ENGINEERING TEST REPORT

MOBITEX AIRBASE 900
FCC ID: LO6BAS900M896

Applicant: **FUTURECOM SYSTEMS GROUP INC.**
110 Snow Blvd., Unit 3 & 4
Concord, Ontario
Canada, L4K 4B8

Tested in Accordance With

Federal Communications Commission (FCC)
CFR 47, PARTS 2 and 90 (Subpart I)

UltraTech's File No.: FGS-023FTX

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: 09/13/99	
Report Prepared by: Dan Huynh	Tested by: Mr. Hung Trinh, EMI/FRI Technician
Issued Date: September 7, 1999	Test Dates: June 24 – July 12, 1999

The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 90 (Subpart 90): 1999
Title	Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 & 90
Purpose of Test:	To gain FCC Certification Authorization for Radio operating in the frequency bands 935-940 MHz (12.5 kHz Channel Spacing).
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.

1.2. NORMATIVE REFERENCES

Note: When the international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	YEAR	Title
FCC CFR Parts 0-19, 80-End	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 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT:	
Name:	FUTURECOM SYSTEMS GROUP INC.
Address:	110 Snow Blvd., Unit 3 & 4 Concord, Ontario Canada, L4K 4B8
Contact Person:	Mr. Tony Bombera Phone #: 1-800-701-9180 Fax #: 1-905-660-6858 Email Address: None

MANUFACTURER:	
Name:	FUTURECOM SYSTEMS GROUP INC.
Address:	110 Snow Blvd., Unit 3 & 4 Concord, Ontario Canada, L4K 4B8
Contact Person:	Mr. Tony Bombera Phone #: 1-800-701-9180 Fax #: 1-905-660-6858 Email Address: None

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Brand Name	FUTURECOM SYSTEMS GROUP INC.
Product Name	MOBITEX AIRBASE 900
Model Name or Number	MOBITEX AIRBASE 900
Serial Number	Pre-production
Type of Equipment	Radio Communication Equipment
External Power Supply	None
Transmitting/Receiving Antenna Type	Non-integral
Primary User Functions of EUT:	This radio transmitter will receive a rf signal in the frequency band from 896-901 MHz, then change its frequency into the 935-940 MHz band with the same signal characteristics.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Stationary (Base Station)
Intended Operating Environment:	Commercial, light industry & heavy industry
Power Supply Requirement:	120V, 60Hz
RF Output Power Rating:	21 Watts
Operating Frequency Range:	935-940 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	12.5 kHz
Occupied Bandwidth (99%):	The authorized BW of the RF output (transmit) signal will be the same as that of the RF input (receive) signal.
Emission Designation*:	14K6F1D
Oscillator Frequencies:	Please refer to the schematics and Block Diagrams
Antenna Connector Type:	N
Antenna Description:	None

Necessary Bandwidth Calculation

For FM Digital Modulation: Channel Spacing = 12.5 kHz, D = 2.5 KHz max., K = 1
M = 9.6/2 kb/s
$B_n = 2M + 2DK = 2(9.6/2) + 2(2.5)(1) =$ **14.6 KHz**
emission designation: 14K6F1D

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RS-232 Port (Note 2)	2	DIN 8 pin	Shielded
2	RF Ports (RF IN & RF OUT)	2	N	Shielded Coax

NOTES:

(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.*

(2) ***Ports which are not connected to cables during normal intended operation*** *(for factory/technical services uses only)*

2.5. SPECIAL CHANGES ON THE EUT'S HARDWARE/SOFTWARE FOR TESTING PURPOSES

None

2.6. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

2.7. RELATED SUBMITAL(S)/GRANT(S)

None

2.8. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	50 Ohm, 50 Watts RF Load
Brand name:	Bird

Ancillary Equipment # 2	
Description:	HP OmiBook Laptop Computer, Model HP OmniBook 5500 CS, FCC ID: B945500, S/N: TW63403246
Brand name:	Hewlett Packard

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. 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.

- 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, 1998.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
90.205 & 2.985	RF Power Output	Yes
90.213 & 2.995	Frequency Stability	Yes
90.242(b)(8) & 2.987(a)	Audio Frequency Response	Not applicable for data equipment
90.210 & 2.987(b)	Modulation Limiting	Not applicable, manufacturer's fixed setting.
90.209, 90.210 & 2.989	Emission Limitation & Emission Masks	Yes
90.210, 2.997 & 2.991	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
90.210, 2.997 & 2.993	Emission Limits - Field Strength of Spurious Emissions	Yes
90.214	Transient Frequency Behavior	Not applicable for this band of frequencies.

MOBITEX AIRBASE 900, Model No.: MOBITEX AIRBASE 900, by **FUTURECOM SYSTEMS GROUP 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.

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	101 kPa
Power input source:	120V, 60Hz

3.2. 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:	Futurecom utility software is provided for selecting test channel frequencies (rf in frquency & rf out frequency)
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohm RF Load and the receiver antenna port connector to the rf signal source.

Transmitter Test Signals:	
Frequencies: ▪ 935-940 MHz band	Lowest, Middle & Highest frequencies each frequency bands that the transmitter covers: • 935 MHz, 937.5 MHz & 940.0 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 21 Watts ▪ 9600 bps random data source ▪ external

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 7 of this report

5.2. 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 6 for Measurement Uncertainties.

5.3. 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.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

5.5. RF POWER OUTPUT @ FCC 2.985 & 90.205

5.5.1. Limits @ FCC 90.205

Please refer to FCC CFR 47, Part 90, Subpart I, Para. 90.205 for specification details.

5.5.2. Method of Measurements

FCC @ 2.985 – The rf output power of the transmitter was measured at the RF output terminals when the transmitter is adjusted by the manufacturer in accordance with the tune-up procedure to give the values of the current and voltage on the circuit elements specified in 2.983(d)(5). The electrical characteristics of the radio frequency load attached to the output terminals was 50 Ohms.

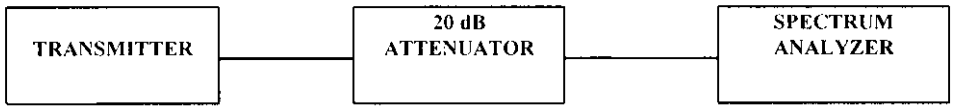
The detailed test method is as follows:

- *The transmitter terminal was coupled to the Spectrum Analyzer through a 20 dB attenuator*
- *Power of the transmitter channel near the lowest, middle and highest of each frequency block/band were measured using the power meter, and the reading was corrected by added the calibrated attenuator's attenuation value and cable loss.*
- *The RF Output was turned on with standard modulation applied.*

5.5.3. 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

5.5.4. Test Arrangement



5.5.5. Test data

TRANSMITTER CHANNEL OUTPUT	FUNDAMENTAL FREQUENCY (MHz)	MEASURED PEAK POWER (Watts)	PEAK POWER RATING (Watts)
Lowest	935.0	20.2	21.0
Middle	937.5	20.7	21.0
Highest	940.0	21.0	21.0

***EIRP Measurements**: -Appropriate antenna type, and adjustment of power output for effective radiated power (ERP) to meet FCC limits will be performed by the manufacturer at location of installation.*

5.5.6. Plots

None

5.5.7. Photographs of Test Setup

None

5.6. FREQUENCY STABILITY @ FCC 2.995 & 90.213

5.6.1. Limits @ FCC 90.213

Please refer to FCC CFR 47, Part 90, Subpart I, Para. 90.213 for specification details.

FREQUENCY RANGE (MHz)	FIXED & BASE STATIONS (ppm)	MOBILE STATIONS (ppm)	
		> 2 W	≤ 2 W
935-940	0.1	1.5	1.5

5.6.2. Method of Measurements

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.

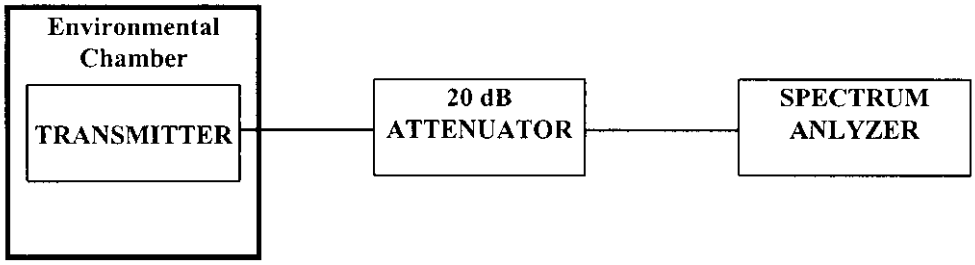
(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply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

5.6.3. 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
Temperature & Humidity Chamber	Tenney	T5	9723B	-40° to +60° C range

5.6.4. Test Arrangement



5.6.5. Test data

Product Name **Model No.**	**MOBITEX AIRBASE 900** **MOBITEX AIRBASE 900**
Center Frequency	935 MHz (lowest of the band)
Full Power Level	20.2 Watts
Frequency Tolerance Limit	0.1 ppm or 93.5 Hz
Max. Frequency Tolerance Measured	-40 Hz or0.043 ppm
Input Voltage Rating	120Volts, 60 Hz

