ENGINEERING TEST REPORT

Variable Gain RF Amplifier
Model: DA4000
FCC ID: PZODA4000

Tested in Accordance With

Federal Communications Commission (FCC)
Cellular Radiotelephone and
Personal Communications Services
47 CFR, PARTS 2, 22 (Subpart H) and 24 (Subpart E)

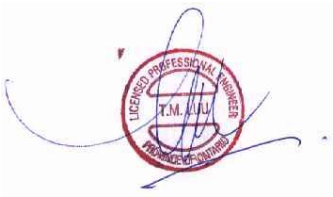
Applicant:

Digital Antenna Inc.
5325 NW 108th Avenue
Sunrise, FL
USA, 33351

Ultratech File Number: BTA01-FTX

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: June 5, 2002



Report Prepared by: Dan Huynh	Tested by: Mr. Hung Trinh, EMI/RFI Technician
Issued Date: June 5, 2002	Test Dates: April 2-8, 2002

The results in this Test Report apply only to the randomly selected, representative test sample(s).

UltraTech

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
	Test Report	• Exhibit 1: Submittal check lists • Exhibit 2: Introduction • Exhibit 3: Performance Assessment • Exhibit 4: EUT Operation and Configuration during Tests • Exhibit 5: Summary of test Results • Exhibit 6: Measurement Data • Exhibit 7: Measurement Uncertainty • Exhibit 8: Measurement Methods	OK
1	Test Report – Test Data Plots	• Band Pass Gain, Plots # 1 to 2 • 99 % Occupied Bandwidth, Plots # 3 to 23 • 26 dB Bandwidth, Plots # 24 to 32 • Emissions Masks, Plots # 33 to 56 • Conducted Spurious Emissions, Plots # 57 to 62 (Cellular Band) and # 81 to 86 (PCS Band) • Band Edge Emissions, Plots # 63 to 80	OK
2	Test Setup Photos	Radiated Emissions Test Setup Photos	OK
3	External Photos of EUT	External EUT Photos	OK
4	Internal Photos of EUT	Internal EUT Photos	OK
5	Cover Letters	• Letter from Ultratech for Certification Request • Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing	OK
6	Attestation Statements	• Manufacturer's Declaration for Equipment Specifications, Installation (if it is professionally installed) and Production Quality Production Assurance. • Manufacturer's Declaration of Conformity (FCC DoC) for compliance with FCC Part 15, Sub. B, Class B - Computing Devices - if required	N/A N/A
7	ID Label/Location Info	• ID Label • Location of ID Label	OK
8	Block Diagrams	DA4000 Block Diagram	OK
9	Schematic Diagrams	DA4000 Schematic	OK
10	Parts List/Tune Up Info	N/A	N/A
11	Operational Description	Technical Description	OK
12	RF Exposure Info	See section 6.10 of this test report for MPE Evaluation	OK
13	Users Manual	User Instructions	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2, 22 (Subpart H) & 24 (Subpart E): 2001
Title:	Telecommunication - Code of Federal Regulations, 47 CFR, Parts 2, 22 & 24
Purpose of Test:	To gain FCC Certification Authorization for Cellular Radiotelephone Service (824-849 MHz band) and Personal Communications Services (1850-1910 MHz band).
Test Procedures:	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.

2.2. NORMATIVE REFERENCES

Publication	Year	Title
FCC 47 CFR Parts 2, 22 & 24	2001	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	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
CISPR 22 & EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	1999	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Digital Antenna Inc.
Address:	5325 NW 108th Avenue Sunrise, FL USA, 33351
Contact Information:	Mr. Bud Gallagher Phone #: (954) 747-7022 Fax #: (954) 747-7088 Email Address: bud@digitalantenna.com

MANUFACTURER	
Name:	Digital Antenna Inc.
Address:	5325 NW 108th Avenue Sunrise, FL USA, 33351
Contact Information:	Mr. Bud Gallagher Phone #: (954) 747-7022 Fax #: (954) 747-7088 Email Address: bud@digitalantenna.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Digital Antenna Inc.
Product Name:	Variable Gain RF Amplifier
Model Name or Number:	DA4000
Serial Number:	Test Sample
Type of Equipment:	Amplifier
External Power Supply:	N/A
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	Booster amplifier

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Mobile Base station (fixed use)
Intended Operating Environment:	Commercial, light industry & heavy industry
Power Supply Requirement:	12 – 24Vdc, 13.5 Vdc nominal
RF Input/Output Impedance:	50 Ohms
Operating Frequency Range:	824-849 MHz (Cellular Band) 1851-1909 MHz (PCS Band)
RF Output Power Rating: (Maximum Peak conducted)	824 – 849 MHz Band: 2.4 W (TDMA) 1.7 W (GSM) 2.1 W (Voice) 1.3 W (Data) 1851-1909 MHz Band: 1.9 W (TDMA) 1.6 W (GSM) 1856-1904 MHz Band: 1.8 W (CDMA)
(1)Amplifier Gain:	▪ 6 dB maximum for 824 – 849 MHz Band ▪ 9.8 dB maximum for 1851 – 1909 MHz Band
Channel Spacing:	Not Applicable for amplifier
(2)Occupied Bandwidth (99%):	824 – 849 MHz Band : 31.49 kHz (TDMA) 242.6 kHz (GSM) 14.71 kHz (Voice) 22.29 kHz (Data) 1851-1909 MHz Band: 88.4 kHz (TDMA) 241.7 kHz (GSM) 1856-1904 MHz Band: 1.298 MHz (CDMA)
Emission Designation:	EXTENDER
(3)Maximum RF Input Specified by the Manufacture:	0.6 W (Cellular Band) 0.2 W (PCS Band)

