VERIFICATION TEST REPORT

for

400 – 512 MHz MOBILE DATA RADIO
MODEL NUMBER: DT450
FCC ID: MI7-ECSDT450TX

MEASUREMENTS PERFORMED IN ACCORDANCE WITH..

.

FCC TITLE 47, PART 90: Private Land Mobile Radio Services

PREPARED FOR:
ElectroCom Communications Systems
10400 Pioneer Blvd., Bldg. E2
Santa Fe Springs, California 90670

Contact: Mr. Louis Chagoya

PREPARED BY:
Aegis Labs, Inc.
22431 Antonio Parkway B160-417
Rancho S. Margarita, CA 92688

Contact: Mr. Louis Chagoya

Agent(s):

Mr. Steve Kuiper President Aegis Labs, Inc.	03/23/00 Date	
Mr. Dick Chiang Staff Engineer Aegis Labs, Inc.		03/23/00 Date

Test Report #: ELECT-990715F
Test Date(s): July 14, 15, 22 & Oct. 18, 1999

	REPORT BODY	APPENDICES			TOTAL
		A	***B***	***C***	
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AEGIS LABS, INC 22431 Antonio Parkway B160-417, Rancho Santa Margarita, CA 92688
949-459-7886 TEL 949-459-7869 FAX

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Measurement/Technical Report Summary

Representative	Louis Chagoya
Manufacturer	ElectroCom Communication Systems
Address	10400 Pioneer Blvd., Bldg. E-2
City, State, Zip	Santa Fe Springs, CA 90670
Phone	(562) 946-9493
Fax	(562) 946-7483
Type of Authorization	Certification for 400-512MHz Mobile Data Radio
Applicable FCC Rules	PART 90 – Private Land Mobile Radio Services Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-98 Edition). The following subparts are applicable to the results in this test report: Part 90, Subpart I – General Technical Standards Part 2, Subpart J – Equipment Authorization Procedures for Certification, and FCC98058 Document The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2 section §2.981 through §2.1005 and Part 90. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions.
Equipment Under Test	400MHz Mobile Data Radio
Production Quantity	Multiple Units
	Model: DT450
Identification of EUT	
	FCC ID: MI7-ECSDT450TX
Testing Date	14, 15, 22 July 1999 & 18 October 1999

Test Facility	Aegis Labs, Inc.
Address	32231 Trabuco Creek Road 22431-B160 Antonio Parkway
City, State, Zip Code	Trabuco Canyon, CA 92678 Rancho Santa Margarita, CA 92688
Country	USA
Phone	(949) 459-7886
Fax	(949) 459-7869

1. GENERAL INFORMATION

1.1 Product Description

Equipment Under Test	400-512MHz Mobile Data Radio
Model Number	DT450
Serial Number	Prototype
Description of EUT	The DT450 is a 400MHz mobile data radio with integral diversity reception system. The transmitter portion of the DT450 operates in the frequency range of 400 – 512MHz, transmit power 40 watts. The receiver side of the DT450 is a post-detection diversity reception system.
Clock Frequencies	10MHz, 44.545MHz

Refer to the product specification data that has been included as an attachment of this report for additional details

1.2 Tested System Details

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component. Refer to the table following Tested System Details for cabling information.

Tested System Details					
Item	Manufacturer	Description	Model No.	Serial No.	FCC ID
1	ElectroCom	Mobile Data Radio	DT450	Prototype	MI7-ECSDT450TX

The following table lists all of the cabling details for the tested system.

Cabling of the Tested System					
Item	Description	Length (m)	Type	Connected from	Connected to
A	Power Cords	1.2	8 gauge wires	EUT	Power Supply
B	DB25 Shielded Cable	1.0	RS232	EUT	Test Fixture
C	RF Coaxial Cable	0.3	RG214 (190-57793)	EUT	Directional Coupler
D	RF Coaxial Cable	1.2	RG214 (190-57793)	EUT (RX Port)	50 ohm Terminator
E	RF Coaxial Cable	0.3	RG214 (190-57793)	Directional Coupler	Spectrum Analyzer
F	RF Coaxial Cable	1.2	RG214 (190-57793)	Directional Coupler	50 ohm Terminator

1.3 Test Facility

The open area test site and measurement facility used to collect the test data is located at the Aegis Labs, Inc. chamber test facility in the city of Rancho Santa Margarita, CA and OATS facility in Trabuco Canyon, CA. This site has been fully described in a report submitted to the FCC and accepted in a letter dated 5, May 1997 (31040/SIT 1300F2). The test facility is also recognized and accredited from the following accreditation organizations.

A2LA (American Asso. for Lab Accredit)	Certificate No.: 1111-01 FCC, CISPR, AS/NZS	Dated:	02/28/2000

2. Technical Description

Type of Emission	20K0F1D
Frequency Range	400 □ 512 MHz
Range of Operating Power	40W
Maximum output Power Level	40W
Maximum Specified Output Power Rating	Location Dependant per Part 90 Subpart S
Final Stage Amplifier DC Voltage, Current	Voltage: 13.8 Vdc Current: 5.5 Amps

2.1 Function of All Active Circuit Devices

Please refer to Attachment (Exhibits).

2.2 Circuit Diagram

Please refer to Figure in Attachment (Exhibits).

2.3 Instruction Manual(s)

Please see Attachment (Exhibits).

3. PRODUCT LABELING

3.1 FCC ID Label

FCC ID: MI7-ECSDT450TX

3.2 Location of Label on EUT

The FCC ID was located at the front topside of EUT. Please refer to the photo in Section 6.1 for the location.

3.3 Information to User

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

4. SYSTEM TEST CONFIGURATION

4.1 Justification

The EUT was used in a system configured for testing in a typical installation as a customer would normally use it.

4.2 EUT Exercise Software/Equipment

The EUT requires the exercise of a software program used during testing to activate data from the PC to the modem and deliver to the test fixture by manually switching the EUT on or off.

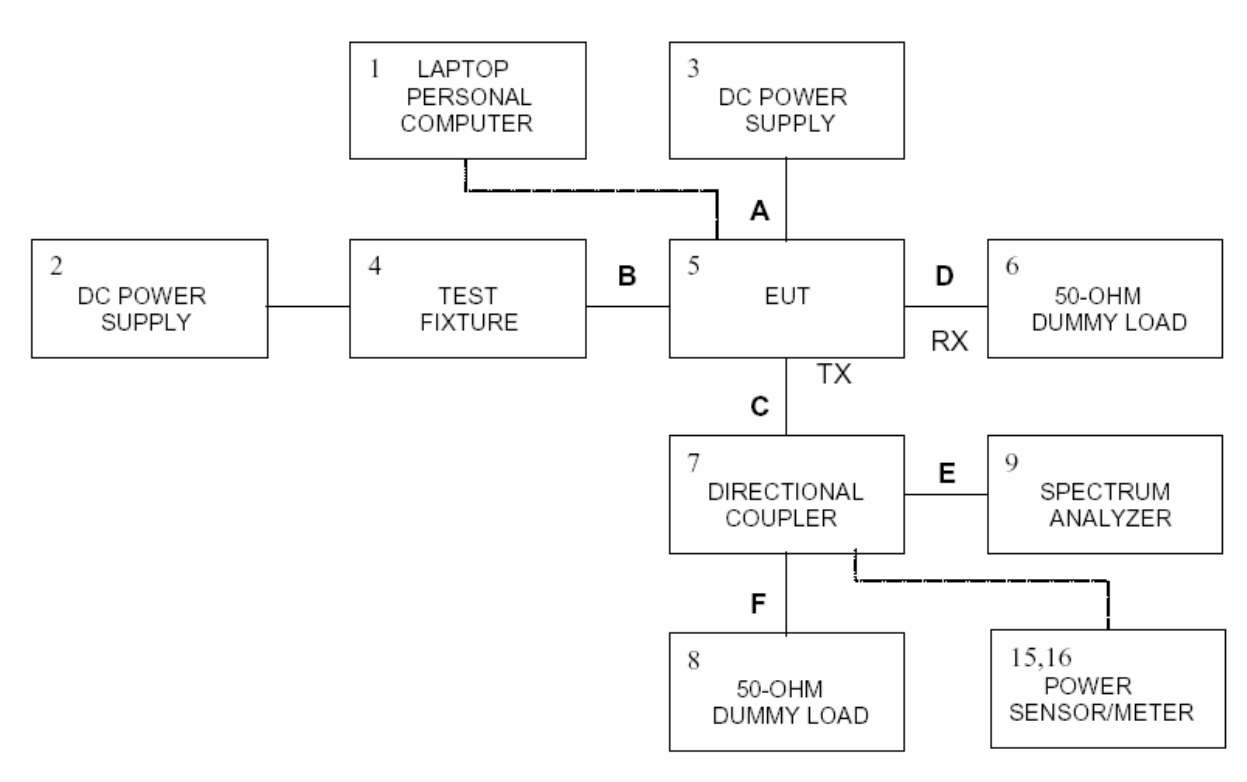
4.3 Special Accessories

The EUT requires no special accessories to comply with the FCC regulations.

4.4 Equipment Modifications

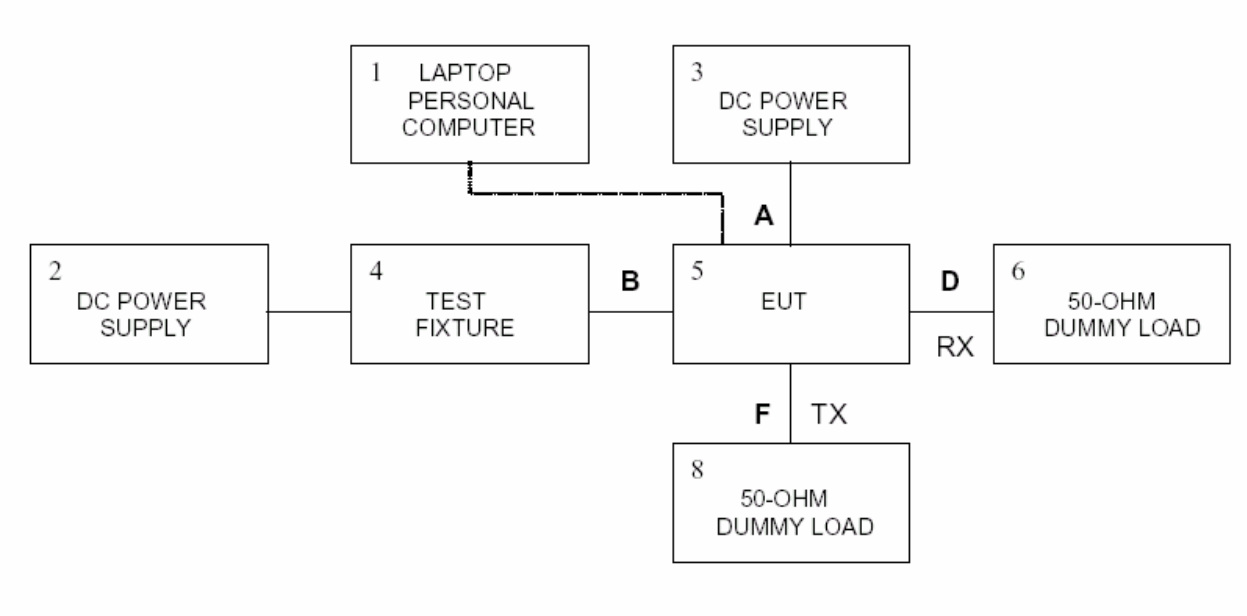
No modifications and/or adjustments were made to the EUT during compliance testing to achieve the required specification limits.

4.5 Configuration of Tested System



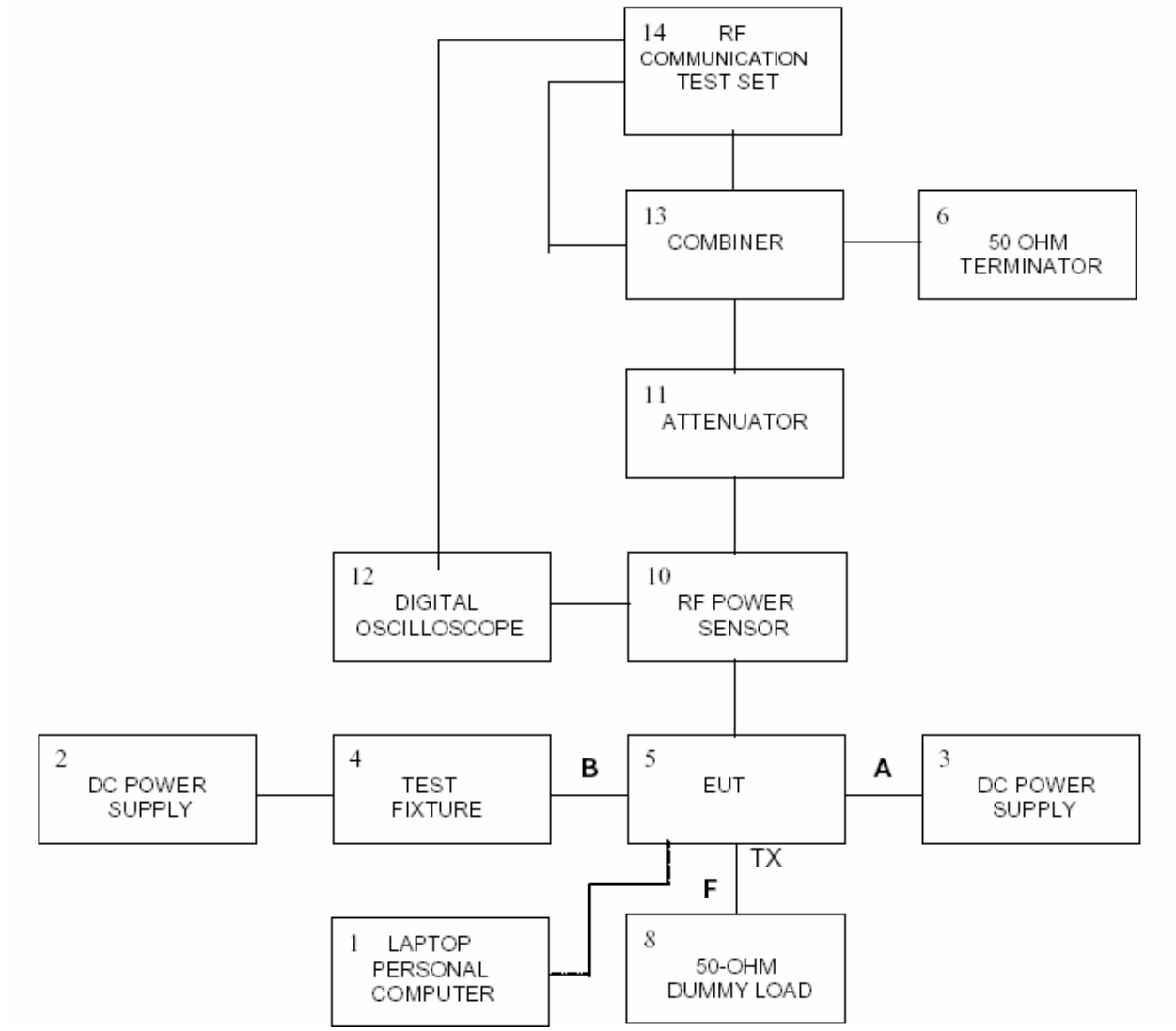
Test Setup Configuration 1

4.5 Configuration of Tested System (Continued)



Test Setup Configuration 2

4.5 Configuration of Tested System (Continued)



Test Setup Configuration 3

4.5 Configuration of Tested System (Continued)

Legend:

Item	Manufacturer	Description	Model No.	Serial No.	FCC ID
1	CTX	Laptop PC	EzBook	F2A300A-8121341	FCC Class B Logo
2	Astron	DC Power Supply	RS-12M	9404046	N/A
3	Astron	DC Power Supply	RS-70M	9702007	N/A
4	ElectroCom	Test Fixture	Prototype	N/A	N/A
5	ElectroCom	Data Radio (EUT)	DT450	Prototype	MI7-ECSDT450TX
6	Pasterneck	50 ohm Terminator	PE6034	N/A	N/A
7	Hewlett Packard	Directional Coupler	778D	1144A08005	N/A
7	Hewlett Packard	Directional Coupler	11691D	1212A00305	N/A
8	Bird Electronics	50 ohm Load	1000-WT-FN	9924	N/A
9	Hewlett Packard	Spectrum Analyzer	8566B	2532A02014	N/A
10	DB Products	RF Power Sensor	DB8881A-350	N/A	N/A
11	Pasterneck	RF Attenuator	PE7021-40	N/A	N/A
12	Tektronix	Digital Oscilloscope	TDS-410A	B010112	N/A
13	Mini-circuits	RF Combiner	ZA3PD-1	09818	N/A
14	Hewlett Packard	RF Comm. Test Set	8920B	4500020132-10	N/A
15	Rohde & Schwarz	RF Power Sensor	NRV-Z5	844855/012	N/A
16	Rohde & Schwarz	RF Power Meter	NRVS	826149/077	N/A

Item	Description	Length (m)	Type	Connected from	Connected to
A	Power Cords	1.2	8 gauge wires	EUT	Power Supply
B	DB25 Shielded Cable	1.0	RS232	EUT	Test Fixture
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F	RF Coaxial Cable	1.2	RG214	Directional Coupler	50 ohm Terminator

5.0 TEST DATA

5.1 RF Power Output

Output power was measured at the Transmitter Module RF output terminal. The test setup and method as shown in Configuration 1.

The output power was measured 40W at each frequency 400MHz, 455MHz, 512MHz tuned with nominal voltage 13.80V and the output power that was measured at the DC power supply was adjusted to ±15% of nominal voltage. The Rohde & Schwarz NRVS power meter and NRV-Z5 power sensor was used to measure RF output power.

Freq. Tuned	85% nominal voltage (11.73V)	nominal voltage (13.80V)	115% nominal voltage (15.87V)
400.0 MHz	25.2W	39.9W	55.0W
455.0 MHz	25.2W	39.9W	45.8W
512.0 MHz	24.0W	37.2W	42.8W

5.2 Modulation Characteristics

Please refer to Exhibit A, FSK modem, Product Support Manual and Product Specification Manual for details description. The modulation characteristics test results are enclosed in appendix B pages B4-B9.

5.3 Occupied Bandwidth

Occupied bandwidth is the frequency bandwidth below its lower and above its upper frequency limits, the mean power radiated by a given emission. The measurements were made with the modulating signal. The authorized occupied bandwidth for emission mask C is 20KHz. The measured occupied bandwidth that was the manufacturer intended to design for sufficient data transmission. Test setup was connected on the equipment per configuration 1. Test results were attached in appendix B pages B10-B18.

Necessary bandwidth Bn = 2M + 2D = 19.6KHz
Where M = 4.8KHz
D = 5.0KHz

5.4 Spurious Emissions at Antenna Terminals

Antenna conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information or required quality for the class of communication desired. The reduction in the level of the spurious emissions will not affect the quality of the information being transmitted. Conducted spurious emissions shall be attenuated at least; 43 + 10 log (Po) dB (where Po is 40W maximum output power) below the maximum level of the carrier frequency in accordance with the transmitter as authorized. Connect the equipment as shown in configuration 1. Adjust the spectrum analyzer to display the modulated carrier and scan the frequency spectrum from the lowest radio frequency generated in the equipment through the 10th harmonic of the carrier frequency. Test results were attached in appendix B pages B19-B33.

5.5 Radiated Spurious Emission

Emissions from the equipment when connected into a non-radiating load on a frequency of frequencies, which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communication desired. The reduction in the level of these spurious emissions will not affect the quality of the information being transmitted. Connect the equipment as shown in configuration 2. All cables were connected to generate maximum emissions from the EUT. The EUT was placed 80 centimeters above the ground plane on a non-conductive tabletop 1.0 meter wide by 1.5 meters long. The amplitude levels of the emissions were maximized by varying the configuration of the EUT and tables. The highest emissions were maximized by rotating the turntable 360 degrees and varying the antenna height 1 to 4 meters. The frequency range was measured up to 10th harmonic utilizing a log-periodic and double-ridged horn antenna. Measurements were made in vertical and horizontal polarizations. The distance between EUT and measuring antenna is 3 meters. Amplitude levels were recorded in dBμV/m. All spurious emissions were attenuated at least 59 dB below each tuned carrier field strength. Test results were attached in appendix B pages B34-B36.

* Field strength = $1/D \times (Po \times RL)^{1/2}$, where D = 3 meters, Po = 40.0W, RL= 50.2 ohm
= $1/3 \times (40 \times 50.2)^{1/2}$
= 143.5 dBμV/m

** FCC Limit = 43 + 10 log (Po), where Po = 40W
= 59dB

5.6 Frequency Stability

The EUT carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency over the variations of extreme ambient temperature. The DT450 was placed in the temperature chamber and measured the power output with the variation of DC power input in room temperature. The temperature was set to the lowest requirement −30°C and waited for a period of at least 2 hours to reach stability inside the unit. Once the chamber temperature and inside unit thermocouple temperatures reach the −30°C, the unit was turned on and output power was measured within one minute with the variations of DC input power from 85% to 115% of nominal voltage. Increasing the temperature by every 10°C step to the maximum extreme temperature of this test is +50°C. For each temperature setting, wait for both the chamber and the unit inside thermocouple to reach the desired temperature and repeat the measurement. Please refer to pages B37−B39 in appendix B for the test results.

5.7 Transient Frequency Behavior

In the frequency band 400 to 512MHz, transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

t_1 = 10 ms
t_2 = 25 ms
t_3 = 10 ms

where

t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{on} is the instant when 1 KHz test signal is completely suppressed, including any capture time due to phasing.
t_{off} is the instant when the 1 KHz test signal starts to rise.

Please refer to test configuration 3 for test setup and the appendix B40-B45 for test results.

5.8 Maximum Permissive Exposure (MPE) Measurement

The DT450 transmitter is designed for police officer used in the mobile vehicle. The transmitter was installed inside the vehicle trunk and transmitted antenna (approx. 8cm height) was mounted on the top of the police vehicle. The maximum permissive exposure (MPE) for mobile device was tested at the distance of 20cm proximity and the test result was compared to the ANSIC95.1-1991 for the controlled and uncontrolled environmental. The measurement was performed in the full-ferrite tile chamber with the antenna mounted at 1-meter height. The isotropic field sensor (AR HI-4422 probe) was placed 20cm and 1 meter away from and around the antenna. The field strength was monitored (AR HI-4416) and the highest reading was recorded. The power density was calculated by the following formula;

$S = E^2 / 3770$

Where E is the electrical field (V/m), and S is the power density (mW/cm^2)

The Power Density for Controlled Environmental is f/300 (mW/cm^2), where f is frequency of transmitting in MHz.

Frequency (MHz)	Power Output Measured @Antenna-port (Watt)	Electrical Field Measured @20cm (V/m)	Power Density Calculated @20cm (mW/cm^2)	Electrical Field Measured @1m (V/m)	Power Density Calculated @1m (mW/cm^2)	Power Density for Controlled Environmental (mW/cm^2)
400	42.0	42.8	0.50	32.5	0.28	1.33
455	41.0	49.5	0.65	38.6	0.40	1.52
512	37.0	48.4	0.62	37.5	0.37	1.71

The Power Density for Uncontrolled Environmental is f/1500 (mW/cm^2), where f is frequency of transmitting in MHz.

Frequency (MHz)	Power Output Measured @Antenna-port (Watt)	Electrical Field Measured @20cm (V/m)	Power Density Calculated @20cm (mW/cm^2)	Electrical Field Measured @1m (V/m)	Power Density Calculated @1m (mW/cm^2)	Power Density for Controlled Environmental (mW/cm^2)
400	42.0	42.8	0.50	32.5	0.28	0.27
455	41.0	49.5	0.65	38.6	0.40	0.30
512	37.0	48.4	0.62	37.5	0.37	0.34

WARNING !!!

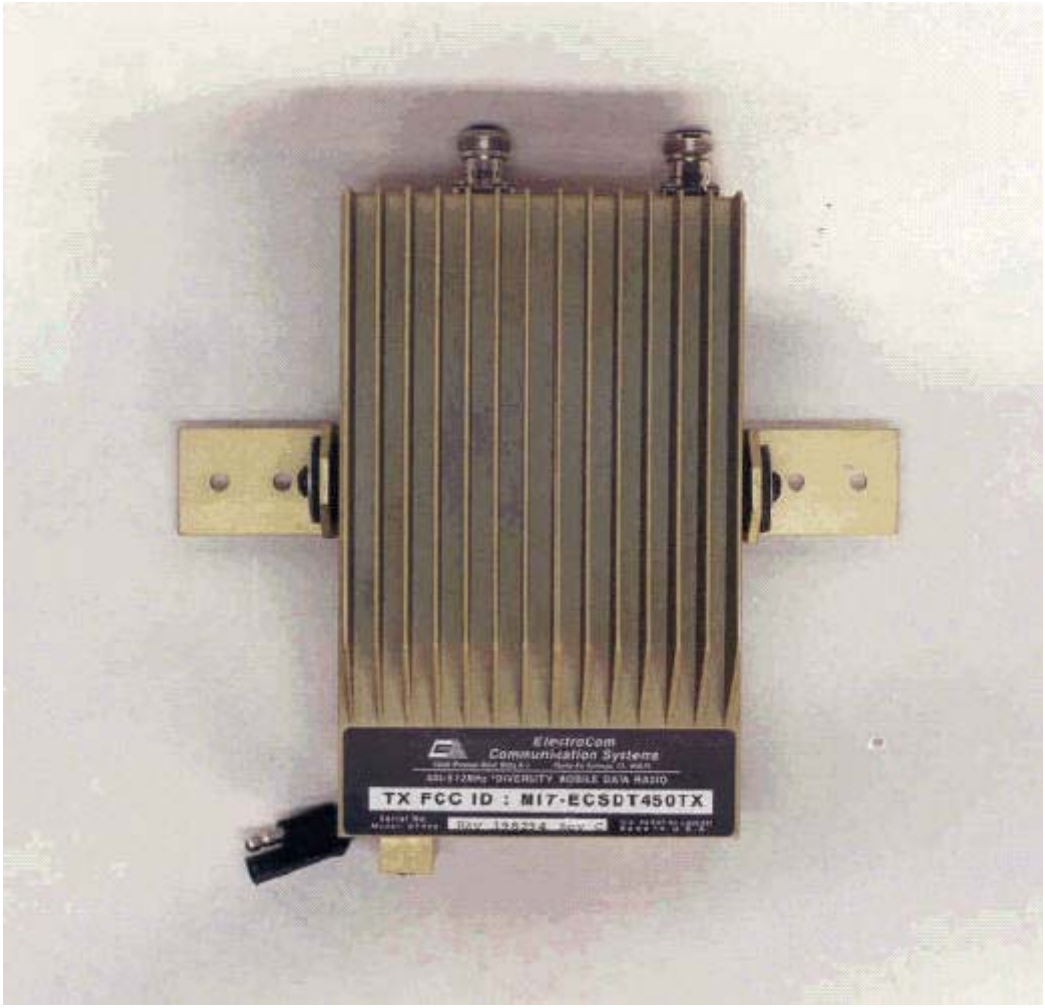
THIS DEVICE WAS EVALUATED TO COMPLY WITH FCC RECOMMENDED RADIO FREQUENCY EXPOSURE LEVEL MPE LIMITS, HOWEVER, GENERAL PUBLIC WAS RECOMMENDED TO KEEP AT LEAST ONE METER DISTANCE AWAY FROM THE PROXIMITY WHERE THE TRANSMITTING ANTENNA WAS INSTALLED.

