Exhibit A
Technical Report
E5MDS4790

Technical Report

MICROWAVE DATA SYSTEMS
MODEL MDS 4790
MASTER STATION

FCC ID: E5MDS4790

Microwave Data Systems
175 Science Parkway
Rochester, NY 14620

716 242 9600 (Voice)
716 241 5590 (Fax)

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List of Exhibits

Exhibit A: Technical Report (this document)

Exhibit B: Test Report to FCC Part 90 - Includes Product Photographs

Exhibit C: Installation and Operation Manual - MDS 4790

1.0 General Equipment Information

This device is marketed and manufactured by Microwave Data Systems as the MDS 4790 Master Station and is intended primarily for use in Point-to-Multipoint networks. The MDS 4790 is used as the master station radio communicating with the multiple points in the network which use so-called remote radios such as the MDS 4710.

The MDS 4790 Master Station is a full-duplex, redundant radio. It contains receiver and transmitter circuits which operate simultaneously on frequencies separated by at least a few Megahertz. A highly selective, internal Duplexer filter is used to permit full duplex operation into a single antenna.

Redundancy is provided by duplication of almost all of the electronic circuits in the MDS 4790. This is accomplished by having two identical main circuit boards, and two identical power supply modules. If either fails, operation is switched over to the reserve unit automatically.

1.1 Summary of RF Parameters

Transmitter

Type:	Synthesized, 12.5 kHz steps
Frequency Range:	380 to 512 MHz.
Power Output:	37 dBm maximum (5 Watts)
Crystal frequency:	16 MHz TCXO

Receiver

Type:	Double conversion superheterodyne
Frequency Range:	380 to 512 MHz.
1st Local Oscillator Range:	462.2 to 594.2 MHz.
First Intermediate Frequency:	82.2 MHz.
Second Intermediate Frequency:	455 kHz.
Crystal Frequencies:	16 MHz, 81.745 MHz.

1.2 Construction Details

The MDS 4790 Master Station consists of a transmitter and receiver constructed on a common printed wiring board assembly. Two identical boards are used for redundancy. The printed circuit boards are mounted in a metal case suitable for either desk-top use or 19 inch rack mounting. Two identical power supplies, which are fully enclosed in their own metal cases, slide into a rear panel opening. Both DC and AC powered power supplies are available. A duplexer is also mounted within the chassis.

Power, interface and antenna connections are made via connectors on the rear panel of the unit.

2.0 Description of Device Operation

2.1 General Operation

The MDS 4790 Master Station is a narrow band radio designed to operate on 12.5 kHz. channels, meeting the requirements of FCC Part 90 and FCC Part 15.

2.2 Description of Circuit Functions

The following is a summary of the operation of the MDS 4790 Master Station. Refer to Figure 1, the block diagram, and to the schematics, to follow the discussion.

2.2.1 Receiver

Receive Front End

RF from the antenna connector passes through the highly selective duplexer, before going to the Interface Board. There, the signal is switched to one of the two, redundant, main circuit boards.
The RF passes through a helical filter FL601 before being fed to the low-noise RF amplifier Q603, whose output goes to a second helical filter FL602. Each helical front-end filter has a 10 MHz 1 dB bandwidth, and are down approximately 20 dB at ±50 MHz. The output goes to a double-balanced mixer M600, whose local oscillator injection voltage is derived from the VCO U603 through a buffer amplifier Q602.

High IF

The 82.2 MHz High IF signal from the mixer enters an IF amplifier JFET Q601 whose output goes to FL604 and FL603, a dual SAW filter which provides part of the IF selectivity of the receiver. The output of FL603 is connected to U601, which contains the Low IF amplifier and other functions.

Low IF

U601 contains several circuit sections: mixer, oscillator, IF amplifier / limiter, quadrature detector and meter drive. The oscillator section uses crystal Y600 and associated components to set the second oscillator frequency at 81.745 MHz.

2.2.4 Processors

Microprocessor

The microprocessor U209 controls many of the functions of the radio. The microprocessor uses the 16 MHz system clock as its clock source.

Digital Signal Processor (DSP)

The DSP controls all of the real time modem functions including FIR filtering, converting/writing to D/A, reading from A/D and running the asynchronous RS-232 interface. It runs a predetermined routine that controls all of its pin functions. The routines are downloaded from the microcontroller's FLASH memory when the radio is powered up. All programmable functions and values are stored by the microprocessor in EEPROM in the microcontroller. These are used when the radio is powered up. These include operating parameters such as receive FIR coefficients and application interface baud rate. The DSP uses the 16 MHz system clock as its clock source.

2.2.5 PLL/Synthesizers

Two independent PLL circuits generate the High IF mixer local oscillator and transmitter local oscillator.

The temperature compensated 16 MHz crystal oscillator Y601 (TCXO) sets the reference frequency for the phase-lock loop (PLL) circuits. The TCXO's output is run to both the transmitter synthesizer IC and the receiver synthesizer IC.

U600 and U700 are CMOS PLL synthesizers consisting of phase detectors, programmable reference dividers, programmable feedback dividers, and prescalers. Data input is serially loaded from the microcontroller; this data consists of binary coded numbers representing the reference and feedback (VCO RF sample) divider ratios required to produce the final transmit and receive frequencies. The reference divider is programmed only on power-up, with a power reset or with a PLL out-of-lock condition. The feedback divider value changes according to the transmit/receive frequencies sent from the microcontroller.

The phase detector output of U600 and U700 are fed to the respective VCO tuning input through an R-C loop filter. U603 and U704 are self-contained voltage-controlled oscillator (VCO) assemblies.

4.0 Design Considerations for EMC

The design of the MDS 4790 Master Station incorporates good design practices developed by MDS during our 10+ years of radio design and manufacturing.

The most important design technique to minimizing both unwanted radiation and undesired susceptibility is in the proper design and layout of the printed circuit board. A 6-layer printed circuit board is used, with critical signal and oscillator traces run on internal layers between layers acting as ground planes. This stripline approach ensures minimum radiation from signal traces, and likewise protects them from induced voltages from external field sources during susceptibility testing.

Almost all components are surface mount, using the smallest outline packages available, which minimizes radiation from components, and allows for very short connecting traces. The enclosed area of any current loops is minimized as well, to reduce radiation. All components are mounted on the top surface of the printed circuit board.

Critical oscillator circuits are enclosed in a shield assembly on the top of the printed circuit board. The bottom side of the printed circuit board under the shield is a continuous copper surface connected to the top shield by plated through copper vias ensuring a good shield connection.

Input and output data and control lines appearing on the DB-25 connector, J3, are individually bypassed with 0.001 uF capacitors.

The Master Station enclosure is a metal case suitable for either desk-top use or 19 inch rack mounting. Two identical power supplies, which are fully enclosed in their own metal cases, slide into a rear panel opening.

This all-metal enclosure provides excellent RF shielding.

The MDS 4790 has been tested and shown to comply with all applicable requirements of FCC Parts 15 and 90.

4.5 Environmental Assessment (EA)

In accordance with Section 1.1307 of the FCC Rules, an environmental assessment is not required for this category of equipment as it does not fall into one of the categories listed in Table 1 of that section.

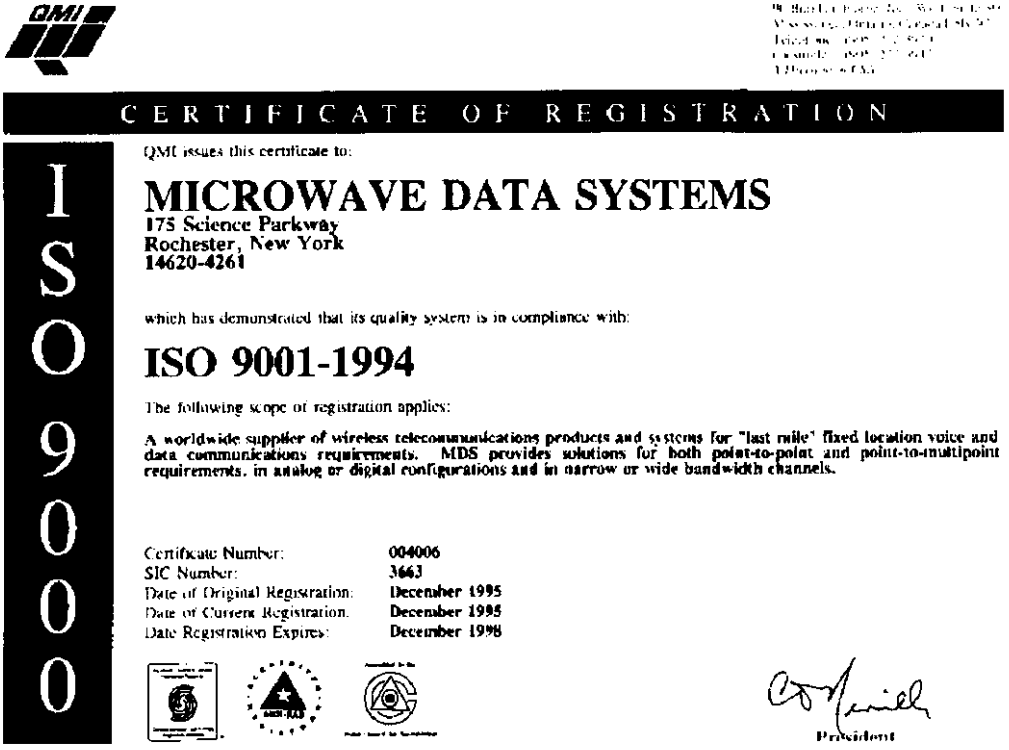
4.6 Spectrum Efficiency (per Section 90.203(j)(3))

This equipment meets the spectrum efficiency standard of one voice channel per 12.5 kHz channel bandwidth, and additionally supports a data rate of 9600 bps

per 12.5 kHz channel bandwidth meeting the requirement of 4800 bps per 6.25 kHz of channel bandwidth.

5.0 Quality System at Microwave Data Systems

Microwave Data Systems has been registered to ISO 9001 since December 1995. A copy of our Certificate of Registration is included with this report.



QMI

CERTIFICATE OF REGISTRATION

ISO 9000

QMI issues this certificate to:

MICROWAVE DATA SYSTEMS
175 Science Parkway
Rochester, New York
14620-4261

which has demonstrated that its quality system is in compliance with:

ISO 9001-1994

The following scope of registration applies:

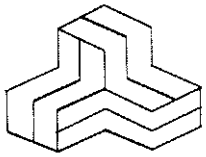
A worldwide supplier of wireless telecommunications products and systems for "last mile" fixed location voice and data communications requirements. MDS provides solutions for both point-to-point and point-to-multipoint requirements, in analog or digital configurations and in narrow or wide bandwidth channels.

