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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

TABLE OF CONTENTS

1. GENERAL INFORMATION'S	3
2. INFORMATION'S ABOUT TEST ITEM	4
2.1 EQUIPMENT INFORMATION	4
2.2 TESTED FREQUENCY	4
2.3 TEST CONDITION	4
3. TEST REPORT	5
3.1 SUMMARY OF TESTS	5
3.2 REQUIREMENTS	6
3.2.1 CARRIER OUTPUT POWER	6
3.2.2 UNWANTED EMISSIONS (TRANSMITTER CONDUCTED) (CONDUCTED)	7
3.2.3 FIELD STRENGTH OF SPURIOUS RADIATION	10
3.2.4 EMISSION MASKS (OCCUPIED BANDWIDTH)	12
3.2.5 FREQUENCY STABILITY	14
3.2.6 NECESSARY BANDWIDTH AND EMISSION BANDWIDTH	16
 APPENDIX	
APPENDIX TEST EQUIPMENT USED FOR TESTS	17

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

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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:

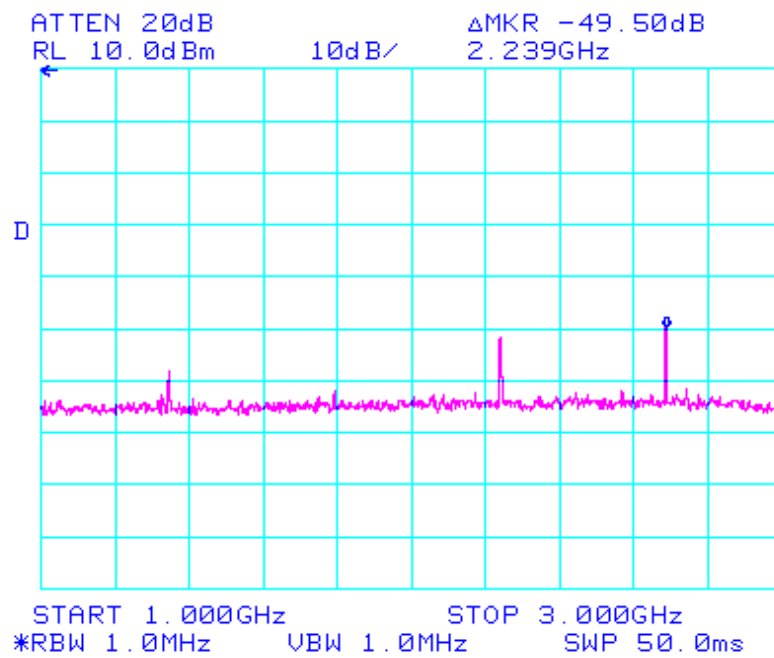
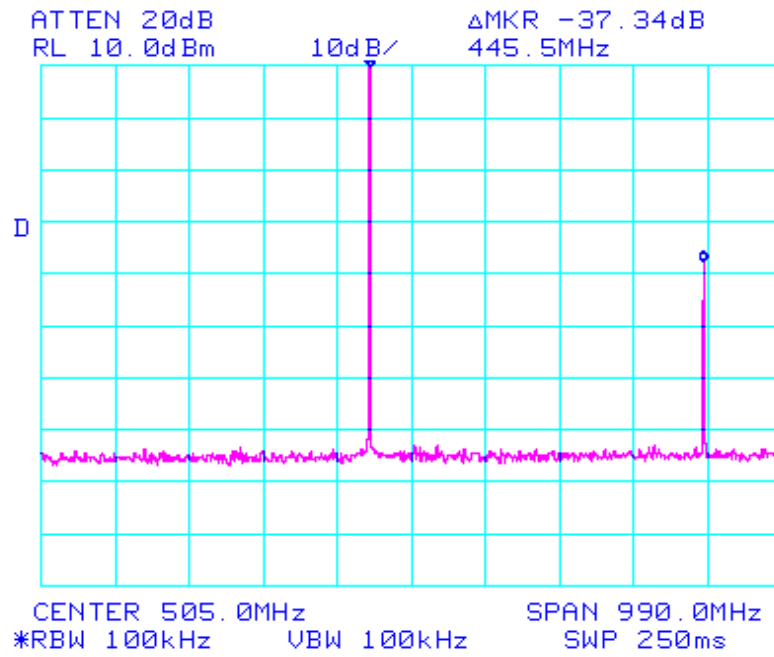
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LIMIT