Notes:

(1) See test data plots # 1 to 2 in Annex 1 for band pass gain measurements.
(2) See test data plots # 3 to 23 in Annex 1 for 99% occupied bandwidth measurements

3.4. LIST OF EUT'S PORTS

Port	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF IN (Phone)	1	Mini- UHF	Shielded
2	RF Output (Antenna)	1	Mini- UHF	Shielded

3.5. MODIFICTIONS INCORPATED INTO THE EUT FOR COMPLIANCE PURPOSES

None.

3.6. ANCILLARY EQUIPMENT

None.

EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TEST

4.1. CLIMATIC TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	13.5 Vdc

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	None.
Special Hardware Used:	None.
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s): 824 - 849 MHz 1851 – 1909 MHz (TDMA and GSM) 1856 – 1904 MHz (CDMA)	Near lowest, near middle & near highest frequencies of each frequency bands that the transmitter covers: Cellular: 824 MHz, 836 MHz and 849 MHz PCS: 1851 MHz, 1880 MHz and 1909 MHz (TDMA & GSM) 1856 MHz, 1880 MHz and 1904 MHz (CDMA)
Transmitter Wanted Output Test Signals: RF Power Output:	 Cellular: 2.4 W PCS: 1.9 W
RF Input Level (Max. Specified by Manufacturer:	Cellular: 600 mW PCS: 200 mW

Note: The DA4000 (Equipment Under Test) is a single channel one way power amplifier. The transmitted output frequency is controlled solely by the telephone wired to its input. The bi-directional feature of this amplifier down link is a low noise, extreme low level receive booster and operates in the -50 dB region with a gain of approx. 10 dB. This boosted down link signal is only passed on wire to the receiver of the attached input telephone and is never re-transmitted over the air. For this reason, the down link output was not tested.

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- 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 site 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: August 8, 2001.

5.2. APPLICABILITY & SUMMARY OF RFI EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
§24.229	Frequencies	Yes
§§2.1046, 22.913 & 24.232	RF Power Output & Intermodulation	Yes
§§ 2.1049, 22.917 & 24.238	Occupied Bandwidth & Emission Mask	Yes
§§ 2.1051, 22.917 & 24.238	Spurious Emissions at Antenna Terminal	Yes
§§ 2.1053, 22.917 & 24.238	Field Strength of Spurious Radiation	Yes
§§ 2.1055 & 24.235	Frequency Stability	Not applicable for Amplifier since the output signal tracks input signal exactly.
§§ 1.1307(b), 2.1091	Radiofrequency Radiation Exposure Evaluation	Yes

Variable Gain RF Amplifier, Model No.: DA4000, manufacture by Digital Antenna Inc. has also been tested and found to comply with FCC Part 15, Subpart B – Radio Receivers and Class B Digital Devices. The engineering test report has been documented and kept in file and it is available anytime upon FCC request.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR RFI EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:1992 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER

The essential function of the EUT is to boost Cell and PCS coverage into enclosed areas.

6.5. FREQUENCIES @ §24.229

6.5.1. Limits

The frequencies available in the Broadband PCS Service are listed as follows:

(a) The following frequency blocks are available for assignment on an MTA (Major Trading Areas) basis
- Block A: 1850-1865 MHz (Mobile) paired with 1930-1945 MHz (Base)
- Block B: 1870-1885 MHz (Mobile) paired with 1950-1965 MHz (Base)

(b) The following frequency blocks are available for assignment on an BTA (Basic Trading Areas) basis
- Block C: 1895-1910 MHz (Mobile) paired with 1975-1990 MHz (Base)
- Block D: 1865-1870 MHz (Mobile) paired with 1945-1950 MHz (Base)
- Block E: 1885-1890 MHz (Mobile) paired with 1965-1970 MHz (Base)
- Block F: 1890-1895 MHz (Mobile) paired with 1970-1975 MHz (Base)

6.5.2. Analysis

The EUT conforms with all frequency Blocks A, B, C, D, E and F for base station uses.