The MPE level for human body exposed to RF hazardous exposure is specified by FCC for the definition of controlled and uncontrolled environments. The device was evaluated to comply with FCC recommended exposure MPE levels for controlled environments and the device was complied with uncontrolled environment levels at the minimum distance of 1 meter. The warning label was recommended for general public to keep at least 1 meter (or 40 inches) distance away from the location where the antenna was installed.

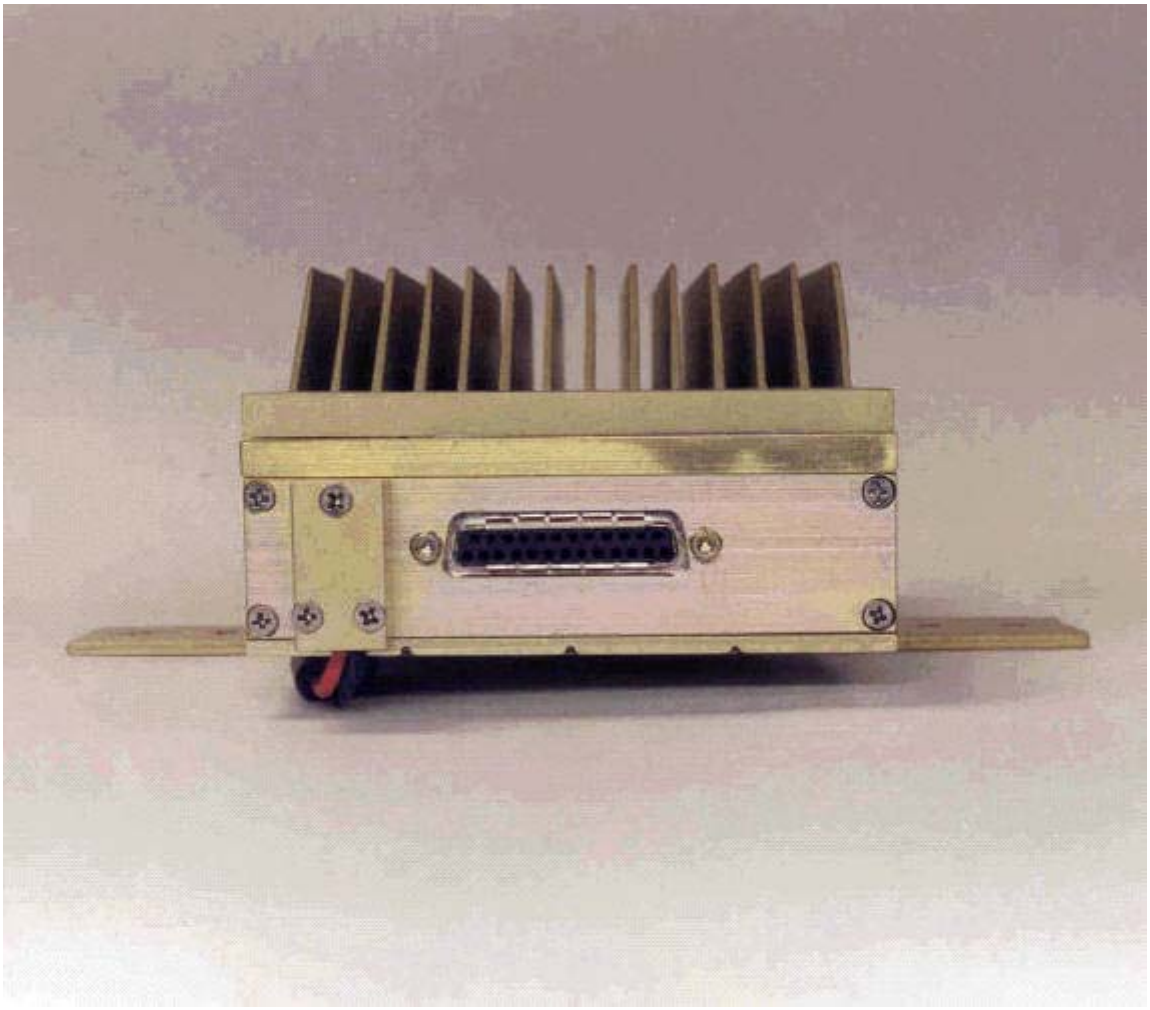
6 PHOTOGRAPHS AND/OR DRAWINGS SHOWING CONSTRUCTION TECHNIQUES

6.1 Photo: EUT 3D View

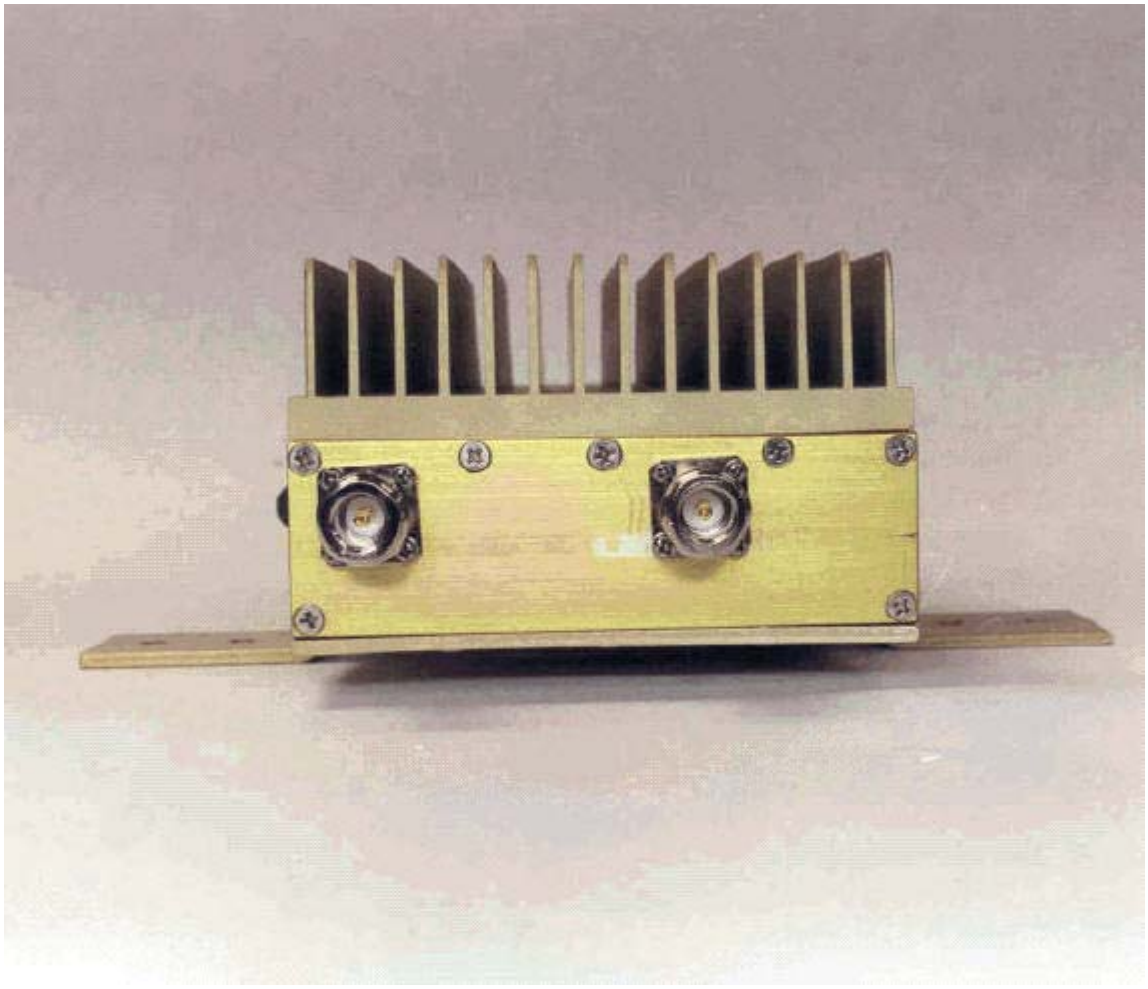
6.2 Photo: EUT Top View



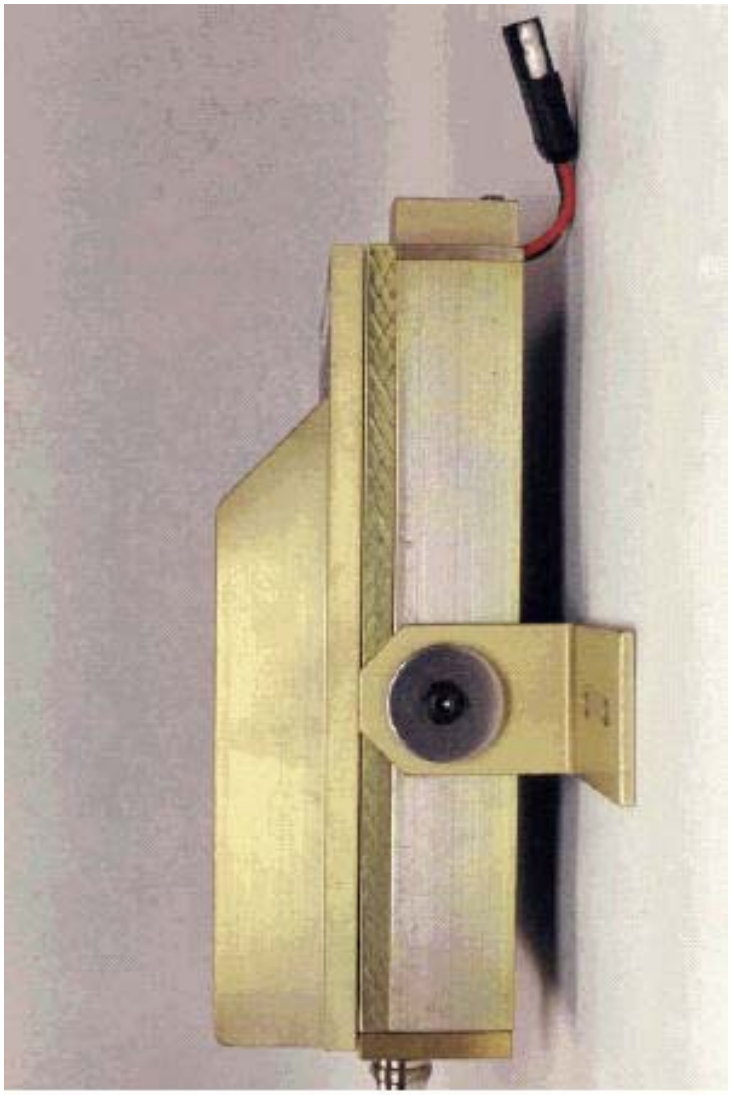
6.3 Photo: EUT Front View



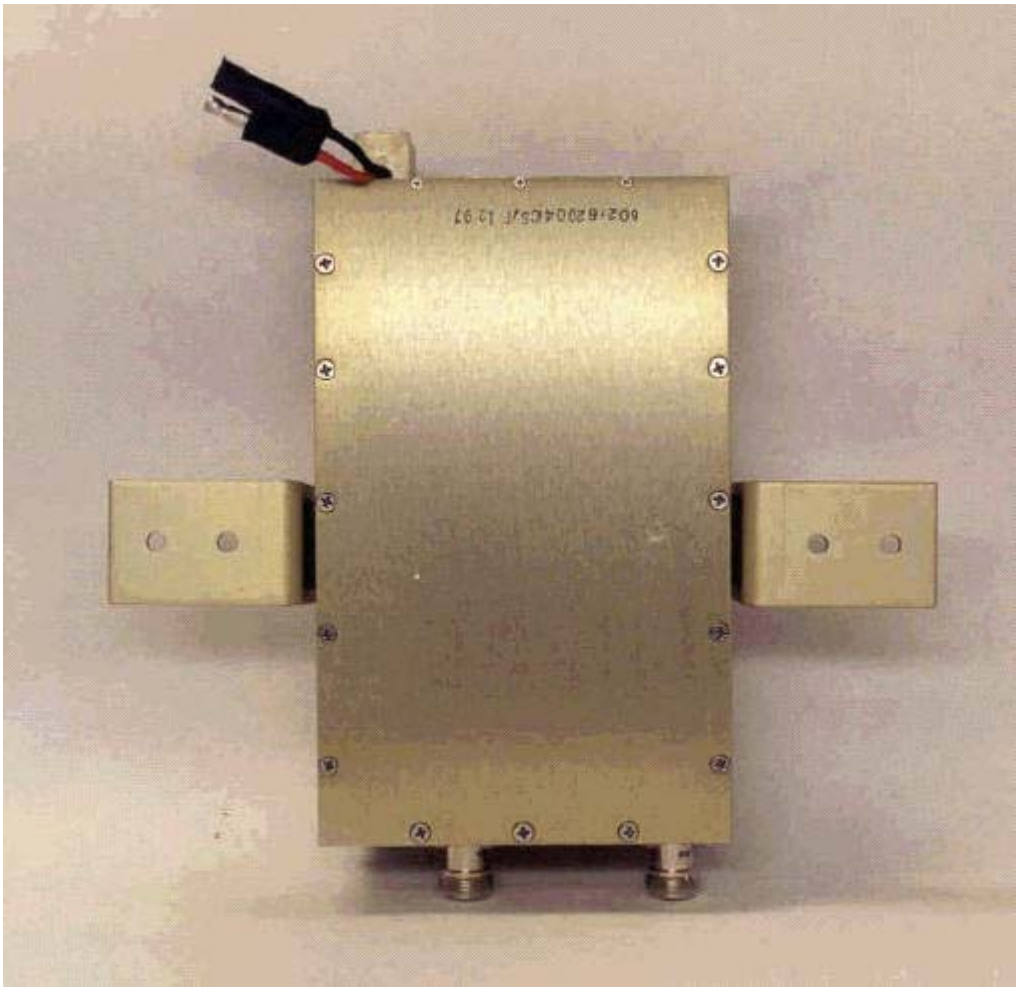
6.4 Photo: EUT Rear View



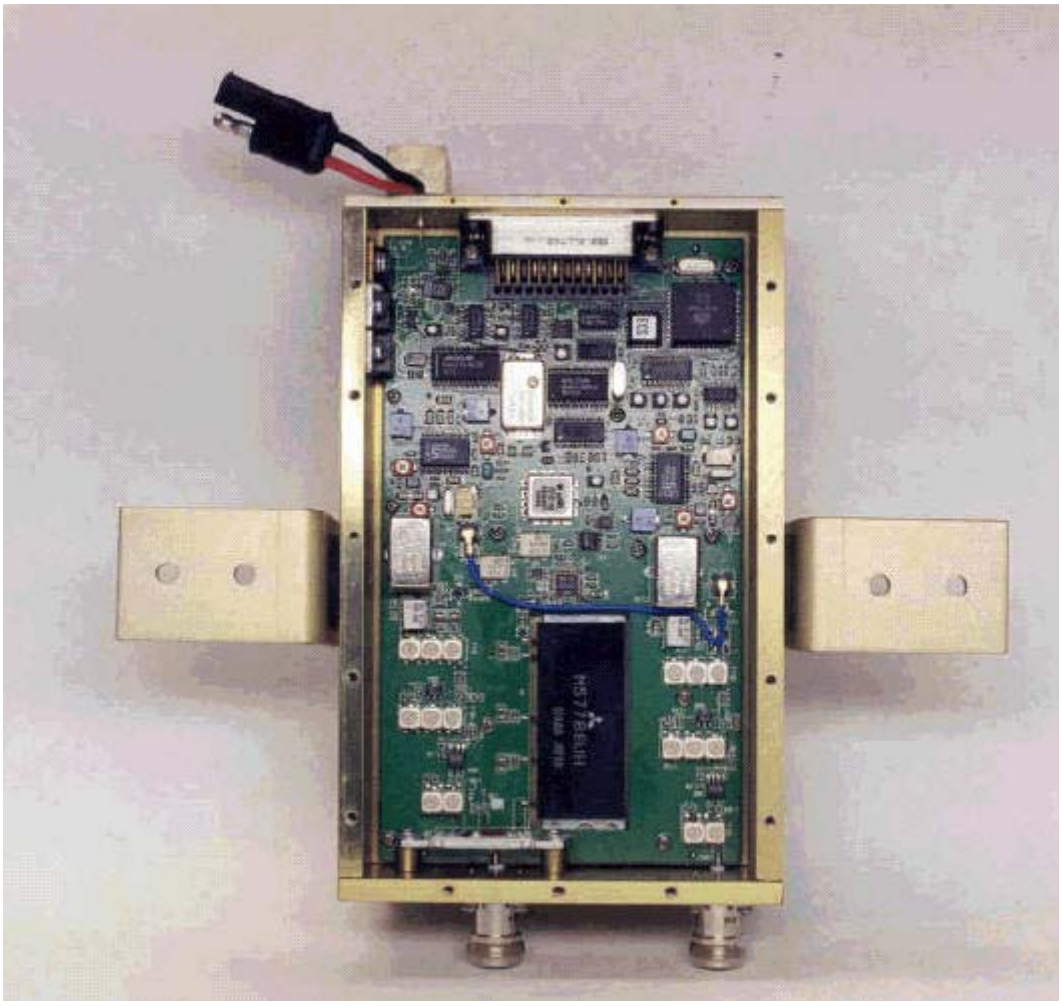
6.5 Photo: EUT Side View



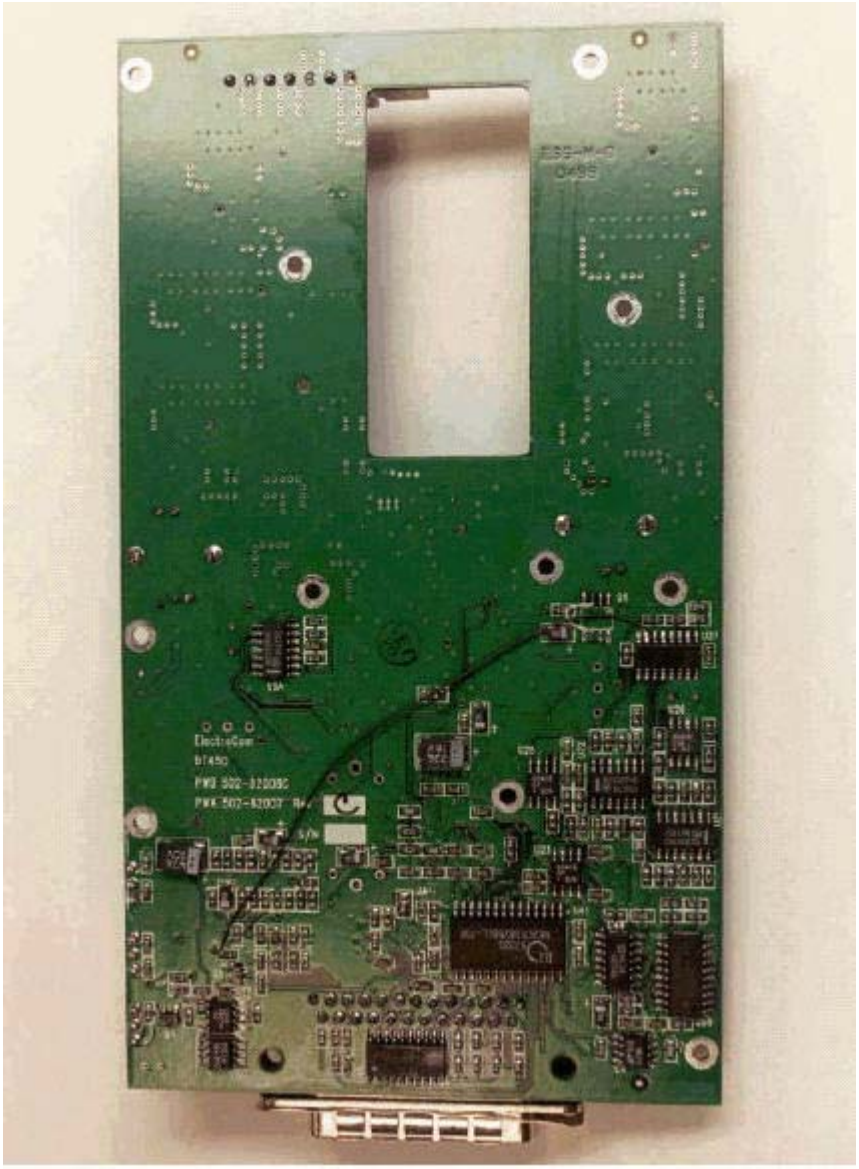
6.6 Photo: EUT Bottom View



6.7 Photo: EUT with cover removed (PCB Top)



6.8 Photo: EUT PCB Bottom



APPENDIX A - Test Equipment Used

A complete list of test equipment used for each test can be found in their perspective test procedure. The equipment absolute performance calibration of the equipment requiring calibration is performed on an as needed basis in accordance with MIL-STD-45662. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least ±2 dB amplitude and ±2% frequency deviation. Equipment certifications showing traceability to NIST (National institute of Standards and Technology) are maintained on file at Aegis Labs offices in Trabuco Canyon or Rancho Santa Margarita, CA. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

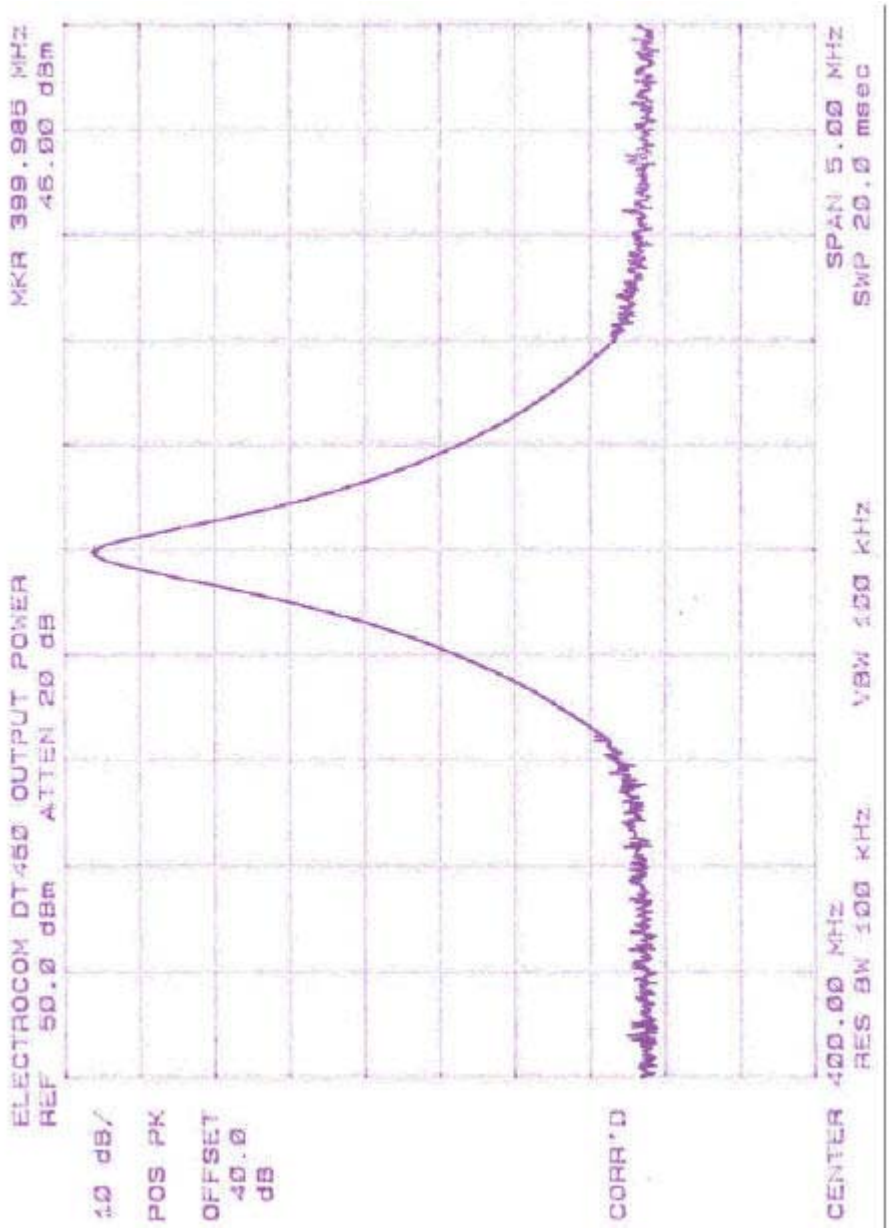
Test Instrument	*Mfg*	*Model No.*	*Serial No.*	*Freq. or Range*	*Cal. Due Date*
EMI Spectrum Analyzer	Hewlett Packard	8566B	2532A02014	100 Hz – 22 GHz	02/16/00
Communication Test Set	Hewlett Packard	8920A	4500020132-10	.4 – 1000 MHz	03/22/00
Digitizing Oscilloscope	Tektronix	TDS410A	B010112	200MHz	04/19/00
Directional Coupler	Amp. Research	DC6080	25315	80 – 1000 MHz	02/25/00
Directional Coupler	Hewlett Packard	11692D	1212A00305	2 – 18 GHz	12/03/99
Directional Coupler	Hewlett Packard	778D	1144A08005	80 – 2000 MHz	12/01/99
Power Sensor	Rohde & Schwarz	NRVS	826149/077	DC – 26.5 GHz	08/29/00
Digital Power Meter	Rohde & Schwarz	NRV-Z5	844855/012	0.1 MHz – 6 GHz	08/29/00
RF Preamplifier	Com-Power	PA-120	N/A	1 – 20 GHz	01/27/00
RF Preamplifier	Com-Power	CPPA-102	N/A	.1 – 1 GHz	12/30/99
Double Ridged Antenna	Com-Power	AH-118	10069	1 – 18 GHz	12/11/99
Log-Periodic Antenna	Com-Power	AL-100	16041	.3 – 1 GHz	12/30/99
Signal Generator	Hewlett Packard	8673B	2823A01357	2 – 26 GHz	11/25/99
Signal Generator	Gigatronics	6062A	9809906	.1 – 2.1 GHz	03/13/00
RF Attenuator	Pasterneck	PE7021-40	N/A	100W	CIP
RF Attenuator	Bird Electronics	500-WA-FFN-20	9903	500W	CIP
50 ohm Resistive Load	Bird Electronics	1000-WT-FN	9924	1000W	CIP
50 ohm Resistive Load	Pasterneck	PE6034	N/A	0.5W	CIP
RF Splitter/Combiner	Mini-Circuits	ZA3PD-1	N/A	0.4 –1 GHz	CIP
RF Power Sensor	Decibel	DB8881A-350	N/A	0.4 –1 GHz	CIP
DC Power Supply	Astron	RS-70M	N/A	0 – 18V, 0 – 70A	CIP
DC Power Supply	Astron	RS-12M	N/A	0 – 18V, 0 – 12A	CIP