Certificate Number:	004006
SIC Number:	3663
Date of Original Registration:	December 1995
Date of Current Registration:	December 1995
Date Registration Expires:	December 1998

President

Exhibit B
Test Report for FCC Compliance

ENGINEERING TEST REPORT



UHF RADIO TRANSCEIVER MASTER STATION
MODEL NO.: MDS 4790

FCC ID: E5MDS4790

FCC PART 2 & PART 90, SUBPART I
RADIO SERVICES FOR COMMERCIAL/INDUSTRIAL USES

UltraTech's FILE NO.: MIC6F90TX

Tested for:

MICROWAVE DATA SYSTEMS
175 Science Parkway
Rochester, New York
USA, 14620-4261

Tested by:

UltraTech - Group of Labs
4181 Sladeview Crescent, Unit 33
Mississauga, Ontario
Canada L5L 5R2

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

DATE: Sep. 18, 1998

UltraTech

33-4181 Sladeview Crescent, Mississauga, Ontario, Canada, L5L 5R2
Telephone (905) 569-2550 Facsimile (905) 569-2480
Web Site: www.ultratech-labs.com Email: vhk.ultratech@sympatico.ca

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

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (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	Yes
90.210 & 2.989	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	Yes

UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790, by **MICROWAVE DATA SYSTEMS** has also been tested and found to comply with **FCC Part 15, Subpart B - Radio Receivers and Class B Digital Devices**. However, since the equipment is only marketed for use as a Class A commercial/industrial device, the FCC Class A engineering test report is prepared and kept in file. It is available anytime upon FCC request.

TESTIMONIAL AND STATEMENT OF CERTIFICATION

THIS IS TO CERTIFY:

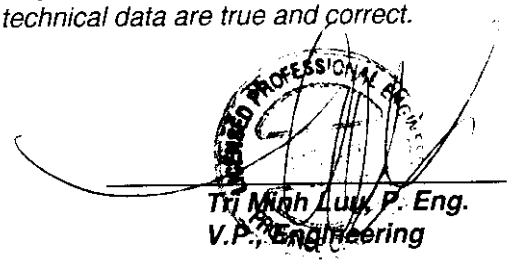
1) *THAT the application was prepared either by, or under the direct supervision of the undersigned.*

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

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

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

Certified by:



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

DATE: Sep. 18, 1998

2. EXHIBIT 2 - GENERAL INFORMATION

2.1. APPLICANT

MICROWAVE DATA SYSTEMS
175 Science Parkway
Rochester, New York
USA, 14620-4261

Applicant's Representative: Mr. Jacob Z. Schanker, P.Eng., CPEng., Director of Agency Compliance

2.2. MANUFACTURER

MICROWAVE DATA SYSTEMS
175 Science Parkway
Rochester, New York
USA, 14620-4261

2.3. DESCRIPTION OF EQUIPMENT UNDER TESTS

PRODUCT NAME:	UHF RADIO TRANSCEIVER MASTER STATION
MODEL NO.:	MDS 4790
SERIAL NUMBER:	preprodction
TYPE OF EQUIPMENT:	Radio Services Transmitters
SERVICES AREAS:	Commercial/Industrial
OPERATING FREQ.:	406 - 512 MHz
CHANNEL SPACINGS	12.5 kHz
POWER RATING:	5.4 Watts max.
OUTPUT IMPEDANCE:	50 Ohms
DUTY CYCLE:	Continuous
99% BANDWIDTH:	9 kHz nominal
BAUD RATES:	9600 b/s maximum
EMISSION DESIGNATION:	11K0F1D

OSC. FREQUENCY(IES):	Local Oscillator Frequency = Transmit Frequency
CPU SPEED:	15 MHz, 16 MHz
INPUT SUPPLY:	AC 120V 60 Hz
ASSOCIATED DEVICES:	N/A
FCC ID:	E5MDS4790
INTERFACE PORTS:	(1) RF Antenna Terminal (N-Type Connector) *(2)* Customer Data Interface Port (DB25). *Note: this one is not a RS-232 type interface.* *(3)* Diagnostic Port (DB9). *Note: This port is for factory or service use only.* (4) Alarm/4-Wire Audio Contacts (Terminal block)

2.4. RELATED SUBMITTALS)/GRANT

Not applicable

2.5. TEST METHODOLOGY

These tests were conducted on a sample of the equipment for the purpose of certification compliance with Code of Federal Regulations, Parts 2 & 90, Subpart I, Radio Services Operating in the Frequency Bands 406 - 512 MHz.

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

2.6. TEST FACILITY

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

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

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: July 16, 1997.

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

2.7. UNITS OF MEASUREMENTS

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

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

3.4. JUSTIFICATION

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

3.5. EUT OPERATING CONDITION

The transmitter output was turned with FM data modulation with 9600 b/s random data. Tests are repeated with at near lowest, middle and near highest frequencies.

3.6. SPECIAL ACCESSORIES

No special accessories were required.

3.7. EQUIPMENT MODIFICATIONS

Not required

4. EXHIBIT 4 - TEST DATA

4.1. POWER AND ANTENNA HEIGHT @ FCC 90.205

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 90, Para. 90.205:- Please refer to FCC CFR 47, Part 80 to End, Para. 90.205 for specification details.

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 21 °C
- Relative humidity: 43%

POWER INPUT:

AC 120V 60 Hz.

TEST EQUIPMENT:

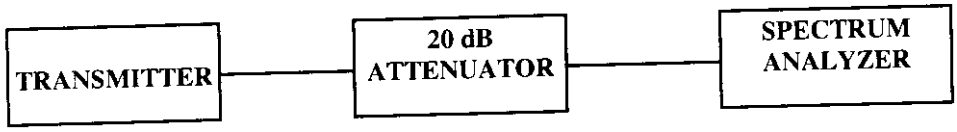
- Advantest Spectrum Analyzer, Model R3271, S/N: 15050203
- Bird Attenuator, 50 Ohm IN/OUT

METHOD OF MEASUREMENTS:

Refer to FCC @ 2.985

(a) For transmitter other than single sideband, independent sideband and controlled carrier radiotelephone, power rf output shall be measured at the RF output terminals when the transmitter is adjusted 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 when this test is made shall be stated.

TEST ARRANGEMENT



TEST RESULTS: Conforms.

TESTED PERSONNEL: Mr. Hung Trinh, EMI/RFI Technician

DATE: Sep. 15, 1998

ULTRATECH GROUP OF LABS
4181 Sladeview Cres., Unit 33, Mississauga, Ontario, Canada L5L 5R2
Tel. #: 905-569-2550, Fax. #: 905-569-2480, Email: vhk.ultratech@sympatico.ca, Wesite: http://www.ultratech-labs.com

MEASUREMENT DATA

PEAK POWER MEASUREMENT AT THE ANTENNA TERMINAL

TEST CONFIGURATION

- *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 no modulation.*

TRANSMITTER CHANNEL OUTPUT	FUNDAMENTAL FREQUENCY (MHz)	MEASURED PEAK POWER (Watts)	PEAK POWER RATING (Watts)
Near Lowest	406	5.3	Shall not exceed the power rating @ 5.4 Watts
Middle	450	4.9	Shall not exceed the power rating @ 5.4 Watts
Near Highest	470	5.4	Shall not exceed the power rating @ 5.4 Watts

ERP 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.

4.2. FREQUENCY STABILITY @ FCC 90.213

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 90, Sub. I, Para. 90.213

The carrier frequency of each transmitter shall be maintained within the following tolerances from the assigned frequencies.

FREQUENCY RANGE (MHz)	FIXED & BASE STATIONS (ppm)			MOBILE STATIONS (ppm)					
				> 2 W			≤ 2 W		
	6.25 kHz	12.5 kHz	25 kHz	6.25 kHz	12.5 kHz	25 kHz	6.25 kHz	12.5 kHz	25 kHz
403 – 512 MHz	0.5	1.5	2.5	1.0	2.5	5.0	1.0	2.5	5.0

CLIMATE CONDITION:

Standard Temperature and Humidity: Please refer to Measurement Data

POWER INPUT:

AC 120V 60 Hz.

TEST EQUIPMENT:

- Advantest Spectrum Analyzer, Model R3271, S/N: 15050203
- Tenney Temp. & Humidity Chamber, Model T5, S/N: 9723B
- Bird Attenuator, 50 Ohm IN/OUT

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:

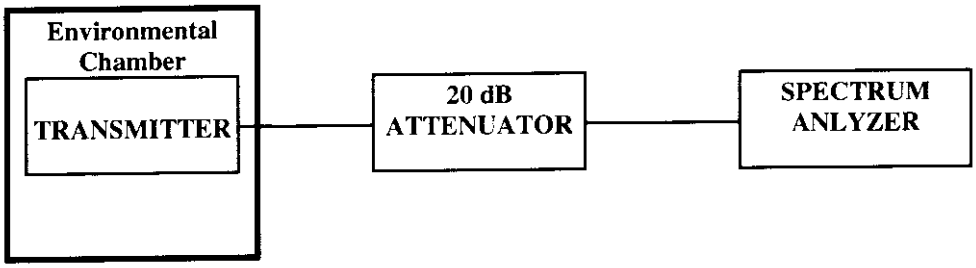
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(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).

TEST ARRANGEMENT



TEST RESULTS: Conforms.

TESTED PERSONNEL: Mr. Hung Trinh, EMI/RFI Technician

DATE: Sep. 16, 1998

MEASUREMENT DATA

FREQUENCY STABILITY

TEST CONFIGURATION

- *The transmitter was placed inside the environmental chamber, and its output terminal was coupled to the Spectrum Analyzer through a 20 dB attenuator.*
- *One transmitter channel frequency was tested.*
- *The DUT was supplied by a variable power supply.*
- *The environmental chamber was cycled down to -30° C. When the chamber reaches -30° C, the EUT was powered on with the nominal voltage level, with the transmitter keyed off. The terminal remained in the chamber at -30°C for a period of 1 hour. After 1 hour the transmitter was continuously keyed on, at **full power**. The transmitter frequency of the terminal was measured from the spectrum analyzer every minute for a period of 10 minutes.*
- *After 10 minutes the variable power supply was adjusted to supply the EUT with voltage of 85% nominal voltage level and measurement was repeated.*
- *After 10 minutes the variable power supply was adjusted to supply the EUT with voltage of 115% nominal voltage level and measurement was repeated,*
- *When the measurement complete, the transmitter was keyed off and the chamber was cycled up to 10° C steps. The EUT remained powered up (unkeyed) at -20° C for a minimum period of 1 hour, after which the measurements will be made as outlined above.*
- *The above was repeated for -10, 0, 20, 30, 40 and 50 degrees Celsius.*

