ENGINEERING TEST REPORT

BI-DIRECTIONAL AMPLIFIER
MODEL NO.: BDA1200

FCC ID: H6M-BDA1200

FCC PART 2 & PART 22, SUBPART H
CELLULAR RADIOTELEPHONE SERVICE
824-849 MHz (Uplink) and 869-894 MHz (Downlink)

UltraTech's FILE NO.: KTI-002FCC90

Tested for:

Kaval Telecom Inc.
60 Gough Road
Markham, Ontario
Canada, L3R 8X7

Tested by:

UltraTech - Group of Labs
3000 Bristol Circle
Oakville, Ontario
Canada L6H 6G4

Report Prepared by: Tri M. Luu, P.Eng.

DATE: June 17/1999

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EXHIBIT 1. SUMMARY OF TEST RESULTS & GENERAL STATEMENT OF CERTIFICATION

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
22.913 & 2.985	Effective Radiated Power LIMITS	Yes
2.995	Frequency Stability	Not applicable for Power Amplifier
22.915(d) & 2.987(a)	Audio Filter Characteristics	Not applicable for power amplifier
22.915 (a), (b) & (c) & 2.987(b)	Modulation Requirements	Not applicable for power amplifier
22.917(a),(b),(c)& 9(d) & 2.989	Emission Limitation/Emission Masks	Yes
22.917(e), (f) & (g), 2.997 & 2.991	Emission Limits – Spurious Emissions at Antenna Terminal	Yes
22.917(e), (f) & (g), 2.997 & 2.993	Emission Limits - Field Strength of Spurious Emissions	Yes

BI-DIRECTIONAL AMPLIFIER, **Model No.: BDA1200**, by **Kaval Telecom Inc.** has also been tested and found to comply with **FCC Part 15, Subpart B - Radio Receivers and Class A Digital Devices**. The engineering test report has been documented and kept in file and it is available anytime upon FCC request.

TESTIMONIAL AND STATEMENT OF CERTIFICATION

THIS IS TO CERTIFY:

1) *THAT the application was prepared either by, or under the direct supervision of the undersigned.*

2) *THAT the measurement data supplied with the application was taken under my direction and supervision.*

3) *THAT the data was obtained on representative production units, representative.*

4) *THAT, to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct.*

Certified by:

_____

Tri Minh Luu, P. Eng.
V.P., Engineering

DATE: June 17/1999

EXHIBIT 2. GENERAL INFORMATION

2.1. APPLICANT

Kaval Telecom Inc.
60 Gough Road
Markham, Ontario
Canada, L3R 8X7

Applicant's Representative: Mr. Alan Aslett

2.2. MANUFACTURER

Kaval Telecom Inc.
60 Gough Road
Markham, Ontario
Canada, L3R 8X7

2.3. DESCRIPTION OF EQUIPMENT UNDER TESTS

PRODUCT NAME:	BI-DIRECTIONAL AMPLIFIER
MODEL NO.:	BDA1200
SERIAL NUMBER:	Preproduction sample
TYPE OF EQUIPMENT:	Radio Power Amplifier
SERVICES AREAS:	Commercial/Industrial
OPERATING FREQ.:	824-849 MHz (Uplink) and 869-894 MHz (Downlink) (Please refer to the uplink and downlink frequency band pairs on page 6 of the user manual)
RF INPUT RATING:	-40 dBm maximum
RF OUPUT POWER RATING:	7 Watts maximum in 824-849 MHz (Mobile) 12.3 Watts maximum in 869-894 MHz (Base)
AMPLIFIER GAIN:	75 dB in 824-849 MHz band 80 dB in 869-894 MHz
AMPLIFIER 20 dB GAIN BW:	30 MHz
RF INPUT/OUTPUT	

