ENGINEERING TEST REPORT

For

PCS Repeater
Model: R231
FCC ID: P6T1901

Tested in Accordance With

Federal Communications Commission (FCC)
PERSONAL COMMUNICATIONS SERVICES
CFR 47, PARTS 2 and 24 (Subpart E)

For

Applicant: *P.G. Electronics Ltd.*
800 Arrow Road, Unit 8
Weston, Ontario
Canada, M9M 2Z8

Ultratech File Number: EES01_24PCS

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

Date: February 27, 2002

Report Prepared by: Mike Tom	Tested by: Mr. Hung Trinh, EMI/RFI Technician
Issued Date: February 27, 2002	Test Dates: Feb. 12-14, 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 - Plots of Measurement Data	Plots # 1 to 158	Ok
2	Test Setup Photos	Photos # 1 to 2	Ok
3	External Photos of EUT	Photos #1 to 4	Ok
4	Internal Photos of EUT	Photos # 1 to 5	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 Ok 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 Ok
8	Block Diagrams	System Block diagram	Ok
9	Schematic Diagrams	Schematic diagrams # 1 to 2	Ok
10	Parts List/Tune Up Info	Parts List	Ok
11	Operational Description	Theory of Operation	Ok
12	RF Exposure Info	Not applicable for base station	N/A
13	Users Manual	Customer Instructions	Ok

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 24 (Subpart E): 1998
Title	Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 & 24
Purpose of Test:	To gain FCC Certification Authorization for Personal Communications Services (PCS) operating in the frequency band 1850 - 1910 MHz (uplink) and 1930-1990 MHz (down link).
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 CFR Parts 2 and 24	1998	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		Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	P.G. Electronics Ltd.
Address:	800 Arrow Road, Unit 8 Weston, Ontario Canada, M9M 2Z8
Contact Information:	Mr. Gerry Graham Phone #: 416-741-7682 Fax #: 416-741-9927 Email Address: gerrygraham@pgelectronics.com

MANUFACTURER	
Name:	P.G. Electronics Ltd.
Address:	800 Arrow Road, Unit 8 Weston, Ontario Canada, M9M 2Z8
Contact Information:	Mr. Gerry Graham Phone #: 416-741-7682 Fax #: 416-741-9927 Email Address: gerrygraham@pgelectronics.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:	P.G. Electronics Ltd.
Product Name:	PCS Repeater
Model Name or Number:	R231
Serial Number:	1000063
Type of Equipment:	Personal Communications Services Bidirectional Amplifier
External Power Supply:	Phihong 120V 60Hz Switching AC Adapter, MN: PSA-30U-180, SN: 12701682D8, 18Vdc Output
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	Used as a drop-in booster for PCS signals. A typical use is provide PCS phone coverage in enclosed areas.

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER		
Equipment Type:	Base station (fixed use)	
Intended Operating Environment:	Commercial, light industry & heavy industry	
Power Supply Requirement:	120V 60Hz AC Adapter, 18Vdc Output	
RF Input/Output Impedance:	50 Ohms	
Operating Frequency Range:	1851 - 1909 MHz (uplink) 1931-1989 MHz (down link)	
RF Output Power Rating: (Maximum Peak conducted)	**1851-1909 MHz Band** 15.8 mW (CDMA) 14.6 mW (TDMA) 11.5 mW (GSM)	**1931-1989 MHz Band** 10.9 mW (CDMA) 9.8 mW (TDMA) 7.7 mW (GSM)
Amplifier Gain:	43 dB maximum	
Channel Spacing:	Not Applicable for bi-directional amplifier	
Occupied Bandwidth (99%):	1300.0 kHz (CDMA) 28.6 kHz (TDMA) 249.0 kHz (GSM)	
Emission Designation:*	1M4F9W (CDMA) 33K1DXW (TDMA) 316KGXW (GSM)	
Maximum RF Input	-32 dBm for Single and Multiple inputs	

** Based on 26 dBc Bandwidth.*

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 Input Port (1)	1	Female N-type	Shielded
2	RF Output Port (1)	1	Female N-type	Shielded
3	DC Power Jack	1	--	Non-shielded

NOTE:
(1) Ports of the EUT which in normal operation were connected to ancillary equipment through interconnecting cables via a representative interconnecting cable to simulate the input/output characteristics. RF input/output was correctly terminated to the 50 Ohm RF Load.