		CENTER FREQUENCY & RF POWER OUTPUT VARIATION					
AMBIENT TEMP. (°C)	KEYED-ON TIME (Minutes)	Supply Voltage (Nominal) Volts		Supply Voltage (85% of Nominal) Volts		Supply Voltage (115% of Nominal) Volts	
		Hz	dB	Hz	dB	Hz	dB
-30	0	Note 1	N/A	N/A	N/A	N/A	N/A
	1		N/A	N/A	N/A	N/A	N/A
	2		N/A	N/A	N/A	N/A	N/A
	3		N/A	N/A	N/A	N/A	N/A
	4		N/A	N/A	N/A	N/A	N/A
	5		N/A	N/A	N/A	N/A	N/A
	6		N/A	N/A	N/A	N/A	N/A
	7		N/A	N/A	N/A	N/A	N/A
	8		N/A	N/A	N/A	N/A	N/A
	9		N/A	N/A	N/A	N/A	N/A
	10		N/A	N/A	N/A	N/A	N/A
-20	0	-1	N/A	N/A	N/A	N/A	N/A
	1	+13	N/A	N/A	N/A	N/A	N/A
	2	+26	N/A	N/A	N/A	N/A	N/A
	3	+23	N/A	N/A	N/A	N/A	N/A
	4	-5	N/A	N/A	N/A	N/A	N/A
	5	-28	N/A	N/A	N/A	N/A	N/A
	6	-40	N/A	N/A	N/A	N/A	N/A
	7	-40	N/A	N/A	N/A	N/A	N/A
	8	-25	N/A	N/A	N/A	N/A	N/A
	9	+16	N/A	N/A	N/A	N/A	N/A
	10	+14	N/A	N/A	N/A	N/A	N/A
-10	0	-10	N/A	N/A	N/A	N/A	N/A
	1	-13	N/A	N/A	N/A	N/A	N/A
	2	-14	N/A	N/A	N/A	N/A	N/A
	3	+6	N/A	N/A	N/A	N/A	N/A
	4	+2	N/A	N/A	N/A	N/A	N/A
	5	-4	N/A	N/A	N/A	N/A	N/A
	6	+9	N/A	N/A	N/A	N/A	N/A
	7	+16	N/A	N/A	N/A	N/A	N/A
	8	+10	N/A	N/A	N/A	N/A	N/A
	9	-10	N/A	N/A	N/A	N/A	N/A
	10	+9	N/A	N/A	N/A	N/A	N/A
0	0	-4	N/A	N/A	N/A	N/A	N/A
	1	+3	N/A	N/A	N/A	N/A	N/A
	2	-3	N/A	N/A	N/A	N/A	N/A
	3	+7	N/A	N/A	N/A	N/A	N/A
	4	+13	N/A	N/A	N/A	N/A	N/A
	5	-5	N/A	N/A	N/A	N/A	N/A
	6	-1	N/A	N/A	N/A	N/A	N/A
	7	-5	N/A	N/A	N/A	N/A	N/A
	8	-10	N/A	N/A	N/A	N/A	N/A
	9	+10	N/A	N/A	N/A	N/A	N/A
	10	+3	N/A	N/A	N/A	N/A	N/A

Note 1: The transmitter stop working at this temperature. No RF output signal.

		CENTER FREQUENCY & RF POWER OUTPUT VARIATION					
AMBIENT TEMP. (°C)	KEYED-ON TIME (Minutes)	Supply Voltage (Nominal) Volts		Supply Voltage (85% of Nominal) Volts		Supply Voltage (115% of Nominal) Volts	
		Hz	dB	Hz	dB	Hz	dB
+10	0	-30	N/A	N/A	N/A	N/A	N/A
	1	-28	N/A	N/A	N/A	N/A	N/A
	2	-21	N/A	N/A	N/A	N/A	N/A
	3	+15	N/A	N/A	N/A	N/A	N/A
	4	+12	N/A	N/A	N/A	N/A	N/A
	5	+19	N/A	N/A	N/A	N/A	N/A
	6	-4	N/A	N/A	N/A	N/A	N/A
	7	-7	N/A	N/A	N/A	N/A	N/A
	8	-23	N/A	N/A	N/A	N/A	N/A
	9	-18	N/A	N/A	N/A	N/A	N/A
	10	-20	N/A	N/A	N/A	N/A	N/A
+20	0	+17	N/A	-8	N/A	-20	N/A
	1	-4	N/A	+17	N/A	-21	N/A
	2	-12	N/A	+15	N/A	+5	N/A
	3	-20	N/A	+5	N/A	+6	N/A
	4	+9	N/A	+2	N/A	-3	N/A
	5	+20	N/A	-25	N/A	-30	N/A
	6	+12	N/A	-24	N/A	-20	N/A
	7	-20	N/A	+29	N/A	+30	N/A
	8	-10	N/A	+7	N/A	-15	N/A
	9	-17	N/A	-13	N/A	-9	N/A
	10	-10	N/A	-33	N/A	-10	N/A
+30	0	-17	N/A	N/A	N/A	N/A	N/A
	1	-18	N/A	N/A	N/A	N/A	N/A
	2	+10	N/A	N/A	N/A	N/A	N/A
	3	+6	N/A	N/A	N/A	N/A	N/A
	4	+17	N/A	N/A	N/A	N/A	N/A
	5	-18	N/A	N/A	N/A	N/A	N/A
	6	-10	N/A	N/A	N/A	N/A	N/A
	7	+10	N/A	N/A	N/A	N/A	N/A
	8	+26	N/A	N/A	N/A	N/A	N/A
	9	-27	N/A	N/A	N/A	N/A	N/A
	10	-20	N/A	N/A	N/A	N/A	N/A
+40	0	+2	N/A	N/A	N/A	N/A	N/A
	1	+3	N/A	N/A	N/A	N/A	N/A
	2	+10	N/A	N/A	N/A	N/A	N/A
	3	-3	N/A	N/A	N/A	N/A	N/A
	4	-3	N/A	N/A	N/A	N/A	N/A
	5	+3	N/A	N/A	N/A	N/A	N/A
	6	0	N/A	N/A	N/A	N/A	N/A
	7	-7	N/A	N/A	N/A	N/A	N/A
	8	-1	N/A	N/A	N/A	N/A	N/A
	9	-5	N/A	N/A	N/A	N/A	N/A
	10	-2	N/A	N/A	N/A	N/A	N/A

		CENTER FREQUENCY & RF POWER OUTPUT VARIATION					
AMBIENT TEMP. (°C)	KEYED-ON TIME (Minutes)	Supply Voltage (Nominal) Volts		Supply Voltage (85% of Nominal) Volts		Supply Voltage (115% of Nominal) Volts	
		Hz	dB	Hz	dB	Hz	dB
+50	0	-30	N/A	N/A	N/A	N/A	N/A
	1	-15	N/A	N/A	N/A	N/A	N/A
	2	-17	N/A	N/A	N/A	N/A	N/A
	3	+6	N/A	N/A	N/A	N/A	N/A
	4	+3	N/A	N/A	N/A	N/A	N/A
	5	0	N/A	N/A	N/A	N/A	N/A
	6	+6	N/A	N/A	N/A	N/A	N/A
	7	+6	N/A	N/A	N/A	N/A	N/A
	8	-4	N/A	N/A	N/A	N/A	N/A
	9	+6	N/A	N/A	N/A	N/A	N/A
	10	13	N/A	N/A	N/A	N/A	N/A

5.6.6. Plots

None

5.6.7. Photographs of Test Setup

None

5.7. EMISSION LIMITATION & EMISSION MASK @ FCC 2.989, 90.209 & 90.910

5.7.1. Limits @ 90.209 & 90.910

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

FREQUENCY RANGE (MHz)	Maximum Authorized BW (KHz)	CHANNEL SPACING (KHz)	Recommended Max. FREQ. DEVIATION (KHz)	FCC APPLICABLE MASK @ FCC 90.210
896-901/935-940	13.6	12.5	2.5	MASK J (Data)

5.7.2. Method of Measurements

FCC CFR 47, Para. 2.989 - Out-of-Band Emissions:

The Emission Masks was measured with the Spectrum Analyzer controls set as shown on the test results (RBW $\geq$ 300 Hz, VBW $\geq$ 300 Hz and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

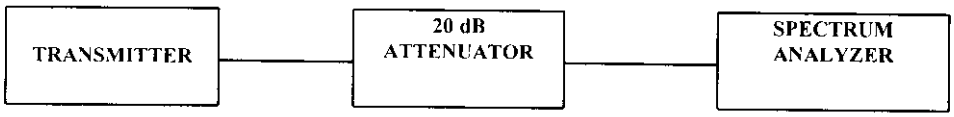
Voice or Digital Modulation Through a Voice Input Port @ 2.989(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: $\pm$2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established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

5.7.3. 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

5.7.4. Test Arrangement



5.7.5. Test data

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

5.7.6. Plots

The following plots graphically represent the test results recorded in the above Test Data Table.

5.7.7. Photographs of Test Setup

None

UltraTech Engineering Labs Inc.

FUTURECOM SYSTEMS GROUP INC.

BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz

Tx Freq.: 935 MHz, Measured RF Output @ Antenna: 20.2 Watts

Modulation: RF IN at max. level of 0 dBm @ 937 MHz

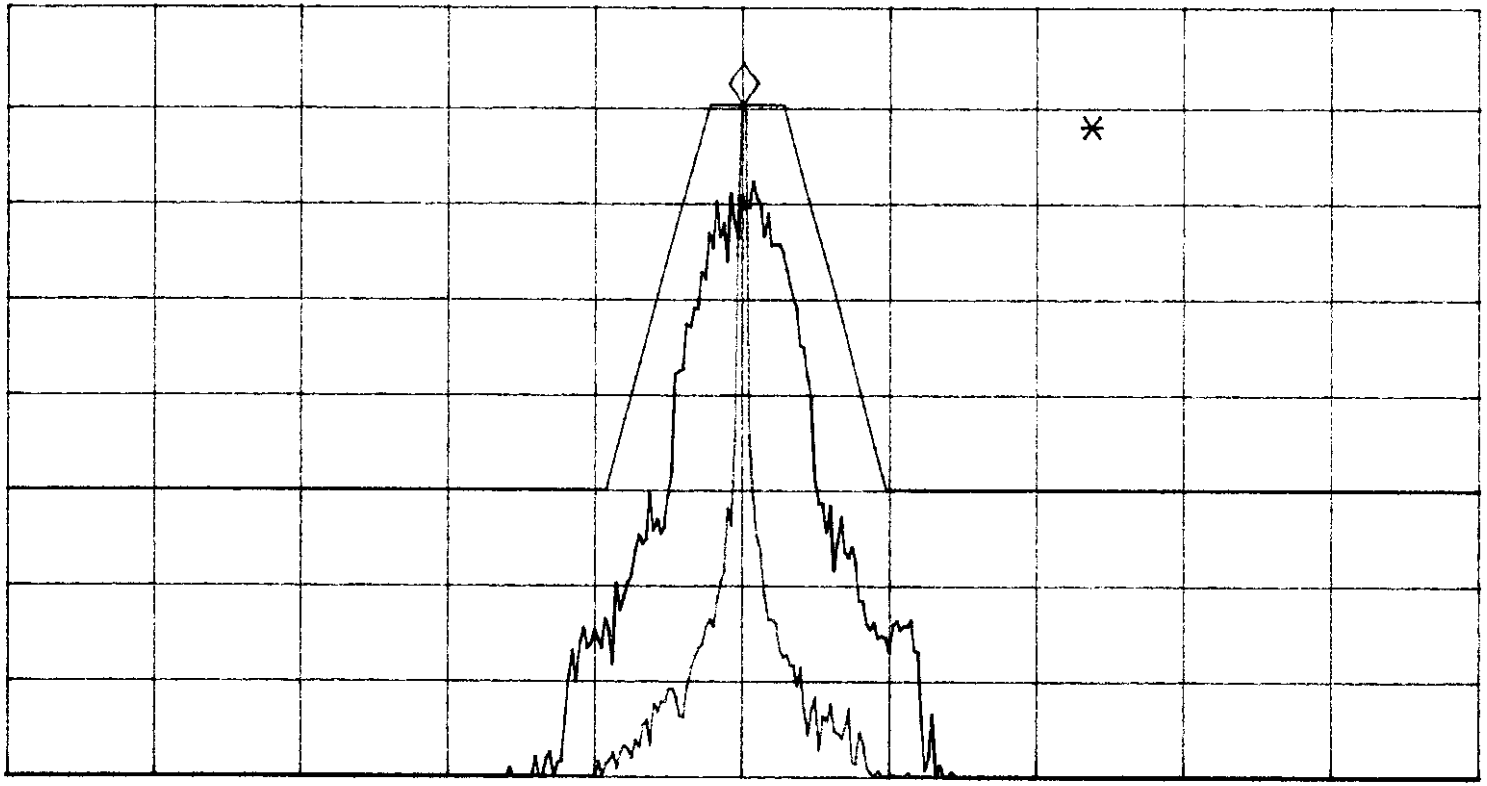
FM Modulated with an ~~internal 9600 b/s~~ external 7600 bps random data. Freq. Dev.: 2 kHz

Date: June 23, 1999
Tested by: Hung Trinh

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 934.9994 MHz
43.80 dBm

No user Menu

REF OFFST 32.0 dB MASK J RF OUT
LOG REF 53.9 dBm
10 dB/
ATN 40 dB



VA VB
SC FC
CORR

CENTER 934.9994 MHz
SPAN 100.0 kHz
#IF BW 100 Hz
AVG BW 100 Hz
SWP 30.0 sec

UltraTech Engineering Labs Inc.

hp

FUTURECOM SYSTEMS GROUP INC.

BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz

Tx Freq.: 937.5 MHz, Measured RF Output @ Antenna: 20.7 Watts

Modulation: RF IN at max. level of 0 dBm @ 937 MHz

FM Modulated with an ~~internal 8000 b/s~~ external 7600 bps random data. Freq. Dev.: 2 kHz

Date: June 28, 1999
Tested by: Hung Trinh

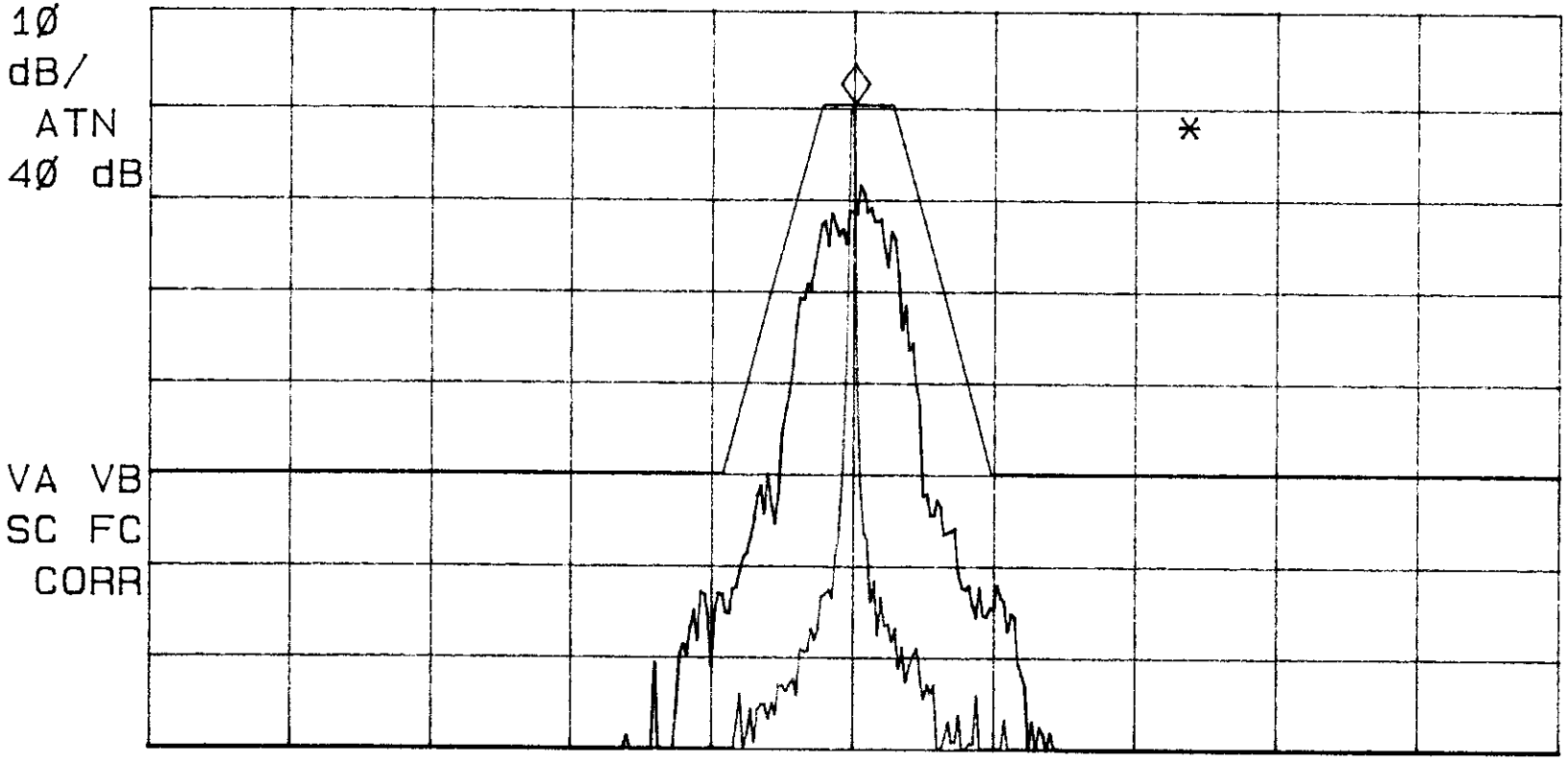
MARKER
937.4995 MHz
43.85 dBm

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 937.4995 MHz
43.85 dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 53.9 dBm

MASK J RF OUT



CENTER 937.4995 MHz
#IF BW 1ØØ Hz
AVG BW 1ØØ Hz
SPAN 1ØØ.Ø kHz
SWP 3Ø.Ø sec

UltraTech Engineering Labs Inc.

hp

FUTURECOM SYSTEMS GROUP INC.

BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz

Tx Freq.: 940 MHz, Measured RF Output @ Antenna: 21 Watts

Modulation: RF IN at max. level of 0 dBm @ 937 MHz

FM Modulated with an ~~internal 9600 b/s~~ internal 9600 b/s random data. Freq. Dev.: 2 kHz

Date: June 28, 1999
Tested by: Hung Trinh

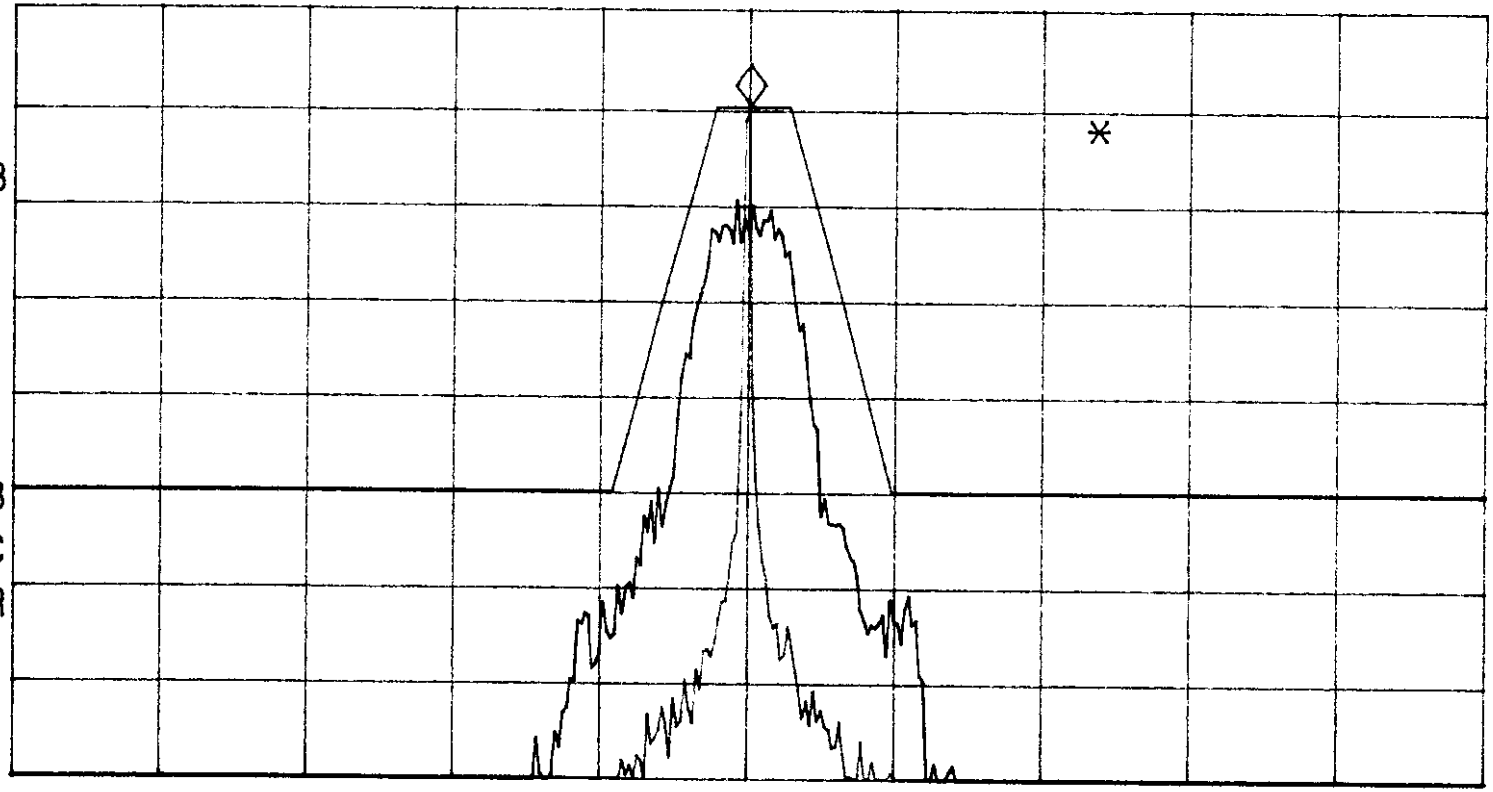
CENTER
939.9995 MHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 939.9995 MHz
43.9Ø dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 53.9 dBm

MASK J RF OUT



CENTER 939.9995 MHz
#IF BW 1ØØ Hz
AVG BW 1ØØ Hz
SPAN 1ØØ.Ø kHz
SWP 3Ø.Ø sec

5.8. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS @ FCC 90.210

5.8.1. Limits @ 90.210

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

FCC RULES	WORST CASE EMISSIONS LIMIT	ATTENUATION LIMIT (dBc)
FCC 90.210 (j)	FCC 90.210 (j)	157log(fd/5.3), 50+10log(P) or 70dB whichever is less

Note: Least attenuation of 39.8 dBc limit was applied to the test data in this section

5.8.2. Method of Measurements

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 10th 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.

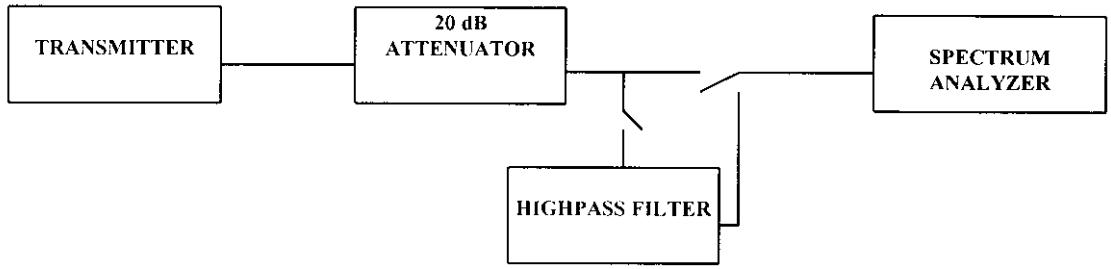
FCC CFR 47, Para. 2.991 - Spurious Emissions at Antenna Terminal:- The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent 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.

5.8.3. 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

5.8.4. Test Arrangement

- *The transmitter was coupled to the Spectrum Analyzer through a 20 dB attenuator.*
- *The insertion loss between the transmitter output terminal and the spectrum analyzer was measured to be 20 dB*
- *The channel frequencies (Low, Middle and High) was established on the extreme edges of the operating band, both upper and lower at its full rated output power. The emissions was investigated up to the tenth harmonic of the fundamental emissions in each case*



5.8.5. Test data

5.8.5.1. Near Lowest Frequency (935 MHz)

Fundamental Frequency:	935 MHz
RF Output Power:	20.2 Watts or 43.1 dBm
Limit:	39.8 dBc or 3.3 dBm
Modulation:	FM modulation with 9600 bps external random data source
No significant RF emissions were found at the transmitter antenna port in the frequency range from 10 MHz to 10 GHz. All RF emissions must be less than 70dBc. Please refer to attached plots for details.	

5.8.5.2. Near Middle Frequency (937.5 MHz)

Fundamental Frequency:	937.5 MHz
RF Output Power:	20.7 Watts or 43.2 dBm
Limit:	39.8 dBc or 3.4 dBm
Modulation:	FM modulation with 9600 bps external random data source
No significant RF emissions were found at the transmitter antenna port in the frequency range from 10 MHz to 10 GHz. All RF emissions must be less than 70dBc. Please refer to attached plots for details.	

5.8.5.3. Near Highest Frequency (940 MHz)

Fundamental Frequency:	940 MHz
RF Output Power:	21 Watts or 43.2 dBm
Limit:	39.8 dBc or 3.4 dBm
Modulation:	FM modulation with 9600 bps external random data source
No significant RF emissions were found at the transmitter antenna port in the frequency range from 10 MHz to 10 GHz. All RF emissions must be less than 70dBc. Please refer to attached plots for details.	

UltraTech Engineering Labs Inc.

hp

FUTURECOM SYSTEMS GROUP INC.

BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz

Tx Freq.: 935 MHz, Measured RF Output @ Antenna: 20.2 Watts

Modulation: RF IN at max. level of 0 dBm @ 937 MHz

FM Modulated with an ~~internal 8000 b/s~~ 9600 b/s random data. Freq. Dev.: 2 kHz