Product Name **Model No.**	**UHF RADIO TRANSCEIVER MASTER STATION** **MDS 4790**
Center Frequency	406 MHz
Full Power Level	5 Watts
Frequency Tolerance Limit	0.00015 % or 609 MHz at 406 MHz
Max. Frequency Tolerance Measured	+520 Hz or +0.00013%
Input Voltage Rating	120 V 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	+520	-1.0	N/A	N/A	N/A	N/A
	1	+520	-1.0	N/A	N/A	N/A	N/A
	2	+520	-1.0	N/A	N/A	N/A	N/A
	3	+520	-1.0	N/A	N/A	N/A	N/A
	4	+520	-1.0	N/A	N/A	N/A	N/A
	5	+520	-1.0	N/A	N/A	N/A	N/A
	6	+520	-1.0	N/A	N/A	N/A	N/A
	7	+520	-1.0	N/A	N/A	N/A	N/A
	8	+520	-1.0	N/A	N/A	N/A	N/A
	9	+520	-1.0	N/A	N/A	N/A	N/A
	10	+520	-1.0	N/A	N/A	N/A	N/A
-20	0	+174	-0.7	N/A	N/A	N/A	N/A
	1	+174	-0.7	N/A	N/A	N/A	N/A
	2	+174	-0.7	N/A	N/A	N/A	N/A
	3	+174	-0.7	N/A	N/A	N/A	N/A
	4	+174	-0.7	N/A	N/A	N/A	N/A
	5	+174	-0.7	N/A	N/A	N/A	N/A
	6	+174	-0.7	N/A	N/A	N/A	N/A
	7	+174	-0.7	N/A	N/A	N/A	N/A
	8	+174	-0.7	N/A	N/A	N/A	N/A
	9	+174	-0.7	N/A	N/A	N/A	N/A
	10	+174	-0.7	N/A	N/A	N/A	N/A
-10	0	+54	+0.1	N/A	N/A	N/A	N/A
	1	+54	+0.1	N/A	N/A	N/A	N/A
	2	+54	+0.1	N/A	N/A	N/A	N/A
	3	+54	+0.1	N/A	N/A	N/A	N/A
	4	+54	+0.1	N/A	N/A	N/A	N/A
	5	+54	+0.1	N/A	N/A	N/A	N/A
	6	+54	+0.1	N/A	N/A	N/A	N/A
	7	+54	+0.1	N/A	N/A	N/A	N/A
	8	+54	+0.1	N/A	N/A	N/A	N/A
	9	+54	+0.1	N/A	N/A	N/A	N/A
	10	+54	+0.1	N/A	N/A	N/A	N/A
0	0	-11	+0.7	N/A	N/A	N/A	N/A
	1	-11	+0.7	N/A	N/A	N/A	N/A
	2	-11	+0.7	N/A	N/A	N/A	N/A
	3	-11	+0.7	N/A	N/A	N/A	N/A
	4	-11	+0.7	N/A	N/A	N/A	N/A
	5	-11	+0.7	N/A	N/A	N/A	N/A
	6	-11	+0.7	N/A	N/A	N/A	N/A
	7	-11	+0.7	N/A	N/A	N/A	N/A
	8	-11	+0.7	N/A	N/A	N/A	N/A
	9	-11	+0.7	N/A	N/A	N/A	N/A
	10	-11	+0.7	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
+10	0	-5.1	+0.2	N/A	N/A	N/A	N/A
	1	-5.1	+0.2	N/A	N/A	N/A	N/A
	2	-5.1	+0.2	N/A	N/A	N/A	N/A
	3	-5.	+0.2	N/A	N/A	N/A	N/A
	4	-5.1	+0.2	N/A	N/A	N/A	N/A
	5	-5.1	+0.2	N/A	N/A	N/A	N/A
	6	-5.	+0.2	N/A	N/A	N/A	N/A
	7	-5.1	+0.2	N/A	N/A	N/A	N/A
	8	-5.1	+0.2	N/A	N/A	N/A	N/A
	9	-5.1	+0.2	N/A	N/A	N/A	N/A
	10	-5.1	+0.2	N/A	N/A	N/A	N/A
+20	0	0.0	0.0	0.0	0.0	0.0	0.0
	1	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0
	4	0.0	0.0	0.0	0.0	0.0	0.0
	5	0.0	00	00	00	00	00
	6	0.0	0.0	0.0	0.0	0.0	0.0
	7	0.0	0.0	0.0	0.0	0.0	0.0
	8	0.0	0.0	0.0	0.0	0.0	0.0
	9	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	0.0	0.0	0.0	0.0
+30	0	-11	-0.1	N/A	N/A	N/A	N/A
	1	-11	-0.1	N/A	N/A	N/A	N/A
	2	-11	-0.1	N/A	N/A	N/A	N/A
	3	-11	-0.1	N/A	N/A	N/A	N/A
	4	-11	-0.1	N/A	N/A	N/A	N/A
	5	-11	-0.1	N/A	N/A	N/A	N/A
	6	-11	-0.1	N/A	N/A	N/A	N/A
	7	-11	-0.1	N/A	N/A	N/A	N/A
	8	-11	-0.1	N/A	N/A	N/A	N/A
	9	-11	-0.1	N/A	N/A	N/A	N/A
	10	-11	-0.1	N/A	N/A	N/A	N/A
+40	0	-63	-0.9	N/A	N/A	N/A	N/A
	1	-63	-0.9	N/A	N/A	N/A	N/A
	2	-63	-0.9	N/A	N/A	N/A	N/A
	3	-63	-0.9	N/A	N/A	N/A	N/A
	4	-63	-0.9	N/A	N/A	N/A	N/A
	5	-63	-0.9	N/A	N/A	N/A	N/A
	6	-63	-0.9	N/A	N/A	N/A	N/A
	7	-63	-0.9	N/A	N/A	N/A	N/A
	8	-63	-0.9	N/A	N/A	N/A	N/A
	9	-63	-0.9	N/A	N/A	N/A	N/A
	10	-63	-0.9	N/A	N/A	N/A	N/A

AMBIENT TEMP. (°C)	KEYED-ON TIME (Minutes)	CENTER FREQUENCY & RF POWER OUTPUT VARIATION					
		Supply Voltage (Nominal) Volts		Supply Voltage (85% of Nominal) Volts		Supply Voltage (115% of Nominal) Volts	
		Hz	dB	Hz	dB	Hz	dB
+50	0	-149	-1.0	N/A	N/A	N/A	N/A
	1	-149	-1.0	N/A	N/A	N/A	N/A
	2	-149	-1.0	N/A	N/A	N/A	N/A
	3	-149	-1.0	N/A	N/A	N/A	N/A
	4	-149	-1.0	N/A	N/A	N/A	N/A
	5	-149	-1.0	N/A	N/A	N/A	N/A
	6	-149	-1.0	N/A	N/A	N/A	N/A
	7	-149	-1.0	N/A	N/A	N/A	N/A
	8	-149	-1.0	N/A	N/A	N/A	N/A
	9	-149	-1.0	N/A	N/A	N/A	N/A
	10	-149	-1.0	N/A	N/A	N/A	N/A

4.3. MODULATION LIMITING @ FCC 90.210

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 2, Sub. J, Para. 2.987(b) & FCC Part 90, Subpart I, Para. 90.210

The EUT shall be installed with a modulation limiter which limits the deviation of the FM carrier less than manufacturer's setting provided that the rf output spectrum must meet the required MASK (recommedned: 1.25 kHz for 6.25 kHz Channel Spacing System, 2.5 kHz for 12.5 kHz Channel Spacing , and 5 kHz for 25 kHz Channel Spacing System).

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 21 °C
- Relative humidity: 43%

POWER INPUT:

AC 120V 60 Hz.

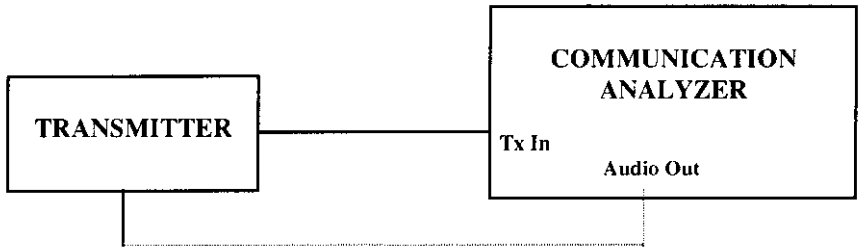
TEST EQUIPMENT:

- Communication Analyzer, Rohde & Schawrz, Model SMFO2, S/N: 879988/057, 0.4 - 1000 MHz including AF & RF Signal Generators, SINAD, DISTORTION, DEVIATION meters and etc...

METHOD OF MEASUREMENTS:

For Data Transmitter with Maximum Frequency Deviation set by Factory:- The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

TEST ARRANGEMENT



TEST RESULTS: Conforms.

TESTED PERSONNEL: Mr. Hung Trinh, EMI/RFI Technician

DATE: Sep. 15, 1998

MEASUREMENT DATA

MODULATION LIMITING FOR DATA TRANSMITTER

Modulation: FM modulation with random data and Modulation Limiter set at a Maximum Frequency Deviation (Factory Setting): 3.1 kHz

DATA BAUD RATE	PEAK DEVIATION (KHz)	MAXIMUM LIMIT (KHz)
9600	-2.6 kHz and 3.1 kHz	Not applicable

4.4. EMISSION MASKS @ FCC 90.210

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 90, Sub. I, Para. 90.210

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

FREQUENCY RANGE (MHz)	Recommeded OBW (KHz)	CHANNEL SPACING (KHz)	Recommended FREQ. DEVIATION (KHz)	FCC APPLICABLE MASK
403 – 512	10.0	12.5	2.5	90.210(d): Mask D – Data

FCC RULES	FREQUENCY RANGE	ATTENUATION LIMIT (dBc)
90.210(d): Mask D – Data	> Fc – 5.625 kHz - < FC + 5.625 kHz Fc ± 5.625 kHz - Fc ± 12.5 kHz > Fc – 12.5 kHz - < Fc + 12.5 kHz	0 7.27(fd-2.88 kHz) $50 + 10\log_{10}(P)$ or 70 dB whichever is less.

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 21 °C
- Relative humidity: 43%

POWER INPUT:

AC 120V 60 Hz.

TEST EQUIPMENT:

- Advantest Spectrum Analyzer, Model R3271, S/N: 15050203
- Bird Attenuator, 50 Ohm IN/OUT

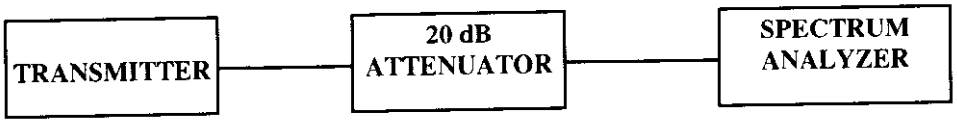
METHOD OF MEASUREMENTS:

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 ≥ 300 Hz, VBW ≥ 300 Hz and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

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 descretion of the user.

TEST ARRANGEMENT



TEST RESULTS: Conforms.

TESTED PERSONNEL: Mr. Hung Trinh, EMI/RFI Technician

DATE: Sep. 15, 1998

MEASUREMENT DATA

Please see attached plots for detailed measurements.

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

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 90, Sub. I, Para. 90.210

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

FREQUENCY RANGE (MHz)	Recommended OBW (KHz)	CHANNEL SPACING (KHz)	Recommended FREQ. DEVIATION (KHz)	FCC SPECIFICATION LIMITS (Para. No.)
403-512	10.0	12.5	2.5	90.210(d): Mask D – Audio & Voice

FCC RULES	FREQUENCY RANGE	ATTENUATION LIMIT (dBc)
90.210(d): Mask D - Voice & Data	Lowest frequency generated from the transmitter circuit to 10^{th} harmonic of the fundamental frequency	$50 + 10\log_{10}(P)$ or 70 dB whichever is less

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 21 °C
- Relative humidity: 43%

POWER INPUT:

AC 120V 60 Hz.