6.6. RF POWER OUTPUT & INTERMODULATION @ §§2.1046, 22.913, 24.232

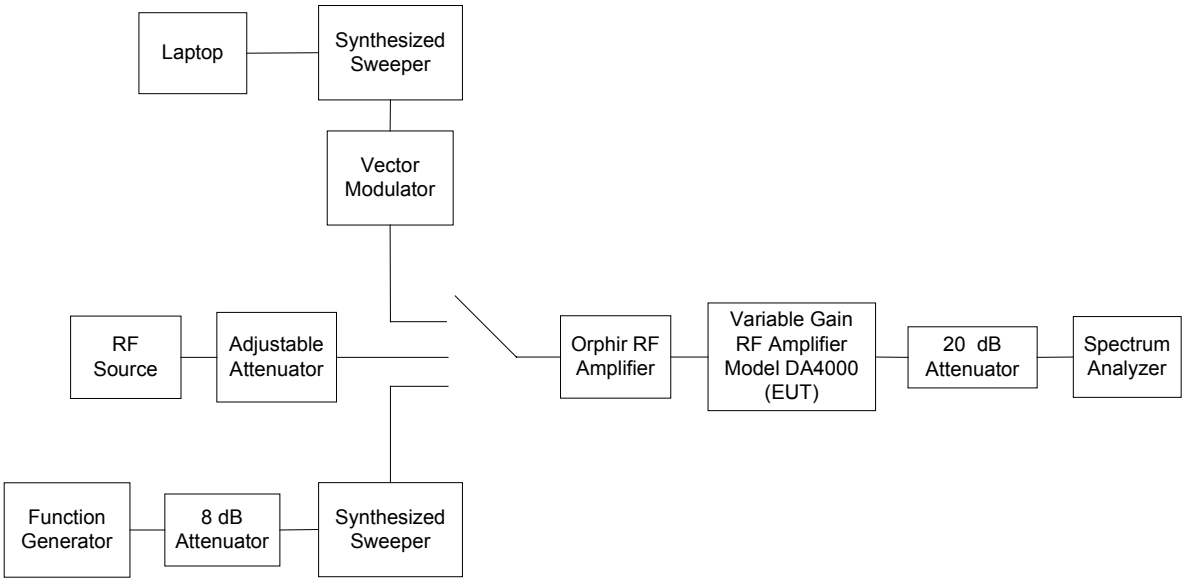
6.6.1. Limits

Please refer to FCC 47 CFR, Sections 22.913 and 24.232 for power limits in different frequency bands.

6.6.2. Method of Measurements

Refer to Exhibit 8 of this test report for details of measurement.

6.6.3. Test Arrangement



6.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz – 26.5 GHz
Attenuator	Weinschel	46-20-34	BM1347	DC – 18 GHz
Amplifier	Orphir	GRF5058	1009	0.8 – 4.2 GHz
Synthesized Sweeper	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz
Vector Modulator	IFR	2029	2029011023	800 MHz – 2.51 GHz
Laptop	IBM	2625	78WWM48	N/A
Adjustable Attenuator	Pasternack Enterprises	PE7033	PE7034-5	DC – 2 GHz
Function Generator	SRS	DS345	34591	1µHz – 30.2 MHz

6.6.5. Test Data

6.6.5.1. Peak Power Measurements

Remark: The maximum RF input level as specified by the manufacturer were applied to the amplifier's RF input.

6.6.5.1.1. 824-849 MHz Band

Transmitter Channel	Frequency (MHz)	Applied Modulation	Maximum RF Input Applied (dBm)	Peak Conducted Output Power @ Antenna Port (dBm)
Cellular Band 824 – 849 MHz				
Lowest	824	TDMA	27.8	31.9
Middle	836	TDMA	27.8	33.8
Highest	849	TDMA	27.8	32.8
Lowest	824	GSM	27.8	30.9
Middle	836	GSM	27.8	32.2
Highest	849	GSM	27.8	31.9
Lowest	824	F3E	27.8	31.8
Middle	836	F3E	27.8	33.3
Highest	849	F3E	27.8	31.5
Lowest	824	F1D	27.8	31.2
Middle	836	F1D	27.8	30.9
Highest	849	F1D	27.8	29.9

6.6.5.1.2. 1850 - 1910 MHz Band

Transmitter Channel	Frequency (MHz)	Applied Modulation	Maximum RF Input Applied (dBm)	Peak Conducted Output Power @ Antenna Port (dBm)
PCS Band 1850 – 1910 MHz				
Lowest	1856	CDMA	23.0	32.5
Middle	1880	CDMA	23.0	31.9
Highest	1904	CDMA	23.0	30.3
Lowest	1851	TDMA	23.0	32.2
Middle	1880	TDMA	23.0	32.7
Highest	1909	TDMA	23.0	30.7
Lowest	1851	GSM	23.0	30.0
Middle	1880	GSM	23.0	32.0
Highest	1909	GSM	23.0	30.2

6.6.5.2. ERP and EIRP

The recommended 9 dBi antenna is configured and specified as follows:

Cell Band

Internal radiating element gain = 8.14 dBi, 6.0 dBd.
Cable length = 20 ft. exposed, 3ft. internal to radom = 23 ft. total.
23 ft cable loss including connector insertion loss @ 800 to 900 MHz = 4.37dB.
DA4000 output power in Cell band = 33.8 dB.
Effective radiated power (ERP) at antenna = 35.43 dBd, (3.5 W)
Effective isotropic radiated power (EIRP)at antenna = 37.57 dBi, (5.75 W)

ERP(35.43 dB, 3.5 W)=Amp output power(33.8 dB)-Cable loss(4.37 dB)+Antenna gain(6 dBd).
EIRP(37.57 dB, 5.75 W)=Amp output power(33.8 dB)-Cable loss(4.37 dB)+Antenna gain(8.14 dBi).