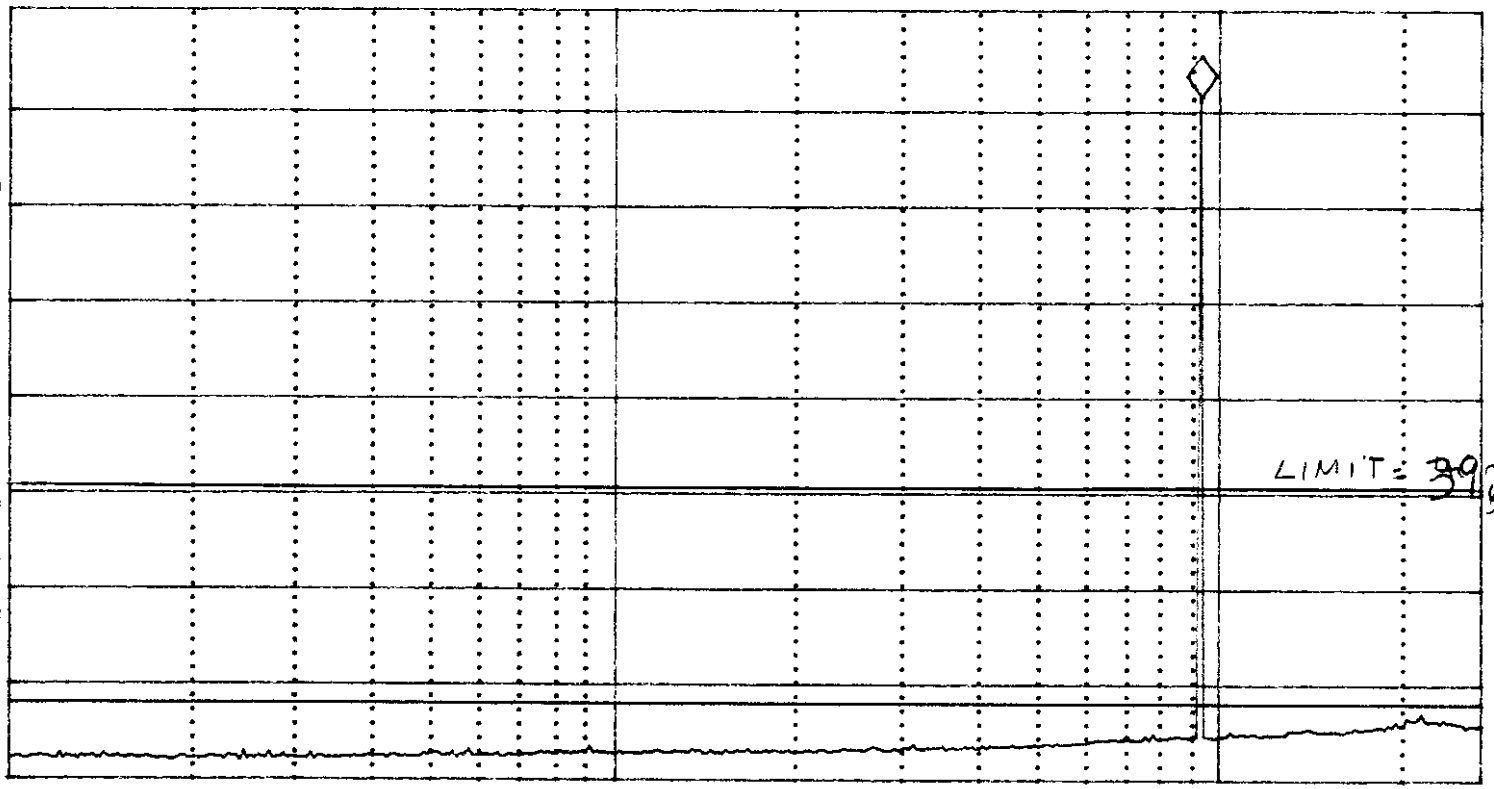
Date: June 28, 1999
Tested by: Hung Trinh

IF BANDWIDTH
3Ø kHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 935 MHz
43.Ø4 dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 52.Ø dBm
1Ø dB/
ATN 3Ø dB



MA SB
SC FC
CORR

START 1Ø MHz
#IF BW 3Ø kHz
AVG BW 3Ø kHz
STOP 2.7ØØ GHz
SWP 9.Ø4 sec

UltraTech Engineering Labs Inc.

FUTURECOM SYSTEMS GROUP INC.

BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz

Tx Freq.: 935 MHz, Measured RF Output @ Antenna: 20.2 Watts

Modulation: RF IN at max. level of 0 dBm @ 937 MHz

FM Modulated with an ~~internal 9600 b/s~~ External 9.6 kbps random data. Freq. Dev.: 2 kHz

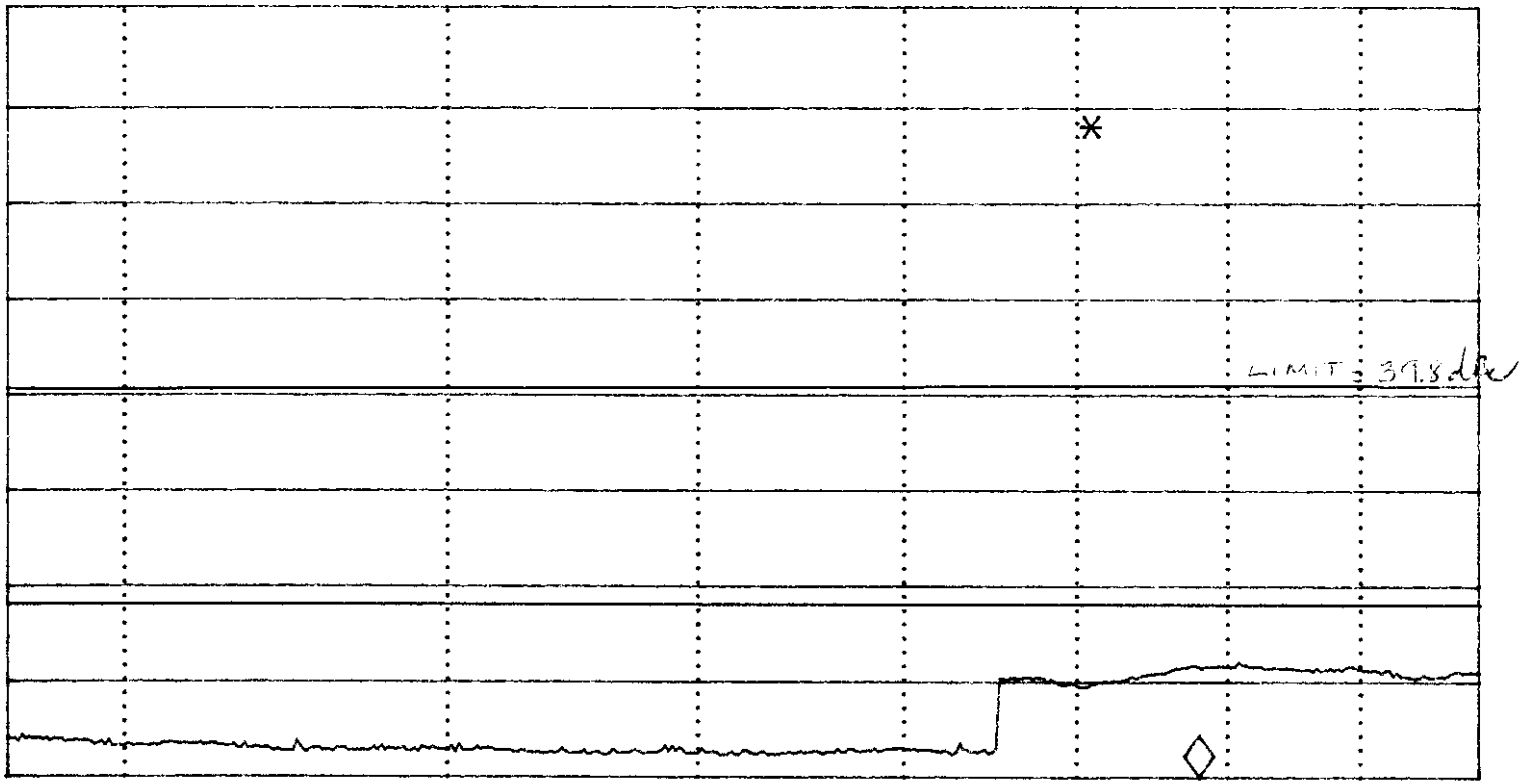
Date: June 28, 1999
Tested by: Hung Trinh

REF LEVEL
42.Ø dBm

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 7.799 GHz
-38.ØØ dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 42.Ø dBm
1Ø dB/
ATN 2Ø dB



WA SB
SC FC
CORR

START 2.7ØØ GHz
#IF BW 3Ø kHz
AVG BW 3Ø kHz
STOP 1Ø.ØØØ GHz
SWP 24.3 sec

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FUTURECOM SYSTEMS GROUP INC.
BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz
Tx Freq.: 937.5 MHz, Measured RF Output @ Antenna: 20.7 Watts
Modulation: RF IN at max. level of 0 dBm @ 937 MHz
FM Modulated with an ~~internal 9600 b/s~~ external 76CC bps random data. Freq. Dev.: 2 kHz