TEST EQUIPMENT:

- Advantest Spectrum Analyzer, Model R3271, S/N: 15050203
- Bird Attenuator, 50 Ohm IN/OUT
- Hihpass Filter, Microphase, P/N: CR220HIB, S/N: IITI11000AB, cut-off freq.: 600 MHz.
- Audio Oscillator, HP, Model 204C, SN: 0989A08798, Output: 0-1.2 MHz, 5 Vrms.

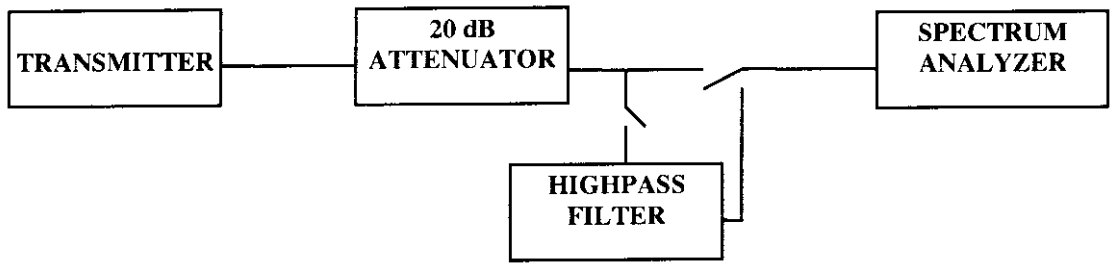
METHOD OF MEASUREMENTS:

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 = 100 kHz, VBW = 100 kHz 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.

TEST ARRANGEMENT



TEST RESULTS: Conforms.

TESTED PERSONNEL: Mr. Hung Trinh, EMI/RFI Technician

DATE: Sep. 15, 1998

MEASUREMENT DATA

SPURIOUS & HARMONIC EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL

TEST CONFIGURATION

- *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 (near low, middle and near 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.*

Fundamental Frequency:	406 MHz
RF Output Power:	5.3 Watts
Modulation:	FM modulation with internal random data @ 9600 b/s
No significant rf spurious/harmonic emissions found in the frequency range from 10 MHz to 5 GHz ; all emissions must be more than 20 dB below the specified limits. Please refer to the attached plot.	

Fundamental Frequency:	450 MHz
RF Output Power:	4.9 Watts
Modulation:	FM modulation with internal random data @ 9600 b/s
No significant rf spurious/harmonic emissions found in the frequency range from 10 MHz to 5 GHz ; all emissions must be more than 20 dB below the specified limits. Please refer to the attached plot.	

Fundamental Frequency:	470 MHz
RF Output Power:	5.4 Watts
Modulation:	FM modulation with internal random data @ 9600 b/s
No significant rf spurious/harmonic emissions found in the frequency range from 10 MHz to 5 GHz ; all emissions must be more than 20 dB below the specified limits. Please refer to the attached plot.	

4.6. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 90.210

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 90, Sub. I, Para. 90.210

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

FREQUENCY RANGE (MHz)	MAXIMUM OBW (KHz)	CHANNEL SPACING (KHz)	MAX. FREQ. DEVIATION (KHz)	FCC SPECIFICATION LIMITS (Para. No.)
403-512	10.0	12.5	2.5	90.210(d): Mask D – Audio & Voice

FCC RULES	FREQUENCY RANGE	ATTENUATION LIMIT (dBc)
90.210(d): Mask D - Voice & Data	Lowest frequency generated from the transmitter circuit to 10th harmonic of the fundamental frequency	$50 + 10\log_{10}(P)$ or 70 dB whichever is less

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 21 °C
- Relative humidity: 43%

POWER INPUT:

AC 120V 60 Hz.

TEST EQUIPMENT:

1. EMI Receiver System/Spectrum Analyzer, Hewlett Packard, Model 8546A, Input +25dBm max., 9KHz-5.6GHz, 50 Ohms, built-in Peak, Quasi-Peak & Average Detectors, Pre-Amplifier and Tracking Signal Generator. This System includes: (1) HP 85460A RF Filter Section, S/N: 3448A00236 and (2) HP 85462A Receiver RF Section/Display, S/N: 3520A00248.
2. Spectrum Analyzer, Advantest, Model R3271, S/N: 15050203, 100 Hz to 32 GHz)
3. Microwave Amplifier, HP, Model 83017A, Frequency Range 1 to 22GHz, 30dB gain nominal, low noise floor type.
4. Active Loop Antenna, Emco, Model 6502, SN 9104-2611, Frequency Range 1 KHz - 30 MHz, @ 50 Ohms.
5. BiconiLog Antenna, Emco, Model 3142, SN 10005, 30-2000 MHz @ 50 Ohms.
6. Log Periodic Antenna, AH System, Model SAS-200/518, SN: 343, Frequency Range: 1GHz-18GHz.
7. FCC Listed Open Field Test Site.

8. METHOD OF MEASUREMENTS:

Refer to **ANSI 63.4**, Para. 8 for detailed radiated emissions measurement procedures.

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, VBW = 100 kHz and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.997 - Frequency spectrum to be investigated

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

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

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

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

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

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

TEST RESULTS: Conforms.

TESTED PERSONNEL: Mr. Hung Trinh, EMI/RFI Technician

DATE: Sep. 15, 1998

MEASUREMENT DATA

TRANSMITTER RADIATED EMISSIONS MEASUREMENTS @ 3 METERS

TEST CONFIGURATION

- *The channel frequencies (Low, Middle and High) was established at its full rated output power. The emissions was investigated up to the tenth harmonic of the fundamental emissions in each case. the measured level of the carrier was recorded and compared to the level of the emissions as required in Part 90.210. The absolute level of each emission shall not be greater than –20 dBm.*
- *For measuring radiated emissions at frequencies below 1 GHz, the Spectrum Analyzer was set as 100 kHz RBW, 100 KHz VBW, SWEEP TIME: AUTO, PEAK DETECTOR.*
- *For measuring radiated emissions at frequencies above 1 GHz, the Spectrum Analyzer was set as 1 MHz RBW, 1 MHz VBW, SWEEP TIME: AUTO, PEAK DETECTOR.*
- *All rf emissions from the lowest frequency generated by the transmitter (...) upto the 10th harmonic of fundamental were scanned, and only emissions less than 20 dB below the limits (-20 dBm) were recorded.*

Fundamental Frequency: 406 MHz
RF Output Power: 5.3 Watts
Modulation: FM modulation with internal random data @ 9600 b/s

FREQUENCY (MHz)	RF LEVEL @3m (dBuV/m)	RF LEVEL (dBm)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
812.00	29.8	-67.7	PEAK	V	-20.0	-47.7	PASS
812.00	29.1	-68.4	PEAK	H	-20.0	-48.4	PASS
1218.00	39.9	-57.6	PEAK	V	-20.0	-37.6	PASS
1218.00	37.1	-60.4	PEAK	H	-20.0	-40.4	PASS
1624.00	36.8	-60.7	PEAK	V	-20.0	-40.7	PASS
1624.00	36.7	-60.8	PEAK	H	-20.0	-40.8	PASS
2030.00	42.9	-54.6	PEAK	V	-20.0	-34.6	PASS
2030.00	41.5	-56.0	PEAK	H	-20.0	-36.0	PASS
2436.00	42.8	-54.7	PEAK	V	-20.0	-34.7	PASS
2436.00	39.3	-58.2	PEAK	H	-20.0	-38.2	PASS
2842.00	45.9	-51.6	PEAK	V	-20.0	-31.6	PASS
2842.00	43.1	-54.4	PEAK	H	-20.0	-34.4	PASS
3248.00	52.2	-45.3	PEAK	V	-20.0	-25.3	PASS
3248.00	47.5	-50.0	PEAK	H	-20.0	-30.0	PASS
3654.00	43.8	-53.7	PEAK	V	-20.0	-33.7	PASS
3654.00	43.7	-53.8	PEAK	H	-20.0	-33.8	PASS
4060.00	48.0	-49.5	PEAK	V	-20.0	-29.5	PASS
4060.00	49.5	-48.0	PEAK	H	-20.0	-28.0	PASS

No other significant rf spurious/harmonic emissions found in the frequency range from 10 MHz to 5 GHz . All emissions levels less than 50 dB below the specified limits were recorded.

4.7. TRANSIENT FREQUENCY BEHAVIOR

PRODUCT NAME: **UHF RADIO TRANSCEIVER MASTER STATION, Model No.: MDS 4790**

FCC REQUIREMENTS:

FCC Part 90, Sub. I, Para. 90.214

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Transient Frequency Behavior for equipment Designed to Operate on 12.5 KHz Channels

		All Equipment
Time Interval [1,2]	**Maximum Frequency Difference [3]**	**421 to 512 MHz**
t1[4]	± 12.5.0 KHz	10.0 ms
t2	± 6.5 KHz	25.0 ms
t3[4]	± 12.5 KHz	10.0 ms

(1) ton: the instant when a 1 KHz test signal is completely suppressed, including any capture time due to phasing.
t1: tme period immediately after ton
t2: time period after t1
t3: time period from the instant when the transmitter is turned off until toff
toff: the instant when the 1 KHz test signal starts to rise.

(2) During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in @ 90.213

(3) Difference between the actual transmitter frequency and assigned transmitter frequency.

(4) If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 21 °C
- Relative humidity: 43%

POWER INPUT:

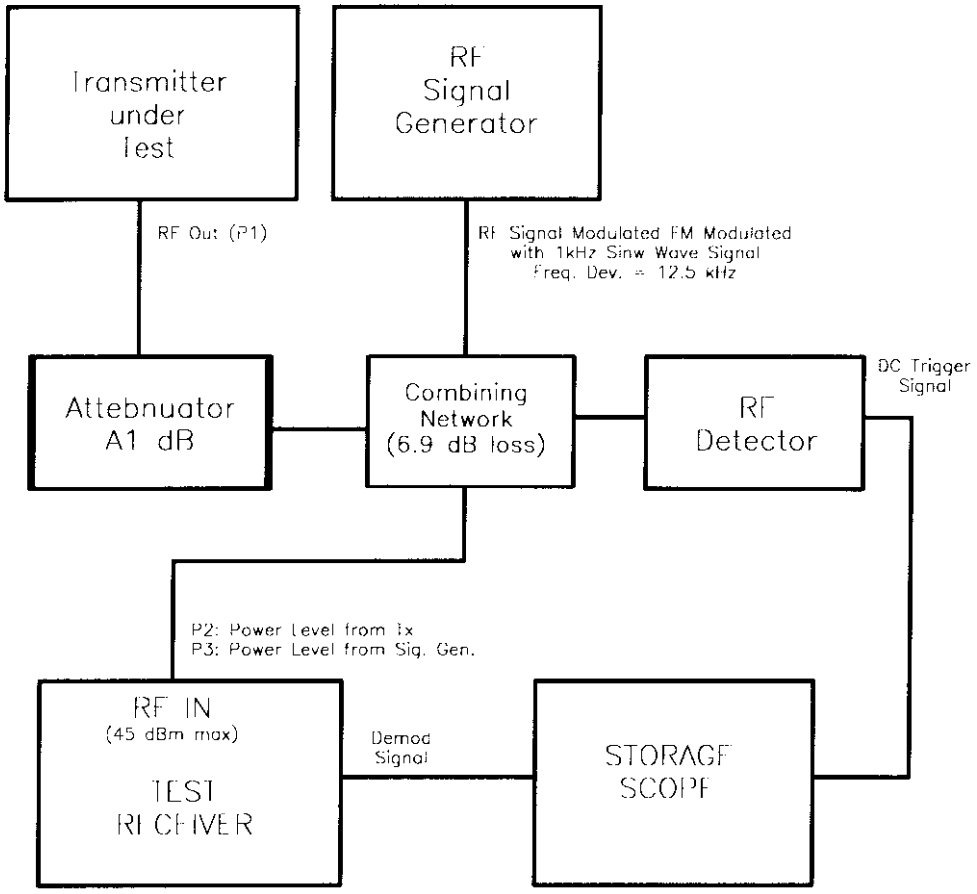
AC 120V 60 Hz.