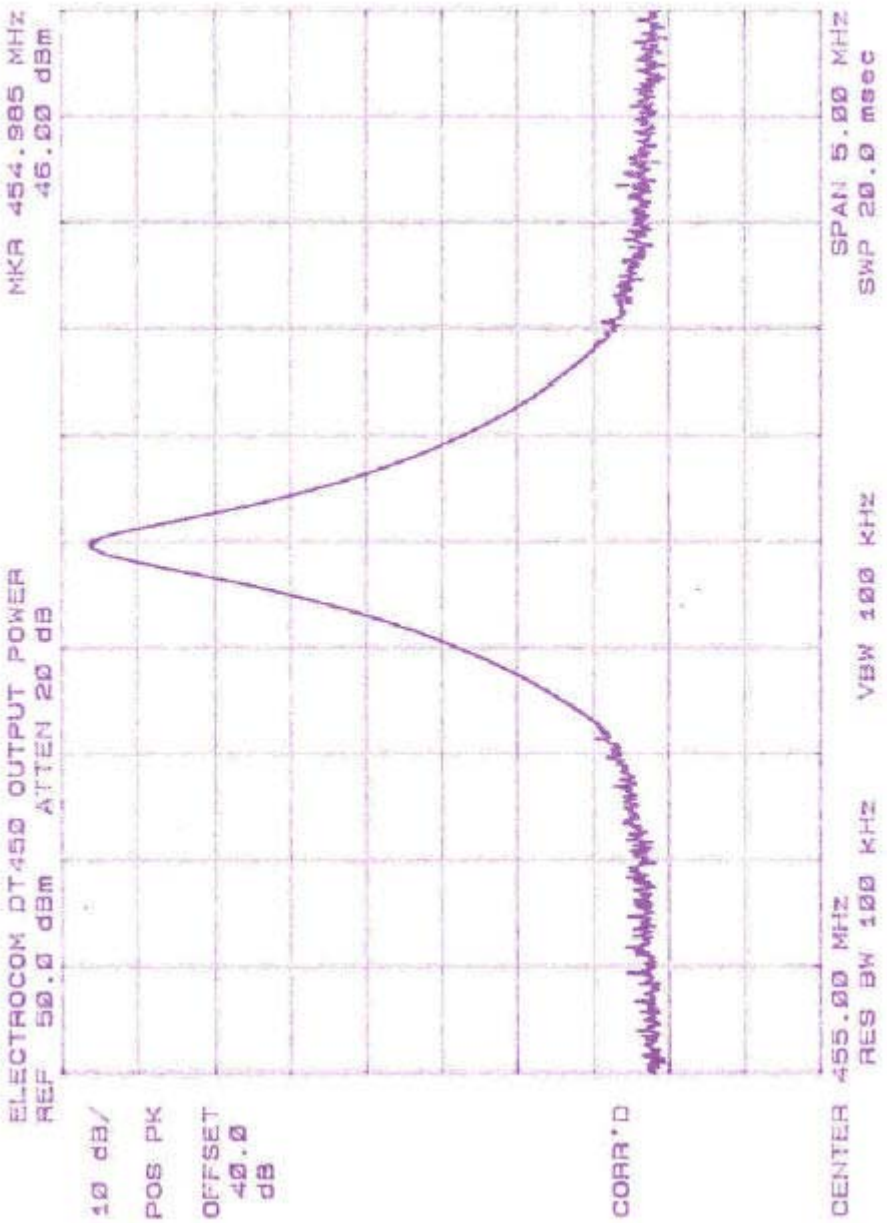
A.1 Specific Equipment Used

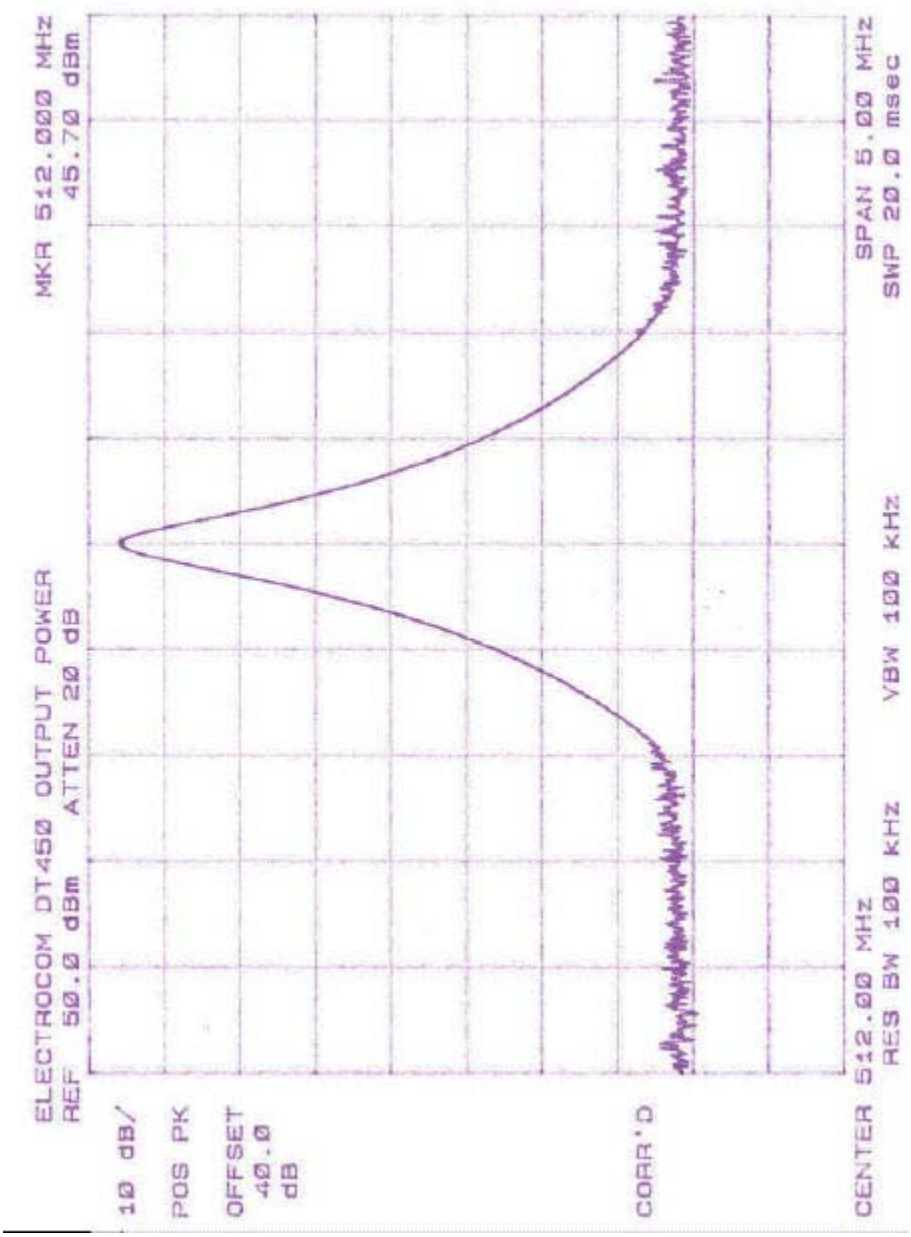
Test Instrument	*Mfg*	*Model No.*	*Serial No.*	*Freq. or Range*	*Cal. Due Date*
DC Power Supply	Sorensen	SRL-60-17M1	0431	0 – 60V, 0 – 17A	CIP
RF Field Probe	Holaday	HI-4422	101309	.1 – 1000MHz	05/21/00
RF Field Monitor	Holaday	HI-4416	N/A	.1 – 1000MHz	CIP
Temperature Chamber	Environ. Equip.	RB-16-705-705	0688603	– 73 ~ + 177°C	11/04/99
Temperature Recorder	Honeywell	DR4501-1000	930589598032	– 60 ~ + 160°C	11/13/99
RF Cables	United Microwave	190-57793	N/A	.1MHz – 10GHz	CIP

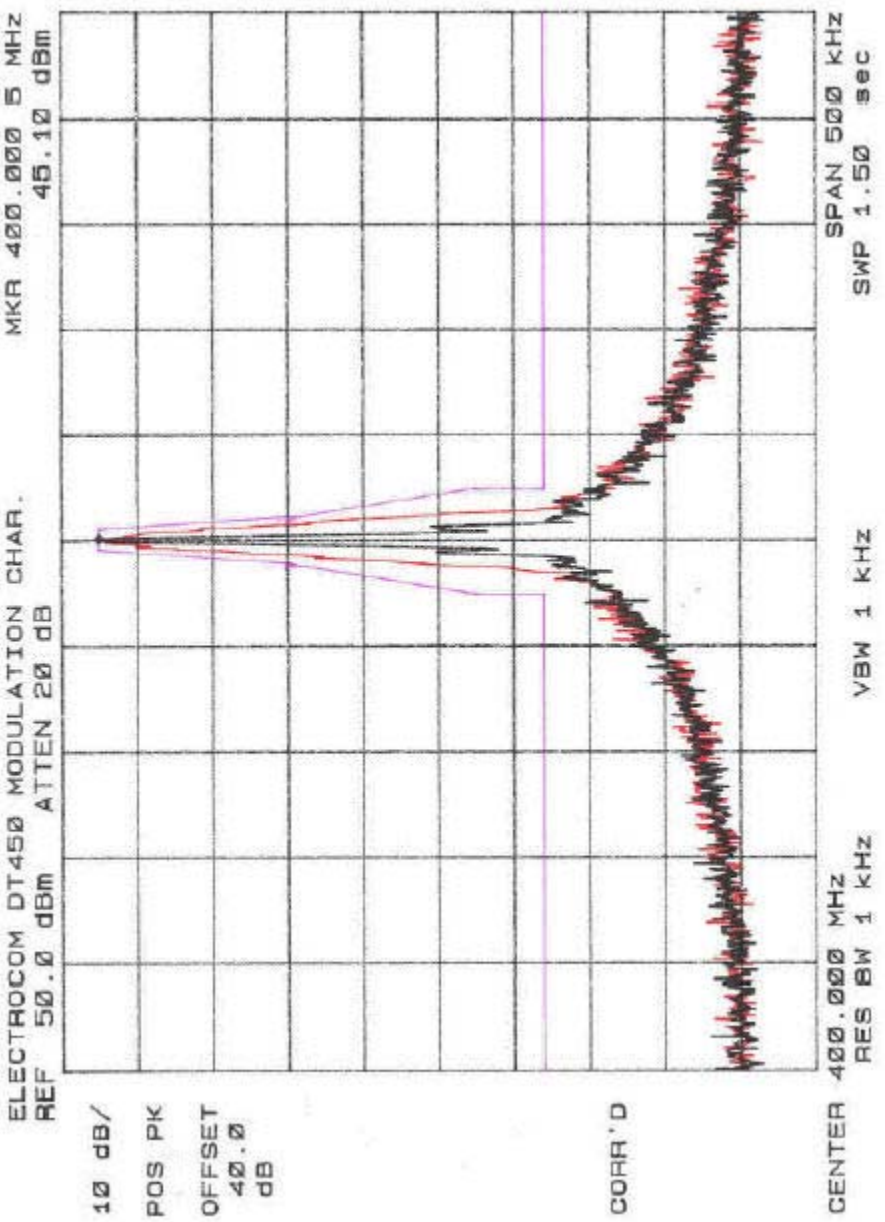
* CIP – calibrate in place

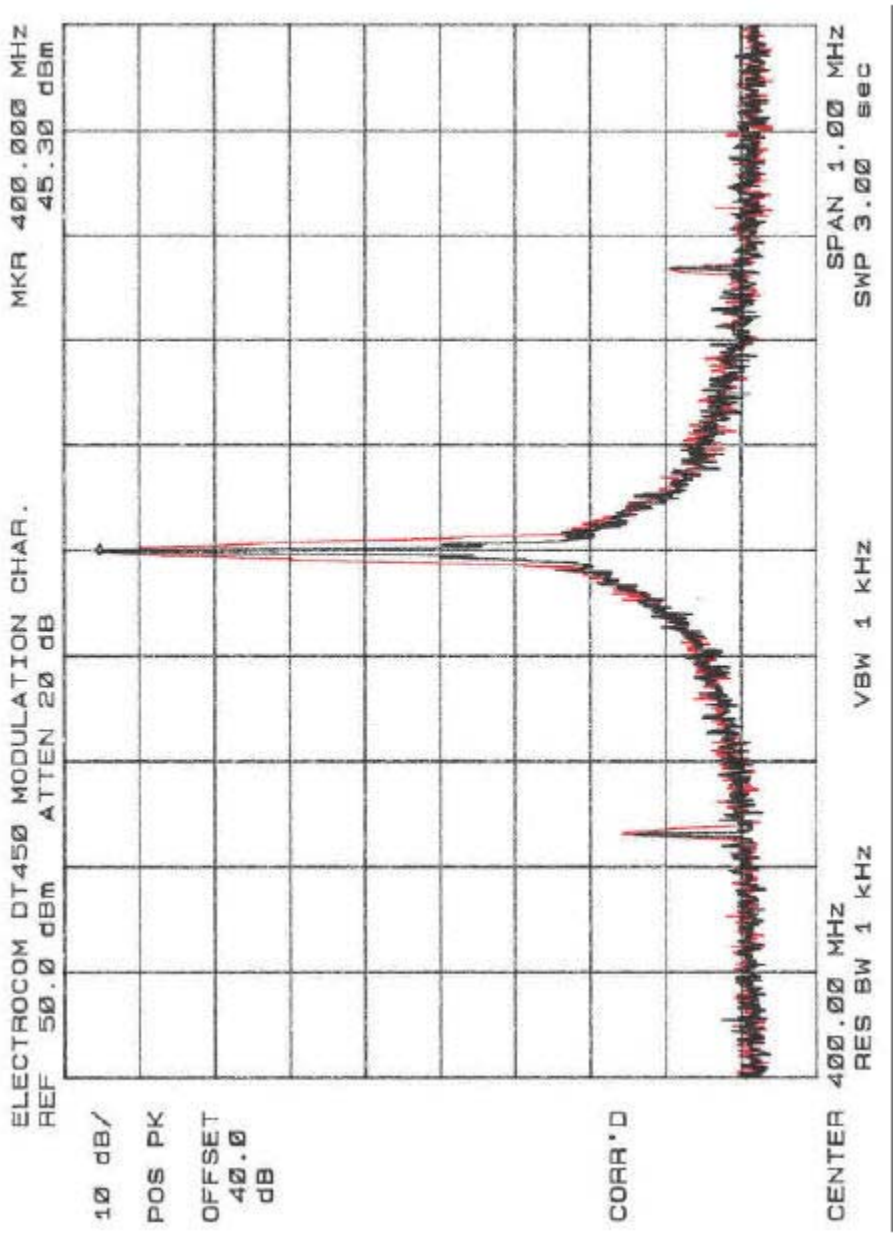
APPENDIX B – SUPPLEMENTS TEST DATA

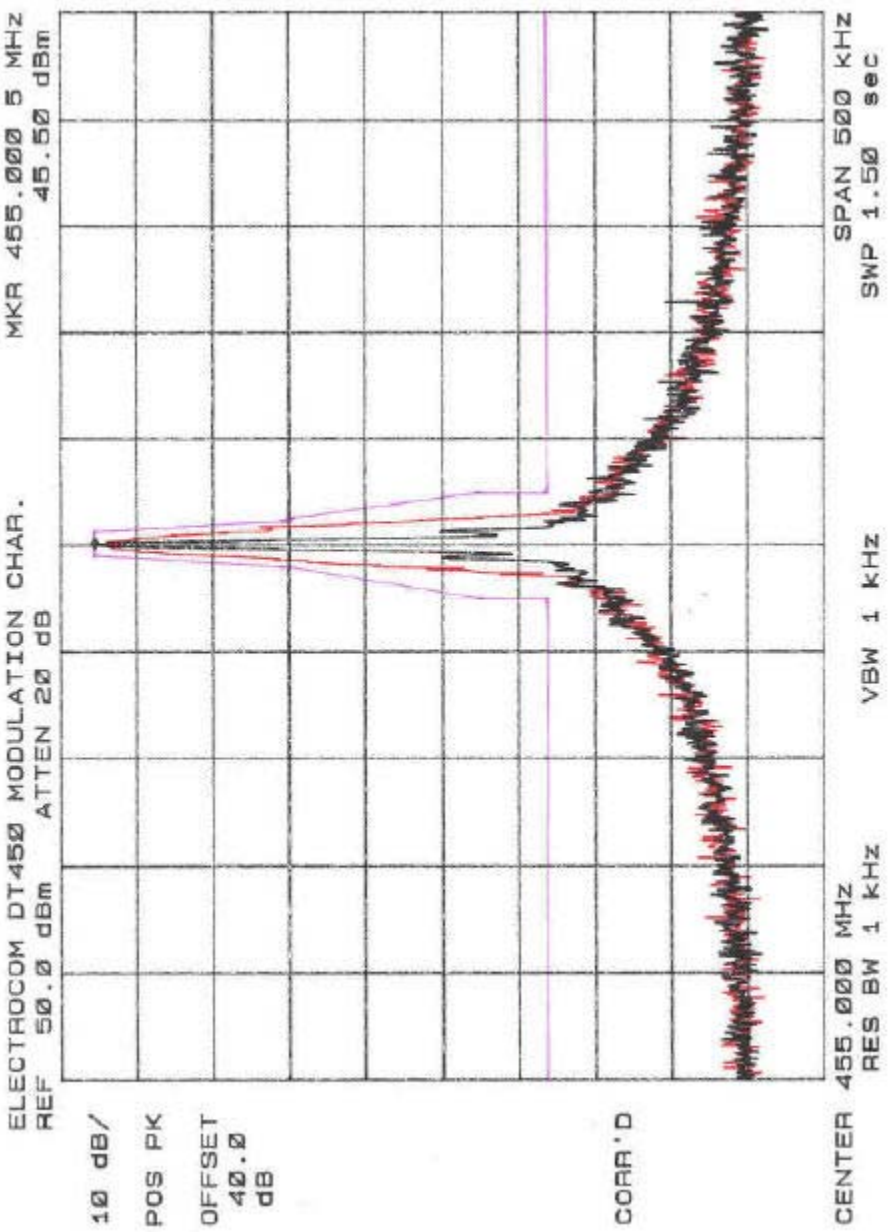


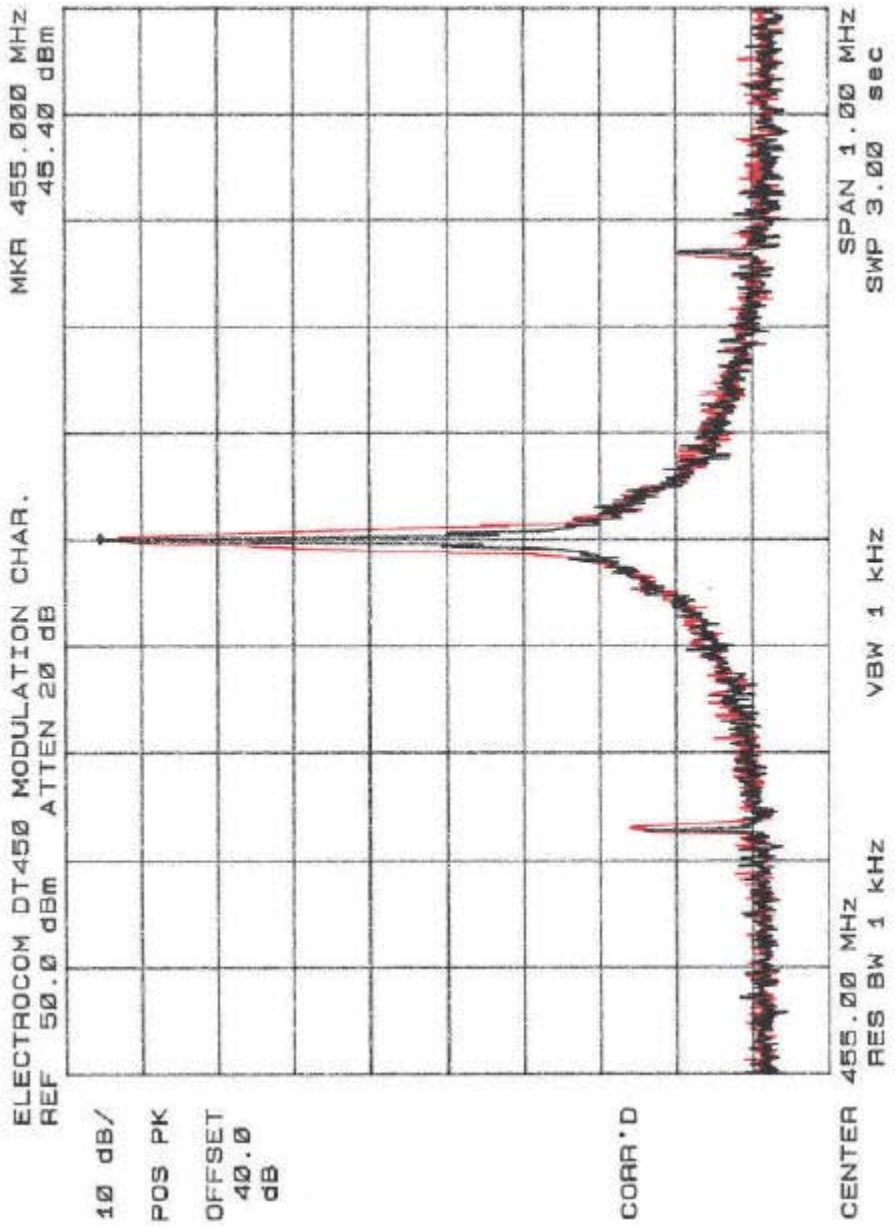

ELECTROCOM DT450 OUTPUT POWER
REF 50.0 dBm ATTEN 20 dB
MKR 454.985 MHz
46.00 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 455.00 MHz
RES BW 100 KHz
VBW 100 KHz
SPAN 5.00 MHz
SWP 20.0 msec


ELECTROCOM DT450 OUTPUT POWER
REF 50.0 dBm ATTEN 20 dB
MKR 512.000 MHz
45.70 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.00 MHz
RES BW 100 kHz
VBW 100 kHz
SPAN 5.00 MHz
SWP 20.0 msec


ELECTROCOM DT450 MODULATION CHAR.
REF 50.0 dBm ATTEN 20 dB
MKR 400.000 5 MHz
45.10 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 400.000 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 500 kHz
SWP 1.50 sec


ELECTROCOM DT450 MODULATION CHAR.
REF 50.0 dBm ATTEN 20 dB
MKR 400.000 MHz
45.30 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 400.00 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 1.00 MHz
SWP 3.00 sec


ELECTROCOM DT450 MODULATION CHAR.
REF 50.0 dBm ATTEN 20 dB
MKR 455.000 5 MHz
45.50 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 455.000 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 500 kHz
SWP 1.50 sec


