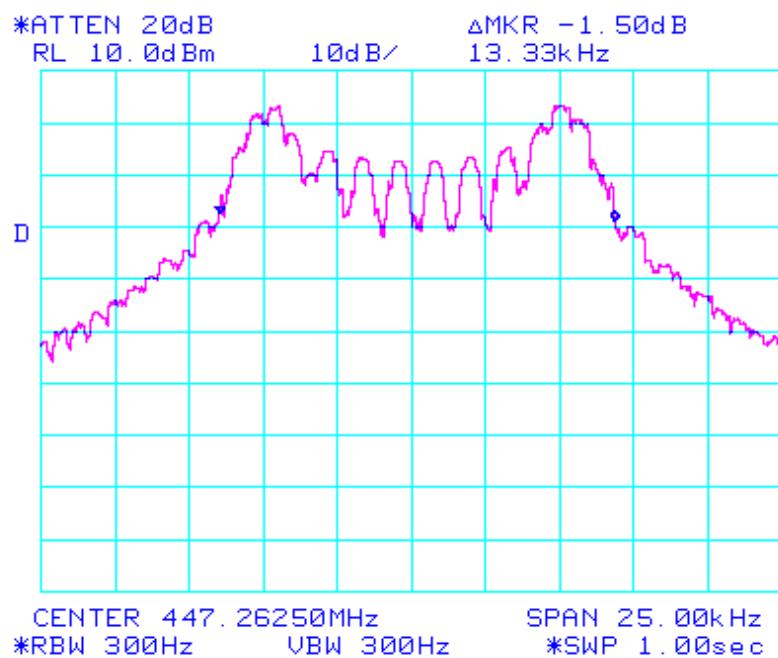
TEST EQUIPMENT USED: 2, 19, 20, 35, 37

Emission Masks Measurement Data:

OPERATING FREQUENCY : 447.2625 MHz
 MODULATION : None



MODULATION mode: (1200bps)



3.2.5 Frequency Stability

Definition:

- Modulation limiting refers to the transmitter circuits ability to limit the transmitter from producing deviations due to modulation in excess of a rated system deviation.

| | | |
|---------------|---|--|
| FCC ID | : | SGLWLS-2002 |
| Specification | : | 47 CFR 2.1055 |
| Test method | : | ANSI/TIA/EIA-603-2001, Paragraph 2.2.2 |

Measurement Procedure:

The frequency stability of the transmitter is measured by:

- a) Temperature: The temperature is varied from -30°C to +50°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 frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ± 0.00025 ($\pm 2.5\text{ppm}$) of the center frequency.

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 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 measurements are 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 re-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.

Measurement Data:

Refer to the next page

TEST EQUIPMENT USED: 2, 19, 20, 35, 37

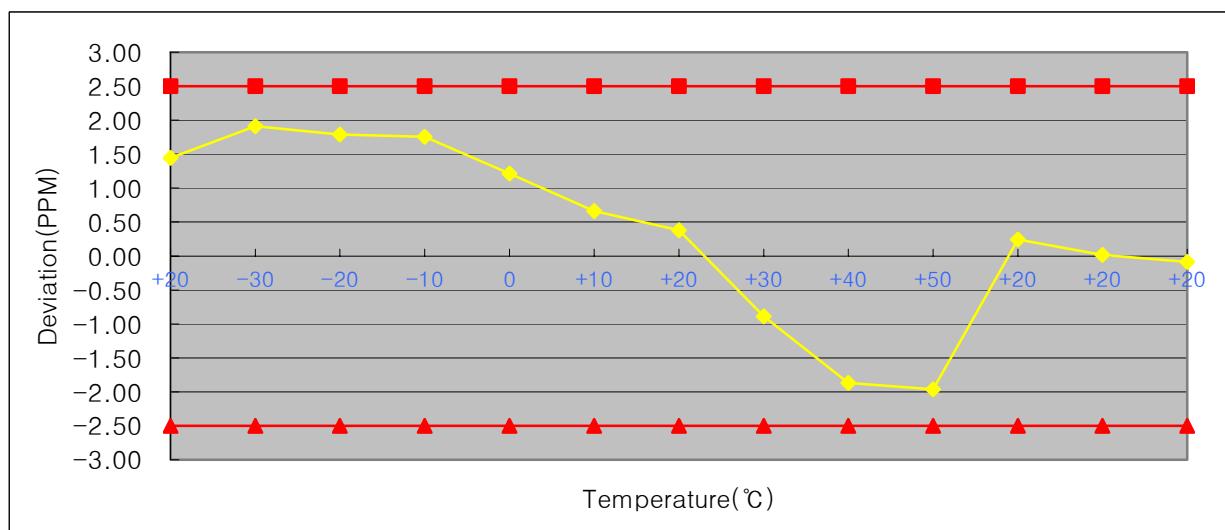
Frequency Stability Measurement Data:

OPERATING FREQUENCY : 447.262500 MHz

REFERENCE VOLTAGE: 3.6 VDC

DEVIATION LIMIT: ± 0.00025 % or 2.5ppm

| VOLTAGE (%) | POWER (VDC) | TEMP (dB) | FREQ (Hz) | Deviation (ppm) |
|---------------|-------------|-----------|-----------|-----------------|
| 100% | 3.6 | +20(Ref) | 447263147 | 1.45 |
| 100% | | -30 | 447263355 | 1.91 |
| 100% | | -20 | 447263301 | 1.79 |
| 100% | | -10 | 447263285 | 1.76 |
| 100% | | 0 | 447263043 | 1.21 |
| 100% | | +10 | 447262797 | 0.66 |
| 100% | | +20 | 447262669 | 0.38 |
| 100% | | +30 | 447262103 | -0.89 |
| 100% | | +40 | 447261664 | -1.87 |
| 100% | | +50 | 447261621 | -1.97 |
| 85% | 3.06 | +20 | 447262608 | 0.24 |
| 115% | 5.52 | +20 | 447262508 | 0.02 |
| BATT.ENDPOINT | 2.80 | +20 | 447262461 | -0.09 |



3.2.6 Necessary Bandwidth and Emission Bandwidth

FCC ID : **SGLWLS-2002**
Specification : 47 CFR 2.202 (g)

Emission Designator = 18K6F1D

NECESSARY BANDWIDTH CALCULATION:

| | |
|-------------------------------|----------------------------------|
| MAXIMUM MODULATION (M), Hz | = 7500 |
| MAXIMUM DEVIATION (D), Hz | = 1500 |
| CONSTANT FACTOR (K) | = 1.2 |
| NECESSARY BANDWIDTH (BN), kHz | = $(2 * M) + (2 * D * K) = 18.6$ |

F = Frequency Modulation

1 = A single Channel containing quantized or digital information without the use of a modulating sub-carrier. Excludes TDM