TEST EQUIPMENT:

1) **RF Synthesized RF Signal Generator**, Fluke, Model 6061A, frequency range 10KHz-1050MHz, power output 13dBm max.
2) **Communication Analyzer (Test Receiver)**, Rohde & Schwarz, SMFP2, SN 879988/047, 0.4-1000 MHz, including SINAD, S/N, Modulation meters, AF & RF signal generators and etc....
3) **Network Combiner**, Minicircuit, P/N: 15542 (7dB loss)
4) **Digital Storage Oscilloscope**, by Phillips, model 3320A, SN DQ 646.
5) **67297 RF Detector**, by Herotex, P/N: DZ122-553, S/N: 63400

METHOD OF MEASUREMENTS:

Refer to ANSI/TIA/EIA - 603 - 1992, Sec. 2.2.19, Page 83



1. Connect the transmitter under tests as shown in the above block diagram
2. Set the signal generator to the assigned frequency and modulate with a 1 kHz tone at ±12.5 kHz deviation and its output level to be 50 dB below the transmitter rf output at the test receiver end.
3. Set the horizontal sweep rate on the storage scope to 10 milliseconds per division and adjust the display to continuously view the 1000 Hz tone from the Demodulator Output Port (DOP) of the Test Receiver. Adjust the vertical scale amplitude control of the scope to display the 1000 Hz at ±4 divisions vertical Center at the display.
4. Adjust the scope so it will trigger on an increasing magnitude from the RF trigger signal of the transmitter under test when the transmitter was turned on. Set the controls to store the display.
5. The output at the DOP, due to the change in the ratio of the power between the signal generator input power and transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it will show the 1 kHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1 kHz test signal is completely suppressed (including any capture time due to phasing) is considered to be t_{on}. The trace should be maintained within the allowed divisions during the period t_1 and t_2.
6. During the time from the end of t_2 to the beginning of t_3 the frequency difference should not exceed the limits set by the FCC in Part 90.214 and the outlined in the Carrier Frequency Stability sections. The allowed limit is equal to the transmitter frequency times its FCC frequency tolerance times ±4 display divisions divided by 25 kHz (eg. at transmitter assigned frequency of 406 MHz, limit = 406 x 0.0015 x 4 / 12.5 = 0.02 div.
7. Repeat the above steps when the transmitter was turned off for measuring t_3.

TEST RESULTS: Conforms.

TESTED PERSONNEL: Tri M. Luu, P.Eng.

DATE: Sep. 18, 1998

MEASUREMENT DATA

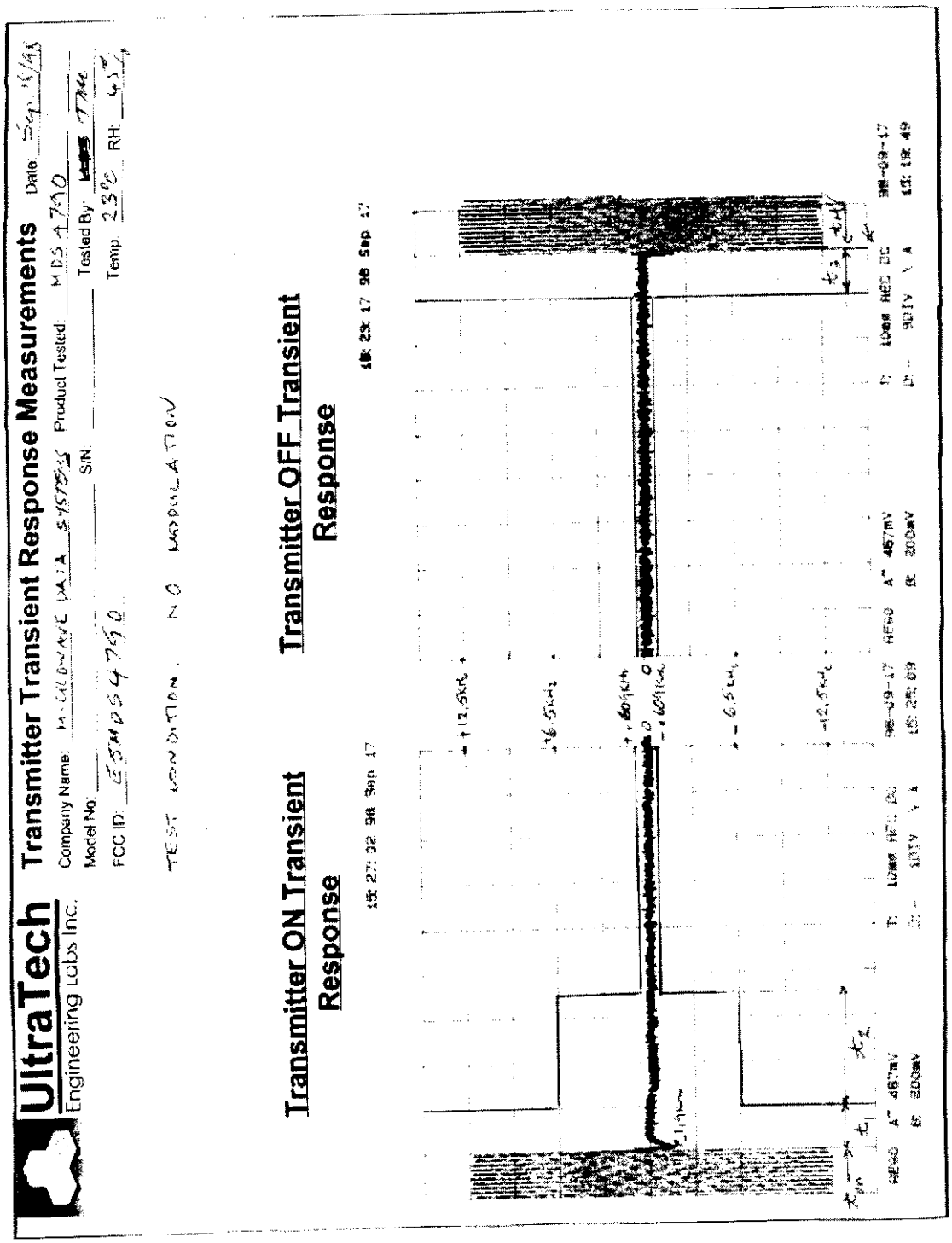
Attenuator A1 = 32 dB
Measured Transmitter RF Output P1: 37 dBm
Measured Transmitter RF Output P2 @ Standard Test Receiver (Max. RF IN: 45 dBm): 5 dBm
Measured Signal generator Output P3 @ Standard Test Receiver (Max. RF IN: 45 dBm): -15 dBm

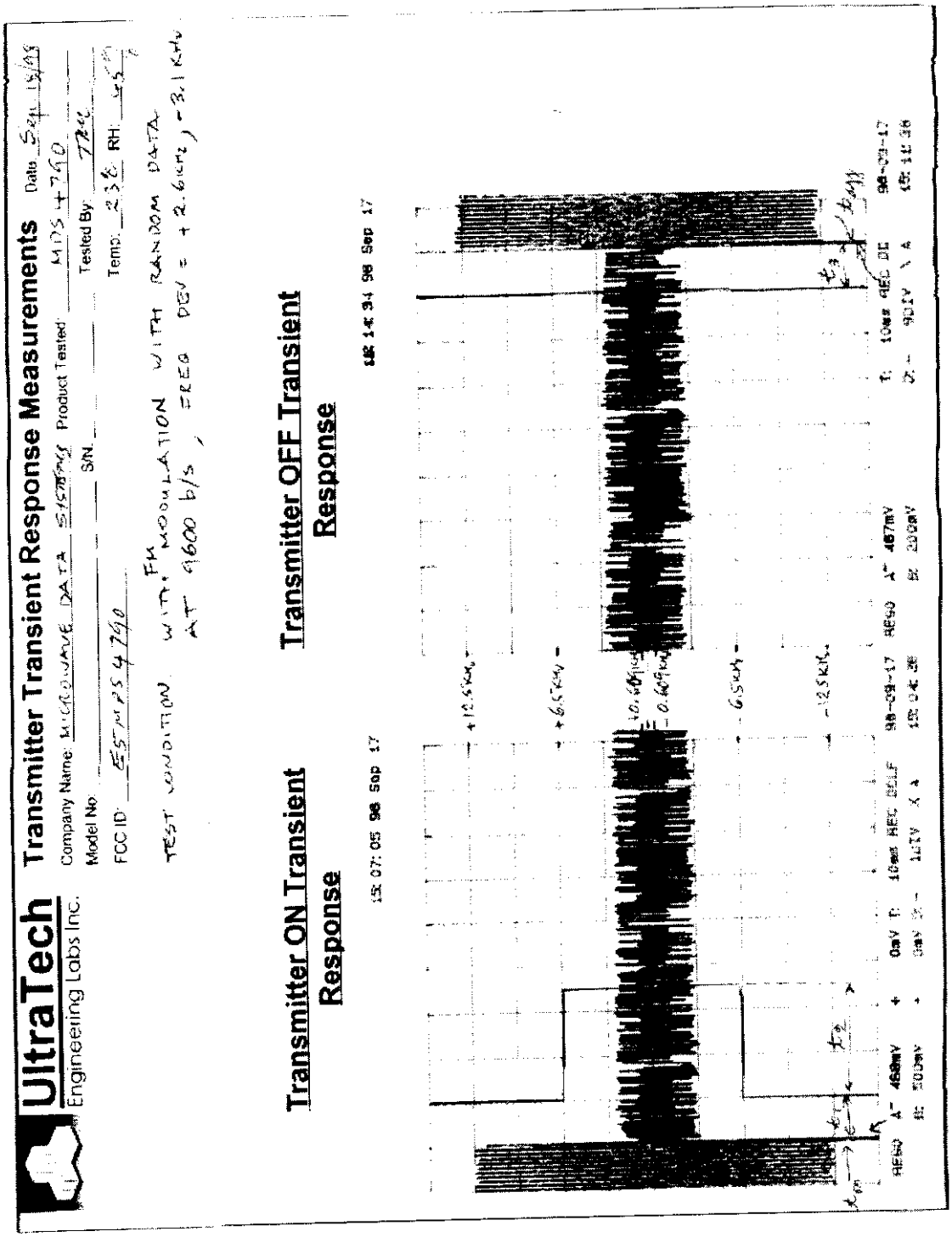
Modulation: Unmodulated

Time Interval	Transient Frequency	Transient Frequency Limit
t1 (10 mS) SWITCH ON CONDITION	-1.9 kHz	No limit for RF Output PWR < 6 Watts
t2 (25 mS) SWITCH ON CONDITION	0 kHz	6.25 kHz
After t2 (10 mS) SWITCH ON CONDITION	0 kHz	FCC Limit = ± 609 Hz (0.00015% @406 MHz)
Before t3 (10 mS) SWITCH OFF CONDITION	0 kHz	FCC Limit = ± 1.007kHz (0.00015% @406 MHz)
t3 (10 mS) SWITCH OFF CONDITION	< -12.5 kHz	No limit for RF Output PWR < 6 Watts