PCS Band

Internal radiating element gain = 8.6 dBi.
Cable length = 20 ft. exposed, 3ft. internal to radom = 23 ft. total.
23 ft cable loss including connector insertion loss @ 1800 to 2000 MHz = 8.51 dB.
DA4000 output power in PCS band = 32.8 dB.
Effective isotropic radiated power (EIRP)at antenna = 32.89 dBi, (1.95 W)

EIRP(32.89 dB, 1.95 W)=Amp output power(32.8 dB)-Cable loss(8.51 dB)+Antenna gain(8.6 dBi).

6.6.5.3. Intermodulation

The DA4000 is a single input, single output device. The transmitted output frequency is controlled solely by the telephone wired to its input. Therefore, the intermodulation test is not necessary.

6.7. OCCUPIED BANDWIDTH & EMISSION MASK @ §§ 2.1049, 22.917 & 24.238

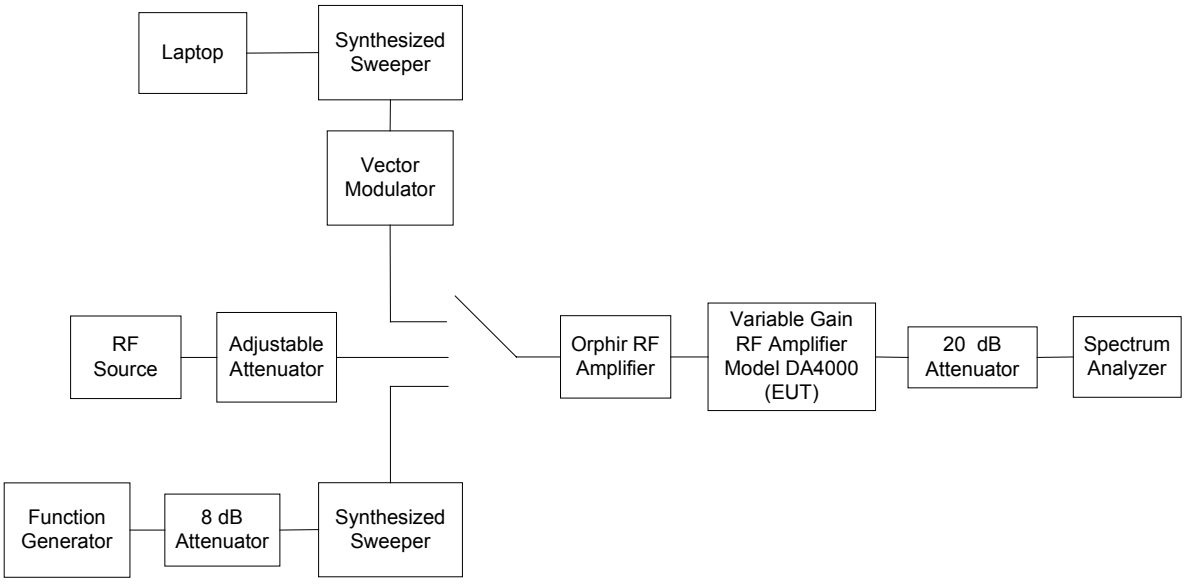
6.7.1. Limits

Refer to FCC 47 CFR, Sections 22.917 and 24.238 for applicable limits

6.7.2. Method of Measurements

Refer to FCC 47 CFR Rules, sections 2.1049, 22.917 and 24.238

6.7.3. Test Arrangement



6.7.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz – 26.5 GHz
Attenuator	Weinschel	46-20-34	BM1347	DC – 18 GHz
Amplifier	Orphir	GRF5058	1009	0.8 – 4.2 GHz
Synthesized Sweeper	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz
Vector Modulator	IFR	2029	2029011023	800 MHz – 2.51 GHz
Laptop	IBM	2625	78WWM48	N/A
Adjustable Attenuator	Pasternack Enterprises	PE7033	PE7034-5	DC – 2 GHz
Function Generator	SRS	DS345	34591	1µHz – 30.2 MHz

6.7.5. Test Data

6.7.5.1. 99% Occupied Bandwidth and 26dBc Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)		26dBc Bandwidth (MHz)
	RF Input	RF Output	
Modulation: TDMA			
824	0.02851	0.03149	--
836	0.02857	0.03149	--
849	0.02851	0.03029	--
Modulation: GSM			
824	0.2417	0.2421	--
836	0.2417	0.2421	--
849	0.2413	0.2426	--
Modulation: FM with 2.5 kHz sine wave ± 8 kHz peak frequency deviation			
824	0.01409	0.01434	--
836	0.01426	0.01471	--
849	0.01420	0.01457	--
Modulation: FM with pseudorandom 10 kbps data pattern at ± 8 kHz peak frequency deviation			
824	0.02216	0.02229	--
836	0.02233	0.02224	--
849	0.02233	0.02224	--
Modulation: TDMA			
1851	0.0339	0.0884	0.300
1880	0.0317	0.0744	0.170
1909	0.0320	0.0720	0.116
Modulation: GSM			
1851	0.2409	0.2409	0.333
1880	0.2396	0.2396	0.319
1909	0.2417	0.2417	0.319
Modulation: CDMA			
1851	1.282	1.296	6.07
1880	1.278	1.298	7.10
1909	1.272	1.288	5.96

Notes:

(1) See Annex 1, test data plots # 3 to 23 for 99 % occupied bandwidth.
(2) See Annex 1, test data plots # 24 to 32 for 26 dBc bandwidth.