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:	120V 60Hz AC Adapter, 18 Vdc Output

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): 1851 - 1909 MHz (uplink) 1931 - 1989 MHz (down link)	Near lowest, near middle & near highest frequencies each frequency bands that the transmitter covers: 1851, 1880 & 1909 MHz 1931, 1960 & 1989 MHz	
Transmitter Wanted Output Test Signals: RF Power Output:*	**Uplink Band** 15.8 mW (CDMA) 14.6 mW (TDMA) 11.5 mW (GSM)	**Downlink Band** 10.9 mW (CDMA) 9.8 mW (TDMA) 7.7 mW (GSM)
Modulation	CDMA, TDMA and GSM	

** measured maximum output power for a single channel input*

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: Aug. 2001.

5.2. APPLICABILITY & SUMMARY OF RFI EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
§24.229	Frequencies	Yes
§24.232 & §2.1046	Effective Radiated Power (ERP) Limits	Yes
§24.235 & §2.1055	Frequency Stability	Not applicable for Amplifier since the output signal tracks input signal exactly.
§24.238 & §2.1051	Emission Limits (Conducted)	Yes
§24.236 & §24.238, §2.1057 & §2.1053	Emission Limits (Radiated)	Yes

PCS Repeater, Model No.: R231, by P.G. Electronics Ltd. 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 or extend the 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 AND EIRP @ §2.1046 & §24.232

6.6.1. Limits

The equivalent isotropic radiated power (EIRP) of transmitters in the Personal Communications Services must not exceed the limits in this section:

	Maximum Peak ERP (Watts)	Antenna Height
Base Transmitters (1930-1975 MHz)	• 1640 Watts • ….	• 300 meters • ….
Portable & Mobile Transmitters & Auxiliary Test Transmitters (1850-1910 MHz)	2 Watts or 33 dBm	N/A

6.6.2. Method of Measurements

The peak conducted power and intermodulation were tested instead of the EIRP since the amplifier was sold without antenna.

Please refer to Exhibit 8 of this test report for details of measurement.