IMPEDANCE:	50 Ohms
DUTY CYCLE:	Continuous
99% BANDWIDTH:	Not applicable
BAUD RATES:	Not applicable
EMISSION DESIGNATION:	F1D & F3E
CPU SPEED:	4 MHz
INPUT SUPPLY:	120V 60 Hz
ASSOCIATED DEVICES:	Not applicable
FCC ID:	H6M-BDA1200
INTERFACE PORTS:	(1) Roof-Top Antenna Port (Type N Connector, Double shielded coaxial cable is required) (2) In-Building Port (Type N Connector, Double shielded coaxial cable is required) (3) AC input (standard 3-conductor AC power cord)

2.4. RELATED SUBMITTALS)/GRANT

Not applicable

2.5. TEST METHODOLOGY

These tests were conducted on a sample of the equipment for the purpose of certification compliance with Code of Federal Regulations, Parts 2 & 22, Subpart H, Radio Services Operating in the Frequency Bands 824-849 MHz (Uplink) and 869-894 MHz (Downlink).

Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.6. TEST FACILITY

AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).

Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Sep. 20, 1999.

The above test site is also filed with Interference Technology International Ltd (ITI - An EC Directive on EMC).

2.7. UNITS OF MEASUREMENTS

Measurements of conducted emissions are reported in units of dB referenced to one microvolt [dB(uV)].

Measurements of radiated emissions are reported in units of dB referenced to one microvolt per meter [dB(uV)/m] at the distance specified in the report, wherever it is applicable.

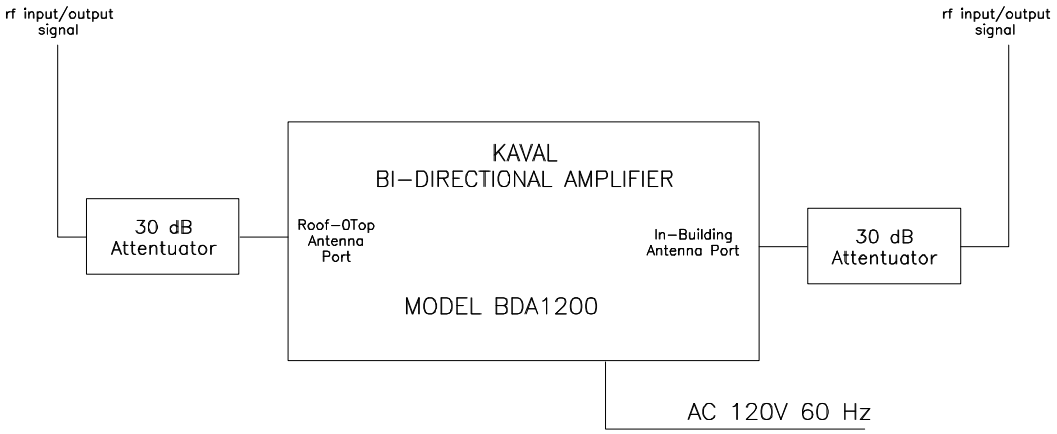
EXHIBIT 3. SYSTEM TEST CONFIGURATION

3.1. TEST SYSTEM DETAILS

The following peripherals, FCC identifiers and types interconnecting cables were used with the EUT for testing:

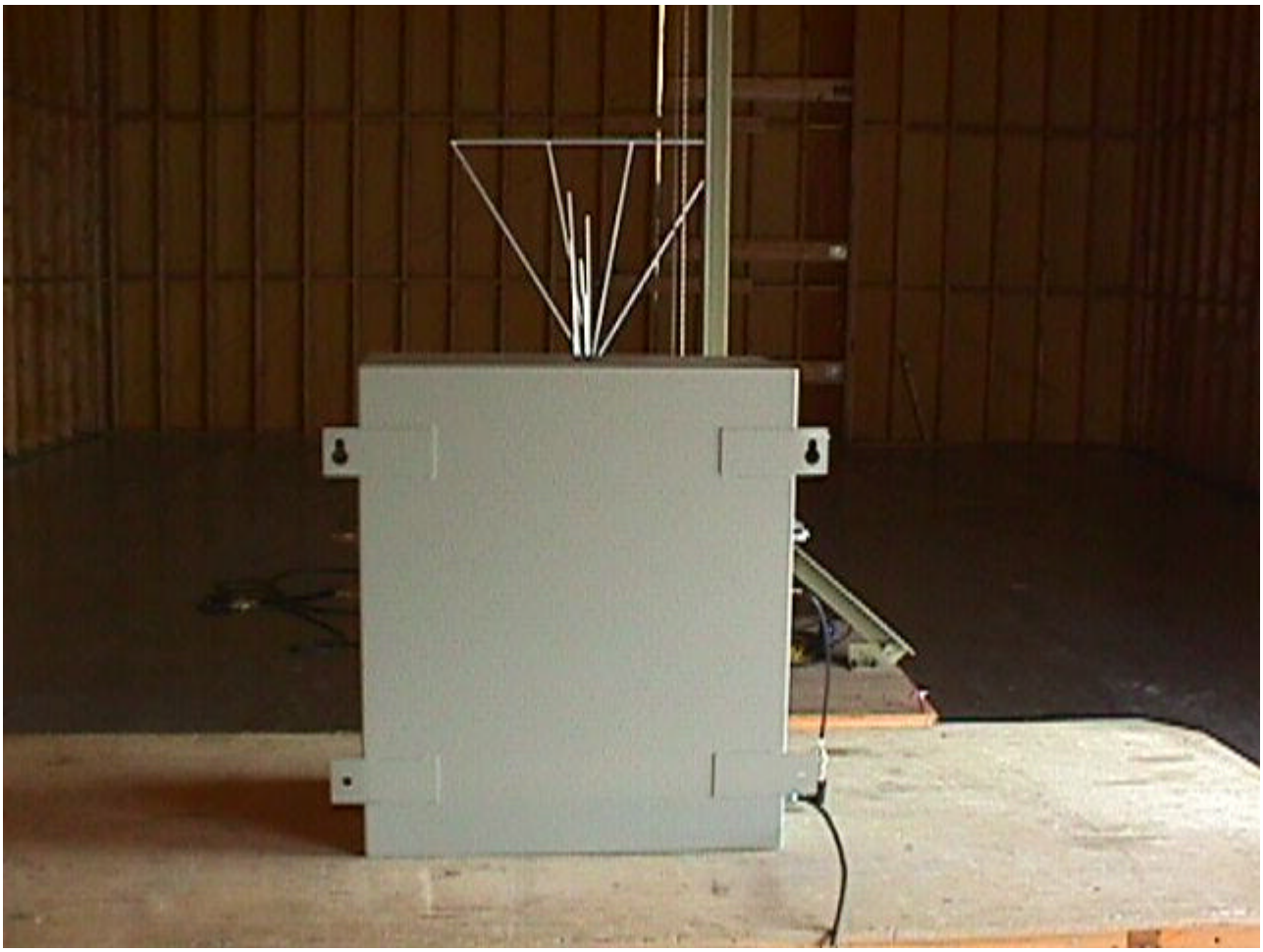
(1) **EUT**: Kaval Telecom Inc., BI-DIRECTIONAL AMPLIFIER, Model : BDA1200, S/N: Preproduction sample, I/O Cable: All I/O cables were shielded
Power Supply Cable: Non-shielded

3.2. BLOCK DIAGRAMS OF TEST SET-UP



3.3. PHOTOGRAPHS FOR TEST SETUP AT OFTS FOR RADIATED EMISSIONS MEASUREMENTS

Tests were performed at the Open Field test Site located in Oakville, Ontario, Canada



3.4. JUSTIFICATION

No deviation, in both configuration and operation manners, different from normal operation were required.

3.5. EUT OPERATING CONDITION

Normal intended operation with the maximum RF input signal provided , maximum gain setting and maximum rf output as specified in the user manual with respect to the number the channel input.

3.6. SPECIAL ACCESSORIES

No special accessories were required.

3.7. EQUIPMENT MODIFICATIONS

Not required.