6.7.5.2. Emission Mask

Remarks: Since the EUT is an amplifier, which does not generate RF output by itself, the Emission Masks for all RF IN and OUT were measured for comparision.

EUT complies with F3E, F1D, TDMA and GSM emission masks of cellular band:

- Refer to Annex 1, test data plots # 33 to 38 for F3E emission mask;
- Refer to Annex 1, test data plots # 39 to 44 for F1D emission mask;
- Refer to Annex 1, test data plots # 45 to 50 for TDMA emission mask;
- Refer to Annex 1, test data plots # 51 to 56 for GSM emission mask

6.8. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS @ §§ 2.1051, 22.917 & 24.238

6.8.1. Limits

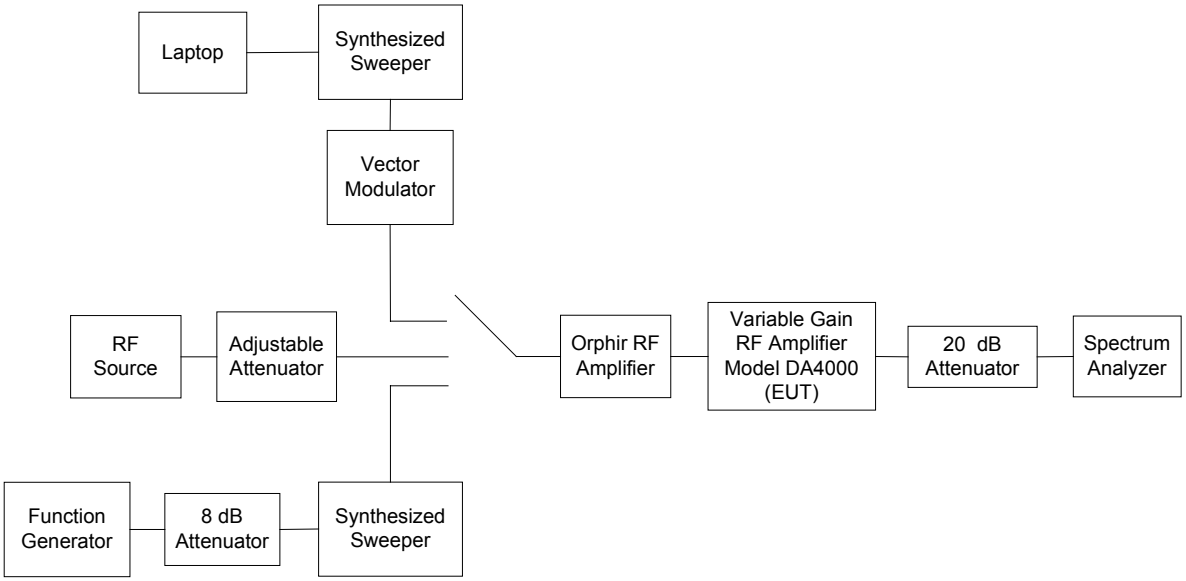
Emissions outside the permitted band shall be attenuated below the mean output power of the transmitter power (P) by at least 43+10log(P) dB.

The mean power of any emissions appearing in the base station frequency range from cellular mobile transmitters operated must be attenuated to a level not to exceed -80 dBm at the transmit antenna connector.

6.8.2. Method of Measurements

Refer to FCC 47 CFR Sections 2.1051, 22.917 and 24.238.

6.8.3. Test Arrangement



6.8.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz – 26.5 GHz
Attenuator	Weinschel	46-20-34	BM1347	DC – 18 GHz
Amplifier	Orphir	GRF5058	1009	0.8 – 4.2 GHz
Synthesized Sweeper	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz
Vector Modulator	IFR	2029	2029011023	800 MHz – 2.51 GHz
Laptop	IBM	2625	78WWM48	N/A
Adjustable Attenuator	Pasternack Enterprises	PE7033	PE7034-5	DC – 2 GHz
Function Generator	SRS	DS345	34591	1µHz – 30.2 MHz

6.8.5. Test Data

6.8.5.1. Cellular Band

Remarks: The test data presented in this section is the worst case test configuration, EUT operating with TDMA modulation. This was determine by prescanning the EUT operating at all different modulations (TDMA, GSM, F3E and F1D) and the test configuration with TDMA yield the highest level of spurious emissions.

Fundamental Frequency: 824 MHz
RF Output Power: 31.9 dBm (conducted)
Modulation: TDMA

Frequency (MHz)	Transmitter Conducted Antenna Emissions		Limit (dBc)	Margin (dB)	Pass/ Fail
	(dBm)	(dBc)			
2466	-18.41	52.21	44.9	-7.3	Pass
The emissions were scanned from 10 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded. Refer to test data plots # 57 to 58 for measurements results.					