ELECTROCOM DT450 MODULATION CHAR.
REF 50.0 dBm ATTEN 20 dB
MKR 455.000 MHz
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10 dB/
POS PK
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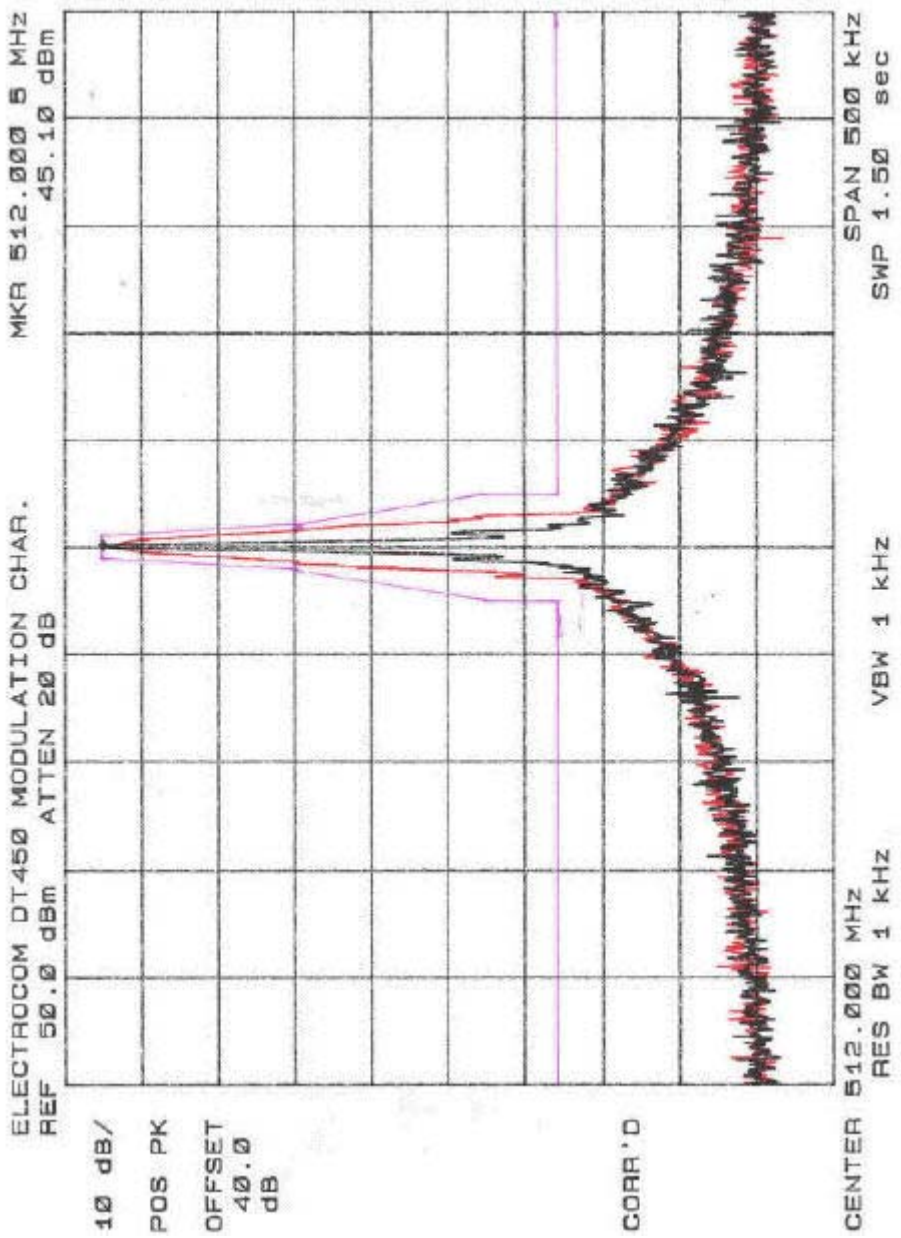
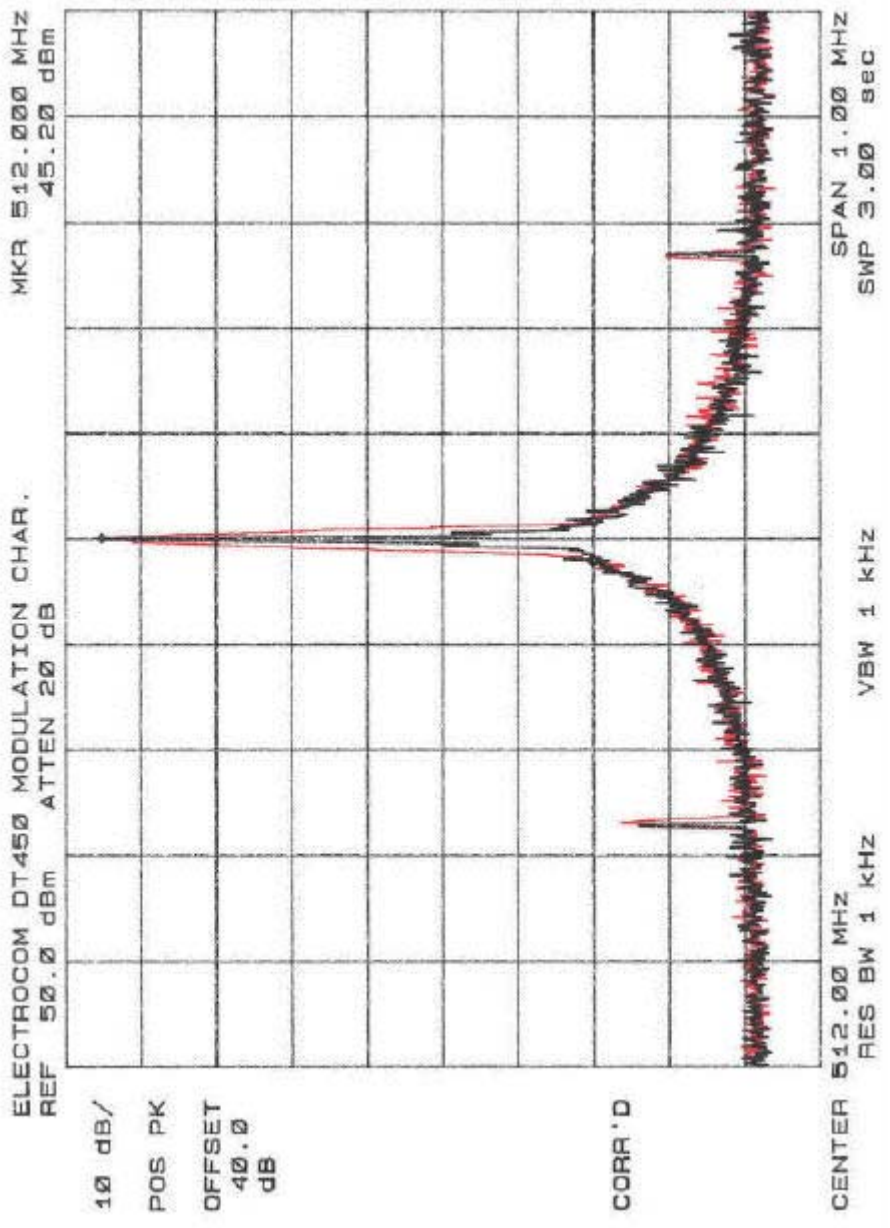
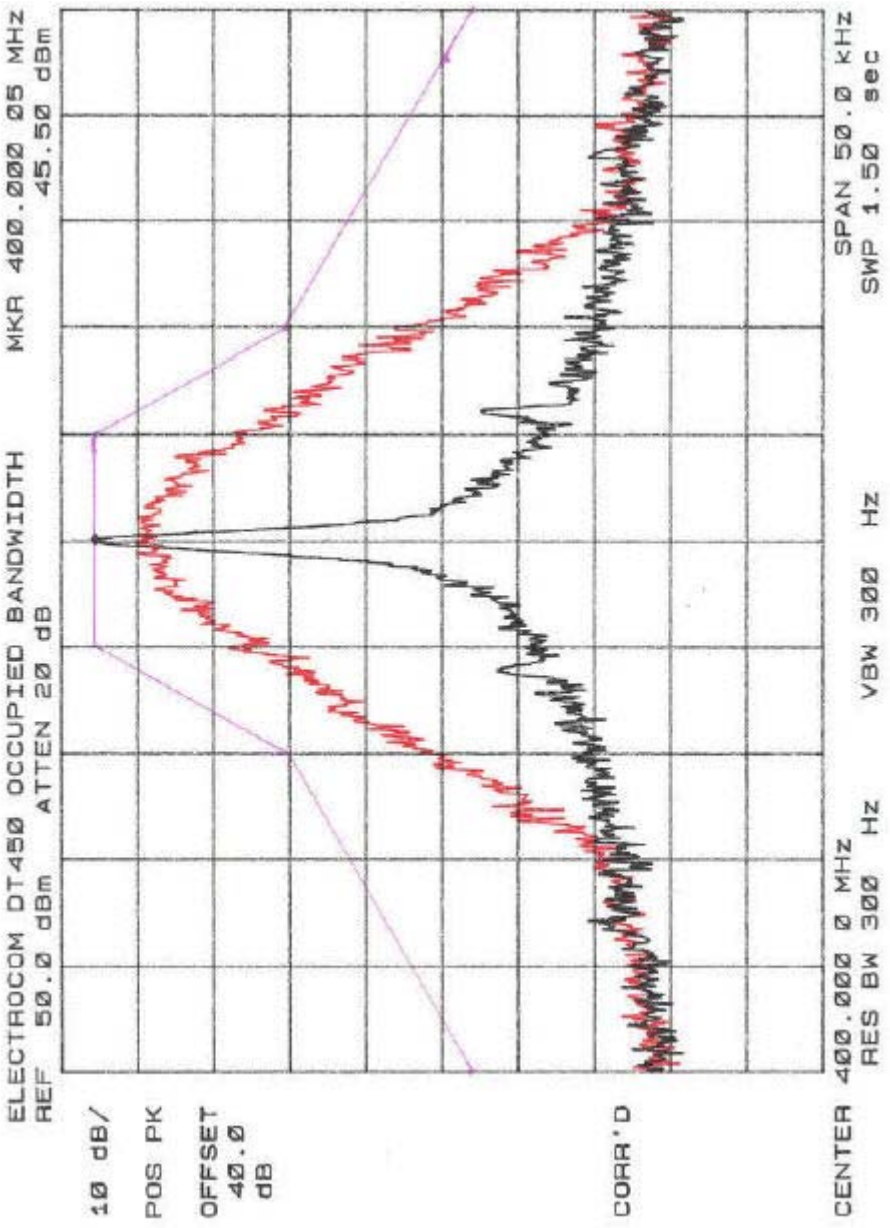
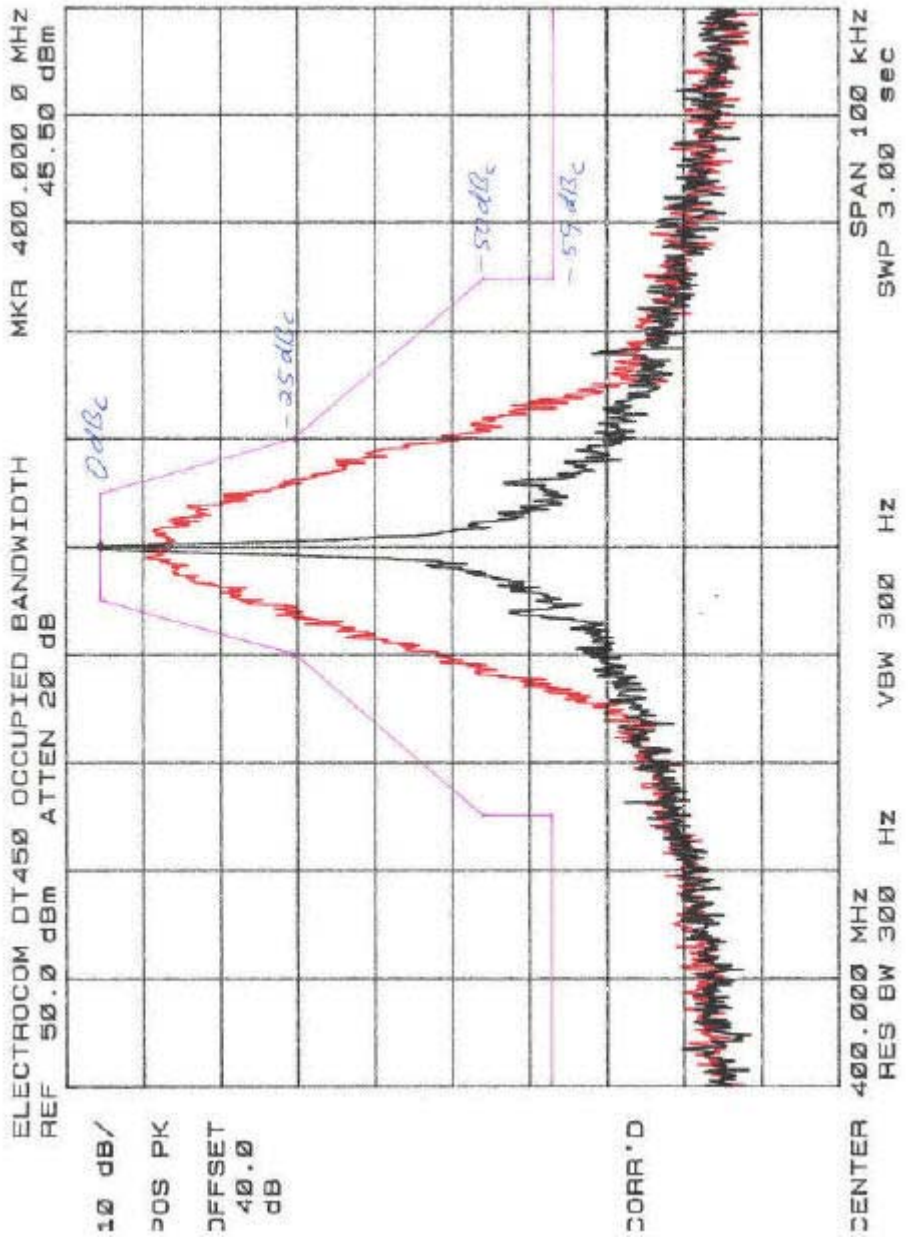
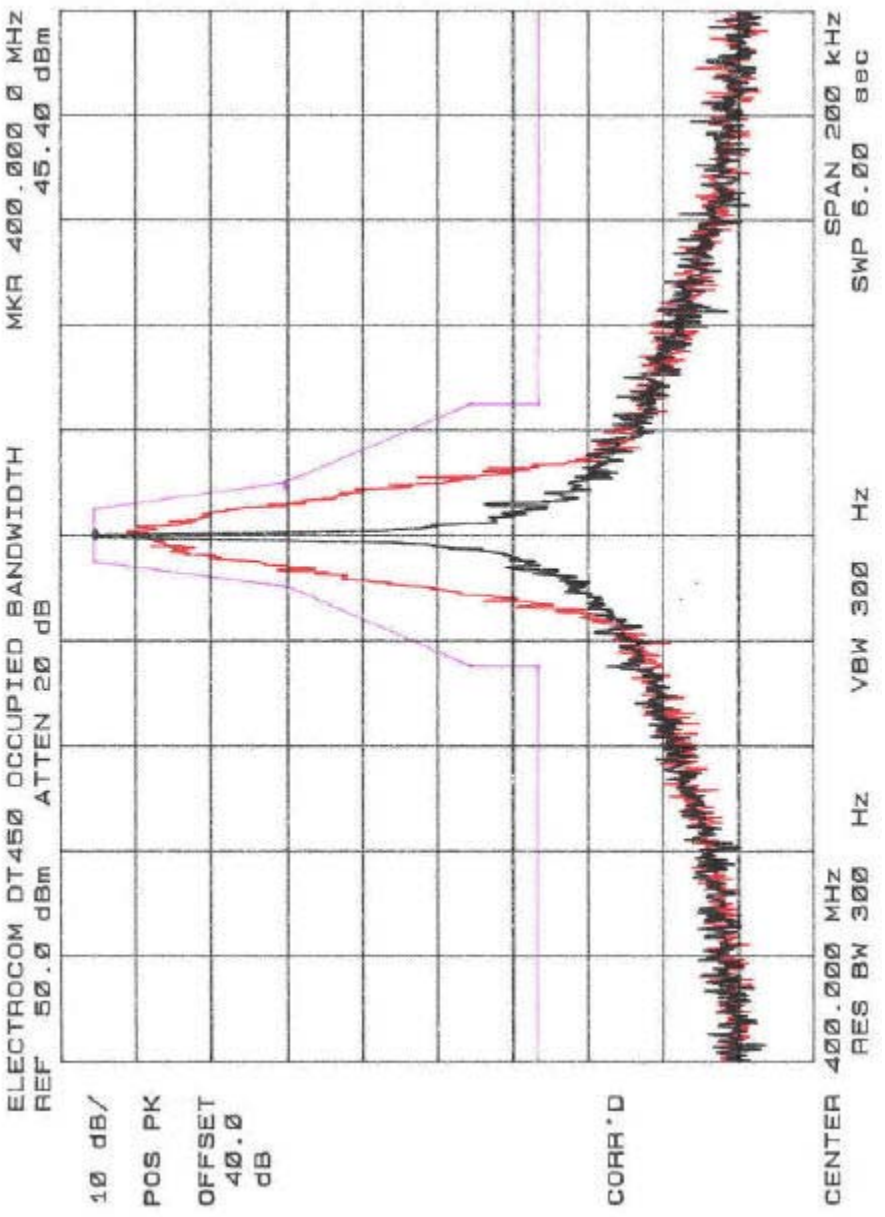
dB
CORR'D
CENTER 455.00 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 1.00 MHz
SWP 3.00 sec

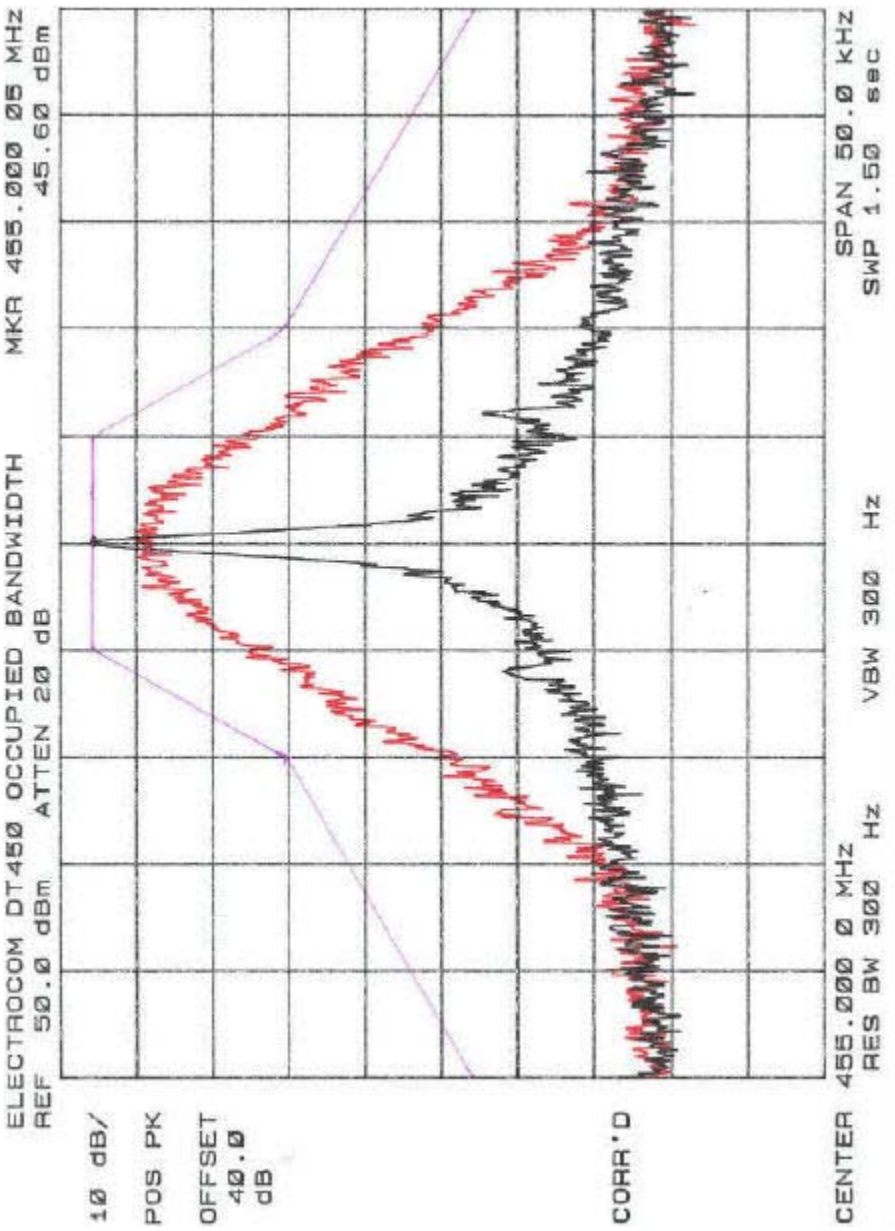

ELECTROCOM DT450 MODULATION CHAR.
REF 50.0 dBm ATTEN 20 dB
MKR 512.000 5 MHz
45.10 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.000 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 500 kHz
SWP 1.50 sec

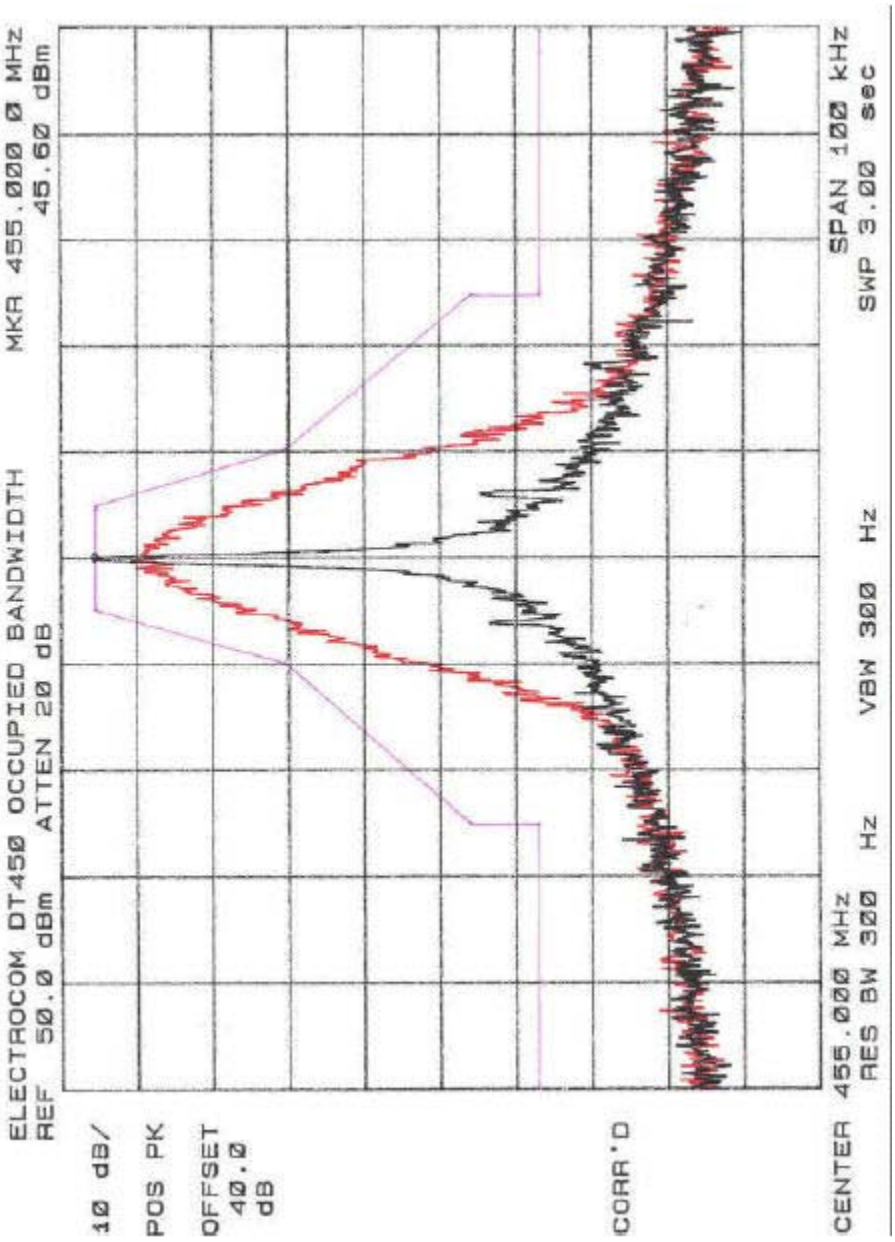

ELECTROCOM DT450 MODULATION CHAR.
REF 50.0 dBm ATTEN 20 dB
MKR 512.000 MHz
45.20 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.00 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 1.00 MHz
SWP 3.00 sec

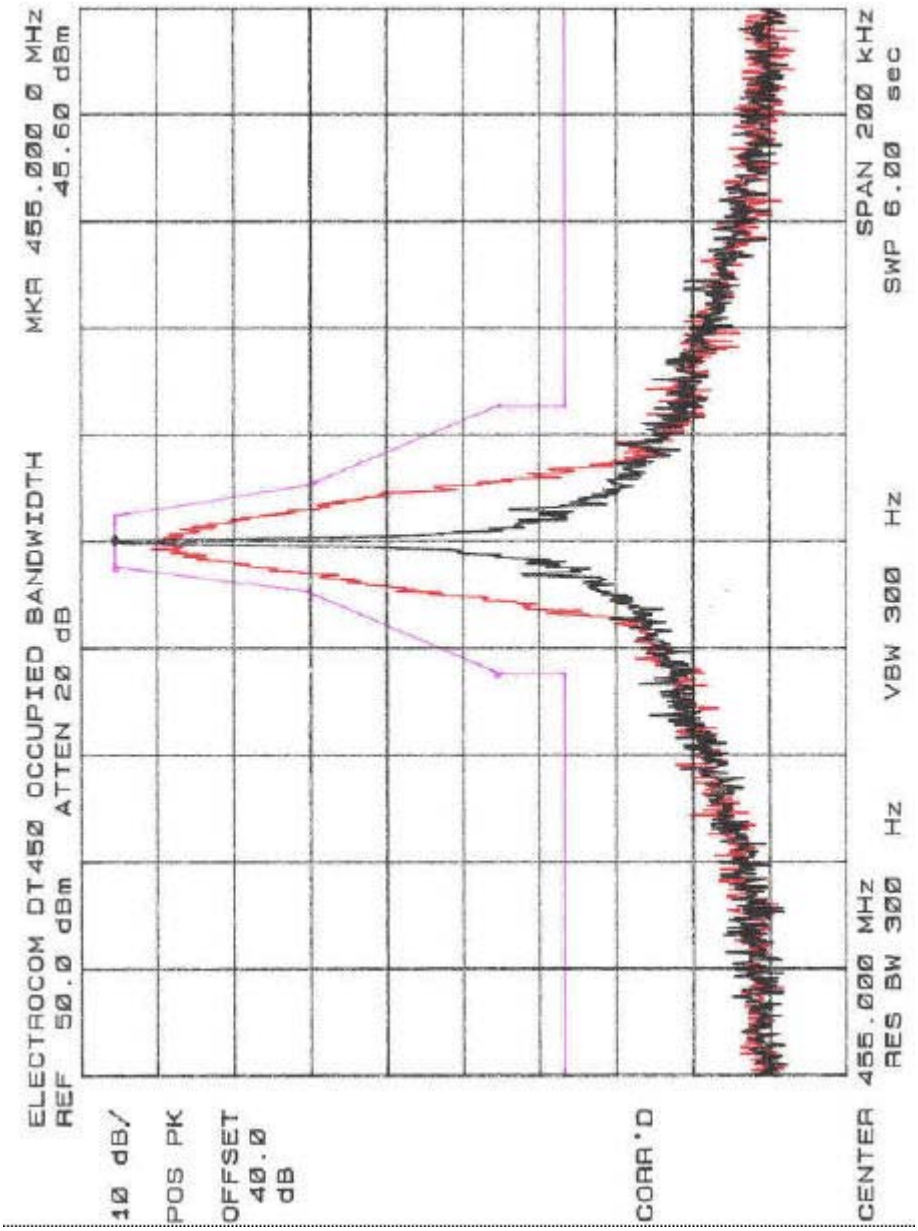

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 400.000 05 MHz
45.50 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 400.000 0 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 50.0 kHz
SWP 1.50 sec