EXHIBIT 4. TEST DATA

4.1. EFFECTIVE RADIATED POWER LIMITS @ FCC 2.985 & 22.913

4.1.1. Limits @ FCC 22.913

The effective radiated power (EIRP) of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section:

	Maximum ERP (Watts)
Base Transmitters (869-894 MHz)	500 Watts
Mobile Transmitters & Auxiliary TestTransmitters (824-849 MHz)	7 Watts

4.1.2. Method of Measurements

Please refer to Exhibit 7, Sec. 7.1 for test procedures and test setup.

4.1.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Dipole Antenna	EMCO	3121C	8907-434	20-1000 MHz
Dipole Antenna	EMCO	3121C	8907-440	20-1000 MHz

4.1.4. Test data

- **Uplink: 824-849 MHz (Mobile)**

TRANSMITTER CHANNEL OUTPUT	FUNDAMENTAL FREQUENCY (MHz)	MEASURED AVERAGE POWER (P) (dBm)	AVERAGE POWER RATING (dBm)	Maximum Allowable EIRP (dBm)	Calculated Maximum Allowable Antenna Gain (dBi)
Lowest	824.000	38.0	38.5	38.5	0.0
Middle	836.500	38.5	38.5	38.5	0.0
Highest	849.000	37.0	38.5	38.5	0.0
Remark: Only unity gain antenna is allowed to be used at the uplink band port.					

- **Uplink: 869-894 MHz (Base)**

TRANSMITTER CHANNEL OUTPUT	FUNDAMENTAL FREQUENCY (MHz)	MEASURED AVERAGE POWER (P) (dBm)	AVERAGE POWER RATING (dBm)	Maximum Allowable EIRP (dBm)	Calculated Maximum Allowable Antenna Gain (dBi)
Lowest	869.000	40.1	40.9	57.0	16.0
Middle	881.500	40.9	40.9	57.0	16.0
Highest	894.000	40.5	40.9	57.0	16.0
Remark: No antenna with the gain exceeding 16 dBi is allowed to be used with this radio amplifier at the down link band port.					

4.2. EMISSION LIMITATION/EMISSION MASK @ FCC 2.989, 22.917(A), (B), (C) & (D)

4.2.1. Limits @ 22.917(a),(b),(c)&(d)

Emissions shall be attenuated below the mean output power of the transmitter as follows:

	EMISISON MASK @ FCC 22.917	
EMISSION TYPE	**Frequency removed from the carrier frequency**	**Attenuation wrt Carrier Level**
F3E/F3D Emission Mask for use with audio filter	▪ 20 kHz to 45 kHz ▪ 45 kHz to 2*Fc	▪ 26 dBc ▪ 60 dBc or 43+10*log(P) dBc (P in Watts) whichever is less
Alternative F3E/F3D Emission Mask for use with audio filter	▪ 12 kHz to 20 kHz ▪ 20 kHz to 2*Fc	▪ 117*log(f_d+12) dBc ▪ 100*log(f_d+11) dBc or 60 dBc or 43+10*log(P) dBc (P in Watts) whichever is less
F1D Emission Mask	▪ 20 kHz to 45 kHz ▪ 45 kHz to 90 kHz ▪ 90 kHz to 2*Fc	▪ 26 dBc ▪ 45 dBc ▪ 60 dBc or 43+10*log(P) dBc (P in Watts) whichever is less

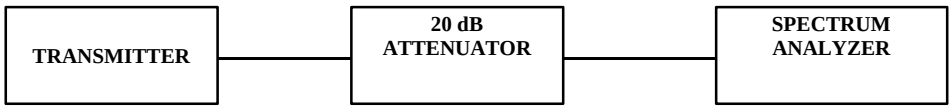
4.2.2. Method of Measurements

Please refer to FCC 2.917(h) and Exhibit 7, Section 7.3 for detailed test procedures.

4.2.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz

4.2.4. Test Arrangement



4.2.5. Test data

Conform. Please refer to the plots below for detailed information.

4.2.6. Plots

Please refer to Exhibit 7 for Plots #1 through #24 for measurement data.