Fundamental Frequency: 836 MHz
RF Output Power: 33.8 dBm (conducted)
Modulation: TDMA

Frequency (MHz)	Transmitter Conducted Antenna Emissions		Limit (dBc)	Margin (dB)	Pass/ Fail
	(dBm)	(dBc)			
2504	-16.09	49.89	46.8	-3.1	Pass
The emissions were scanned from 10 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded. Refer to test data plots # 59 to 60 for measurements results.					

Fundamental Frequency: 849 MHz
RF Output Power: 32.8 dBm (conducted)
Modulation: TDMA

Frequency (MHz)	Transmitter Conducted Antenna Emissions		Limit (dBc)	Margin (dB)	Pass/ Fail
	(dBm)	(dBc)			
1694	-32.22	65.02	45.8	-19.2	Pass
2543	-14.44	47.24	45.8	-1.4	Pass
The emissions were scanned from 10 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded. Refer to test data plots # 61 to 62 for measurements results.					

6.8.5.2. Broadband PCS

6.8.5.2.1. Bandedge Emissions

Tests performed with TDMA, GSM and CDMA modulations. See Annex 1, test data plots # 63 to 80 for detailed measurements.

6.8.5.2.2. Out of Band Emissions

Remarks: The test data presented in this section is the worst case test configuration, EUT operating with CDMA modulation. This was determine by prescanning the EUT operating at all different modulations (CDMA, TDMA and GSM) and the test configuration with CDMA yield the highest level of spurious emissions.

Fundamental Frequency: 1856 MHz
RF Output Power: 32.5 dBm (conducted)
Modulation: CDMA

Frequency (MHz)	Transmitter Conducted Antenna Emissions		Limit (dBc)	Margin (dB)	Pass/ Fail
	(dBm)	(dBc)			
3694	-14.01	46.51	45.5	-1.0	Pass
5529	-28.92	61.42	45.5	-15.9	Pass
7389	-27.17	59.67	45.5	-14.2	Pass
The emissions were scanned from 10 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded. Refer to test data plots # 81 to 82 for measurements results.					

Fundamental Frequency: 1880 MHz
RF Output Power: 31.9 dBm (conducted)
Modulation: CDMA

Frequency (MHz)	Transmitter Conducted Antenna Emissions		Limit (dBc)	Margin (dB)	Pass/ Fail
	(dBm)	(dBc)			
3720	-28.61	60.51	44.9	-15.6	Pass
5606	-30.73	62.63	44.9	-17.7	Pass
7493	-33.04	64.94	44.9	-20.0	Pass
The emissions were scanned from 10 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded. Refer to test data plots # 83 to 84 for measurements results.					

Fundamental Frequency: 1904 MHz
RF Output Power: 30.3 dBm (conducted)
Modulation: CDMA

Frequency (MHz)	Transmitter Conducted Antenna Emissions		Limit (dBc)	Margin (dB)	Pass/ Fail
	(dBm)	(dBc)			
3772	-20.95	51.25	43.3	-8.0	Pass
5684	-28.86	59.16	43.3	-15.9	Pass
7596	-25.04	55.34	43.3	-12.0	Pass
The emissions were scanned from 10 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded. Refer to test data plots # 85 to 86 for measurements results.					

6.9. TRANSMITTER SPURIOUS/HARMONIC RADITATED EMISSIONS @ §§2.1053, 22.917 & 24.238

6.9.1. Limits

On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10log(P) dB.

6.9.2. Method of Measurements

Refer to the Exhibit 8, Section 8. 2 of this test report, ANSI C63-4:1992 for radiated emissions test method and FCC 47 CFR Sections 2.1051, 22.917 and 24.238.

6.9.3. 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	3116A00661	1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 MHz – 1 GHz
Dipole Antenna	EMCO	3121C	8907-440	30 MHz – 1 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz
RF Amplifier	Com-Power	PA-102	1425	1 MHz to 1 GHz, 30 dB gain nomimal

6.9.4. Test Data

Carrier Frequency (MHz): 824
Power (dBm): 31.9
Limit (dBc): -44.9

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
1648	77.13	Peak	V	-24.9	-56.8	-44.9	-11.9
1648	75.53	Peak	H	-28.4	-60.3	-44.9	-15.4
2472	86.47	Peak	V	-16.3	-48.2	-44.9	-3.2
2472	86.43	Peak	H	-18.0	-49.9	-44.9	-4.9
3296	86.48	Peak	V	-15.0	-46.9	-44.9	-1.9
3296	85.00	Peak	H	-18.0	-49.9	-44.9	-4.9
4120	71.84	Peak	V	-31.6	-63.5	-44.9	-18.6
4944	80.75	Peak	V	-20.9	-52.8	-44.9	-7.8
4944	76.83	Peak	H	-25.9	-57.8	-44.9	-12.9
Emissions were scanned from 30 MHz to the 9 GHz and all emissions within 20 dB below the permissable limits are recorded, which represents the worse case spurious emissions.							