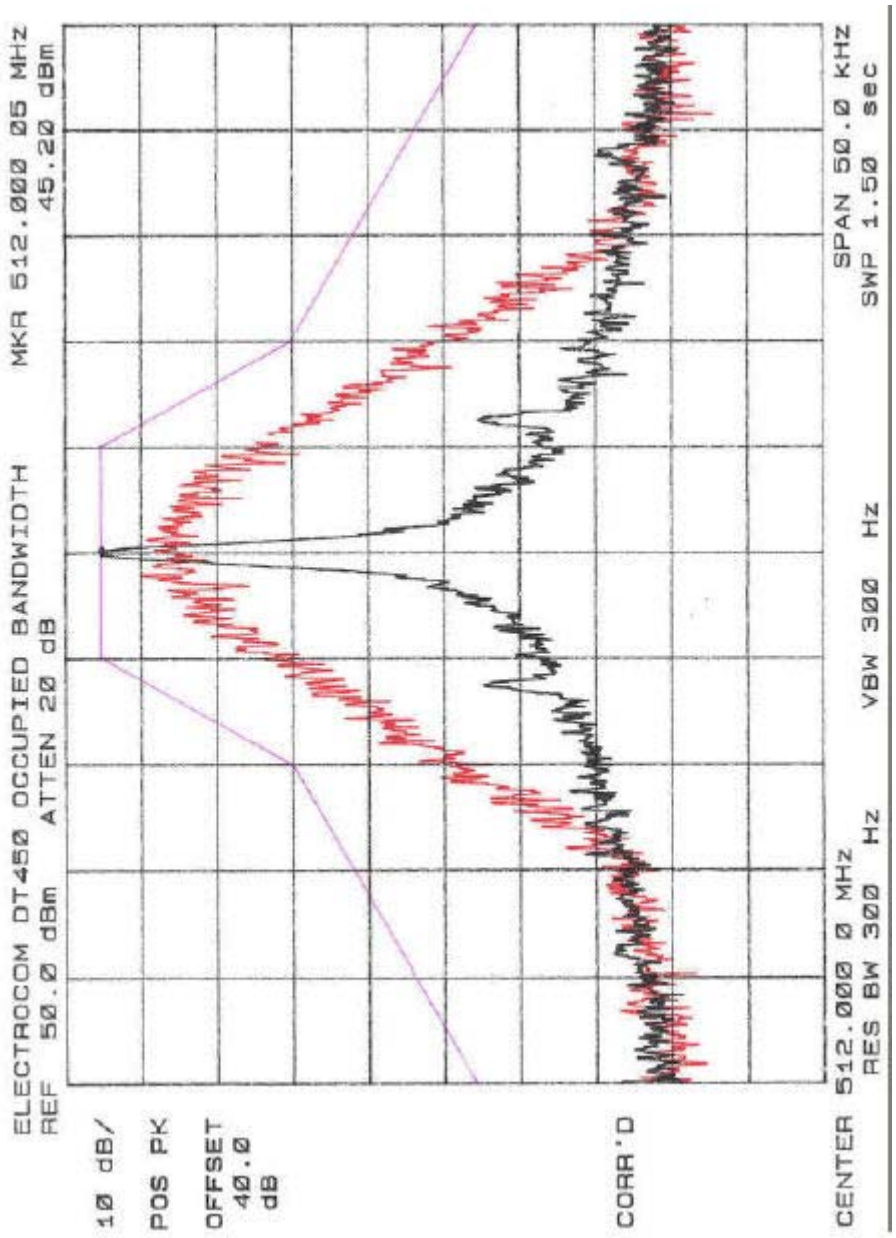

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 400.000 0 MHz
45.50 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
0dBc
-35dBc
-52dBc
-59dBc
CENTER 400.000 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 100 kHz
SWP 3.00 sec

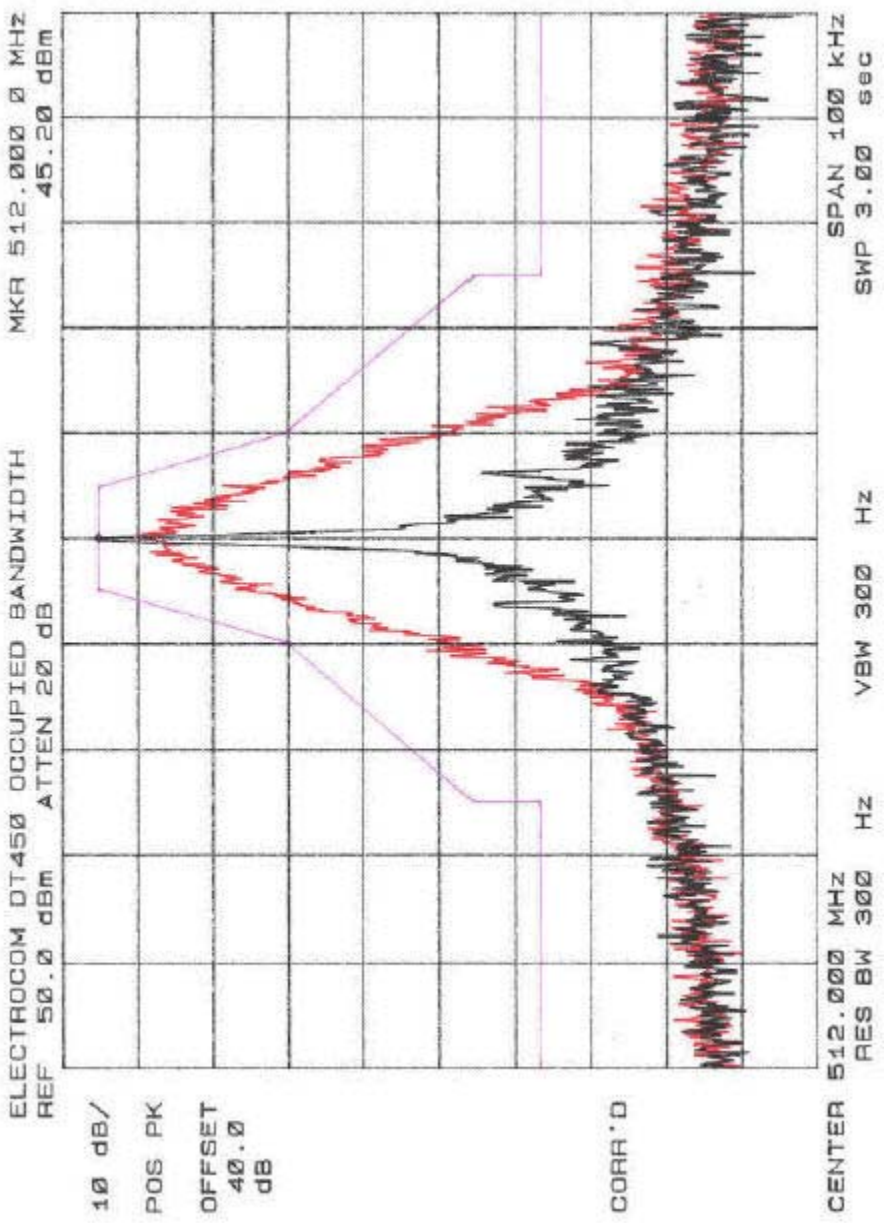

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm
ATTEN 20 dB
MKR 400.000 0 MHz
45.40 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 400.000 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 200 kHz
SWP 6.00 sec

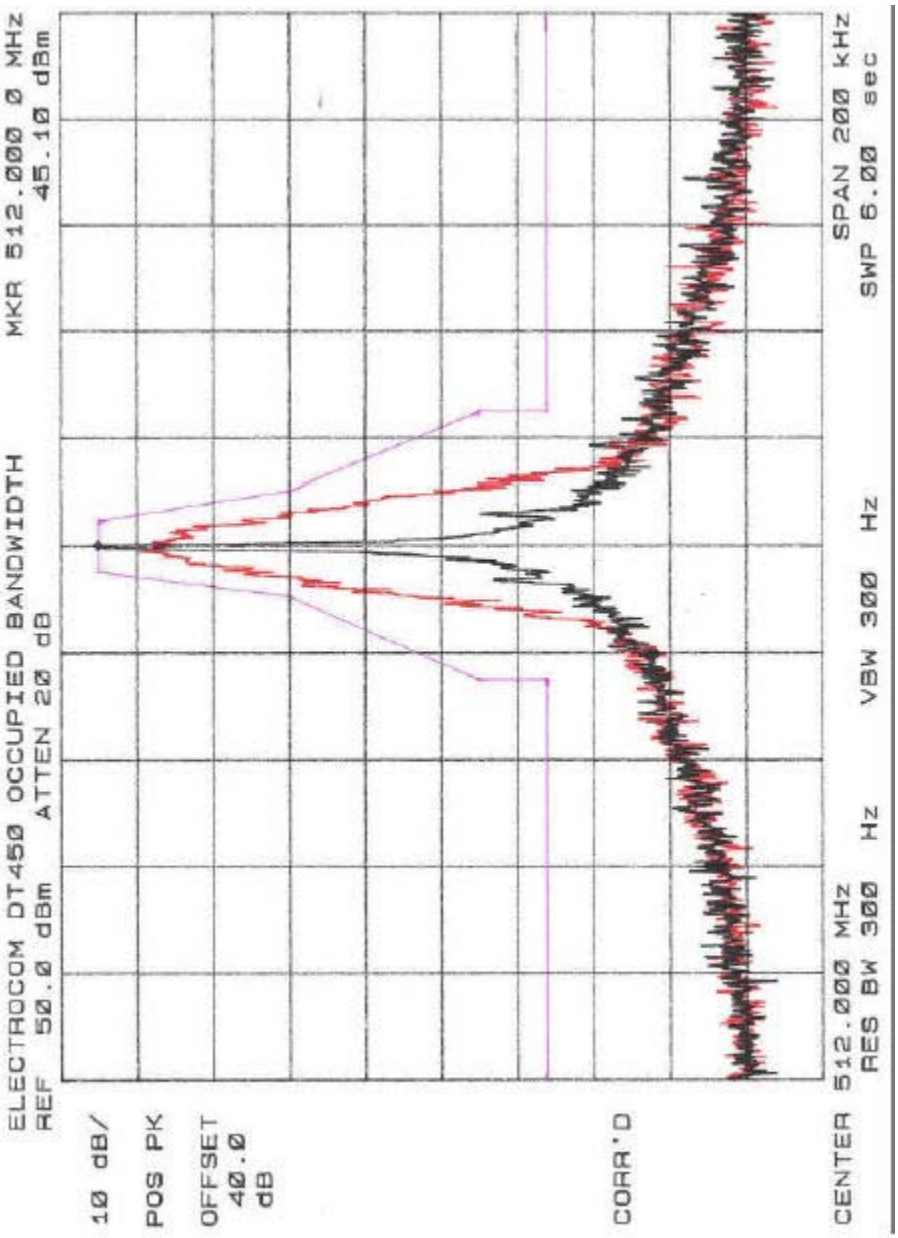

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 455.000 05 MHz
45.60 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 455.000 0 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 50.0 kHz
SWP 1.50 sec

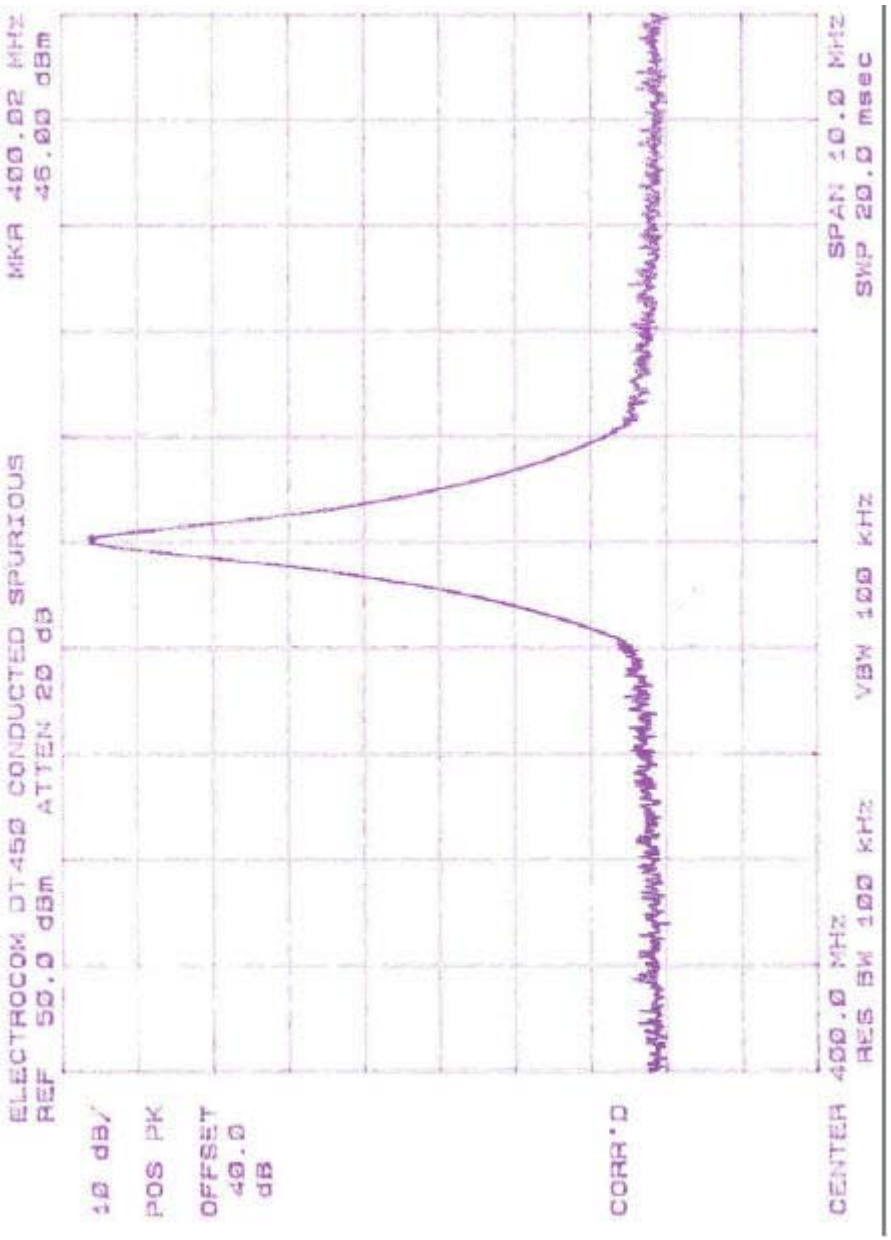

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 455.000 0 MHz
45.60 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 455.000 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 100 kHz
SWP 3.00 sec

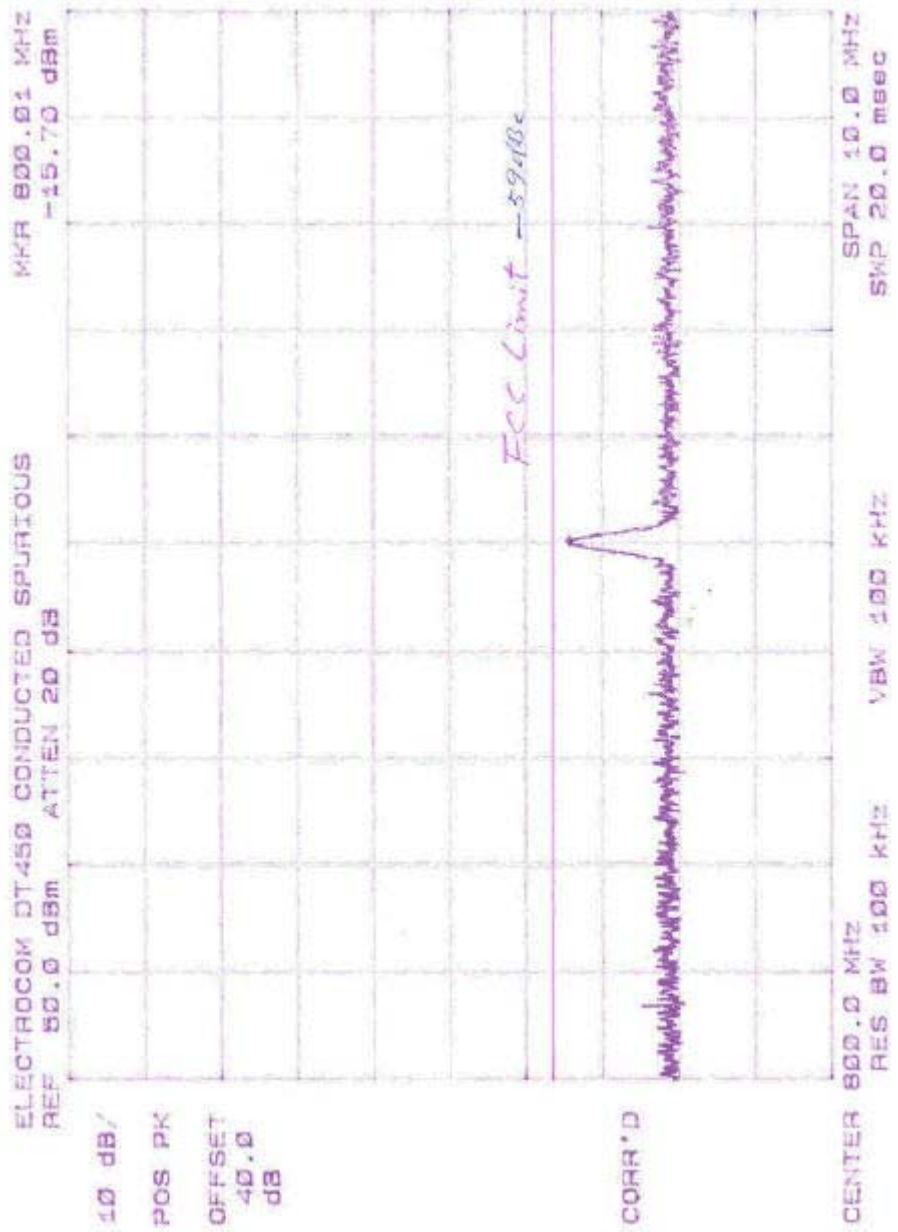

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 455.000 0 MHz
45.60 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 455.000 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 200 kHz
SWP 6.00 sec

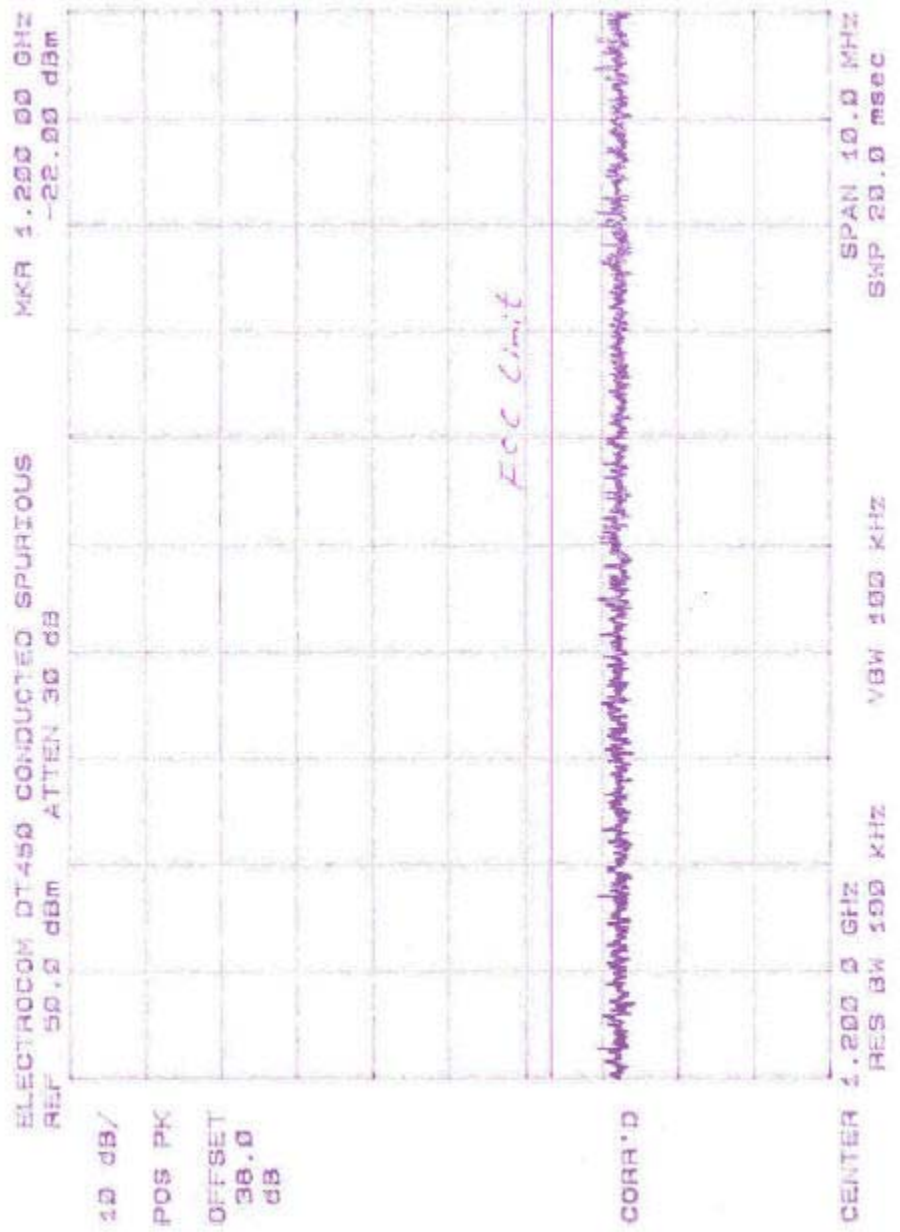

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 512.000 05 MHz
45.20 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.000 0 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 50.0 kHz
SWP 1.50 sec

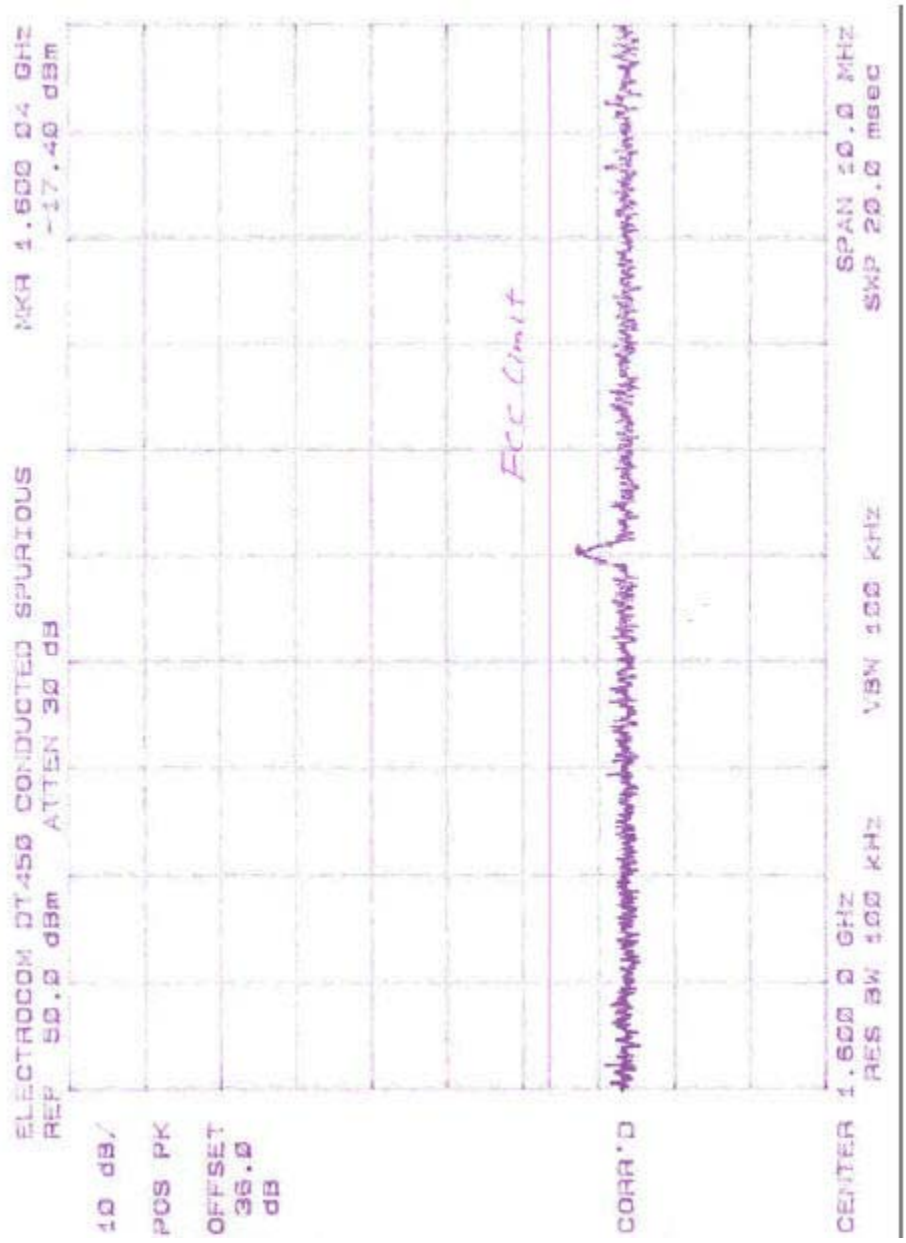

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 512.000 0 MHz
45.20 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.000 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 100 kHz
SWP 3.00 sec