D = Data transmission

APPENDIX

TEST EQUIPMENT USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

| | Type | Manufacturer | Model | Cal.Due.Date (dd/mm/yy) | S/N |
|----|------------------------------|--------------|----------|----------------------------|------------------|
| 01 | Spectrum Analyzer | Agilent | E4404B | 04/10/04 | 30601-01-6025569 |
| 02 | Spectrum Analyzer | H.P | 8563E | 04/10/04 | 3551A04634 |
| 03 | Power Meter | H.P | EPM-442A | 04/10/04 | GB37170413 |
| 04 | Power Sensor | H.P | 8481A | 07/07/05 | 3318A96332 |
| 05 | Frequency Counter | H.P | 5342A | 07/07/05 | 2119A04450 |
| 06 | Multifunction Synthesizer | H.P | 8904A | 14/09/04 | 3633A08404 |
| 07 | Signal Generator | H.P | 8673D | 23/10/04 | 2844A00753 |
| 08 | Signal Generator | H.P | E4421A | 23/10/04 | US37230529 |
| 09 | Signal Generator | H.P | 8657A | 07/04/05 | 3430U02049 |
| 10 | Audio Analyzer | H.P | 8903B | 15/10/04 | 3011A0944B |
| 11 | Modulation Analyzer | H.P | 8901B | 12/05/05 | 3028A03029 |
| 12 | Sensor Module | H.P | 11722A | 15/10/04 | 3111A04665 |
| 13 | Oscilloscope | LeCroy | 9314A | 21/06/05 | 93144390 |
| 14 | CDMA Mobile Station Test Set | H.P | 8924C | N/A | US35360688 |
| 15 | Power Splitter | WEINSCHEL | 1593 | N/A | 332 |
| 16 | BAND Reject Filter | Wainwright | WRCG824 | 23/05/05 | SN1 |
| 17 | BAND Reject Filter | Wainwright | WRG1750 | 07/07/05 | SN2 |
| 18 | AC Power supply | DAEKWANG | 5KVA | 29/08/04 | N/A |
| 19 | DC Power Supply | H.P | 6622A | 22/08/04 | 465487 |
| 20 | Attenuator (30dB) | H.P | 8498A | N/A | 50101 |
| 21 | Attenuator (10dB) | WEINSCHEL | 23-10-34 | N/A | BP4387 |
| 22 | HORN ANT | EMCO | 3115 | N/A | 6419 |
| 23 | HORN ANT | EMCO | 3115 | N/A | 21097 |
| 24 | HORN ANT | A.H.Systems | SAS-574 | N/A | 154 |
| 25 | HORN ANT | A.H.Systems | SAS-574 | 04/10/04 | 155 |
| 26 | Dipole Antenna | Schwarzbeck | VHA9103 | 04/10/04 | 2116 |

| | Type | Manufacturer | Model | Cal.Due.Date (dd/mm/yy) | S/N |
|----|---------------------------|---------------|-------------|----------------------------|----------------|
| 27 | Dipole Antenna | Schwarzbeck | VHA9103 | 04/10/04 | 2117 |
| 28 | Dipole Antenna | Schwarzbeck | UHA9105 | 04/10/04 | 2261 |
| 29 | Dipole Antenna | Schwarzbeck | UHA9105 | 04/10/04 | 2262 |
| 30 | RFI/FIELD Intensity Meter | Kyorits | KNM-504D | 07/07/05 | SN-161-4 |
| 31 | Frequency Converter | Kyorits | KCV-604C | 07/07/05 | 4-230-3 |
| 32 | TEMP & HUMIDITY Chamber | JISCO | J-RHC2 | 14/09/04 | 021031 |
| 33 | Log Periodic Antenna | Schwarzbeck | UHALP9108A1 | 23/10/04 | 1098 |
| 34 | Biconical Antenna | Schwarzbeck | VHA9103 | 23/10/04 | VHA91031946 |
| 35 | Digital Multimeter | H.P | 34401A | 07/04/05 | 3146A13475 |
| 36 | Attenuator (10dB) | WEINSCHEL | 23-10-34 | 15/10/04 | BP4386 |
| 37 | High-Pass Filter | ANRITSU | MP526 | 12/05/05 | M27756 |
| 38 | Attenuator (3dB) | Agilent | 8491B | 15/10/04 | 58177 |
| 39 | Oscillo Scope | Tektronics | TDS644B | 10/11/04 | B010834 |
| 40 | RFI/FIELD Intensity Meter | Kyorits | KNW-2402 | 07/07/05 | 4N-170-3 |
| 41 | LISN | Kyorits | KNW-407 | 29/08/04 | 8-317-8 |
| 42 | LISN | Kyorits | KNW-242 | 22/08/04 | 8-654-15 |
| 43 | Spectrum Analyzer | H.P | 8591E | 23/05/05 | 3649A05889 |
| 44 | Software | ToYo EMI | EP5/CE | N/A | Ver 2.0.801 |
| 45 | CVCF | NF Electronic | 4400 | N/A | 344536 4420064 |