Date: June 25, 199
Tested by: Hung Trin

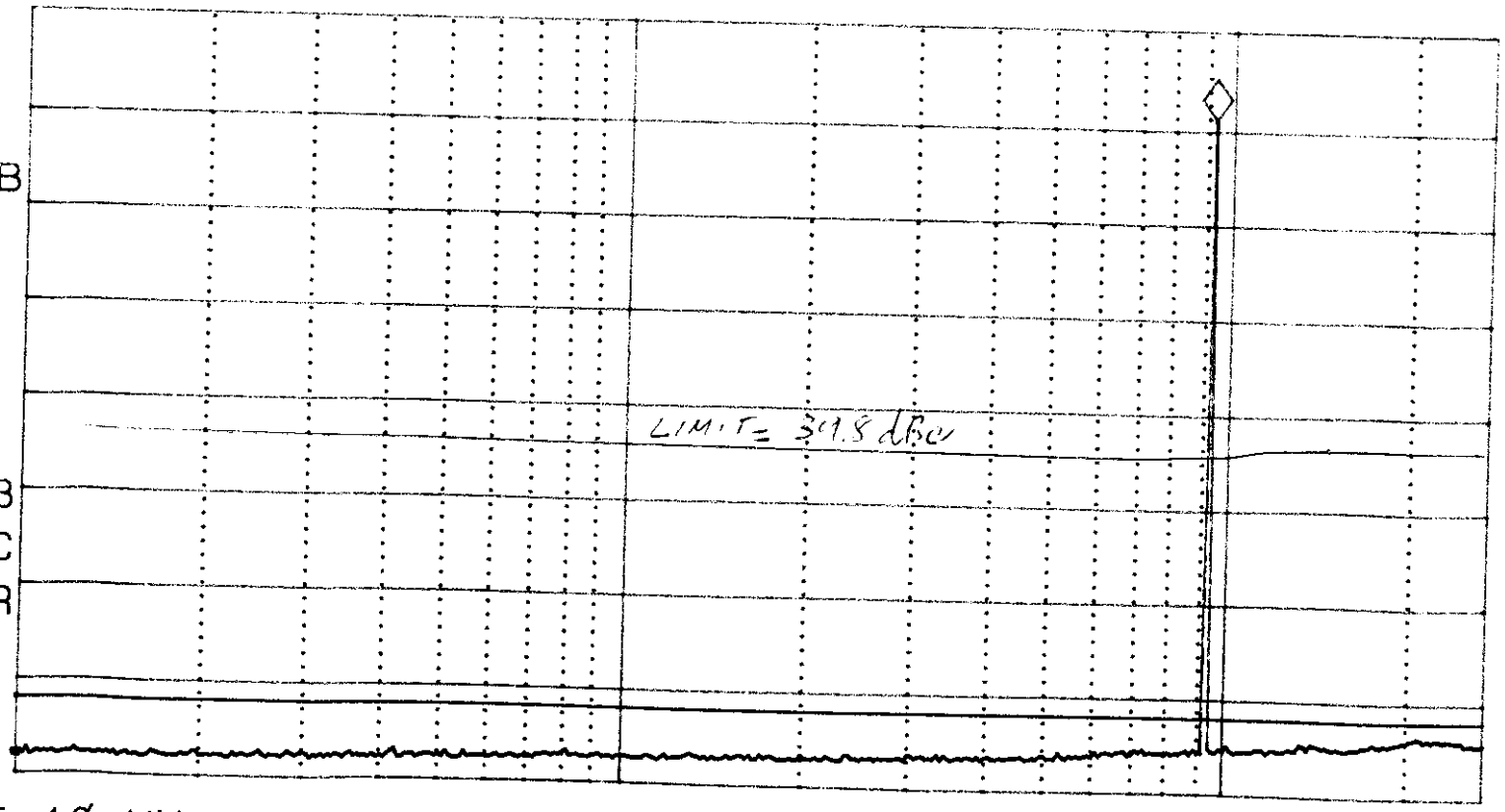
hp

REF LEVEL
52.Ø dBm

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 935 MHz
42.68 dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 52.Ø dBm
1Ø dB/
ATN 3Ø dB



MA SB
SC FC
CORR

START 1Ø MHz
#IF BW 3Ø kHz
#AVG BW 3Ø kHz
STOP 2.7ØØ GHz
SWP 9.Ø4 sec

UltraTech
Engineering Labs Inc.

FUTURECOM SYSTEMS GROUP INC.
BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz
Tx Freq.: 937.5 MHz, Measured RF Output @ Antenna: 20.7 Watts
Modulation: RF IN at max. level of 0 dBm @ 937 MHz
FM Modulated with an ~~internal 8000~~ b/s random data. Freq. Dev.: 2 kHz
external 9600 bps

Date: June 25, 1999
Tested by: Hung Trinh

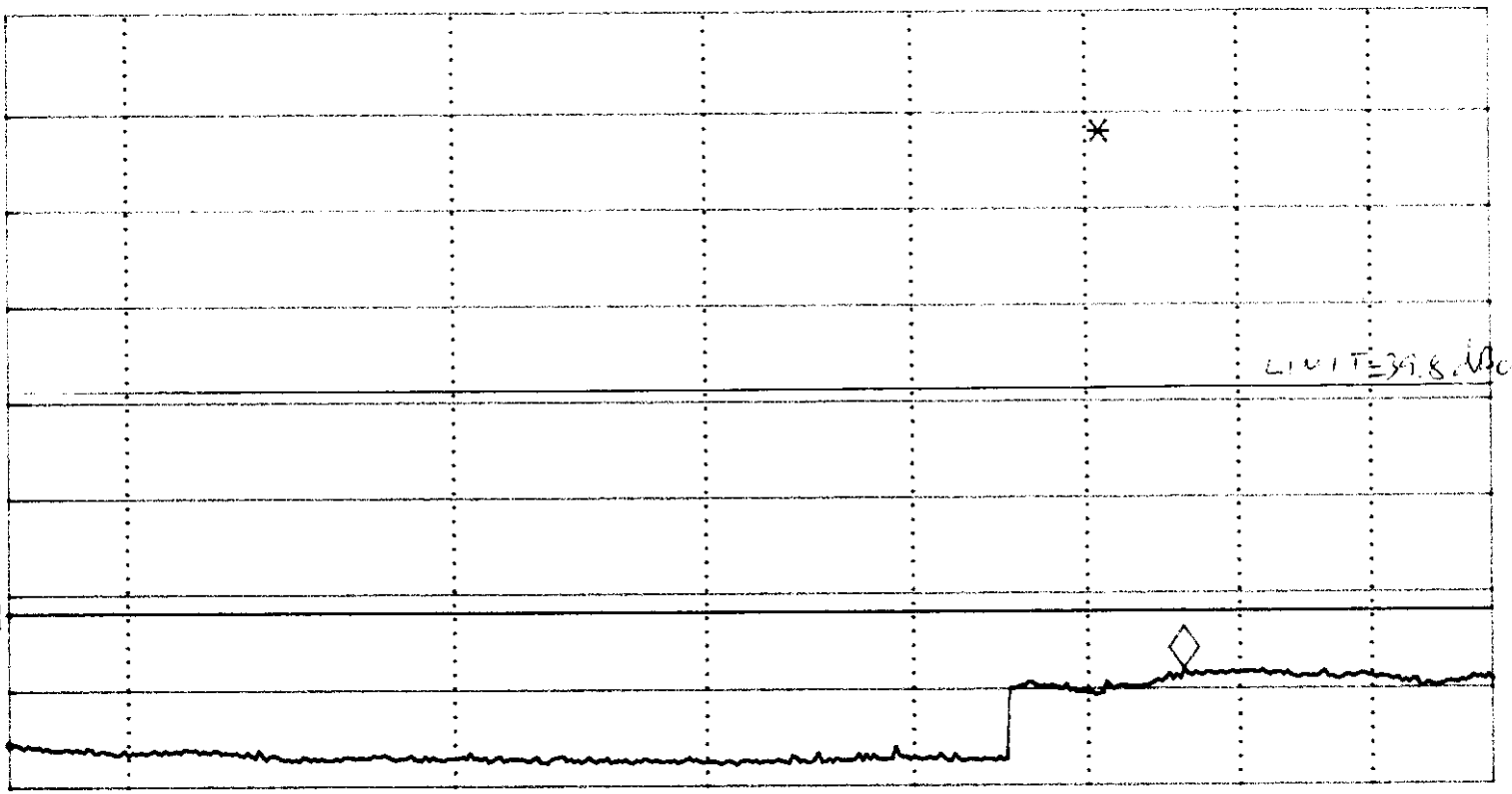
hp

REF LEVEL
42.Ø dBm

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 7.624 GHz
-26.Ø8 dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 42.Ø dBm
1Ø dB/
ATN 2Ø dB



MA SB
SC FC
CORR

START 2.7ØØ GHz
#IF BW 3Ø kHz
#AVG BW 3Ø kHz
STOP 1Ø.ØØØ GHz
SWP 24.3 sec

UltraTech Engineering Labs Inc.

FUTURECOM SYSTEMS GROUP INC.
BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz
Tx Freq.: 940 MHz, Measured RF Output @ Antenna: 21 Watts
Modulation: RF IN at max. level of 0 dBm @ 937 MHz
FM Modulated with an ~~internal 8000 b~~/s random data. Freq. Dev.: 2 kHz
~~internal 9601 bps~~