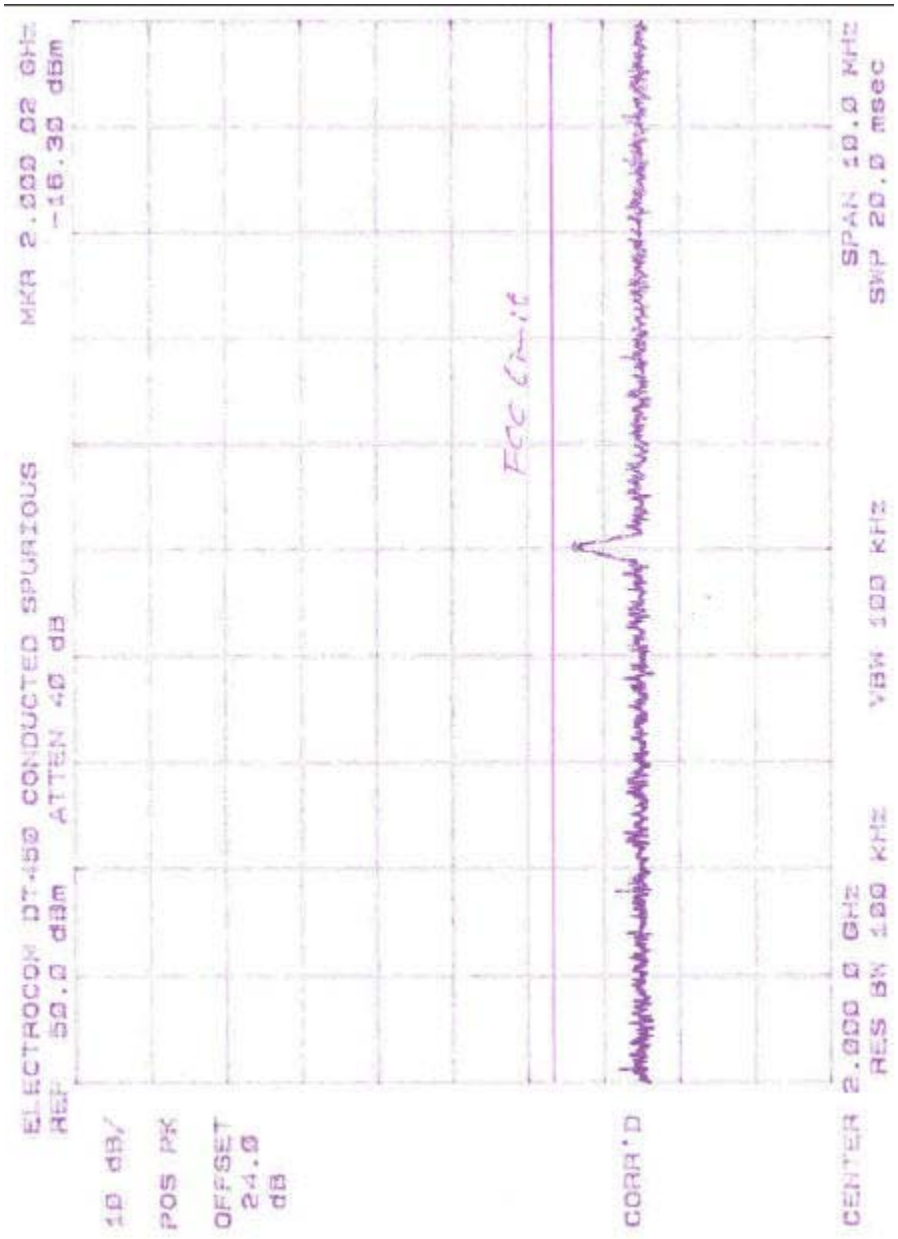

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 20 dB
MKR 512.000 0 MHz
45.10 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.000 MHz
RES BW 300 Hz
VBW 300 Hz
SPAN 200 kHz
SWP 6.00 sec

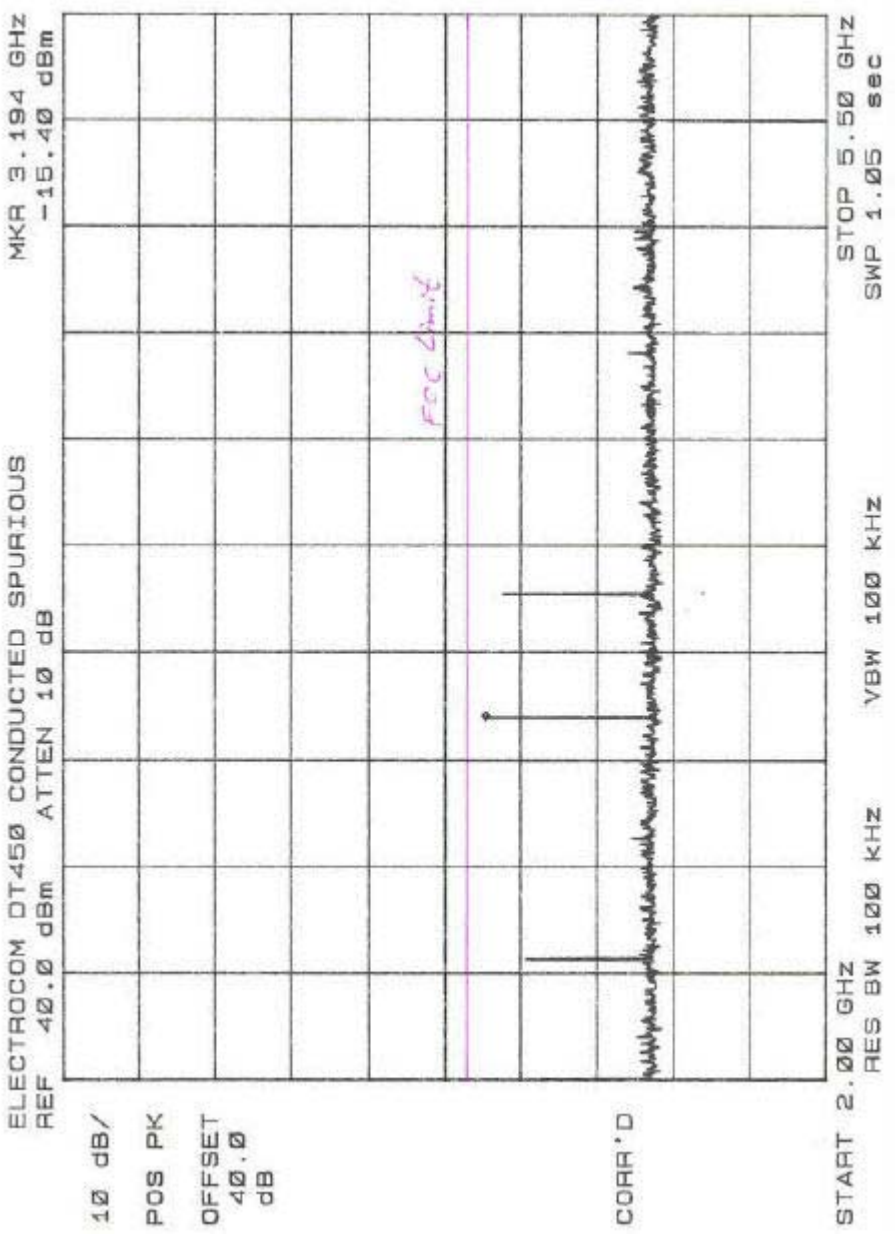

ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 20 dB
MKR 400.02 MHz
46.00 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 400.0 MHz
RES BW 100 KHz
VBW 100 KHz
SPAN 10.0 MHz
SWP 20.0 msec

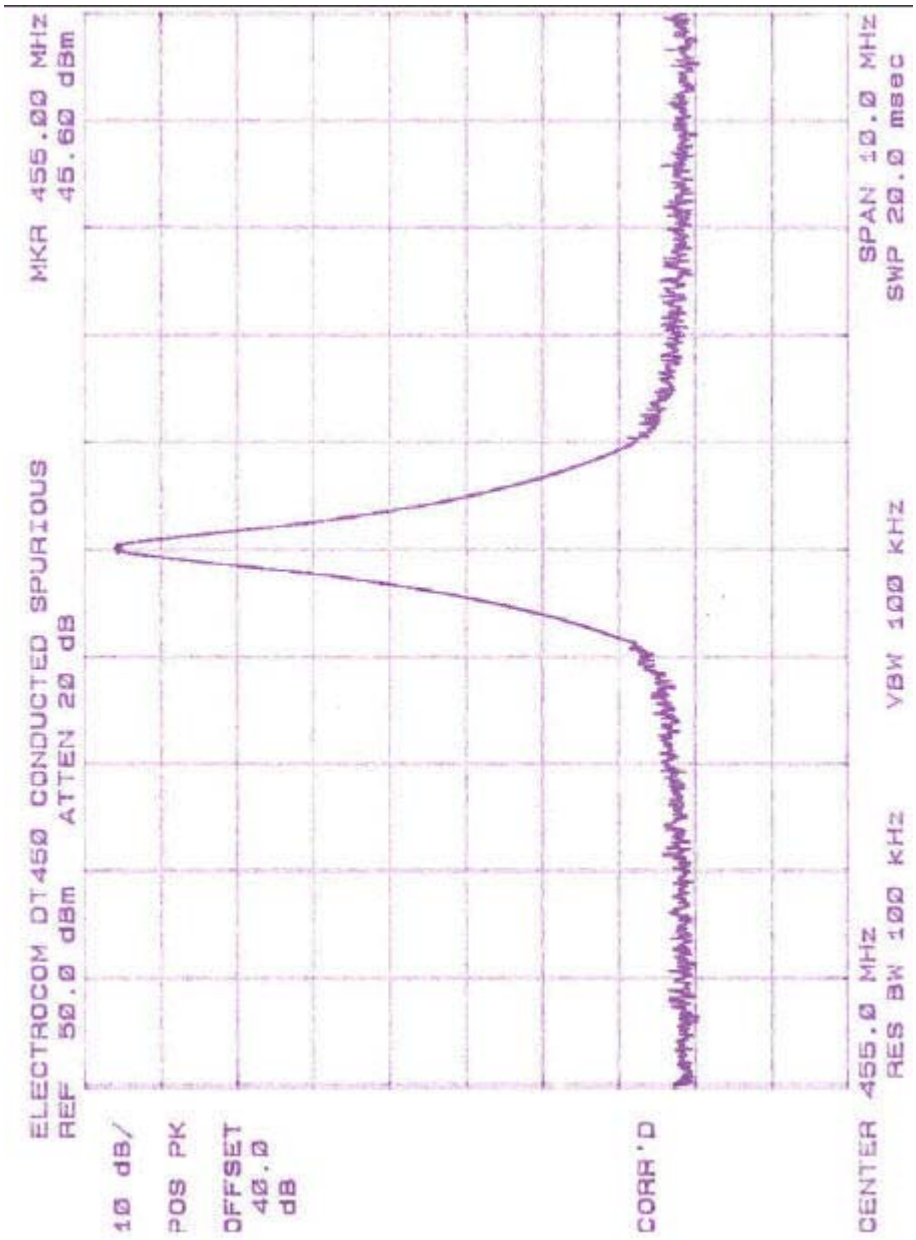

ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 20 dB
MKR 800.01 MHz
-15.70 dBm
10 dB/
POS PK
OFFSET
40.0
dB
FCC Limit -59dBc
CORR'D
CENTER 800.0 MHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec

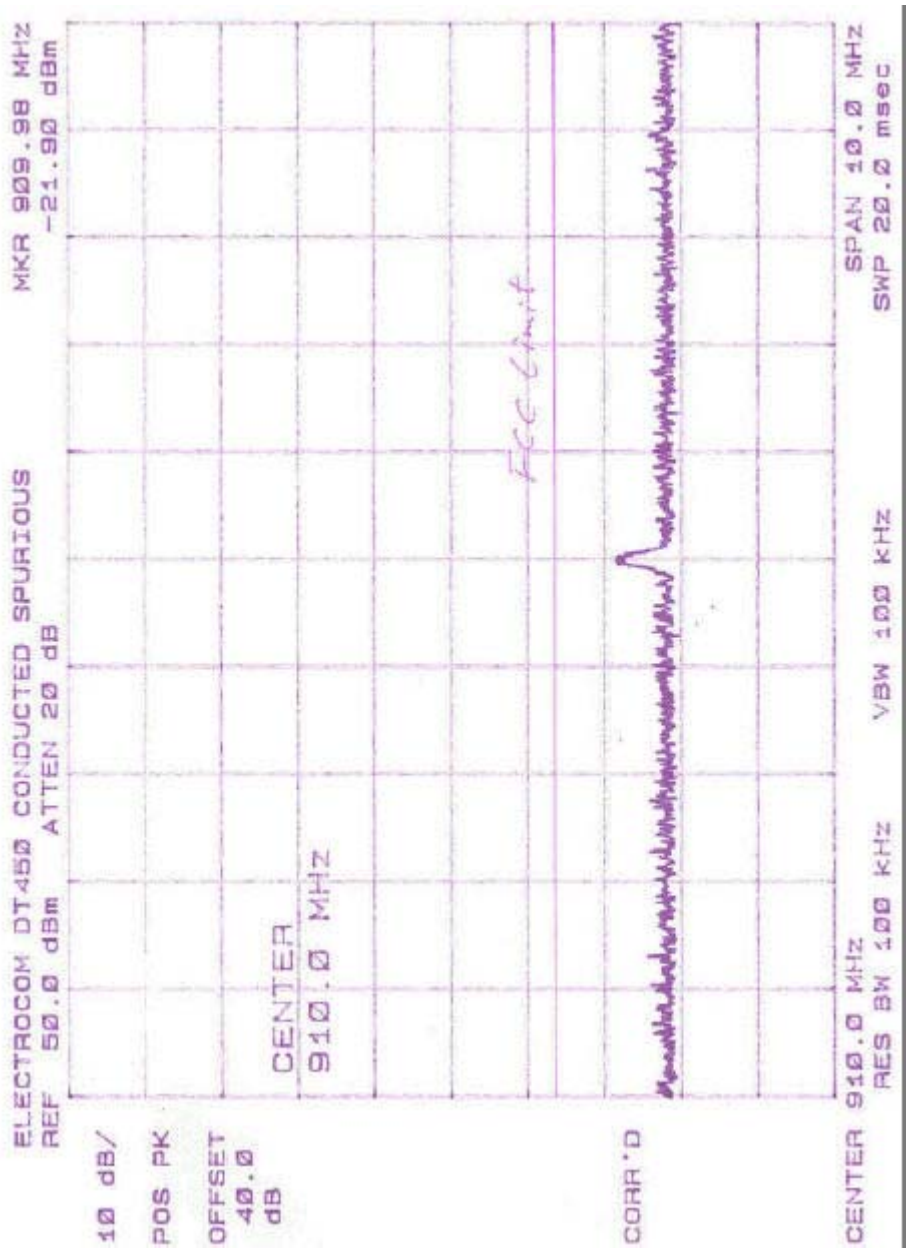

ELECTROCOM DT450 CONDUCTED SPURIOUS
MKR 1.200 00 GHz
-22.00 dBm
REF 50.0 dBm
ATTEN 30 dB
10 dB/
POS PK
OFFSET
38.0
dB
FCC Limit
CORR'D
CENTER 1.200 0 GHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec

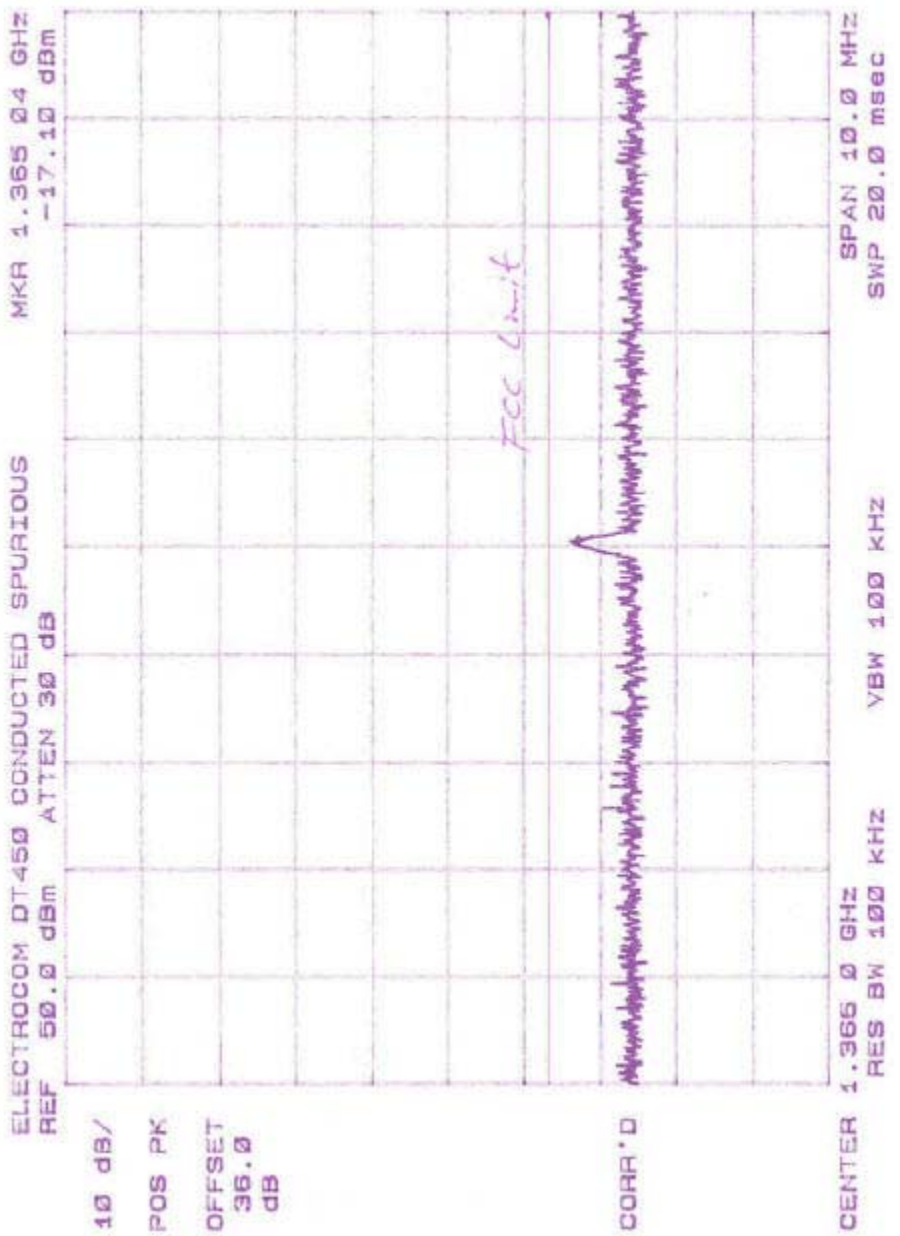

ELECTROCOM DT450 CONDUCTED SPURIOUS
MKR 1.600 04 GHz
-17.40 dBm
REF 50.0 dBm
ATTEN 30 dB
10 dB/
POS PK
OFFSET
35.0
dB
FCC Limit
CORR'D
CENTER 1.600 0 GHz
RES BW 100 KHz
VBW 100 KHz
SPAN 20.0 MHz
SWP 20.0 msec

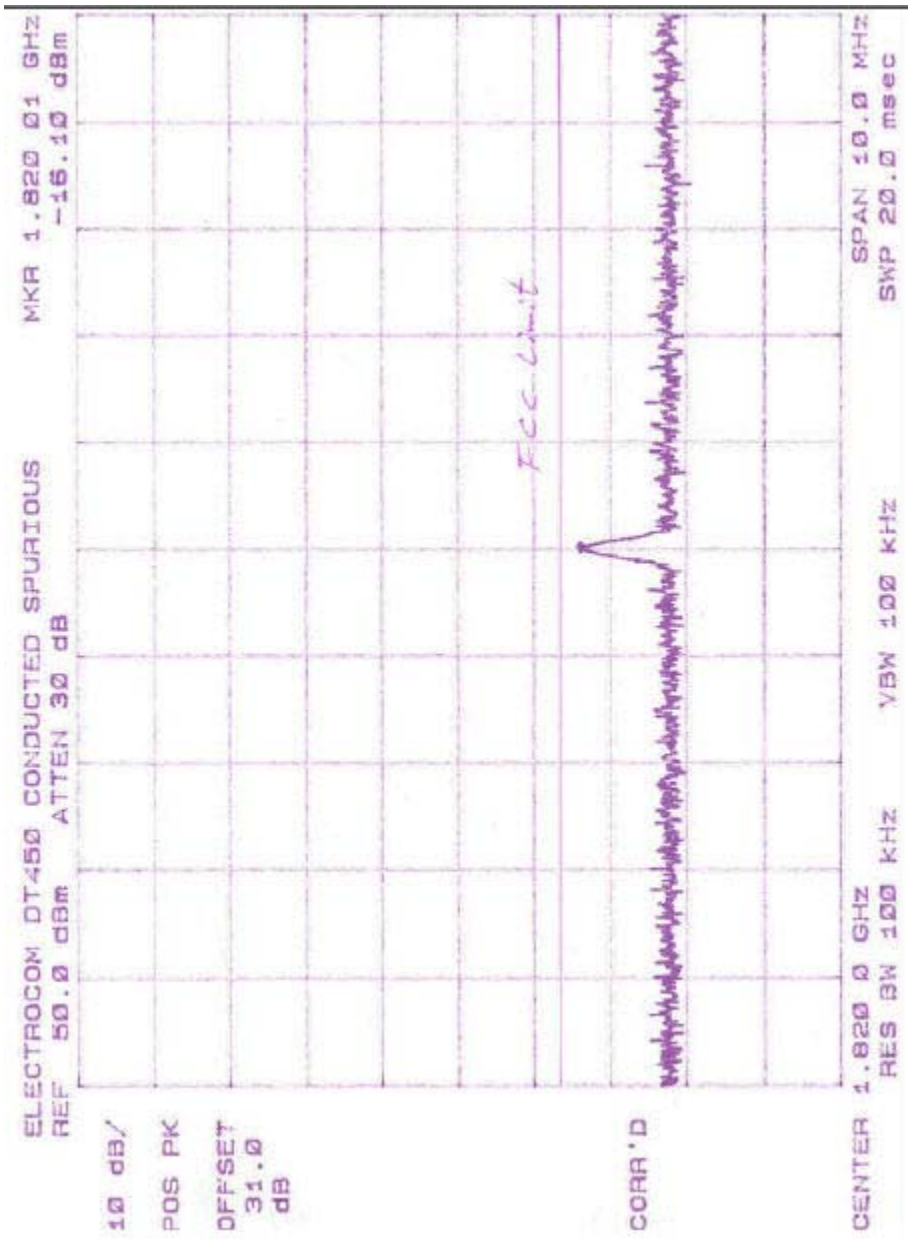

ELECTROCOM DT-450 CONDUCTED SPURIOUS
MKR 2.000 02 GHz
-16.30 dBm
REF 50.0 dBm
ATTEN 40 dB
10 dB/
POS PK
OFFSET
24.0
dB
FCC Limit
CORR'D
CENTER 2.000 0 GHz
RES BW 100 KHz
VBW 100 KHz
SPAN 10.0 MHz
SWP 20.0 msec

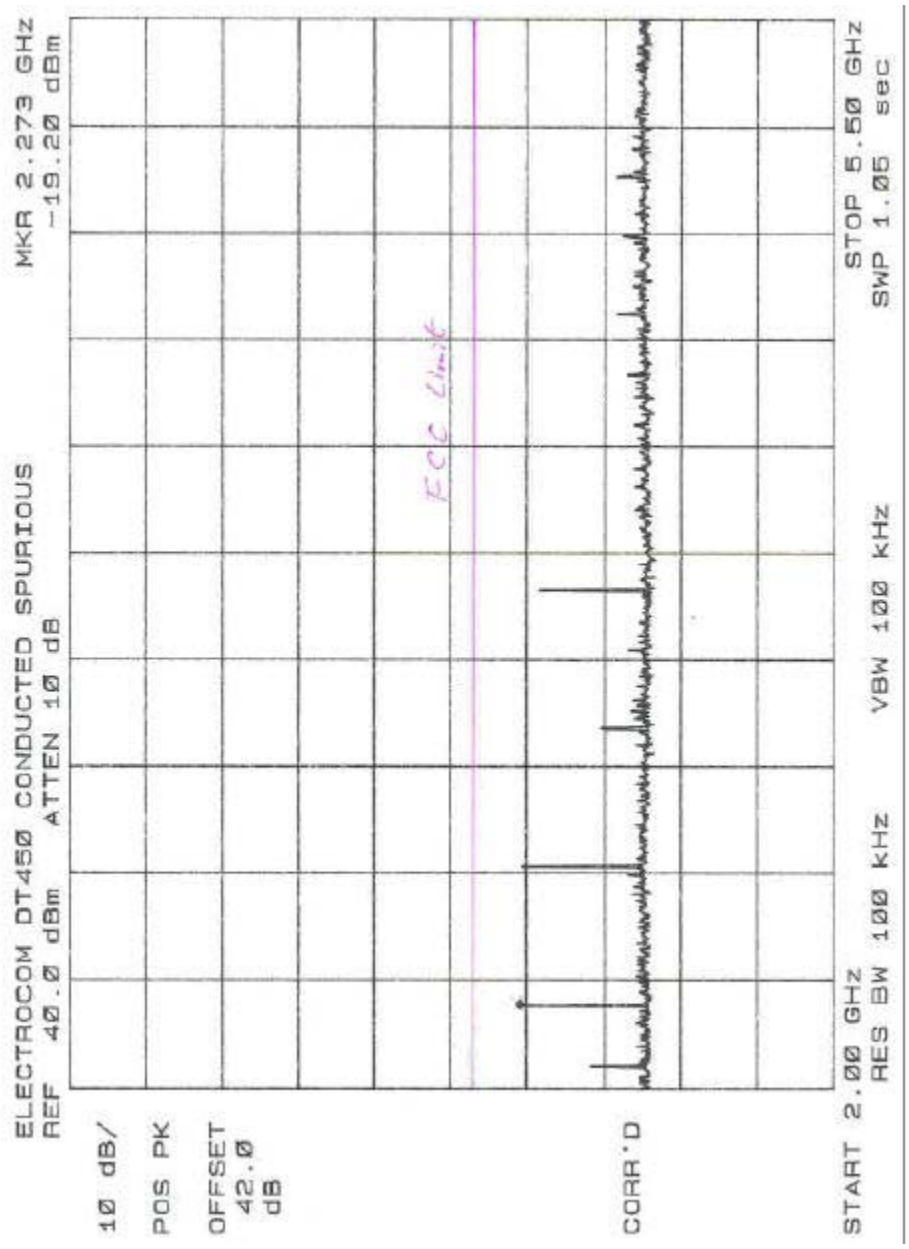

ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 40.0 dBm ATTEN 10 dB
MKR 3.194 GHz
-15.40 dBm
10 dB/
POS PK
OFFSET
40.0
dB
FCC Class B
CORR'D
START 2.00 GHz
RES BW 100 KHz
VBW 100 KHz
STOP 5.50 GHz
SWP 1.05 sec