6.6.3. Test Arrangement

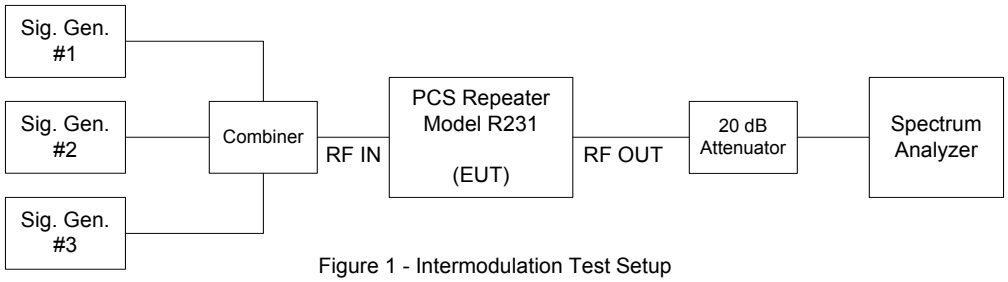


Figure 1 - Intermodulation Test Setup

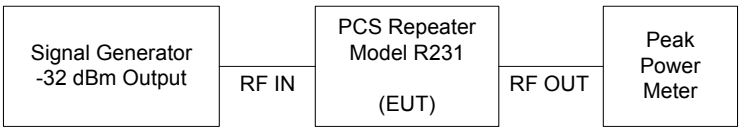


Figure 2 - Peak Power Measurement

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
RF Signal Generator #1	Hewlett Packard	HP E4432B	064005419	250 kHz – 3 GHz
RF Signal Generator #2	Gigatronics	GT9000	91026	0.01 –20 GHz
RF Signal Generator #3	Eaton Advance Electronics	382AM	118-18210	10 MHz – 2 GHz
Power Divider	Weinschel	1515	LW725	DC – 18 GHz
Power Divider	Weinschel	1515	LW400	DC – 18 GHz
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz to 50 GHz
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz
Synthesized Sweeper	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz

6.6.5. Plots

Please refer to Plots #1 to #18 for Intermodulation measurements.

6.6.6. Test Data

6.6.6.1. Peak Power Measurements

6.6.6.1.1. 1851-1909 MHz Band

Transmitter Channel	Frequency (MHz)	Applied Modulation	Maximum RF Input Applied (dBm)	Peak Conducted Output Power @ Antenna Port (dBm)
Lowest	1851	CDMA	-32	4.5
Middle	1880	CDMA	-32	12.0
Highest	1909	CDMA	-32	2.8

Lowest	1851	TDMA	-32	4.1
Middle	1880	TDMA	-32	11.6
Highest	1909	TDMA	-32	2.6

Lowest	1851	GSM	-32	3.4
Middle	1880	GSM	-32	10.6
Highest	1909	GSM	-32	1.80

6.6.6.1.2. 1931-1989 MHz Band

Transmitter Channel	Frequency (MHz)	Applied Modulation	Maximum RF Input Applied (dBm)	Peak Conducted Output Power @ Antenna Port (dBm)
Lowest	1931	CDMA	-32	5.8
Middle	1960	CDMA	-32	10.4
Highest	1989	CDMA	-32	9.2
Lowest	1931	TDMA	-32	5.4
Middle	1960	TDMA	-32	9.9
Highest	1989	TDMA	-32	8.7
Lowest	1931	GSM	-32	4.8
Middle	1960	GSM	-32	8.9
Highest	1989	GSM	-32	8.1

Notes: (1) Refer to Figure 2. in section 6.6.3 above for test data arrangement.

6.6.6.2. Intermodulation Measurements

6.6.6.2.1. Near Lowest Frequency in the 1851-1909 MHz Band

Number of Channels	Fundamental Frequency (MHz)	Maximum RF Input Applied (dBm) (2) (3)	Modulation	Measured Peak Power (dBm)	Manufacturer's Power Rating (dBm)
1	1851.0	-32.0	Unmodulated	0.84	(1)
2	1851.0 & 1851.2	--21.8	Unmodulated	10.94	(1)
3	1850.8, 1851.0 & 1851.2	-23.8	Unmodulated	8.34	(1)

6.6.6.2.2. Near Middle Frequency in the 1851-1909 MHz Band

Number of Channels	Fundamental Frequency (MHz)	Maximum RF Input Applied (dBm) (2) (3)	Modulation	Measured Peak Power (dBm)	Manufacturer's Power Rating (dBm)
1	1880	-32.0	Unmodulated	12.59	(1)
2	1880 & 1880.2	-33.1	Unmodulated	11.31	(1)
3	1879.8, 1880 & 1880.2	-34.3	Unmodulated	8.91	(1)

6.6.6.2.3. Near Highest Frequency in the 1851-1909 MHz Band

Number of Channels	Fundamental Frequency (MHz)	Maximum RF Input Applied (dBm) (2) (3)	Modulation	Measured Peak Power (dBm)	Manufacturer's Power Rating (dBm)
1	1909.0	-32.0	Unmodulated	-1.94	(1)
2	1909.0 & 1908.8	-19.8	Unmodulated	9.94	(1)
3	1908.8, 1909.0 & 1909.2	-19.4	Unmodulated	7.59	(1)

Notes: (1) Refer to Plot #19 and #20 for power output characteristics. Refer to Figure 1 in section 6.6.3 above for details of test arrangement

(2) The maximum RF input level applied for a single channel is –32 dBm as specified by the manufacturer.