Carrier Frequency (MHz): 836
Power (dBm): 33.8
Limit (dBc): -46.8

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
1672	78.75	Peak	V	-24.8	-58.6	-46.8	-11.8
1672	75.22	Peak	H	-29.0	-62.8	-46.8	-16.0
2508	83.84	Peak	V	-19.4	-53.2	-46.8	-6.3
2508	84.94	Peak	H	-19.3	-53.1	-46.8	-6.2
3344	80.31	Peak	V	-21.5	-55.3	-46.8	-8.5
3344	80.97	Peak	H	-22.1	-55.9	-46.8	-9.0
Emissions were scanned from 30 MHz to the 9 GHz and all emissions within 20 dB below the permissable limits are recorded, which represents the worse case spurious emissions.							

Carrier Frequency (MHz): 849
Power (dBm): 32.8
Limit (dBc): -45.8

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
1698	81.34	Peak	V	-22.4	-55.2	-45.8	-9.3
1698	82.31	Peak	H	-22.2	-55.0	-45.8	-9.1
2547	84.38	Peak	V	-18.5	-51.3	-45.8	-5.5
2547	84.97	Peak	H	-19.1	-51.9	-45.8	-6.0
3396	83.81	Peak	V	-18.7	-51.5	-45.8	-5.6
3396	84.28	Peak	H	-18.5	-51.3	-45.8	-5.5
4245	74.06	Peak	V	-28.1	-60.9	-45.8	-15.1
5094	69.91	Peak	V	-31.7	-64.5	-45.8	-18.7
6792	69.38	Peak	V	-31.3	-64.1	-45.8	-18.3
7641	72.47	Peak	H	-32.2	-65.0	-45.8	-19.2

Emissions were scanned from 30 MHz to the 9 GHz and all emissions within 20 dB below the permissable limits are recorded, which represents the worse case spurious emissions.

Carrier Frequency (MHz): 1856
Power (dBm): 32.5
Limit (dBc): -45.5

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
3712	71.56	Peak	V	-29.6	-62.1	-45.5	-16.6
3712	70.63	Peak	H	-30.7	-63.2	-45.5	-17.7
5568	73.41	Peak	V	-28.7	-61.2	-45.5	-15.7
5568	74.50	Peak	H	-28.5	-61.0	-45.5	-15.5

Emissions were scanned from 30 MHz to the 20 GHz and all emissions within 20 dB below the permissable limits are recorded, which represents the worse case spurious emissions.

Carrier Frequency (MHz): 1880
Power (dBm): 31.9
Limit (dBc): -44.9

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
3760	72.41	Peak	V	-28.2	-60.1	-44.9	-15.2
3760	71.75	Peak	H	-30.0	-61.9	-44.9	-17.0
5640	70.72	Peak	V	-32.6	-64.5	-44.9	-19.6
5640	72.06	Peak	H	-31.6	-63.5	-44.9	-18.6
7520	71.19	Peak	V	-32.4	-64.3	-44.9	-19.4
7520	72.28	Peak	H	-32.4	-64.3	-44.9	-19.4
Emissions were scanned from 30 MHz to the 20 GHz and all emissions within 20 dB below the permissable limits are recorded, which represents the worse case spurious emissions.							

Carrier Frequency (MHz): 1904
Power (dBm): 30.3
Limit (dBc): -43.3

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
3808	70.28	Peak	V	-30.8	-61.1	-43.3	-17.8
3808	71.75	Peak	H	-29.2	-59.5	-43.3	-16.2
7616	71.44	Peak	H	-32.9	-63.2	-43.3	-19.9
Emissions were scanned from 30 MHz to the 20 GHz and all emissions within 20 dB below the permissable limits are recorded, which represents the worse case spurious emissions.							

6.10. RADIOFREQUENCY RADIATION EXPOSURE EVALUATION @ §§1.13.07(b) & 2.1091

FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to center of radiation in cm

$$r = \sqrt{PG/4\Pi S}$$

6.10.1. MPE Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: • 34 cm (PCS) • 53 cm (Cellular)	Manufacturer' instruction for separation distance between antenna and persons required: 6 meters
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Please refer to user's manual for details
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Please refer to user's manual for RF exposure information.
Any other RF exposure related issues that may affect MPE compliance	None

Note: RF safety distance were calculated using the following formula and parameters:

EXPOSURE DISTANCE LIMITS: $r = (PG/4\Pi S)^{1/2}$
$S = 1$ mW/cm^2 (PCS Band), f/1500 (Cellular Band)
$P = 1800$ (PCS Band), 2400 mW (Cellular Band)
$G = 9$ dBi $= 10^{(9/10)}$ numeric (The maximum antenna gain to be used with this amplifier is 9 dBi)

EXHIBIT 7. MEASUREMENT UNCERTAINTY

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

7.1. 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 Directivity	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 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER 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 if the transmitter's transmission is transient

- Using a EMI Receiver 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.