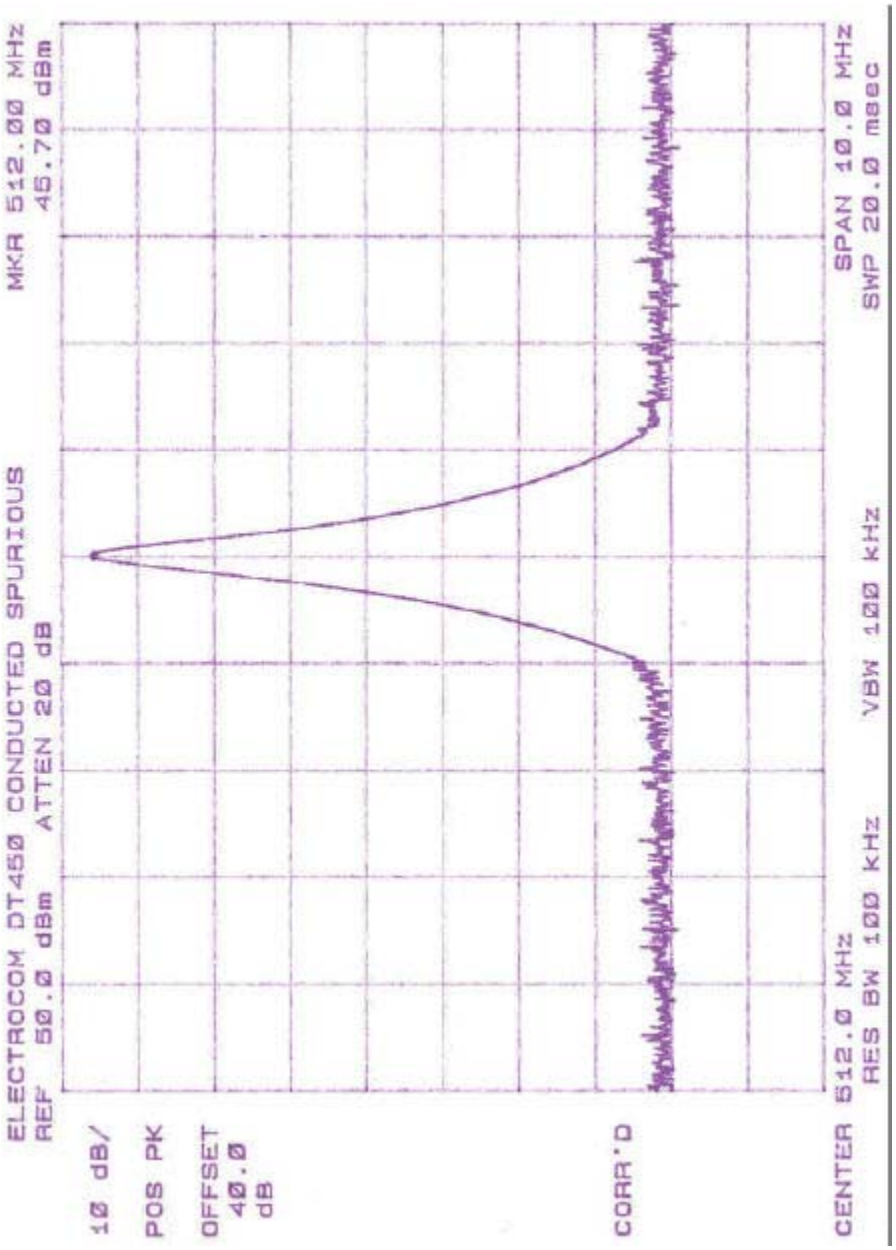

ELECTROCOM DT460 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 20 dB
MKR 455.00 MHz
45.60 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 455.0 MHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec

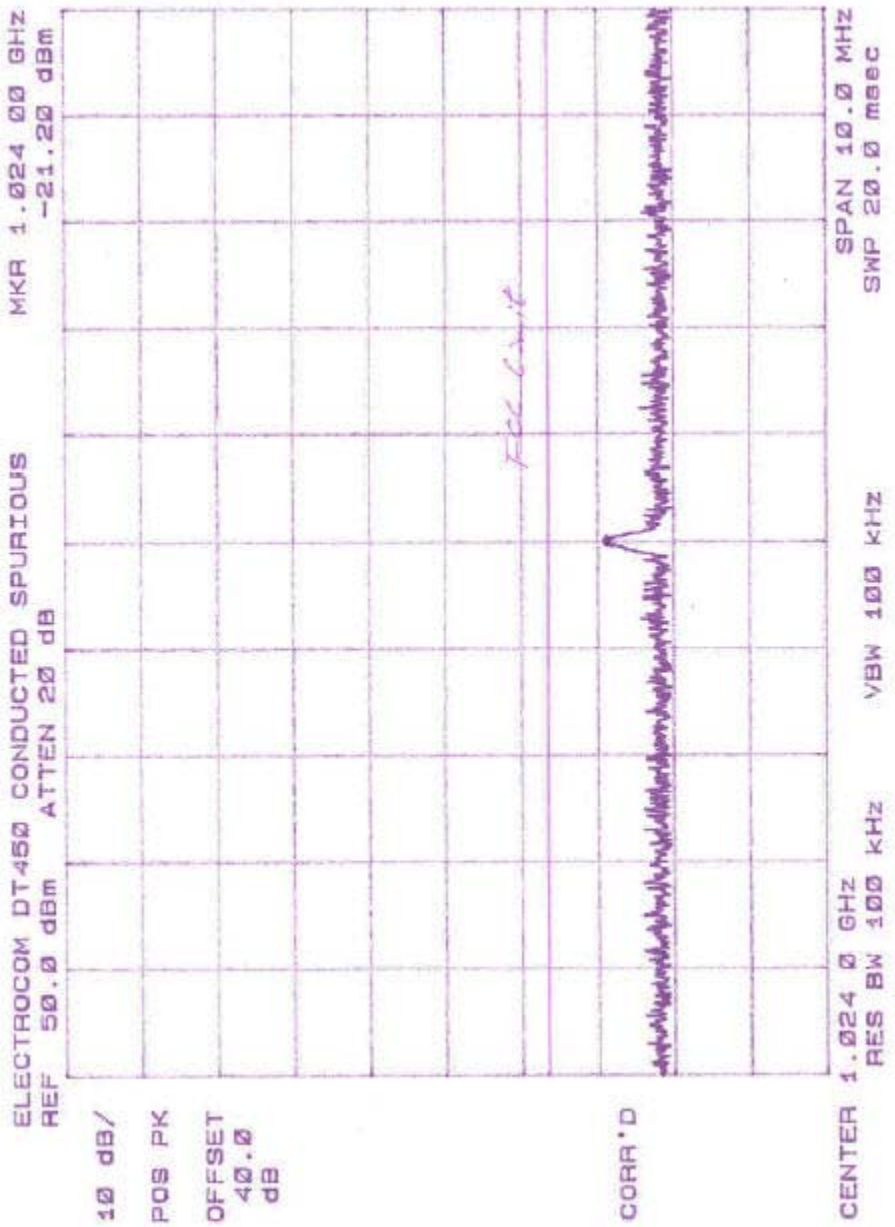

ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 20 dB
MKR 909.98 MHz
-21.90 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CENTER
910.0 MHz
FCC Limit
CORR'D
CENTER 910.0 MHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec

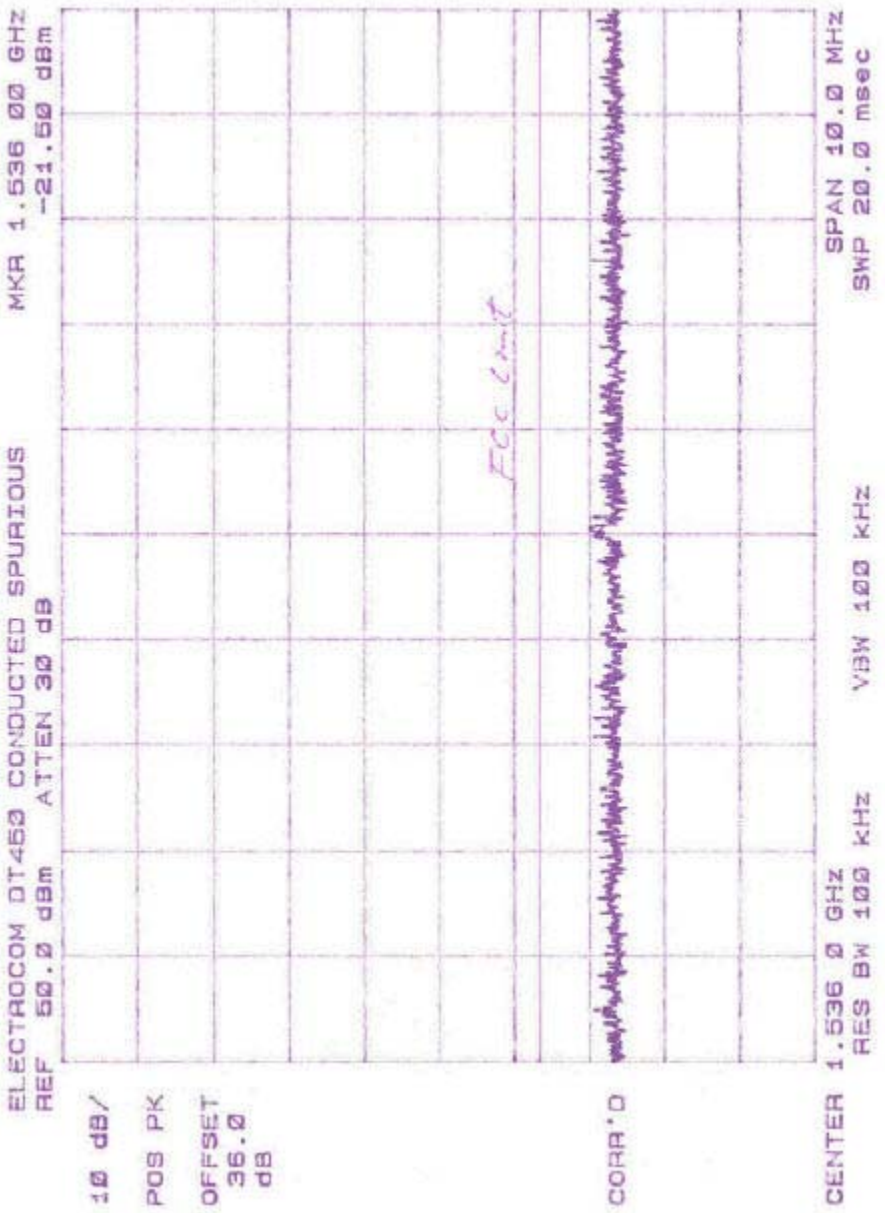

ELECTROCOM DT-450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 30 dB
MKR 1.365 04 GHz
-17.10 dBm
10 dB/
POS PK
OFFSET
36.0
dB
Fcc Limit
CORR'D
CENTER 1.366 0 GHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec

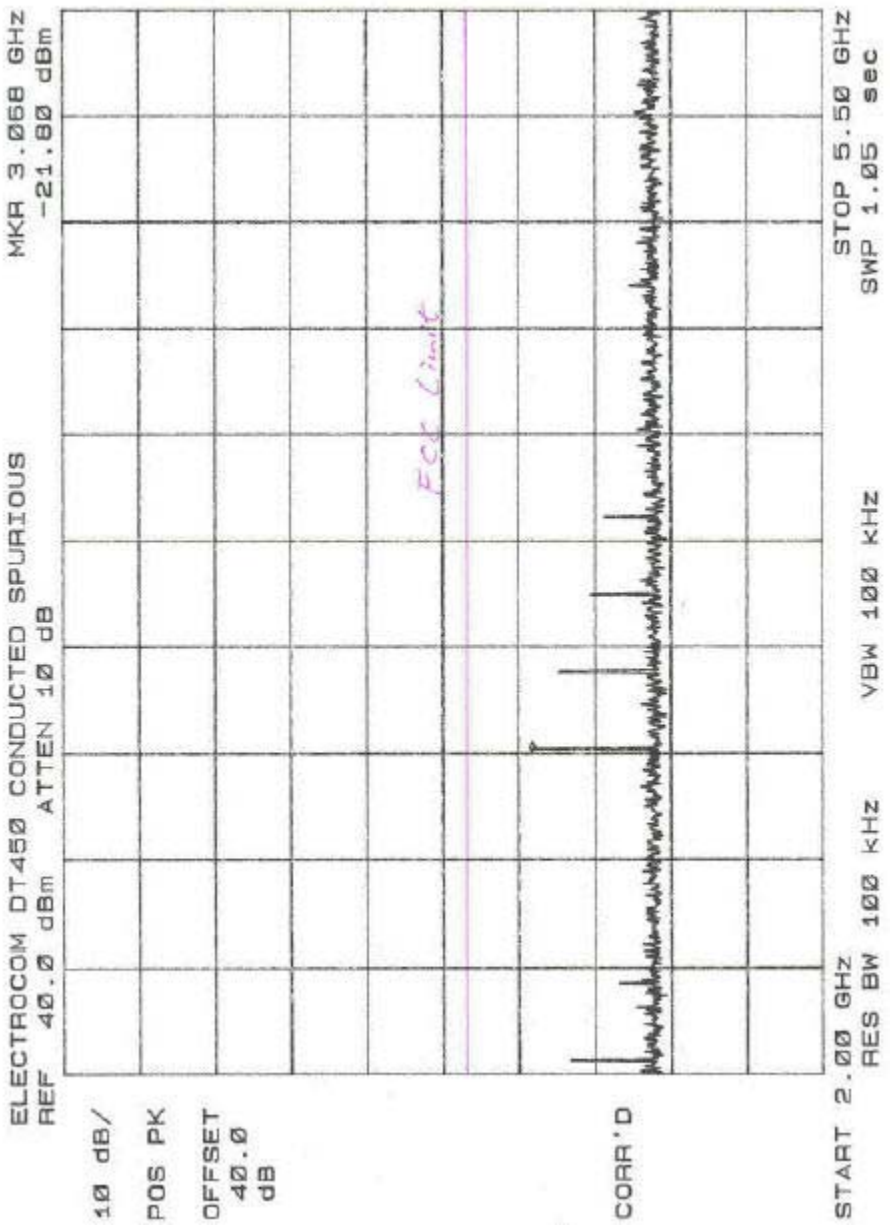

ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 30 dB
MKR 1.820 01 GHz
-16.10 dBm
10 dB/
POS PK
OFFSET
31.0
dB
FCC Limit
CORR'D
CENTER 1.820 0 GHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec


ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 40.0 dBm ATTEN 10 dB
MKR 2.273 GHz
-19.20 dBm
10 dB/
POS PK
OFFSET
42.0
dB
ECC Limit
CORR'D
START 2.00 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 5.50 GHz
SWP 1.05 sec


ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 20 dB
MKR 512.00 MHz
45.70 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 512.0 MHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec


ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 50.0 dBm ATTEN 20 dB
MKR 1.024 00 GHz
-21.20 dBm
10 dB/
POS PK
OFFSET
40.0
dB
CORR'D
CENTER 1.024 0 GHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec


ELECTROCOM DT460 CONDUCTED SPURIOUS
REF 50.0 dBm
ATTEN 30 dB
MKR 1.536 00 GHz
-21.50 dBm
10 dB/
POS PK
OFFSET
36.0
dB
FCC Limit
CORR'D
CENTER 1.536 0 GHz
RES BW 100 kHz
VBW 100 kHz
SPAN 10.0 MHz
SWP 20.0 msec


ELECTROCOM DT450 CONDUCTED SPURIOUS
REF 40.0 dBm ATTEN 10 dB
MKR 3.068 GHz
-21.80 dBm
10 dB/
POS PK
OFFSET
40.0
dB
FCC Limit
CORR'D
START 2.00 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 5.50 GHz
SWP 1.05 sec

Radiated Emissions Field Strength Measurement Data Sheet Date: 10/18/99

Antenna Polarization (V or H)	Frequency Tuned (MHz)	Frequency of Emission (MHz)	Spectrum Analyzer Reading (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp. Gain (dB)	Field Strength @ 3m (dBμV/m)	Field Strength below Carrier (dBμV/m)	FCC Limit @ 3m (dBμV/m)
V	400.0	800.0	54.8	23.1	4.0	34.7	47.2	–96.3	–59.0
H	400.0	800.0	51.7	23.1	4.0	34.7	44.1	–99.4	–59.0
V	400.0	1200.0	36.8	26.0	6.0	25.5	43.3	–100.2	–59.0
H	400.0	1200.0	37.4	26.0	6.0	25.5	43.9	–99.6	–59.0
V	400.0	1600.0	39.8	27.7	6.2	27.7	46.0	–97.5	–59.0
H	400.0	1600.0	37.6	27.7	6.2	27.7	43.8	–99.7	–59.0
V	400.0	2000.0	42.7	29.4	6.5	30.6	48.0	–95.5	–59.0
H	400.0	2000.0	44.0	29.4	6.5	30.6	49.3	–94.2	–59.0
V	400.0	2400.0	48.9	28.6	6.8	28.5	55.8	–87.7	–59.0
H	400.0	2400.0	46.8	28.6	6.8	28.5	53.7	–89.8	–59.0
V	400.0	2800.0	47.0	30.0	7.2	27.5	56.7	–86.8	–59.0
H	400.0	2800.0	45.8	30.0	7.2	27.5	55.5	–88.0	–59.0
V	400.0	3200.0	39.5	31.8	7.8	26.4	52.7	–90.6	–59.0
H	400.0	3200.0	40.4	31.8	7.8	26.4	53.6	–89.7	–59.0
V	400.0	3600.0	*						
H	400.0	3600.0	*						
V	400.0	4000.0	*						
H	400.0	4000.0	*						

* No detectable signal

Radiated Emissions Field Strength Measurement Data Sheet Date: 10/18/99

Antenna Polarization (V or H)	Frequency Tuned (MHz)	Frequency of Emission (MHz)	Spectrum Analyzer Reading (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp. Gain (dB)	Field Strength @ 3m (dBμV/m)	Field Strength below Carrier (dBμV/m)	FCC Limit @ 3m (dBμV/m)
V	455.0	910.0	58.2	23.0	4.6	35.0	50.8	–92.7	–59.0
H	455.0	910.0	53.0	23.0	4.6	35.0	45.6	–97.9	–59.0
V	455.0	1365.0	40.5	27.0	6.1	27.0	46.6	–96.9	–59.0
H	455.0	1365.0	42.6	27.0	6.1	27.0	48.7	–94.8	–59.0
V	455.0	1820.0	48.4	28.1	6.3	27.8	55.0	–88.5	–59.0
H	455.0	1820.0	46.8	28.1	6.3	27.8	53.4	–90.1	–59.0
V	455.0	2275.0	46.3	28.0	6.5	27.5	53.3	–90.2	–59.0
H	455.0	2275.0	40.6	28.0	6.5	27.5	47.6	–95.9	–59.0
V	455.0	2730.0	37.8	30.0	7.0	27.5	47.3	–96.2	–59.0
H	455.0	2730.0	35.5	30.0	7.0	27.5	45.0	–98.5	–59.0
V	455.0	3180.0	34.9	31.5	7.8	26.5	47.7	–95.8	–59.0
H	455.0	3180.0	32.8	31.5	7.8	26.5	45.6	–97.9	–59.0
V	455.0	3640.0	*						
H	455.0	3640.0	*						
V	455.0	4095.0	*						
H	455.0	4095.0	*						
V	455.0	4550.0	*						
H	455.0	4550.0	*						

* No detectable signal

Radiated Emissions Field Strength Measurement Data Sheet Date: 10/18/99

Antenna Polarization (V or H)	Frequency Tuned (MHz)	Frequency of Emission (MHz)	Spectrum Analyzer Reading (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp. Gain (dB)	Field Strength @ 3m (dBμV/m)	Field Strength below Carrier (dBμV/m)	FCC Limit @ 3m (dBμV/m)
V	512.0	1024.0	51.7	24.0	5.0	22.0	58.7	–84.8	–59.0
H	512.0	1024.0	47.9	24.0	5.0	22.0	54.9	–88.6	–59.0
V	512.0	1536.0	40.5	27.7	6.2	27.5	46.9	–96.6	–59.0
H	512.0	1536.0	38.8	27.7	6.2	27.5	45.2	–98.3	–59.0
V	512.0	2048.0	39.5	29.5	6.5	30.0	45.5	–98.0	–59.0
H	512.0	2048.0	37.2	29.5	6.5	30.0	43.2	–100.3	–59.0
V	512.0	2560.0	47.3	28.8	6.8	28.5	54.4	–89.1	–59.0
H	512.0	2560.0	48.6	28.8	6.8	28.5	55.7	–87.8	–59.0
V	512.0	3072.0	40.6	31.0	7.5	27.0	52.1	–91.4	–59.0
H	512.0	3072.0	40.8	31.0	7.5	27.0	52.3	–91.2	–59.0
V	512.0	3584.0	37.5	30.8	8.4	26.5	50.2	–93.3	–59.0
H	512.0	3584.0	35.4	30.8	8.4	26.5	48.1	–95.4	–59.0
V	512.0	4096.0	*						
H	512.0	4096.0	*						
V	512.0	4608.0	*						
H	512.0	4608.0	*						
V	512.0	5120.0	*						
H	512.0	5120.0	*						

* No detectable signal

Frequency Stability Measurement (Reference: FCC Part 2, Subpart J, §2.995)

Frequency Tuned: 400.0MHz Date: 07/22/99

Temperature (°C)	DC Power Supply Voltage						**FCC Limit** (2.5ppm)
	–15% Nominal Voltage (11.73V)		Nominal Voltage (13.80V)		+15% Nominal Voltage (15.87V)		
	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Δf=0.001000MHz
+24°C (Room Temp.)	399.999816	44.0	399.999784	46.0	399.999835	47.4	0.000216
–30°C	399.999790	44.5	399.999761	46.3	399.999737	47.6	0.000263
–20°C	399.999898	44.5	399.999818	46.2	399.999890	47.6	0.000182
–10°C	400.000093	44.4	400.000085	46.0	400.000098	47.5	0.000098
+ 0°C	400.000140	44.3	400.000146	46.0	400.000149	47.5	0.000149
+10°C	400.000087	44.2	400.000082	46.0	400.000074	47.4	0.000087
+20°C	399.999714	43.6	399.999760	45.3	399.999818	46.8	0.000286
+30°C	399.999898	44.0	399.999931	45.7	399.999954	47.0	0.000102
+40°C	399.999925	43.8	399.999984	45.7	399.999858	47.0	0.000142
+50°C	399.999877	43.6	399.999874	45.4	399.999852	46.8	0.000148

Frequency Stability Measurement (Reference: FCC Part 2, Subpart J, §2.995)

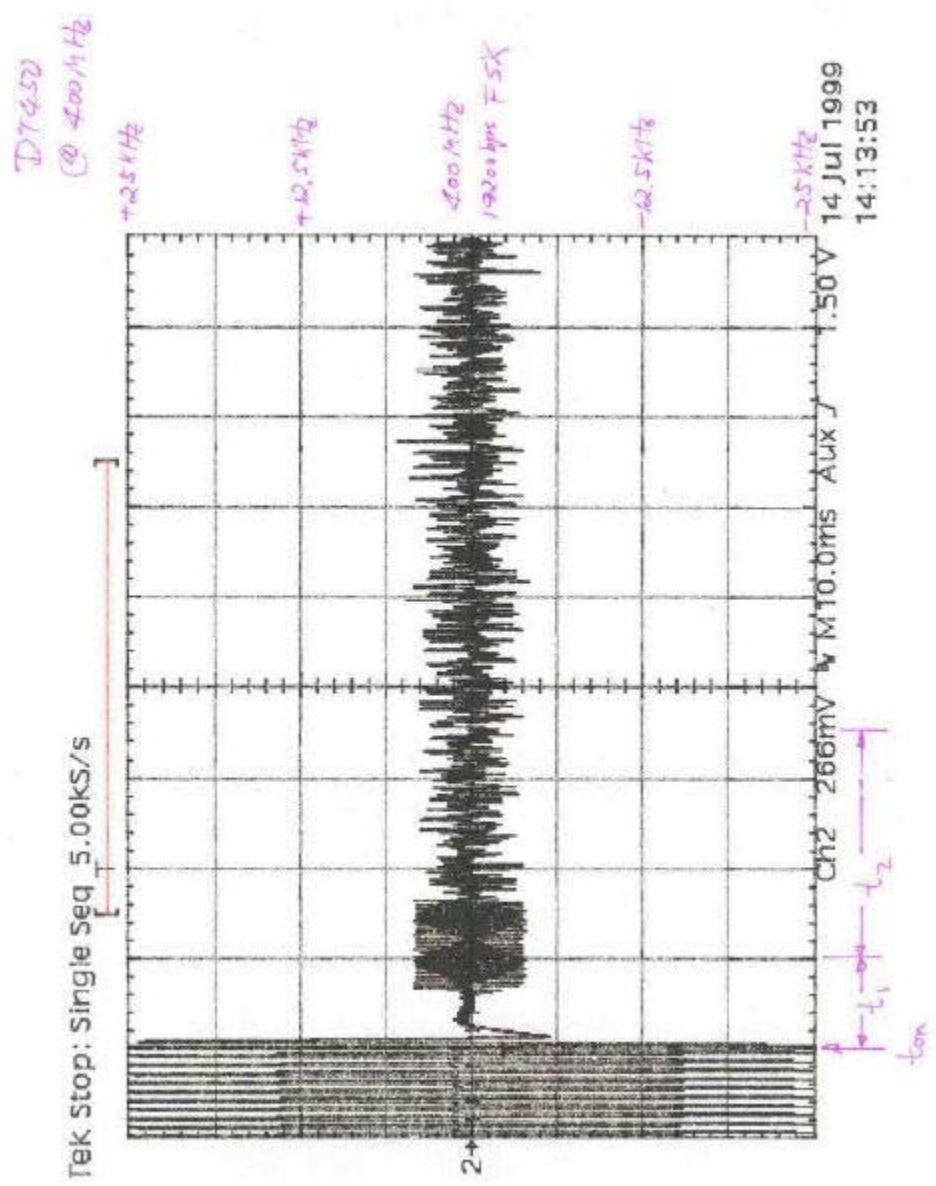
Frequency Tuned: 455.0MHz Date: 07/22/99