(3) The RF inputs for multiple channels are derived from Intermodulation test results to meet –13 dBm for I.M. components. They were to be higher than the manufacturer's ratings of –32 dBm.

6.6.6.2.4. Near Lowest Frequency in the 1931 - 1989 MHz Band

Number of Channels	Fundamental Frequency (MHz)	Maximum RF Input Applied (dBm)(2) (3)	Modulation	Measured Peak Power (dBm)	Manufacturer's Power Rating (dBm)
1	1931.0	-32.0	Unmodulated	2.72	(1)
2	1931.0 & 1931.2	-24.5	Unmodulated	9.88	(1)
3	1930.8, 1931.0 & 1931.2	-26.8	Unmodulated	8.19	(1)

6.6.6.2.5. Near Middle Frequency in the 1931 - 1989 MHz Band

Number of Channels	Fundamental Frequency (MHz)	Maximum RF Input Applied (dBm)(2) (3)	Modulation	Measured Peak Power (dBm)	Manufacturer's Power Rating (dBm)
1	1960	-32.0	Unmodulated	11.97	(1)
2	1960 & 1960.2	-33.0	Unmodulated	11.00	(1)
3	1959.8, 1960 & 1960.2	-34.2	Unmodulated	8.94	(1)

6.6.6.2.6. Near Highest Frequency in the 1931 - 1989 MHz Band

Number of Channels	Fundamental Frequency (MHz)	Maximum RF Input Applied (dBm)(2) (3)	Modulation	Measured Peak Power (dBm)	Manufacturer's Power Rating (dBm)
1	1989.0	-32.0	Unmodulated	10.31	(1)
2	1989.0 & 1988.8	-30.0	Unmodulated	10.97	(1)
3	1988.8, 1989 & 1989.2	-31.3	Unmodulated	8.88	(1)

Notes: (1) Refer to Plot #19 and #20 for power output characteristics. Refer to Figure 1 in section 6.6.3 above for details of test arrangement

(2) The maximum RF input level applied for a single channel is –32 dBm as specified by the manufacturer.

(3) The RF inputs for multiple channels are derived from Intermodulation test results to meet –13 dBm for I.M. components. They were to be higher than the manufacturer's ratings of –32 dBm.

6.7. EMISSION LIMITS (CONDUCTED) & OCCUPIED BANDWIDTH @ §24.238 & §2.1049

6.7.1. 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.

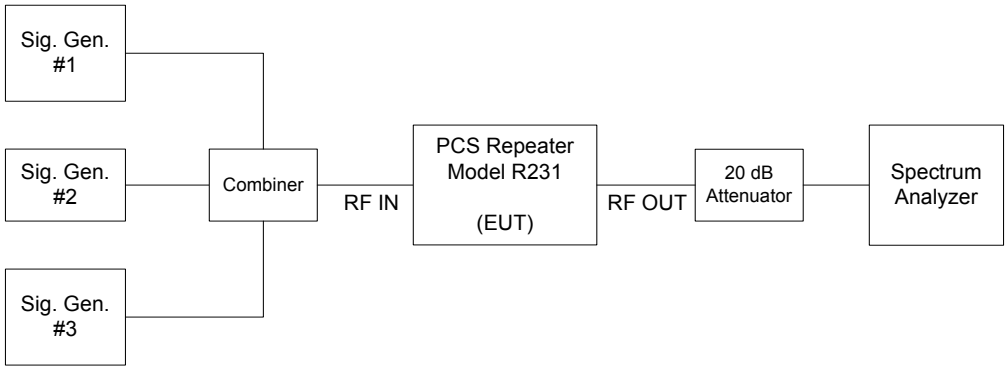
6.7.2. Method of Measurements

Please refer to FCC 24.238(b) - (d) and Exhibit 8, Section 8.1 for detailed test procedures.