Modulation: FM modulation with 9600 b/s random data, Freq. Dev.: +2.6 kHz & -3.1 kHz

Time Interval	Transient Frequency	Transient Frequency Limit
t1 (10 mS) SWITCH ON CONDITION	< -12.5 kHz	No limit for RF Output PWR < 6 Watts
t2 (25 mS) SWITCH ON CONDITION	0 kHz	6.25 kHz
After t2 (10 mS) SWITCH ON CONDITION	0 kHz	FCC Limit = ±609 Hz (0.00015% @406 MHz)
Before t3 (10 mS) SWITCH OFF CONDITION	0 kHz	FCC Limit = ±609 Hz (0.00015% @406 MHz)
t3 (10 mS) SWITCH OFF CONDITION	< -12.5 kHz	No limit for RF Output PWR < 6 Watts


UltraTech
Engineering Labs Inc.
Transmitter Transient Response Measurements
Company Name:
Model No:
FCC ID:
Product Tested:
S/N:
Tested By:
Temp:
RH:
Transmitter ON Transient Response
Transmitter OFF Transient Response



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- **Accredited by ITI (UK) Competent Body, NVLAP (USA) Accreditation Body & ACA/AUSTEL (Australia)**
- **Recognized/Listed by FCC (USA), Industry Canada (Canada)**
- ***All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)***

5. EXHIBIT 5 - GENERAL TEST PROCEDURES

5.1. AC POWERLINE CONDUCTED EMISSIONS MEASUREMENTS - GENERAL TEST METHOD

- AC Powerline Conducted Emissions were performed in the shielded room, 16'(L) by 12'(W) by 12'(H).
- Conducted power-line measurements were made over the frequency range from 450 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 power-line 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 outlets. 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 (10 KHz RBW, 10 KHz VBW), frequency span 450KHz-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 perfomed.

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 10 KHz RBW and 10 KHz VBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz VBW) and the final highest RF signal level and frequency was record.

- ***Broad-band ac powerline conducted emissions***:- If the EUT exhibits ac powerline conducted emissions that exceed the limit with the instrument set to the quasi-peak mode, then measurements should be made in the average mode. If the amplitude measured in the quasi-peak mode is at least 6 dB higher than the amplitude measured in the average mode, the level measured in quasi peak mode may be reduced by 13 dB before comparing it to the limit.

5.2. ELECTRICAL FIELD RADIATED EMISSIONS MEASUREMENTS - GENERAL TEST METHOD

- The radiated emission measurements were performed at the Ultratech's 3 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.

- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO biconilogl antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated A.H. Systems log periodic antenna in the frequency range above 1000 MHz (1GHz - 18 GHz).
3. Calibrated EMI receiver or 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 (100 KHz RBW and 100 KHz VBW).

   – If any rf emission was observed to be a broadBand noise, the spectrum analyzer's CISPR QUASI-PEAK detector (120 KHz RBW and 1MHz VBW) 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 (each variable within bounds specified elsewhere) 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:

$$\mathbf{FS = RA + AF + CF - AG}$$

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.

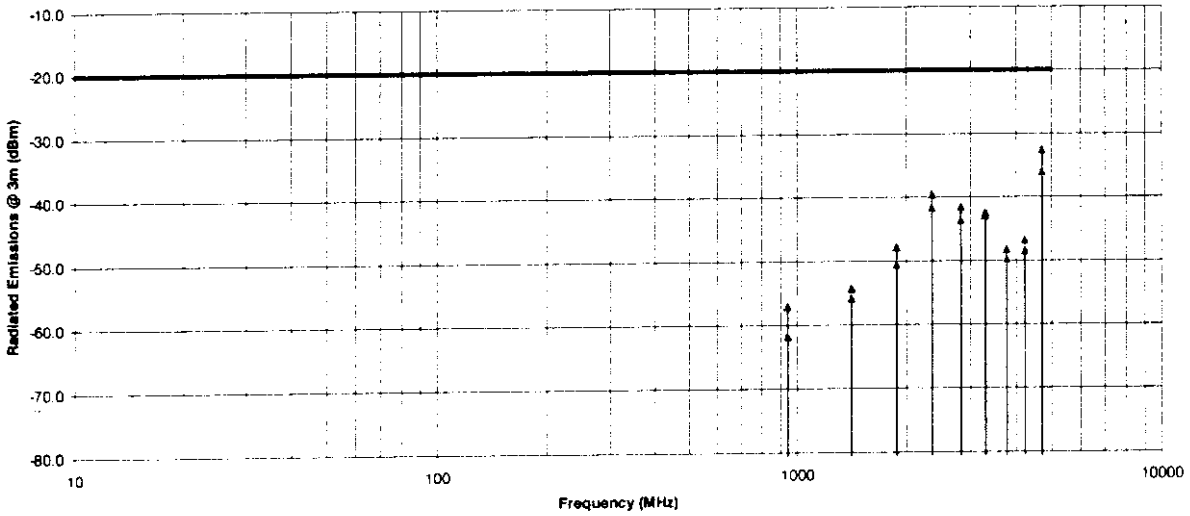
Notes: The frequency and amplitude of at least six highest conducted emissions relative to the limit are recorded unless such emissions are more than 20 dB below the limit. If less than six emissions are within 20dB of the limit, the background or receiver noise level shall be reported at representative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

Fundamental Frequency: 470 MHz
RF Output Power: 5.4 Watts
Modulation: FM modulation with internal random data @ 9600 b/s

FREQUENCY (MHz)	RF LEVEL @3m (dBuV/m)	RF LEVEL (dBm)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
940.00	35.8	-61.7	PEAK	V	-20.0	-41.7	PASS
940.00	40.5	-57.0	PEAK	H	-20.0	-37.0	PASS
1410.00	43.3	-54.2	PEAK	V	-20.0	-34.2	PASS
1410.00	41.7	-55.8	PEAK	H	-20.0	-35.8	PASS
1880.00	49.7	-47.8	PEAK	V	-20.0	-27.8	PASS
1880.00	47.0	-50.5	PEAK	H	-20.0	-30.5	PASS
2350.00	58.0	-39.5	PEAK	V	-20.0	-19.5	PASS
2350.00	55.9	-41.6	PEAK	H	-20.0	-21.6	PASS
2820.00	56.0	-41.5	PEAK	V	-20.0	-21.5	PASS
2820.00	53.9	-43.6	PEAK	H	-20.0	-23.6	PASS
3290.00	55.1	-42.4	PEAK	V	-20.0	-22.4	PASS
3290.00	54.6	-42.9	PEAK	H	-20.0	-22.9	PASS
3760.00	47.8	-49.7	PEAK	V	-20.0	-29.7	PASS
3760.00	49.3	-48.2	PEAK	H	-20.0	-28.2	PASS
4230.00	50.8	-46.7	PEAK	V	-20.0	-26.7	PASS
4230.00	49.1	-48.4	PEAK	H	-20.0	-28.4	PASS
4700.00	65.0	-32.5	PEAK	V	-20.0	-12.5	PASS
4700.00	61.5	-36.0	PEAK	H	-20.0	-16.0	PASS

No other significant rf spurious/harmonic emissions found in the frequency range from 10 MHz to 5 GHz . All emissions levels less than 50 dB below the specified limits were recorded.

Tranmitter Emissions Measurements at 3 Meter OFTS
MICROWAVE DATA SYSTEMS - MDS 4790 UHF TRANSMITTER
Center Freqyenc: 470 MHz, RF Ouptut Power = 5.4 Watts
Modulaion: FM with internal random data source @ 9600 b/s

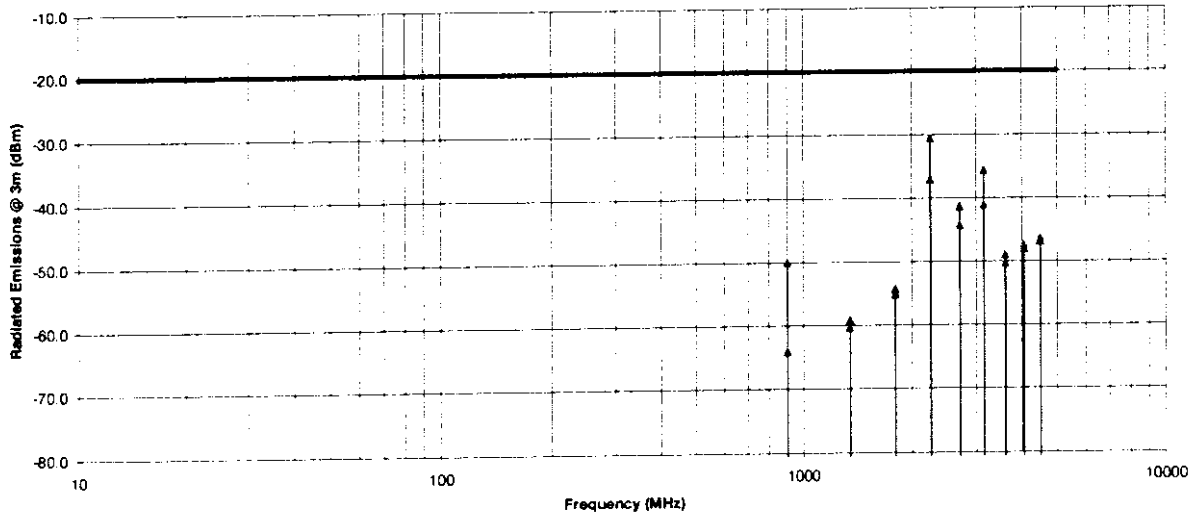


Fundamental Frequency: 450 MHz
RF Output Power: 4.9 Watts
Modulation: FM modulation with internal random data @ 9600 b/s