$= 43 + 10 \log_{10} (P) \text{ dBc (or -13 dBm)}$
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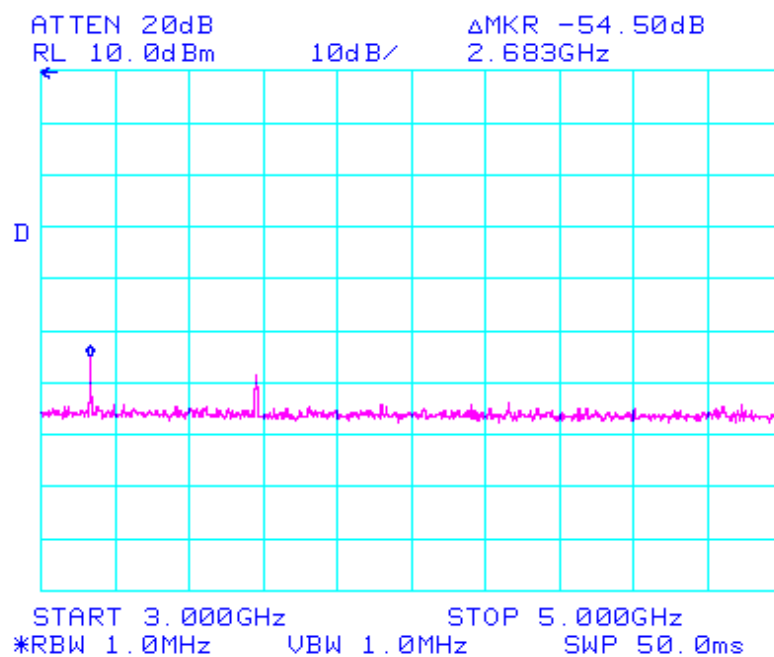
TEST EQUIPMENT USED: 2, 19, 20, 35, 37

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 desired.

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 (dBd)	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

- Measurements above 1GHz is performed using a minimum resolution bandwidth of 1MHz.
- 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.

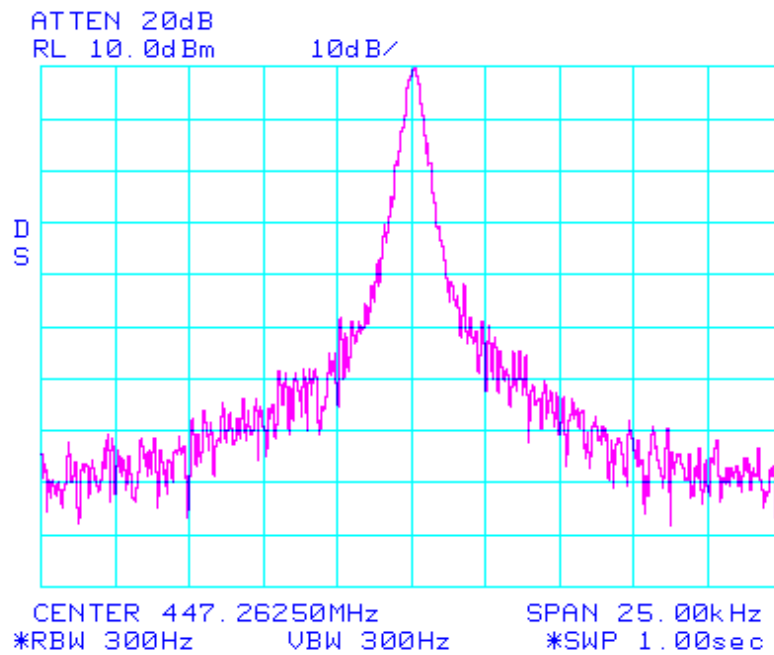
Measurement Data:

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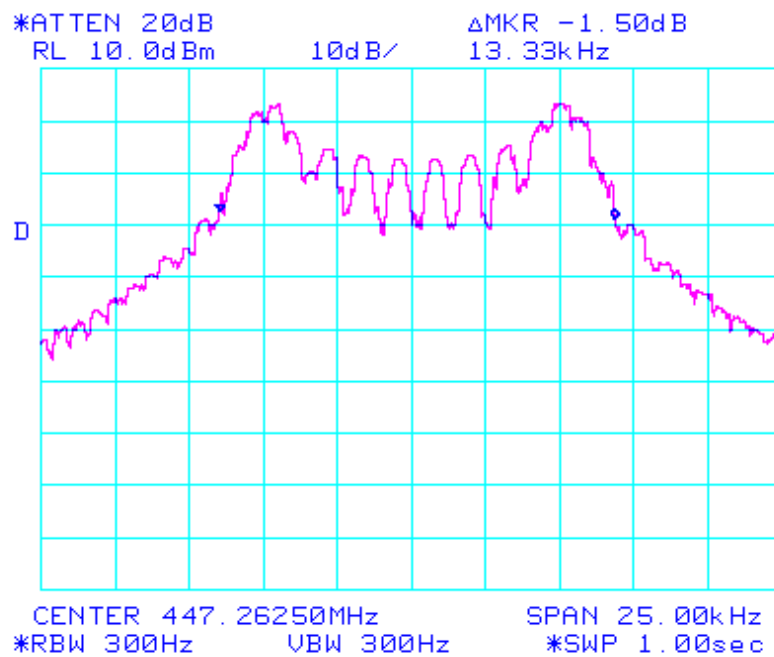
TEST EQUIPMENT USED: 2, 19, 20, 35, 37

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 $\pm 0.00025(\pm 2.5\text{ppm})$ 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
.....

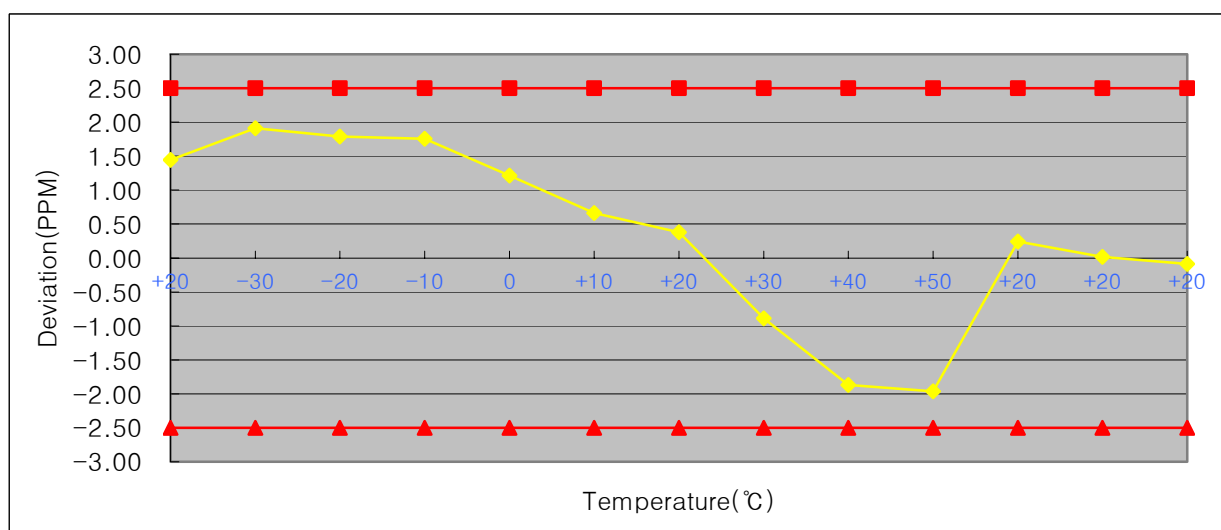
Frequency Stability Measurement Data:

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	WRCG1750	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