Measuring Bandwidths:

- Outside the permitted band block: RBW = 1 MHz, VBW $\geq$ RBW

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(s)	Bird	..	…	DC – 22 GHz
RF Signal Generator #1	Hewlett Packard	HP E4432B	064005419	250 kHz – 3 GHz
RF Signal Generator #2	Gigatronics	GT9000	91026	0.01 –20 GHz
RF Signal Generator #3	Eaton	382AM	118-18210	10 MHz – 2 GHz
Power Divider	Weinschel	1515	LW725	DC – 18 GHz
Power Divider	Weinschel	1515	LW400	DC – 18 GHz
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz to 50 GHz
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz

6.7.5. Plots

- Refer to Plot #21 to 38 in Annex 1 for detailed measurement data of 26 dBc bandwidth measurement plots.
- Refer to Plots #39 to 56 in Annex 1 for details of 99% OBW measurement plots.

6.7.6. Test Data

6.7.6.1. 99% Occupied Bandwidth And -26dBc Bandwidth

Frequency (MHz)	Modulation Applied	99% Occupied Bandwidth (MHz)		-26dBc Bandwidth (MHz)
		RF Input	RF Output	
1851.0	CDMA	1.3	1.3	1.4
	TDMA	0.0281	0.0280	0.0331
	GSM	0.2430	0.2440	0.3130
1880.0	CDMA	1.3	1.3	1.4
	TDMA	0.028	0.0281	0.0330
	GSM	0.2430	0.2440	0.3140
1909.0	CDMA	1.3	1.3	1.4
	TDMA	0.0284	0.0284	0.0331
	GSM	0.2440	0.2480	0.3130
1931.0	CDMA	1.3	1.3	1.4
	TDMA	0.0284	0.0286	0.0330
	GSM	0.249	0.244	0.3160
1960.0	CDMA	1.3	1.3	1.4
	TDMA	0.028	0.0279	0.0327
	GSM	0.243	0.243	0.3090
1989.0	CDMA	1.3	1.3	1.4
	TDMA	0.0281	0.0281	0.0331
	GSM	0.247	0.0246	0.3130

- The RBW = 30 kHz will be used for emissions inside the permitted, band and RBW = 1 MHz is used for emissions outside the permitted band.

6.7.6.2. RF Input Signal Fitted Inside Permitted Band

Plots #57 to #96 show the RF input and output emissions inside the permitted band ± 2 MHz. The RF input and output signals are modulated using CDMA, TDMA and GSM.

6.7.6.3. Conducted Spurious Emissions

Plots #97 to #132 show the RF emissions outside the permitted band with 1 RF Input/Output channel modulated with CDMA, TDMA and GSM.

Plots #133 to #156 show the RF emissions with 2 and 3 RF Input/Output channels, unmodulated.

6.7.6.3.1. Near Lowest Frequency in 1851-1909 MHz band

Carrier Frequencies: No. of input/output channels : RF output: Maximum RF input:	1851.0 MHz 1 4.5 dBm -32 dBm
With the EUT operating under CDMA, TDMA and GSM modulating conditions, the frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #97 to #102 in Annex 1 for details.*	

Carrier Frequency: No. of input/output channels : RF Input/Output Frequencies RF output: Maximum RF input	1851 MHz 2 1851.0 MHz and 1851.2 MHz 10.78 dBm -21.8
The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #133 and #134 in Annex 1 for details.*	

Carrier Frequency No. of input/output channels : RF Input/Output Frequencies RF output: Maximum RF Input	1851 MHz 3 1850.8, 1851.0 MHz and 1851.2 MHz 8.78 dBm -23.9
The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #135 and #136 in Annex 1 for details.*	

6.7.6.3.2. Near Middle Frequency in 1851-1909 MHz band

Carrier Frequencies:	1880 MHz
No. of input/output channels :	1
RF output:	12.0 dBm
Maximum RF input:	-32 dBm

With the EUT operating under CDMA, TDMA and GSM modulating conditions, the frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit.