Date: June 25, 1999
Tested by: Hung Trinh

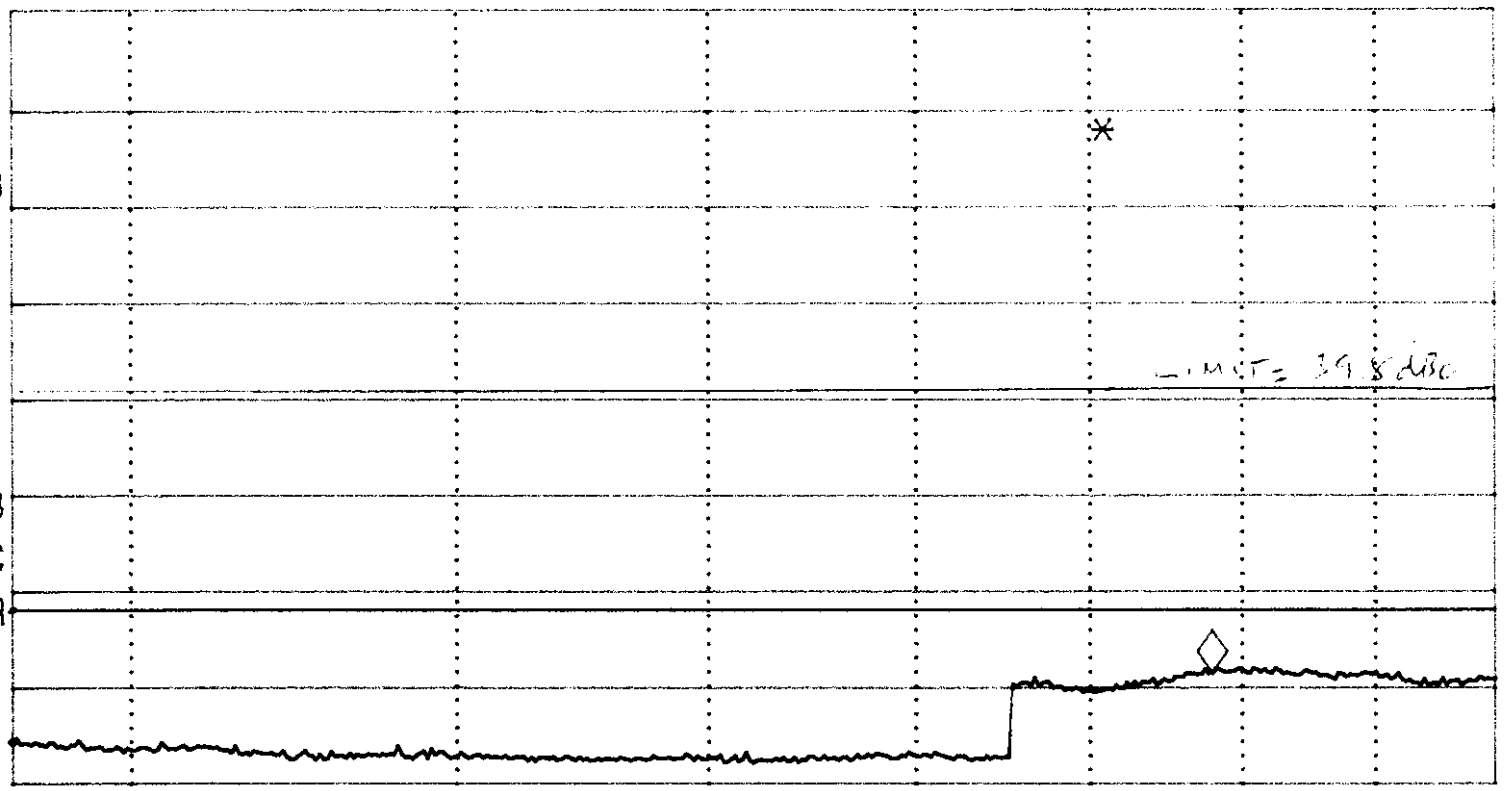
hp

REF LEVEL
42.Ø dBm

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 7.799 GHz
-26.58 dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 42.Ø dBm
1Ø dB/
ATN 2Ø dB



MA SB
SC FC
CORR

START 2.7ØØ GHz
STOP 1Ø.ØØØ GHz
#IF BW 3Ø kHz
#AVG BW 3Ø kHz
SWP 24.3 sec

5.9. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 90.210

5.9.1. Limits @ FCC 90.210

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

FCC RULES	WORST CASE EMISSIONS LIMIT	ATTENUATION LIMIT (dBc)
FCC 90.210 (j)	FCC 90.210 (j)	157log(fd/5.3), 50+10log(P) or 70 dB whichever is less

Note: least attenuation of 39.8 dBc limit was applied to the test data in this section.

5.9.2. Method of Measurements

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

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 ≥ 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 10th 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.

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):

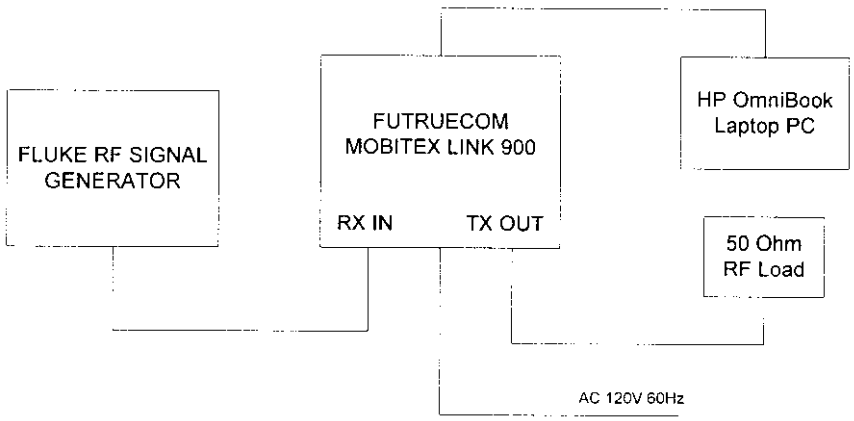
$P(W) = [E(V/m)xD/7.01]^2$
$P(mW) = P(W)x1000$
=> $P(dBm) = 10logP(mW)$
$= 20logE(V/m) + 20log(D) - 20log(7.01) + 10log1000$
$= E(dBV/m) + 20logD + 13$
$= E(dBuV/m) - 120 + 20log(D) + 13$
$= E(dBuV/m) + 20log(D) - 107$

The Transmitted Power @ D = 3 Meters

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

5.9.3. Test Arrangement

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



5.9.4. 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

5.9.5. Test data

5.9.5.1. Near Lowest Frequency (935 MHz)

Fundamental Frequency: 935 MHz
RF Output Power: 20.2 Watts or 43.1 dBm
Limti: 39.8 dBc or 3.3 dBm
Modulation: FM modulation with 9600 bps external random data source

FREQUENCY (MHz)	FIELD LEVEL (dBμV/m)	POWER LEVEL (dBm)	ANTENNA PLANE (H/V)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
1870.0	59.7	-37.8	H	3.3	-41.1	PASS
1870.0	58.6	-38.9	V	3.3	-42.2	PASS
28.05.0	64.1	-33.4	H	3.3	-36.7	PASS
28.05.0	61.8	-35.7	V	3.3	-39.0	PASS
37.40.0	50.7	-46.8	V	3.3	-50.1	PASS
4675.0	55.8	-41.7	H	3.3	-45.0	PASS
4675.0	57.4	-40.1	V	3.3	-43.4	PASS
5610.0	59.9	-37.6	H	3.3	-40.9	PASS
5610.0	66.6	-30.9	V	3.3	-34.2	PASS
7480.0	57.0	-40.5	H	3.3	-43.8	PASS
7480.0	59.1	-38.4	V	3.3	-41.7	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 50 dB below the limits were recorded.

5.9.5.2. Near Middle Frequency (937.5 MHz)

Fundamental Frequency: 937.5 MHz
RF Output Power: 20.7 Watts or 43.2 dBm
Limti: 39.8 dBc or 3.4 dBm
Modulation: FM modulation with 9600 bps external random data source

FREQUENCY (MHz)	FIELD LEVEL (dBμV/m)	POWER LEVEL (dBm)	ANTENNA PLANE (H/V)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
1850.0	59.5	-38.0	H	3.4	-41.1	PASS
1850.0	57.5	-40.0	V	3.4	-43.4	PASS
2812.5	60.4	-37.1	H	3.4	-40.5	PASS
2812.5	63.8	-33.7	V	3.4	-37.1	PASS
3750.0	51.0	-46.5	V	3.4	-49.9	PASS
4687.5	56.6	-40.9	V	3.4	-44.3	PASS
4687.5	57.6	-39.9	H	3.4	-43.3	PASS
5625.0	61.4	-36.1	V	3.4	-39.5	PASS
5625.0	66.6	-30.9	H	3.4	-34.3	PASS
7500.0	61.9	-35.6	V	3.4	-39.0	PASS
7500.0	62.7	-34.8	H	3.4	-38.2	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 50 dB below the limits were recorded.

5.9.5.3. Near Highest Frequency (940 MHz)

Fundamental Frequency: 940 MHz
RF Output Power: 21 Watts or 43.2 dBm
Limti: 39.8 dBc or 3.4 dBm
Modulation: FM modulation with 9600 bps external random data source

FREQUENCY (MHz)	FIELD LEVEL (dBμV/m)	POWER LEVEL (dBm)	ANTENNA PLANE (H/V)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
1880.0	59.9	-37.6	H	3.4	-41.0	PASS
1880.0	60.9	-36.6	V	3.4	-40.0	PASS
2820.0	64.5	-33.0	H	3.4	-36.4	PASS
2820.0	64.9	-32.6	V	3.4	-36.0	PASS
4700.0	57.3	-40.2	H	3.4	-43.6	PASS
4700.0	55.7	-41.8	V	3.4	-45.2	PASS
5640.0	59.8	-37.7	H	3.4	-41.1	PASS
5640.0	61.8	-35.7	V	3.4	-39.1	PASS
7520.0	62.3	-35.2	V	3.4	-38.6	PASS

The emissions were scanned from 10 MHz to 10 GHz and all emissions less 50 dB below the limits were recorded.

5.9.6. Plots

None

EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC Γ_1 = 0.03 LISN VRC Γ_R = 0.8(9 kHz) 0.2 (30 MHz) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 150 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

6.2. 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 7. MEASUREMENT METHODS

7.1. GENERAL TEST CONDITIONS

7.1.1. Test Conditions

- The measurement shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications.
- An attempt shall be made to maximize the detected radiated emissions, for example moving cables of the equipment, rotating the equipment by 360° and moving the measuring receiving antenna up and down within 1 to 4 meters high.
- Where appropriate, a single tone or a bit stream shall be used to modulate the transmitter. The manufacturer shall define the modulation with the highest emission in transmit mode.

7.1.2. Method of Measurements - AC Mains Conducted Emissions

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 16'(L) by 16'(W) by 12'(H).
- The test was performed were made over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlFCC. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency span 150KHz-30MHz.