4.3. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS @ FCC 22.917(E), (F) & (G)

4.3.1. Limits @ 22.917(e), (f) & (g)

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC RULES	ATTENUATION LIMIT
FCC 22.917(e)	43+10*log(P) dBc, P is power in watts
FCC 22.917(f) for Mobile emissions	Mean power in 869-894 MHz band shall be less than –80 dBm
FCC 22.917(g)	If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

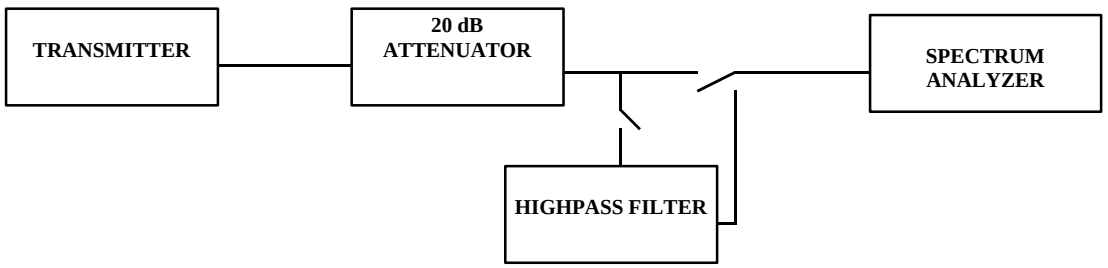
4.3.2. Method of Measurements

Please refer to FCC 2.917(h) and Exhibit 7, Section 7.4 for detailed test procedures.

4.3.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz
Hihpass Filter, Microphase	Microphase	CR220HID	IITI11000AC	Cut-off Frequency at 600 MHz, 1.3 GHz or 4 GHz

4.3.4. Test Arrangement



4.3.5. Test data

824-849 MHz Uplink Band (Voice Modulation)

RF Input/Output Frequency: 824 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 6.3 Watts
Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (Dbm)	MARGIN (dB)	PASS/ FAIL
1648	-17.9	-13.0	-4.9	PASS
3296	-28.4	-13.0	-15.4	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 20 dB below the limits were recorded. Refer to Plot #25 in Exhibit 7 for Measurement Data.

No emissions were found in the 869-894 MHz band.

RF Input/Output Frequency: 836.5 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 7.0 Watts
Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
1673	-25.2	-13.0	-12.2	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 20 dB below the limits were recorded. Refer to Plot #26 in Exhibit 7 for Measurement Data.

No emissions were found in the 869-894 MHz band.

RF Input/Output Frequency: 849 MHz (single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 5.0 Watts
Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm) Note 2	MARGIN (dB)	PASS/ FAIL
1698	-28.3	-13.0	-15.3	PASS
2547	-27.2	-13.0	-14.2	PASS
3396	-29.4	-13.0	-16.4	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 20 dB below the limits were recorded. Refer to Plot #27 in Exhibit 7 for Measurement Data.

No emissions were found in the 869-894 MHz band.

824-849 MHz Uplink Band (Digital Modulation)

RF Input/Output Frequency: 824 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 6.3 Watts
Modulation: FM modulation with 9600 b/s random data signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (Dbm)	MARGIN (dB)	PASS/ FAIL
1648	-19.2	-13.0	-6.2	PASS
3296	-27.4	-13.0	-14.4	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 20 dB below the limits were recorded. Refer to Plot #28 in Exhibit 7 for Measurement Data.

No emissions were found in the 869-894 MHz band.

RF Input/Output Frequency: 836.5 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 7.0 Watts
Modulation: FM modulation with 9600 b/s random data signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
1673	-25.5	-13.0	-12.5	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 20 dB below the limits were recorded. Refer to Plot #29 in Exhibit 7 for Measurement Data.

No emissions were found in the 869-894 MHz band.

RF Input/Output Frequency: 849 MHz (single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 5.0 Watts
Modulation: FM modulation with 9600 b/s random data signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm) Note 2	MARGIN (dB)	PASS/ FAIL
1698	-28.6	-13.0	-15.6	PASS
2547	-26.3	-13.0	-13.3	PASS
3396	-30.8	-13.0	-17.8	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 20 dB below the limits were recorded. Refer to Plot #30 in Exhibit 7 for Measurement Data.