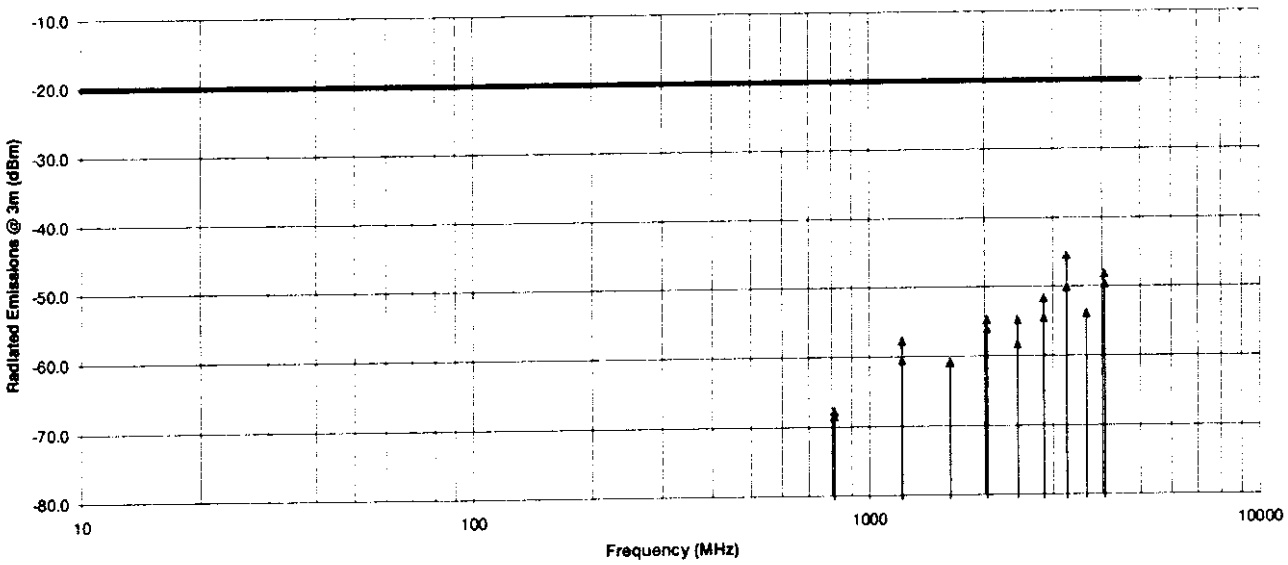
FREQUENCY (MHz)	RF LEVEL @3m (dBuV/m)	RF LEVEL (dBm)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
900.00	33.6	-63.9	PEAK	V	-20.0	-43.9	PASS
900.00	47.6	-49.9	PEAK	H	-20.0	-29.9	PASS
1350.00	38.4	-59.1	PEAK	V	-20.0	-39.1	PASS
1350.00	37.3	-60.2	PEAK	H	-20.0	-40.2	PASS
1800.00	42.5	-55.0	PEAK	V	-20.0	-35.0	PASS
1800.00	43.3	-54.2	PEAK	H	-20.0	-34.2	PASS
2250.00	60.5	-37.0	PEAK	V	-20.0	-17.0	PASS
2250.00	67.0	-30.5	PEAK	H	-20.0	-10.5	PASS
2700.00	56.2	-41.3	PEAK	V	-20.0	-21.3	PASS
2700.00	53.2	-44.3	PEAK	H	-20.0	-24.3	PASS
3150.00	56.5	-41.0	PEAK	V	-20.0	-21.0	PASS
3150.00	61.9	-35.6	PEAK	H	-20.0	-15.6	PASS
3600.00	47.3	-50.2	PEAK	V	-20.0	-30.2	PASS
3600.00	48.6	-48.9	PEAK	H	-20.0	-28.9	PASS
4050.00	50.2	-47.3	PEAK	V	-20.0	-27.3	PASS
4050.00	49.5	-48.0	PEAK	H	-20.0	-28.0	PASS
4500.00	51.2	-46.3	PEAK	V	-20.0	-26.3	PASS
4500.00	50.7	-46.8	PEAK	H	-20.0	-26.8	PASS

No other significant rf spurious/harmonic emissions found in the frequency range from 10 MHz to 5 GHz . All emissions levels less than 50 dB below the specified limits were recorded.

Tranmitter Emissions Measurements at 3 Meter OFTS
MICROWAVE DATA SYSTEMS - MDS 4790 UHF TRANSMITTER
Center Freqyenc: 450 MHz, RF Ouptut Power = 4.9 Watts
Modulaion: FM with internal random data source @ 9600 b/s



Tranmitter Emissions Measurements at 3 Meter OFTS
MICROWAVE DATA SYSTEMS - MDS 4790 UHF TRANSMITTER
Center Freqyenc: 406 MHz, RF Ouptut Power = 5.3 Watts
Modulaion: FM with internal random data source @ 9600 b/s



Date: September 15, 1998
Tested by: Hung Trinh

MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: 4720 MHz, RF Output Power: 5 dd Watts
Modulation: FM Modulation with internal random data source @ 9600b/s

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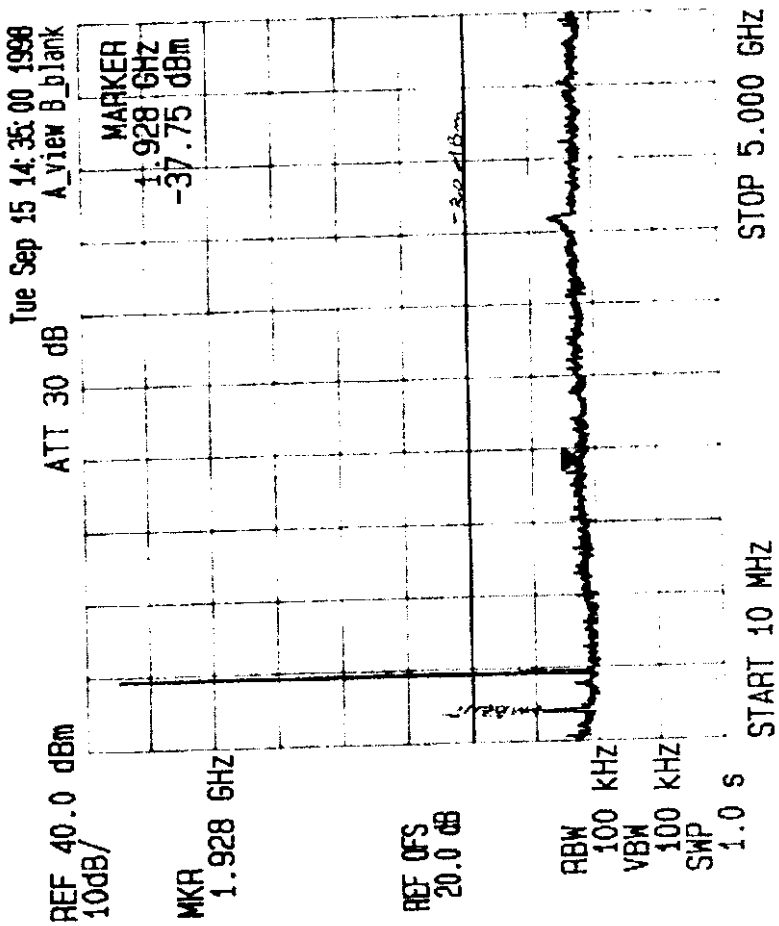
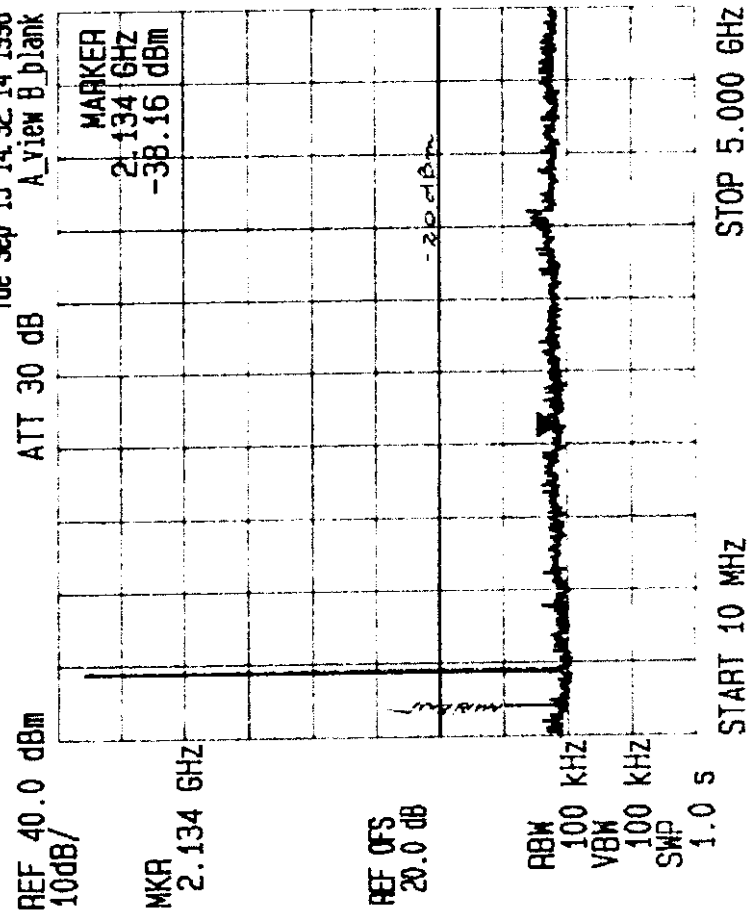


Date: September 15, 1998
Tested by: Hung Trinh

MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: 450 MHz, RF Output Power: 4.9 Watts
Modulation: FM Modulation with internal random data source @ 9600b/s



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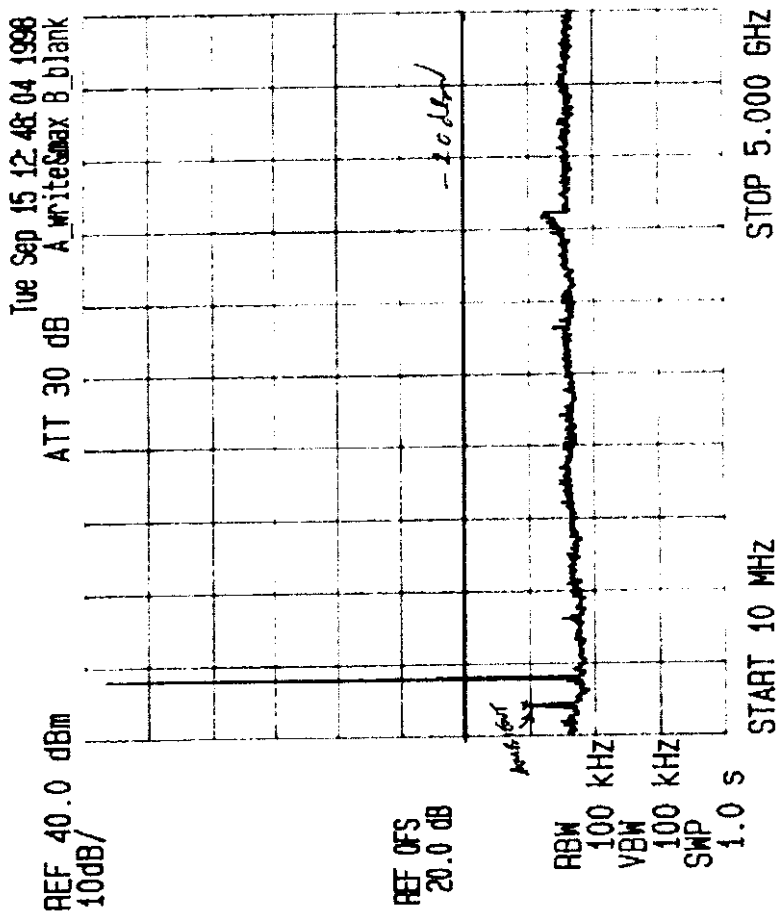
Date: September/4/1998
Tested by: Hung Trinh

MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: #06 MHz, RF Output Power: 5.303 Watts
Modulation: FM Modulation with Internal random data source @ 9600b/s



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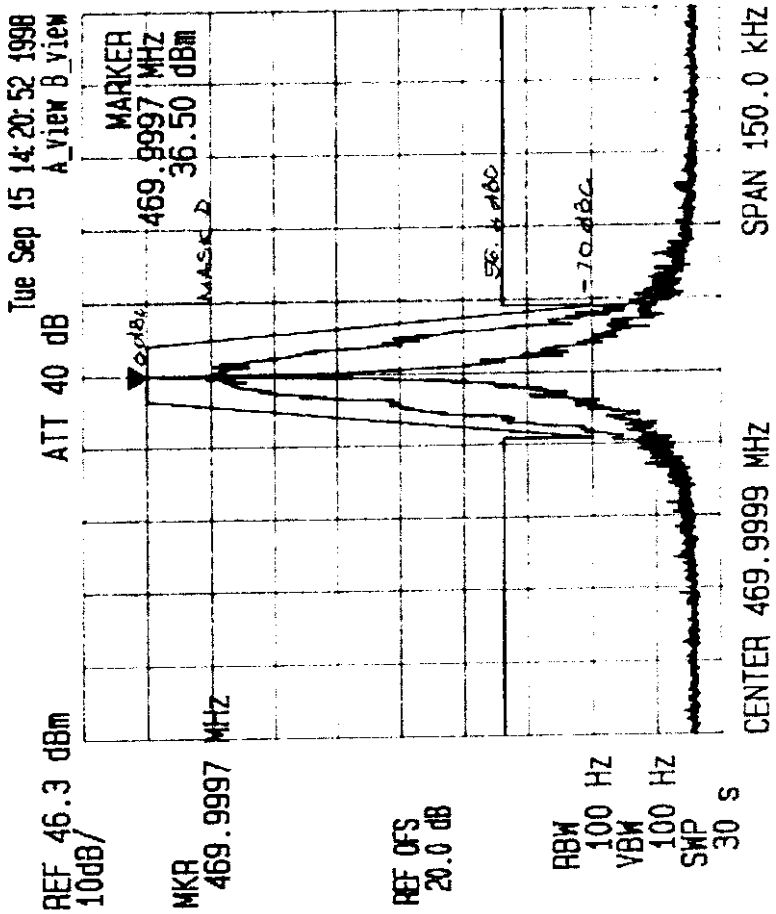
Date: September 25, 1998
Tested by: Hung Trinh

MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: 470 MHz, RF Output Power: 2.4 Watts
Modulation: FM Modulation with internal random data source @ 9600b/s



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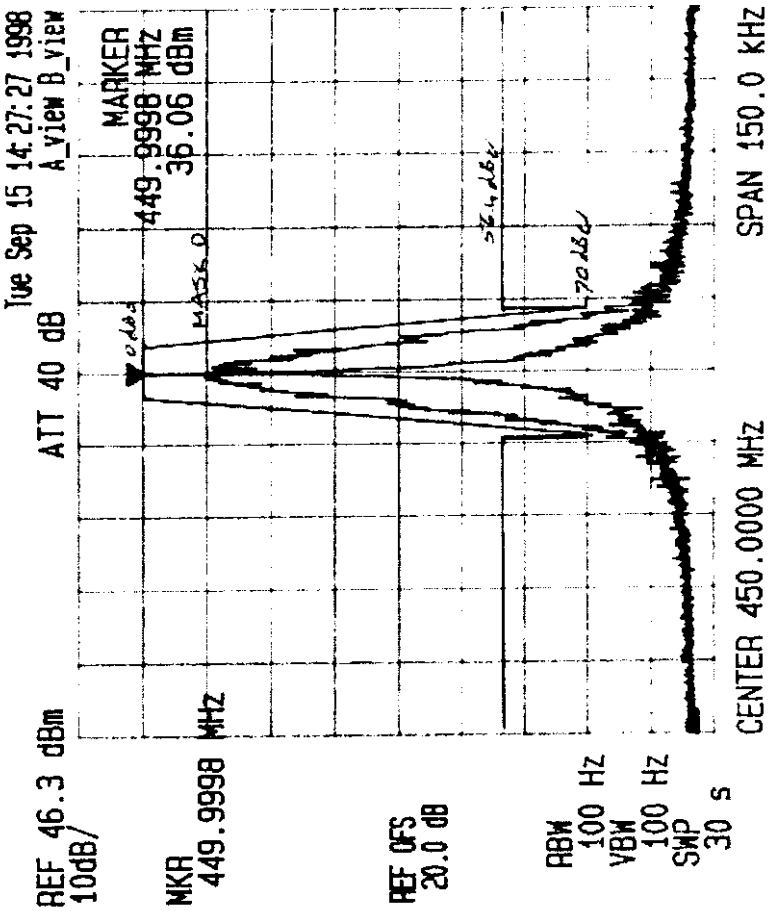
Engineering Labs Inc.

Date: September 15 1998
Tested by: Hung Trinh

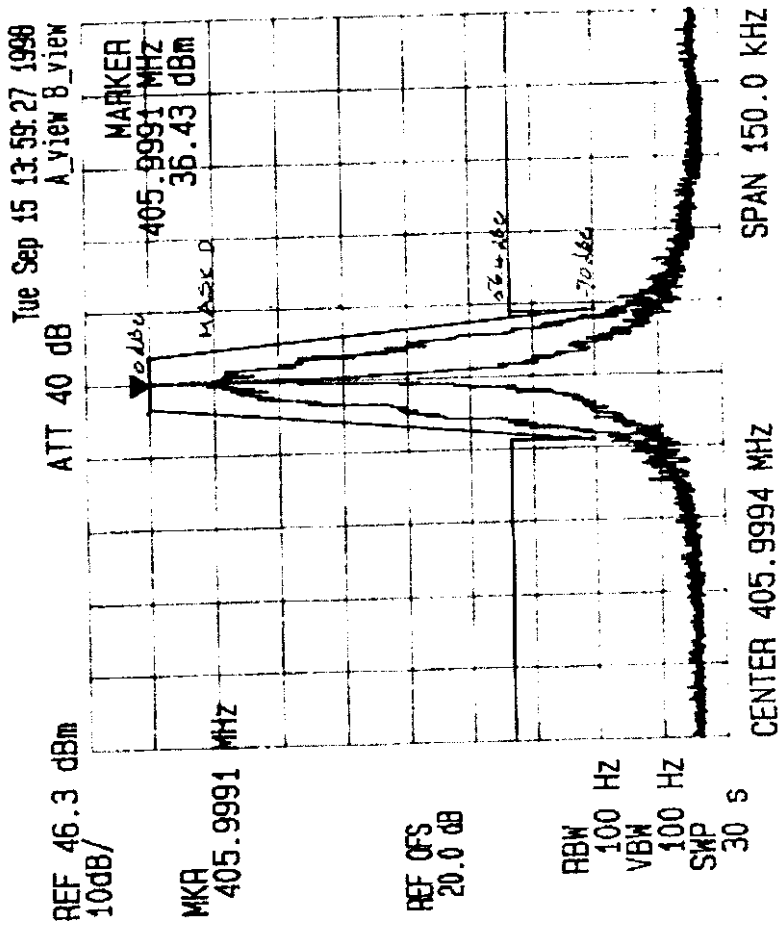
MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: 450 MHz, RF Output Power: 4.4 Watts
Modulation: FM Modulation with internal random data source @ 9600b/s



UltraTech
Engineering Labs Inc.

Date: September 15, 1998
Tested by: Hung Trinh

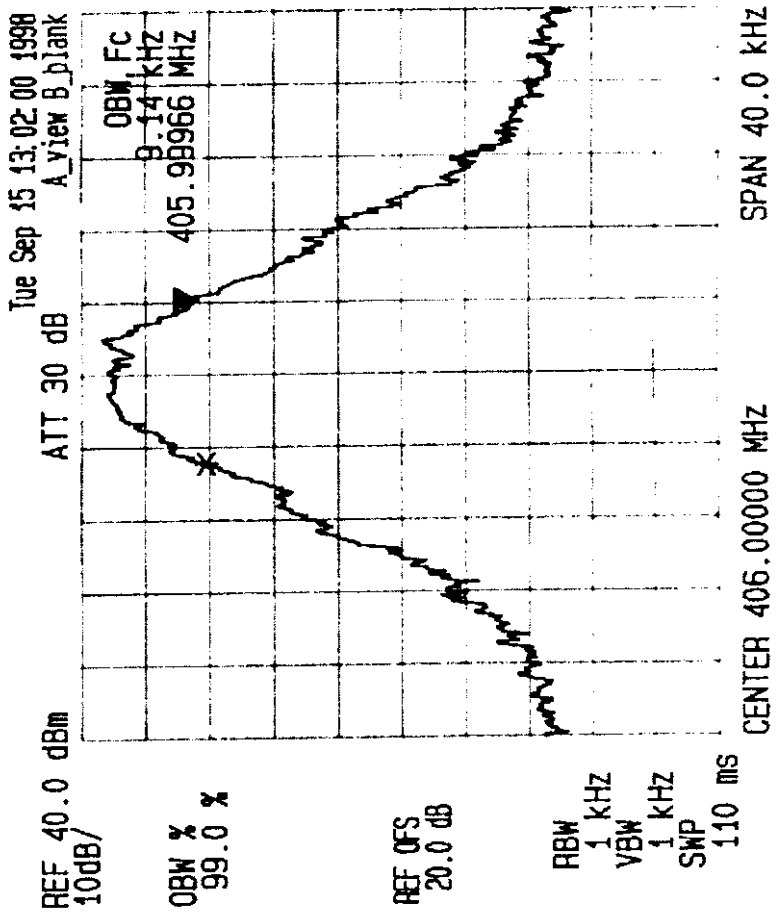
MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: 406 MHz, RF Output Power: 5.802 Watts
Modulation: FM Modulation with internal random data source @ 9600b/s



UltraTech
Engineering Labs Inc.

Date: September 15, 1998
Tested by: Hang Trinh

MICROWAVE DATA SYSTEMS
MDS 4790 TRANSCEIVER, MODEL MDS4790
Tx Frequency: 406 MHz, RF Output Power: 5.309 Watts
Modulation: FM Modulation with internal random data source @ 9600b/s



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