- The maximum conducted emission for a given mode of operation was found by using the following step-by-step procedure:

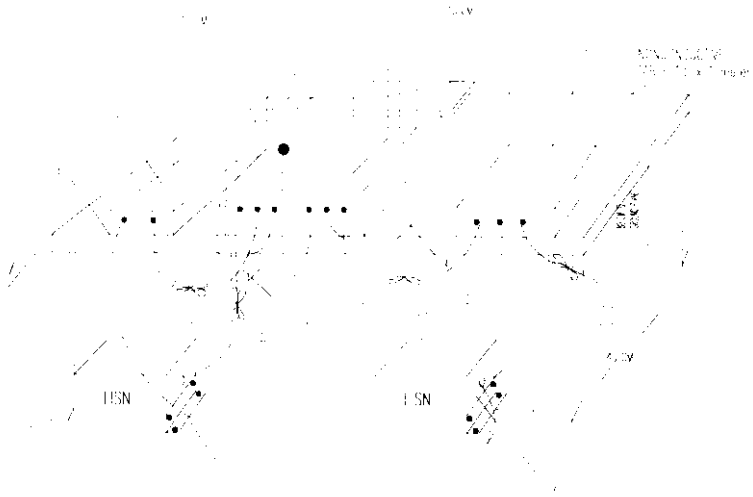
  Step1. Monitor the frequency range of interest at a fixed EUT azimuth.

  Step2. Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step3. The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.

Step4. After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test.

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 9 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz VBW) and AVERAGE detector mode (9 kHz RBW, 1 MHz VBW). The final highest RF signal levels and frequencies were record.



Tabletop Equipment Conducted Emissions

LEGEND:

Floor Standing Equipment Conducted Emissions

7.1.3. Method of Measurements - Electric Field Radiated Disturbance

- The radiated emission measurements were performed at the UltraTech's 10 or 30 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

  1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
  2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
  3. Calibrated Advantest spectrum analyzer and pre-selector. In general, the spectrum analyzer would be used as follows:

     - The rf electric field levels were measured with the spectrum analyzer set to PEAK detector (120 KHz VBW and VBW $\geq$ RBW).

     - If any rf emission was observed to be a broadband noise, the spectrum analyzer's CISPR QUASI-PEAK detector (120 KHz RBW and VBW $\geq$ RBW) was then set to measure the signal level.

     - If the signal being measured was narrowband and the ambient field was broadband, the bandwidth of the spectrum analyzer was reduced.

- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

  The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

  Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

  Step4: Move the antenna over its full allowed range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

Calculation of Field Strength:

The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

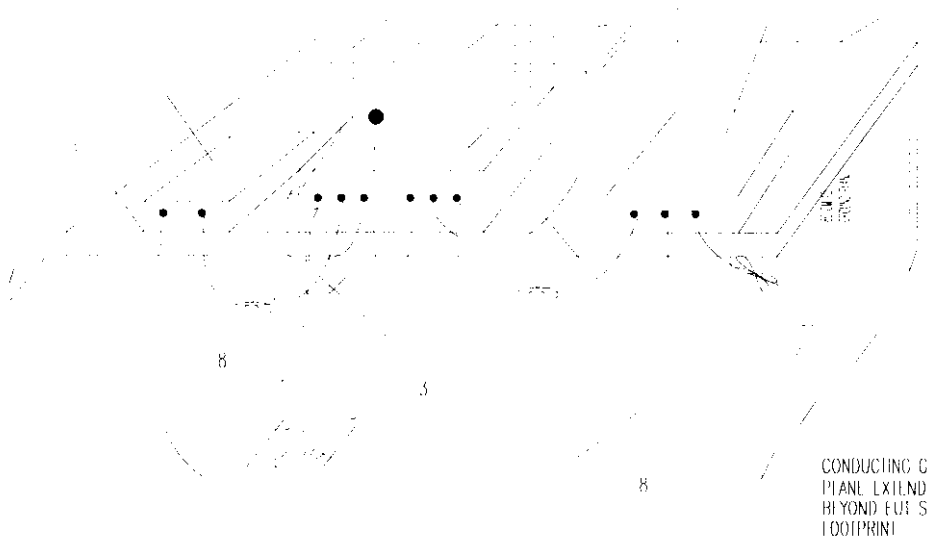
Where	FS	=	Field Strength
	RA	=	Receiver/Analyzer Reading
	AF	=	Antenna Factor
	CF	=	Cable Attenuation Factor
	AG	=	Amplifier Gain

Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:.

Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.

Field Level = $10^{(38/20)}$ = 79.43 uV/m.

NOTE: The frequency and amplitude of at least six highest conducted emissions relative to the limit are recorded unless such emissions are more than 20 dB below the limit. If less than six emissions are within 20dB of the limit, the background or receiver noise level shall be reported at representative frequencies.



LEGEND:

Tabletop Equipment Radiated Emissions

LINE):

Floor Standing Equipment Radiated Emissions

EXHIBIT 8. FCC FORM 731, APPLICANT'S LETTERS & STATEMENT

8.1. FCC FORM 731

8.2. APPLICANT'S AUTHORIZATION TO APPOINT ULTRATECH ENGINEERING LABS INC. TO ACT AS AN AGENT

8.3. LETTER REQUEST FOR FCC CONFIDENTIALITY FILING

UltraTech Engineering Labs Inc.

FUTURECOM SYSTEMS GROUP INC.

BASE / MOBILE CM900 TRANSMITTER, 896-901 MHz, 935-940 MHz

Tx Freq.: 940 MHz, Measured RF Output @ Antenna: 20.99 Watts

Modulation: RF IN at max. level of 0 dBm @ 937 MHz

FM Modulated with an ~~internal 8000~~ b/s random data. Freq. Dev.: 2 kHz

external 9600 bps

Date: June 25, 1999
Tested by: Hung Trinh

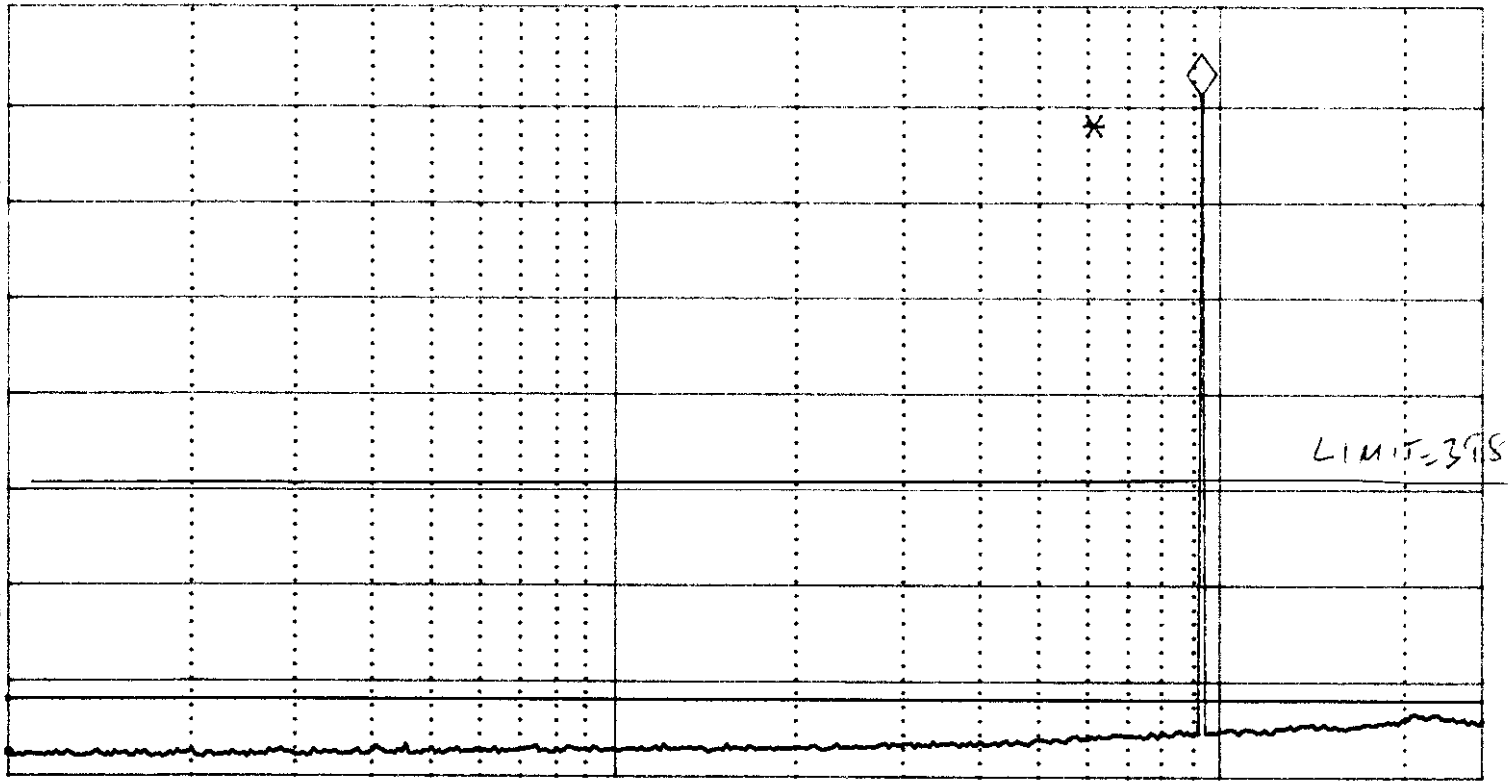
hp

AVERAGE BANDWIDTH
3Ø kHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 935 MHz
42.77 dBm

No user Menu

REF OFFST 32.Ø dB
LOG REF 52.Ø dBm
1Ø dB/
ATN 3Ø dB



MA SB
SC FC
CORR

START 1Ø MHz
STOP 2.7ØØ GHz
#IF BW 3Ø kHz
#AVG BW 3Ø kHz
SWP 9.Ø4 sec