No emissions were found in the 869-894 MHz band.

869-894 MHz Downlink Band (Voice Modulation)

RF Input/Output Frequency: 869 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 10.3 Watts
Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 20 dB below the limit. Refer to Plot #31 in Exhibit 7 for Measurement Data.				

RF Input/Output Frequency: 881.5 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 12.3 Watts
Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 20 dB below the limit. Refer to Plot #32 in Exhibit 7 for Measurement Data.				

RF Input/Output Frequency: 894 MHz (single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 11.1 Watts
Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 20 dB below the limit. Refer to Plot #33 in Exhibit 7 for Measurement Data.				

869-894 MHz Downlink Band (Digital Modulation)

RF Input/Output Frequency: 869 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 10.3 Watts
Modulation: FM modulation with 9600 b/s random data signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 20 dB below the limit. Refer to Plot #34 in Exhibit 7 for Measurement Data.				

RF Input/Output Frequency: 881.5 MHz (Single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 12.3 Watts
Modulation: FM modulation with 9600 b/s random data signal, frequency deviation = ±4 kHz

FREQUENCY (MHz)	RF LEVEL 100 kHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 20 dB below the limit. Refer to Plot #35 in Exhibit 7 for Measurement Data.				

RF Input/Output Frequency: 894 MHz (single input/output)
RF Power Input: -40 dBm (maximum input level)
RF Power Output: 11.1 Watts
Modulation: FM modulation with 9600 b/s random data signal, frequency deviation = ±4 kHz

No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 20 dB below the limit. Refer to Plot #36 in Exhibit 7 for Measurement Data.

4.4. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 22.917(E), (F) & (G)

4.4.1. Limits @ 22.917(e), (f) & (g)

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC RULES	ATTENUATION LIMIT
FCC 22.917(e)	43+10*log(P) dBc, P is power in watts
FCC 22.917(f) for Mobile emissions	Mean power in 869-894 MHz band shall be less than –80 dBm
FCC 22.917(g)	If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

4.4.2. Method of Measurements

Please refer to the Exhibit 7, Sec. 7. 5 of this test report and ANSI C63-4:1992 for radiated emissions test method.

4.4.3. Test Arrangement

The following drawings show details of the test setup for radiated emissions measurements

4.4.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3160-09	..	18 GHz – 26.5 GHz
Horn Antenna	EMCO	3160-10	..	26.5 GHz – 40 GHz
Mixer	Tektronix	118-0098-00	..	18 GHz – 26.5 GHz
Mixer	Tektronix	119-0098-00	..	26.5 GHz – 40 GHz

4.4.5. Test data

824-849 MHz Uplink Band (FM Analogue Modulation)

RF Input/Output Frequency: 824 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 6.3 Watts Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 836.5 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 7.0 Watts Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 849 MHz (single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 5.0 Watts Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

824-849 MHz Uplink Band (FM Digital Modulation)

RF Input/Output Frequency: 824 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 6.3 Watts Modulation: FM modulation with 9600 b/s random data signal source, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 836.5 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 7.0 Watts Modulation: FM modulation with 9600 b/s random data signal source, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 849 MHz (single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 5.0 Watts Modulation: FM modulation with 9600 b/s random data signal source, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

869-894 MHz Downlink Band (FM Analogue Modulation)

RF Input/Output Frequency: 869 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 10.3 Watts Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 881.5 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 12.3 Watts Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 894 MHz (single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 11.1 Watts Modulation: FM modulation with 2.5 kHz sine signal, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

869-894 MHz Downlink Band (FM Digital Modulation)

RF Input/Output Frequency: 869 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 10.3 Watts Modulation: FM modulation with 9600 b/s random data signal source, frequency deviation = ±4 kHz
No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

RF Input/Output Frequency: 881.5 MHz (Single input/output) RF Power Input: -40 dBm (maximum input level) RF Power Output: 12.3 Watts Modulation: FM modulation with 9600 b/s random data signal source, frequency deviation = ±4 kHz
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No significant emissions were found in 10 MHz to 10 GHz range; all emissions were more than 60 dB below the limit of 84.5 dBµ or –13.0 dBm.