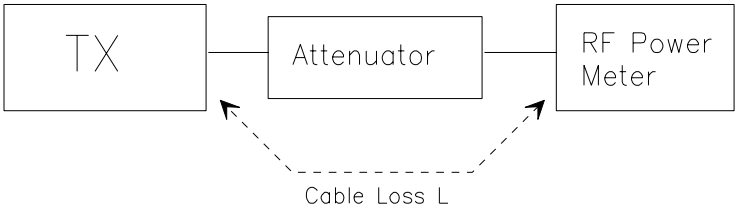
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average 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)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Levels (E-Field)

(1) The measurements was performed with full rf output power and modulation.
(2) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(3) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(4) The Biconilog antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(5) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

(6) Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
(7) E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(8) Set the EMI Receiver #1 and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(9) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(10) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(11) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(12) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(13) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(14) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions Using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level.

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Replace the EUT with a signal generator and one of the following transmitting antenna (substitution antenna):
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

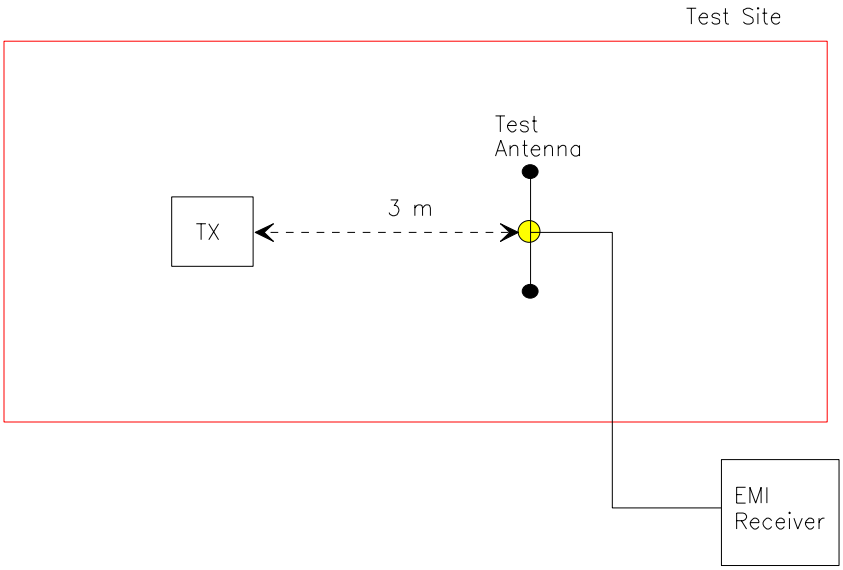
(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

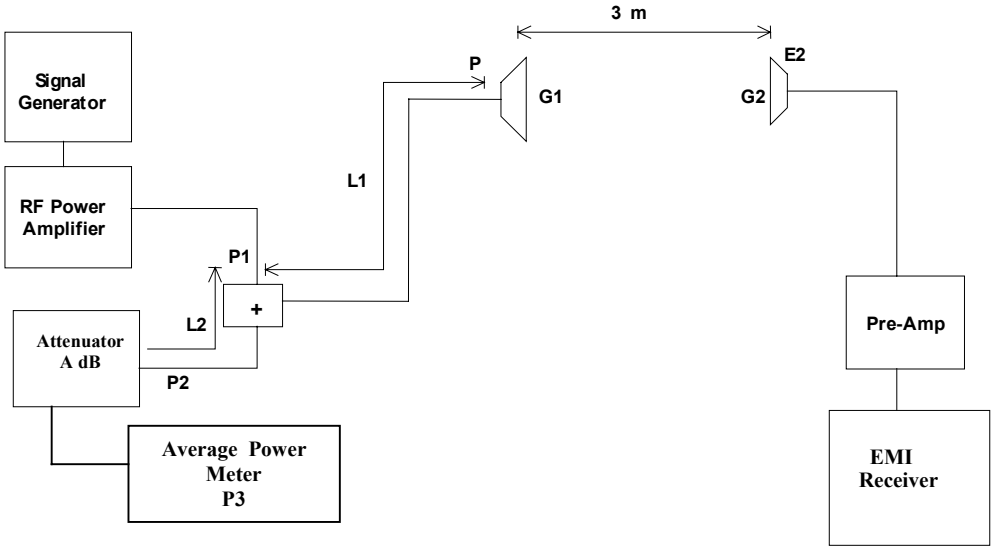
(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where:	P:	Actual RF Power fed into the substitution antenna port after corrected.
	P1:	Power output from the signal generator
	P2:	Power measured at attenuator A input
	P3:	Power reading on the Average Power Meter
	EIRP:	EIRP after correction
	ERP:	ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o).
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.


Test Site
Test Antenna
3 m
TX
EMI Receiver


3 m
Signal Generator
RF Power Amplifier
Attenuator A dB
Average Power Meter P3
P
G1
L1
P1
L2
P2
+
E2
G2
Pre-Amp
EMI Receiver

8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(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).

8.4. SPURIOUS EMISSIONS & OCCUPIED BANDWIDTH (CONDUCTED)

The transmitter's output was connected to the EMI receiver's input through an attenuator. The spurious and harmonic emissions were measured with the EMI Receiver controls set as follows:

- Outside the permitted band block: RBW = 1 MHz, VBW $\geq$ RBW
- Inside or on the permitted band block: RBW = 1% of -26dBc Bandwidth, VBW $\geq$ RBW

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.

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 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.