Please refer to Plots #103 to #108 in Annex 1 for details.

Carrier Frequency:	1880 MHz
No. of input/output channels :	2
RF Input/Output Frequencies:	1880.0 MHz and 1880.2 MHz
RF output:	11.13 dBm
Maximum RF input:	-33.1 dBm

The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit.

Please refer to Plots #137 and #138 in Annex 1 for details.

Carrier Frequency:	1880 MHz
No. of input/output channels :	3
RF Input/Output Frequencies:	1879.8, 1880.0 MHz and 1880.2 MHz
RF output:	13.66 dBm
Maximum RF input:	--34.4 dBm

FREQUENCY (MHz)	TRANSMITTER CONDUCTED EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
1880.00	13.7	--	--	--	--
3723.00	-20.1	-33.8	-13.0	-20.8	PASS

The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found within 20 dB of the limit were recorded.

Please refer to Plots #139 and #140 in Annex 1 for details.

6.7.6.3.3. Near Highest Frequency in 1851-1909 MHz band

Carrier Frequencies:	1909 MHz
No. of input/output channels :	1
RF output:	2.8 dBm
Maximum RF input:	-32 dBm
With the EUT operating under CDMA, TDMA and GSM modulating conditions, the frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #109 to #114 in Annex 1 for details.*	

Carrier Frequency:	1909 MHz
No. of input/output channels :	2
RF Input/Output Frequencies:	1909.0 MHz and 1909.2 MHz
RF output:	9.88 dBm
Maximum RF input:	-19.8 dBm
The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #141 and #142 in Annex 1 for details.*	

Carrier Frequency:	1909 MHz
No. of input/output channels :	3
RF Input/Output Frequencies:	1908.8, 1909.0 MHz and 1909.2 MHz
RF output:	8.38 dBm
Maximum RF input:	-19.4 dBm
The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #143 and #144 in Annex 1 for details.*	

6.7.6.3.4. Near Lowest Frequency in 1931-1989 MHz band

Carrier Frequencies:	1931.0 MHz
No. of input/output channels :	1
RF output:	5.8 dBm
Maximum RF input:	-32 dBm
With the EUT operating under CDMA, TDMA and GSM modulating conditions, the frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #115 to #120 in Annex 1 for details.*	

Carrier Frequency:	1931.0 MHz
No. of input/output channels :	2
RF Input/Output Frequencies	1931.0 MHz and 1931.2 MHz
RF output:	4.22 dBm
Maximum RF input:	-24.5 dBm
The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #145 and #146 in Annex 1 for details.*	

Carrier Frequency	1931.0 MHz
No. of input/output channels :	3
RF Input/Output Frequencies	1930.8, 1931.0 MHz and 1931.2 MHz
RF output:	8.16 dBm
Maximum RF input:	-26.8 dBm
The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit. *Please refer to Plots #147 and #148 in Annex 1 for details.*	

6.7.6.3.5. Near Middle Frequency in 1931-1989 MHz band

Carrier Frequencies:	1960.0 MHz
No. of input/output channels :	1
RF output:	10.4 dBm
Maximum RF input:	-32.0 dBm

FREQUENCY (MHz)	CONDUCTED (dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
CDMA MODULATION				
3921	-28.7	-13.0	-15.7	PASS
TDMA MODULATION				
--	--	-13.0	--	PASS
GSM MODULATION				
--	--	-13.0	--	PASS

The emissions were scanned from 10 MHz to 20 GHz and all emissions within 20 dB below the limits were recorded.

Please refer to Plots #121 to #126 in Annex 1 for details.