EXHIBIT 5. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

5.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 6. TEST PROCEDURES

6.1. EFFECTIVE RADIATED POWER (ERP) MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements

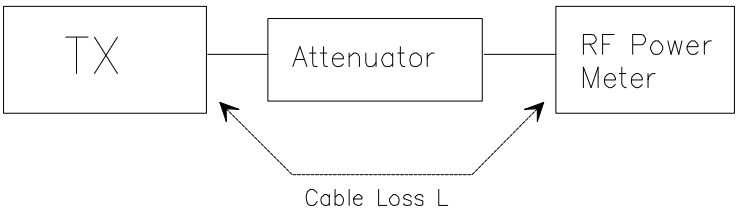
- Using a spectrum analyzer with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with $0<x<1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

Figure 1.



Step 3: Substitution Method. See Figure 2

(a) The measurements was performed in the absence of modulation (un-modulated)
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The dipole test antenna was used and tuned to the transmitter carrier frequency.
(e) The spectrum analyzer was tuned to transmitter carrier frequency. The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(f) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.

(g) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(h) The substitution dipole antenna and the signal generator replaced the transmitter and antenna under test in the same position, and the substitution dipole antenna was placed in vertical polarization. The test dipole antenna was lowered or raised as necessary to ensure that the maximum signal is stilled received.
(i) The input signal to the substitution antenna was adjusted in level until an equal or a known related level to that detected from the transmitter was obtained in the test receiver. The maximum carrier radiated power is equal to the power supply by the generator.
(j) The substitution antenna gain and cable loss were added to the signal generator level for the corrected ERP level.
(k) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(l) Actual gain of the EUT's antenna is the difference of the measured ERP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

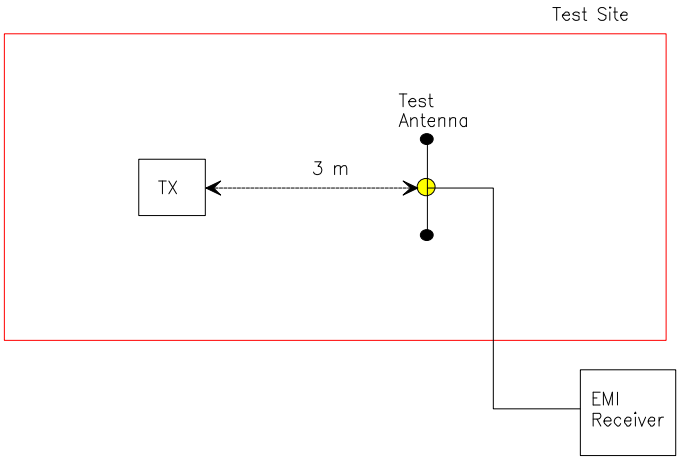
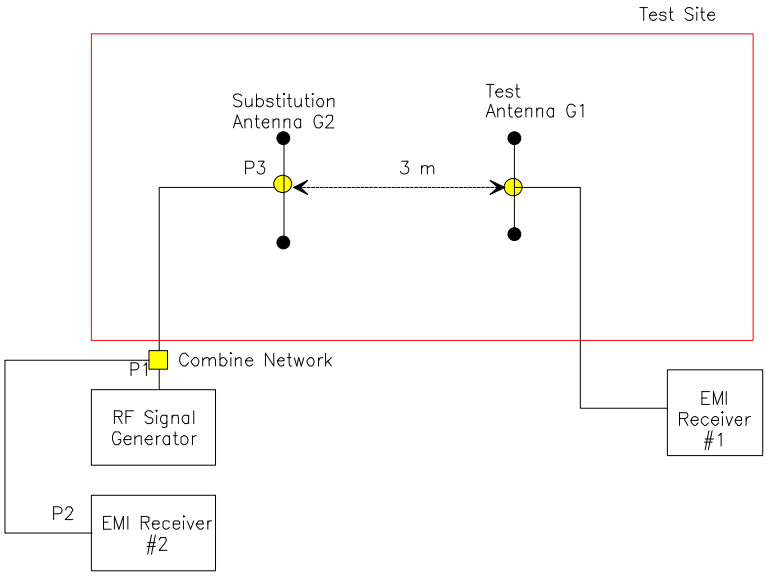