Temperature (°C)	DC Power Supply Voltage						**FCC Limit** (2.5ppm)
	–15% Nominal Voltage (11.73V)		Nominal Voltage (13.80V)		+15% Nominal Voltage (15.87V)		
	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Δf=0.001137MHz
+24°C (Room Temp.)	454.999856	44.0	454.999776	46.0	454.999765	46.6	0.000235
–30°C	454.999804	44.2	454.999887	45.6	454.999825	47.0	0.000196
–20°C	454.999748	43.8	454.999802	45.5	454.999817	46.9	0.000252
–10°C	454.999922	43.7	454.999945	45.5	454.999954	47.0	0.000078
+ 0°C	455.000066	43.8	455.000084	45.6	455.000052	46.8	0.000084
+10°C	455.000152	43.9	455.000148	45.5	455.000135	46.8	0.000148
+20°C	455.000098	44.0	455.000083	45.5	455.000075	46.6	0.000098
+30°C	454.999884	44.0	454.999833	45.5	454.999852	46.4	0.000167
+40°C	454.999724	44.0	454.999706	45.6	454.999688	46.7	0.000312
+50°C	454.999683	44.0	454.999698	45.5	454.999708	46.6	0.000317

Frequency Stability Measurement (Reference: FCC Part 2, Subpart J, §2.995)

Frequency Tuned: 512.0MHz Date: 07/22/99

Temperature (°C)	DC Power Supply Voltage						**FCC Limit** (2.5ppm)
	–15% Nominal Voltage (11.73V)		Nominal Voltage (13.80V)		+15% Nominal Voltage (15.87V)		
	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Δf=0.001280MHz
+24°C (Room Temp.)	511.999910	43.8	511.999967	45.7	512.000018	46.3	0.000033
–30°C	511.999830	43.9	511.999796	45.4	511.999766	46.6	0.000234
–20°C	511.999855	43.8	511.999906	45.4	511.999829	46.5	0.000171
–10°C	511.999891	43.7	511.999898	45.3	511.999916	46.5	0.000109
+ 0°C	511.999872	43.6	511.999876	45.2	511.999880	46.4	0.000128
+10°C	511.999826	43.5	511.999816	45.0	511.999804	46.3	0.000196
+20°C	511.999942	43.9	511.999958	45.4	511.999972	45.9	0.000058
+30°C	511.999878	43.2	511.999896	45.7	511.999827	46.3	0.000173
+40°C	512.000018	42.8	511.999976	45.5	511.999957	45.8	0.000043
+50°C	511.999954	42.5	511.999942	45.2	511.999922	45.6	0.000078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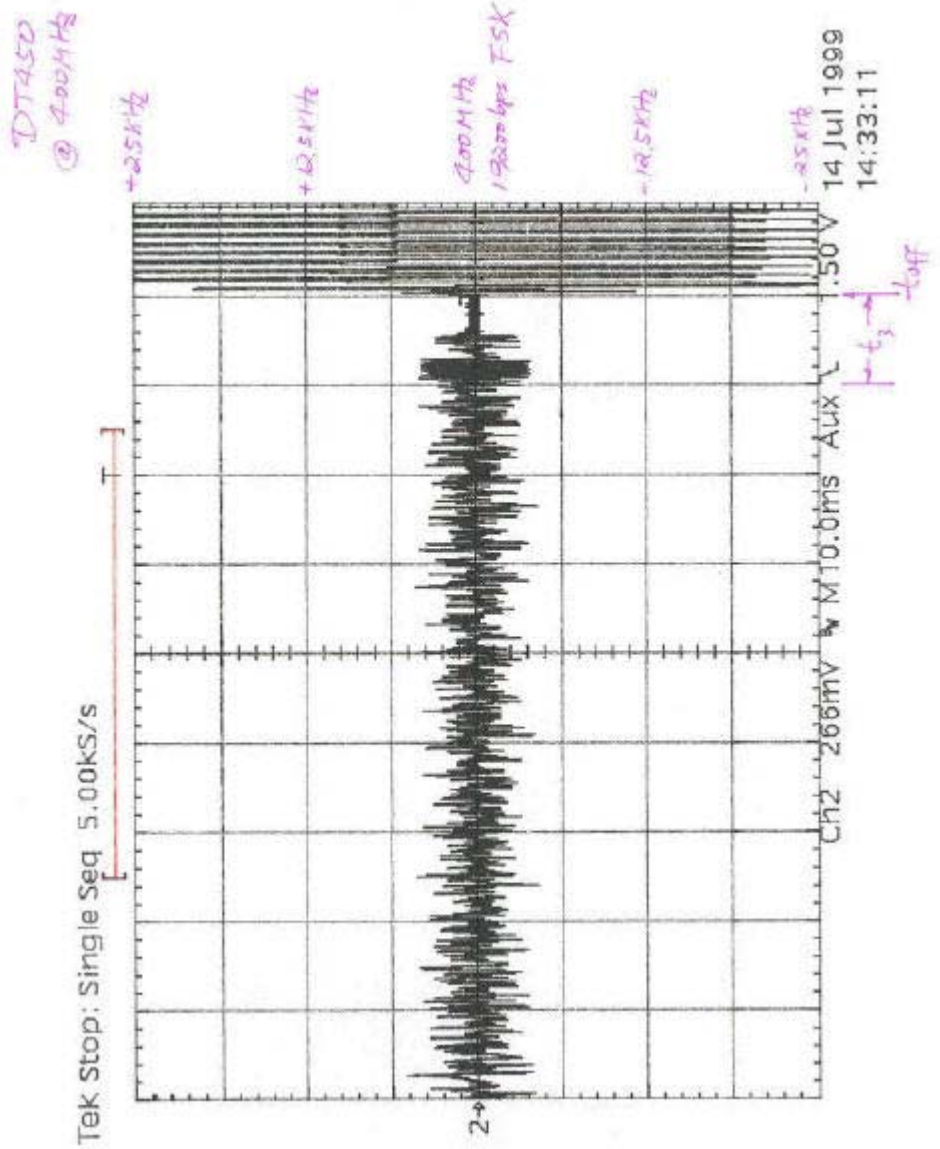
+25 kHz
+12.5 kHz
400.4 Hz
1920 bps FSK
-12.5 kHz
-25 kHz
14 Jul 1999
14:13:53
Tek Stop: Single Seq 5.00kS/s
Ch2 266mV M10.0ms Aux 7.50 V
t1
t2
ton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+25kHz
+12.5kHz
400kHz
19.2kbps FSK
-12.5kHz
-25kHz
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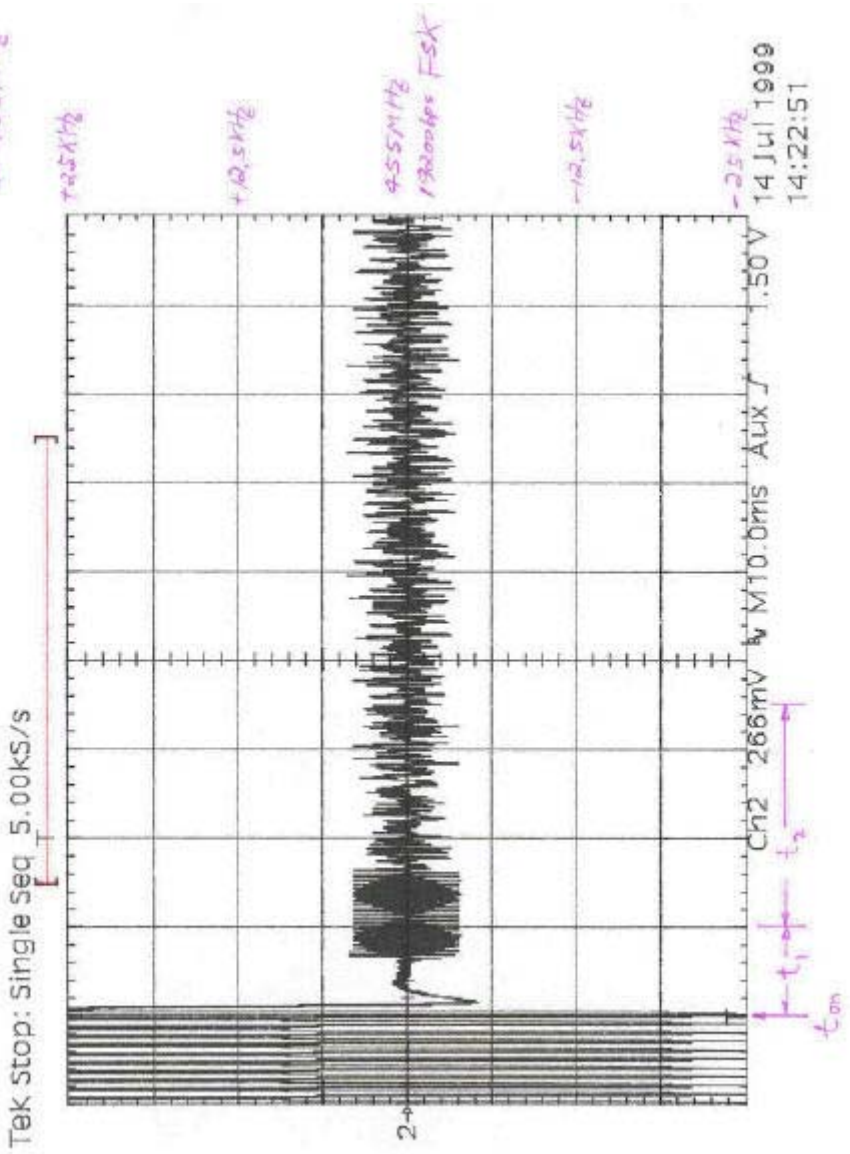
Ch2 266mV M 10.0ms Aux
Tek Stop: Single Seq 5.00kS/s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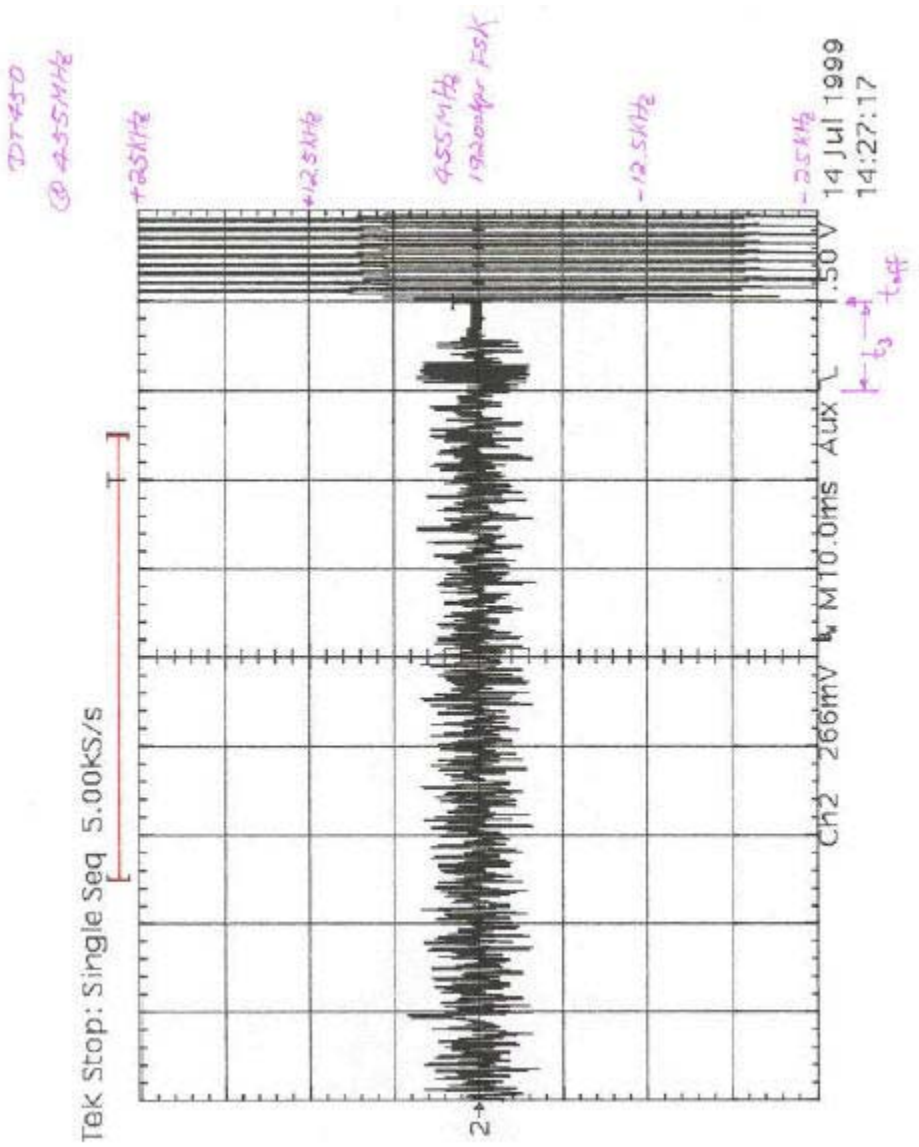
@ 455MHz
+25kHz
+12.5kHz
455MHz
19200bps FSK
-12.5kHz
-25kHz
14 Jul 1999
14:22:51
Ch2 266mV M10.0ms Aux 1.50 V
Tek Stop: Single Seq 5.00kS/s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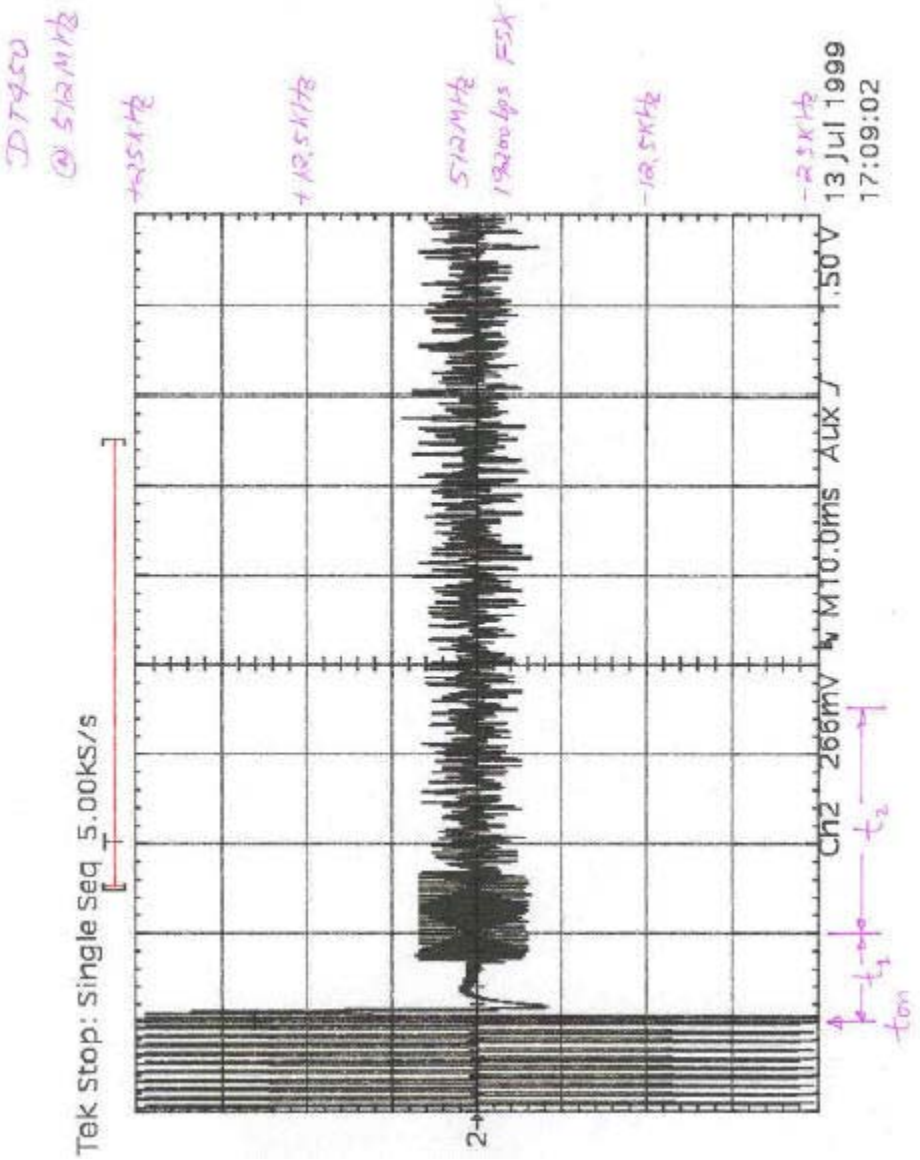
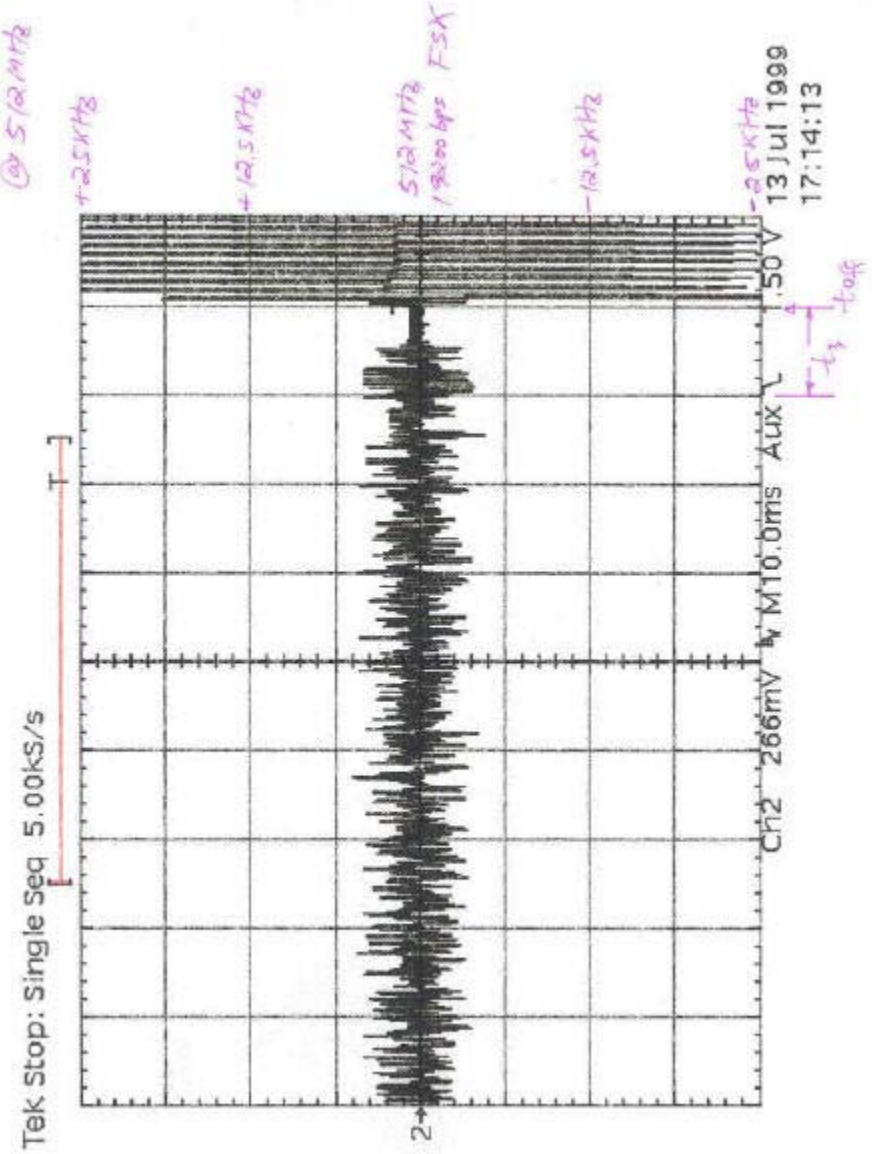
@ 455MHz
+25kHz
+12.5kHz
455MHz
19.2ksps FSK
-12.5kHz
-25kHz
14 Jul 1999
14:27:17
1.50 V
M10.0ms Aux
Ch2 266mV
Tek Stop: Single Seq 5.00kS/s


DT450
@ 512 kHz
+25 kHz
+12.5 kHz
512 kHz
19200 bps FSK
-12.5 kHz
-25 kHz
13 Jul 1999
17:09:02
Ch2 266mV M10.0ms Aux 1.50 V
Tek Stop: Single Seq 5.00kS/s
2
t_2
t_1
t_{on}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@ 512 kHz
+25kHz
+12.5kHz
512 kHz
19200 bps FSK
-12.5kHz
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13 Jul 1999
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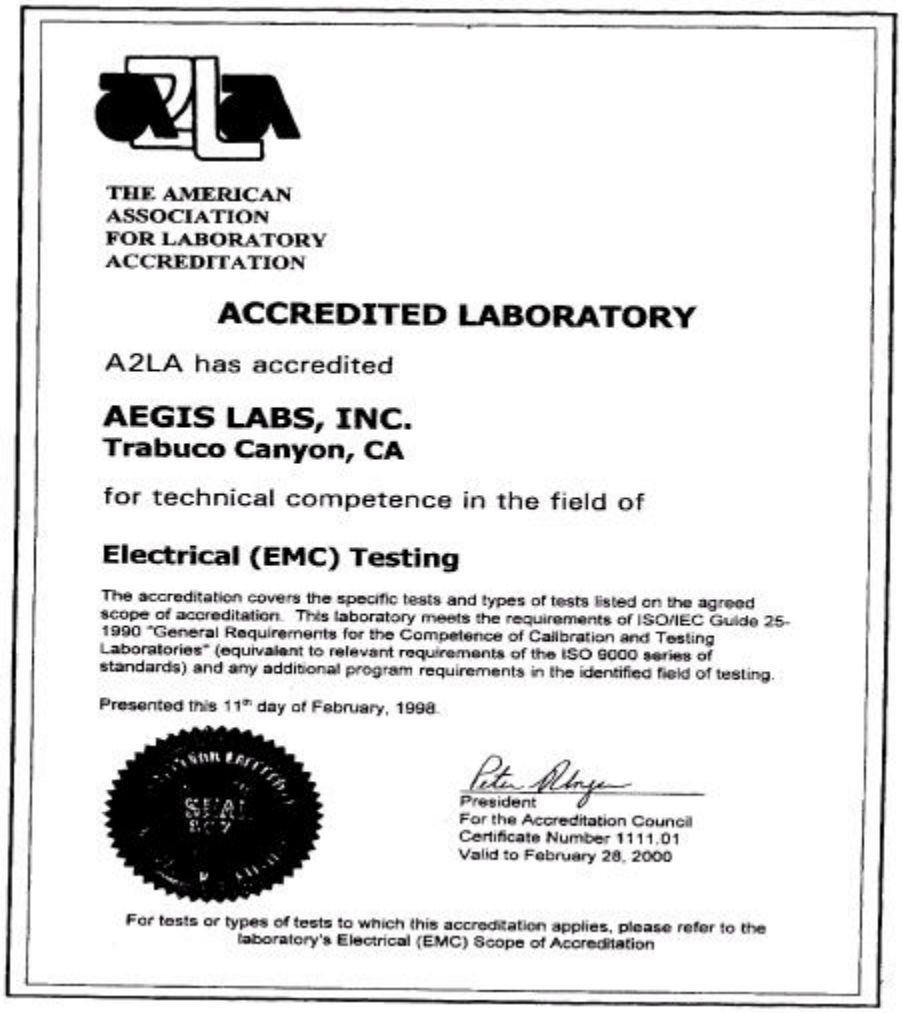
Tek Stop: Single Seq 5.00kS/s
Ch2 266mV M10.0ms Aux

APPENDIX C – ACCREDITATION CERTIFICATE



THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

AEGIS LABS, INC.
Trabuco Canyon, CA

for technical competence in the field of

Electrical (EMC) Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC Guide 25-1990 "General Requirements for the Competence of Calibration and Testing Laboratories" (equivalent to relevant requirements of the ISO 9000 series of standards) and any additional program requirements in the identified field of testing.

Presented this 11th day of February, 1998.

President
For the Accreditation Council
Certificate Number 1111.01
Valid to February 28, 2000

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) Scope of Accreditation

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC GUIDE 25-1990

AEGIS LABS, INC.
32231 Trabuco Creek Road
Trabuco Canyon, CA 92678
Steve Kuiper Phone: 714 459 7886

ELECTRICAL (EMC)

Valid to: February 28, 2000 Certificate Number: 1111-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Conducted Emissions

Radiated Emissions

Electrostatic Discharge (ESD)

Electrical Fast Transient/Burst

Surge

On materials and products related to the following:

Information Technology Equipment (ITE)

Using the following standards:

Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 (Class A & B) using ANSI C63.4 - 1992: Methods of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

AS/NZS 3548-1991: Emissions Standard for Residential, Commercial and Light Industry Environment of Information Technology Equipment

EN: 50082-1, 55011 (Class A), 55016, 55022 (Class A & B)

IEC 1000-4-2 - 95: Electrostatic Discharge Immunity Test

IEC 1000-4-4 - 95: Electrical Fast Transient/Burst Immunity Test

IEC 1000-4-5 - 95: Surge Immunity Test

Peter Mayo

656 Quince Orchard Road, #620 • Gaithersburg,MD 20878-1409 • Phone: 301 670 1377 • FAX: 869 1495