Carrier Frequency:	1960.0 MHz
No. of input/output channels :	2
RF Input/Output Frequencies	1960.0 MHz and 1960.2 MHz
RF output:	12.06 dBm
Maximum RF input:	-33.0 dBm

FREQUENCY (MHz)	TRANSMITER CONDUCTED EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
1960.00	12.1	--	--	--	--
3929.00	-18.9	-30.9	-13.0	-17.9	PASS

The emissions were scanned from 10 MHz to 20 GHz and all emissions within 20 dB below the limits were recorded.

Please refer to Plots #149 and #150 in Annex 1 for details.

Carrier Frequency	1960.0 MHz
No. of input/output channels :	3
RF Input/Output Frequencies	1959.8, 1960.0 MHz and 1960.2 MHz
RF output:	9.22 dBm
Maximum RF input:	-34.2 dBm

FREQUENCY (MHz)	TRANSMITTER CONDUCTED EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
1960.00	9.2	--	--	--	--
3903.00	-24.0	-33.3	-13.0	-20.3	PASS

The emissions were scanned from 10 MHz to 20 GHz and all emissions within 20 dB below the limits were recorded.

Please refer to Plots #151 and #152 in Annex 1 for details.

6.7.6.3.6. Near Highest Frequency in 1931-1989 MHz band

Carrier Frequencies:	1989.0 MHz
No. of input/output channels :	1
RF output:	10.31 dBm
Maximum RF input:	-32 dBm

FREQUENCY (MHz)	CONDUCTED (dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
CDMA MODULATION				
3972	-31.5	-13.0	-18.5	PASS
TDMA MODULATION				
--	--	--	--	--
GSM MODULATION				
--	--	--	--	--

The emissions were scanned from 10 MHz to 20 GHz and all emissions within 20 dB below the limits were recorded.

Please refer to Plots #127 to #132 in Annex 1 for details.

Carrier Frequency:	1989.0 MHz
No. of input/output channels :	2
RF Input/Output Frequencies	1989.0 MHz and 1988.8MHz
RF output:	11.06 dBm
Maximum RF input:	-19.8 dBm

FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
1989.00	11.1	--	--	--	--
3980.00	-21.9	-33.0	-13.0	-20.0	PASS

The emissions were scanned from 10 MHz to 20 GHz and all emissions within 20 dB below the limits were recorded.

Please refer to Plots #153 and #154 in Annex 1 for details.

Carrier Frequency	1989.0 MHz
No. of input/output channels :	3
RF Input/Output Frequencies	1988.8, 1989.0 MHz and 1989.2 MHz
RF output:	8.41 dBm
Maximum RF input:	-31.3 dbm

The frequency band from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit.

Please refer to Plots #155 and #156 in Annex 1 for details.

6.8. EMISSION LIMITS (RADIATED) @ §2.1049, §24.236 & §24.238

6.8.1. Limits

- The predicted or measured field strength at any location on the border of the PCS Service area shall not exceed 47 dBμV/m unless the parties agree to higher field strength.
- 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.

6.8.2. Method of Measurements

Please refer to the Exhibit 8, Sec. 8. 2 of this test report and ANSI C63-4:1992 for radiated emissions test method.

Measuring Bandwidths:

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

6.8.3. 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

6.8.4. Photographs of Test Setup

Please refer to Photos # 1 to 2 for detailed information of the test setup

6.8.5. Test Data

Remark: According to the RF Spurious/Harmonic Conducted Emission measurements in Section 6.7 of this test report, the rf emissions with 1 channel input /output was found to be the worst case of interference. Therefore, transmitter radiated emissions with 1 channel input/output were performed and represented the worst case of interference.

For the download band and uplink band, the frequency range from 10 MHz to 20 GHz was scanned for emissions, and all emissions found were more than 20 dB below the limit.

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.