Figure 3



P3 = P2 + Insertion Loss (P1-P3
EIRP = P3 + G2

6.2. FREQUENCY STABILITY

Refer to FCC @ 2.995.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

6.3. EMISSION MASK

Voice or Digital Modulation Through a Voice Input Port @ 2.989(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.989(h):- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following spectrum analyzer bandwidth shall be used for measurement of spurious emissions:

(1) When operating in the radio telephony mode or the supervisory audio tome mode:
- (i) Any emission not more than 45 kHz removed from the carrier frequency: 300 Hz
- (ii) Any emission more than 45 kHz removed from the carrier frequency: 30 kHz

(2) When operating in the wideband data mode or the signaling tone mode:
- (iii) Any emission not more than 60 kHz removed from the carrier frequency: 300 Hz
- (iv) Any emission more than 60 kHz removed from the carrier frequency: 30 kHz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

6.4. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.989, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the Spectrum Analyzer controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.997 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The
amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.991 - Spurious Emissions at Antenna Terminal:- The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.989 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

6.5. SPURIOUS EMISSIONS (RADIATED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.989, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the Spectrum Analyzer controls set as RBW = 100 kHz minimum , VBW $\geq$ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.997 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.993 - Field Strength Spurious Emissions

(a) Measurements was made to detect spurious emissions radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data were supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph 2.989(c) as appropriate. For equipment operating on frequencies below 1 GHz, an Open Field Test is normally required, with the measuring instrument antenna located in the far field at all test frequencies. In event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurement will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with the reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) Measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

Maximizing the filed strength level:

(a) The measurements was performed with standard modulation
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The biconilog Antenna (20 MHz to 1 GHz) or Horn Antenna (1 GHz to 18 GHz) was used for measuring.
(e) The spectrum analyzer was tuned to transmitter carrier frequency. The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(f) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(g) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.

(h) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(i) The field strength level measured at 3m is converted to the power in dBm by subtracting a constant factor of 97.5 dB

METHOD OF CALCULATION FOR TRANSMITTED POWER (P) FROM THE MEASURED FIELD STRENGTH LEVEL (E):

According to IEC 801-3, the power density can be calculated as follows:

$S = P / (4xPIxD^2)$ Where: S: Power density in watts per square feet
P: Transmitted power in watts
PI: 13.1415
D: Distance in meters

The power density S (W/m^2) and electric field E (V/m) is related by:

$S = E^2/(120xPI)$

Accordingly, the field intensity of isotropic radiator in free space can be expressed as follows:

$E = (30xP)^{1/2}/D = 5.5x(P)^{1/2}/D$

For Halfwave dipole antenna or other antennas correlated to dipole in direction of maximum radiation:

$S = (1.64xP)/(4xPIxD^2)$
$E = (49.2xP)^{1/2}xD = 7.01x(P)^{1/2}/D$

$$P = (ExD/7.01)^2$$

Calculation of transmitted power P (dBM) given a measured field intensity E (dBuV/m):

$P(W) = [E(V/m)xD/7.01]^2$
$P(mW) = P(W)x1000$
=> $P(dBm) = 10logP(mW)$
$= 20logE(V/m) + 20log(D) - 20log(7.01) + 10log1000$
$= E(dBV/m) + 20logD + 13$
$= E(dBuV/m) - 120 + 20log(D) + 13$
$= E(dBuV/m) + 20log(D) - 107$

The Transmitted Power @ D = 3 Meters

P(dBm) = E(dBuV/m) - 97.5

EXHIBIT 7. PLOTS OF MEASUREMENT DATA

Please refer attached electronic file “kti2plt.pdf” for details