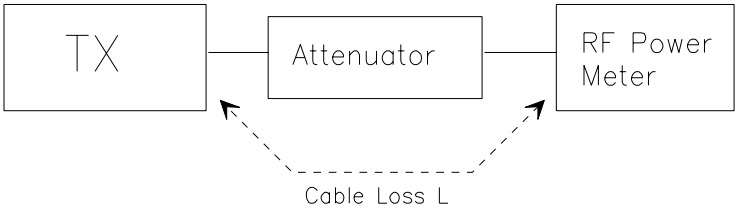
Step 2: Calculation of Average EIRP. See Figure 1

- 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 }.

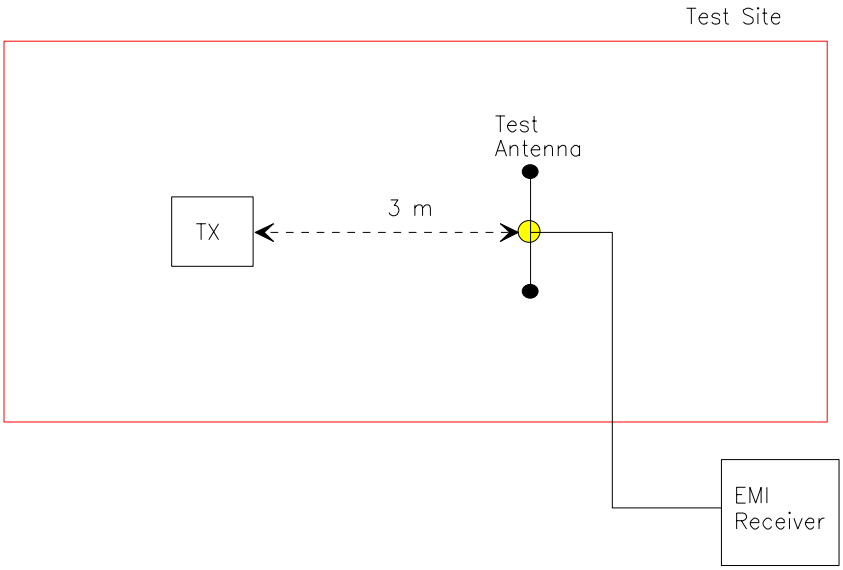
(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

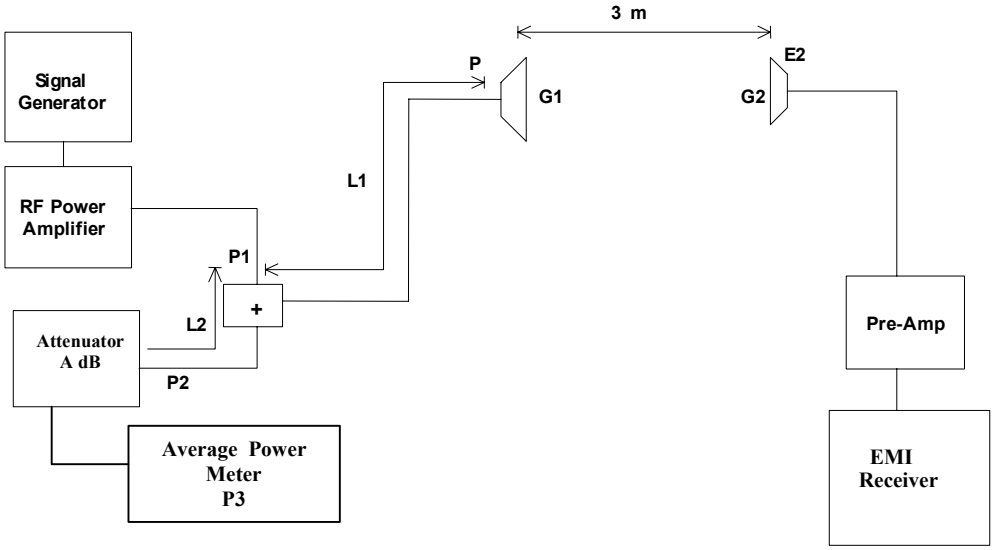
(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} 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.